

# THE POWER OF OPTIMISM

Managing scale and complexity as  
the energy transition accelerates

Energy Industry Insights 2022



## ABOUT THE RESEARCH

The Power of Optimism explores the confidence, sentiment, and priorities for the energy industry in the year ahead.

The research draws on DNV's annual survey of more than 1,000 senior professionals and a programme of in-depth interviews with leaders and experts. It is developed and created by teams from DNV and Longitude (a Financial Times company).

The research was conducted during December 2021 and January 2022. Survey respondents were drawn from across the energy industry, including publicly listed companies and privately held firms, and spanning power, renewables, oil and gas, industry specialists

(e.g. in technology, finance or policy), and industrial energy consumers. The organizations surveyed vary in size: 33% had annual revenue of USD 100 million or less, while 28% had annual revenue in excess of USD 1 billion. The survey respondents represent a range of functions within the industry, from board-level executives to senior engineers.

*The Power of Optimism* is published by DNV, the world's leading resource of independent energy experts and technical advisors.

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### Acknowledgements

We extend our thanks to the following interviewees for sharing their time and insights with us:

**Espen Barth Eide**, The Royal Norwegian Ministry of Climate and Environment, Norway

**Andrew Brown**, Head of Engineering, Woodfibre LNG, Canada

**Steinar Eikaas**, Vice President Low Carbon solutions, Equinor, Norway

**Christian Hürlimann**, Renewables CEO, MET Group, Switzerland

**Martin Jagger**, Operations Director, WeConnect Energy, United Arab Emirates

**Jiang Jun**, Manager of Strategy and Development, COSCO Shipping Specialized Carriers, China

**Francisco Laverón**, Head of Energy Prospective, Iberdrola, Spain

**Angus McIntosh**, Director of Energy Futures, SGN, UK

**Nora'in Md Salleh**, Head of CCS Enterprise, Petronas, Malaysia

**Ana Lia Roja**, Executive Director, Chilean Association for Renewable Energies and Storage, Chile

**Marc Schmitz**,  
Managing Director and Head of Renewable Energy Project Finance Europe, Rabobank, The Netherlands

**Lord Adair Turner**, Chair, Energy Transitions Commission, UK

**A Senior Energy Economics Researcher**, with one of China's largest State-owned oil companies (who preferred to remain unnamed)

We thank our survey respondents from across the energy industry.



1,088

senior energy professionals surveyed



29%

of respondents are C-level



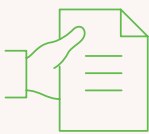
92

countries represented



28%

of respondents from companies with revenue of more than USD 1 billion

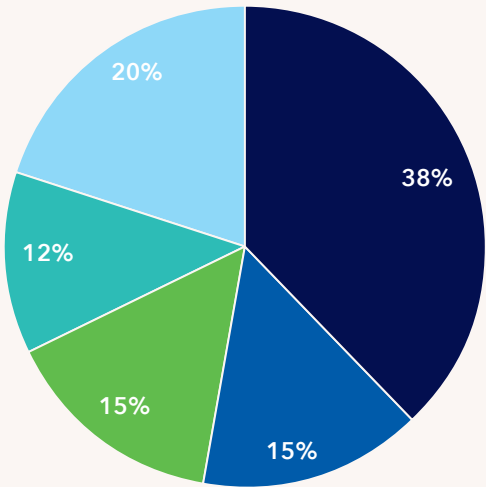


13

in-depth interviews with experts

Sector

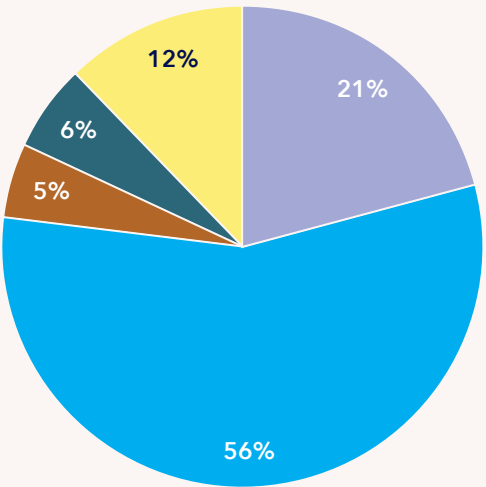
- Oil and gas
- Power
- Renewables
- Cross-industry specialists
- Energy-consuming industries



Region

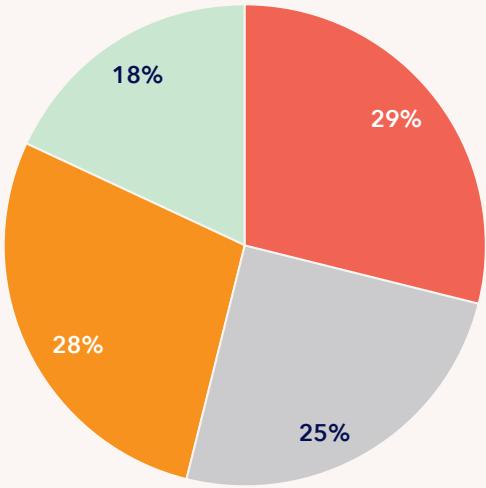
- Asia Pacific
- Europe
- Latin America
- Middle East and Africa
- North America

Data shows the demographic splits of the 1,088 respondents to our survey



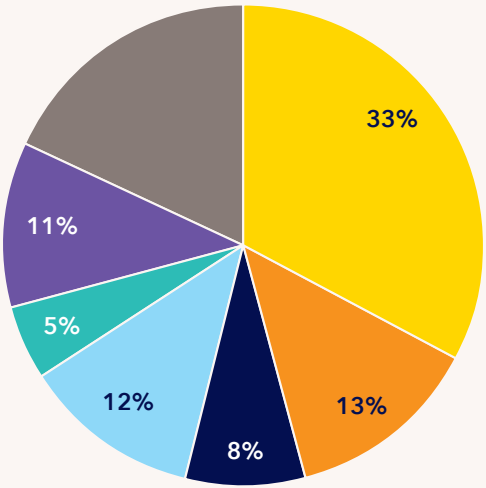
Seniority

- C-suite
- C-suite -1
- C-suite -2
- Other



Revenue

- <\$100m
- \$100–500m
- \$500m–1bn
- \$1bn–5bn
- \$5bn–10bn
- >\$10bn
- Don't know/NA





# CONTENTS

## About the research

Five key trends for 2022

1	<b>Growing optimism</b>	7
2	<b>Critical decisions in a decade of transformation</b>	15
3	<b>The challenges blocking faster progress</b>	25
4	<b>Tackling complexity through collaboration and digitalization</b>	35
5	<b>COP26 – Progress to build on</b>	43
	<b>Conclusion: Sustainable optimism</b>	49



Launch of DNV's Energy Transition Outlook research in September 2021. From left: Ditlev Engel, CEO, Energy Systems at DNV; Christoffer Lokrheim, Client Executive, Microsoft Norway; Kimberly Mathisen, General Manager, Microsoft Norway







# 1

## GROWING OPTIMISM

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Clear acceleration in the pace of the energy transition  
Fully focused on transition

9  
10

# 1 GROWING OPTIMISM

We are living through one of the biggest transformations in modern history. Like the industrial revolution, electrification and computerization, the energy transition is disrupting the status quo and driving major industrial, commercial, political, and social change.

Challenges and uncertainties abound but opportunities and innovations are flourishing. Our research finds the energy industry suitably full of ambition and enthusiasm for 2022 and beyond. But, at the same time, there are also deep concerns about barriers to progress and the risks inherent in the global energy transition.

Among the senior energy industry professionals we surveyed, three quarters (74%) are optimistic about their part of the industry's growth prospects for 2022. Only 13% are pessimistic.

Respondents reported lower, but still strong, optimism about reaching their own organization's revenue targets (67%), with power (74%) and renewables (75%) sectors somewhat more positive than oil and gas (65%) and energy consuming industries (67%).

The leading drivers of this optimism are organizational strategies within renewables and green/decarbonized gas markets and national or international energy policy changes or reforms.

These drivers are linked – like almost every important energy trend today – to the transition away from emissions and hydrocarbons, the transformation of local, national and global energy systems, and the decarbonization of human activities.

“What’s happening now is an increasing sense of alarm and urgency over the climate crisis.”

**Espen Barth Eide**, Norway’s Minister of Climate and Environment.

“This has seen energy transition and decarbonization elevated from being a concern among many, to a priority at the top of the strategy agendas for leaders everywhere,” says Barth Eide.

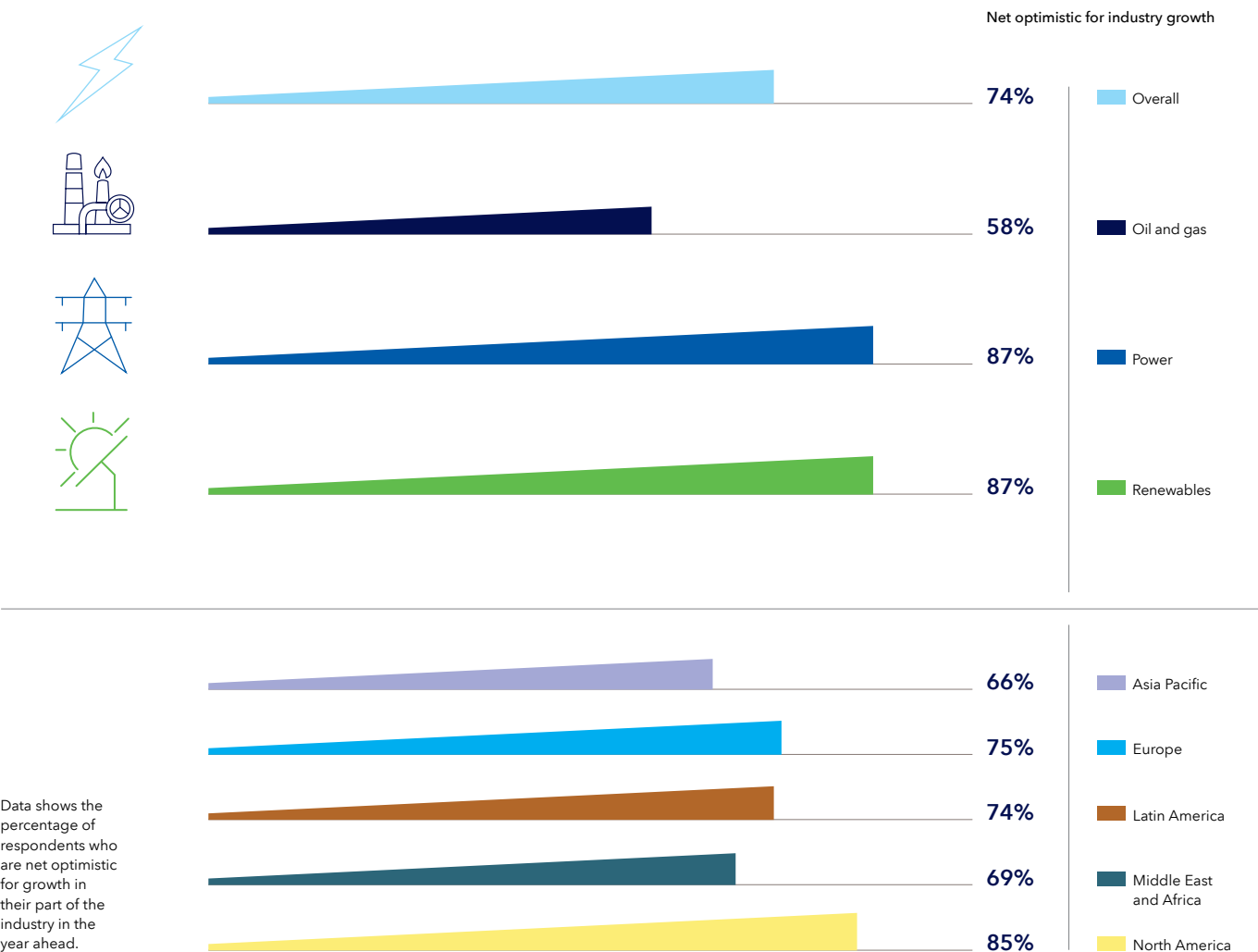
The energy transition is the mega-trend of this decade, and probably the next two, and it is now a major part – if not the driving force – behind most decisions in the energy sector today. It is, at the same time, the source of the most positive prospects and the most complex challenges, but again the industry is, on balance, optimistic: 72% say that the energy transition is more of a commercial opportunity than a commercial risk.

There are pathways to a 1.5-degree future that are feasible and can be achieved with a massive scale-up of existing technologies, but they are very challenging.<sup>1</sup> Optimism is a much-needed and powerful force to find in the energy industry today. It is needed because there are so many challenges to overcome, and there is so much to transform and so much work to be done. The power of optimism is behind most of humanity’s greatest accomplishments, from medicines to moon-landings, and an energy transition that limits global warming to 1.5°C would easily fall into that category.

<sup>1</sup> Pathway to Net Zero Emissions, DNV



Strong optimism for growth in 2022, particularly in power, renewables and North America



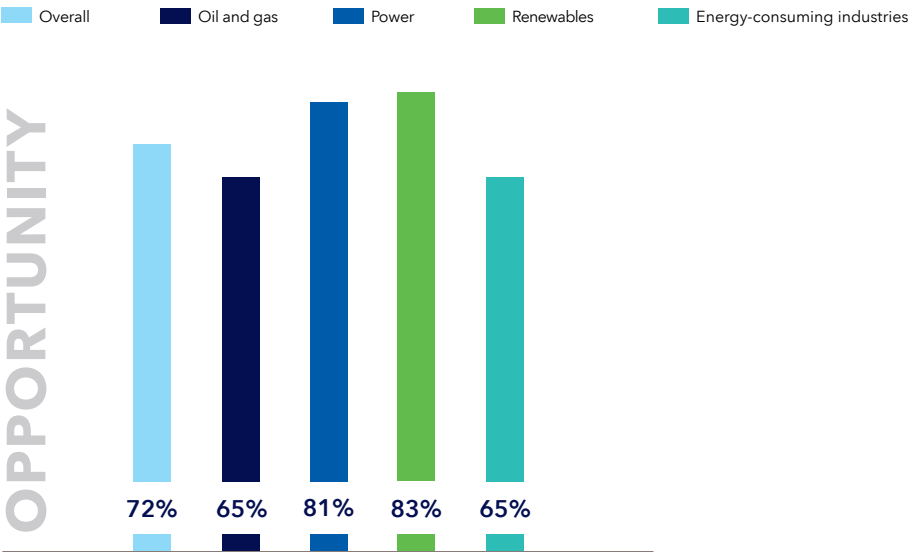
Clear acceleration in the pace of the energy transition

Overall, most senior energy professionals (80%) say the pace of the energy transition is accelerating. "There are two reasons for this evolution," says Francisco Laverón, Head of Energy Prospective, at Iberdrola, a Spanish multinational electric utility. "The first one is the technology revolution we are witnessing as costs of renewables and batteries have fallen faster than we expected. The second one is about policy."

"People are increasingly aware of climate change and the importance of the energy transition, and this is translated into politics, leading to better policies for climate change, renewables, electric mobility and related areas," he says.

This accelerated pace in industry and society needs to be maintained, bringing the opportunities and the challenges of the transition to the centre of C-level debates in energy companies and government decision-making around the world.

The energy transition is more of a commercial opportunity than a risk



Data shows net agreement among respondents

Fully focused on transition

The opportunities presented by the transition appear to be strongly in focus for the power and renewables sectors, where 87% of respondents are optimistic about industry growth. There is less optimism among oil and gas respondents (58%), but this number is still substantially higher than one year ago, when just 39% were optimistic.

Most in the power and renewables sectors are expecting future growth to be driven by technological innovations. A strong majority also believe growth will come from changes in government policy. These two drivers are deeply related for power and renewables companies, because governments often control the regulations which may support or inhibit the new technologies that companies may want to deploy.

Electric cars are one example of this. The majority of power and renewables respondents (63%) say that governments have underestimated how quickly grid infrastructure can adapt to a rapid rise in electric vehicle adoption.

Another example is smart grids, which offer numerous opportunities for innovation and technology-driven growth. But these are often blocked or slowed by dependencies on state-owned or -controlled infrastructure, such that close to eight-in-ten (78%) say that smart grid implementation is not happening quickly enough to support their energy transition ambitions.

Oil and gas industry respondents cite higher oil and gas prices as the strongest driver of optimism for their own organization’s prospects, and higher prices have been a major factor over the past year. We have seen record breaking natural gas prices in Europe and Asia during 2021.<sup>2</sup> And in early 2022, oil prices passed seven-year highs, with many analysts expecting \$100 a barrel this year.<sup>3</sup>

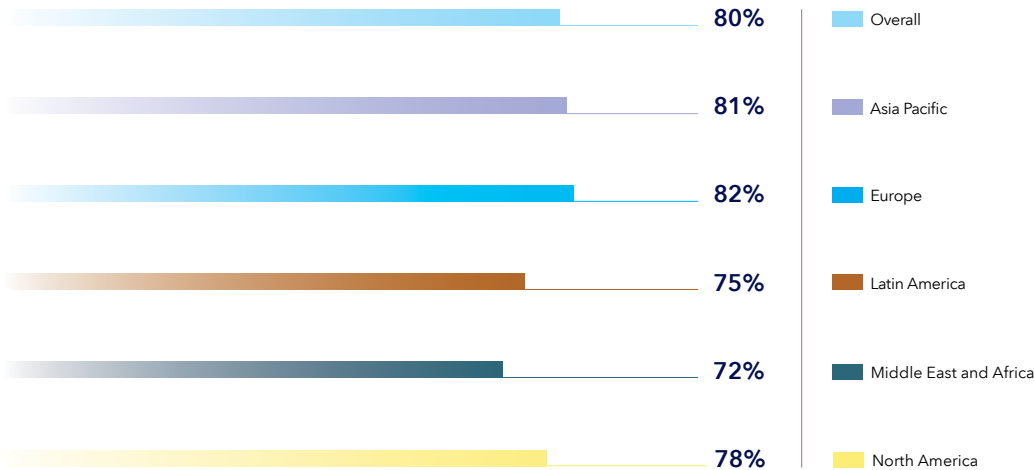
With strong prices driving potentially substantial boosts to operating margins, we may have expected many more oil and gas respondents to be optimistic – perhaps something closer to the 76% we saw three years ago – rather than just 58%.

<sup>2</sup> Explainer: Could more LNG supplies get to Europe in the event of a crisis? Reuters

<sup>3</sup> Traders on ‘high alert’ for supply glitches after oil hits seven-year peak, Financial Times

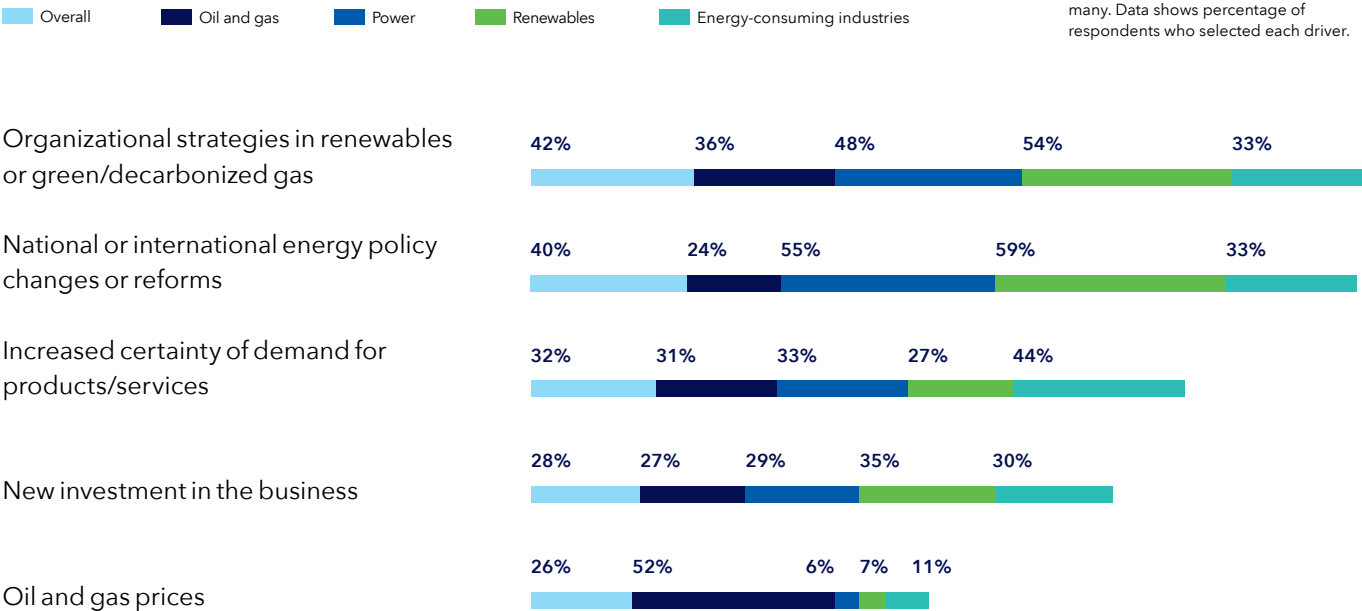
The pace of the energy transition is accelerating

Data shows net agreement among respondents



Low-carbon strategies and policy changes drive optimism

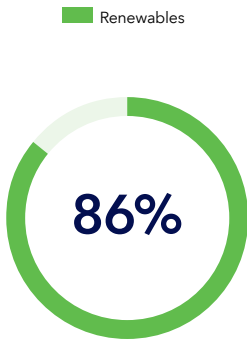
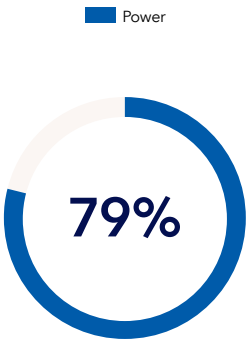
Respondents were invited to select their top three drivers from a list of many. Data shows percentage of respondents who selected each driver.



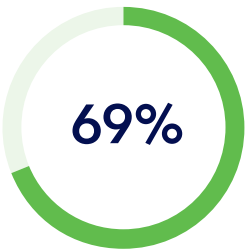
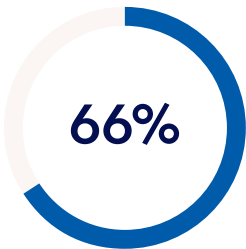


**Innovation key to growth for power and renewables sectors**

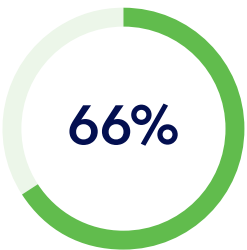
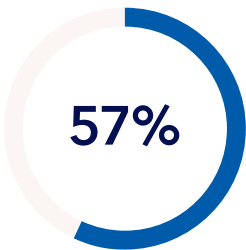
Growth for my organization relies on technology innovation



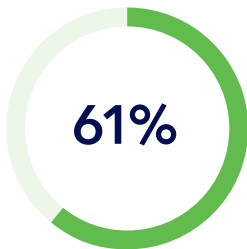
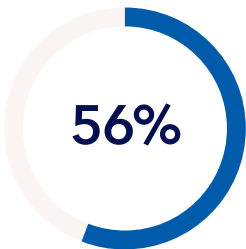
Growth for my organization relies on change to government policy



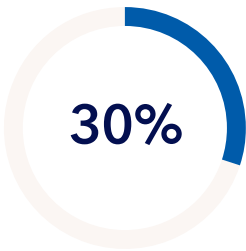
Growth for my organization relies on diversification into other geographic markets



Growth for my organization relies on capital flowing away from fossil fuels



Growth for my organization relies on diversification outside of energy



Data shows net agreement among respondents

The relatively lower optimism for the oil and gas sector could be because the profits generated by these strong prices have not yet cascaded into capital investments, and there may be more optimism if these prices lead to an increase in new and expanded upstream activities.<sup>4</sup> This has not yet happened (a topic we return to in the next chapter).

It seems likely that the acceleration of the transition, along with societal criticism and financial industry pressure, has impacted the outlook for oil and gas. This seems most plausible among publicly-listed, international oil companies – these companies have historically been the biggest investors in upstream activities, but in 2021

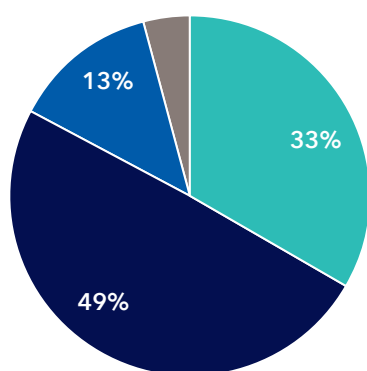
they spent roughly half of the amount they spent in 2015.<sup>5</sup> Like the power and renewables sectors, the energy transition holds major opportunities for the oil and industry to leverage. However, it also holds existential threats, and demands – ultimately – a much more extensive transformation for oil and gas companies.

“I think the sentiment has changed in the oil and gas sector,” says Angus McIntosh, Director of Energy Futures, at SGN, a UK gas distribution company. “I think oil and gas companies are fully focused on how they can transition now, which is a mindset that may have seemed much further away, even just a few years ago.

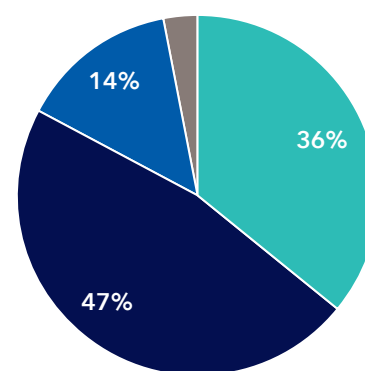
### Half the industry increasing capex and R&D investment

■ Increase investment/focus ■ Maintain the same level ■ Decrease investment/focus ■ Not applicable/don't know or no investment planned or existing

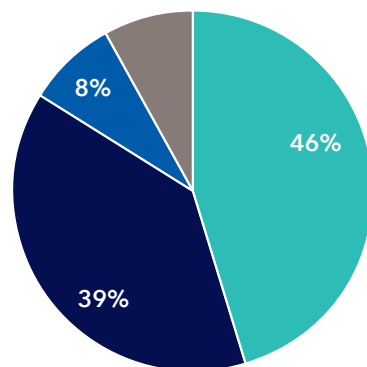
#### Operating expenditure



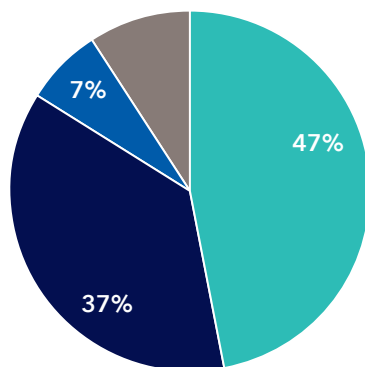
#### Headcount



#### Capital



#### R&D/innovation



<sup>4</sup> Energy Outlook: Oil and gas markets to tighten on lack of upstream spending, ING

<sup>5</sup> World Energy Investment 2021, IEA



zero emission H<sub>2</sub>

-WASSERSTOFF-

H<sub>2</sub>  
WASSERSTOFF  
AN ENERGY OF THE FUTURE



# 2

## CRITICAL DECISIONS IN A DECADE OF TRANSFORMATION

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Choosing pathways	16
Multiple transitions, multiple solutions	18
Timing the transition	18
Reliance on fossil fuels	20
Betting on hydrogen	22

## 2 CRITICAL DECISIONS IN A DECADE OF TRANSFORMATION

The energy industry is turning plans into action as the enormous task of transforming the energy system gains pace.

The industry is expecting significant progress. We see an 11-percentage point increase, from 47% today to 58% in five years' time, for organizations expecting *half or more* of their business to be dedicated to fossil fuels. The proportion expecting *half or more* of their business to be dedicated to clean energy is expected to jump 12 points over the same period (from 52% to 64%).

This will require significant investment capital. It is positive to see that the majority of respondents in our survey (62%) say that their organizations made significant, long-term, strategic investments in the past two years – despite that period coinciding with (we hope) the very worst of the challenges presented by the global pandemic.

In 2022, 67% say that more large, capital-intensive projects will be approved (within their part of the energy industry) than in 2021, and 46% say their organization will increase capital expenditure in 2022.

Looking further ahead, energy industry organizations need to budget for regular capital flows into energy transformation projects for many years. It has been estimated that total energy spending in a transition to a net zero world will require \$275 trillion to be spent on physical assets between 2021 and 2050.<sup>6</sup>

### Choosing pathways

So, what energy sources and systems are energy companies investing in? Overall, green hydrogen (52%), solar photovoltaic (44%), floating offshore wind (40%), and carbon capture and storage (CCS, 40%) are the areas seeing more of the industry increasing investment over the year ahead.

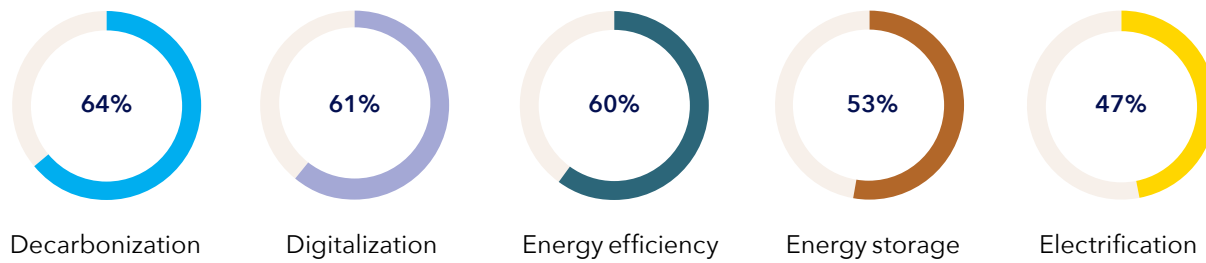
There are important similarities and differences by sector, however. There is much discussion on hydrogen produced from renewables (green hydrogen) and hydrogen from fossil fuels using carbon capture and storage (blue hydrogen). Many oil and gas companies are increasing investment in both green hydrogen (48%) and blue (43%) hydrogen, while far more power (53%) and renewables (68%) companies are increasing spending on green hydrogen compared to blue (just 20% in both cases). The added focus on blue hydrogen is also a likely reason why the oil and gas industry (51%) also has the highest proportion intending to increase investment in CCS.

Offshore wind (both fixed and floating) is seeing similar numbers increasing investment (40-50%) from all parts of the industry, but only the renewables sector has significant numbers (58%) increasing spending on onshore wind too. Much of this could be from the Asia Pacific region, which has higher numbers investing in onshore wind relative to other regions.

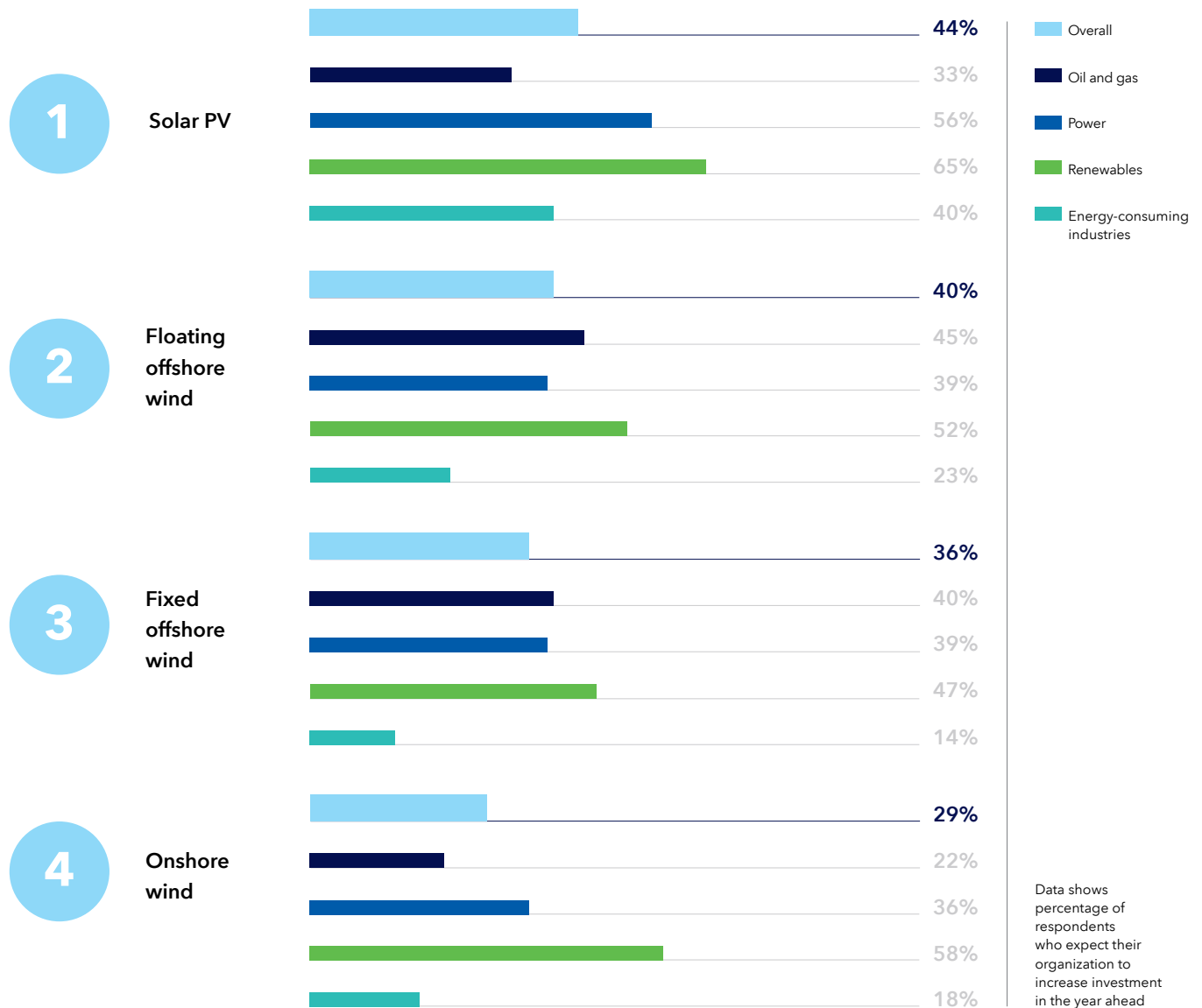
Across fixed- and floating-offshore wind, fewer in the North America and Middle East and Africa regions are investing compared to other regions. Many more Middle East and Africa respondents said their organization was increasing investment in gas (46%) and oil (31%) than the averages (26% and 16% respectively). At least 40% in all regions are increasing investments in both green hydrogen and photovoltaic solar.

In terms of wider infrastructure, there is also increased investment expected by significant proportions overall in decarbonization (64%), digitalization (61%), energy efficiency (60%), storage technologies (53%) and electrification (47%). The first three of these being areas where all parts of the energy industry are relatively aligned on the need to invest.

### Decarbonization, digitalization and energy efficiency leading areas for increased investment



### Solar PV leading technology for increased investment in renewables; floating wind seeing greatest focus from oil & gas





## Multiple transitions, multiple solutions

The energy transition pathways chosen by different organizations, sectors and regions are influenced by the relevant circumstances – which could include everything from geological formations to political demonstrations. There is certainly no single right answer for every company or country, and most energy transition forecasts predict important roles for many solutions.

“Hydrogen and CCS are very much complementary to renewable solutions but often they are put up against each other.”

**Steinar Eikaas**, Vice President Low Carbon Solutions, at Equinor.

“However, both help to deal with areas renewables are less suited to. In different ways, they both help with the variability of renewables generation, and also with the sectors that are difficult and expensive to decarbonize. There is no need to choose one, we need both,” says Eikaas. Equinor is a Norwegian, state-owned, multinational energy company.

Similarly, in our survey, the majority of respondents (58%) believe that natural gas and renewables are competing against each other. However, even in DNV’s pathway to net zero<sup>7</sup>, gas remains a significant source of electrical power through to 2050. Gas and renewables together are both indispensable parts of the energy transition, and in many markets, there will be no choice but to make use of both.

## Timing the transition

However, even as individual decision-makers settle on a direction, harder questions remain around timing. Implementing key strategies too early can be costly (see Protecting Pioneers, in Part 4), while being too late might leave the organization far behind competitors. It is also important to note that timing is quite often determined by forces outside of the organization, such as investors and access to finance, regulators, and government departments (a topic we explore further in the next chapter).<sup>8</sup> An example that is relatively common to many countries is delays in approvals for (or connections to) high-voltage transmission lines to connect new renewable energy sources to industrial centres.<sup>9</sup>

Nowhere is the challenge of timing the transition more acute than in the oil and gas sector. In the past, high oil and gas prices tended to result in investments that boost supply, meeting demand and cooling prices. But this cyclical rebalancing is changing because of growing pressure on the industry – particularly larger, publicly-listed organizations – to reduce spending on new fields, wells and upstream infrastructure. In our survey, 62% of oil and gas industry respondents say that investor sentiment towards the industry is negatively impacting their organization.

This will be a telling year for the future of oil and gas because it will test both the resolve of climate commitments and the capacity of the industry to meet current and future demand.

<sup>7</sup> Pathway to Net Zero Emissions, DNV

<sup>8</sup> Financing the Energy Transition, DNV

<sup>9</sup> Overwhelmed by Solar Projects, the Nation’s Largest Grid Operator Seeks a Two-Year Pause on Approvals, Inside Climate News

Some analysts believe that if the capital is not invested now, it never will be.<sup>10</sup> This could lead to serious consequences. There are realistic scenarios where oil could rise to \$100pb - or even \$200pb, some say - over the next five years.<sup>11</sup> The effects of this differ by country, but in major consumers of oil, such as the US, sustained high oil prices can cause inflation, high interest rates, asset price crashes, recession, and social unrest.<sup>12</sup>

In DNV's Pathway to Net Zero Emissions, fossil fuel use reduces by 80% to account for 21% of the energy mix in 2050. In this scenario that limits global warming to 1.5°C, no oil and gas capacity additions will be needed after 2024 in developed countries, and after 2028 in developing countries.

The majority of the oil and gas industry believes that not enough is being invested in oil (57%) or gas (61%) exploration and upstream expansion to meet medium- and/or long-term demand. In addition, a high minority, expect significant oil (43%) or gas (47%) supply shortages or shocks to occur over the next five years. If these occur, the world will need to rapidly adapt to higher prices.

While this may cause a great deal of economic harm, it may also accelerate the shift away from oil and gas and towards renewable energy sources. However, a natural gas shortage could also slow the shift away from coal. These issues are examples of how challenging it will be to balance energy supply and demand in the transition, and they are also points of healthy debate in the industry.

"The word 'transition' can make it seem like we know what the future is going to look like, and we know how long it's going to take, and I don't think we know either of those things with any certainty," says Andrew Brown, Head of Engineering, at Woodfibre LNG, a liquefied natural gas (LNG) export facility on the west coast of Canada.

"There are places where we have tried to go too fast and we've exposed the frailties of the system. Europe's gas crisis is an example. I view that as a risk because the response can cause a jump back to coal. But the supply issues don't stop there."

Others argue that Europe's issues have been driven by not moving fast enough, blaming gas market dynamics rather than the shift to clean energy. Whatever the cause, there was a failure in matching the pace of scaling down one source with the pace of scaling up another, in terms of raw total energy, but also in the security and reliability of that energy.

The pace at which the world reduces the carbon intensity of fossil fuels will be a significant factor in the energy transition. Much of the debate today focuses on the need to balance energy security and reductions in the emissions intensity of oil and gas, while avoiding greater emissions in the long term by significantly increasing the lifetime of oil and gas assets.

"In the future, demand will be focused on lower emission energy sources," says Brown. "Recognizing that, the energy industry is undergoing a transformation - especially within the natural gas sector - where we believe sustainability innovations will be able to make some products so low-emission that they could reasonably be categorized as clean energy. Technology on the supply side is rising to meet higher environmental standards on the demand side. If we can expand the mix of sustainable energy sources, we will have an easier path toward long-term energy security."

<sup>10</sup> Traders on 'high alert' for supply glitches after oil hits seven-year peak, Financial Times

<sup>11</sup> Commodity trader king eyes \$200 oil after record hedge fund gain, Bloomberg

<sup>12</sup> Biden Desperately Needs To Bring Oil Prices Down, Oilprice

<sup>13</sup> Europe and the world need to draw the right lessons from today's natural gas crisis, IEA

## Reliance on fossil fuels

Some 38% of oil and gas respondents say that their organization is finding it increasingly difficult to secure reasonably priced finance for projects. "Access to capital could become a big problem for some companies," says Martin Jagger, Operations Director, Weconnect Energy, a network of energy specialists. "Banks and other financial institutions are increasingly scrutinized about the carbon risk in their investment portfolios. It could get to the stage where companies are unable to access the capital they need to invest in oil and gas projects, and that could also include some national oil companies."

The world's reliance on oil and gas is often underestimated, as are the challenges of moving away from these fuels. DNV forecasts that by 2030, global oil demand will have fallen around 5% compared to pre-pandemic levels, while we expect demand for natural gas will continue to grow, peaking in the early 2030s at around 4% higher than today.<sup>14</sup>

Many oil and gas companies will shift their strategy towards opportunities outside of oil and gas in the year ahead, with 62% of respondents expecting their organization to do so. It is not yet clear to what extent this trend will impact the future oil and gas supply-demand equation.

"It is very important that we maintain current oil and gas competencies. It should be about how we transition rather than stopping immediately."

**Angus McIntosh**, Director of Energy Futures, at SGN, a UK gas distribution company.

"We have to be pragmatic and realistic about how to change the world without serious negative consequences for society", says McIntosh.

A further challenge for oil and gas companies is that the energy transition may be quicker than expected, and then investments made to meet a higher, long-term demand scenario could end up as stranded assets.

This would cut large chunks from the balance sheets of the companies that own these assets, and where publicly listed, from their share prices too. Institutions, governments, pension funds and other investors in them would suffer the losses. As such, it is a risk increasingly priced in, or simply one that investors are not willing to take.<sup>15</sup>

<sup>14</sup> Energy Transition Outlook 2021, DNV

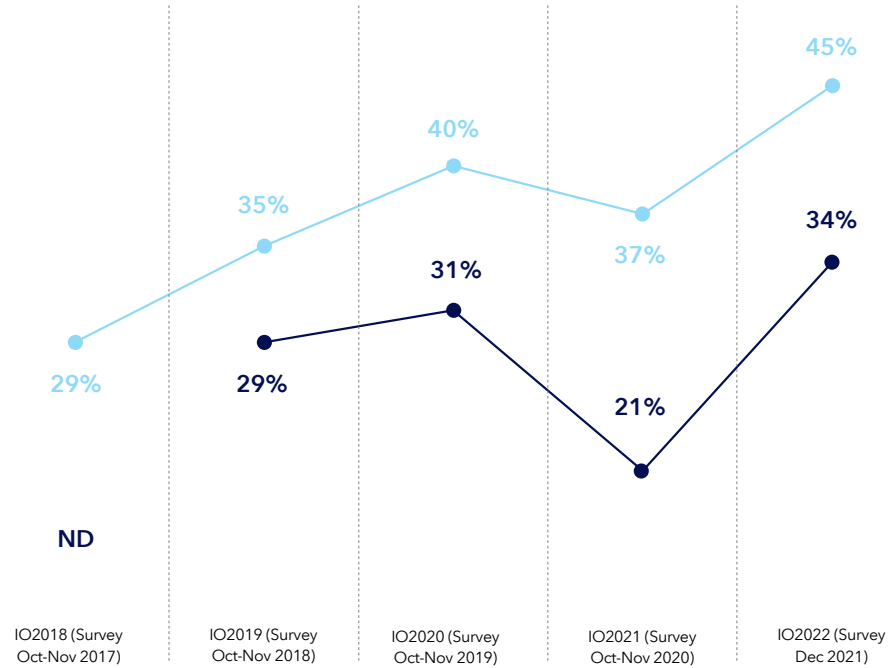
<sup>15</sup> Financing the Energy Transition, DNV



### Greater number of oil and gas companies expect to increase investment in oil and gas portfolios

Gas projects/portfolio  
Oil projects/portfolio

Data shows percentage of respondents who expect their organization to increase investment in the year ahead



### Green hydrogen the leading energy technology for increased investment

Overall Oil and gas Power Renewables Energy-consuming industries

Blue hydrogen



Green hydrogen



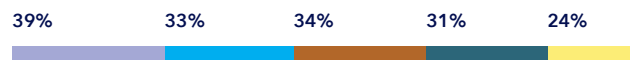
CCS



Data shows percentage of respondents who expect their organization to increase investment in the year ahead

Asia Pacific Europe Latin America Middle East and Africa North America

Blue hydrogen



Green hydrogen



CCS



### Betting on hydrogen

Some 62% of senior energy professionals say hydrogen will be a significant part of the energy mix by 2030, and 47% say their own organization is actively entering the hydrogen market.

Just a few years ago, the debate around hydrogen was about whether or not it would be part of the future energy mix at all. It now seems certain that it will be important for some applications and regions, and it is a strong contender for others, but there is still some debate about the timeline, how to scale-up the hydrogen economy, and how to create the markets that will support it.

DNV forecasts that hydrogen will only start to scale as an energy carrier from the late 2030s, reaching 5% of global energy demand by 2050, but with large regional variations: 10% of energy in Europe, for example.<sup>16</sup> We see the challenge not in the ambition, but in accelerating the timeline for a full-scale hydrogen economy.<sup>17</sup>

### Green hydrogen needs time to scale

"We are clear that the ultimate solution for industrial sectors is green hydrogen, but there is not enough green electricity available today for this to make sense," says Steinar Eikaas, Vice President Low Carbon Solutions, at Equinor. "Our vision is to build up the infrastructure of hydrogen based on blue hydrogen, because that's something we can do based on what exists today. Once this has been established, it will be easier for green hydrogen to grow into it."

As Eikaas points out, green hydrogen produces intermittent supply of hydrogen because it is created from variable renewables, and like in the electricity system, hydrogen users will need a controllable base supply. "We need a predictable supply and blue hydrogen will deliver that and be able to absorb and adjust capacity when there is a lot of green hydrogen coming in. It will be very similar to how the electricity grid is working, with a baseload that is adjusted depending on demand and generation from renewables."

Ultimately, stores of green hydrogen could provide predictable supply, but this requires extensive growth of hydrogen storage facilities. "I still think there is a gap in the storage," says Angus McIntosh, Director of Energy Futures, at SGN. "There's not been the level of development yet into hydrogen storage that there needs to be in order to be ready for full system transformation."

### Blue hydrogen needs to be cleaner

Blue hydrogen might be cheaper to produce at scale initially, but this depends on the cost of CCS, natural gas, green electricity, the capital investments required, and the geographic location. Ultimately, green hydrogen is expected to be superior in all respects, but it is not clear how long this will take and the extent to which blue hydrogen will be needed in the transition. Only 40% of those we surveyed expect green hydrogen to be cost competitive with blue hydrogen by 2030.

In recent years there have been several advances in the technologies used to capture greenhouse gas emissions in blue hydrogen production. Recent DNV research finds that blue hydrogen could qualify as a clean fuel under existing taxonomies but this will depend heavily on reducing CO<sub>2</sub> and methane emissions in the natural gas supply chain, as well as a combination of hydrogen production technology and carbon capture that focuses on high conversion rates and high CO<sub>2</sub> capture rates.<sup>18</sup>

Francisco Laverón, Head of Energy Prospective, at Iberdrola, believes blue hydrogen will be developed just in very specific places where there is abundant natural gas and CO<sub>2</sub> storage, that is close enough geographically, and guaranteed to be secure for the long term. The production process would also need to advance to a point where carbon capture ratios get close to 100% and methane leakages are reduced almost to zero. "Ultimately, if you have cheap renewables, green hydrogen is going to be cheaper," he says, "and I believe this will be the case for the majority of hydrogen produced all around the world."

<sup>16</sup> Energy Transition Outlook 2021, DNV

<sup>17</sup> Rising to the Challenge of a Hydrogen Economy, DNV

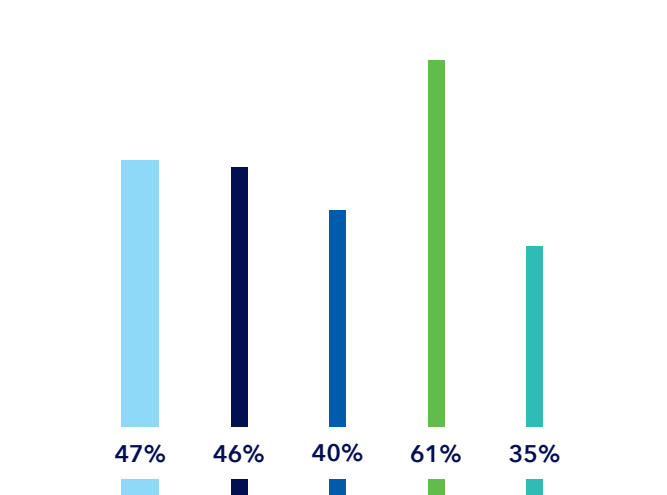
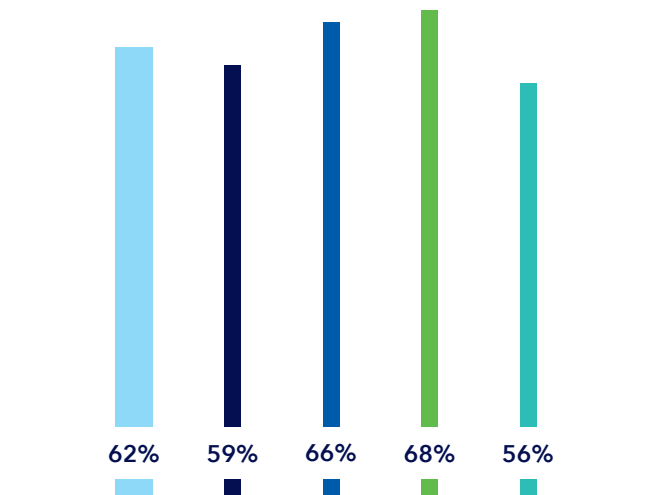
<sup>18</sup> Blue Hydrogen in a Low Carbon Energy Future, DNV

## Strong ambitions for a hydrogen economy by 2030

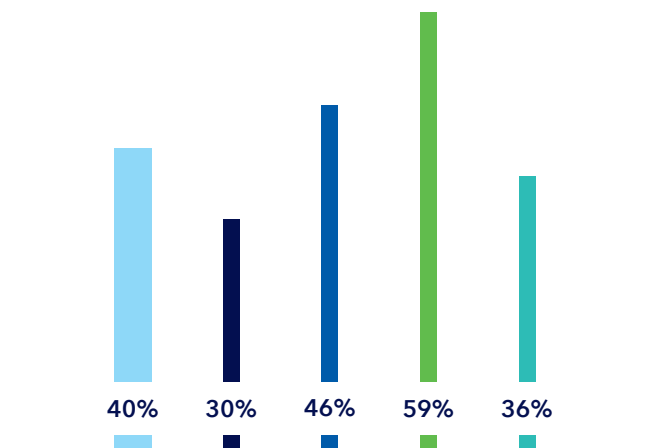
Overall Oil and gas Power Renewables Energy-consuming industries

Hydrogen will be a significant part of the energy mix by 2030

My organization is actively entering the hydrogen market



Green hydrogen will be cost competitive with blue hydrogen by 2030









# 3

## THE CHALLENGES BLOCKING FASTER PROGRESS

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New policies for a new energy system	26
Beyond one-size policies	27
Faster permits and brave decisions	28
New energy supply chains	29
The battle for new energy talents	30
A river of capital changing course	31
Building a free market for CO <sub>2</sub> storage and use	32

### 3 THE CHALLENGES BLOCKING FASTER PROGRESS

The industry has significant concerns about barriers to progress – from a skills shortage, to policies, financing, supply chains, and permitting.

From a climate change perspective, the pace of the energy transition needs to increase much further still. Current projections – which result in a 45% reduction in energy-related CO<sub>2</sub> emissions by 2050 – will still not be enough to avoid dangerous levels of global warming.<sup>19</sup>

The pressure to change is mounting. Renewables are now the cheapest form of replacement or additional electricity generation. In hydrogen and CCS we have solutions to address areas that are hard to abate or electrify. So why isn't change set to happen faster?

This is a question we must keep asking, because it lead us to collectively focus on the key problems. Many of these are complex, multidimensional and interconnected, but we believe they are all solvable with enough ingenuity and cooperation.

#### **New policies for a new energy system**

One of the biggest problems is the inertia of the past. "Everything is designed for fossil fuels," says Francisco Laverón, Head of Energy Prospective, at Iberdrola, a Spanish multinational electric utility. "The current

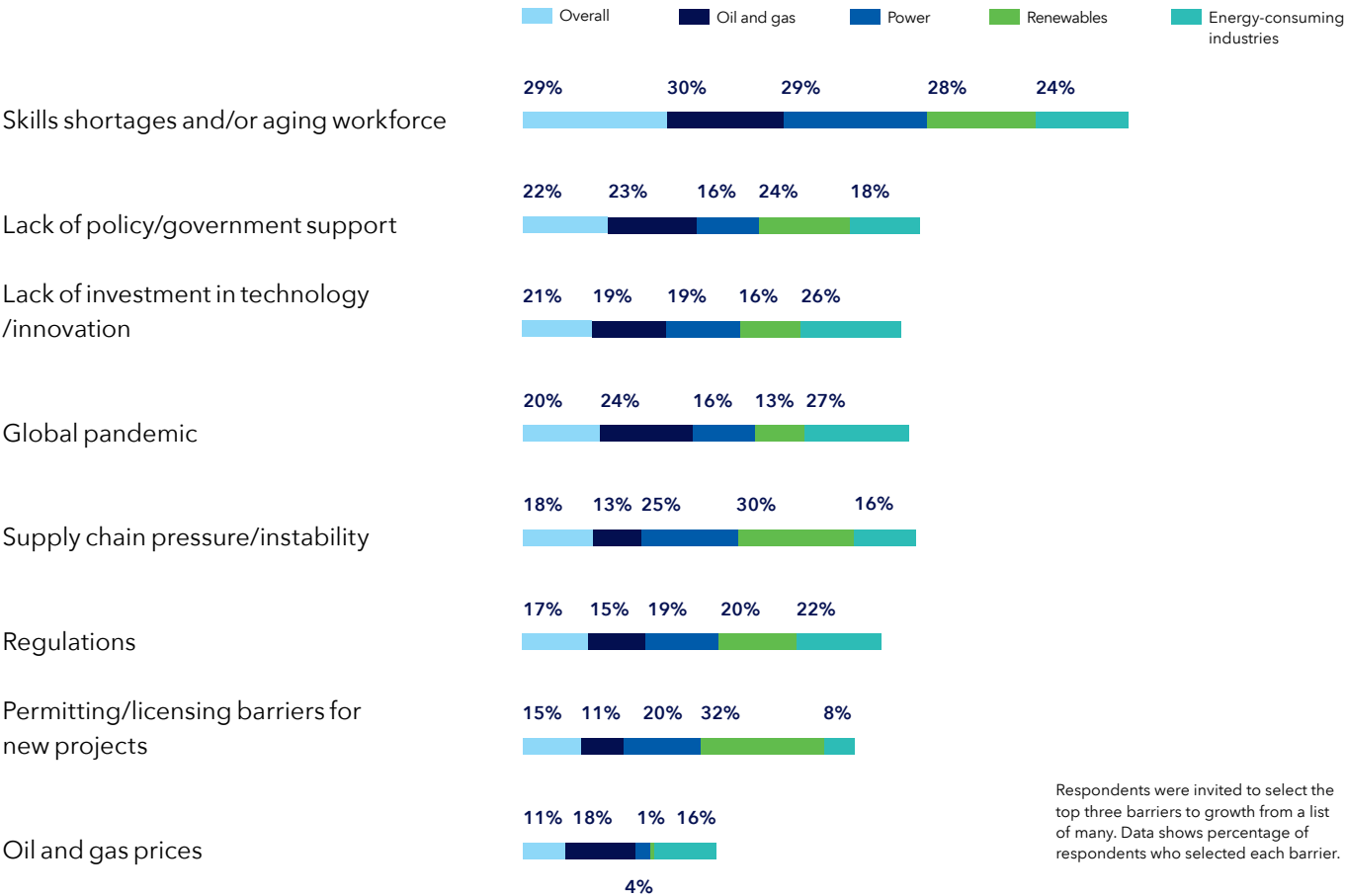
framework, including markets, regulation, taxation, infrastructure and many other things were designed and created for the economy of the 20th century, which is based on fossil fuels. For example, in Europe and other places, electricity consumers pay for carbon emissions and yet gas, petrol and diesel consumers do not," he says.

Individual organizations cannot redesign the future energy system alone, nor can individual countries. But governments often do have the power to break through this inertia with progressive changes to policies, permits, regulations, and taxes.

A lack of policy or government support is the second biggest barrier for growth for organizations in our survey, while the top-rated risk to near-term success is political or policy surprises/failures. Companies need clear and consistent policies in order to invest, but are concerned that sudden policy shifts could affect their business model and leave them with stranded assets. In fact, three quarters of those in our survey (74%) also believe that policy failures are holding back greater action on climate change.

<sup>19</sup> Energy Transition Outlook 2021, DNV

Skills shortages and lack of policy support top barriers to growth



Beyond one-size policies

One key issue for policy makers is that regions, nations, states, counties and cities are at different stages in their journey to a low carbon energy system. China is a case in point. "Beijing, for example, has reached emission peak and is making steps in carbon neutrality. Conversely, Dezhou, Tangshan and other cities with a good deal of heavy chemical plants are far from the goal," says a Senior Energy Economics Researcher we interviewed, who is linked to a key NOC in China. "In China it might be better devolving carbon taxation policies to city administrations, setting carbon peak targets according to local conditions.

It could also empower each city to balance economic development and carbon emissions. At the same time local government could also control urban power grid resources and integrate gas and heat networks to suit local conditions."

While local management might work well in some contexts, we live in a globalized world and a shared atmosphere. Disparities in policies and industrial regulation need careful consideration, and ideally, progressive coordination between governments. One of the key issues concerns carbon emissions controls and carbon prices.

The fact that most carbon-emitting industries, from generation through to industrial processes, do not pay enough or at all for the cost of carbon can itself be seen as a subsidy.<sup>20</sup> An effective price on carbon would properly price the damage caused by emissions and be set at a level that makes technologies such as CCS commercially viable.

However, if there are jurisdictions that allow free, unabated emissions to continue, while these are controlled and taxed in others, it could jeopardize any chance of success in the battle against harmful climate change. (Also see Part 5 of this report for more on evolving carbon pricing models.)

"I am very concerned about the carbon pricing policy in Europe," says Jiang Jun, Manager of Strategy and Development, at COSCO Shipping Specialized Carriers, based in China. "A carbon pricing model for the shipping industry is likely to be implemented in Europe in 2023, but the carbon price in China is different from that in the EU. In Europe, the carbon price is in the range of 90-100 Euros per tonne (February 2022), while in China it is 50-60 RMB (7.00 - 8.50 Euros) per tonne. This is a major cost gap for companies which will be difficult for the industry to resolve."

Also recognizing this issue, the EU is considering a 'CO<sub>2</sub> border tax', which would extend a price on carbon to imported products.<sup>21</sup>

### **Faster permits and brave decisions**

Permitting and licensing is the greatest barrier to growth for the renewables sector in the year ahead. Governments have the potential to dramatically accelerate the energy transition by reforming permitting laws and speeding up permit processes. "You can build a PV plant in one year, but it might take four or five years to get the permissions you need," says Laverón. "We need a huge acceleration in permitting processes. This is something that we are asking for in Europe, in the US, everywhere. There is a clear bottleneck with permitting and we have to find a way for companies to do things better regarding environmental and biodiversity

impacts, and for public bodies to accelerate permitting without losing any fairness or environmental guarantees."

But projects are sometimes rejected by citizens. We find that negative public sentiment is the sixth greatest risk for the energy industry in 2022, and the fourth greatest risk for the renewables sector. Society has to change to allow governments to accelerate the energy transition. "We see that support for renewables is only growing stronger everywhere but it is true that in some cases there are local objections," says Laverón. "But if we want renewable electricity, then we need a lot of facilities in the countryside or closer to where people live. With fossil fuels, people don't see much of the pollution, because the infrastructure is built far away, but with renewables you may see these assets from your home or in your neighbourhood. That is something we need to adapt to. Industry and governments need to work together to keep explaining the benefits of renewables to all groups in society to keep increasing support for their deployment."

There are similar issues all over the world. "We need transmission systems to be constructed in the right places and at the right speed," says Ana Lia Rojas, Executive Director, at the Chilean Association for Renewable Energies and Storage. "We are very worried because it's obvious that the speed of transmission construction is very, very slow in relation to the pace we can invest in and construct new renewables capacity."

Indeed, three quarters (74%) of energy professionals from the power and renewables sectors believe ageing power grid infrastructure is a significant barrier to greater use of renewables. Some 63% also believe that transmission infrastructure cannot adequately connect sources of renewable energy to areas of high demand.

Accelerating transmission infrastructure development - and many other elements of the future energy mix - will require brave, principled political leadership. That is, leadership that will be unpopular for some, but better for most.

"The problem is that we need to dare to tell people that you can't always get what you want, and that all good

<sup>20</sup> Financing the Energy Transition, DNV

<sup>21</sup> EU Green Deal (carbon border adjustment mechanism), EU Commission



things do not always come in a nice package,” says Espen Barth Eide, Norway’s Minister of Climate and Environment. “You have to make balanced decisions, where you have to give something up, to get something else. That’s the political challenge.”

**New energy supply chains**

Despite the fact that 64% of energy professionals expect their organization to increase investment in decarbonization in 2022, it is telling that only 42% are optimistic about reaching their decarbonization targets, and 28% are outright pessimistic.

In the near-term, supply chain issues could explain why less than half of respondents are optimistic about these targets. Almost two thirds of our survey respondents (65%) say that supply chain issues are slowing down the energy transition, and 73% say that suppliers will drive notable price inflation over the year ahead.

“The biggest impact of the pandemic on the logistics and offshore wind power industry is the supply of labour

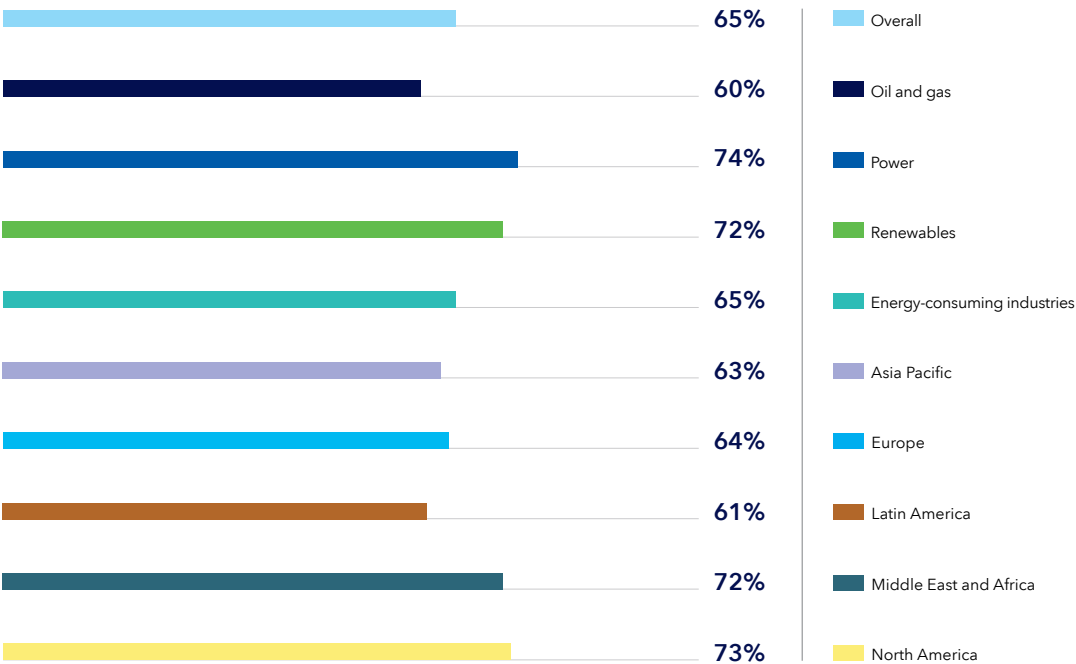
and basic materials, especially in regions where the pandemic is more serious and the industry chain is more difficult to build,” says Jiang Jun, Manager of Strategy and Development, at COSCO Shipping Specialized Carriers, based in China.

Local content and manufacturing requirements for major energy projects – largely aimed at achieving important just transition aims such as creating jobs and stimulating local economies – could also contribute to supply chain issues and slow down developments in some regions.

The energy industry needs to overcome these challenges quite urgently, and some are optimistic about this at least in terms of the supply of goods. “The supply chain has been a major challenge, making the procurement of equipment very challenging and more expensive,” says Christian Hürlimann, Renewables CEO, at MET Group, a Swiss-based, European energy company. “But we are quite optimistic. Business cases are still possible, even if more challenging, and we expect the pressure on the supply chain to ease up a bit during 2022.”

**Supply chain issues are slowing down the energy transition**

Data shows net agreement among respondents



The battle for new energy talents

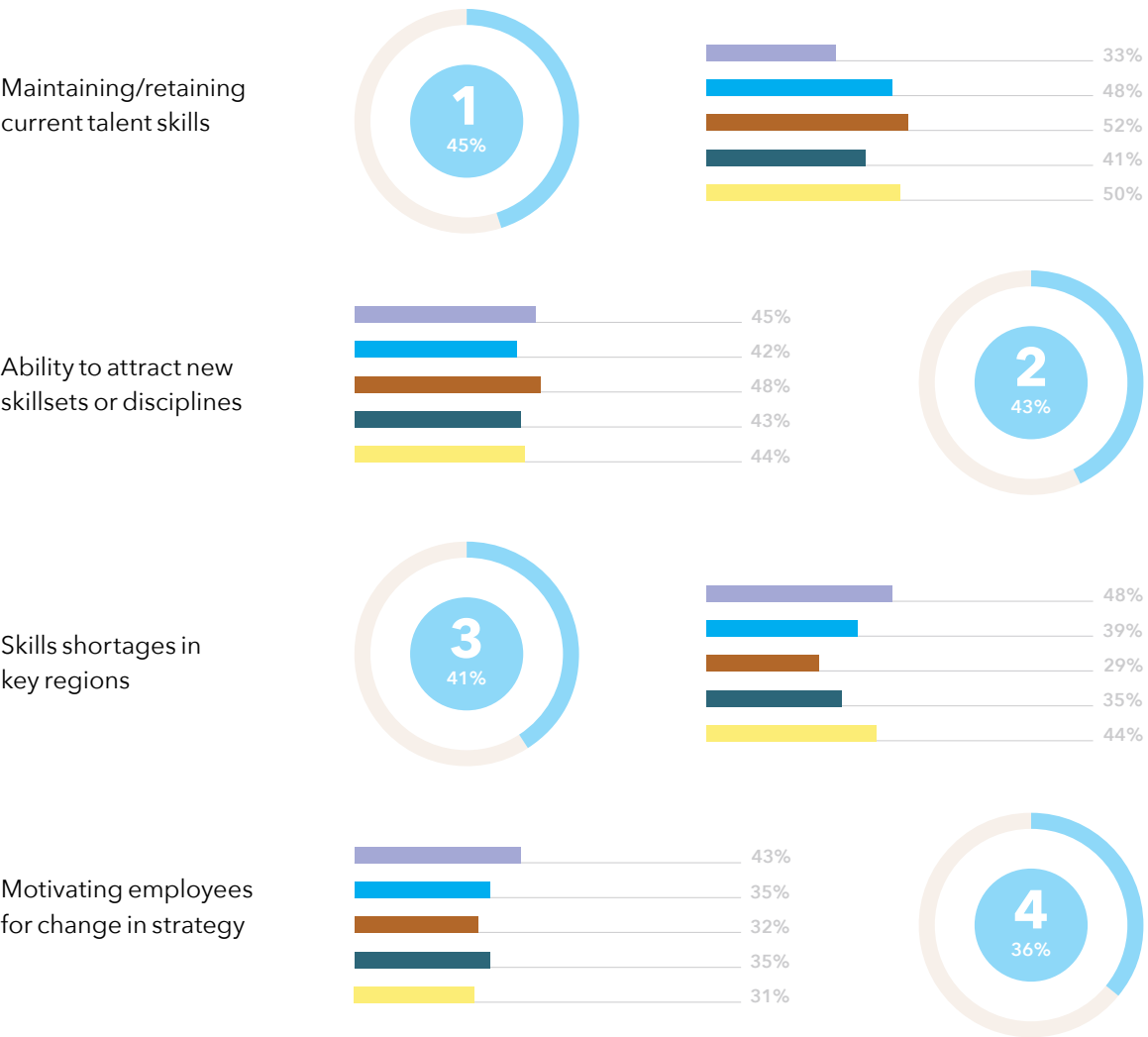
Skills shortages represent another problem that is hopefully more of a short-term squeeze than a long-burning barrier. It is not clear at the moment that the energy industry can develop and attract the workforce it needs to drive – or keep pace with – an accelerating energy transition. It is estimated that the energy transition will create 200 million jobs, while losing 185 million.<sup>22</sup>

This implies a revolution in education, retraining, and reallocation on a scale to match the revolution in energy generation, distribution and consumption. Currently, based on our survey, skills shortages are the greatest barrier to growth for much of the energy industry, with close to two thirds (65%) saying that they struggle to find people with both the domain/industry experience and digital/data skills they require.

Retaining current talent and skills the greatest workforce challenge

Overall Asia Pacific Europe Latin America Middle East and Africa North America

Respondents were invited to select their organization's top three workforce challenges from a list of many. Data shows percentage of respondents who selected each challenge.



<sup>22</sup> The net-zero transition: What it would cost, what it could bring, McKinsey

Digitalization is of course a major part of the evolution of the energy system, and a key area where more skills are needed. “We are now encountering some new challenges in our development process because the new energy industry is fully digitalized and so this requires a higher level of knowledge among our teams,” says a Jiang Jun, Manager of Strategy and Development, at COSCO Shipping Specialized Carriers, based in China. “We hope that the supply of workforce would become more fluid and effective, on the one hand, but we need the knowledge structures and self-qualification of the workforce to better match some of these new challenges.”

### **A river of capital changing course**

The financial sector has a central role to play in accelerating the energy transition, and the world’s biggest financial institutions are more unified on that point than ever before. The Glasgow Financial Alliance for Net Zero (GFANZ), for example, was launched in 2021 in the lead up to COP26. It now has over 450 financial firms signed up from 45 countries, and is responsible for assets of over \$130 trillion.<sup>23</sup>

GFANZ is focussed on accelerating decarbonization by enhancing and standardising the ways in which financial firms assess the transition plans of those that they invest in, insure, and finance.<sup>24</sup> GFANZ is just one sign of the growing power that the financial sector has to hold back higher carbon projects while enabling lower carbon alternatives. Indeed, to reach net zero, financiers need to not only to support clean-energy projects, but also to disincentivize fossil fuels and the status quo.<sup>25</sup>

While carbon pricing is the key tool to redirect capital away from fossil fuels, some investors are also attracted to the greater certainty and lower volatility of clean-energy projects.

“Offshore wind is a very different proposal in terms of risk,” says Marc Schmitz, Managing Director and Head of Renewable Energy Project Finance Europe, at Rabobank, a Dutch multinational financial services company, “because with wind and solar there’s no equivalent to the feedstock risk you get with a gas power plant. The sun and wind are free. So even if establishment is delayed or construction costs are higher than expected, there is low risk of losing your investment, it may just take a bit longer to recuperate it.”

All companies present shareholders with a different mix of risk and return. The power and renewables sectors essentially offer investors a share in infrastructure, with stable, long-term cash flows that often have an element of inflation correlation. Oil and gas companies have always offered something quite different: higher risk, higher volatility, and potentially, high rates of return.

“I think it’s almost inevitable that the energy system will head in the long-term to more predictable returns, which is good for society,” says Lord Adair Turner, Chair, at the Energy Transitions Commission. “But oil and gas companies face a challenge in terms of what they look like to the capital markets. One of the things that they have to do is communicate to shareholders that they are migrating to the lower risk, lower return end of the capital market spectrum.”

<sup>23</sup> Glasgow Financial Alliance for Net Zero (GFANZ)

<sup>24</sup> The Glasgow Financial Alliance for Net Zero, Our progress and plan towards a net-zero global economy

<sup>25</sup> Financing the Energy Transition, DNV

### **Building a free market for CO<sub>2</sub> storage and use**

CCS will be especially important in manufacturing industries, but it is a complex task to scale and build new value chains. “The technology required to abate each industrial sector is quite specific,” says Martin Jagger, Operations Director, at Weconnect Energy, a network of energy specialists. “So specific systems and processes are needed to decarbonize steel, aluminium, cement, oil and gas, and so on. After this stage, however, offsets and CCS are universal.”

The difficulty is in the rate and magnitude of scaling-up required. “Too many projects are small scale,” says Jagger, “we have the capability globally today to sequester just under 40 million tonnes of CO<sub>2</sub> per annum. The net zero scenario now means we are looking at needing 7.6 giga-tonnes by 2050, that’s 200 times bigger than we are today.”

Currently, the cost of CCS relative to the carbon price is too great for CCS to gain momentum. Our survey respondents appear to recognize this, with 70% of the opinion that lowering the cost of CCS is critical to meeting the Paris Agreement goals. On the flip side, it will be essential to also increase the cost of unabated emissions, to a point where CCS becomes financially viable.

### **Steps towards a viable, global CO<sub>2</sub> storage market**

In many cases, CCS is held back by markets, policies and misinformation. The technology and expertise is available, the geological sites exist, but business models and commercial viability is still lacking. “There is a critical perspective shift that is needed, because CO<sub>2</sub> is sometimes still viewed as a contaminant or waste, when technically neither is the case if we are looking through the lenses of industries outside of upstream oil and gas production, such as steel, cement and power industries,” says Nora’in Md Salleh, Head of CCS Enterprise, at Petronas, a Malaysian oil and gas company. “We need the right policy and advocacy to educate people and get everyone behind CCS as a viable pathway for carbon

management, to achieve real progress on climate action plans as CCS eliminates the physical release of CO<sub>2</sub> emissions into the atmosphere.”

Ultimately, because CCS requires specific geological features and technical expertise, we will most likely see oil and gas producing regions evolve into regional CCS hubs. These hubs could be served by both tanker ships and pipelines linking multiple industrial centres to giant CO<sub>2</sub> storage infrastructure.

CCS business models will depend on building CO<sub>2</sub> purification, liquefaction, transport, and storage infrastructure. At present there is no fleet of tankers that can safely transport high volumes of CO<sub>2</sub> long distances. Where feasible, pipelines may be more cost effective, but these will require significant time and capital to develop. Once in place, a viable market is conceivable.

“When we go to this stage we believe we will be able to offer transport and storage for CO<sub>2</sub> at about 100 Euro per tonne,” says Steinar Eikaas, Vice President Low Carbon Solutions, at Equinor, a Norwegian, state-owned, multinational energy company, “and we expect this to happen before 2030. In the same timeframe, we also expect that the tax for emitting CO<sub>2</sub> will reach the same level. In other words, we believe that CCS will become a healthy business in this decade, but this requires investment in large projects now, as well as the right tax and regulatory support to get the market established.”

The Northern Lights project offshore Norway<sup>26</sup>, a collaboration between Equinor, Shell, and Total Energies, is in many respects leading the way in developing a CCS value chain, aiming to transport CO<sub>2</sub> from industrial sources via ship and then pipeline to storage sites in the North Sea.

Overall, the energy industry has a relatively positive short-term view on CCS, with 58% of our respondents saying it will scale up rapidly in the next five years.

<sup>26</sup> Northern Lights show the way to seaborne CCS solutions, DNV



**Strong expectations for scaling CCS in the next five years**

Overall Oil and gas Power Renewables Energy-consuming industries

Carbon capture and storage will scale up rapidly in the next five years



Lowering the cost of carbon capture and storage is critical to meeting the Paris Agreement goals



Data shows net agreement among respondents

Asia Pacific Europe Latin America Middle East and Africa North America

Carbon capture and storage will scale up rapidly in the next five years



Lowering the cost of carbon capture and storage is critical to meeting the Paris Agreement goals



Data shows net agreement among respondents







# 4

## TACKLING COMPLEXITY THROUGH COLLABORATION AND DIGITALIZATION

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Taking collaboration to a new level	36
Digital control over complexity	38
Efficient solutions	40
Protecting pioneers	41

## 4 TACKLING COMPLEXITY THROUGH COLLABORATION

The complexity of the energy transition takes many forms. Part of it is the scale of change required, and to such critical, ubiquitous systems.

Another part of the complexity is the creation of a more fragmented, multi-modal web of energy generation and storage systems, requiring power infrastructure that can enable multi-directional flows of electricity, molecules, and data.

Sometimes nature adds another layer to the complexity. In Chile, for example, there is a concern that despite progress in adding renewables to the energy mix, the share of coal is not going down. "You could be tempted to conclude that we are advancing very rapidly in terms of adding renewables into the grid at the pace of demand growth, averaging around 6 to 7% per year," says Ana Lia Rojas, Executive Director, at the Chilean Association for Renewable Energies and Storage, "But this is only replacing hydroelectric generation, which has been falling for 10 years because of droughts. Coal remains at 35%, even though we have increased non-conventional renewables to 37% within the energy generation matrix."

Almost everything about the energy transition creates more complexity. Without well-coordinated, intelligent implementation, this complexity can drive up costs and risks, while reducing resilience. In addition, the visibility of information – and the sharing of data – also becomes key to supporting this collaboration.

Some of this complexity is linked to change and the need to develop new models and involve new stakeholders. But once established, new energy systems are still intrinsically more complex as a result of the decentralization of energy generation and storage, the variability of renewables, and the diversity of inputs that need to be integrated with gas and electricity networks, transport, and industrial processes. Up front, collaborative work to establish and communicate boundary conditions will be essential,

ensuring that new or adapted assets are able to readily integrate with the rest of the energy system.

### **Taking collaboration to new levels**

The complexity of new energy systems means organizations are needing to build relationships with new stakeholders and deepen the level of integration and cooperation with entities outside their walls.

Perhaps this is why such a high proportion – 81% – of our survey respondents say their organization will increase the scale of its collaboration with other organizations in the year ahead. And why almost all respondents (92%) feel that global collaboration is essential to a just and equitable energy transition.

"We have taken the decision to be very open about what we can achieve," says Steinar Eikaas, Vice President Low Carbon Solutions, at Equinor, a Norwegian, state-owned, multinational energy company. "We are working very closely in vertical partnerships, as opposed to horizontal partnerships which we are more used to. We work much more closely now with our suppliers and with our customers. Together with them, we can develop the full value chain of solutions for how to decarbonize."

Collaboration appears especially important to enable the newer elements of the energy system. Some 78% of respondents say that to adapt to the energy transition, their organization is collaborating with new stakeholders that they have not worked closely with in the past.

"I think collaboration will play a very big role for us in making CCS happen," says Nora'in Md Salleh, Head of CCS Enterprise, at Petronas, a Malaysian oil and gas company. "You need to come together, not only among

## Complexity is driving greater digitalization and collaboration

Overall

Oil and gas

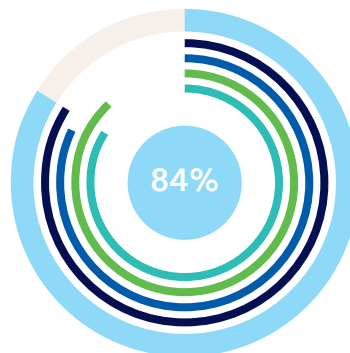
Power

Renewables

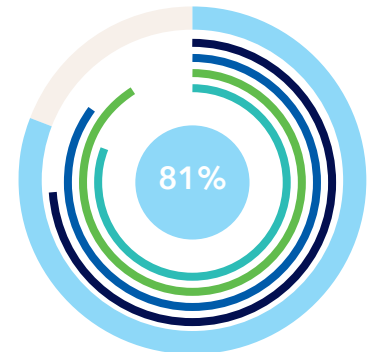
Energy-consuming industries

Data shows net agreement among respondents

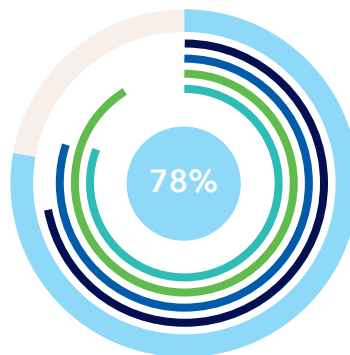
The industry needs to develop new operating models to achieve further cost efficiencies



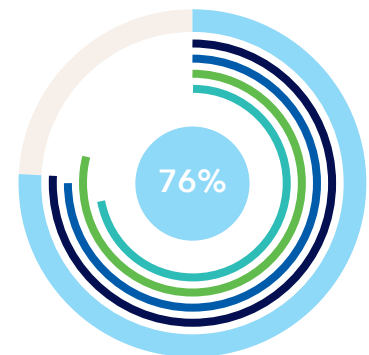
My organization will increase the scale of its collaboration with other organizations in the year ahead



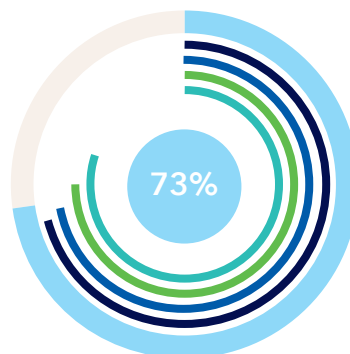
To adapt to the energy transition, my organization is collaborating with new stakeholders we have not worked closely with in the past



My organization will seek to achieve greater standardization of its tools and processes to reduce costs over the year ahead



Suppliers will drive notable price inflation over the year ahead



the oil and gas players, but also the energy consuming industries, because they sometimes have technology or technical knowledge that can make the whole process and the value chain more competitive."

There are similar needs in other new energy segments. "In offshore wind the deals are so big that you mainly see two or more equity holders in partnership to get

the transactions done," says Marc Schmitz, Managing Director and Head of Renewable Energy Project Finance Europe, at Rabobank, a Dutch multinational financial services company. "Funding these is also complex, with the capital requirements sometimes needing 20 or 25 banks to collaborate. You need good relationships. Working together with them, with the other stakeholders, with government – it is really important."



### Digital control over complexity

Most agree that digitalization is crucial to managing the burgeoning complexity of the new energy system, where multiple inputs must be integrated, and numerous processes need to be automated to ensure services are reliable and resilient. Indeed, 79% of the power and renewables respondents to our survey say that a reliable decentralized energy system is impossible without digitalization.

It is not surprising then to see that the majority of our survey respondents (71%) say that their organization has increased focus on digitalization over the past year. "When it comes to balancing markets and balancing costs, we need to develop better data-driven forecasting and automation," says Christian Hürlimann, Renewables CEO, at MET Group, a Swiss-based, European energy company. "This includes using artificial intelligence, particularly for predictive maintenance. If we can prevent unexpected failures then we can better integrate into the energy markets and improve profitability. At the same time, we can ensure better production forecasting, saving on the balancing costs that can occur if, for example, a wind power plant suddenly fails during a time of high market prices, thereby triggering a high forecast-production discrepancy."

This perspective is shared by the energy industry, with 72% of our respondents believing that their organization needs to embrace digitalization to increase profitability.

A major part of this is making improvements to data capabilities.

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"How to process, share, and understand our data is a key priority."

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**Christian Hürlimann**, Renewables CEO, at MET Group

"When we look at PV plants for example, there is so much data that is collected. It is about how we mine that data, how we choose what to erase, because you cannot process it all. You need to make the right decisions and really understand the data and that is where there is still a lot to be done", says Hürlimann.

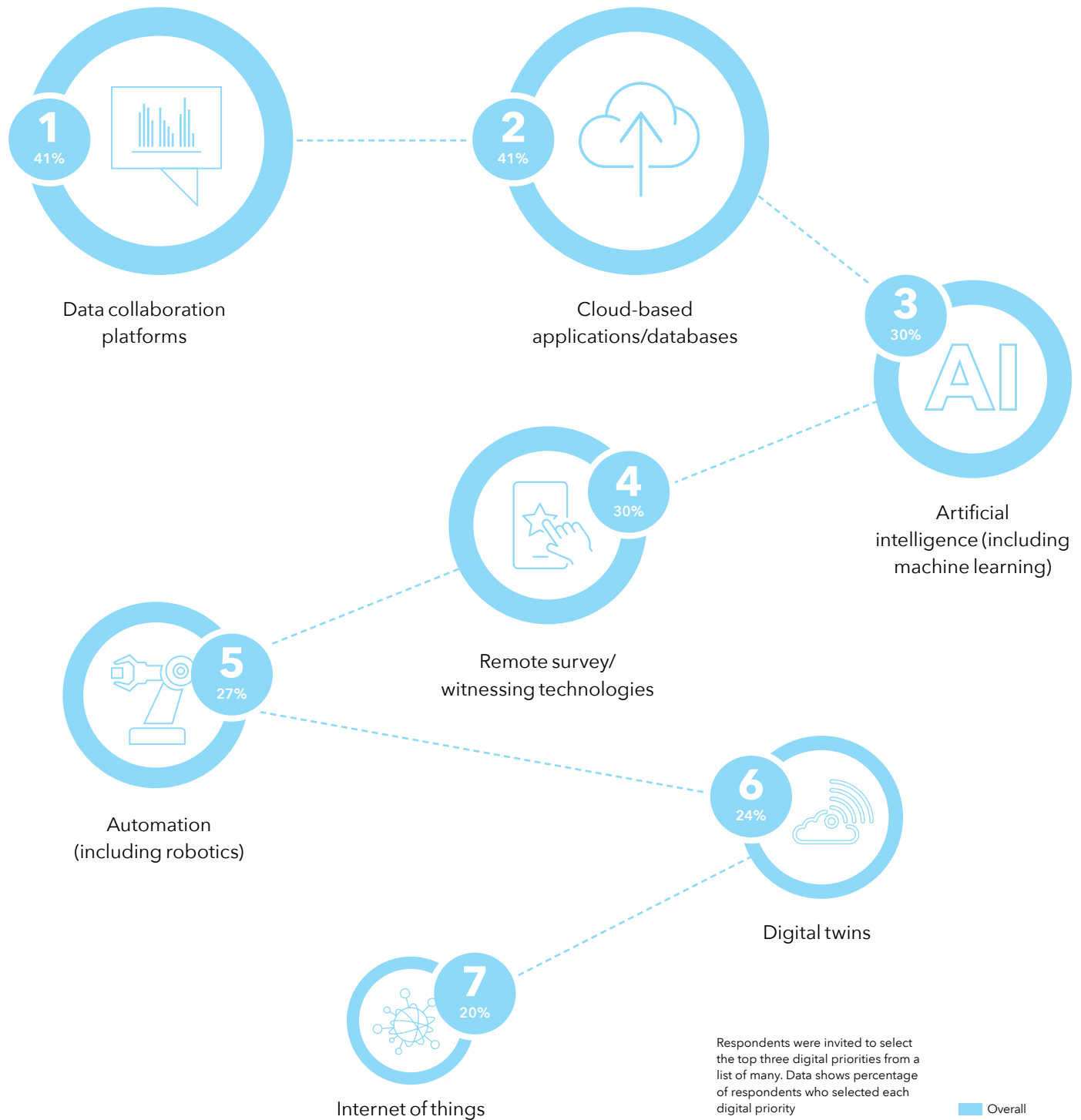
Many are also working one step back from this, with 72% of those we surveyed saying that their organization will prioritize improving data quality and availability in 2022.

Decarbonization will also rely heavily on digital systems. "Digital methods are essential to decarbonization," says Jiang Jun, Manager of Strategy and Development, at COSCO Shipping Specialized Carriers, based in China. "From real-time monitoring and calculation of carbon to the entire process of energy transition, which cannot be achieved without digital methods and intelligent devices."

This is a key point and one that will only increase both the available investment in digitalization as well as the demand for associated skills.

An important example could be the use of blockchain in carbon measurement and trading. "The world ahead of us requires a blockchain solution for carbon accounting," says Martin Jagger, Operations Director, at Weconnect Energy, a network of energy specialists. "This would ensure that you cannot double-count scope one, two and three emissions. It allows for those definitions to be adjusted without losing track of what has been accounted for. It is something we need to properly manage the low-carbon supply chains that are emerging."

## Digitalization priorities reflect increasing importance of data driven strategies and automation



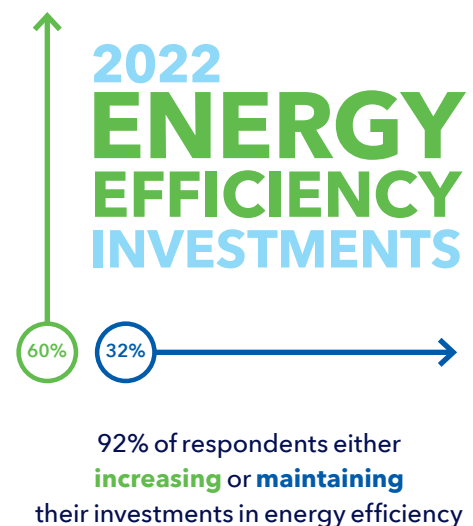
## Efficient solutions

The challenge of complexity, digitalization and decarbonization all come together when we talk about energy efficiency, particularly for policy makers.

Energy efficiency requires policy makers to collaborate with a diverse range of parties, including individuals, businesses, utilities, technology and data providers. The challenge is to develop policies that are both far-reaching and targeted, without causing additional bureaucratic burdens or holding back innovation. This requires detailed data and connectivity to allow easier access and support future energy efficiency policy.<sup>27</sup>

DNV has previously described efficiency as the “unsung hero of the energy transition” and argued that it should be the number one priority for companies and governments.<sup>28</sup> Overall, the energy industry appears to share this view, with 92% of respondents either increasing (60%) or maintaining (32%) their investments in energy efficiency in 2022. Energy efficiency is also the greatest investment focus for energy consumers, ahead of decarbonization and digitalization.

DNV’s Energy Transition Outlook finds that without any energy-efficiency improvements, global energy demand would increase by 65% by 2050. In contrast, we forecast an almost flat development in energy demand, with energy efficiency measures offsetting growth in overall consumption.<sup>29</sup>



<sup>27</sup>. Better energy efficiency policy with digital tools, IEA

<sup>28</sup>. Energy Transition Outlook 2021, DNV

<sup>29</sup>. Financing the Energy Transition, DNV

### Protecting pioneers

Much like it was in the early decades of the 20th century, today's energy industry is full of first movers and pioneers. But being among them comes with significant costs, which can take many forms.

Integrating renewables into electric grids is one example: "Projects that look viable in terms of location and land can be complicated by the need to upgrade the grid," says Christian Hürlimann, Renewables CEO, at MET Group. "The first company to trigger these needs often ends up paying the costs of the upgrades, which can benefit future competitors."

Some argue that power grids, which are often government owned or controlled, should do more to integrate and adapt to the wider energy sector. "Seeking profits from the power grid and pipe network is not important. The national economy is important. China's renewable energy development is important. Achieving carbon neutrality as soon as possible is important," says a Senior Energy Economics Researcher we interviewed, who is linked to a key NOC in China.

In fact, some organizations have an explicit 'wait and see' or 'fast follower' strategy to deliberately wait in the wings for new infrastructure to be built, costs to fall and new markets to be established. "Because everyone expects costs to fall, there is an incentive to wait and see, and a disincentive to move early," says Steinar Eikaas, Vice President Low Carbon Solutions, at Equinor. "This needs to be offset by subsidies and other measures to help organizations justify making these investments early. You need some security that you can plan around. You need confidence you have a fair chance to compete in the future market you are helping to create."

This is important because building the energy systems of tomorrow requires an enormous amount of research and development capital. This may not be needed for

wind or solar anymore, but it is still the case for many areas that are earlier in their development. Angus McIntosh, Director of Energy Futures, at UK gas distributor, SGN, says: "It is hard to convince people to invest in projects that don't make any money, like most R&D and demonstration projects." His point is that, without government and regulatory support, pioneering companies can end up paying a heavy penalty without any guarantee of reward or compensation. "That is important because it affects the speed and the timeline for change," says McIntosh.

Ensuring a safe transition is also essential, as accidents have the potential to set back new industries. One example is the 2019 Kjørbo incident near Oslo, in which a hydrogen refueling station exploded, leading to the (albeit temporary) shutdown of stations across Europe and halts to deliveries of hydrogen cars to Norway. For hydrogen, CCS, and other technologies, industry and regulators need to prove the safety case, and this task inevitably falls to pioneers.

Protecting pioneers, in the form of ensuring competitiveness, is also an issue among countries and regions. The first countries to raise carbon pricing, for example, could lose businesses to neighbouring countries with lower rates. This is a concern for all countries and regions, with China and the EU contending with it, but it may be particularly difficult for smaller countries that are less able to go it alone. This shows the importance of international agreements and cooperation, whether it's COP26 pledges and the Paris Agreement or decarbonization targets set by global industry organizations – such as the International Maritime Organization (IMO) for the shipping industry.

<sup>30</sup> Norway hydrogen station explodes, Toyota and Hyundai halt sales, Autoblog

<sup>31</sup> Heating homes with hydrogen: proving the safety case







# 5

## COP26 – PROGRESS TO BUILD ON

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A step towards a global carbon market

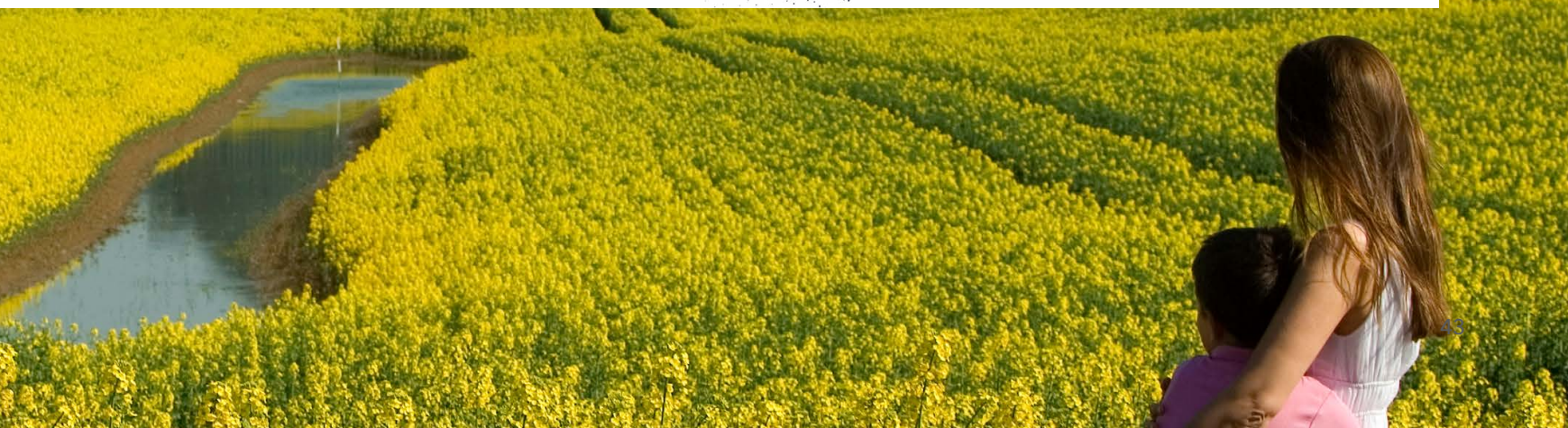
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Three models for the price of carbon

46

Not perfect, but a step forward

47



## 5 COP26 – PROGRESS TO BUILD ON

The summit came at a pivotal moment to avert the worst effects of the climate crisis.

There is no global accord on power sockets, paper sizes, traffic laws, units of measurement, cellular frequencies or even spelling. It is just difficult to get people to agree – even within families, or groups of friends, let alone between the regulators, industries and governments of different countries.

This is why few were surprised by how tense and painstaking it was to negotiate the Glasgow Climate Pact, which was finally signed – a few days late – at the 26th United Nations Climate Change Conference of the Parties (COP26) in November 2021.<sup>32</sup>

The Pact left some frustrated, some relieved, and many somewhere between.

“I actually think COP26 went quite well, by the standards of previous climate conferences,” says Espen Barth Eide, Norway’s Minister of Climate and Environment.



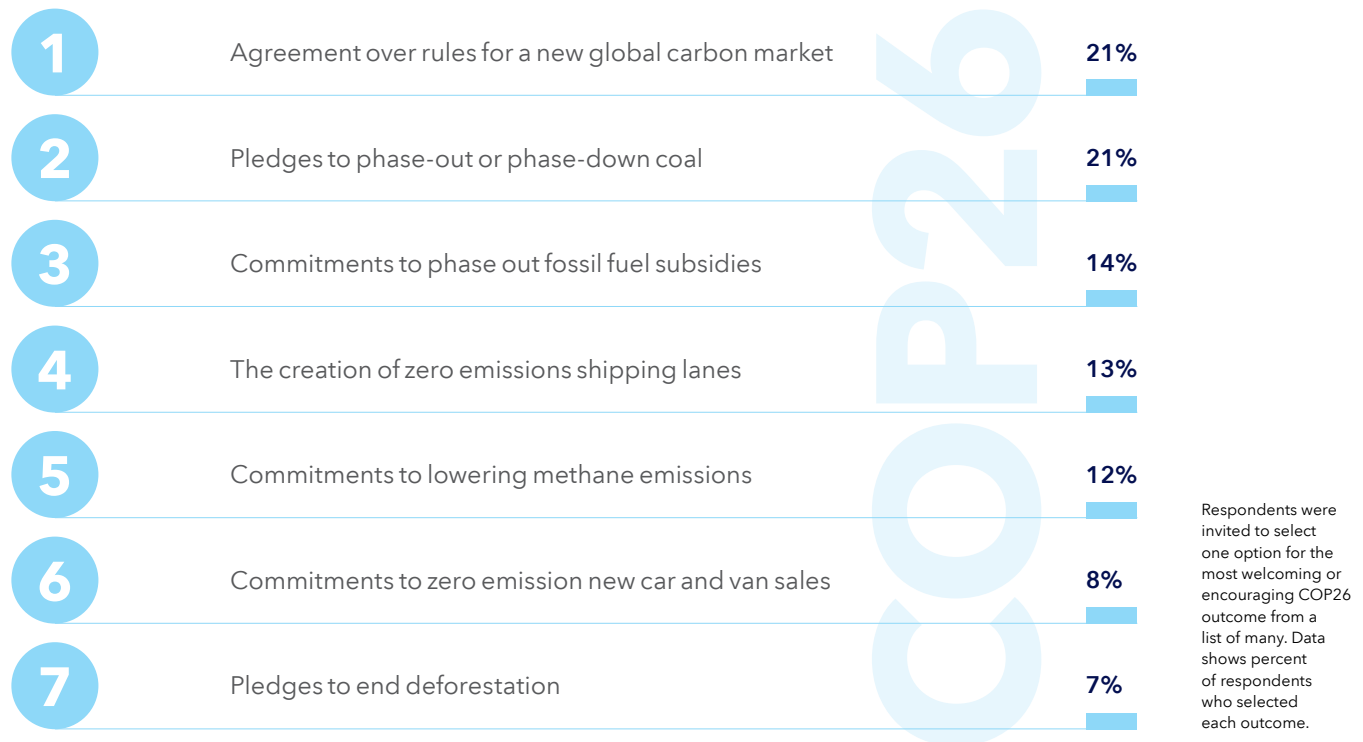
“I believe we need to do more and do it faster, but there were some strong outcomes.”

**Espen Barth Eide**, Norway’s Minister of Climate and Environment.

Senior energy professionals believe that pledges to reduce the use of coal, as well as those to end deforestation, are the COP26 outcomes that will have the most positive impact for the global fight against climate change.

### A step towards a global carbon market

About half of the senior energy professionals we surveyed (52%) believe COP26 will help the Paris Agreement mechanisms operate more effectively. An important part of this is likely to be the rules that were agreed to support a global carbon market. This was the COP26 outcome that our respondents rate as the most welcome or encouraging for their part of the energy industry, and 79% say that the world cannot reach the goals of the Paris Agreement without a globally regulated carbon price/market.

**Agreement over rules for a new global carbon market most encouraging COP26 outcome**

The Article 6 negotiations were led by Minister Barth Eide and his counterpart from Singapore, Grace Fu. “Finally we had a breakthrough on the common UN rules for quota systems and emissions trading globally – Article 6 of the Paris Agreement – which is a major outcome, and something that had not been solved, despite several attempts at previous summits. There was also recognition of the urgency that the IPCC scientific basis demonstrates,<sup>33</sup> which was a topic area agreed unanimously for the first time,” says Minister Barth Eide.

The progress on Article 6 could accelerate the trade of carbon credits and offsets. “A strong international carbon trading market would be a game changer for Canadian LNG,” says Andrew Brown, Head of Engineering, at Woodfibre LNG, an LNG export facility on the west coast of Canada.

“We can have more impact on reducing emissions internationally than we can domestically in Canada, by exporting less-emissions-intensive energy products. It’s a win-win from an environmental mitigation perspective. Millions of tonnes of greenhouse gas can be avoided in regions with higher total emissions, by switching from coal to Canadian gas, while in Canada, we protect citizens against the impacts of climate change. Article 6 implementation could trigger this positive change, unleashing a lot of potential by helping clarify where activities in one country can support emissions reductions in another,” says Brown.

<sup>33</sup>. AR6 Climate Change 2021: The Physical Science Basis, Intergovernmental Panel on Climate Change (IPCC)

Three models for the price of carbon

Over three-quarters of senior energy professionals (77%) believe carbon prices will rise sharply over the next five years. While this rise is already underway in some regions,<sup>34</sup> there are many that believe a global carbon price is unlikely to develop soon. “I’m not holding out for a global or universal carbon price any time soon,” says Lord Adair Turner, Chair, at the Energy Transitions Commission.

Instead, Turner believes a sector-by-sector approach is more realistic, and he anticipates three main models emerging. The first are local challenges, like residential heat, where it does not matter if countries take different approaches to decarbonization – some might use building regulations and taxes, others might use subsidised insulation and electrification. These choices are not likely to impact one country’s competitiveness in a major global market.

By contrast, the second group of sectors are precisely those where a carbon price in one country will just see markets exploit lower prices from countries that do not apply carbon prices. Prime examples are energy-intensive industries that produce relatively commoditized goods, such as steel, aluminium, fertilizer, and chemicals.

“In an ideal world, we would apply a global carbon price of ‘X’ to these sectors, which would go up over time,” says Turner, “but I think there is very little likelihood of that occurring. Instead, some jurisdictions will go ahead with carbon prices on their local industries, but they will also impose border tariff carbon adjustments on imports.”

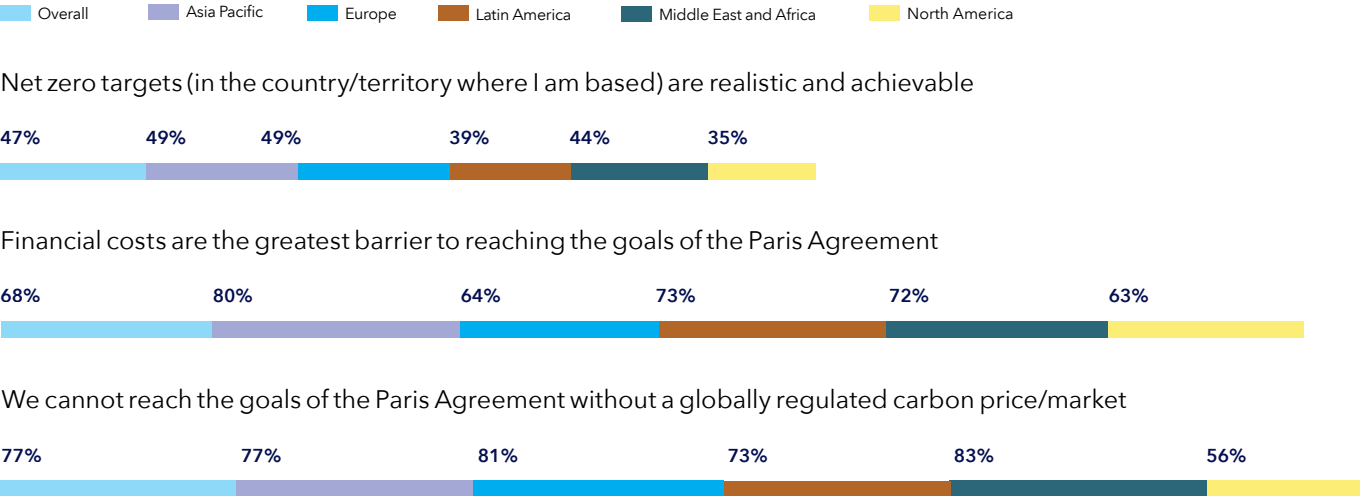
This kind of tariff is set to be phased in by the EU from 2023. Dubbed the ‘Carbon Border Adjustment Mechanism,’ it is designed to “equalise the price of carbon between domestic products and imports and ensure that the EU’s climate objectives are not undermined by production relocating to countries with less ambitious policies.”<sup>35</sup>

These kinds of measures may ultimately lead other countries to follow suit, so they too can maintain the competitiveness of domestic industries, while major exporters may begin to produce more low-carbon products to avoid the tariffs.

The third group are arguably the only two sectors that have a strong history of truly global, rule-making power: shipping and aviation. The globally accepted regulations of the International Civil Aviation Organization (ICAO) and the International Maritime

Financial costs less of a barrier to reaching climate goals for Europe and North America

Data shows net agreement among respondents



<sup>34</sup>. Europe's Carbon Prices Surge to Fresh Records on Tight Supply, Bloomberg, January 2022  
<sup>35</sup>. Carbon Border Adjustment Mechanism: Questions and Answers, European Commission

Organization (IMO) evolved for safety reasons, but they are already evolving to govern emissions.

### Not perfect, but a step forward

The majority of the energy industry surveyed (62%) says COP26 did not achieve enough, and three quarters (74%) say that policy failures are holding back greater action on climate change.

The industry is not especially confident about the pledges made by their nation's political leaders. Less than half of respondents (47%) say that net zero targets in the country or territory where they are based are realistic and achievable. Europe (49%), Asia Pacific (49%) and the Middle East and Africa (44%) have proportions close to the overall average, but faith in net zero strategies is significantly lower in Latin America (39%) and North America (35%).

While these numbers sound negative, the summit was progressive, and we should not forget that what is being attempted by the IPCC is extremely difficult. Even though aspects were not perfect, as Minister Barth Eide points out: "increasing recognition and agreement on key issues helps, because you can build on that."

The system is imperfect because all the commitments are voluntary. While countries may agree that the target should be 1.5°C, they then put forward nationally determined contributions (NDCs) which countries decide for themselves (following the process developed at the COP21 summit in Paris). They are free to submit inadequate NDCs and claim that these represent their limit. Many countries did just this at COP26 - almost none of the NDCs submitted were on the pathway to 1.5°C.

"There's no mathematical framework," says Turner, "so you have some inherent imperfection, but it remains powerful because it brings us all under some sort of collective responsibility." Turner points out that the NDCs have created a language of international discussion - a language for countries to use to refer to commitments and hold each other accountable. "It's as good a process as we're going to get," he says, "COP26 was a step forward - a step made with a process that is imperfect, but which still makes a difference."

*COP26 came at a pivotal moment for the world's climate. A 1.5°C future is still possible, but it requires massive action starting today, as set out in DNV's Pathway to Net Zero Emissions.<sup>36</sup>*

## Power and renewables unified on belief that policy failures are limiting climate action

Data shows net agreement among respondents

Overall Oil and gas Power Renewables Energy-consuming industries

COP26 will lead to significant emissions reductions (from my part of the energy industry)



COP26 will lead to changes in my organization's strategy



Policy failures are holding back greater action on climate change



<sup>36</sup> Pathway to Net Zero Emissions, DNV







# 6

## CONCLUSION: SUSTAINABLE OPTIMISM

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"Optimism is the sense that we will keep improving and solving problems. But for optimism to be sustainable, this progress needs to go beyond meeting revenue and profit targets, to also meeting climate targets."

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## 6 CONCLUSION: SUSTAINABLE OPTIMISM

The energy industry is optimistic and making critical decisions in the energy transition, but there is a mismatch between optimism and the world's longer-term progress on decarbonization.

Energy systems are becoming both more fragmented, in terms of generation and storage, and more interconnected, as digitalization and automation progress. These trends are creating new dynamics for energy industry forecasters to grapple with. Take this excerpt for example:

"If the wind blows strongly in Europe, if it rains on hydro dams in China, we could easily see a slump in global gas prices."

**Dr Graeme Bethune**, chief executive of Australian energy consultancy, EnergyQuest (not interviewed for this report), as reported by The Sydney Morning Herald, October 2021, in a story about high gas prices.<sup>37</sup>

Market, weather and climate forecasts – short and long term – are more important than ever. Leaders are making pivotal, long-term decisions on the basis of today's models.

Uncertainty about those forecasts is natural, and yet dangerous. It can lead to decision paralysis – the fear of getting major choices wrong can make it seem safer to wait, to see what happens next.

But as the IPCC's 2021 report on "the most up-to-date physical understanding of the climate system" made very clear: we cannot afford to wait and see.<sup>38</sup> The world is not on track to meet the targets of the Paris Agreement, with DNV forecasting a most likely future in which the world exhausts the carbon budget for the Paris Agreement's 1.5°C limit on global warming by 2029, and the 2°C limit by 2053. Our forecasts point to warming of 2.3°C above pre-industrial levels by the end of the century.

Energy industry leaders and government decision-makers are rightly under pressure to make brave calls, and act without delay. While it is easy to point at uncertainties – such as the pandemic, geopolitics, or regulations – there is no doubt about the direction of some of today's key trends. The energy transition itself is now unstoppable and accelerating. Energy systems are growing more and more digital, automated and data-driven.

It is perhaps these pillars of certainty that are supporting the strong optimism we see among the 1,088 senior professionals that completed our survey.

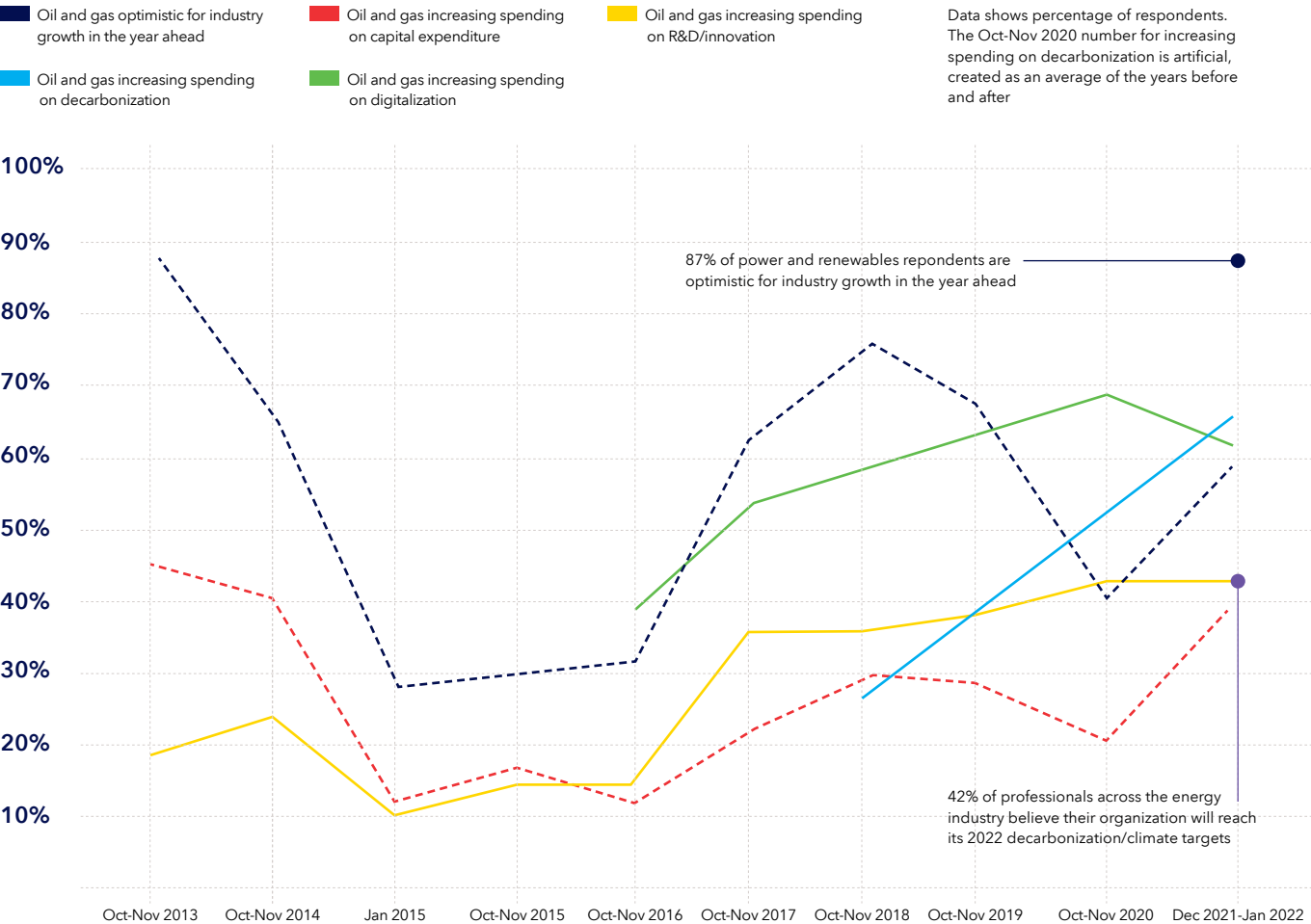
Optimism is the sense that we will keep improving and solving problems. The energy industry will continue to reduce emissions and meet energy demand, and while barriers and surprises may slow us down, none will stop our progress entirely. But for optimism to be sustainable, this progress needs to go beyond meeting revenue and profit targets, to also meeting climate targets.

Have no doubt, a great deal of optimism is needed in the energy industry - in 2022 and beyond - as the transition

accelerates and future uncertainties become present realities. But to see such high levels of optimism in place at present - given all that has happened over the past two years - suggests the industry believes it has the strength to meet the challenges ahead.

Nevertheless, meeting transition challenges is not just a question of optimism, nor a question just for the energy industry; it is a question of cost and commitment, of difficult decisions and deep decarbonization, and it is a question for governments and societies as well as the energy industry.

**Multi-year increases in decarbonization, digitalization, and R&D spending decouple from cyclical outlook for capex and industry growth**



## About DNV

DNV is an independent assurance and risk management provider, operating in more than 100 countries, with the purpose of safeguarding life, property, and the environment. As a trusted voice for many of the world's most successful organizations, we help seize opportunities and tackle the risks arising from global transformations. We use our broad experience and deep expertise to advance safety and sustainable performance, set industry standards, and inspire and invent solutions.

### In the energy industry

We provide assurance to the entire energy value chain through our advisory, monitoring, verification, and certification services. As the world's leading resource of independent energy experts and technical advisors, we help industries and governments to navigate the many complex, interrelated transitions taking place globally and regionally, in the energy industry. We are committed to realizing the goals of the Paris Agreement, and support our customers to transition faster to a deeply decarbonized energy system.

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