



BARRELS & BYTES

**A Digital Revolution in
the Energy Transition.**



GE VERNOVA

CONTENTS

03

FOREWORD

05

INTRODUCTION

07

**PRIORITIZING DIGITALIZATION
& THE TRANSITION**

10

**DIGITAL
DECARBONIZATION**

13

**SOFTWARE IN
TRANSITION**

17

**SOFTWARE
ADOPTION**

21

**BARRIERS
& SCALING**

24

**OUTLOOK &
CONCLUSIONS**

27

REFERENCES

FOREWORD

Make no mistake, the energy transition is here. We see it in action all around us, with every wind turbine and solar farm erected, and as coal plants give way to gas power or simply fade away. We see it, too, as battery storage, carbon capture and hydrogen inch their way toward maturity and mainstream adoption.

And while the goal of net zero is necessary, we must balance this future with the growing demand for available and affordable energy today.

Every step towards reaching net zero adds potential fragility to the entire ecosystem. Traditional power generation wasn't built for the dexterity needed today, let alone the future.

This isn't to say we should stop or even slow our progress. Quite the opposite.


The energy transition is a multi-variate equation that only grows in complexity with every advancement.

For example, a thermal generator can burn more fuel on spinning reserve and spend more money on replacement power to make up for uncertainties, all for the sake of availability. Additionally, we see renewables not fully utilized due to unknown risk. In either case, the result is wasted resources, a sin in the energy transition.

These are just a few examples to highlight that what we're doing isn't working. It hasn't for some time.

And while it will take decades to modernize our physical infrastructure, software that tangibly accelerates progress is here today. Software can collect and synthesize disparate sources of data – both internal and external – for the purpose of real-time visibility into the status of operations. It can apply AI/ML for insights and industry expertise for strategic recommendations. Software can orchestrate entire fleets of mixed generation types to prioritize renewables and reduce waste and uncertainty.

For a second year, we've commissioned Reuters Events – the world's leading media organization with a focus on the energy transition – to conduct a blind study on our behalf. This report highlights what we're already seeing: There is clear and accelerating year-over-year growth in software designed to make power, energy and materials needed for clean energy more reliable, affordable, and sustainable.



The energy transition is a multi-variate equation that only grows in complexity with every advancement.”

The energy transition requires big, systems-of-systems thinking.

Addressing reliability or uptime alone and at a single plant or site is not enough. Fixing a problem with a point solution doesn't account for the enterprise-wide orchestration required to make marked gains in decarbonization.

As the report reveals, the industry is recognizing the need for enterprise-grade and integrated (composable) software that allows them to select and assemble software components.

Another interesting finding is that of the software use cases offered, no one strategy stood out. Much like the physical transformation needed, the tools for a digital transformation are also diverse, requiring not one solution, but many. This perhaps best underscores the need for an integrated, composable technology stack to enable faster time to value and insights.

However, we do see a fairly dramatic shift in respondents who state a need for more accurate emissions measurement – now 62 percent, up from 49 percent in 2023.

Despite our focus on hardware and software thus far, there is yet another lever in the energy transition equation: People.

In some cases, software can run autonomously, requiring little to no human intervention except for the occasional audit or upgrade if not running in the cloud. However, the majority of software solutions require workforce adoption if outcomes are to be achieved.

For this reason, the software solution, as well as the implementation, requires industry expertise. It also requires executive sponsorship and functional leader empowerment of the workforce's use of digital solutions. Additionally, we know that adoption is greater when the digital solution is built with the understanding of the business use cases and personas accountable for success.

All paths lead to software.

We're proud to be an enabler of the energy industry as it finds its way to net zero. We know there's no one way through this journey, but we know that all paths require software.



Linda Rae

General Manager, Power Generation and Oil & Gas

GE Vernova's software business

INTRODUCTION



From predicting renewable generation to managing asset performance, software and other digital technologies are key to the energy transition. Software capabilities are advancing rapidly, and many energy and industrial businesses are actively targeting digitalization and digital transformation.

According to the International Energy Agency (IEA), “digital technologies can help integrate increasing shares of variable renewables and improve the reliability of grids, while for end-users they can improve energy and material efficiency and reduce emissions.”¹

The IEA recognizes the positive impacts on efficiency and data transparency that software and digital technology offer to energy stakeholders - however, the agency also lists digitalization as being off track as far as achieving global climate targets is concerned.

“Much of the progress so far is limited to developed countries and further efforts by policy makers and industry are necessary to realize digitalization’s full potential to accelerate clean energy transitions,” says the IEA.²

To better understand core challenges around software adoption, digital technologies, and the transition to net zero in 2024, this report draws on research carried out by Reuters in association with GE Vernova, an industrial digitalization leader accelerating the path to more reliable, affordable, and sustainable energy.

The research polled more than 800 senior decision makers from the Reuters Events database, asking about digitalization and energy transition plans.



41% SENIOR MANAGEMENT

37% MID- MANAGEMENT

This report focuses on the responses from 350 companies with more than 5,000 staff, unless otherwise stated. Among these companies, most of the survey respondents belonged to senior (41%) and middle management (35%), with 8% working at board level.

Almost all companies surveyed were related to the energy sector, with 27% operating in downstream oil and gas, 26% acting as utilities and a similar percentage developing renewables.

Additionally, 24% of respondents came from companies operating in upstream oil and gas and 23% working for integrated energy companies.

The fact that these percentages add up to more than 100% illustrates how most of the large companies surveyed operate across multiple parts of the energy value chain.

Where relevant, the results of this research have been compared to those of two other Reuters surveys: the Digital Energy Survey (DES 2023) and the Digital Carbon Accounting Survey (DCAS 2023).

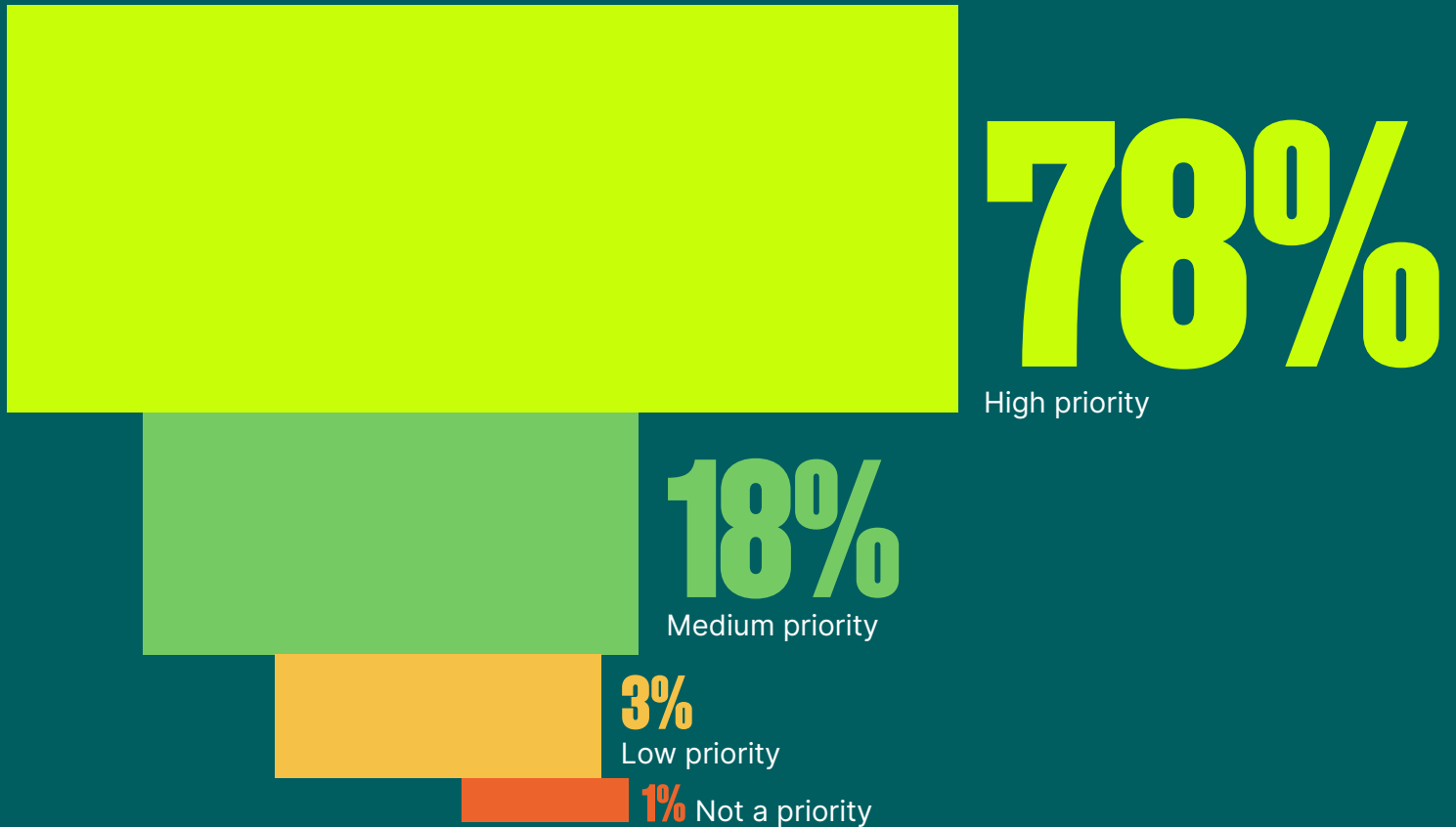
While every attempt has been made to ensure the accuracy of the results, this report is provided for information purposes only and Reuters and GE Vernova accept no liability for its use.

Readers should be aware of the limitations of the sample used, with responses self-submitted.

PRIORITIZING DIGITALIZATION & THE TRANSITION

There is now little doubt over the need for urgent action on climate, with record-breaking global temperatures in 2023 underscoring the need for a rapid transition away from fossil fuels.

How is your organization prioritizing the energy transition process?



The results of our research broadly reflect this view, with 78% of large companies rating the energy transition as a high priority.

This level was eight percentage points higher than for sub-5,000-employee companies, likely underscoring the extent to which larger companies' climate plans are now subject to public scrutiny.

At the same time, the 78% level is below the rate cited by large-company executives in the DES 2023, where 94% said the energy transition was a high priority for their organizations.

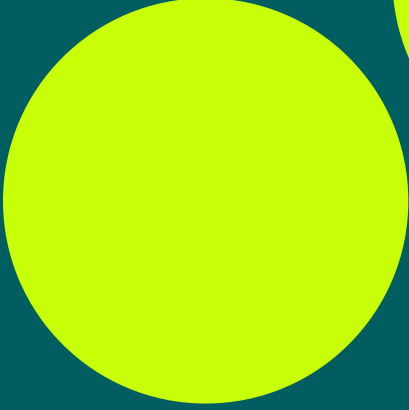
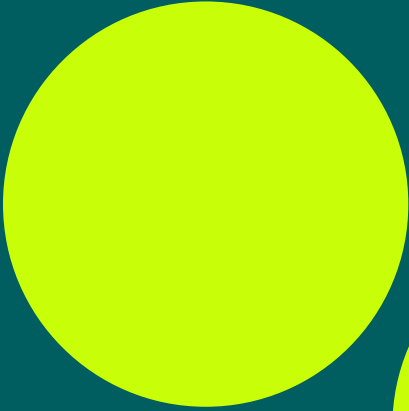
This discrepancy could in part be explained by the smaller sample size of the DES 2023, which covered 142 companies with more than 5,000 employees.

Another partial explanation might be that some companies are de-emphasizing decarbonization as their energy transition plans move from proposal to execution and ultimately business as usual.

Finally, some companies may have downgraded the priority given to energy transition in line with a cooling of environmental, social and governance (ESG) sentiment. The Thomson Reuters Institute says ESG has become politicized, potentially affecting business leader attitudes.



In your opinion, how important is digital transformation to a successful energy transition?



“The resulting backlash has been most visible in the United States, where anti-woke rhetoric and policies from far-right Republican states have all but made the ESG label a bit too hot for many companies to handle, at least overtly,” said the institute.³

Around four out of five (81%) of large-company executives see digitalization as being key to their energy transition plans, which again is slightly below the level seen in the DES 2023 (86%)—although within the margin of error for the latter’s sample size.⁴

Given this importance, it is good to see digital transformation being handled by C-suite executives in 67% of the large companies surveyed, the same as the level uncovered in the DES 2023.

A further positive finding is that responsibility for digitalization appears to be shared across a range of functional units, including sustainability (30%), strategy (28%), operations (24%) and of course IT and digital teams (53%).

Finally, it appears digitalization of operations and maintenance could be contributing to decarbonization, with 55% of large companies prioritizing investments to operate sustainably. That is close to the level seeking improved reliability (57%) and above those increasing production (50%).



81%

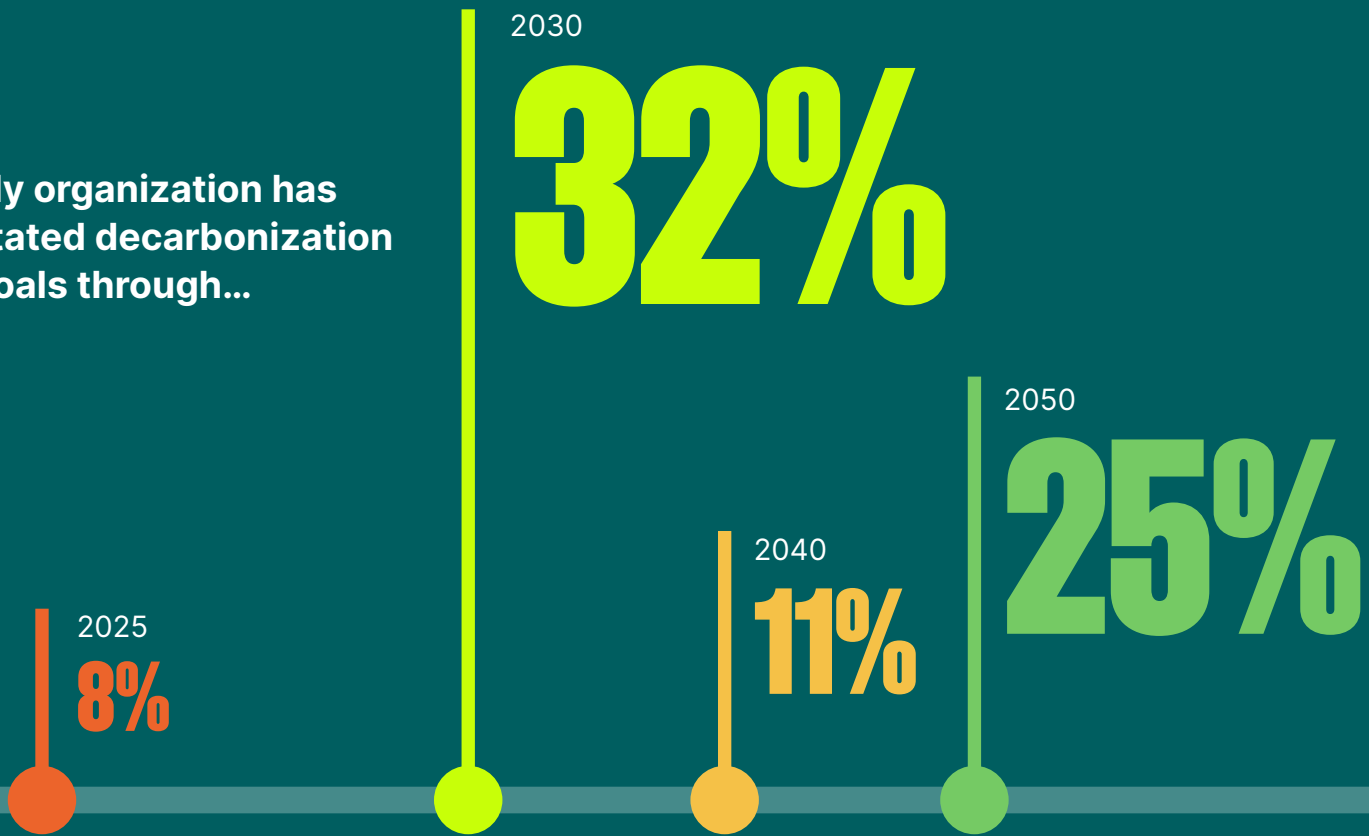
large-company executives see digitalization as being key to their energy transition plans



DIGITAL DECARBONIZATION

Large organizations are taking decarbonization seriously, with only one in 10 not having a set date for carbon neutrality—compared to 31% for smaller companies. Most of the large businesses surveyed have goals in place for 2050, 2040, 2030 and—in an 8% of trailblazers—2025.

My organization has stated decarbonization goals through...



It is unclear from the survey whether these goals relate to complete or partial decarbonization, but one notable indicator is that only a quarter of companies cited a 2050 target, compared to 41% in the DCAS 2023.

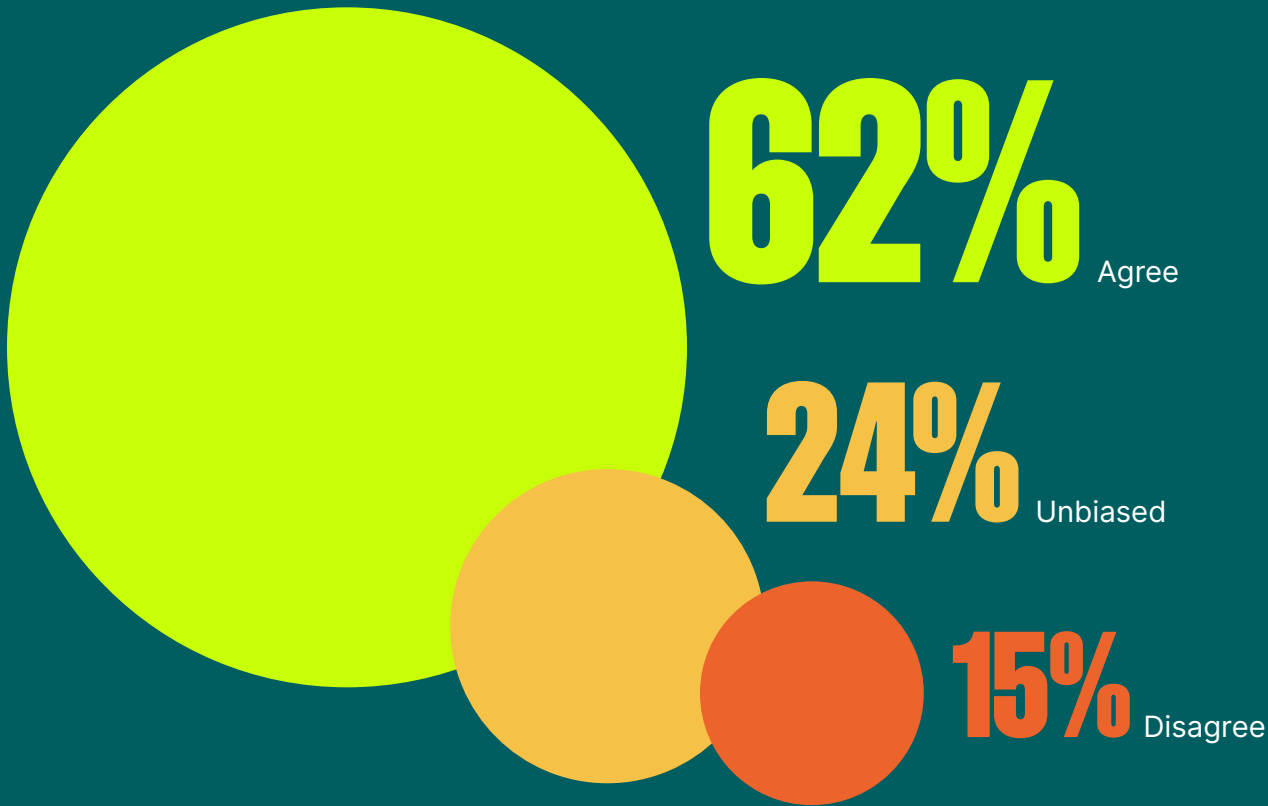
This difference appears to be beyond the margin of error and potentially implies that enterprises are increasingly working towards decarbonization ahead of 2050.

Although 27% of large companies are still struggling with when to decarbonize—and how to pay for it—most (58%) have grasped the financial and timeline implications of decarbonization and almost three quarters (73%) are reporting on progress internally and externally.

A further 9% are reporting internally only, while 4% of the large organizations surveyed are not providing any reports.

The generally high level of decarbonization reporting seen in the survey is consistent with increased levels of ESG compliance being demanded by markets and stakeholders.

My organization needs a more accurate way of measuring our carbon emissions and reporting.



In the U.S., for example, the Securities and Exchange Commission has proposed rule changes that would require companies to include certain climate-related disclosures in their registration statements and periodic reports.⁵

In June 2023, meanwhile, the International Sustainability Standards Board issued inaugural standards “ushering in a new era of sustainability-related disclosures in capital markets worldwide.”⁶

Likely linked to these regulatory developments, plus wider stakeholder calls for transparency around ESG claims, 68% of large companies are now making strategic decisions based on emissions data and insights.

This level is less than the 73% of large companies claiming to use emissions data for strategic decisions in the DCAS 2023, although the difference is within the margin of error for the sample sizes involved.

The need for accurate sustainability reporting appears to be hampered by a lack of adequate tools, with 62% of large company respondents agreeing that their organization needs a more accurate way of measuring carbon emissions.

This represents a marked uplift from the 49% level seen in the DCAS 2023, highlighting the growing importance of digital technology in sustainable reporting.

“
...68% of large companies are now making strategic decisions based on emissions data and insights.



SOFTWARE IN TRANSITION

Digital technology is seen as key for the energy transition, yet current investments fall short of what is needed for decarbonization. This is the main message from the research around the importance of software in net zero plans.

Software is foundational to a successful energy transition.



82%

Agreed that software is foundational to the energy transition

7%
Disagreed

More than four out of five respondents (82%) agreed that software is foundational to the energy transition, while only 7% disagreed.

A large part of this benefit would appear to come from improved employee efficiency, with 82% of large company respondents agreeing that software could ease pressure on workforce challenges—and only 4% disagreeing.

Within the technology tools available automation and artificial intelligence are seen as paramount, with 75% of large company representatives viewing such applications as providing industry expertise and insights that positively affect the energy and materials workforce.

Half of those surveyed agreed strongly with this proposition, but the importance of implementing digital tools for the energy transition is not being met with investment. Only 26% of those surveyed said the industry was investing enough in the energy transition, versus 41% that disagreed.



Which are the top three drivers for your organizational investment in carbon emissions management tools?

01

CORPORATE MISSION

02

REGULATORY COMPLIANCE

03

STAKEHOLDERS & INVESTORS

Investment is not just a problem for the industries surveyed, but also for the companies involved. Only 38% of large company representatives said their organizations were investing enough in digital technologies, with almost the same amount—33%—saying they were not.

Almost another third (29%) remained neutral about investment, potentially highlighting challenges in gauging the right amount of digital expenditure that is required for efficient decarbonization.

Despite this, half of large-company representatives believe their organizations should scale up software investment to help meet energy transition goals, compared to just 21% that disagree.

There are three main drivers for organizational investment in carbon emissions management tools, according to the responses from companies of all sizes.

These are corporate mission, regulatory compliance and stakeholders and investors, all listed as important drivers by three-fifths of those surveyed.

A somewhat positive finding given concerns around corporate greenwashing is that only 41% of the survey listed public relations as a driver for investment—although it could be argued that this level is still too high.

Equally notable is the fact that roughly half the sample (53%) saw investment in carbon emissions management tools as a driver for profitability.

There are several ways that digital decarbonization tools can indeed improve corporate profits, from avoiding the risk of regulatory fines to helping improve energy efficiency or reducing exposure to fuel price volatility by integrating renewables into the generation mix.

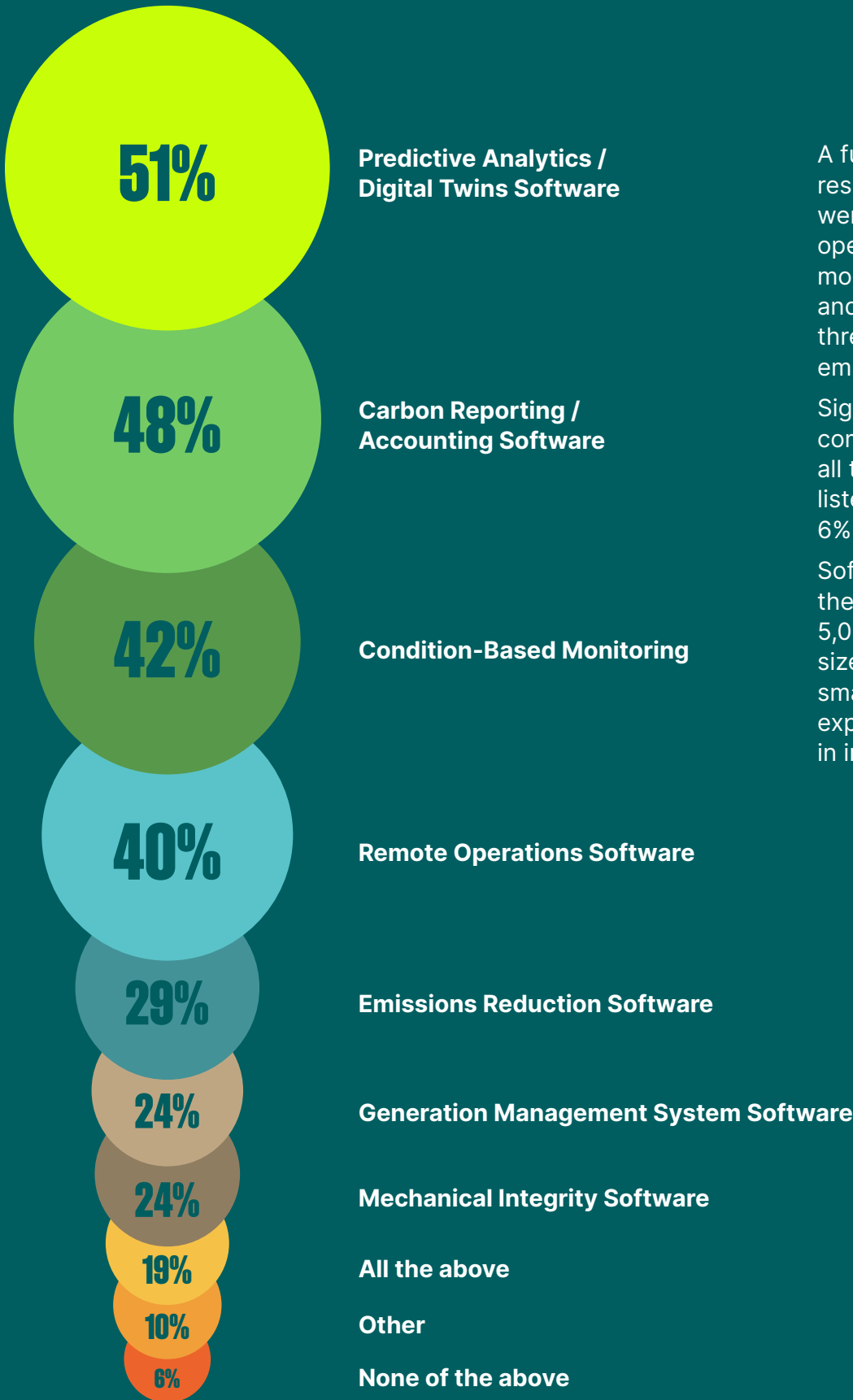
KEY TAKEAWAY

Given respondents' clear support for digital tools in pursuing decarbonization and improving revenues, it seems likely the level of investment will grow in future.

SOFTWARE ADOPTION

Despite a perceived lack of investment in software, the large companies in our sample appeared to be relatively advanced in terms of adoption.

Which of the below software solutions is your organization currently pursuing?



A further two out of five respondents said their companies were using software for remote operations, condition-based monitoring and carbon reporting and accounting, while almost three out of 10 (29%) were using emissions reduction applications.

Significantly, 19% of the large companies polled were using all the software platforms listed in the survey, while only 6% were not using any.

Software adoption across the board is higher for 5,000-employee-plus sized companies than for smaller ones, which is to be expected given differences in investment capacity.



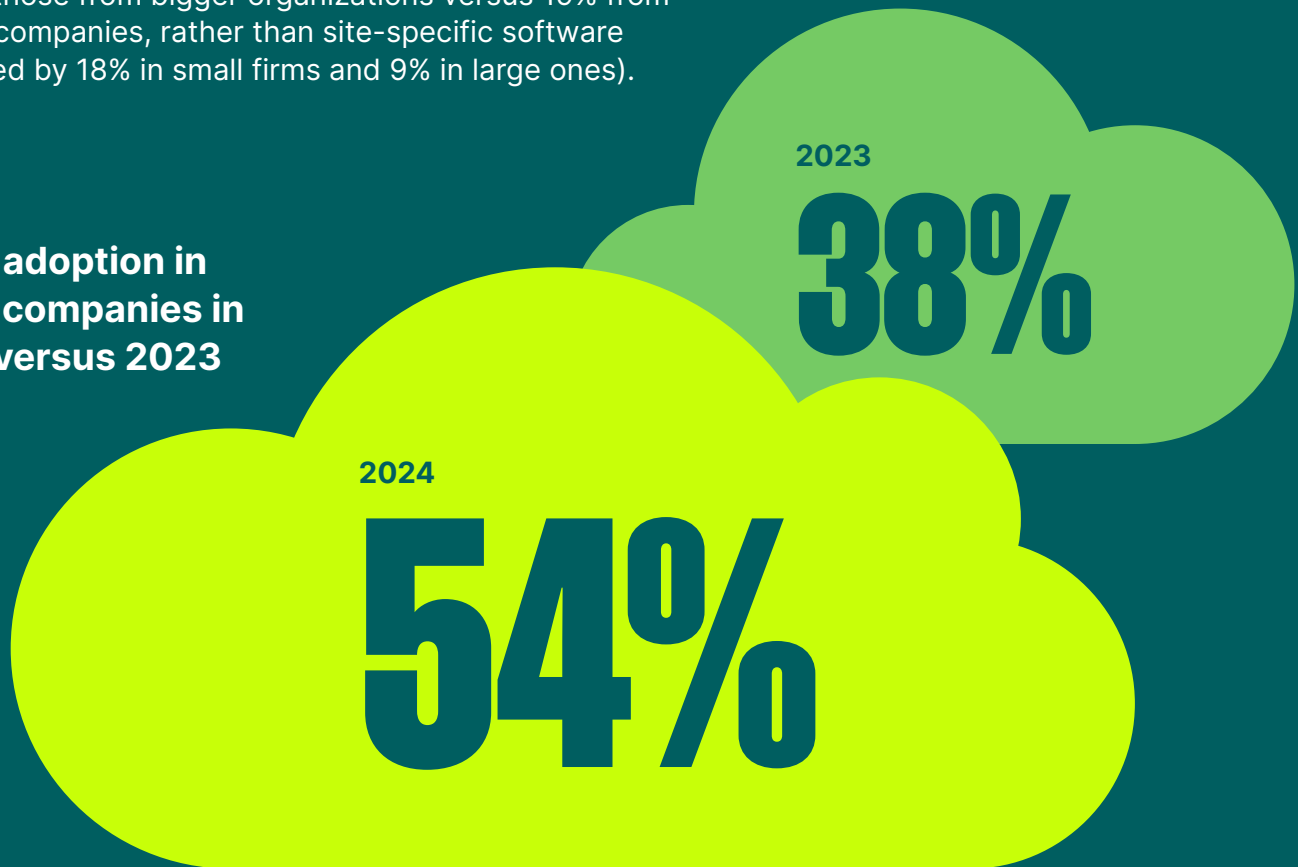
Another difference between larger and smaller companies is the extent of cloud adoption, with 54% of 5,000-plus-employee businesses claiming to have a cloud-first IT strategy. This compares to 45% among smaller companies and 38% among larger businesses polled in the DES 2023.

While the figures would seem to indicate a growing appetite for cloud services, it is notable that 26% of respondents from large companies did not know whether their organizations had a cloud-first strategy or not.

It is unclear whether this reflects a lack of corporate strategy relating to the cloud, or simply a failure of the IT function to communicate its preferred infrastructure hosting option.

Finally, large company respondents also expressed more of a preference for cross-enterprise systems, cited by 33% of those from bigger organizations versus 19% from smaller companies, rather than site-specific software (preferred by 18% in small firms and 9% in large ones).

Cloud adoption in larger companies in 2024 versus 2023



What type of solutions is your organization looking for right now?

Similarly, large companies appear somewhat more likely to select composable software—systems that can be extended through modules—over point solutions, although the differences are within the margin of error for the sample size. A quarter of respondents had no preference or used both.

What is clear is that large companies in general prefer composable systems over point ones, which is unsurprising given that these businesses are more likely to invest in enterprise IT platforms that can easily be built out to handle new applications.

Underscoring this, in the DES 2023 research more than half (53%) of large-company respondents said there was “more value in composable software.”

9%

Site-Specific Solutions

33%

Cross-Enterprise Solutions

38%

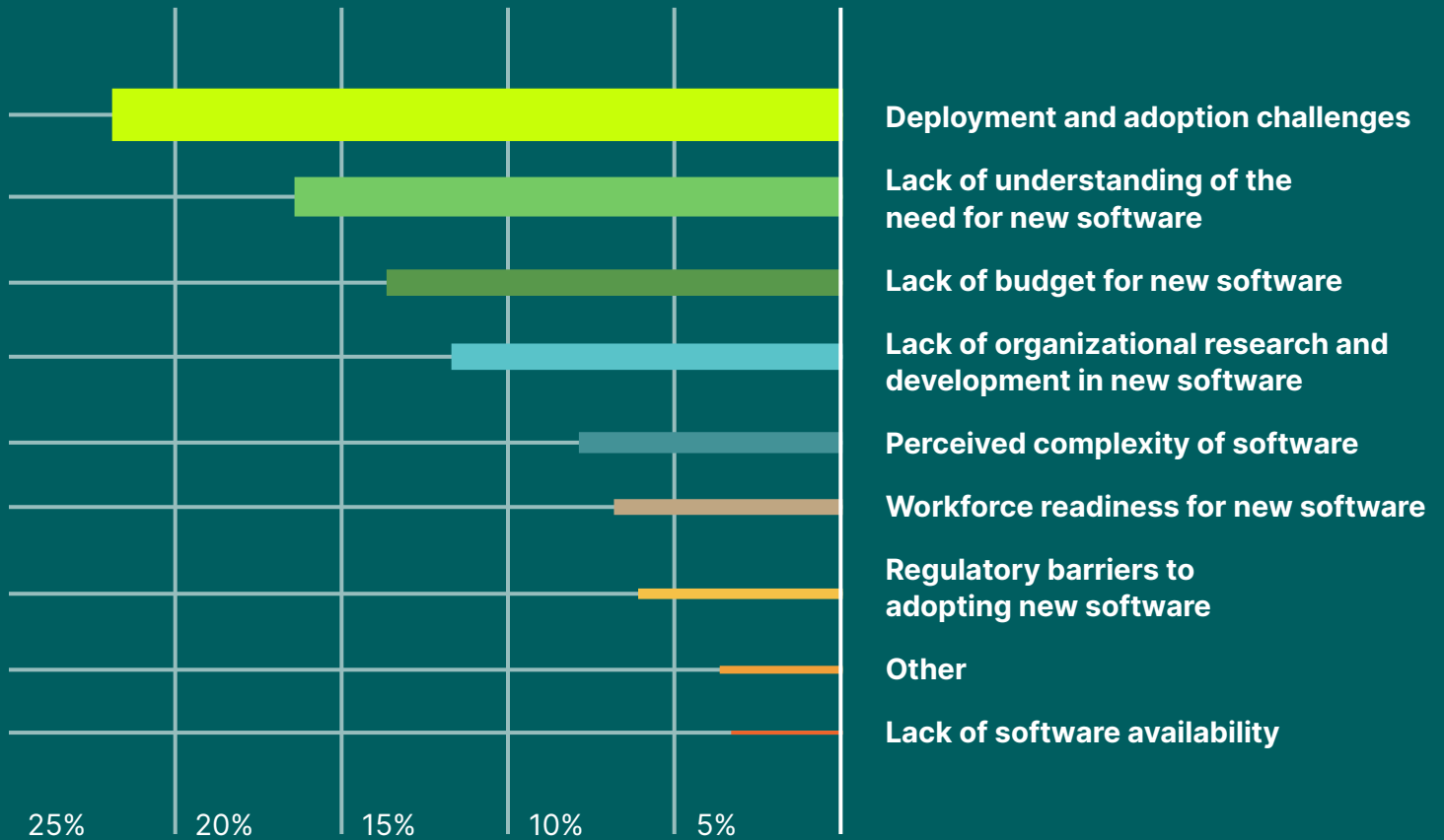
Both



BARRIERS & SCALING

Even as large enterprises look to adopt new software for the energy transition, they continue to experience deployment and adoption challenges. These were cited as a top-three barriers to digitalization by half (51%) of respondents from large companies, more than any other concern.

What are the key barriers to implementing software solutions to your energy transition challenges?



Likely linked to this, 37% of large-company respondents also put workforce readiness for new software among their top three barriers to implementation, and a similar percentage cited a lack of understanding of the need for new software.

Software deployment and adoption are consistently problematic for larger companies, emerging as the most-often cited top concern among large-company executives surveyed for the DES 2023 too.

Given this, it is unsurprising that companies express a preference for composable software, since having a single platform and common interface for multiple applications might be expected to facilitate adoption.

Also unsurprising is the finding that three-fifths of executives ranked 'improved business models for deployment' as one of the top three factors contributing to the speed and scale of software adoption in the energy and materials sectors.



Please rank the top three options below in order of their potential to increase the speed and scale of software solution adoption within the energy and materials sectors.



Almost a quarter (24%) of large-company representatives listed improved business models for deployment as the single most important factor contributing to software adoption.

Workforce readiness was another important factor, listed by 59% of respondents as a top-three contributor to adoption, and by 17% as the number-one issue.

More than half of executives (53%) also say a better understanding of offerings would help with software adoption, pointing to a need for vendors to clearly articulate the benefits and features of their products.

Budget remains an important barrier to software adoption, cited by almost half (47%) of large-company executives..

Interestingly, more internal research and development, more software options and more regulatory support are all seen as having relatively minor importance when it comes to adoption. These factors were listed as a top-three issue by barely a quarter of the respondents in the survey.

Another thing that does not appear to be a particular concern for adoption is a lack of software availability.

Although some emerging energy transition applications require quite specific digital tools, only 12% of respondents listed lack of software options as a barrier to implementing systems that could help with the energy transition.



OUTLOOK & CONCLUSIONS

The results of this survey underscore previous studies and the conclusions of bodies such as the IEA, highlighting the value of digital technologies in achieving the goals of the energy transition while noting that there are still important barriers to adoption.

These barriers, which can partly stem from lack of budget but also include factors such as workforce readiness and an understanding of available systems, help provide an explanation for why larger companies are tending to prefer composable, enterprise-wide software packages.

Such packages can often support new applications through the addition of product modules, without the need for costly and risky integrations and without requiring staff to grapple with new user interfaces or training programs.

A further benefit of these packages is that they can increasingly be delivered through the cloud, which is emerging as the hosting paradigm of choice for the energy sector.

These scale effects will be important for improved software adoption as today's nascent energy transition industries go mainstream.

One example is GE Vernova's Asset Performance Management (APM) suite of software. Its architecture offers organizations the flexibility to deploy APM applications separately or all together as a holistic enterprise-grade solution. This gives organizations of any size the flexibility to get started with select applications of a top-rated APM solution and expand to include more applications as needed in future.

The composable APM architecture enables different APM functionalities to be split into self-contained services. Each service focuses on a specific APM capability, such as data collection and integration, analytics, visualization, reporting, security and so on.

THE SCALE YOU NEED NOW

The rapid evolution of such systems is giving large organizations an increasingly rich toolkit with which to overcome their decarbonization challenges—just as the race to net zero needs to pick up speed.



APM'S BREADTH OF CAPABILITIES

Learn more about GE Vernova's asset performance management (APM) suite of software – and how it enables companies to meet enterprise goals for production and sustainability.

Explore



REFERENCES

- 1 IEA, 2024: Digitalization. Available at <https://www.iea.org/energy-system/decarbonisation-enablers/digitalisation#tracking>.
- 2 Ibid.
- 3 Thomson Reuters, December 4, 2023: New white paper examines current state of ESG activity and backlash around the globe. Available at <https://www.thomsonreuters.com/en-us/posts/esg/esg-navigating-past-the-noise/>.
- 4 PennState Eberly College of Science, 2023: STAT 100 Statistical Concepts and Reasoning. Available at <https://online.stat.psu.edu/stat100/lesson/2/2.3>.
- 5 U.S. Securities and Exchange Commission, Sep 11, 2023: Climate-Related Disclosures/ESG Investing. Available at <https://www.sec.gov/securities-topics/climate-esg>.
- 6 International Financial Reporting Standards Foundation press release, June 26, 2023: ISSB issues inaugural global sustainability disclosure standards. Available at <https://www.ifrs.org/news-and-events/news/2023/06/issb-issues-ifrs-s1-ifrs-s2/>.