
Business and the Fourth Wave of Environmentalism

Findings from Environmental Defense Fund's 2019 Fourth Wave Adoption Benchmark Survey

Introduction

Consumers, investors and employees are using their influence to demand solutions to our global climate crisis. From calling for reduced carbon emissions to supporting companies that use sustainable products, they are making it clear that improving the world around us is a top priority — and business leaders are realizing that what's good for the planet can also be good for their bottom line.

Executives may not know it, but they are well poised to deliver on these demands. They are already investing in cutting edge-technologies, such as robotics and data analytics, to drive business growth and maintain their competitive edge. But they are missing an even greater opportunity to leverage these same technologies to lessen their environmental impact.

Data from the Environmental Defense Fund's second annual Fourth Wave of Environmentalism Adoption Benchmark Survey show that while 92% of leaders agree that new and emerging Fourth Wave innovations can boost both economic and environmental results, only 59% are actually investing in new technologies today with that dual goal in mind.

What is the Fourth Wave?



The Fourth Wave of Environmentalism is how we

describe the potential for technological innovation to supercharge and scale companies' sustainability efforts. Our awareness of environmental issues, and our ability to address those issues, has slowly evolved over the last century from land conservation to protecting people and nature through policymaking, and eventually to finding market-based solutions to reduce environmental impact. Today, change comes a lot faster. Fourth Wave technological innovations, including artificial intelligence, automation, blockchain, data analytics and sensors, allow businesses to lower resource consumption, decrease pollution and carbon emissions, and reduce waste — all while also boosting their bottom line.

The urgency and opportunity are stronger than ever before for business leaders to raise the bar for sustainability. Our 2019 report illuminates how top decision-makers across five sectors—retail, manufacturing, energy, technology and finance — can navigate technological

innovation to increase sustainability and the bottom line.

This report reflects what we heard from 600 U.S. senior business leaders — from chief executives to directors, all at companies with \$500 million or greater revenue — about the relationship between business, technology and sustainability in their organizations. Second-year trends show that business leaders are increasingly familiar with emerging technologies, are weaving sustainability goals more deeply into business strategy, and yet aren't fully connecting the dots between how the innovative technologies they use to run their companies can also be their best solutions for more meaningful sustainability.

In short: CEOs are missing a golden opportunity to turn their technology investments into a one-two punch that delivers business results and protects the planet. Read on for how executives can lead their industries in meeting stakeholders' demands by delivering results that boost revenue and sustainability.

There's a 33-point opportunity gap for leaders to accelerate their sustainability initiatives by applying the Fourth Wave innovations they already use.

About the Fourth Wave Adoption Benchmark Survey

Our second annual survey explores how the Fourth Wave is taking hold in businesses across the United States. Using opinion research firm KRC Research, we surveyed 600 U.S. senior business professionals to understand:

What it means to be both a business leader and environmental steward in top companies today.

How companies are leveraging new technologies to expand their sustainability and drive business results.

How companies and industries have progressed in adopting Fourth Wave strategies and innovations.

Where business leaders are feeling the pressure to balance profits and sustainability.

How seniority provides a different view on businesses' application and use of Fourth Wave technologies for sustainability.



KRC Research conducted an anonymous online survey from March 13 to April 12, 2019, with 600 leaders

at the director, vice president/senior vice president and CEO levels in companies with \$500 million to \$5 billion in revenue. Quotas ensured a balanced sample across five industries (retail, manufacturing, energy, technology and finance) and five functional areas (marketing, finance, operations/R&D, strategy/executive and IT). Respondents also had insight into their companies' business, growth and tech strategies, sustainability practices, and approaches to corporate social responsibility, talent acquisition, and diversity and inclusion. New this year, our survey included directors, who are often closer to the implementation of new technologies across the business than executives are. Their responses provide a more robust, up-close understanding of companies' Fourth Wave commitments and investments. Please note, since directors were not included in the 2018 survey, any year over year comparisons are for VPs and C-suite responses only.

About Environmental Defense Fund



Environmental Defense Fund (EDF) is one of the world's largest environmental nonprofit organizations, with more than 2.5 million members and a staff of 700 scientists, economists, policy experts and other professionals working around the world. EDF finds practical and lasting solutions to the world's most serious environmental problems. Working with leading businesses, innovators, scientists and academics, EDF is catalyzing scalable solutions for minimizing the environmental, economic and human health risks associated with rising climate pollution.

Table of Contents

The gap between opportunity and investment	1
Emerging technologies are surging	1
TechCrunch's take: How businesses are riding the Fourth Wave	5
The 33-point opportunity gap	7
Case study: Applying technology to sustainability is a win-win for business and profit	15
Growth ahead	20
Case study: UPS: Using data to boost performance, reduce cost	26
Executives are raising the bar	27
Conclusion	32

The gap between opportunity and investment



1 Uptake surging

Businesses are embracing Fourth Wave technologies more than ever before. About 8 in 10 companies are using at least one of these innovations: data analytics, automation, artificial intelligence, sensors and blockchain. And 9 in 10 say these technologies are relevant for their core business.



2 Competition leads

94% of business leaders agree that investing in emerging technologies is essential to staying competitive.

3 Tech is good for the planet

92% of business leaders agree that emerging technologies can boost both ROI and sustainability.

4 But investment lags

59% of leaders are currently investing in Fourth Wave tech for sustainability. The retail, finance and manufacturing industries are least likely to be using these innovations to solve environmental problems.

5 This creates an opportunity gap



There's a 33-point gap where businesses can accelerate their sustainability initiatives with the innovations they already have at hand.

6 Business and sustainability goals are more at odds

The share of executives who say their business and environmental objectives are at odds has increased 37 points since 2018.

7 Yet leaders feel the heat

7 in 10 C-suite leaders and VPs are feeling pressure from customers and investors to make sustainability a strategic priority, and 8 in 10 feel pressure from regulators.



8 Consumers want accountability



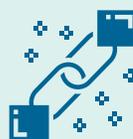
More than 9 in 10 business leaders say consumers will likely hold them accountable for their environmental impact, up 12 points from 2018.

9 Energy, tech sectors finding success



The energy and technology sectors are furthest ahead in applying Fourth Wave innovations to sustainability. Both industries lead the charge in using data, AI, automation and sensors and see strong potential in how they can improve environmental impact.

10 Blockchain, sensors still nascent



These technologies are the least used Fourth Wave innovations, which makes them important areas where leaders can gain a competitive edge — especially if blockchain increases clean energy use or is powered by renewable energy.

11 Growth potential ahead

CEOs are driving the vision for their companies' sustainability, but directors have insight into hurdles on the ground. Senior leaders and directors can combine vision, investment and implementation to deepen their sustainability efforts.



What are Fourth Wave technologies?

New and emerging technologies play an increasingly influential role in raising the bar for corporate sustainability. Fourth Wave technologies are the innovations with the potential to drive both business and environmental goals for a company. For this report, we asked business leaders about the following five technologies:

ARTIFICIAL INTELLIGENCE (AI) Computers learn, adjust and perform human-like tasks to better enable automation and deliver precise data and results.

AUTOMATION TECHNOLOGIES These allow processes to be controlled without human involvement, often increasing efficiency and reducing waste.



BLOCKCHAIN Blockchain uses cryptography to securely record transactions in a public ledger. This makes it valuable for storing and manipulating sensitive data such as financial, medical, identity, voting or chain of custody information.

DATA ANALYTICS Broadly speaking, this involves processing information to gain insights. In practice, it can range from simple statistical analysis to sophisticated data mining and machine learning.

SENSORS These have proliferated in recent years, allowing companies to detect, visualize and measure a wide variety of variables.

What do we mean by Fourth Wave?

The Fourth Wave of environmental innovation refers to a powerful new era of environmentalism that uses cutting-edge technologies to supercharge the work of previous waves. The environmental movement has evolved from land conservation, to policymaking to protect people and nature, to market-based solutions for reducing environmental impact. Now business leaders have technological innovations at hand to accelerate sustainability efforts while also driving revenue growth. This report examines businesses' progress with the Fourth Wave and where they can boost their efforts.

Emerging technologies are surging

Competition and opportunity poise businesses for big impact

Companies across every industry today are using cutting-edge technology to drive business results and stay relevant. Retailers use advanced data analytics to predict online purchasing trends and deliver customers tailored search results. Suppliers harness blockchain to better track products and transactions for improved efficiency. Manufacturers are enhancing mechanical processes with artificial intelligence for safer, more precise output. In every sector, Fourth Wave technologies are becoming more vital to modern business as leaders feel the pressure to stay competitive.

Data from our 2019 survey shows that leaders in all industries are embracing these innovations more deeply as companies strive to gain their edge. While top executives in 2018 told us that Fourth Wave technologies helped them more closely align their business and sustainability goals, this year's data shows that leaders are seeing

“

Time is money,” responded an IT vice president in the retail sector, whose company has invested in cloud data and AI technologies. “When you can get things done with more speed, you can increase both your cash flow and revenue.”

Fourth Wave innovations driving progress and efficiency — and they're feeling the pressure to keep up.

More familiarity, more leverage

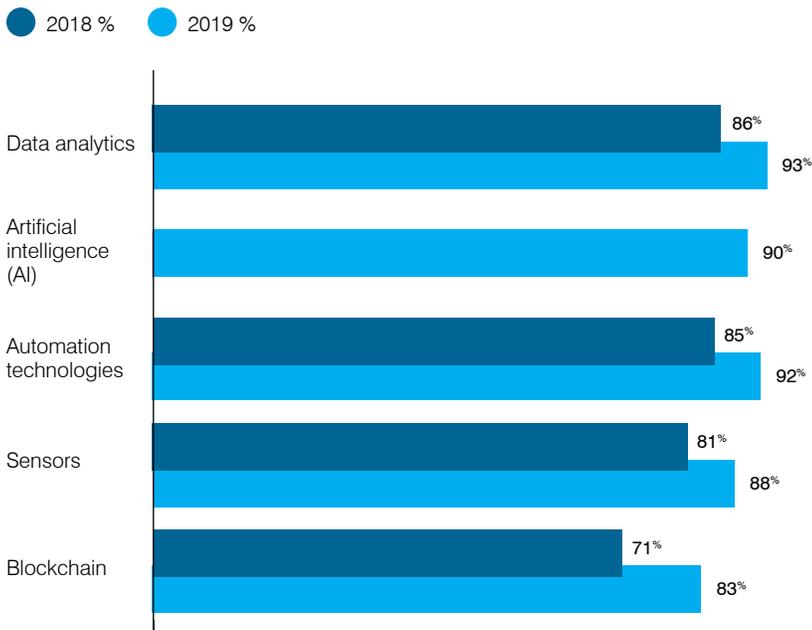
Uptake of Fourth Wave technologies is surging as business leaders become more familiar with these innovations. Among executives surveyed this year, over 90% say their businesses are either in the early adoption phase or have successfully integrated data analytics and automation into their work, compared to 86% and 85%, respectively, last year.

We see robust but slightly slower uptake this year with AI (88%), sensors (85%) and blockchain (79%). Implementation or early adoption has increased across all technologies since 2018. (AI was not included in our 2018 survey, so we could not track its uptake to date.)

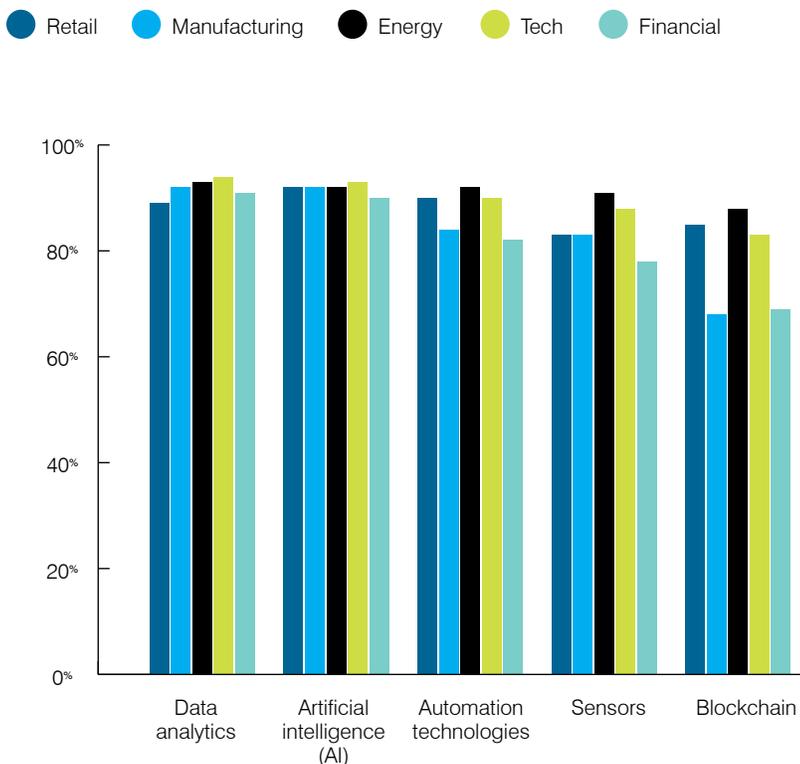
Figure 1

Uptake of Fourth Wave technologies is surging

Growth in companies using Fourth Wave technologies from 2018 to 2019.



Adoption of Fourth Wave technologies by industry.



At an industry level, the energy and tech sectors are most likely to leverage these technologies, perhaps because they are so directly applicable to their businesses. In fact, more than 6 in 10 tech leaders say they have successfully implemented and integrated data analytics into their processes, and half say automation technologies are fully implemented into their business. Among energy leaders, more than half have applied analytics and automation into their work. Across all technologies, retail businesses and financial firms show a slightly slower rate of adoption, but they are definitely engaged. The Fourth Wave appears to be well baked into all sectors today.

Competition is the main reason for this surge. This year, **62% of CEOs and vice presidents agree completely that investing in emerging technologies is essential for staying competitive**, a response up 18 points from last year. When we widen our lens, 94% of leaders are in somewhat or complete agreement with that statement. Competition seems to be the driving force however you slice the data across industry, revenue level or perspective.

Good for business

It's clear **that Fourth Wave technologies are good for business**. At least 9 in 10 leaders surveyed say data, automation, sensors and AI are relevant for their core business, and 88% put blockchain in that category. Data analytics tops the list: 100% of directors say it's relevant for their work, and VPs and the C-suite rank it nearly as high.



Data has a better idea

“

We are investing in data mining with data analytics to try and reduce our carbon footprint during the shipping process of our materials.

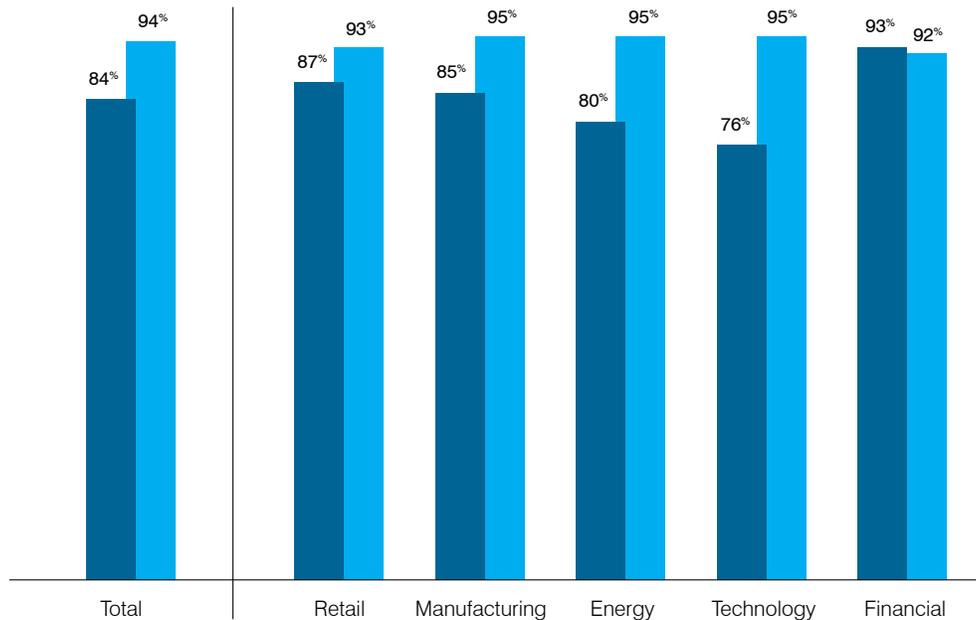
Senior director of IT
in the energy industry

Figure 2

Technology adoption - key to staying competitive

More than ever before, business leaders believe that investing in emerging technologies is essential to staying competitive, with only the financial sector showing a decrease since 2018.

● 2018 %
● 2019 %



Respondents agree that these technologies also can improve their organizations' operations and business strategies.

More than 90% of leaders say each innovation has potential for their company, just slightly higher than what we heard in 2018. Data analytics, AI and automation top the list (99%), followed by sensors (98%) and blockchain (97%). Leaders across all five industries ranked these technologies similarly, indicating that every sector is putting stock in the value of Fourth Wave innovations for their companies.

The forecast for using these technologies indicates **more growth ahead**. Business leaders say the

impact of these innovations, from business and economic development to improved quality of life, are more widely felt now than in 2018. And they anticipate seeing new and emerging innovations even more deeply entrenched in their organizations five years from now. Data analytics will continue to be most relevant across all sectors, with AI, automation and sensors not far behind. Competition, no doubt, will continue to drive leaders forward — yet there's more they can do to stay ahead of the curve.

How businesses are riding the Fourth Wave



The Fourth Wave of environmentalism appears to be surging.



Investments from venture capital and private equity firms into sustainable technologies surged to over \$9 billion last year. And their appetite to invest in new technologies transforming everything from energy generation to energy efficiency and automation to the electrification of mobility remains unabated.

The \$9.2 billion that investment firms committed to new technologies in 2018 was a 127% jump from 2017 and returns the category to highs it had not seen since the height of the cleantech bubble in 2010, according to the clean energy and sustainability tracking and analytics firm Bloomberg New Energy Finance.

Thanks to continuing advances in sensor technology, data processing, materials science, genetics, and the falling costs of existing renewable power technologies, sustainable technologies are indeed poised for a renaissance — and at price points that should make large corporations take notice.

Boon for employees

Indeed, the adoption of renewable technologies improves operational efficiencies within companies and may

even (in some cases) improve productivity among employees. The benefits reflect the broad swath of industries where clean and sustainable technologies can be applied.

For example, the largest investment in 2018 was a \$1.1 billion commitment into View — a company that uses sensors and coatings to create what it calls smart windows. The company's product can improve energy efficiency and, it argues, productivity.

View claims it can increase a building's energy efficiency by 20% while giving employees the benefit of working in natural light, which has been shown to have health benefits.

Improving data centers and operations

While View is focused on conservation and health, other sensor technologies are tackling rising sources of energy consumption — and emissions — through adding efficiencies to data center operations.

Companies like Amazon, Alphabet and Microsoft have established global networks that supply hosted internet services to many of the world's businesses.

These data centers are quickly rising as a source of concern among environmentalists, and they are turning to technology solutions to slow the pace of their energy consumption.

Data centers currently use nearly 200 terawatt hours each year, which equates to about 1% of global energy demand and 0.3% of overall carbon emissions, according to a 2018 article in *Nature*. However, the information and communications technology industry as a whole, including mobile phone networks, personal digital devices and televisions, accounts for 2% of global emissions.

Notably, as of April 2018, Apple was powered entirely by renewable energy and has convinced over 20 of its suppliers to engage in carbon offsets to make more of its own supply chain carbon neutral as well. The other tech companies are also forging ahead. Google is the world's largest buyer of renewable energy to offset emissions, while Apple has also slashed its emissions by 58% since 2011.

Even companies like Facebook and Amazon are getting into the act. Facebook aims to power its operations entirely with renewable energy by 2020, and Amazon says half of its shipments will be carbon neutral by 2030. Amazon already claims to have eliminated 244,000 tons of packaging materials and avoided shipments of 500 million boxes.

These companies are, in many ways, exemplars of how to apply technology to business operations to drive down costs, improve efficiencies and reduce emissions. Conversion to renewable energy — or the use of offsets — is one arrow in the quiver of these companies. But so is a deep knowledge of their operations through visibility they can acquire by deploying automation and sensing technologies to optimize efficiency.

A growing industry of sustainability tech

Emerging technologies from companies like Spark Meter, which is driving down the cost of meters for microgrid energy; AMP Robotics, which is automating factories to improve efficiency; and even new blockchain-based software platforms for new application development, like the Energy Web Foundation, are becoming viable businesses on the back of investments from venture capital firms and large technology companies.

And while the founders and executives of these companies reap the benefits from technology deployments in their organizations, they are investing some of their wealth in startups that could improve their operations even more down the road.

For instance, Jeff Bezos, Bill Gates and Mark Zuckerberg are all backers of Breakthrough Energy Ventures — a venture fund committed to backing

moonshots at the far edges of technological possibility.

These startups touch everything from nuclear fusion technologies (Commonwealth Fusion Systems) to new, low-carbon manufacturing technologies for making steel (Boston Metal) and cement (Carbon Cure).

Shifts toward clean energy

Underpinning all of these advances, and providing support for technology development when profit-seeking investors abandoned the market, have been the big utility and energy companies themselves.

There can be no deep decarbonization without them, and these companies have actually been making progress in meeting the demands of regulators and investors to make the shift to clean energy possible.

Whether through investments in infrastructure to support electric vehicles or software and services to ease the transmission of renewable power across the grid, utilities have provided key support to the startups developing these technologies of tomorrow.

As the Fourth Wave surges, it is this combination of utilities and industry, responding to the demands of consumers, investors and regulators that will implement the technologies that will show an upside for both business and the environment.

The 33-point opportunity gap

Commitments aren't keeping pace with potential impact

While familiarity and uptake of Fourth Wave technologies are strong among the 600 leaders we surveyed, **companies are missing the opportunity to apply the technologies they already use for business to simultaneously address sustainability goals.**

Nearly every CEO and VP we surveyed agrees that emerging technologies have at least some potential to improve their organization's environmental impact, and **92% of all leaders agree that these technologies can help businesses improve their bottom line as well as their sustainability. Yet only 59% of leaders say their business is currently making these investments.** That's a 33-point margin for potential growth.

Among the C-suite and VPs only, that number is just slightly higher than half, and it's down significantly from 76% in 2018.

92% of leaders agree 4W technologies can help improve both their bottom line and sustainability.

Yet only 59% are investing for this purpose.

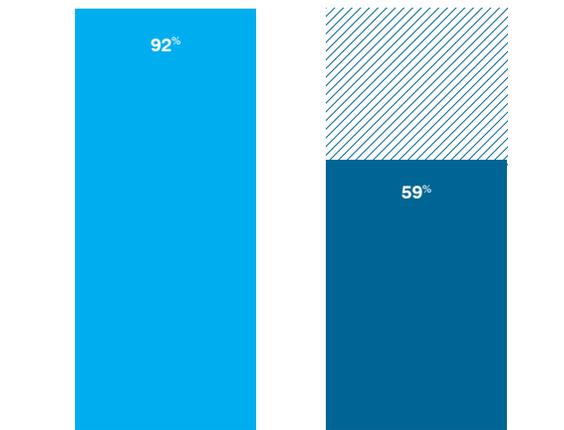
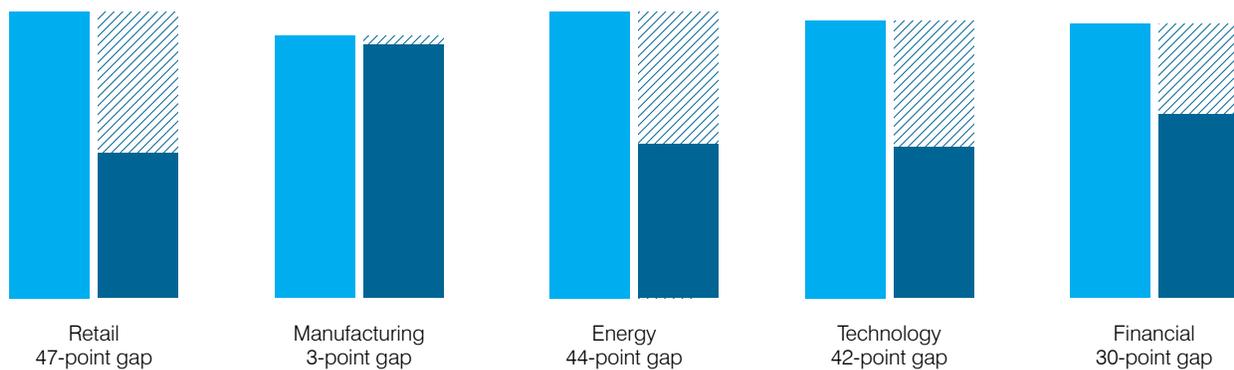


Figure 3

The opportunity gap: commitment vs. investment in technology for sustainability

● Commitment ● Investment ▨ Opportunity gap



Four pillars of business sustainability leadership

Business leaders can map a more resilient future by following EDF's framework:

1. Commit to corporate sustainability.

By publicly committing to science-based sustainability goals, leaders send a strong signal to customers, employees, shareholders and suppliers that sustainability is core to business.

2. Collaborate for scale.

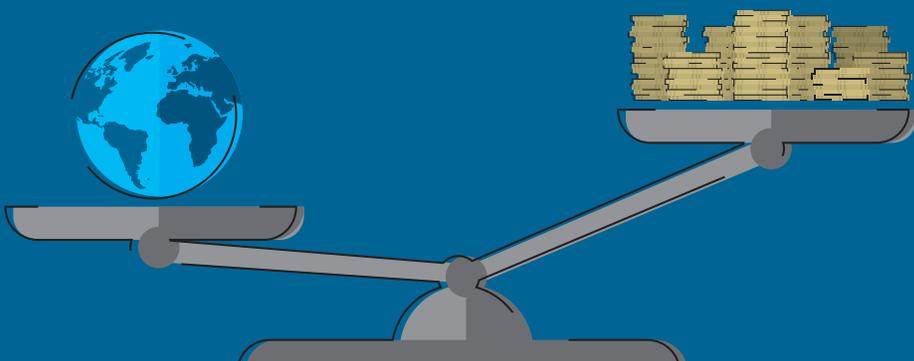
Leaders can leverage their influence beyond their own operations, driving impact at scale by collaborating across industries and global supply chains.

3. Advocate for smart environmental policy.

Corporate actions must extend to supporting environmental safeguards that benefit business, drive innovation and reduce risk.

4. Accelerate environmental innovation.

Better alignment between business and sustainability goals is at leaders' fingertips. Business innovation must also drive environmental progress.



How are executives embracing the pillars of sustainability leadership?

	2019							
	C & VP	Direct	Total	Retail	Manuf.	Energy	Tech	Financial
Setting science-based sustainability goals	88%	75%	86%	91%	80%	92%	93%	75%
Collaborating across your industry for sustainability	94%	79%	91%	91%	88%	96%	90%	90%
Scaling sustainability across your supply chain	92%	79%	90%	93%	88%	95%	89%	85%
Publicly weighing in on environmental policy	70%	66%	69%	52%	75%	66%	82%	71%
Using emerging technology to increase your organization's sustainability	94%	81%	92%	95%	87%	95%	92%	91%

Strong case for investment

Why is this a missed opportunity? For one thing, **the business case for investing in Fourth Wave tech for sustainability is strong**. When a corporation applies planet-friendly, value-added practices to its business, it can boost competitive advantage, gain customer and employee loyalty, demonstrate transparency, and strengthen its bottom line. (See sidebar, “The push for businesses to adapt and adopt.”)

And our data suggests that business leaders are feeling the heat to adapt and move beyond business as they know it.

These rates are higher across the board than in 2018.

Leaders feel the squeeze

And those pressures will continue. More than 9 in 10 leaders (93%) believe consumers are likely to hold businesses accountable for their environmental impact, up 12 points from last year’s response from VPs and the C-suite. Close behind consumers are investors and shareholders (85%), employees (85%) and regulators (84%).

Among the CEOs and VPs we surveyed, 7 in 10 say they feel the push from customers investors to make sustainability a strategic priority for their organization, and 8 in 10 note pressure from regulators.

The push for businesses to adapt and adopt

The days when business leaders could dodge social or political issues are coming to an end. CEO engagement on issues such as health care, sexual harassment, gun control and immigration have been steadily on the rise — in large part in response to stakeholder pressure to act.

On climate change, it’s no longer enough to post sustainability rhetoric on an intranet. Investors, customers, employees and future employees are demanding that executives publicly and visibly walk the walk.

Investor pressures

Shareholders are increasingly recognizing that climate change is bad for business and are pressuring companies to analyze their climate risk or reveal their carbon footprints. [The Wall Street Journal reported](#) that in 2019, the number of climate-related shareholder proposals in U.S. companies jumped to more than 75, up from just 17 proposals in 2013.

[According to Bloomberg](#), “Adding to the pressure is the Climate Action 100+, a group of 320 investors that manage more than \$33 trillion in assets that’s demanding companies adhere to the Paris targets.”

In 2019, thousands of Amazon employees signed a letter to CEO Jeff Bezos and the company's board of directors, asking for broad action to fight climate change.



Customers demand more

[Nielsen studies](#) have shown that more than 80% of customers “feel strongly that companies should help improve the environment. This passion for corporate social responsibility is shared across gender lines and generations. Millennials, Gen Z and Gen X are the most supportive, but their older counterparts aren’t far behind.”

Further, in 2018 Unilever’s Sustainable Living Brands [grew 69% faster](#) than the rest of the business, compared to 46% in 2017. Sales of these more sustainable products delivered 75% of the company’s growth in 2018.

According to Unilever CEO Alan Jope, “Two-thirds of consumers around the world say they choose brands because of their stand on social issues, and over 90% of millennials say they would switch brands for one which champions a cause.”

Employees raise their voices

In 2019, thousands of Amazon employees signed [a letter](#) to CEO Jeff Bezos and the company’s board of directors, asking for broad action to fight climate change. They pointed out that Amazon’s action on climate has not come close to the level of ambition and innovation the world expects and requires of its largest internet retailer and cloud computing company.

As BlackRock CEO Larry Fink wrote in his [annual letter to executives](#), “contentious town halls” where employees speak up about the importance of corporate purpose are becoming a fact of life. “This phenomenon will only grow,” Fink predicted, “as millennials and even younger generations occupy increasingly senior positions in business.”

Future employees have a stake

Nearly [40% of millennials](#), who will represent one in three workers [by 2020](#), have chosen a job because of its approach to corporate sustainability. This young workforce expects employers to have a strong environmental agenda and wants CEOs to take a leadership role.

Tech’s potential for action

With pressure mounting on corporate America to wield its influence to address climate change, more businesses need to get off the sidelines and take charge. One of the most immediate actions companies can take to get started is to use technology to reduce environmental impacts. As companies move from early adoption to successful implementation of tech in their business, they’re missing out on an opportunity to apply it to sustainability.



and in hand with these external motivators, **there's growing awareness internally for businesses to up their game on environmental accountability.** A sizable majority of business leaders (85%) think businesses will adopt new technology to protect the environment on their own, regardless of pressure from other groups. That share has also increased 10 points from 2018.

Figure 4

Who's holding businesses accountable for environmental impact?

● 2018 %
● 2019 %

Consumers

will hold businesses more accountable for their impact on the environment.



Businesses

will adopt new technologies that improve their environmental impact on their own, regardless of pressure from consumers, governments or investors.



Investors and Shareholders

will hold businesses more accountable for their impact on the environment.



Employees

will hold their employers more accountable for their impact on the environment.



Government Regulators

(federal, state and/or local) will hold business more accountable for their impact on the environment.



Hard to see return

So why aren't we seeing companies make deeper investments in the Fourth Wave? One answer may be in proving the Fourth Wave's worth. About 4 in 10 leaders say their companies are hindered in making environmentally positive choices because of a **lack of clear return on these investments.** And 1 in 3 cite **lack of a quick return on their investment.** At nearly half, leaders in energy were more likely to say lack of ROI kept them from investing, while 4 in 10 retail leaders want to see a faster return.

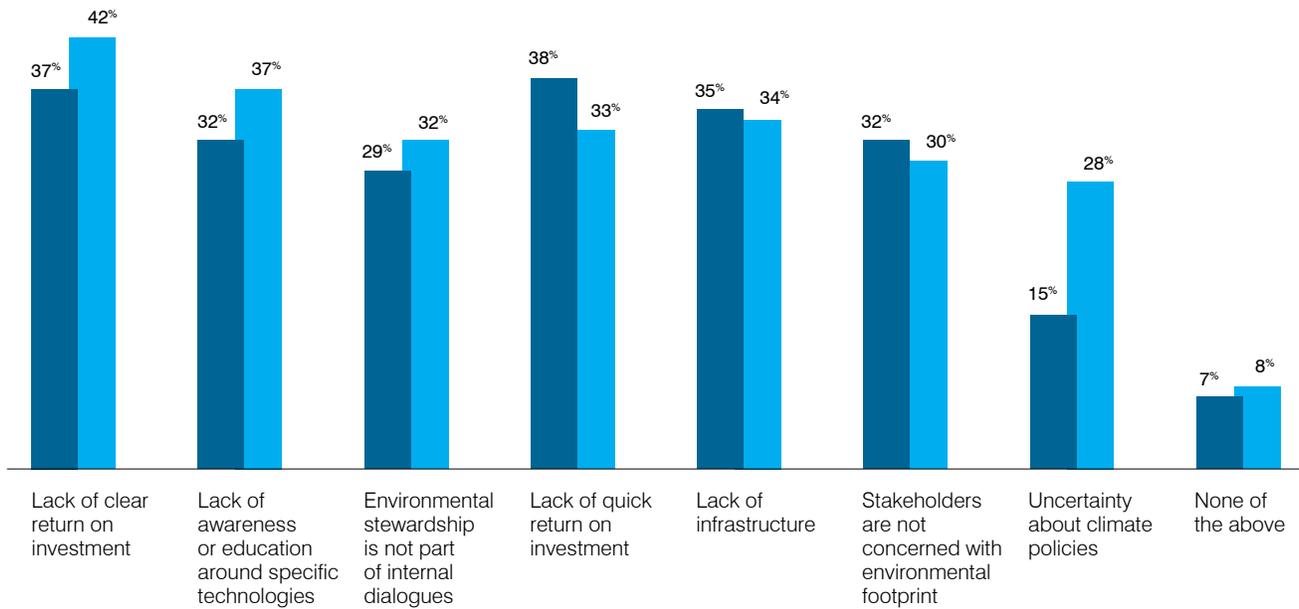
Figure 5

Impediments to progress: clarity on the ROI of sustainability

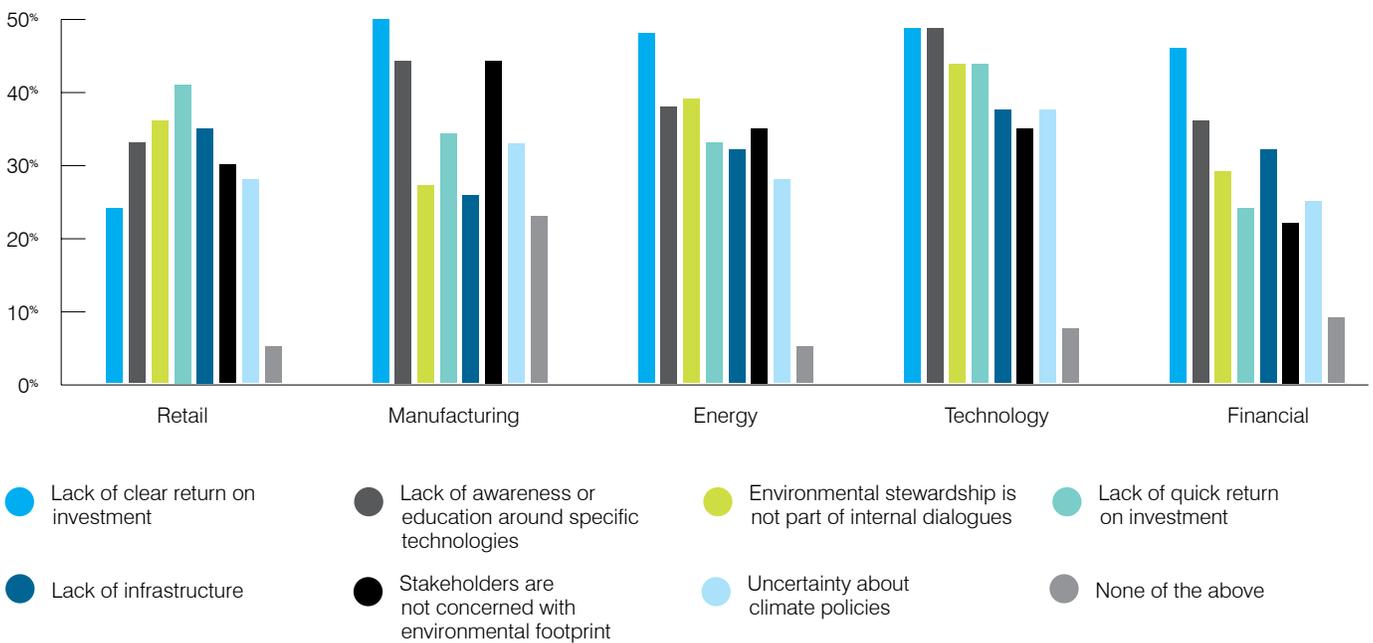
What C-suite and VP business leaders think hinder their organization’s ability to make choices that have a positive impact on the environment.

● 2018 %
● 2019 %

2018 vs. 2019



2019 by industry





Other factors are at play too, from how well companies are primed for such investments to what the current political climate means for business. Internally, companies could use **more education and conversation** about the Fourth Wave's potential.

One in 3 leaders says their organization lacks awareness around specific technologies, and the same amount say their company lacks internal dialogue about environmental stewardship.

Externally, concerns about the **regulatory environment** are growing. More than 25% of leaders say their sustainability-focused commitments are slowed by uncertainty about climate policies, up from 15% last year.



Applying technology to sustainability is a win-win for business and profit



Technology enables measurement

Sensors aren't new, but they have proliferated in recent years, with the global environmental sensors market predicted to be worth more than [\\$3 billion annually by 2027](#). These sensors are making it easier and more affordable for companies to detect, visualize and manage a wide array of environmental impacts.

For example: Methane, the primary component of natural gas, is a [potent greenhouse gas](#) responsible for 25% of the warming we're experiencing today. The largest source of industrial emissions is the oil and gas industry, which loses \$30 billion worth of methane each year from operations. That's why companies like ExxonMobil and Schlumberger are working with Stanford and Environmental Defense Fund to [uncover best in class](#) mobile methane monitoring technologies that can help the oil and gas industry find and manage emissions in a faster, more efficient way.



My company uses machine learning to study and maintain water quality; machine learning is making it possible to follow marine litter in real-time, enabling responses that are quick, targeted, and more effective.

Vice president of operations in the energy industry



Technology improves efficiency

Google is using AI and machine learning to consume less energy, cut energy bills, and reduce emissions. Its [DeepMind](#) team has been able to use AI to [reduce the amount of energy](#) for cooling in their data centers by up to 40 percent. The company is also using machine-learning algorithms to harness the power of wind energy by predicting wind output 36 hours in advance and delivering optimal hourly delivery commitments to the power grid. Google reports that “machine learning has boosted the value of our wind energy by roughly 20 percent, compared to the baseline scenario of no time-based commitments to the grid.”

Research from PwC estimates that using [AI for environmental applications](#) in agriculture, water, energy, and transportation could contribute up to \$5.2 trillion to the global economy, 38.2 million net new jobs, and reduce greenhouse gas emissions by 4% in 2030 — an equivalent to the 2030 annual emissions of Australia, Canada and Japan combined.

Technology minimizes risk

The climate risk analysis industry is also on the rise. Jupiter Intelligence, for example, [recently raised \\$23 million](#) to expand its business into new areas like wildfire risk assessment for companies and cities.

Forward-thinking companies like AT&T are also using supercomputers to analyze climate change risk and inform business decisions. AT&T has collaborated with the U.S. Department of Energy’s [Argonne National Laboratory](#) to create climate model datasets that help zero in on extreme weather risks.

The company then uses the data to determine how climate change will affect its business and ensure the safety of its employees, customers, and communities. In addition, AT&T is sharing the climate data with the public — from communities to universities — to help all become more climate resilient.

A shifting balance

Tensions within organizations

may also be holding back investments in tech for environmental ends. About half of CEOs and VPs say that their companies' business objectives and environmental goals are more closely aligned today than five years ago, while the other half say these goals are more at odds with each other. Interestingly, directors are more likely than the C-suite and VPs to see internal alignment, with 80% of directors noting their organizations' goals are more in sync now. Across industries and leadership levels, more than 90% of leaders say the balance is shifting one way or another, indicating this change is far from static.

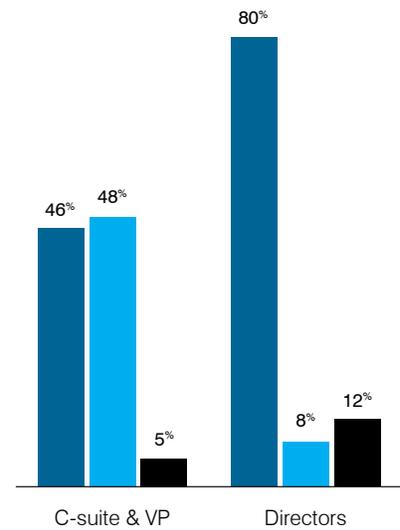
Within industries, leaders in manufacturing see the closest alignment of business and environmental goals, mostly spurred by emerging technologies, customer demands and the drive to stay competitive. Energy leaders say their organizations' goals are more often at odds, fueled by a mix of competition, demands from customers and employees, and advances in technology. That perspective has flip-flopped since 2018, when 72% cited closer alignment of business and environmental goals. Growing pressure from a more stringent regulatory environment seems to be contributing to that shift.

Figure 6

Room for growth: aligning business and environmental goals

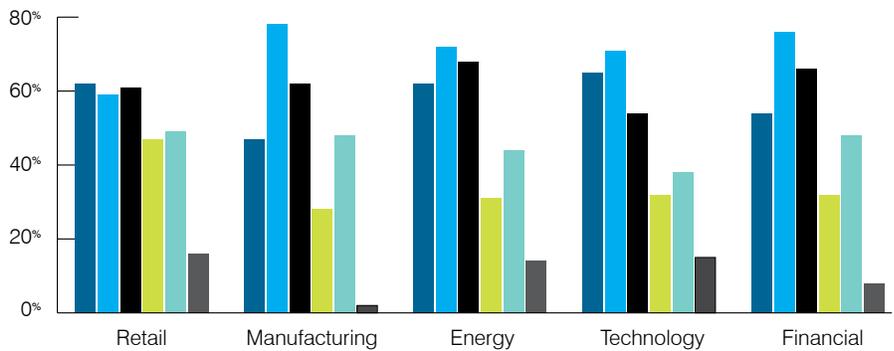
Compared to five years ago, are you finding that your business objectives and environmental goals are:

- More closely aligned
- More often at odds
- No change

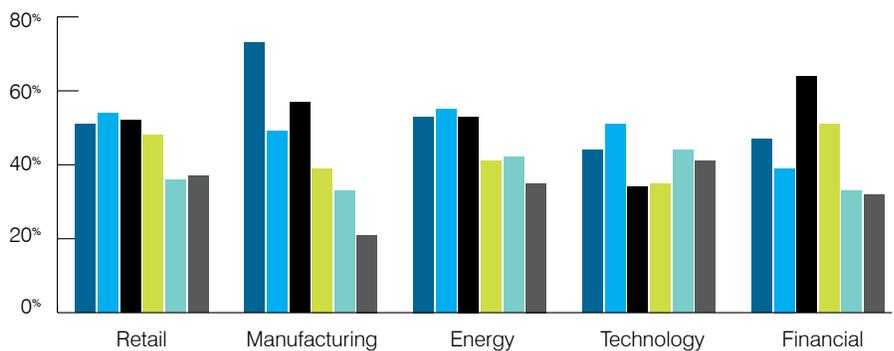


Reasons business objectives and environmental goals are:

More closely aligned



More often at odds



- Increased competition
- Technological advancements
- Customer demands
- Employee demands
- More stringent regulation/policy
- Lack of regulation

B

ut leaders across all sectors agree that there is room for

growth. More than 9 in 10 say their organizations have made at least some commitments to Fourth Wave technologies for sustainability, and nearly all see the potential in data analytics, automation, AI, sensors and blockchain for improving sustainability within their businesses. And more than 8 in 10 say these technologies are at least beginning to take root in their industries for enhancing both business and environmental outcomes.

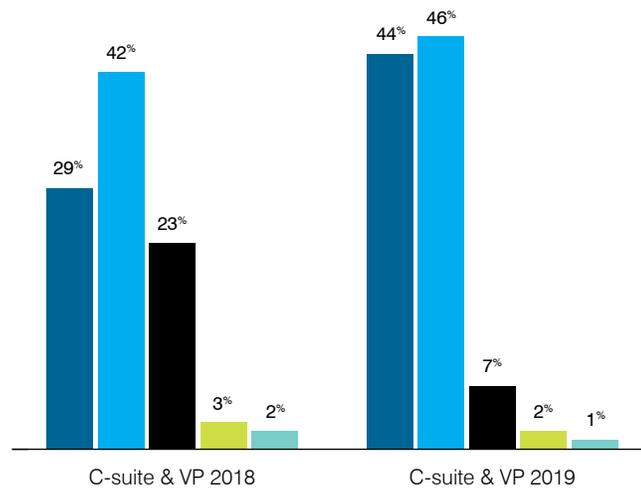
Nonetheless, a large gap remains between how leaders talk about their sustainability commitments and where they actually are investing the resources to get there. They have the technology they need to make it happen. Now it's up to leaders to take bold action to close the opportunity gap and make these commitments count.

Figure 7

Taking root: Fourth Wave technologies for sustainability and the bottom line

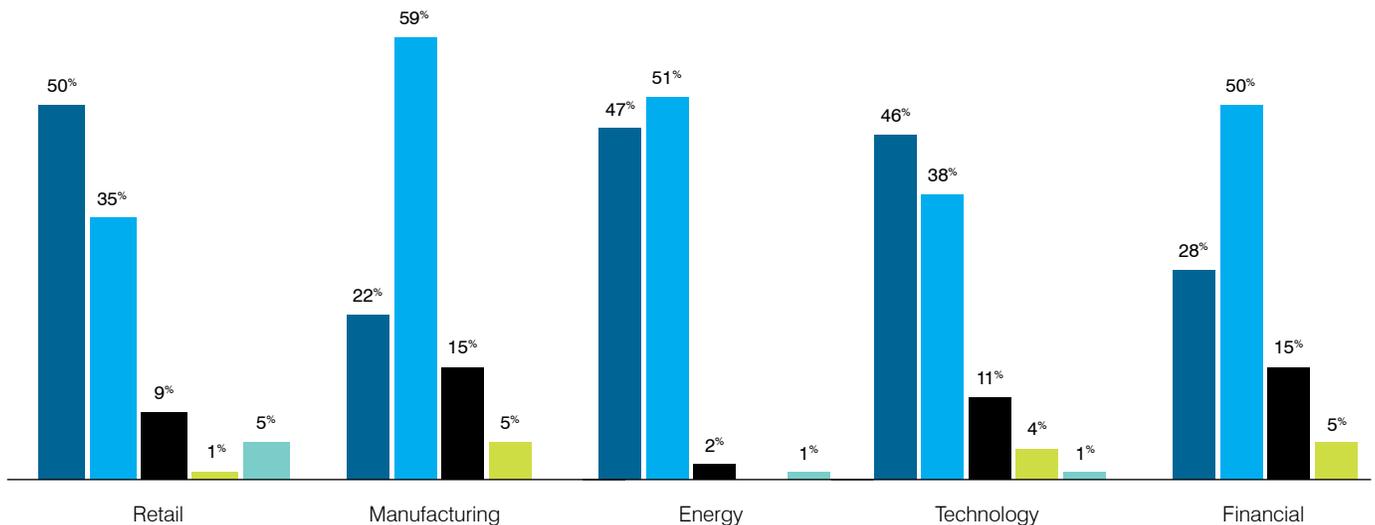
To what extent has implementing emerging technologies that improve both business and environmental outcomes taken root in your industry?

2018 vs. 2019



● To the fullest extent
 ● To some extent
 ● To a limited extent
 ● To a very limited extent
 ● Not at all

By industry





“

We are leveraging investments in sensor and data analytics with a heavy emphasis on reducing pollution from coal-powered generation facilities.

Senior director of IT
in the energy industry

Growth ahead

Where leaders can take action now

As the Fourth Wave takes hold, **corporate leaders recognize that business as usual will no longer keep them at the head of the pack.** To stay competitive and relevant in today's sustainability-driven climate, companies must embrace the innovations that can take their environmental commitments to the next level — while also continuing to find ways to boost their bottom line. The good news is they can use their current investments in emerging technologies to position themselves as leaders as the Fourth Wave of environmentalism takes hold.

Growing pressures from consumers, investors and employees means companies have to innovate now or risk playing catch-up in the future. The technology and energy industries are leading the charge in integrating sustainability with revenue, according to this year's survey results. Other industries should look to these sectors as models for how to make new technologies serve the dual goals of profitability and sustainability.

Figure 8

How the Fourth Wave will shape companies' futures

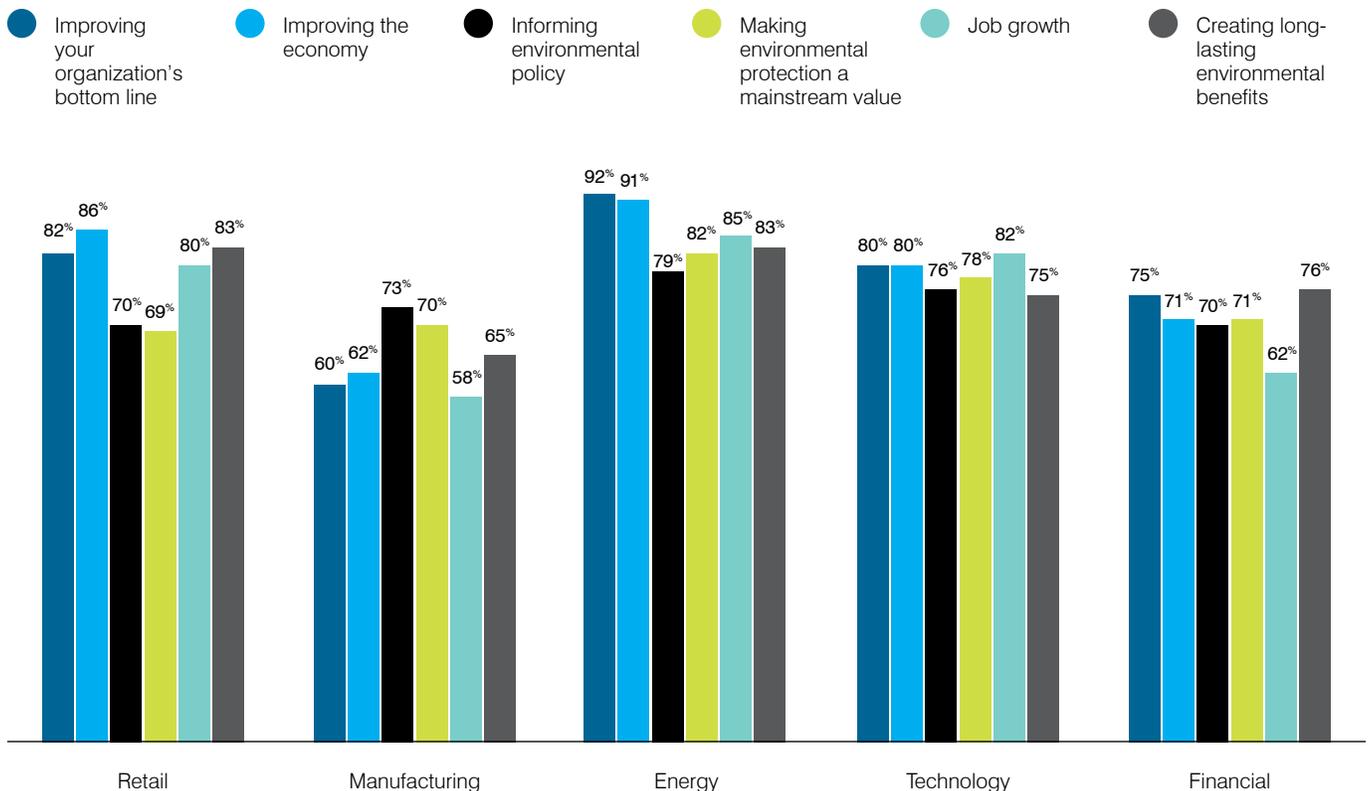
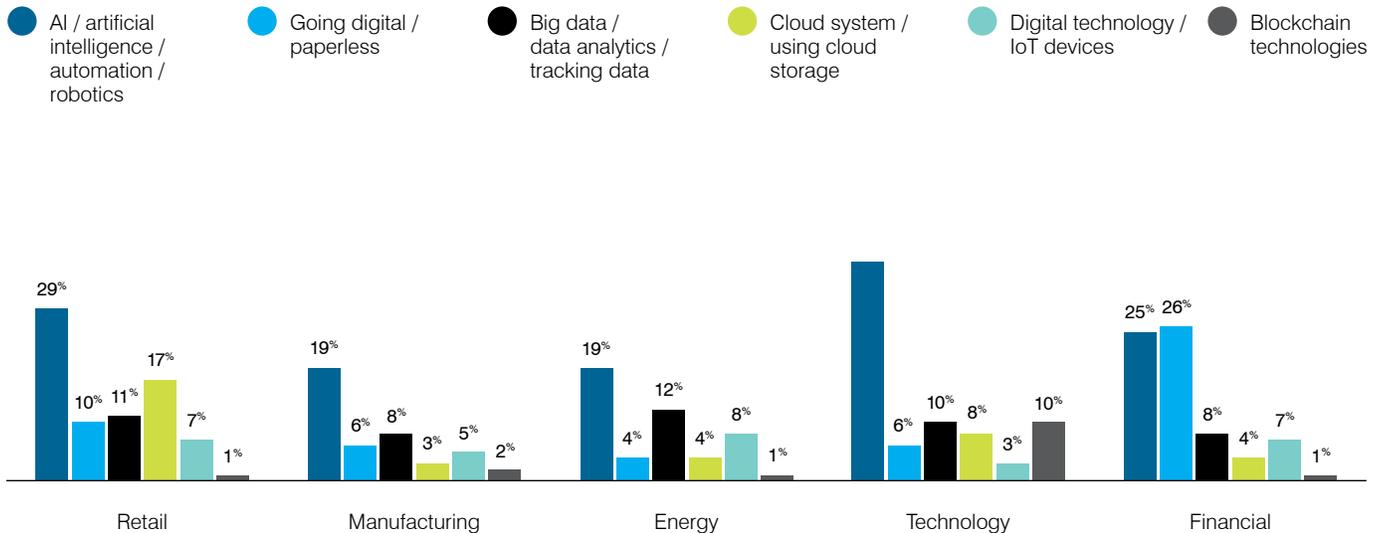


Figure 9

Following the money: AI, automation and robotics lead investment

Of the executives who responded that they were investing in technologies that delivered a win-win for the environment and the bottom line, these were the current types of tech most often noted.



Industry opportunities

Energy rides biggest Fourth Wave

In the energy industry, leaders show the greatest confidence in Fourth Wave technologies for boosting business. Ninety-two percent say that Fourth Wave technologies will improve their revenue, 91% say the same for improving the economy, and 85% say the same for job growth — all more than other industries.

Some of this confidence may come from the fact that the industry is already further along than others in its use of Fourth Wave innovations. Energy leaders are more likely to say policies like cap and trade and technologies like sensors and blockchain are having a significant effect on the way their business impacts the environment, in line with the [exciting potential](#) we see for these innovations in the future.

Tech firms embrace AI

Technology companies, too, are making strides in pro-sustainability innovations, especially leveraging artificial intelligence. Half of tech leaders say they have successfully implemented and integrated AI into their business processes, higher than in other industries. Looked at another way, more than one-third of technology leaders who are investing in innovation to solve environmental problems and improve the bottom line say they are doing so via AI, automation or robotics.

These investments send important signals in the tech industry, where respondents most often completely agree that companies who are making these investments are leaders in the field. CEOs and VPs in other industries could take a page from tech's playbook to establish their own companies as best in class for sustainability.

“

We are currently investing in both artificial intelligence and automation technologies. We want to create a more productive way of manufacturing our products using these technologies to lessen our imprint on the environment.

C-suite IT executive
in the retail industry



Retail has room to grow

Retail leaders see the greatest potential for data analytics to improve both their operations and environmental impact, followed by AI and automation technologies. But they are slower than other industries to leverage these technologies in their business. Retail executives looking to gain a foothold in sustainability can move more swiftly to weave Fourth Wave innovations into their operations.

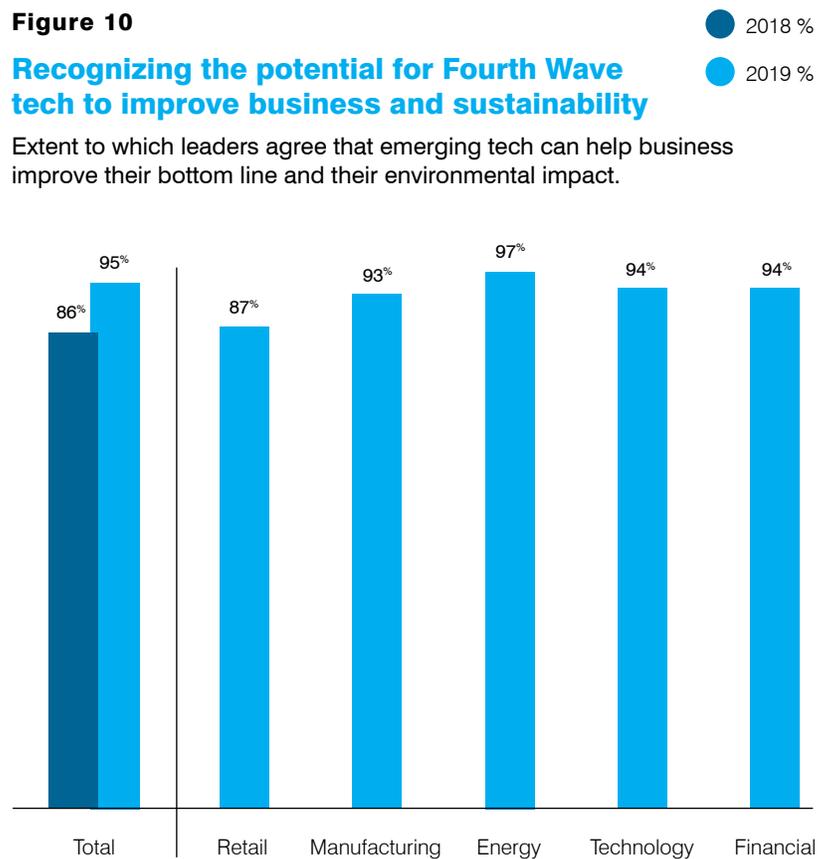
They may need more convincing, however. Compared to other industries, retail is least likely to agree that emerging technologies will lead to solutions that improve both their bottom line and sustainability.

The retail industry sees less likelihood than others that government regulations will hold them accountable for their environmental impact, perhaps explaining why retail leaders are least likely to weigh in on environmental policy (52% compared to 66–82% in other industries).

Figure 10

Recognizing the potential for Fourth Wave tech to improve business and sustainability

Extent to which leaders agree that emerging tech can help business improve their bottom line and their environmental impact.



Manufacturing gaining momentum

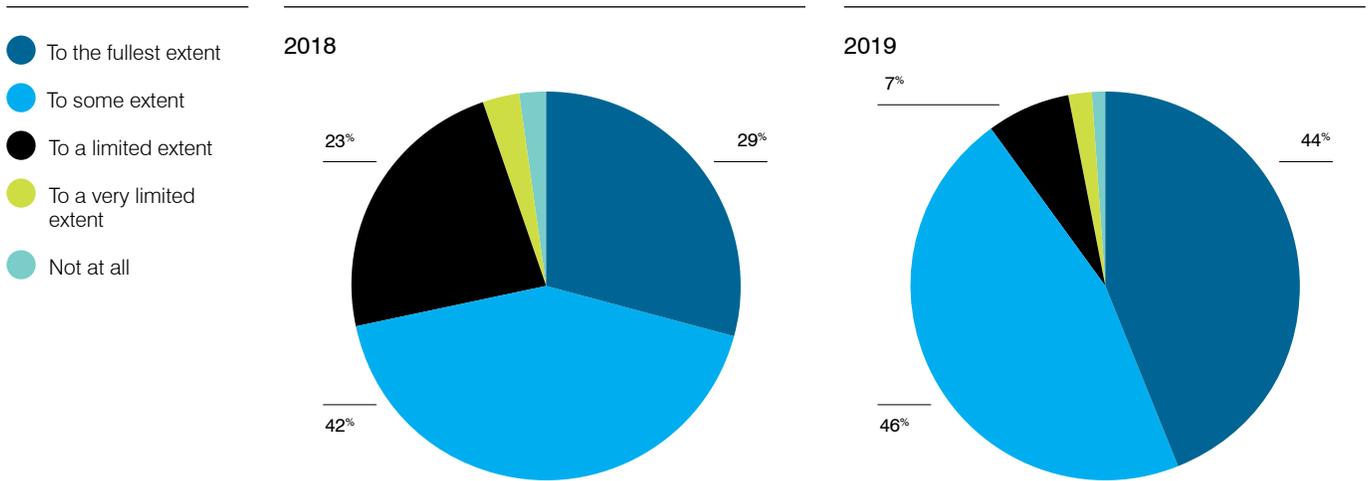
In many ways, manufacturing is embracing the Fourth Wave. It is the most likely of all industries to see emerging technology having a positive impact on protecting the environment, especially around analytics. Eight in 10 manufacturing leaders see the most potential for analytics to improve operations and strategies, and more companies in manufacturing than in any other industry have integrated analytics

into their business (72% compared to 58–65% in other industries).

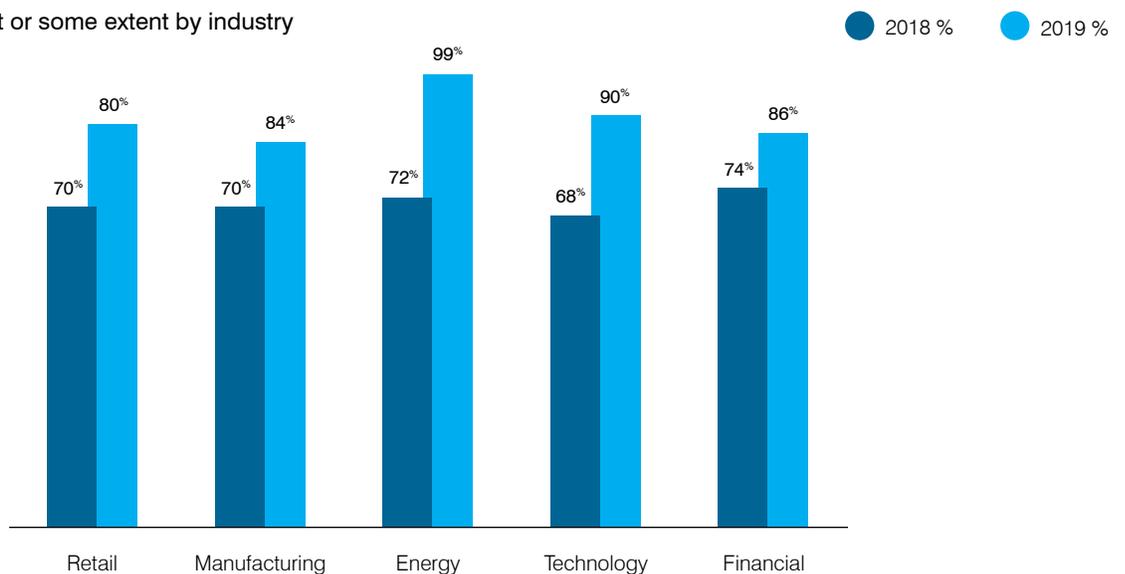
Yet manufacturers are least confident that the Fourth Wave will boost job growth, the economy or their organizations' bottom lines. Perhaps in part because of these attitudes, just 19% of manufacturers — the least of all industries surveyed — say the implementation of emerging technologies to improve both business and sustainability has taken root to the fullest extent.

Figure 11

How emerging technologies for business and sustainability are taking root



Taking root to the fullest or some extent by industry





Finance lags under fewer pressures

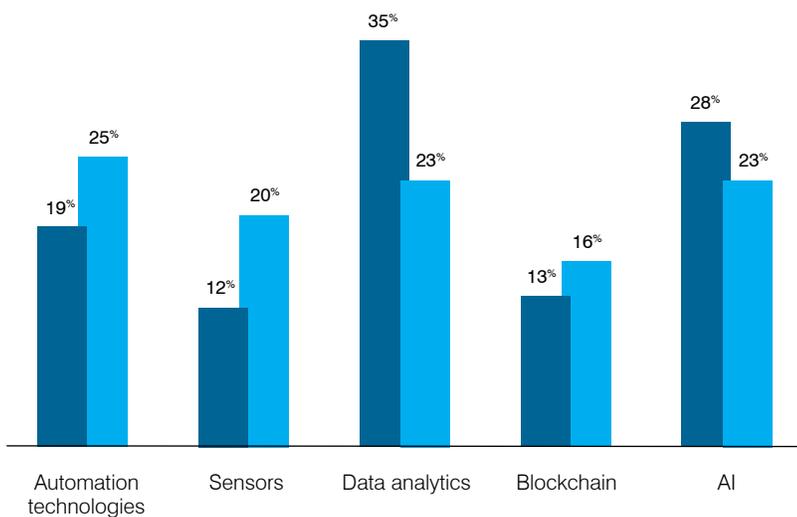
Finance leaders are feeling less pressure from their key stakeholders to adapt, and they have been less likely to set sustainability goals. Finance is the least likely of any industry to say it has successfully implemented key Fourth Wave technologies. More than any other industry, though, financial firms cite brand reputation as an extremely compelling reason to embrace technology that benefits the environment.

Finance firms that are making the effort are focusing a large share of their attention on going digital or paperless (26% compared to 10% or less in other industries). Nearly half of financial leaders see strong potential for data analytics to impact their bottom line in the future, more than leaders in any other industry.

Figure 12

The impact of technology on sustainability will vary by industry

- Biggest impact on bottom line
- Biggest impact on environmental footprint



Technologies for impact

Data, AI and automation top the list

There's no consensus on which technology will have the greatest impact on businesses' environmental footprints, but data analytics, artificial intelligence, automation and sensors rank highest among business leaders. Data analytics is most recognized for its potential impact on the bottom line (35%), with AI (28%) and automation (19%) following.

Leaders say they're applying these technologies to a wide variety of environmental ends, such as monitoring pollution from coal-powered facilities, more cost-effectively using 3D printing in product development, and revealing areas where they can roll back their environmental footprint while also saving money. But these technologies have still more potential that is yet to be tapped.



“

We are investing in blockchain technology which we believe will enable cross-border collaboration and investment in emissions reductions.

C-suite R&D executive in the manufacturing industry

Blockchain still nascent

Blockchain is the least-familiar Fourth Wave technology to survey respondents, who seem skeptical of its application. Less than half of leaders believe it is very relevant to their industry, the lowest of all tech in our survey. And only about 4 in 10 believe it has great potential for either operations and business strategies or their companies' environmental impact. Overall, just 38% of leaders say they have successfully implemented and integrated blockchain into their business. As companies do embrace it, they must be sure that they choose blockchain that is energy-lean or enables renewable energy.

Sensors are seeing growth

Sensors are the second-least utilized technology behind blockchain, according to this year's survey, and so they are another key innovation executives can use to lead the pack. The finance industry appears especially skeptical of how sensors can benefit their environmental impact, while energy and manufacturing leaders more readily point to their potential for sustainability efforts. As such, only about 1 in 4 financial firms surveyed has integrated sensors into their organization, while more than half of energy firms have done so, with manufacturing, tech and retail right behind them.

Bottom line: businesses can step up their commitments

Not enough leaders are embracing the Fourth Wave's potential to deliver on both ROI and sustainability in their companies. With plenty of room for growth as these innovations evolve, executives can drive the charge to ensure they stay ahead of the competition.



UPS: Using data to boost performance, reduce cost

Did you know UPS drivers make an average of 120 delivery stops per day? This makes the number of potential route combinations far greater than the number of nanoseconds the Earth has existed. Every extra minute and mile driven adds cost and environmental impact for the company, as well as the supply chains of its customers. That's why improving route optimization is a top priority for UPS, which worked for more than a decade to develop its On-Road Integrated Optimization and Navigation (ORION) program.

ORION uses package-level detail, customized map data, advanced algorithms and delivery commitment times to determine the most efficient route each day. Today, ORION computes tens of thousands of route optimizations per minute. In 2019, UPS plans to add real-time optimization for changing conditions, such as traffic congestion or service updates. UPS is also using technologies like those made by telematics company Geotab to help track the location of its delivery trucks and identify ways for drivers to make adjustments and improve their performance based on aggregated data.

Since its first full year of use in 2017, the ORION software has saved UPS

100 million miles and avoided 10 million gallons of fuel consumption per year. This has resulted in reducing carbon dioxide emissions by 100,000 metric tons per year, while also realizing an additional \$10 million reduction in operating expenses over the expected \$400 million in savings.



Advancements that drive business performance and enhance customer experience have transformed UPS from a logistics and transportation company to a technology company capable of supporting the most complex supply chains while reducing time, costs, and emissions," says Juan Perez, UPS chief information and engineering officer.

"We're now working on a next generation of ORION, which will help us further improve efficiency and reduce miles driven by optimizing routes dynamically as drivers complete their work."

Executives are raising the bar

Directors can show where the vision stalls

As their companies' chief visionaries, C-suite leaders have the most optimistic view on how the Fourth Wave can fuel environmental commitments and drive business at the same time. They are carving the path to make sustainability a standard practice in their companies and across sectors. But their directors are best positioned to point out roadblocks in their way. As executives take their companies' sustainability to the next level, they should be prepared to navigate the obstacles ahead.

C-suite sees progress ahead

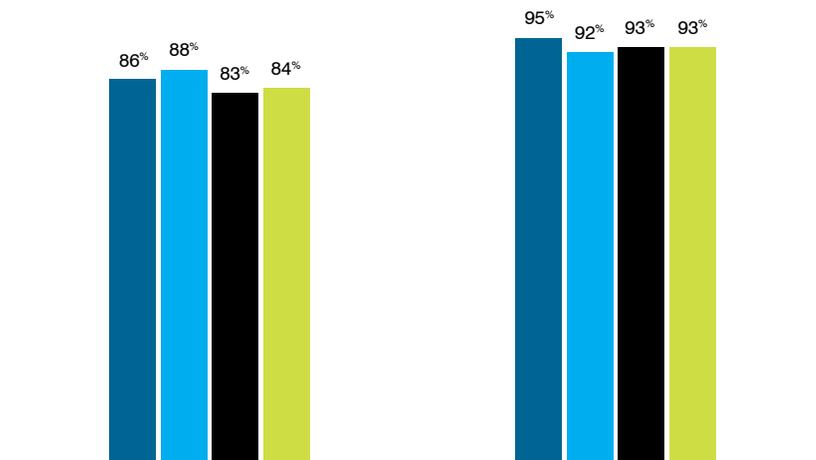
Of the three levels of leadership we surveyed (with directors added as a new segment this year), C-suite executives offer the most positive assessments of their organizations' commitments to the Fourth Wave. More than VPs or directors, CEOs completely agree that:

- Recent and emerging technologies can help business improve their bottom line and their environmental impact (57%, compared to 32% of VPs and 37% of directors).
- Their businesses are constantly trying to find new ways to lessen their environmental impact (52%, compared to 39% of VPs and 25% of directors).
- Their organizations seriously consider the impact that a new technology will have on the environment when deciding whether to implement it (43%, compared to 34% of VPs and 24% of directors).

Figure 13

Business, sustainability and tech: how leadership perception has changed

C-suite & VP change from 2018 to 2019



- Recent and emerging technologies can help businesses improve their bottom line as well as their impact on the environment.
- The ability to measure a business' impact on the environment will mean that businesses change their processes and strategies to lessen their negative impact on the environment.
- Businesses that use technologies to improve their impact on the environment are leading companies within their industry.
- Having environmentally sustainable business practices helps me attract and retain top talent.

“

We're using AI technology to recycle heat within facilities and maximize the efficiency of heating and cooling. We recycle water to cool computer servers, and we also use water condensed on the windows to absorb heat from the sun and recirculate it.

C-suite financial executive in the retail industry



And this widespread optimism carries over to their commitments for sustainability. C-suite leaders are more likely than VPs or directors to say their organizations are significantly committed to using emerging technology to increase sustainability, collaborating across industries for sustainability, scaling sustainability across the supply chain, and publicly weighing in on environmental policies. Looking ahead, they are more confident than other leaders that the Fourth Wave will create long-lasting environmental benefits and make environmental protection a mainstream value.

Directors cautiously optimistic

While the C-suite puts great faith in the Fourth Wave and how it can be good for both business and sustainability, directors have a more tempered perspective. Broadly, just half of directors agree that new technologies driving corporate sustainability will disrupt their industries (51%, compared to 73% of the C-suite and 82% of VPs).

Directors are also less confident in the Fourth Wave's potential for improving the economy (57%, compared to 82% of the C-suite and 86% of VPs) or improving their organization's bottom line (51%, compared to 81% of the C-suite and 85% of VPs).

These disparities may point to directors' on-the-ground view of their companies' sustainability initiatives — insight that the C-suite would be wise to embrace.

Figure 14

How perceptions differ by executive level

2019 C-suite and VPs (left) versus Directors (right)

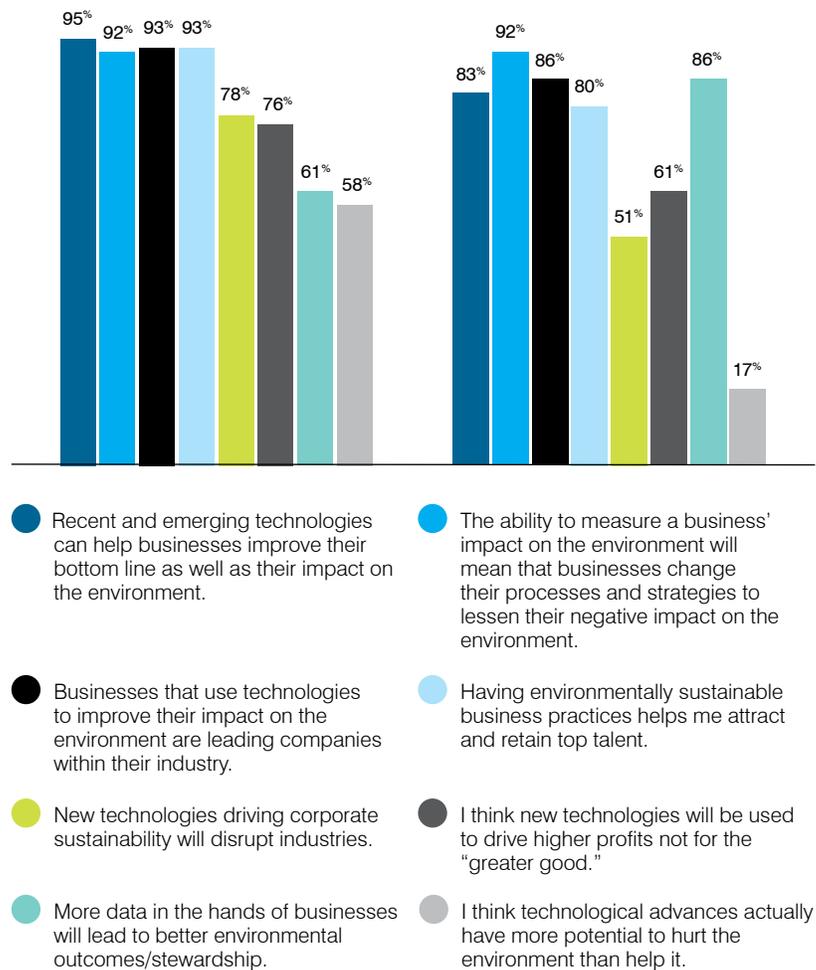
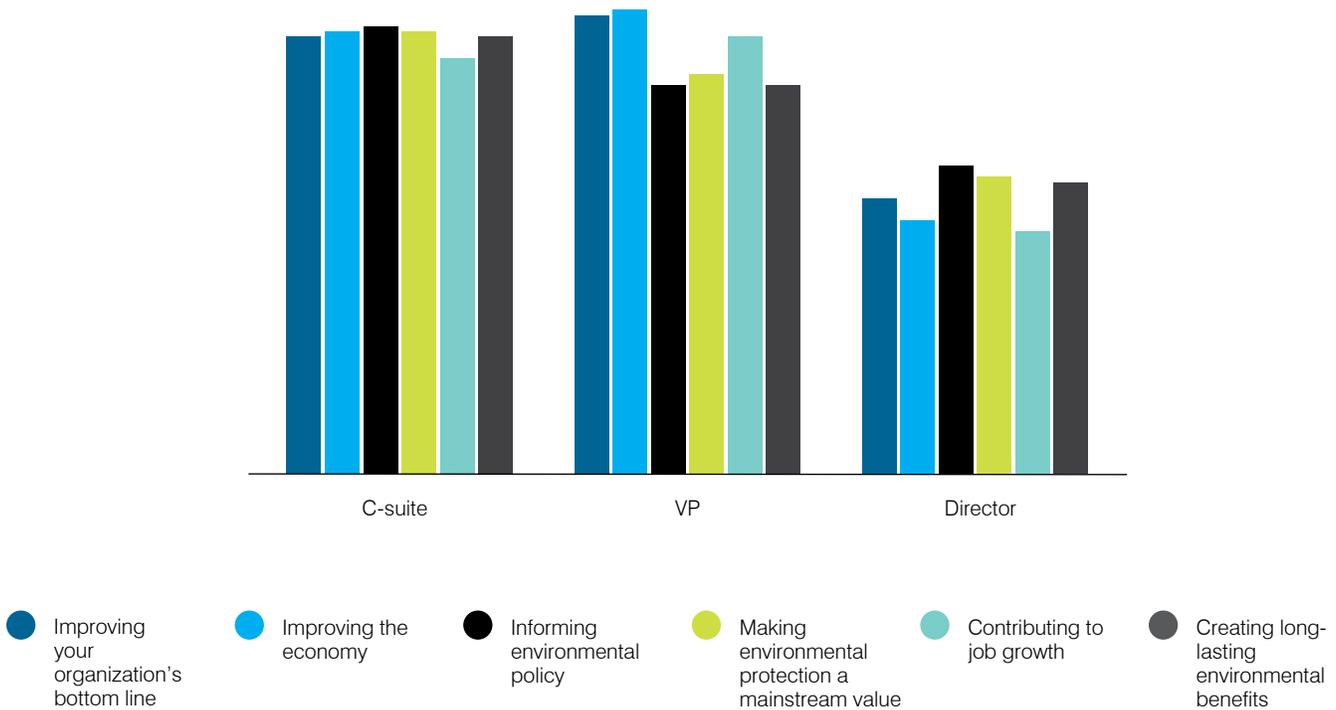


Figure 15

Varying confidence: how leaders view the Fourth Wave's impact



Collaboration is key

Though directors' views are still optimistic overall, their somewhat lower expectations for the Fourth Wave may indicate a disconnect that senior leaders must understand and solve. While top executives are setting the vision and making investments for improving sustainability, their sustainability directors, supply-chain leaders, logistics officers and others are leading implementation. At that level, they are likely in the best position to see the obstacles in the way.

The C-suite has an opportunity to tighten the way their company leverages new innovations for sustainability, hand in hand with the people who will lead the roll out. When vision, investment and implementation combine seamlessly, the impact will be a boon for business goals and the planet.



“

We use quite a few robotic machines in our production unit which gives us extreme precision, saves time, increases efficiency and saves the environment by limiting waste.

Senior director of operations
in the manufacturing industry

Conclusion

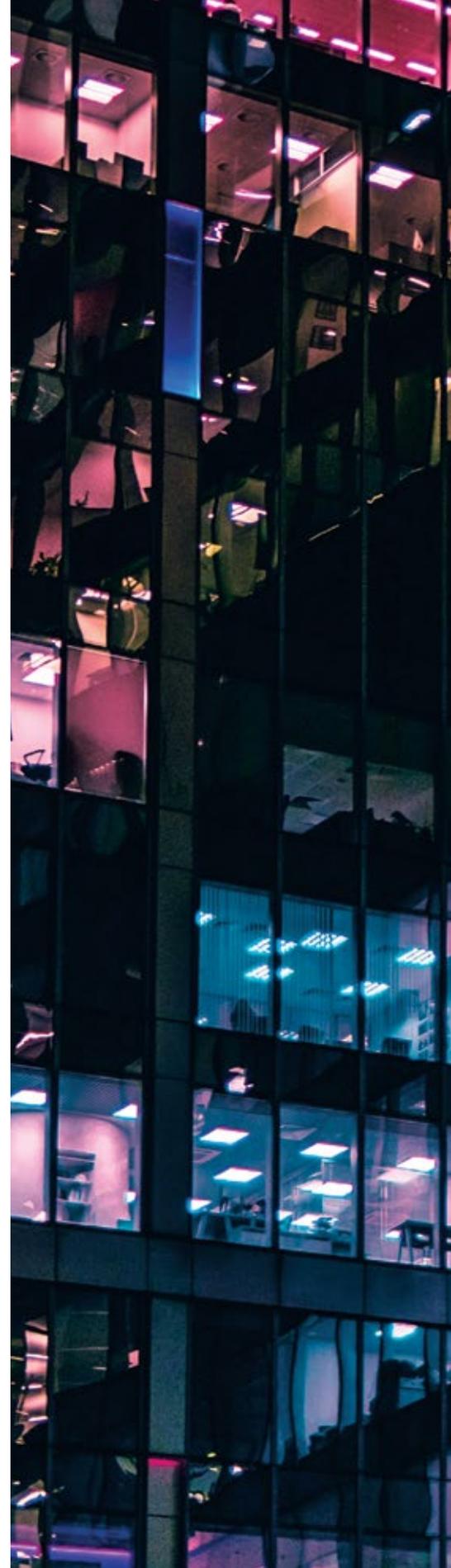
As the climate crisis collides with our fast-paced, technology-driven world, business leaders have more responsibility than ever before to shape the future of our planet.

With growing pressures from consumers, investors and employees, corporate leaders understand that they must shoulder the responsibility to prosper with purpose.

But business leaders also have more opportunity to do just that: as they put artificial intelligence, data, robotics and other emerging innovations into practice to beat their competitors, they can also put those technologies to work to accelerate the transition to a clean-energy economy.

This year's Fourth Wave of Environmentalism Adoption Benchmark Survey shows that leaders are well-positioned to close the 33-point opportunity gap we've identified, by pointing the technologies that are already becoming core to their business toward their sustainability efforts too. They have a greater understanding than ever before of how Fourth Wave innovations can deliver on their goals, and they have the will and urgency to get it done.

Whether companies are in early adoption or have successfully woven cutting-edge technology into their corporate fabric, their long-term leadership and competitive edge depend on innovation that drives a win-win for business and the planet.





Sustainability resources for business leaders:

[Business.edf.org](https://www.business.edf.org)

[Supplychain.edf.org](https://www.supplychain.edf.org)

[edf.org/Leadership](https://www.edf.org/Leadership)

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