AECOM

FUTURE OF INFRASTRUCTURE

Lost in transition?

The report

Delivering a better world

FUTURE OF
INFRASTRUCTURE

Lost in transition?

Introduction:
energy transition at speed and scale

Climate change demands an unprecedented transformation: we must harness new sources and use our energy more efficiently than ever before. A massive shift in how energy is produced, consumed and managed is already getting underway around the world.

But this transformation needs to move ahead in harmony with other global priorities — continued prosperity, resource efficiency, social mobility, public health and, of course, the secure supply of reliable and affordable energy.

This is important because the world needs to transition faster. The Paris Agreement set a target of reducing greenhouse gas emissions 43 percent by 2030 (relative to 2010), but the United Nations says emissions are going to rise 10 percent by 2030. The latest technical report from the United Nations Framework Convention on Climate Change (UNFCCC), which will shape discussions at COP28 (Conference of the Parties 28), calls for a "radical decarbonization" of the economy: rapid, dramatic progress in every industry and sector.

At the same time, the energy transition is broader than a shift to carbon neutrality. For many nations, it is also a path toward energy independence and security and, ultimately, to lowering the overall cost of energy. Already, utility-scale solar is the cheapest option for new electricity generation in most countries.

Clean, secure and affordable energy
To meet all these needs, our approach must accelerate the energy transition and adapt as circumstances change. This presents new challenges, but there are also tremendous opportunities in the energy transition. Success at speed and scale is possible for many, but it requires clear-sighted ambition and focused determination to achieve.

Here, we investigate how to do this. This report is based on qualitative and quantitative research carried out with nearly 850 senior executives covering nine industries and 22 countries. We use their insights, recommendations and success stories to explore how organizations can accelerate a practical, profitable, predictable and people-centric transition to net zero.

It's an enormous and complex task. Some organizations will have more challenges; some will have more opportunities. But wherever you find yourself on the energy transition continuum, there are ways to close the gap between aspiration and implementation.

Troy Rudd
Chief Executive Officer, AECOM

The energy transition continuum:
where we stand

The energy transition is a continuum: a process of transformation that is different for every organization depending on its unique mix of characteristics, knowledge and awareness. Each organization enters this era of transition proceeding along its own route, influenced by industry and regional pressures that will impact the pace and pathways possible.

The key for leaders is therefore to know where their organization stands on the energy transition continuum. This provides a useful vantage point from which to order priorities and determine the practical steps to take next. There will be plenty of opportunities to learn from the journeys of others on the continuum, but each organization must plot its own path.

A decarbonization gap is opening up

In practice, it's not simply that some organizations are further along the continuum than others; the pace of change also varies. Our research finds that one in five organizations are uncertain about the actions they need to take to address the challenge of transformation, while closer to one-third (29 percent) cannot attract the kind of skills they need to transform. For those organizations, it is a struggle to keep up. Others have what they need, but are waiting for others to take the lead or postponing change until forced. But many have found a way to advance quickly, pressing forward ahead of regulations and industry peers.

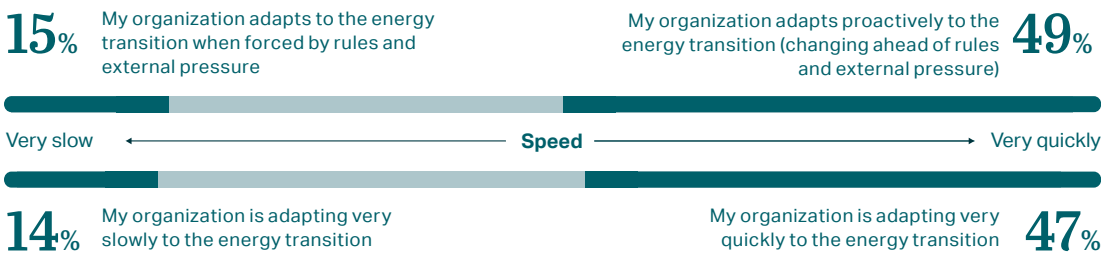
Organizations have different planning horizons too. Some are looking decades ahead, while others aren't able to look beyond the next quarter — particularly when the economic and geopolitical backdrop is so volatile. Whatever your outlook, strategies that can be started quickly are needed to address the urgency of the energy transition.

"Overall, I still don't feel like the industry — and I include policymakers and regulators — is seized with the urgency of the situation," says Rachel Fletcher, director of regulation and economics at Octopus Energy, a British renewable energy group.

What explains this lack of urgency? Different organizations face different obstacles — 35 percent of organizations surveyed in our research point to the high costs of equipment and technology, and 21 percent cite uncertainty about future energy and emissions policies.In some cases, there may also be a sense that climate change is a long-term problem that can be dealt with later, or that their own efforts will have only a minimal impact.

Global momentum is growing

But many organizations are taking bold steps forward. Organizations we surveyed are three times more likely to be adapting proactively to the need for energy transition (49 percent) than just reacting to rules and external pressure. And almost half (47 percent) say they are adapting very quickly to the need for energy transition.

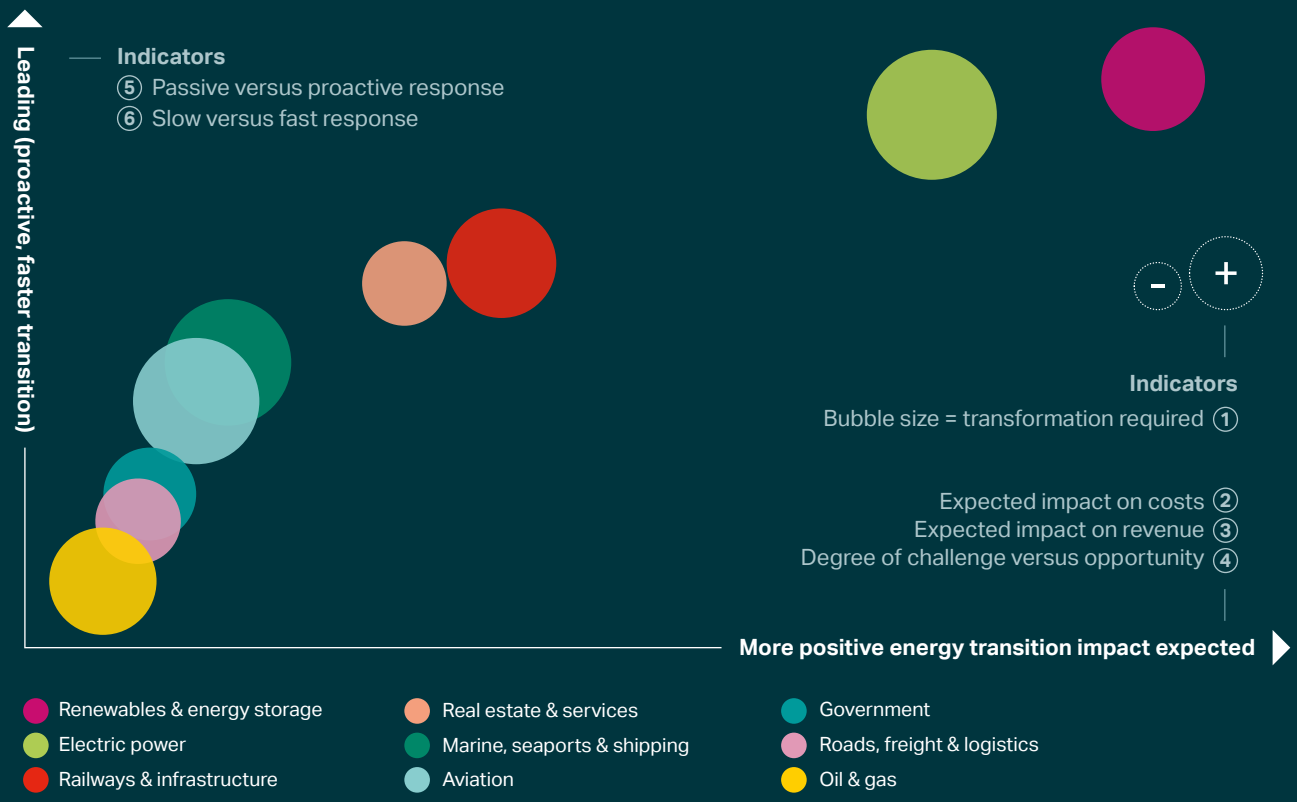


Percentages = net two responses at either end of a 5-point scale.

"There are challenges to overcome, particularly around cost and supply chain capacity, but we are making progress," says Anna Su, CEO of Synera Renewable Energy (SRE), a Taiwan-based offshore wind developer and one of Asia's early champions of renewable energy. "The market is beginning to see how deployments of technologies such as floating offshore wind can be a key driver of future growth."

What does the energy transition continuum tell us?
At the industry level, there's a strong correlation between the expected impact of the energy transition and how quickly and proactively that industry is responding.

> "There are challenges to overcome, particularly around cost and supply chain capacity, but we are making progress."
>
> **Anna Su, CEO, Synera Renewable Energy (SRE)**



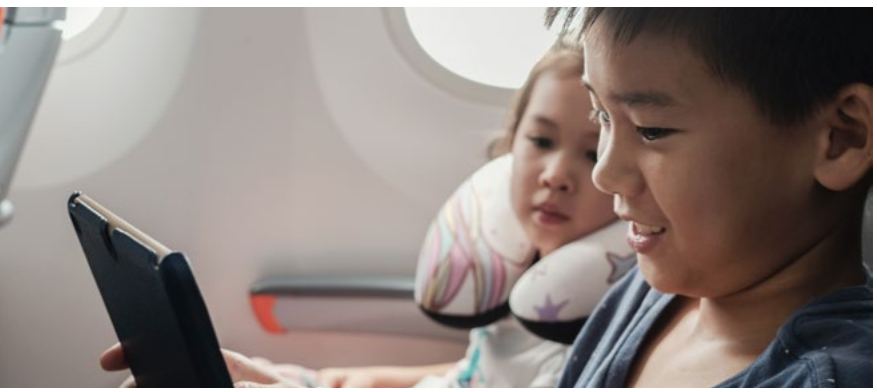
An industry-level view of the energy transition continuum
Source: AECOM Energy Transition Survey. The industry average data used in the chart below is based on our "six indicators of the energy transition continuum" (see indicators 1–6 on graph).

<5%

Overall oil and gas industry's capital spending in cleaner and greener alternatives in 2022 compared to spending on upstream oil and gas.

Industry averages are relatively close together, but individual organizations vary dramatically within the wider continuum. In the oil and gas sector, for instance, we see a broad span across respondents saying they are taking a passive versus proactive approach. While some integrated oil and gas companies and supply chain businesses are aggressively building renewable energy businesses, these are often relatively small compared to fossil fuel interests. Overall, the industry's capital spending on low-emissions alternatives in 2022 amounted to less than five percent of upstream spending according to the International Energy Agency (IEA).

Other industries facing big transformations are taking significant steps. In the marine sector, the technology for ships to be powered on zero-carbon fuels (eMethanol) exists today and ships are in service that can use them. There is, however, not enough fuel supply in commercial production at present, so some companies in the industry are proactively taking action to fill this gap and produce zero-carbon fuels themselves.



The aviation industry has a different path to follow with its own set of obstacles. There are some long-term significant approaches that will be transformative to achieve major reductions in carbon, but they're not ready yet. This includes scaling the production of costly sustainable aviation fuels (SAFs). These alternative fuel sources are in high demand, but supply remains low and they have not been approved for high-percentage blending (with conventional jet fuel) at present.

Airports are looking to lower their overall energy consumption, diversify sources and lower their ground transportation emissions. In some cases, the cost of transition for the industry is still prohibitive, but in others work to develop sustainability plans and carbon reduction strategies has been underway for a decade or more — an example of the diversity and complexity of paths found on the energy transition continuum.

How to move more quickly through the continuum

The most proactive organizations in our research include 'new economy' organizations such as renewable energy businesses and energy storage specialists, but also many from the electricity and real estate sectors.

The oil and gas sector, roads, freight and logistics operators, and government agencies, in contrast, have to make an enormous shift away from fossil fuels, under significant cost and regulatory pressures.

Recognizing disadvantages is the first step to overcoming them. There are legitimate reasons why some industries, organizations, or regions may be starting from further back — their legacy technologies, a lack of infrastructure or higher costs involved in transition.

In Texas, for instance, it's a challenge to add more rail to the transportation mix. "Texas never developed the rail system as much as they did in the eastern [U.S.] cities," says Darran Anderson, director of strategy and innovation at the Texas Department of Transportation. "The cost of building whole new rail lines is exorbitant today, because it involves a lot of right-of-way purchasing, the destruction or modification of existing infrastructure, and much more time, when compared to improving a more extensive rail network."

How can we close the gap?
The energy transition needs a multifaceted response from government, industry and the professional services that support and integrate them. And that response needs to address practicality, profitability, predictability and people with the necessary skills to make the transition a reality.

Thriving through the energy transition requires organizations to overcome a diverse range of practical obstacles, to explore new business models and routes to profit, and to equip their people with new skills and experience. And all of this will take place in an evolving regulatory environment, so policymakers are urged to provide a predictable and consistent landscape so that commercial businesses feel confident about investing.

Many of the experts we talked to for this research make similar points. They stress the importance of collaboration and the interconnectedness of organizations' efforts, the essential nature of a system-wide approach, and the crucial role third parties can play in orchestrating participation.

Don't let perfection be the enemy of progress
Others say there is a need to simply do what we can when we can and get away from the idea that all the challenges can be resolved with a single initiative or response. In practice, energy transition plans will be multifaceted.

"There is no one silver bullet. We need to use every tool in our toolbox. We need to use everything we can as quickly as we can," says Carolyn Bowen, director of climate and environment at the City of Calgary in Canada. "And we need to work with everybody: citizens, businesses, organizations, institutions. Those partnerships and connections are going to be critical as we look to scale up and speed up."

The Texas Department of Transportation's Darran Anderson adds, "We can't look at one solution. We need a system of systems and we will have to employ as many of those as we can in our toolkit."

Time is of the essence and we can't afford to let perfection become the enemy of the good. We need to deploy the best solutions available today, taking the practical steps we can to move the energy transition forward as fast as possible.

There are plenty of opportunities to do exactly that. This research focuses on how to put those practical solutions in place, how to do so cost-effectively, how to use opportunity to create prosperity, how to work with policymakers and how to achieve a people-centric energy transition.

> "We can't look at one solution. We need a system of systems and we will have to employ as many of those as we can in our toolkit.
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> **Darran Anderson, Texas Department of Transportation**

A practical transition:

getting implementation right

Organizations are ramping up their energy transition, but most are still early in their decarbonization journey, grappling with high costs and slow emission reductions. To move ahead, start with a tailored energy plan, then tackle small projects that demonstrate clear benefits to build momentum.

> Almost three-quarters (74 percent) are now significantly accelerating their adaptation to the energy transition. But many concede that their work has only just begun.

Many organizations say their work is speeding up. Almost three-quarters (74 percent) are now significantly accelerating their adaptation to the energy transition. But many concede that their work has only just begun. For example, just 17 percent have reached an advanced level on their core decarbonization ambitions. Many have made substantial progress reducing their Scope 1 and 2 emissions, but are still struggling to find their footing in reporting and reducing Scope 3 emissions.

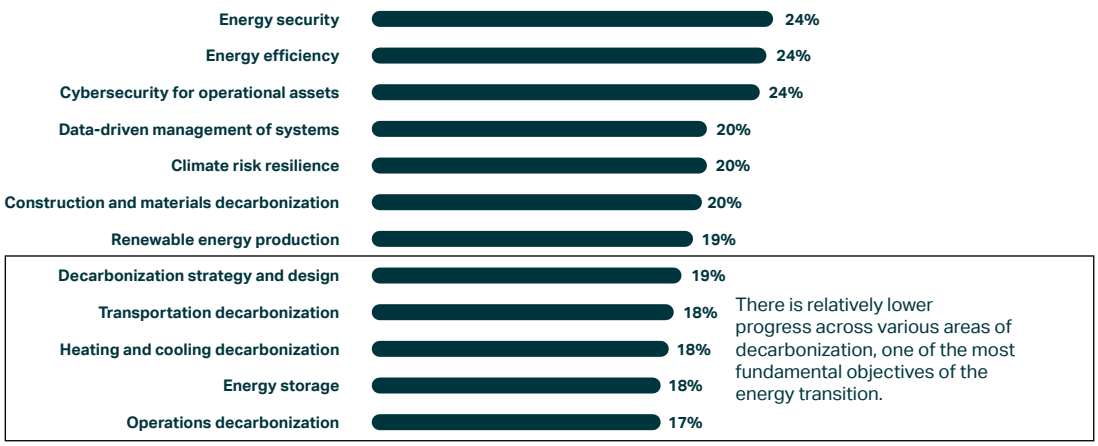
Our own experience suggests there are plenty of important lessons to learn from how organizations have progressed to date. For example, reducing Scope 3 emissions cannot simply be a set of demands to supply chain partners. It involves an open and supportive approach, raising expectations incrementally, as well as specific, phased plans for implementation.

Where there are lower barriers and a sense of urgency, progress is being made. About one-quarter of organizations (24 percent), for instance, are pleased with the progress they have made on improving energy efficiency in their facilities and buildings. And progress is also happening in areas threatened by external factors. Faced with geopolitical risk, 24 percent say they are well advanced in their plans to improve energy security.

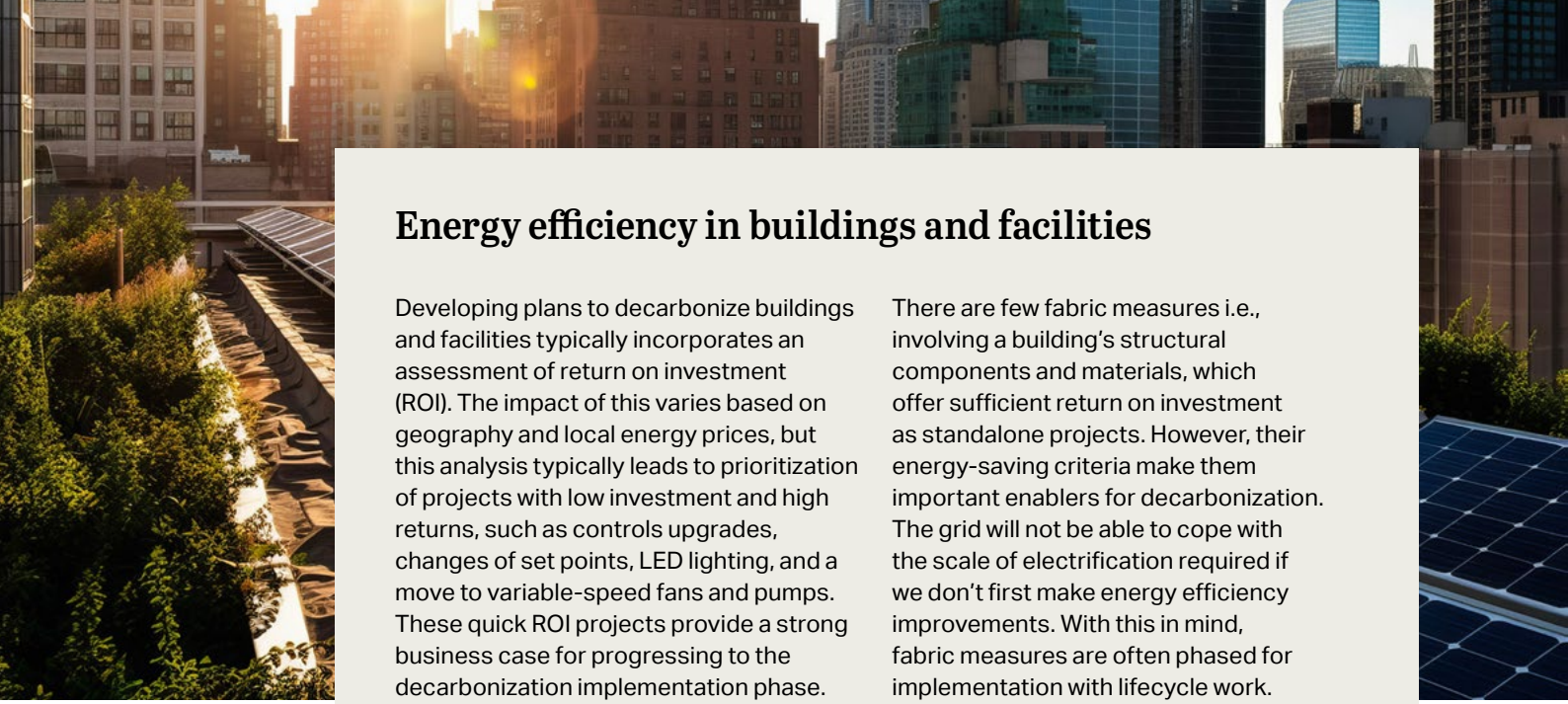
24%

Organizations pleased with progress on improving energy efficiency of facilities and buildings.

Respondents reporting their organization is at an advanced stage of progress in the pursuit of the following energy transition goals



Source: AECOM Energy Transition Survey.



Energy efficiency in buildings and facilities

Developing plans to decarbonize buildings and facilities typically incorporates an assessment of return on investment (ROI). The impact of this varies based on geography and local energy prices, but this analysis typically leads to prioritization of projects with low investment and high returns, such as controls upgrades, changes of set points, LED lighting, and a move to variable-speed fans and pumps. These quick ROI projects provide a strong business case for progressing to the decarbonization implementation phase.

There are few fabric measures i.e., involving a building's structural components and materials, which offer sufficient return on investment as standalone projects. However, their energy-saving criteria make them important enablers for decarbonization. The grid will not be able to cope with the scale of electrification required if we don't first make energy efficiency improvements. With this in mind, fabric measures are often phased for implementation with lifecycle work.

56%

believe competing companies should share data, resources and expertise with rivals to accelerate and optimize the energy transition.

Start with a plan

Every organization needs to build a tailored energy plan for transformation. Developing this should involve an advisor with the right technical ability — knowledge of the increasingly multifaceted energy infrastructure landscape, plus implementation experience of new and coming technologies — to build a long term road map to follow and evolve.

That roadmap will typically consist of discrete projects, and some will be larger and more demanding than others. Focusing on the smaller and more affordable initiatives first will bring early results that help to build momentum and encourage more dramatic future change.

Darran Anderson of the Texas Department of Transportation suggests that it makes sense to move iteratively. Anderson gives the example of the U.S.'s approach to the development of a comprehensive network of electric vehicle charging points. "To start with, we want all 50 states to build out the interstate [the national network of highways] infrastructure first, so you are guaranteed a fast charger every 50 miles," explains Anderson. "That's the seed, but private business will then take it forward through competition — there will be a race to get the EV charging infrastructure in place to gain a share of the market."

In a trial for National Highways in the United Kingdom (U.K.), AECOM installed a highway fence with integrated solar panels (photo-voltaic noise barriers). Confidence derived from the successful energy and acoustic impacts of the trial have sparked discussion around the operational and environmental benefits of a diverse range of other non-highway applications, including compounds, railways and parking lots.

Sharing for the collective win

Cultural changes will be necessary if organizations are going to put aside traditional rivalries and work together on meeting Paris Agreement targets. The majority (56 percent) of those in our survey believe competing companies should share data, resources and expertise with rivals to accelerate and optimize the energy transition.

Sharing data, lessons learned and paths to progress on climate objectives (without compromising important competitive advantages) is the first step toward having a more standard, repeatable set of interventions where speed of implementation can be accelerated and costs can come down.

Competition doesn't have to get in the way of this collaboration. Standardizing and anonymizing data can often make it more shareable without reducing its value. "There are too few resources available for competitors not to work together," says Jacqui Bridge, executive general manager of energy futures at Powerlink, a government-owned corporation responsible for the electricity transmission network in Queensland, Australia. "Our markets have been set up on the idea

that competition leads to lower costs and better outcomes, but in the case of energy transformation we need to allocate labor and equipment effectively," says Bridge. "It's the overall result for decarbonization that matters, not who gets there first."

Partnerships drive progress
Partnerships have long been used in industry to build capabilities and spread financial and technical risk. Given the pace, scale and complexity required to decarbonize society, partnership models will be critical to success. Companies and governments simply do not have all the skills, financial muscle and appetite for risk to go it alone.

Public and private sector partnership is a powerful combination when it works. The creation of the U.K. offshore wind industry is a case in point. Government ambition to become a leader in offshore wind, combined with regulatory support and private sector capital and innovation, saw the sector grow from zero to more than 14 gigawatts of capacity by 2023.

Collaboration and partnership can be even more important for organizations moving into new areas. "Our development into new markets is always about the partnership strategy," says SRE's Anna Su. "Each time we enter a new market, we partner with local champions. It's so important because offshore wind projects are highly regulated, policy driven, capital intensive and technology intensive, with elevated risks."

How are costs impacting the energy transition?
In an uncertain economic environment, with high inflation causing problems in many countries, organizations are understandably concerned about the cost implications of the energy transition. More than one-third say the high cost of new equipment and technology is a significant barrier to transformation; and more than one-quarter cite high energy costs, where geopolitical factors, as well as supply and demand imbalances and significant procurement delays, are adding to the pressure.

Today's biggest barriers to energy transition

1. Higher costs of equipment and technology
2. Higher energy costs
3. Lack of renewable energy/ energy storage

Future barriers: the biggest expected increases

1. Interest rates
2. Higher costs of equipment and technology
3. Higher energy costs

Source: AECOM Energy Transition Survey.

Asked about the issues likely to become more difficult in the coming years, organizations rank these cost challenges high on their lists. Organizations are concerned that higher interest rates are making project financing more expensive and increasing upfront capital costs for low-carbon projects. Cost inflation is exacerbating this trend, making the procurement of equipment and technology more expensive.

Almost three-quarters of organizations taking part in our study (72 percent) believe that the energy transition will need to become more affordable for progress to accelerate. Some larger organizations, particularly in the public sector, may need to intervene to keep the transition moving. "The affordability conversation is absolutely top of mind," says Carolyn Bowen of the City of Calgary. She points out that "this is where the government and the city are looking at what they can do to balance costs, risks and returns for the community."

72%

believe that the energy transition will need to become more affordable for progress to accelerate.

> In Europe, carbon emissions hit a record of US$105 (€100) a ton in 2023, but if you look at how the World Meteorological Association has tracked what we have spent as a global community on disasters, our actual cost of emissions is US$480 (€450) to US$635 (€600) a ton.
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> **Caroline Stancell, Air Products**

20%

organizations that think the transition will drive up their costs.

41%

organizations that think the transition will drive down their costs.

Thinking differently about costs

Governments and businesses alike need to see the bigger picture on costs. The energy transition can be expensive, but not acting may be even more costly. "In Europe, carbon emissions hit a record of US$105 (€100) a ton in 2023," says Caroline Stancell of Air Products, "but if you look at how the World Meteorological Association has tracked what we have spent as a global community on disasters, our actual cost of emissions is US$480 (€450) to US$635 (€600) a ton." Stancell adds, "If you attach that quantity of money to natural gas or grey hydrogen, then low carbon solutions such as green hydrogen are as competitive."

There are reasons to be optimistic, particularly as innovative technologies and practices with the potential to reduce cost become available. "We are going to see the application of some new construction methods coming through for power grid infrastructure that can make a big impact," says Alistair Parker, CEO of Australia's VicGrid, a government agency that coordinates the development of transmission infrastructure and renewable energy in the Australian State of Victoria. "This could be prefabrication of components off-site, which enables more modular construction. This is quicker to implement and reduces the demand for technical skills out in the field."

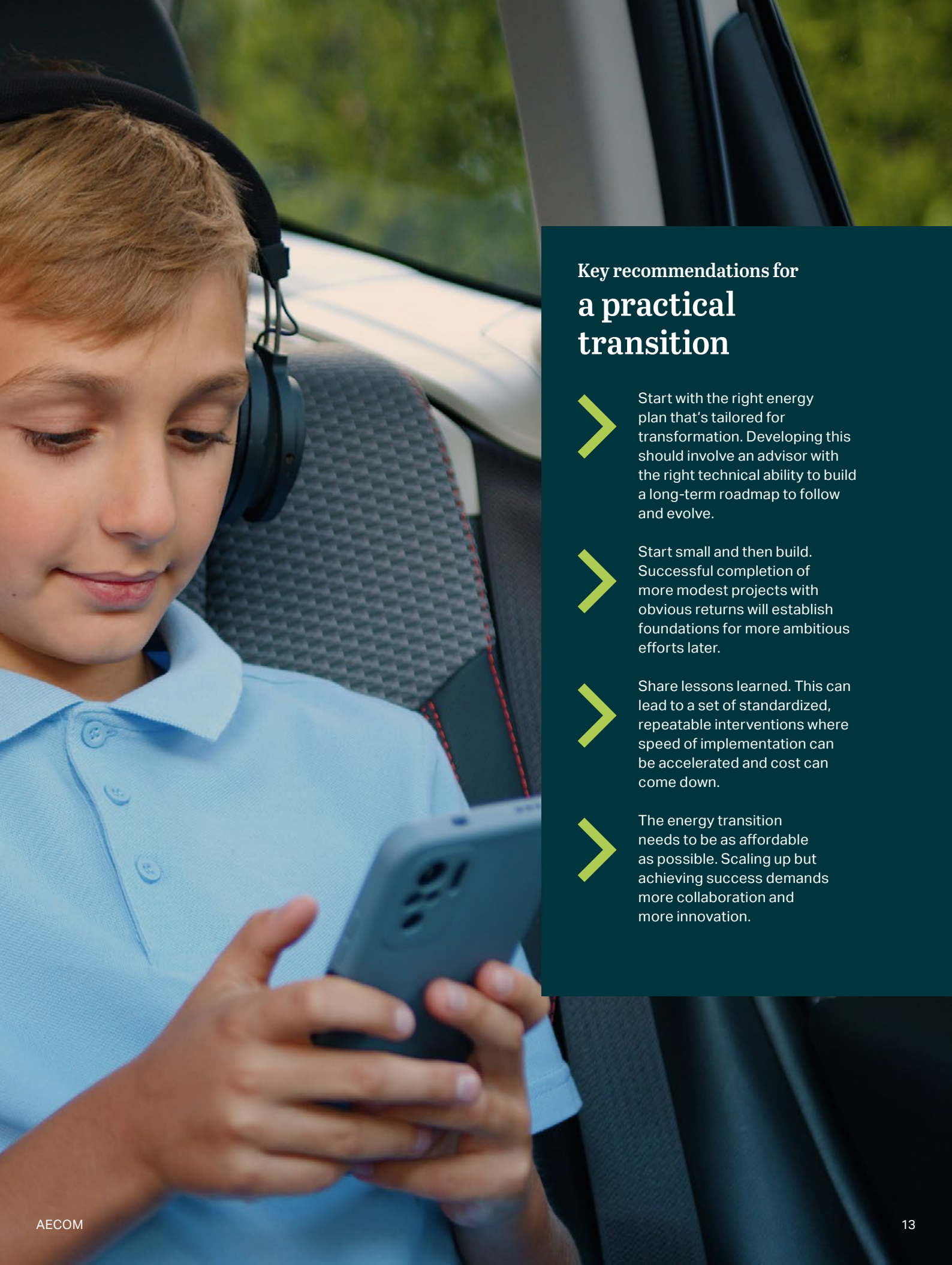
At SRE, Anna Su highlights how quickly offshore wind has been rolled out, driving potential economies of scale: "The size of the turbines used in each of our wind projects has doubled, from 4 megawatts to 8 megawatts and now to 15 megawatts. The technology is evolving very fast."

A practical energy transition needs to make business sense

It may be challenging in some industries or sectors to see energy transition as an opportunity in the current economic environment. While 20 percent of organizations say the transition will significantly drive up their costs, more than twice as many — 41 percent — say it will drive costs down.

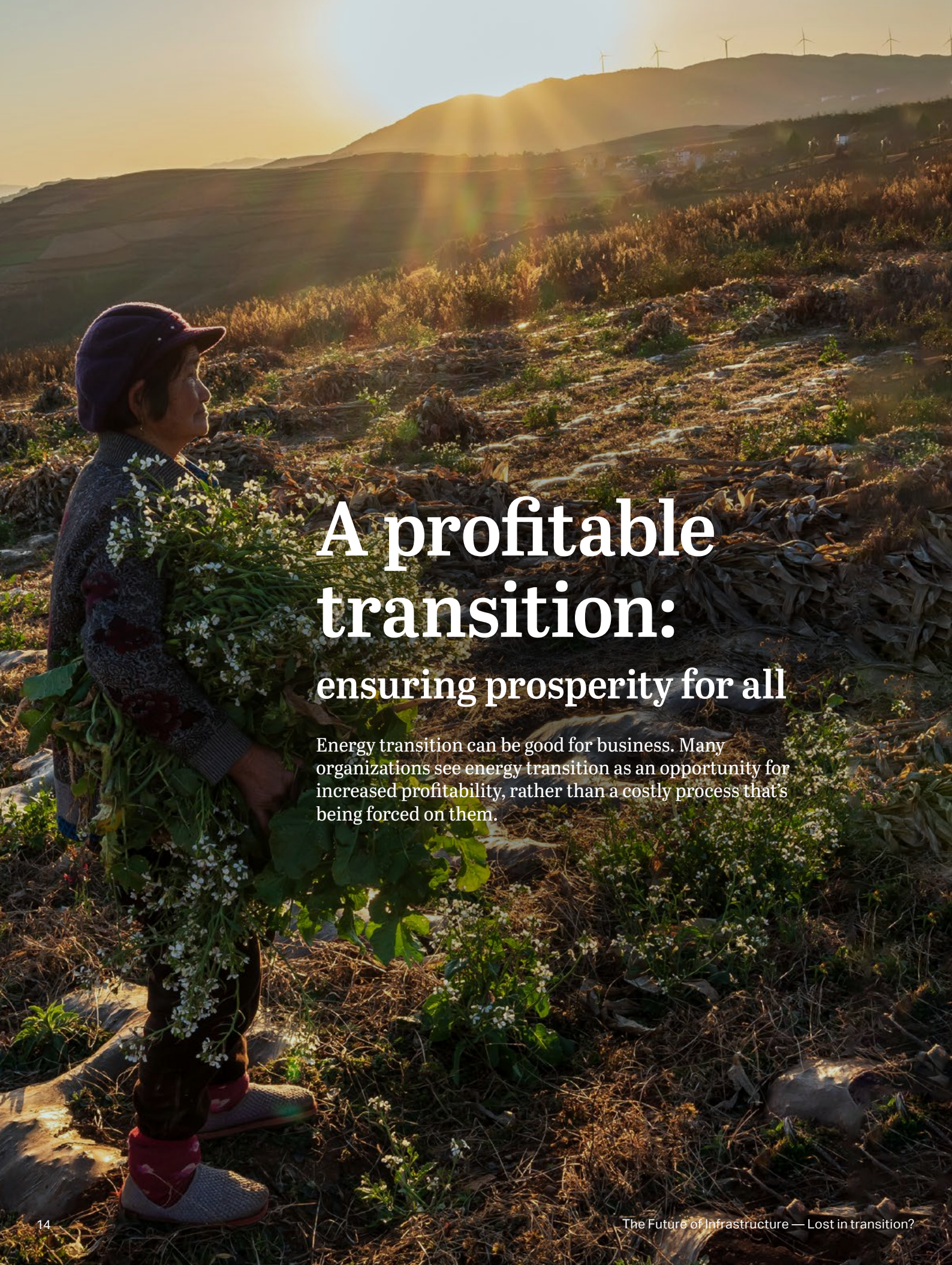
"We could do with hearing more about what an incredible opportunity this is," says Powerlink's Jacqui Bridge. "It's an economic opportunity for Australia. We've got so much resource, so much land and so much opportunity to develop new exports as well as to decarbonize our own economy."

The imperative to decarbonize society remains and significant funding in clean technology continues to flow. According to the IEA, global spending on clean energy is projected to reach US$1.8 trillion in 2023, outpacing the US$1.1 trillion allocated to fossil fuels. Taking a longer-term view, the transition will continue to present many opportunities.



Key recommendations for
a practical transition

- Start with the right energy plan that's tailored for transformation. Developing this should involve an advisor with the right technical ability to build a long-term roadmap to follow and evolve.
- Start small and then build. Successful completion of more modest projects with obvious returns will establish foundations for more ambitious efforts later.
- Share lessons learned. This can lead to a set of standardized, repeatable interventions where speed of implementation can be accelerated and cost can come down.
- The energy transition needs to be as affordable as possible. Scaling up but achieving success demands more collaboration and more innovation.



A profitable transition:

ensuring prosperity for all

Energy transition can be good for business. Many organizations see energy transition as an opportunity for increased profitability, rather than a costly process that's being forced on them.

Three times as many participants in our survey believe this transformation will drive a significant increase in revenue (49 percent) as those that believe the opposite (14 percent). And 46 percent say it's business opportunity that's driving their response to the energy transition imperative, which is more than any other factor.

But nearly half of organizations say that a lack of certainty about returns is undermining their confidence in investment. In some sectors and geographies, the proportion is significantly higher. This could reflect the difference between current sentiment and long-term potential, but it also suggests a lack of clarity (or requisite support) from regulators and policymakers.

Organizations need a support system

Targeted and committed support for the energy transition can be the impetus that markets need to become financially viable and sustainable. For instance, in June 2022, The People's Republic of China (PRC) published its 14th Five-Year Plan for Renewable Energy, which set a target of 33 percent of electricity generation to come from renewables by 2025. In 2022, the PRC was already responsible for half of global wind power capacity additions. And in the U.S., the Inflation Reduction Act is estimated to have driven US$278 billion (about US$860 per person in the U.S.) in new private clean energy investments in just 12 months.

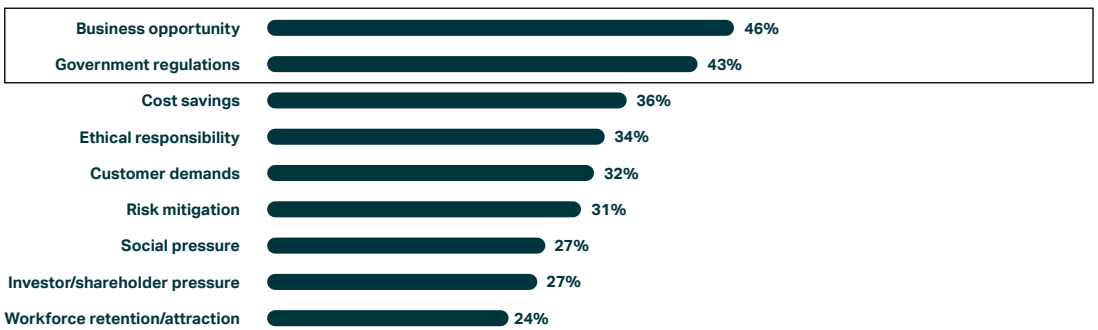
"Solar power and onshore wind are now subsidy-free in large parts of the world: these are the technologies that have come so far down the cost curve that you can pretty much implement them wherever planning regimes allow," says Simon Virley, Vice Chair and Head of Energy and Natural Resources at consultant KPMG U.K.. "At the other end, you've got areas such as hydrogen, and carbon capture and storage, both essential technologies for the energy transition, that are still out of the money. They still need government support and clear regulatory frameworks to be cost effective — to, say, build an electrolysis plant to create green hydrogen." That kind of support can be one way to supercharge progress.

Still, many new projects will only be viable — financially and in terms of competency — when several partners come together. Caroline Stancell gives the example of Air Products' involvement with NEOM Green Hydrogen Company (NGHC) in Saudi Arabia, an equal joint venture with ACWA Power, Air Products and NEOM. "NGHC are investing in more than 4 gigawatts of solar panels and onshore wind to power 2.2 gigawatts of electrolyzers across over 300 square kilometers to produce green hydrogen in the form of green ammonia" says Stancell. "The project operates at competitive levelized cost of hydrogen. It became bankable because you had three strong players that were all willing to invest and, more importantly, because Air Products were willing to commit to a 30-year offtake agreement with NGHC."

50%

In 2022, the People's Republic of China (PRC) was already responsible for half of global wind power capacity additions.

What are the biggest drivers of your organization's response to the energy transition?



Source: AECOM Energy Transition Survey. Percentages show the frequency with which each driver was selected by respondents (who could select only three from the list).

45%

Expected reduction in energy bills by 2035 if developed countries accelerate energy transition.

The energy transition is driven forward by bankable projects — the ones that make business sense — but in many cases, it takes time, ingenuity or wider changes for the necessary elements to align. For example, a utility company in Asia is open to building a smart grid but has not yet found the right business model to develop one. The company has issued smart meters, but this is just one step along the path to a proper smart grid, with bi-directional energy flows, dynamic pricing and intelligent automation. The utility is seeking a profitable model to make that vision a reality. A key challenge is to find the right stakeholders, partners and operators. But until it makes business sense, they are not suitably incentivized to build the kind of grid that many view as a necessary component of our new energy systems.

The customer is an important partner

Octopus Energy's Rachel Fletcher suggests that it will also be important to build demand for new initiatives and business models. In the U.K., low public support for developments in their local area has sometimes deterred investors from onshore wind, and local planning authorities are reluctant to grant planning permission for new turbines despite the recent loosening of restrictions. But Fletcher believes this could be changed by clearly showing people what they will gain.

"The best way to get to net zero is to bring customers with you," says Fletcher. "We have a number of single wind turbines that are serving local communities, and customers in those communities get low-price electricity when the wind is blowing. When we've publicized that model, we've had a tsunami of communities writing to us to say they want their own turbine. You're starting to create a very different story about what the energy transition is all about."

Indeed, research by the We Mean Business Coalition found that if developed countries accelerate their energy transition, in 2035 the average citizen would spend almost 45 percent less on their combined energy bills across electricity, natural gas and gasoline compared to the business-as-usual scenario.

Energy for life: prosperity means more than profit

The energy transition represents an opportunity to benefit several important groups in a variety of ways — everything from saving money for individual consumers to entire infrastructure upgrades for communities and the social value that comes with it.

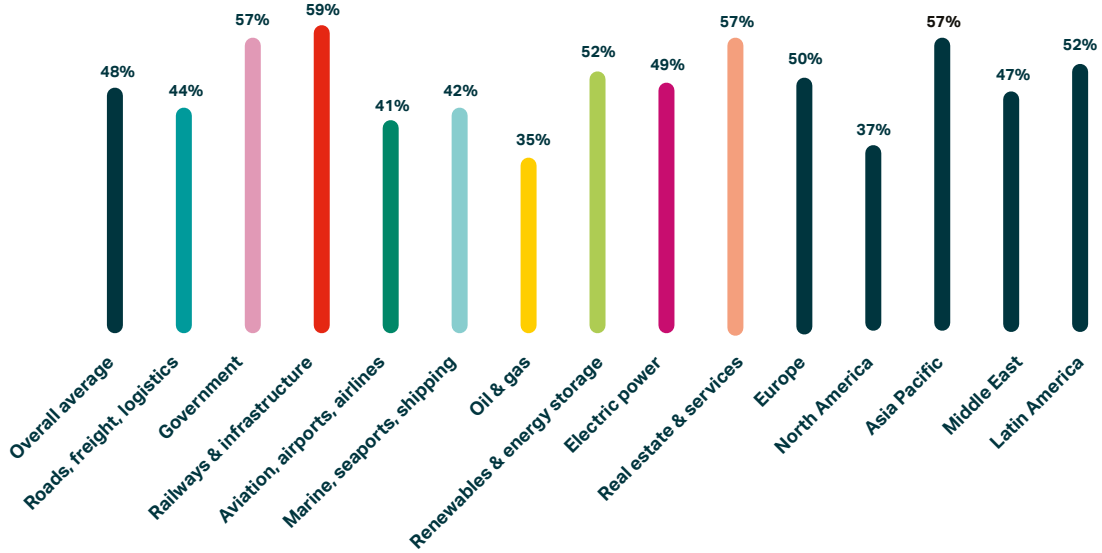
The IEA expects 14 million new jobs to be generated globally in clean energy by 2030. Research from the COP26 Universities Network highlights the way in which countries, including Costa Rica, Cuba, Canada, Germany, New Zealand, South Africa and Spain have legislated for a "just transition" that helps to bring jobs to economically disadvantaged areas and moves energy production and distribution closer to communities and end users.

Lack of access to energy constrains economies, impacts the delivery of critical public services and puts strain on government budgets. Transitioning to decentralized renewable energy solutions is critical to maximizing socio-economic development. Organizations considering investment naturally want to see returns, but more than one-third (34 percent) of the organizations in our research say their response to the energy transition is driven by an ethical responsibility.

Kick-starting new energy markets

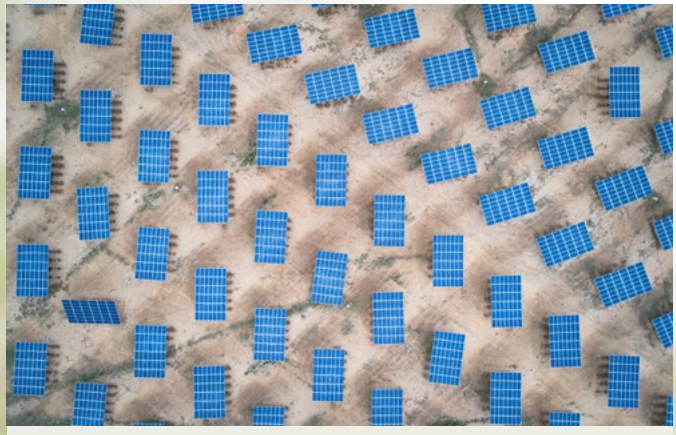
Companies won't switch to green hydrogen unless they can bank on reliable, affordable supply. But energy providers cannot invest in green hydrogen without sufficient — and certain — demand to justify the capital required. Aberdeen City Council in the U.K. decided to tackle this classic chicken-and-egg dilemma with a public competition. Private companies were to propose plans for green hydrogen production. For the winners, the Council provided guarantees that it would purchase green hydrogen they produced from day one (to power bus fleets). To further smooth the risk profile, the council proposed a joint venture operating model. Models like this are needed to help get markets off the ground and into new territories.

Uncertainty about the rate of return for new energy investments prevents my organization from full-scale progress.



Almost half of respondents are prevented from progressing by uncertain returns on investments in energy.

Source: AECOM Energy Transition Survey. Percentages reflect the proportion of respondents selecting "agree" or "strongly agree" in response to the statement shown on the chart.



Increasing energy security as part of the energy transition

The concept of energy security is one of the key elements in the energy trilemma, alongside sustainability and affordability. In recent years energy security has risen up the political agenda across multiple governments. In Europe, many countries sought to diversify their dependence on imported pipeline gas.

At a national level, the energy transition can give greater security and independence, according to Landon Derentz, Senior Director and Morningstar Chair for Global Energy Security at the Atlantic Council Global Energy Center, a think tank based in Washington, D.C., in the U.S. "The broader geopolitical overlay is that many countries are working to increase their indigenous energy supply," says Derentz. "Domestic deployment of clean energy allows countries to maximize energy production from their natural resources, reducing trade vulnerabilities and dependence on conventional oil and gas imports."

Countries with abundant solar, wind, geo-thermal or hydro-power resources can pursue this, but not all countries are so lucky. In these places, local supply may rely on nuclear power, carbon capture, waste-to-energy, biofuels or further innovations in energy generation. Some major energy importers, such as Japan and South Korea, are planning to continue bringing in energy from abroad, just not oil, gas or coal, but instead things like green hydrogen or renewable electricity via high voltage direct current (HVDC) cables.

Key recommendations for
a profitable transition

- Focus on prosperity in the broadest sense of the word. Beyond commercial advantages, the energy transition represents an opportunity to build social value, community engagement and workforce benefits.
- Work with policymakers to build a supportive environment for investment. For example, grants should be dependent on transparently de-risking initiatives that are not yet commercial to make sure the wider industry can learn from them.
- The energy transition is driven forward by bankable projects — the ones that make business sense — but in many cases, it takes time, ingenuity or wider changes for the necessary elements to align. Sometimes a creative kick-start is needed.

A predictable transition:

managing regulations

A crucial piece of the energy transition jigsaw is a supportive policy and regulatory backdrop. This doesn't have to come in the form of subsidies or other state support — though some areas may not grow without this — but the organizations in our research say they need consistent, coherent regulatory frameworks to take decisive steps through the energy transition.

In Australia, the State of Victoria has created renewable energy zones to support the development of clean energy generation and to enable efficient development and expansion of transmission infrastructure. "The zones make it easier to engage with communities, to plan and allocate resources, and there are economies of scale from the concentration of renewable energy assets in one area," says VicGrid CEO Alistair Parker. "There are lots of benefits but one of the most important is just how the zones offer certainty and a clear focus, which in turn helps to coordinate development efforts involving multiple stakeholders, particularly between utilities, developers, communities and the regulator."

Building predictability in times of change is vital. However, the energy transition also requires policymakers to evolve and adapt legislation as the transition advances. In many industries that are transitioning to cleaner energy, the existing regulatory framework is no longer appropriate or even relevant. In other places, regulators must adapt to a changing marketplace or recent technologies. So regulatory changes are inevitable — often necessary — but businesses need as much time as possible to prepare for new rules. Early and frequent communication with all stakeholders is essential.

Stability enables investment and progress

Nearly three-quarters of organizations (73 percent) say that stable energy and emissions regulations encourage more capital and better terms from financial institutions, and the same proportion say that laws should be passed to keep energy and emissions regulations consistent over time. This suggests that, currently, regulators are not providing the consistency and predictability that organizations need.

Another part of the challenge is also to recognize that in a market where many of the leading players are acting globally, it's a problem if regulations between regions are inconsistent. In Latin America, for example, 81 percent of organizations we surveyed say that regulation in the region needs to be better aligned with wider national or international policies and commitments.

In Asia, meanwhile, SRE's Anna Su wants to see the same support for the renewable sector as governments in Europe have provided, particularly because many corporate PPA offtakers (businesses that enter into Power Purchase Agreements to buy electricity directly from renewable energy projects) in this space are still relatively small. "There are good local champions, but they don't have an international credit rating and the costs and risks are much higher here," says Su.

Most organizations we surveyed see the potential benefits of greater liberalization and increased competition:

- 71 percent say regulation should make it easier for companies from other industries to enter the energy industry
- 63 percent think energy markets should be made less restrictive for utilities

Most respondents want stable and consistent regulations

Source: AECOM Energy Transition Survey. Percentages reflect the proportion of respondents selecting "agree" or "strongly agree" in response to the statements shown.

73%

We need stable energy/emissions regulations to encourage more capital and better terms from financial institutions.

73%

Laws should be passed to keep energy and emissions regulations consistent over time.

Game-changing interventions
The most ambitious government interventions have the potential to rapidly propel an industry through the energy transition continuum. In the U.S., the Atlantic Council's Landon Derentz gives the example of the Biden administration's Inflation Reduction Act (IRA), which has provided financial support for green energy projects and initiatives totaling $370 billion (about $1,100 per person in the U.S.) over the next 10 years. Just one example: the IRA allocates $7.5 billion to electric vehicle (EV) charging infrastructure and this will support growth in the EV infrastructure market to around $100 billion by 2040, while the number of EV charge points to rise from 4 million today to 35 million in 2030, according to a PwC analysis.

"The IRA is an absolutely transformative piece of legislation for the U.S.," says Derentz, "but it is also inspiring progress in other regions and the global economy as a whole." While the IRA provides a powerful policy and market signal, each region must create the right framework to suit local dynamics. "The E.U. (European Union) is trying to respond in kind with its own Green Deal," says KPMG's Simon Virley. "It's a slightly different construct — not just based on tax credits but with flexibility around direct government support — but it's a move to respond."

> The IRA is an absolutely transformative piece of legislation for the U.S.," says Derentz, "but it is also inspiring progress in other regions and the global economy as a whole.
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> —
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> **Landon Derentz, Senior Director and Morningstar Chair for Global Energy Security, Atlantic Council Global Energy Center**

Regulatory change supercharging offshore wind

Parts of the offshore wind industry have recently slowed, putting projects on hold due to the convergence of several factors — cost inflation, high interest rates and strained supply chains.

In some jurisdictions, however, government intervention has played a significant role in reducing the cost of capital and stimulating investment in the industry. This is particularly true of policies that support the development of associated infrastructure such as ports, grids and local manufacturing. Similarly, power purchase agreements or renewable energy credit mechanisms can be structured so that the value changes based on standard economic factors, including central bank interest rates and commodity prices. That way offshore wind developers can recover some of their increased capital and operational costs during inflationary times.

Addressing development risk in this way has the potential to accelerate rollout and reduce production costs for projects, lessening the need for public support to make them financially feasible.

Thea rapid expansion of offshore wind is enabled in large part via government auctions. Through a variety of policy instruments, auctions are set up to enable a level of revenue stability. The structure of an auction — varying significantly by region and market maturity — determines the level of protection provided against risk associated with fluctuating market prices.

For the first time since 2009, the United States significantly streamlined its regulations for offshore wind development earlier this year. The changes included more flexibility for construction and operations plans to simplify what is otherwise a complex permitting and approval process. The updates also allow developers to pay the cost of decommissioning at the end of an asset's life rather than upfront. This change alone is estimated by the U.S. Bureau of Ocean Energy Management (BOEM) to save developers US$1 billion over 20 years.

Governments that don't provide support may experience a slower pace of change, with research suggesting that government policy can be instrumental in reducing the cost of capital and stimulating investment. "A lack of support doesn't stop us from investing," says Susannah Wood, VP of public affairs and sustainability for Statkraft, a Norwegian state-owned energy company and Europe's largest renewable energy producer. "But it does help broader investor confidence if the government is positively and unapologetically supporting what we're trying to do in the green transition."

Beyond financial support, governments and regulators also play a vital role in orchestrating transformation across the whole energy system and all associated infrastructure. Strategies should be developed in tandem with relevant non-governmental stakeholders. Using hydrogen as an example, this group might include private sector industry leaders, the hydrogen hub consortia, as well as impacted environmental and social justice stakeholders. By working closely with all interested parties, governments can ensure that the transition keeps moving forward, equitably.

> "A lack of support doesn't stop us from investing, but it does help broader investor confidence if the government is positively and unapologetically supporting what we're trying to do in the green transition."
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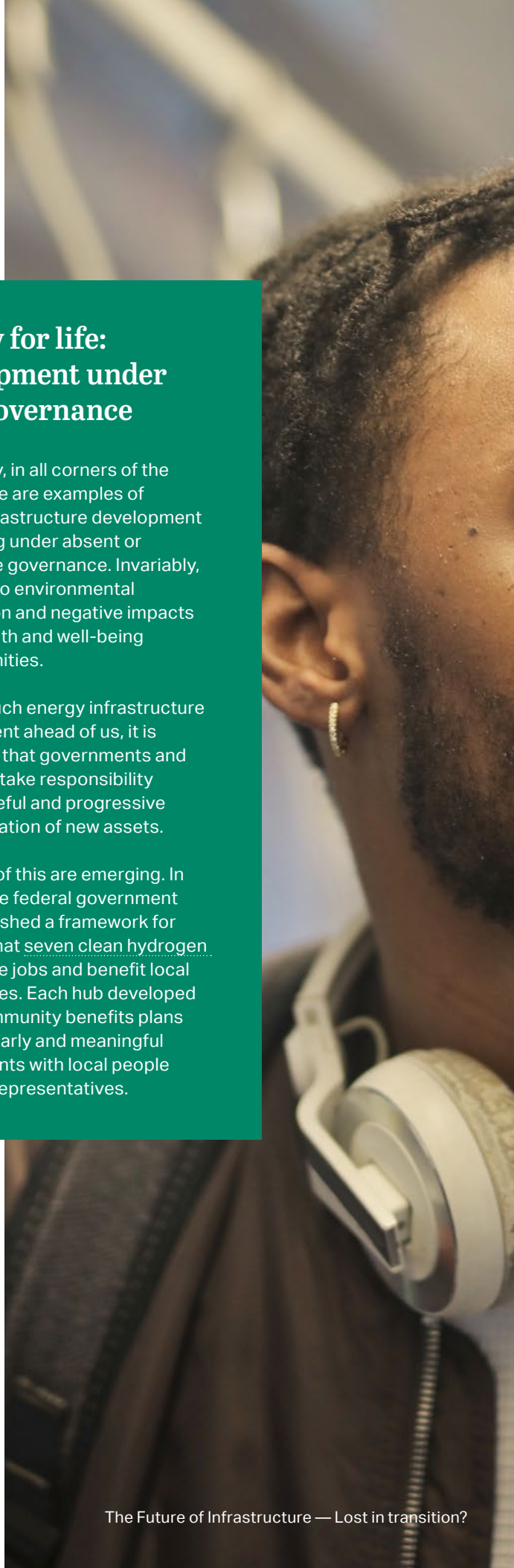
> **Susannah Wood, VP of public affairs and sustainability for Statkraft**

Energy for life: development under good governance

Historically, in all corners of the world, there are examples of energy infrastructure development proceeding under absent or inadequate governance. Invariably, this leads to environmental degradation and negative impacts on the health and well-being of communities.

With so much energy infrastructure development ahead of us, it is imperative that governments and regulators take responsibility for the careful and progressive implementation of new assets.

Examples of this are emerging. In the U.S., the federal government has established a framework for ensuring that seven clean hydrogen hubs create jobs and benefit local communities. Each hub developed formal community benefits plans based on early and meaningful engagements with local people and labor representatives.



Key recommendations for
a predictable transition

- Policymakers need to set out clear and consistent frameworks and regulations to give organizations the confidence to invest long-term.
- Organizations independent of politics and election cycles are essential partners in aiding regulatory predictability given their ability to plan and advise politicians with a longer-term view.
- It is essential for governments and regulators to develop strategies in tandem with non-governmental stakeholders.
- Regulators in different regions can work together for the common good. The race to net zero is a global one with shared problems and solutions. Common standards and collaborative principles will ensure broader progress.

A people-centric transition:

addressing skills and adoption

One big challenge for many organizations is expertise: they lack people with the skills needed to make progress on the energy transition today and into the future. This is a problem: this transformation must be driven by people. And those people need both technical expertise and the softer skills required for collaboration, persuasion and leadership. People will have to work together, share information and consider the needs and interests of various groups in order to progress through the continuum.

Some organizations are struggling to attract the right talent

Nearly two-thirds of organizations in our research (67 percent) say they already have the skills needed for the energy transition, but it isn't clear that they have enough of the skills needed to meet the scale of transformation required. And 29 percent say their industry doesn't attract the kind of skills needed for change.

"Human capital bottlenecks are increasingly beginning to manifest," warns the Atlantic Council's Landon Derentz. "There is a major need for engineers, and the people knowledgeable about how to achieve these outcomes from a technical standpoint — these areas are deficient right now."

And it's not just technical expertise that's missing. Many organizations are also worried about shortages of skills in areas such as change management and transformation; they worry about the process of energy transition.

That includes concerns about digitalization: 46 percent say they are struggling to retrain staff in more digital and data-driven ways of working.

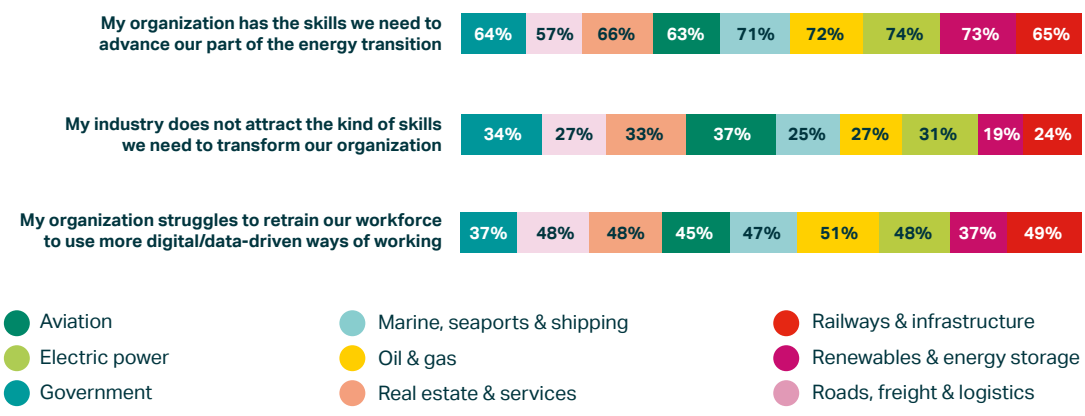
New demands for skills will continue to emerge as the energy transition gathers pace. Statkraft's Susannah Wood, gives an example of this: "We're now recruiting process engineers, who we didn't need for building wind and solar, but who are now essential because we are looking at green hydrogen projects."

Skills shortfalls are a major threat to delivering the transition. France, for example, will need 100,000 new jobs for the hydrogen economy by 2030. Even redeploying and reskilling staff from petrochemicals or the oil and gas industries will not close the gap.

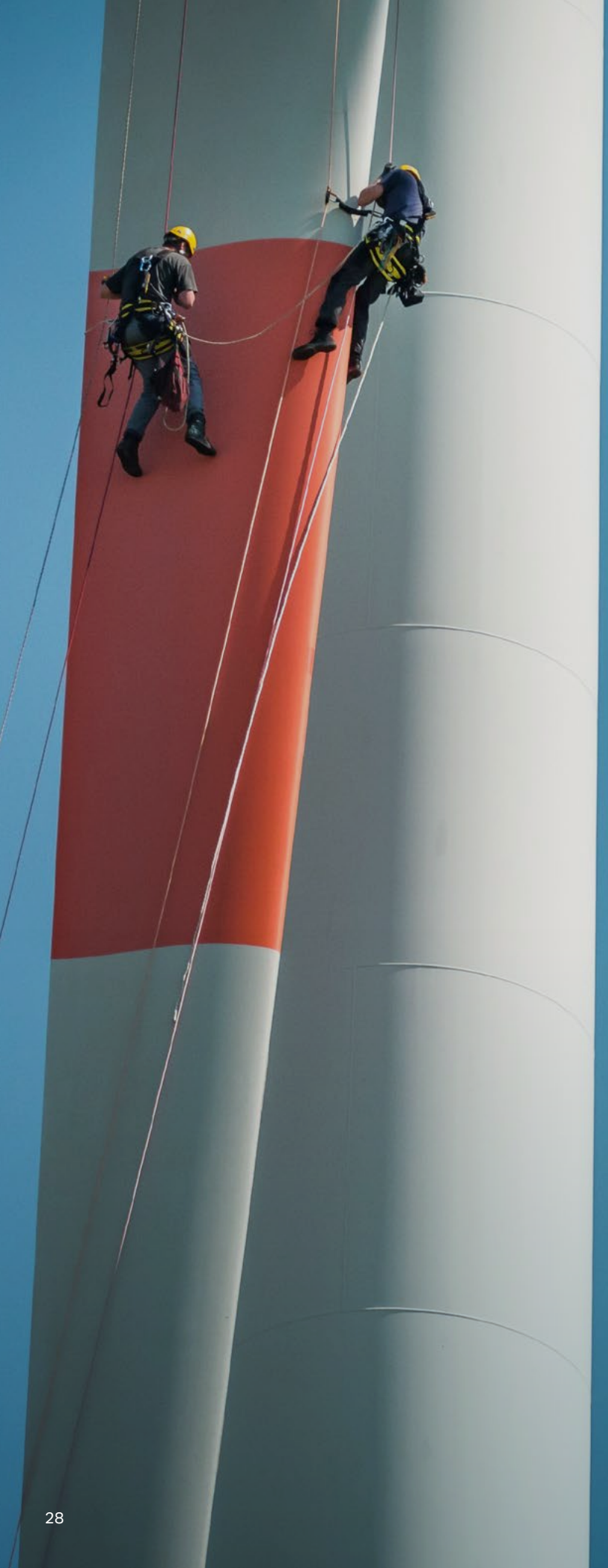
100k

France will need 100,000 new jobs for the hydrogen economy by 2030

The human transition



Source: AECOM Energy Transition Survey. Percentages reflect the proportion of respondents selecting "agree" or "strongly agree" in response to the statements shown.



> Everyone joining the renewable energy sector at its outset came from a different sector, transferred their skills and learned what they needed to on the job.
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> —
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> **Susannah Wood, VP of public affairs and sustainability for Statkraft**

How will organizations address their skills gaps?

According to Statkraft's Susannah Wood, one technique is to recruit people with transferable skills rather than assuming you can hire the finished article. "We can't all compete for the same people; we should take people with different skillsets," says Wood. "Everyone joining the renewable energy sector at its outset came from a different sector, transferred their skills and learned what they needed to on the job."

That may require direct intervention. At Powerlink, an Australian transmission network operator, they are supporting a research center that's creating some short courses (and possibly a master's course) to help people transition from other industries into the electricity industry. The creation of training resources are also an opportunity for collaboration, especially in regulated industries where competition is less of a concern.

Employers become educators

Another pathway to closing the skills gap will be employers taking responsibility for training the workforce of the future. At the City of Calgary, Carolyn Bowen says there are ways to develop a pipeline of skills with local education providers, pointing to opportunities to partner with tertiary education institutions to build large-scale training programs. And at Powerlink, the company's recruitment team has visited schools and universities to talk about energy and build enthusiasm for careers in the sector. In some locations courses are even appearing in secondary education to help younger students see the energy industry as a viable career choice.

Pathways can also be designed to ensure workers are not left behind when major policy shifts are needed. When San Francisco, California banned natural gas from new buildings, for example, there was opposition from pipefitters concerned about job loss. Simultaneously, the city faced a severe drought, so it introduced regulations requiring large buildings to collect and reuse greywater to conserve water resources. This created new demand for pipefitter skills, helping to preserve jobs. This example highlights the potential for innovative and collaborative solutions that address both environmental goals and employment concerns.

Innovate with workforce development
In any new or emerging area, it is always useful to make as much explicit as possible. The energy transition spans many such areas and so an invaluable step for people working here is to begin documenting approaches they use — especially the ones that are most important or successful. These evolve into technical standards that set baseline positions, demonstrate expectations, support training and provide a record of the way a sector has matured its technical approach.

There are many workforce benefits to this. It helps standardize new working practices, so new people can be integrated, the quality of delivery can be benchmarked, other parts of the organization can understand advantages and limitations, client communication can be enhanced, and more — all from an effort to document and standardize.

Workforces and communities

Renewable energy employment worldwide reached 12 million in 2020, up by more than 60 percent since 2012. A big workforce challenge in the energy transition is to develop the human and cultural aspects of jobs, in addition to the technical skills.

Many governments are addressing this by driving a more diverse renewable energy workforce, with programs to train women, Indigenous Peoples and other underrepresented groups. The energy transition is a megatrend for the future, and the workforce behind it should reflect the communities it will support.

New energy generates jobs in wind turbines, electricity, hydrogen and energy storage industries but reduces jobs in gas turbines, oil and internal combustion engines. With the decline in fossil fuel jobs comes the potential of long-term unemployment challenges for those workers if they lack the required skills to adapt as economies undergo change. Early workforce training can go some of the way to ensuring an equitable transition. We cannot expect perfectly even access to opportunities created by the energy transition, but it is important to open the benefits to as many as possible.

60%

Renewable energy employment worldwide reached 12 million in 2020, up by more than 60 percent since 2012.

57%

Organizations that are linking executive pay to energy transition goals.

Transformation at the top

Transformation isn't only a question of what organizations do; it also requires a cultural change. This must happen from the top down because leaders set the tone for strategy, decision-making and organizational processes.

There are people-centric ways to drive this. This research reveals a growing number of organizations that are linking executive pay to progress on decarbonization: 57 percent now tie the remuneration of senior leaders to energy transition goals.

"C-suite remuneration will become more closely linked to ESG (Environmental, Social and Governance) metrics, including carbon footprint reduction," says KPMG's Simon Virley."That's already happening, and those metrics will become more important in the future."

Wider energy industry collaboration

We are also likely to see energy companies increasingly engaging non-traditional partners, such as community stakeholders and non-governmental organizations (NGOs), to drive progress on transition-related themes. Simon Virley of KPMG gives the example of the Sustainable Homes and Buildings Coalition in the U.K., which includes NatWest, British Gas, Worcester Bosch and the charity, Shelter.

"The overarching message is that no single organization [or individual] has all the answers," says Virley. "We all need to think in different ways about this, rather than thinking we can solve it all ourselves."

A good example will be the build-out of transmission and distribution infrastructure. As decentralized and clean power hubs proliferate (such as wind and solar photovoltaic) connecting these sources to the grid will be critical. Significant investment in reinforcing the grid will be necessary. In this context, close cooperation and sharing of best practice between grid operators should be more straightforward than, for example, between technology or equipment companies, because losing competitive advantage is less of a risk.

However, as new transmission lines are planned, it will be essential to engage and partner with stakeholder communities to ensure a smooth planning and approval process is achieved. Without a social license to operate, permission to build new grid infrastructure can become difficult or impossible.

> There was a kind of realization that if every proponent developed its own transmission infrastructure along established processes it would harm local communities.
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>
> **Alistair Parker, VicGrid**

Energy for life: building social license

Infrastructure development should not proceed without anticipating the impact on people near and far and adapting plans to maximize benefit and minimize harm. For governments and regulators, this can involve ensuring that all policies fit within a wider, structured plan that protects and promotes communities.

For example, the government in the State of Victoria, in Australia, announced ambitious offshore wind targets which would require significant investments in new transmission infrastructure. "There was a kind of realization that if every proponent developed its own transmission infrastructure along established processes it would harm local communities," says VicGrid's Alistair Parker.

This is one of the reasons why the organization has reformed the transmission planning framework in Victoria. Parker says the reforms bring forward changes that are designed to help build social license, create benefit-sharing opportunities with communities and improve consultations over infrastructure development.

Wider collaboration is also important in implementing and operating transmission infrastructure. “We have technical expertise in-house that we make available to our supply chains,” says Powerlink’s Jacqui Bridge of the company’s experience operating transmission systems. “We help them to understand how the equipment operates in the field, enabling them to overcome problems that could cause even bigger issues across a whole fleet of assets.” Almost three-quarters of organizations in our research (73 percent) say they are prepared to help suppliers and partners accelerate their adaptation to the energy transition.

Collaboration can also serve to increase the overall size of the market, which benefits everyone. “We understand that placing substantial orders can be a catalyst for suppliers to invest in new factories and expand capacity,” says VicGrid’s Alistair Parker. “Our commitment to scaling up operations sends a powerful signal to suppliers — it encourages them to invest in new factories.”

Energy for life: reciprocal relationships

We need new approaches to ensure that energy is accessible, affordable and people-centric, all while also addressing the need for decarbonization. A significant proportion of the energy transition will involve the very human element of adoption and effective use of new technologies. The right incentives can encourage support and cooperation in energy-saving and sustainable practices.

“Start with the customer and think about how to make things easy and affordable, rather than just imposing a decarbonized solution onto them in the interest of speed and the planet,” says Rachel Fletcher of Octopus Energy. “What we’ve found is that if you make it easy for customers to do things, and even if you give them a small reward, it’s amazing how much support and cooperation you get.”

Key recommendations for
a people-centric transition

- Consider skills in the broadest sense. Organizations need to train the technicians of the future, but other skills will be needed too — particularly in areas such as change management.
- The skills required will evolve at pace. People therefore need to learn, continue to learn and be open to "relearning" when best practice is rewritten over brief time horizons.
- Sell the sector as an exciting and positive place to work; aiming to be truly representative of the people it serves. In addition to targeting those leaving education, recruit and retain staff with transferable skills from other sectors.
- Early, inclusive and consistent community engagement can enable a smoother permitting process across all new energy infrastructure projects.
- Culture change and adoption take time. Inclusivity is essential. Make changes as easy and affordable as possible and demonstrate value early on.

Conclusion:
the path to a better world

There's no single blueprint for navigating the energy transition but there are a multitude of actions organizations can take to accelerate a practical, profitable, predictable and people-centric transition to net zero. This research highlights the lessons learned by those in various places on the energy transition continuum, and we thank our survey respondents and expert contributors for their valuable insights.

Expert contributors:

Darran Anderson, Director of Strategy and Innovation, Texas Department of Transportation

Carolyn Bowen, Director of Climate and Environment, The City of Calgary

Jacqui Bridge, Executive General Manager of Energy Futures, Powerlink

Landon Derentz, Senior Director and Morningstar Chair for Global Energy Security, Atlantic Council Global Energy Center

Rachel Fletcher, Director of Regulation and Economics, Octopus Energy

Alistair Parker, Chief Executive Officer, VicGrid

Caroline Stancell, General Manager for Hydrogen for Mobility, Air Products

Anna Su, Chief Executive Officer, Synera Renewable Energy

Simon Virley, Vice Chair and United Kingdom (U.K.) Head of Energy and Natural Resources, KPMG

Susannah Wood, Vice President of Public Affairs and Sustainability, Statkraft

AECOM steering committee:

Craig Bearsley

Karen Britton

Andrew Bui

Lucy Carraz

Marie-Jose Croonen

Adrian Del Maestro

Laura Fluck

Amy Ford

Dawn MacDonald

Sam Mackilligin

Jennifer Obertino

Frank Sweet

Toby Uppington

Bridget Williams

Our hope is that this report will inform, stimulate discussion and support collaboration across industries and sectors. Working as a collective, there is indeed a prosperous path to net zero and a better world.

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