Spotlight on Decarbonization

*The crucial role of mindset and technology
in leading industries to decarbonize*
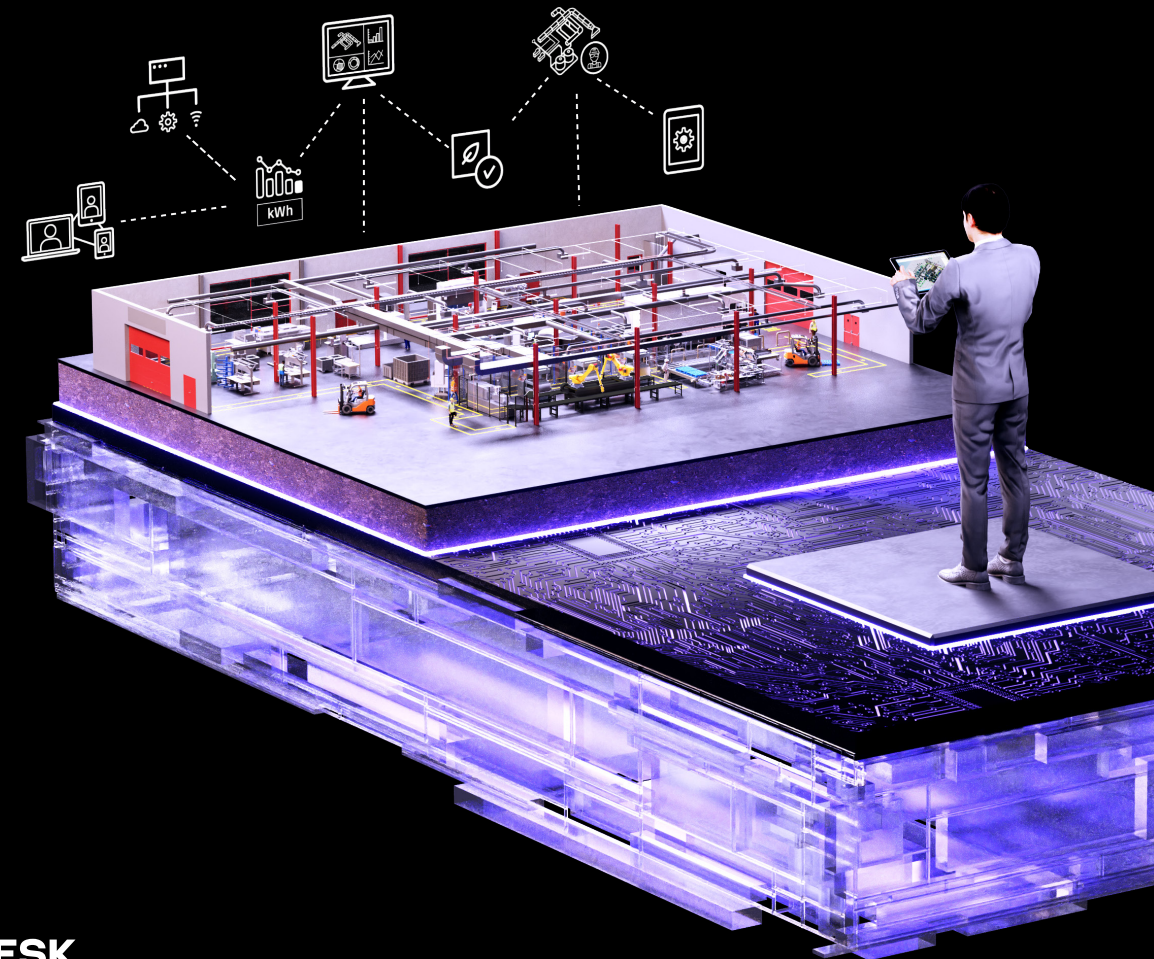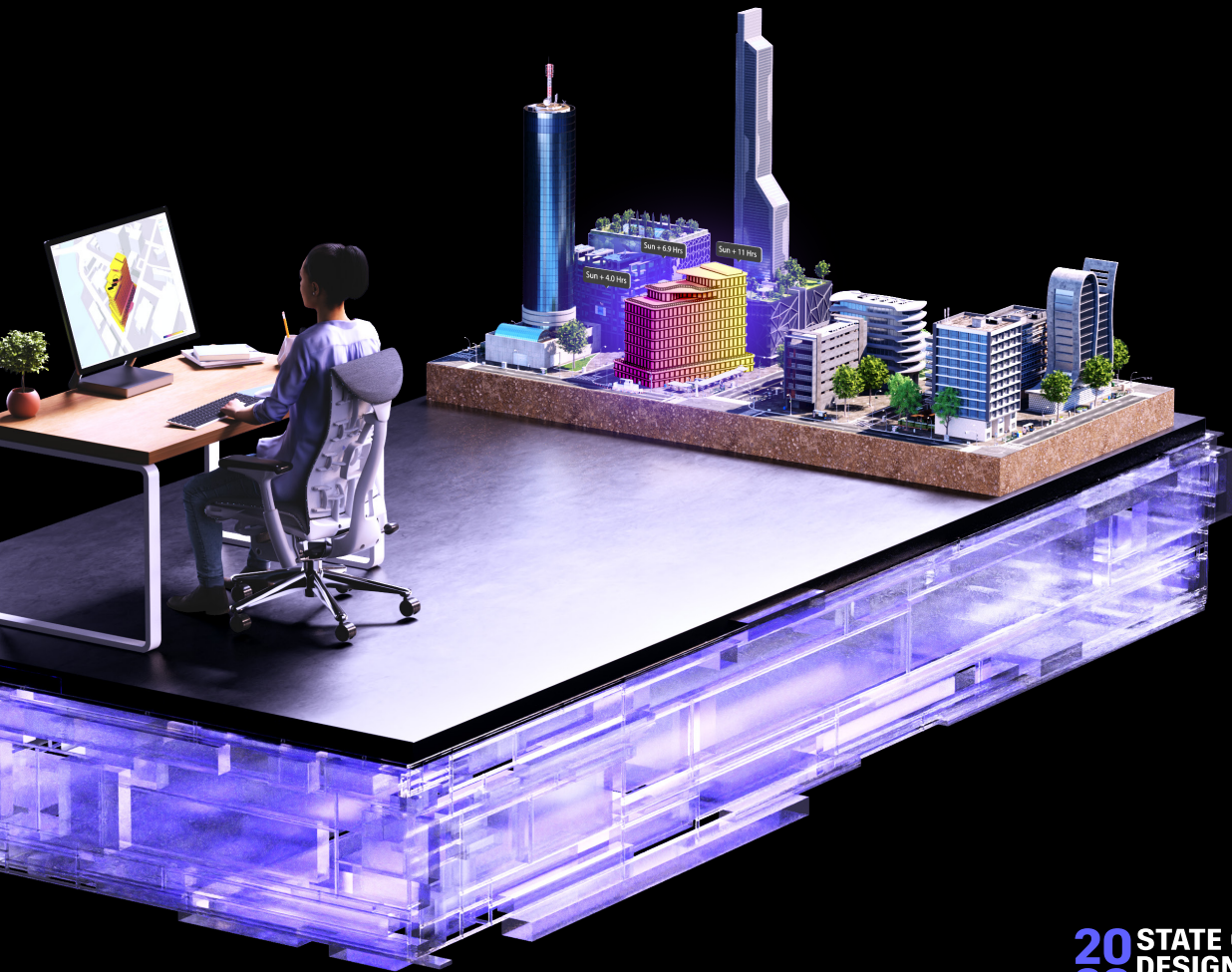
2023 STATE OF DESIGN & MAKE

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Introduction

The impacts of climate change are being felt across the globe more than ever before—from flash floods and hurricanes to record-breaking heatwaves and hundreds of millions of acres of land burned by wildfires. In 2022 alone, the world experienced $360 billion worth of weather and climate disasters.[1]

These impacts go beyond the governmental and individual levels and are impacting organizations across the world. Increasingly, business leaders in industries like architecture, engineering, and construction (AEC) and design and manufacturing (D&M) recognize a corporate responsibility to address sustainability issues—and also a business case for doing so.

Since organizations in these sectors are responsible for designing and making much of the modern world, they account for a significant share of the global carbon emissions contributing to climate change. However, *this outsized influence also gives these industries an opportunity to make an outsized positive impact through decarbonization actions that reduce carbon dioxide emissions or* remove them from the atmosphere. These practices—which include creating net-zero buildings, designing circular products, reducing construction waste, and driving sustainability as a priority across supply chains—could cut carbon emissions dramatically if adopted at scale across the AEC and D&M sectors.

But how important is sustainability to business leaders? What are some of the key barriers for companies that haven't taken action? And more importantly, how can companies take meaningful steps to decarbonize their projects and operations?

This report seeks to answer these questions.

"**The decarbonization journey is a long-term journey, and there are no quick fixes**. We need to come together as an industry. I don't think that companies can do it individually. It's a collaborative, lifetime commitment."

—Katharina Gerstmann, Global Lead for Technical Excellence and Innovation, WSP

[1] https://www.ajg.com/gallagherre/-/media/files/gallagher/gallagherre/gallagher-re-nat-cat-review-2022.pdf
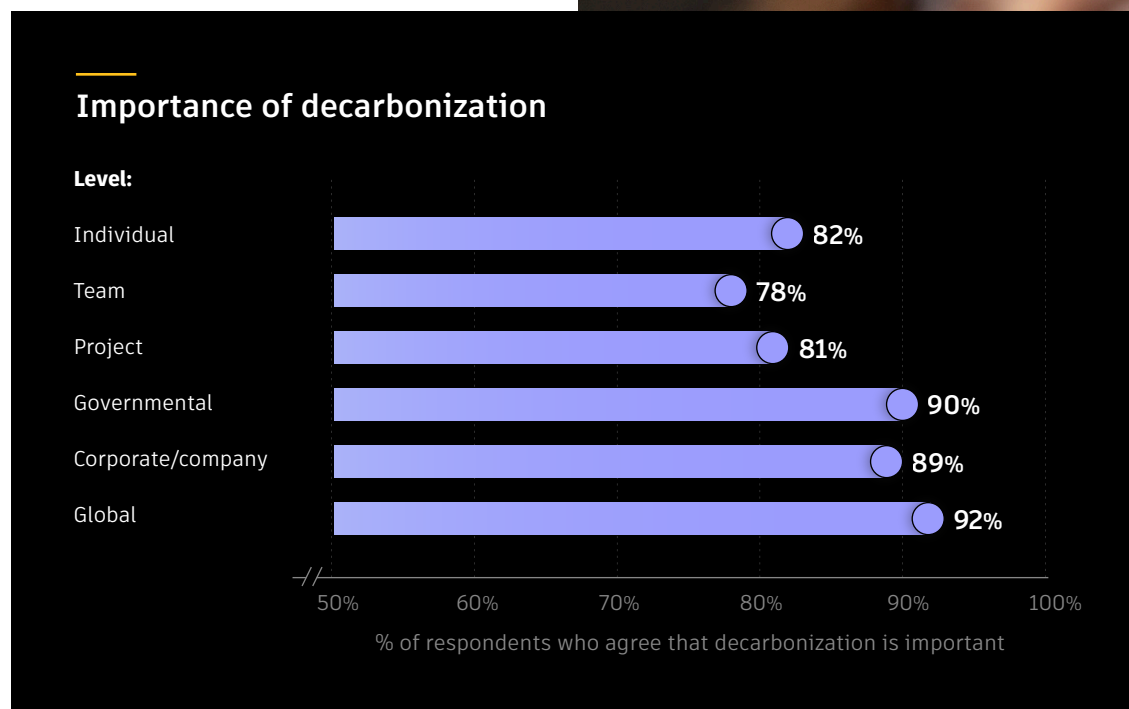
At the crossroads of mindset and maturity

There is a clear connection between the level of importance an organization places on decarbonization (mindset) and the amount of action the company takes as a result (maturity). The greater the level of importance business leaders place on decarbonization, the greater the level of action at their organizations.

On the whole, unfortunately, maturity trails mindset for many companies—with significantly fewer respondents reporting specific actions to address sustainability than those saying that sustainability is important to their company.

The importance of decarbonization is undisputed.

Among stakeholders in the AEC and D&M industries, there is near-universal agreement that decarbonization is important. Historically, decarbonization has been perceived as the domain of government regulation. But new research shows that business leaders see an important role for their companies, with 90% and 89% of respondents saying decarbonization is important at a government and corporate level, respectively.

Importance of decarbonization

Level:

Individual	82%
Team	78%
Project	81%
Governmental	90%
Corporate/company	89%
Global	92%

50% 60% 70% 80% 90% 100%

% of respondents who agree that decarbonization is important

"**If we can improve energy efficiency, we can see returns immediately**. Our data center consumes a lot of energy, and if we can improve our energy efficiency by even 1%, we'll save a lot of electricity. **This is good both for our customers and our planet**."

—Kunyueh Lin, General Manager, Building Automation Solution Business Unit, Delta Electronics

ROUNDTABLE

How important is decarbonization for your industry, your company, your team, and you personally?

"**For the company, it's critical.** That's the main outcome that we want and what we want to be experts in. **For me personally, it's very important to feel that I'm working to push the world in a good direction**. I think it's a fantastic driver for motivation."

—Alexander Stålhandske, Architect, Sweco

"**For the business, it is a very important driver right now, especially for attracting and retaining talent**. More and more people feel really passionate about making carbon a major focus of their work—rather than an engineering focus with a decarbonization add-on."

—Katharina Gerstmann, Global Lead for Technical Excellence and Innovation, WSP

"**We're getting more demand for sustainability from building owners, especially public building or project owners**. It's very important for them, and we see increasingly that this is something we have to deliver on."

—Frode Tørresdal, Sustainability Manager, Norconsult Digital

"**Decarbonization is critical to our ability to provide our clients with informed and responsible guidance**. Our leadership team is realizing that this is in line with what our people want and also fulfills our commitment to help our clients make the best-informed decisions."

—Mike Carragher, PE, VHB Chair and CEO; ACEC (American Council of Engineering Companies) Research Institute Board Chair

"In the private sector, the demand for CO2 emission calculations is increasing rapidly, and we believe that major developers and general contractors will accelerate their response, without waiting for detailed rules to be made. **The actual construction of decarbonized buildings is still in its infancy, but the groundwork is being laid. The tide of decarbonized design is about to turn**."

—Yoichi Hosoya, Executive Officer & Deputy Divisional Manager of Timber and Building Materials Division, Sumitomo Forestry Co., Ltd.

In this report, **"sustainability leader"** is defined as a company that is a member of one or more decarbonization associations such as **Business for Social Responsibility (BSR)**, **Green Climate Initiative (GCI)**, or **Carbon Disclosure Project (CDP)**. While association membership does not necessarily require companies to take action on sustainability, our data shows a broad correlation between association membership and a range of sustainability actions. It is these actions that make these companies leaders in this area.

Companies identified as sustainability leaders actively incentivize employees to act more sustainably.

The gap in attitude, action, and outcomes between sustainability leaders and other companies is significant. For instance, 77% of sustainability leaders offer incentives to employees who participate in sustainability initiatives, compared to just 30% of other companies. Asked to identify the most common incentives, business leaders most often cited financial incentives such as bonuses, paid days off, and profit sharing. Others mentioned programs that offer perks such as vouchers and meals or provide incentives such as public recognition and accelerated promotions.

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Employee sentiment regarding sustainability initiatives is higher at leading sustainability companies.

Sustainability leaders also significantly outpace others in the number of respondents who say that sustainability is important for business growth, that their company is making good progress toward sustainability goals, and that their company is "leading the way" when it comes to sustainability.

To the extent that membership in a sustainability association is indicative of the mindset within a company, this data appears to show a strong connection between mindset and progress on sustainability initiatives. At organizations identified as sustainability leaders, employees not only feel better about their companies' efforts, but these organizations are also taking clear steps to embrace and leverage digital tools to assist with decarbonization. This connection between sustainability and talent also came up in Autodesk's *2023 State of Design & Make* report, which found that employees are an influential force in driving sustainability initiatives at 72% of companies. This seems to suggest that employees both help create, and respond positively to, sustainability-focused company cultures.

However, actions have yet to catch up with expressed commitment.

Nearly nine in 10 business leaders in this survey say sustainability is important on the company level, and in the *2023 State of Design & Make* report, eight in 10 said sustainability is a good long-term business decision. And yet, the number of respondents who report that their companies are taking significant action to address the issue is much lower.

Around two-thirds of respondents say their company strives to reduce the carbon emissions of each project and that they are actively reducing carbon emissions on the projects that they work on. There is a similar discrepancy in action on the individual level—58% say their managers actively support the use of decarbonization solutions in their work, and slightly fewer say they are personally "very familiar" with how to reduce carbon emissions on the projects they work on.

Sustainability initiatives

● Sustainability leader ● Other companies

My company's sustainability initiatives are key to its business growth strategy for the next three years — 41% / 87%

My company provides incentives or rewards for employees who actively participant in sustainability initiatives — 30% / 77%

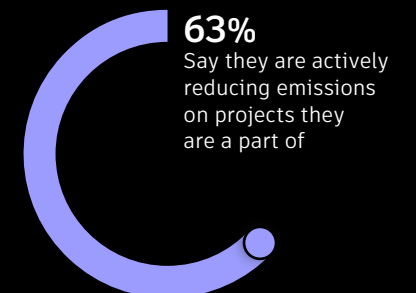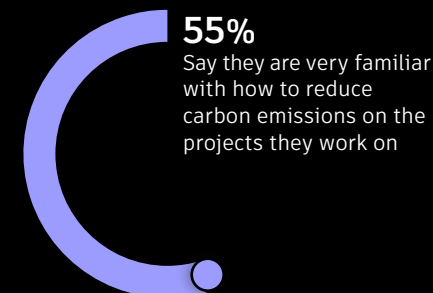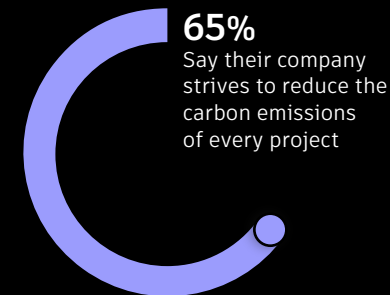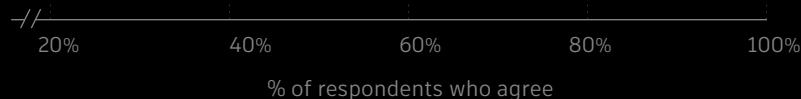My company is making good progress toward achieving our sustainability goals — 47% / 87%

My company is leading the way in the industry when it comes to sustainability — 30% / 73%

I am proud of my company's sustainability initiatives — 49% / 89%

% of respondents who agree

(x-axis: 20% 40% 60% 80% 100%)

65% Say their company strives to reduce the carbon emissions of every project

58% Say their manager actively supports the use of decarbonization tools and solutions in their work

55% Say they are very familiar with how to reduce carbon emissions on the projects they work on

63% Say they are actively reducing emissions on projects they are a part of

Top obstacles to implementation

To bridge the gap between mindset and action requires accessible paths forward. According to respondents, two of the most significant hurdles to decarbonization are a lack of available digital tools and a lack of awareness about how to address sustainability on projects. Most organizations have not implemented structured processes for seeking out and evaluating these tools.

Business leaders believe the overall availability and awareness of decarbonization tools are low, which creates a significant obstacle to sustainability initiatives.

The lack of availability of digital decarbonization/sustainability tools is a topic with widespread agreement. Among business leaders at leading sustainability companies, 72% agree that the availability of decarbonization/sustainability digital tools is low, with 69% of respondents from other companies saying the same.

More than half (56%) of all respondents say that a general lack of awareness regarding how to effectively address sustainability on projects is the most significant obstacle to decarbonization in their company.

"**It's all about reporting**. To set sustainability goals and monitor them, and, above all, to improve your sustainability performance, you need to have data. You need to know—and record—how much energy you're using and where, how many flight hours and car hours go into operations. And if that can be done digitally, then you can report and achieve your goals more quickly."

—Thomas Blindenbacher, Deputy Chief Executive Officer, Amstein & Walthert AG

ROUNDTABLE

How can companies keep up with the rapidly evolving landscape of technology?

"We have to be extremely agile and challenge even our own role. As architects, we have to reimagine the types of expertise we can provide. **We have to keep up on the latest developments in sustainability and how we can do things better with tools and the latest in science**."

—Alexander Stålhandske, Architect, Sweco

"**Companies should create a committee—a core group of employees who will research and come back with ideas about how to reduce resource use in construction**. You'll need someone to look at the construction side of things or maybe just the energy side of things. But you need that committee, and you need to reward and incentivize them to keep coming back with ideas."

—Kareem Farah, Chief Executive Officer, Engineering Contracting Company LLC

"**You have to keep your finger on the pulse of the times; otherwise, you'll be left behind**. But the trick is to not just take the latest thing, but instead to ask what people actually need and be able to make the business case."

—Thomas Blindenbacher, Deputy Chief Executive Officer, Amstein & Walthert AG

47% say their company has a structured **process for <u>discovering</u> new tools** that address sustainability challenges

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49% say their company has a structured **process for <u>evaluating</u> new tools** that address sustainability challenges

Less than half of organizations have a process in place to discover and evaluate new digital tools.

Along with low awareness of available decarbonization tools, many companies do not have established processes for discovering such tools. For companies that do have such a process, the most common approaches for finding new tools include external research (such as studies), industry sources (such

as trade shows and consultants), and in-house research by company sustainability teams.

A similarly low number of respondents say their companies have a structured process in place for evaluating these tools. Asked to identify these evaluation processes, business leaders at companies with such systems cite on-the-job user assessments, external research, and designated in-house teams that test out prospective new tools.

"Digital tools that enable users to measure and manage the carbon impacts of the products they design—and evaluate trade-offs across competing criteria like cost or compliance—are a critical step in decarbonizing the industry. Their effectiveness to enable change depends on the accuracy of results and how well they can be integrated into existing development workflows. **Given the market and regulatory trends, companies that prioritize finding, evaluating, and using such systems now will quickly outpace their competition**."

—Neil D'Souza, Founder and CEO, Makersite

Matt Taylor, Design Automation Lead, WSP, New Zealand

Q: What decarbonization tools does your firm use in its work?

A: WSP has created and implemented a tool called Carb0nise, which automates carbon estimation in [Autodesk] Revit. If you create a new wall, it actually adds the carbon for that as you create it, and so you can make those decisions that impact carbon early on. We have a goal to reduce the carbon output of our advice and designs by 50% by 2030. It's a pretty lofty goal, and it's imperative that we use dedicated tools, because we can't determine our carbon savings if we're not benchmarking using data to record our progress.

Q: What capabilities would make the tool even more effective?

A: We're not measuring the whole of life operational data at the moment, which is the next stage. That would be worthwhile, especially for mechanical, electrical, and plumbing systems.

Q: What would you say to someone who thinks that decarbonization tools are not accessible?

A: I would say that there are actually many simple ways to reduce carbon, mainly exploring the impacts of substitutions—for example, replacing regular concrete with reduced-carbon concrete. Sometimes, it's just being a bit more versatile about what products you're using.

Q: What challenges are holding decarbonization tools back?

A: The hardest thing is probably the data set for environmental product declarations, EPDs. That really comes down to availability. In the UK, you've got a database that gives you carbon data for the concretes, the steels, the timbers, the copper. It takes quite a bit of time to accrue all the EPDs in a specific market. But even in less mature markets, you can try to reduce the volumes of materials that you're using, which will reduce embedded carbon.

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Digital decarbonization tools in action

Despite most respondents saying that the availability of digital decarbonization tools is low, many companies are charging ahead. Around half of companies reported using tools to address their sustainability goals, with AEC and D&M business leaders identifying industry-specific actions.

**Roughly half of companies are using digital tools to become more sustainable.**

Even though most respondents say that the availability of decarbonization tools is low, just about half say their companies are using digital tools to improve energy efficiency, reduce waste, conduct lifecycle assessments, and address sustainability challenges on every project.

Looking at these findings alongside other survey data, an interesting picture emerges: Almost all respondents say that decarbonization is important, and most say that the availability of tools to address the issue is low. But the actual number of

respondents using digital solutions to address sustainability is somewhere in between.

An analysis of data from Autodesk Forma—Autodesk's industry cloud for AEC, which includes tools that analyze resource and energy consumption—offers another interesting window into how companies are using sustainability tools. For instance, Forma features a microclimate analysis tool that empowers users to design more comfortable, sustainable outdoor spaces based on climate data and environmental conditions such as sun and wind. In the first five months after Forma was launched in May 2023, utilization of this feature increased by 22% on a per-user basis.
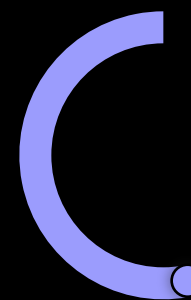
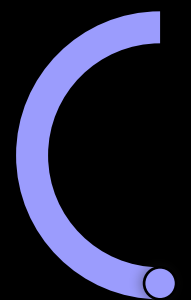## Digital decarbonization tools: Investment and usage
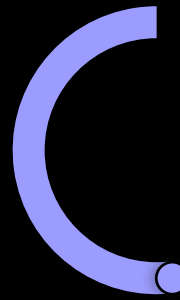
52%
Say their company uses digital tools to improve the energy efficiency of every project
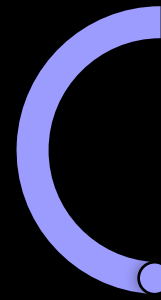
49%
Say their company uses digital tools to conduct lifecycle assessments on every project
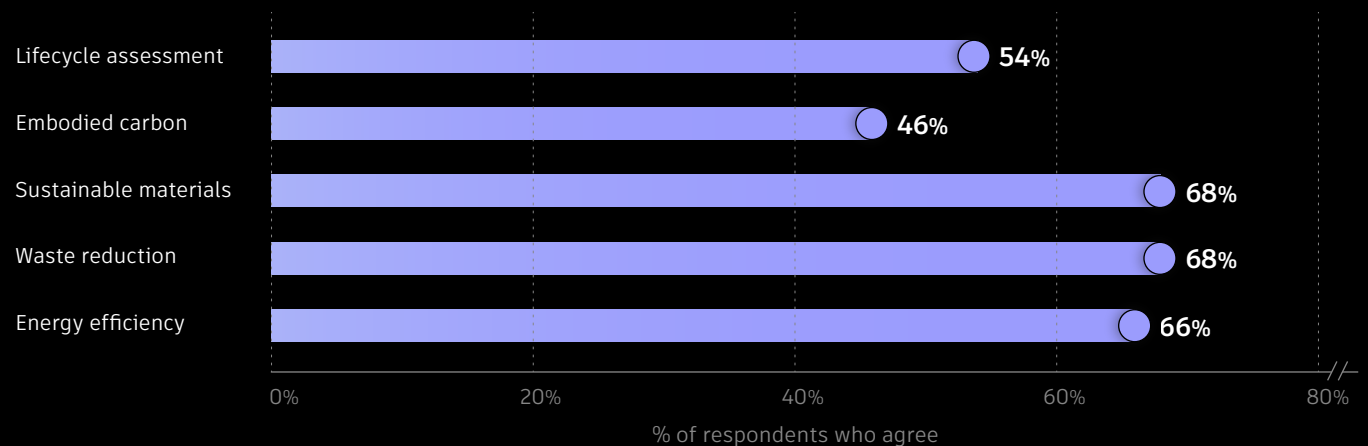
53%
Say their company is seeking out new digital tools to address sustainable challenges on projects

50%
Say their company is investing in new digital tools to address sustainability challenges on projects

I am familiar with digital tools that address:

Lifecycle assessment	54%
Embodied carbon	46%
Sustainable materials	68%
Waste reduction	68%
Energy efficiency	66%

% of respondents who agree

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Autodesk Technology Center in San Francisco

What are the barriers for organizations using decarbonization tools?

"**The main barrier to using these tools is there is often no data flow between them**. Everyone has their own Excel spreadsheet or application, and those tools don't talk with each other. The solution is to have a common data environment—one source where all the data is located—and all the tools would integrate into that database. In the future, we will see more and more of that."

—Frode Tørresdal, Sustainability Manager, Norconsult Digital

"Embodied carbon calculation methods, databases, and other standards are being discussed in working groups and conferences led by the Ministry of Land, Infrastructure, Transport and Tourism, MLIT, and we are in the process of solidifying the framework for the future. **There is an overwhelming lack of EPDs applicable to the Japanese market, and we urgently need to develop that**."

—Yoichi Hosoya, Executive Officer & Deputy Divisional Manager of Timber and Building Materials Division, Sumitomo Forestry Co., Ltd.

"Building a tool is only 10 to 20% of the job; 80% is how you implement it, how you convince people to use it. **The biggest obstacles for that are cost of implementation, integration challenges, and resource constraints**. People are often so busy, they say: 'I don't want extra tools. I want to keep using what I'm using today.'"

—Abed Aarabi, Technical Project Manager, Artelia Group

"This is an industry that has a history of incremental change, usually in response to codes and criteria. **Existing decarbonization tools don't necessarily fit naturally into companies' current workflows.** They're not yet required by clients, they're not required by codes, so as a company that is driven by a desire to deliver sustainable solutions to our clients and communities, we need to provide insights and opportunities for our firm leaders to be ahead of the regulations and help clients recognize the importance of decarbonization."

—Mike Carragher, PE, VHB Chair and CEO; ACEC (American Council of Engineering Companies) Research Institute Board Chair

Business leaders are beginning to quantify the effectiveness of digital decarbonization tools.

Only half of business leaders say their company has a clear process in place to evaluate whether the digital tools they adopt to address sustainability are successful.

In interviews, business leaders say that the effectiveness of digital decarbonization tools often depends on the data that is currently available;

several say that their companies are collecting this data in an effort to create benchmarks they can compare future projects against. For example, one AEC organization is tracking its waste and resource data and monitoring that information via digital dashboards to determine whether its sustainability-focused practices are having the desired impact.

Although business leaders note that some sustainability measures, such as solar panels, provide cost

savings and energy reductions that can be measured and predicted with a fair amount of precision, several interviewees also state that the lack of environmental product declarations (EPDs) in some world markets make it difficult to track the carbon impact of project and product decisions with digital tools. Also, one source notes, it is impossible for digital tools to measure the "soft" benefits, such as social equity, that are an important part of many organizations' sustainability goals.
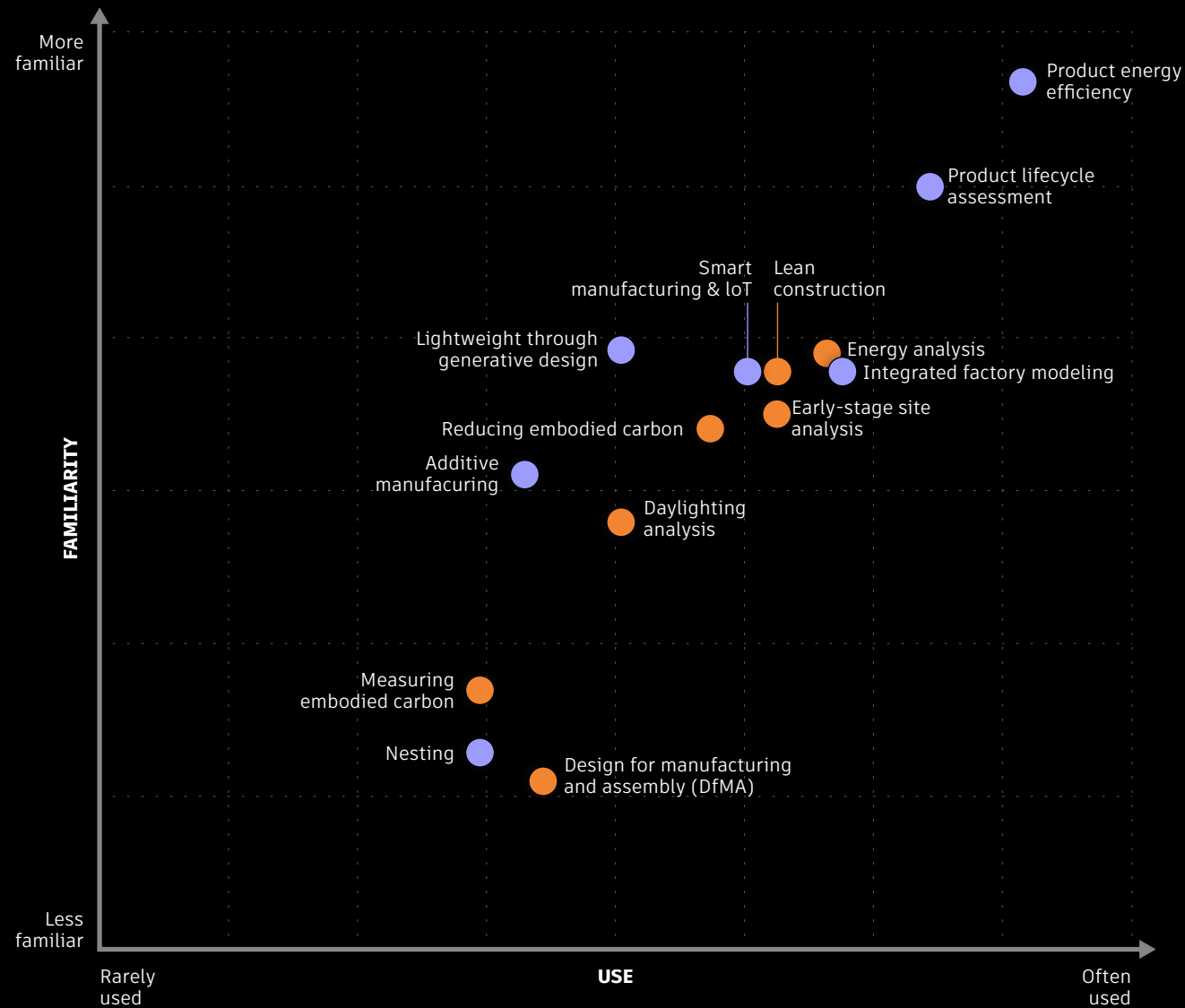
"**You need to have that use case that is scalable, where people can leverage resources and data around repeatable opportunities**. Encouraging our partners in academia and small business to share data allows us to learn from and explore the possibility of printing with more sustainable and recycled materials. Seeing waste not as garbage, but instead as a resource, is going to continue to be a focus for many groups. I think we'll see some real upsides in the next year to 10 years that will help recruit others into the conversation."

—Samantha Snabes, Co-founder, re:3D Inc.

Sustainability strategies

● D&M sustainability leaders　　● AEC sustainability leaders

FAMILIARITY (vertical axis: More familiar → Less familiar)

USE (horizontal axis: Rarely used → Often used)

- Product energy efficiency (D&M)
- Product lifecycle assessment (D&M)
- Smart manufacturing & IoT (D&M)
- Lean construction (AEC)
- Energy analysis (AEC)
- Integrated factory modeling (D&M)
- Lightweight through generative design (D&M)
- Early-stage site analysis (AEC)
- Reducing embodied carbon (AEC)
- Additive manufacuring (D&M)
- Daylighting analysis (AEC)
- Measuring embodied carbon (AEC)
- Nesting (D&M)
- Design for manufacturing and assembly (DfMA) (AEC)

Companies in different sectors have different approaches to reducing their carbon footprints.

Roughly half of respondents in both the AEC and D&M industries say their companies are actively using digital tools to drive sustainable outcomes.

For example, AEC respondents are most likely to say their companies use digital tools for energy analysis, early-stage site analysis, and lean construction. In D&M, companies are most often using digital tools to assist with product energy efficiency and product lifecycle assessment.

Unsurprisingly, the data for the most-used approaches closely tracks the number who say they are familiar with the tools—once again suggesting that awareness and action are closely linked.

An analysis of user data from Autodesk's AEC industry cloud, Forma, provides another window into how companies in the industry are using sustainability tools to drive decision-making. Users of Forma's energy analysis tool make an average of around six changes per session to their designs, users of the wind analysis tool make an average of nearly five changes, and users of the noise analysis tool average around four changes. Given that these users are making changes in response to analyses provided by the tools, the data suggest that when users have access to digital sustainability tools, they use these solutions to try to achieve project outcomes.

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What is the most effective strategy to convince companies to adopt more decarbonization initiatives?

"You start from the aspect of saving the planet. If that doesn't work, then you have to go down to the money aspect, which works with most people. Then, you also have the aspect of reputation. **Your reputation is worth billions.** And for us, if we spend to boost our reputation in the market, that will bring more business."

—Kareem Farah, Chief Executive Officer, Engineering Contracting Company LLC

"Decarbonization is a bit of an abstract concept for clients. We show clients with numbers—an efficient heating system or double insulation might be a bit more expensive now, but if you look at what you save in 10 to 15 years, it's obvious that you have to invest. **There are two types of clients: the ones who can think with a long-term view and the ones who can't**."

—Aurelien Leriche, Managing Partner, OUYOUT

"**Try to show that it has an added value that maybe they haven't seen or thought about before.** Sustainability doesn't always have to be more expensive for them. Sometimes, it's just changing your mindset or how you do things. I think you can find that in every type of project, if you're willing to see it. And it doesn't have to be huge steps. It's about getting your foot in the door."

—Alexander Stålhandske, Architect, Sweco

Conclusion

It is clear that business leaders in the AEC and D&M industries highly value decarbonization. However, much more needs to be done when it comes to driving sustainable outcomes across these industries, especially as organizations look to incorporate digital solutions to achieve these objectives; awareness of available digital tools is low, and many businesses still do not have clearly established protocols for discovering and evaluating decarbonization tools.

Decarbonization is a collective journey, requiring collaboration among organizations, governments, and individuals to scale effective solutions. Given the findings of this new research, companies should keep the following things in mind as they seek to optimize their sustainability programs:

The journey to decarbonization is much more than a single decision about a particular project, building material, or digital solution. It involves transforming the very industries that shape the world for generations to come. With the right mindset and toolset, organizations in the AEC and D&M industries are uniquely positioned to shape this journey—and to design and make a better world for all.

1

Employees are a driving force behind sustainability initiatives. Establishing incentives and cultivating a culture that values sustainability can significantly accelerate a company's decarbonization efforts.

2

There is a clear, demonstrated connection between the awareness of decarbonization tools and their implementation. Increased education, training, and information-sharing about available tools and methods is vital. While many business leaders cite a lack of availability as a challenge to implementing digital decarbonization tools, large numbers also say their companies are using such tools. This suggests that organizations can overcome this obstacle by making intentional efforts to seek out and adopt digital decarbonization solutions.

3

One common challenge is the absence of consistent processes to evaluate new decarbonization tools. As companies adopt new technologies, they need a structured mechanism to assess the efficacy and fit of these tools. The establishment of robust evaluation processes will ensure that new solutions align with organizational goals and deliver tangible results.

4

The use of digital tools in decarbonization efforts is showing promise. When companies leverage technology, they can more effectively measure, assess, and implement sustainable solutions.

5

Beyond environmental and ethical concerns, there is a compelling business case for sustainability. Long-term financial savings, reputational benefits, and market differentiation are strong motivators for companies to intensify their decarbonization endeavors.

ABOUT THE RESEARCH

The *State of Design & Make* report is a global, annual study for leaders who design and make places, objects, and experiences. It identifies the most pressing drivers of change that are shaping today's business decisions to help leaders prioritize and invest in the future.

For the *State of Design & Make Special Edition: Spotlight on Decarbonization*, quantitative data was collected from 613 professionals in architecture, engineering, and construction (AEC) (77%); and design and manufacturing (D&M) (23%). In addition, 10 new qualitative interviews of business leaders were conducted.

The quantitative data was collected in July and August 2023, through a 10-minute online survey, including responses from Albania, Argentina, Australia, Bahrain, Belgium, Canada, Chile, China, Denmark, Egypt, Finland, France, Germany, Hong Kong, India, Ireland, Japan, South Africa, Spain, Sweden, Switzerland, United Arab Emirates, United Kingdom, and United States.

In some instances, Autodesk references analysis of its own anonymized data. Software usage data has been analyzed to identify trends toward Forma products. This data has been aggregated and anonymized.

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Autodesk is changing how the world is designed and made. Its technology spans architecture, engineering, construction, product design, manufacturing, and media and entertainment, empowering innovators everywhere to solve challenges big and small. From greener buildings to smarter products to more mesmerizing blockbusters, Autodesk software helps customers design and make a better world for all. For more information, visit autodesk.com or follow @autodesk on social media.

Contact Autodesk at state.of.design.and.make@autodesk.com about this research report or to sign up to participate in future research programs.

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