Executive Summary

Climate technologies – a diverse range of innovative technologies that includes renewables, batteries, low-carbon hydrogen, carbon capture and alternative fuels – are crucial to formulating an effective response to the climate and ecological crisis. Three-quarters of the executives we surveyed say their organizations will not achieve their sustainability goals without climate tech. On average, executives expect climate tech to help their organizations achieve 37% of their decarbonization or net zero goals.

However, cost is a major barrier. Close to eight in ten (77%) executives say that climate tech adoption will push up product costs. Existing green premiums[1] for climate tech adoption – i.e., the difference in cost between low-carbon products and their high-emitting alternatives – are often significant. For example, the cost of low-carbon cement produced using carbon capture is estimated to be 75–140% higher than conventional cement;[2] steel produced using low-carbon hydrogen is estimated to cost 20–30% more than steel produced using conventional methods;[3] sustainable aviation fuel is estimated to cost 123% more than jet fuel.[4] In contrast, our research suggests that, on average, organizations would only be willing to accept an increase in cost (or green premium) of around 9%. There is, therefore, a long way to go to make these proposals commercially viable. Working in worrying opposition to this target, the rate of increase in corporate investment in climate tech remains uninspiring, predicted to be just 7.7% over the next two years.

Digital technologies such as AI and digital twins will be vital to reducing development costs, increasing efficiencies, and speeding up innovation processes. Nearly eight in ten (78%) executives say that data and digital technologies will play an important role in accelerating climate tech adoption. Executives view AI as the most promising technology for accelerating climate tech adoption, cited by 77%, followed by digital twins (56%). Further, 71% of organizations have already realized cost advantages from using digital technologies to scale climate tech.

Executive Summary

Our research also shows that, despite the challenges, there are pockets of rapid progress in climate tech adoption. These include technologies where green premiums have fallen significantly, such as solar photovoltaic (PV) and electric vehicles (EVs), as well as technologies where green premiums are still high, such as carbon capture for cement, green hydrogen for steel, and SAF for aviation. Executives in these industries expect adoption of the technology within the industry to spread rapidly: within three years for EVs in the automotive industry, within four years for solar PV in the energy and utilities sector; within three years for SAF in the aviation industry; and within two years for carbon capture in the cement industry. Increased government support; private financing from venture capital firms (VCs) and financial institutions; as well as corporate action such as long-term offtake agreements for climate tech, facilitated by platforms such as the First Movers Coalition, can bring down costs more rapidly than previously anticipated and help scale adoption.

For example, tax credits offered under the US Inflation Reduction Act (IRA) are expected to bring down climate tech costs by 40% on average.[5]

Executive Summary

To scale climate adoption at speed, we recommend the following actions and enablers for corporate organizations.

ACTIONS

I. **New business models.** Implementing offtake agreements to improve the financial viability of greenfield climate tech deployments and utilizing as-a-service business models to reduce the cost and complexity of brownfield deployments.

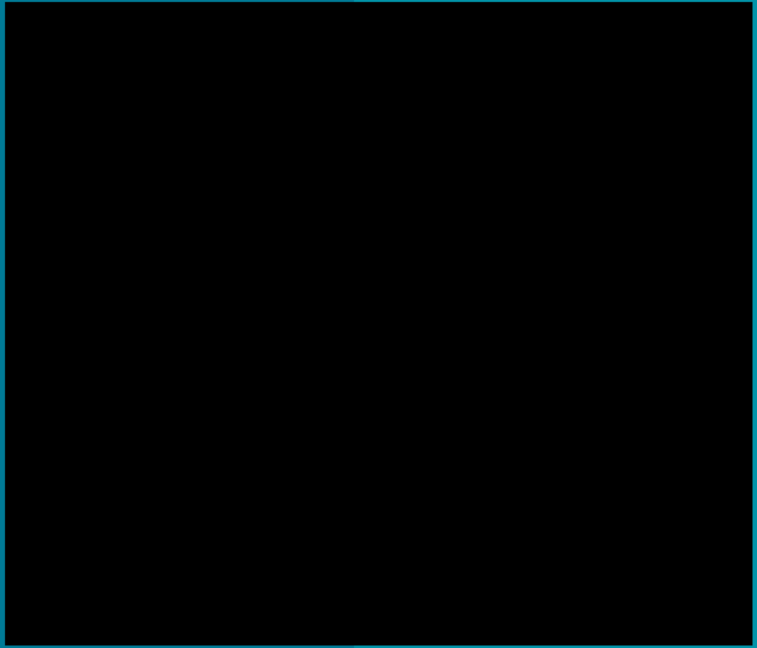
II. **Product/technology to system integration.** Assessing the impact of climate tech adoption on existing systems – including impact on overall costs, product performance, reliability, sustainability, and compliance.

III. **Ecosystem integration.** Working as part of an ecosystem of organizations across the value chain and wider industry to address the complexities of climate tech adoption.

IV. **Analog to digital.** Developing digitally enabled industrial systems that can be optimized and modernized as climate tech evolves.

ENABLERS

- **Securing access to finance** – tapping into increasing public and private funding (government grants, subsidies and tax credits, VC funding, debt financing) to fast-track the development and deployment of climate tech.
- **Developing new skills** – partnering with startups and academics to access new skillsets and investing in employee reskilling and upskilling programs.
- **Harnessing digital technologies** – harnessing digital technologies such as AI, digital twins and 3D printing to enhance innovation processes, and reduce the cost of climate tech adoption.



Defining climate tech

Climate tech refers to innovative technologies specifically designed to mitigate the impact of environmental challenges such as climate change and resource depletion. Climate tech includes technologies such as renewable energy, energy storage, carbon capture, low-carbon hydrogen, alternative fuels, electric vehicles (EVs), alternative materials, sustainable agriculture and food systems, and energy-efficiency technologies (such as energy-efficient equipment, smart grids, and manufacturing processes). Climate tech includes both hardware solutions such as solar PV, EVs, energy storage, and carbon capture, while examples of software-based climate tech include climate intelligence and climate-modelling software.

Who should read this report and why?

This report offers extensive insights into the importance of climate tech in tackling environmental challenges; the cost barrier and level of green premiums that corporates are willing to accept; timelines for mainstream adoption of key climate tech; and the role of digital technologies in reducing costs and scaling climate tech adoption. The report is intended for business leaders from functions such as strategy, sustainability, R&D, product innovation, product engineering, manufacturing, and technology who are involved in their organization's decarbonization and wider environmental sustainability efforts. We offer practical recommendations to assist executives in accelerating climate tech adoption. The report also provides insights into the climate tech financing plans of VCs and financial institutions.

This report is based on original findings from an extensive industry survey of 1,350 senior executives (director level and above) from large organizations across 13 countries (~90% of organizations have annual revenue above $1 billion) and 16 industries, as a well as a survey of 500 large VCs and financial services organizations. See the research methodology at the end of the report for more details.

Introduction

As the Intergovernmental Panel on Climate Change (IPCC) highlights in its March 2023 report, the adverse impacts of climate change are being felt in every region of the world. Every fraction of a degree of additional warming will intensify these impacts, with increasingly severe and irreversible consequences. The report calls for deep and rapid reductions in greenhouse gas (GHG) emissions to limit the rise in global temperature to 1.5°C, using technology, along with financing and international cooperation, as key levers of accelerated climate action.[6] Technology also has a crucial role to play in addressing other pressing environmental challenges, given that humanity has already transgressed six of the nine planetary boundaries that define a safe operating space for Earth. Johan Rockström, Director of the Potsdam Institute for Climate Impact Research (PIK) and Professor of Environmental Science at the Stockholm Resilience Centre at Stockholm University, says: ***"We don't know how long we can keep transgressing these key boundaries before combined pressures lead to irreversible change and harm."***[7]

In many cases, technologies with the potential to address these challenges are already available. A recent report from the International Energy Agency (IEA) shows that the majority (around 63%) of the emissions reductions required for the energy sector to reach net zero by 2050 are already available in the market. Only 35% of the required reductions rely on technologies that are under development, while the remaining reductions (around 2%) depend on behavioral changes.[8]

Against this backdrop, we wanted to explore the significance of climate tech within organizations' sustainability strategies. During August and September 2023, we surveyed senior executives (director level and above) from 1,350 organizations (~90% of the organizations had annual revenue above $1 billion). The survey covers organizations from 16 industry sectors and 13 countries across North America, Europe, and APAC. We also surveyed 500 VCs and executives from financial services organizations on their climate tech financing plans. In addition, we interviewed more than 15 experts across industries, including VCs (please refer to the research methodology at the end of the report for more details).

Introduction

Based on this research, this report explores five broad themes:

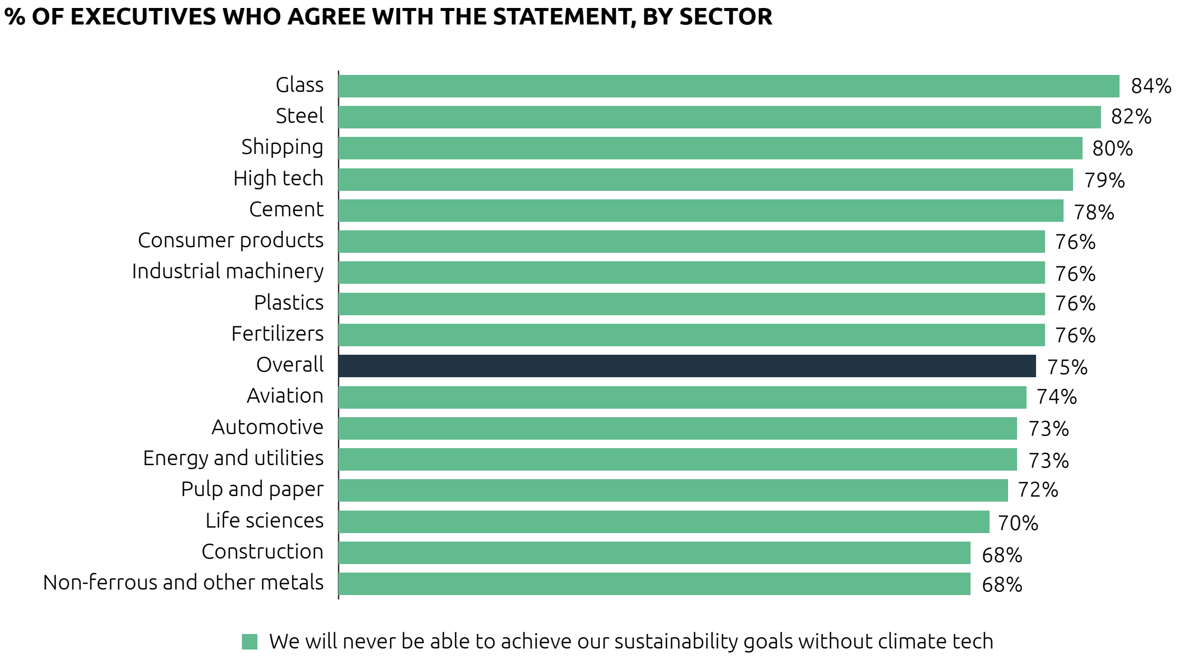
1. Organizations see a substantial role for climate tech in addressing the climate and ecological crisis
2. Cost is a major obstacle for climate tech adoption
3. Digital technologies are key to accelerating the adoption of climate tech and driving down costs
4. Despite the challenges, there are pockets of rapid progress
5. Recommendations for organizations to accelerate climate tech adoption in order to meet their sustainability goals

01 ORGANIZATIONS SEE A SUBSTANTIAL ROLE FOR CLIMATE TECH IN ADDRESSING THE CLIMATE AND ECOLOGICAL CRISIS

Three-quarters of executives say their organizations will never be able to achieve their sustainability goals without climate tech

Organizations see climate tech as crucial to meeting their sustainability goals: 75% of surveyed executives say that their organizations will not achieve their sustainability goals without climate tech. This view is shared by the majority of executives across sectors, with the highest proportions in the glass (84%), steel (82%), and shipping (80%) industries (see Figure 1).

FIGURE. 1
Across sectors, the majority of executives believe climate tech is critical to the achievement of sustainability goals



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations.

“Climate technologies are absolutely crucial for us, and we will not achieve net zero if we don't use many of these technologies. Carbon capture is the biggest pillar of decarbonization for the cement industry because most of the CO_2 that we emit as an industry comes from the chemical transformation process that is part of cement manufacturing, so we cannot eliminate it completely. In addition to carbon capture, we are also looking at other technologies such as process electrification, and the use of green fuels such as green hydrogen or biomass-based fuels.”

JESÚS SUBERO
R&D Director, Cement Manufacturing,
at Swiss multinational cement company Holcim

Jesús Subero, R&D Director, Cement Manufacturing, at Swiss multinational cement company Holcim, highlights the criticality of climate tech to the cement industry: *“Climate technologies are absolutely crucial for us, and we will not achieve net zero if we don't use many of these technologies. Carbon capture is the biggest pillar of decarbonization for the cement industry because most of the CO_2 that we emit as an industry comes from the chemical transformation process that is part of cement manufacturing, so we cannot eliminate it completely. In addition to carbon capture, we are also looking at other technologies such as process electrification, and the use of green fuels such as green hydrogen or biomass-based fuels.”*

Among surveyed countries, Sweden and the UK have the highest proportion of executives who say their organizations will not be able to achieve their sustainability goals without climate tech (see Figure 2).

75%

of executives say that their organizations will not achieve their sustainability goals without climate tech

FIGURE. 2

Across countries, the majority of executives believe climate tech is critical to achieving sustainability goals

% OF EXECUTIVES WHO AGREE WITH THE STATEMENT, BY COUNTRY

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations.

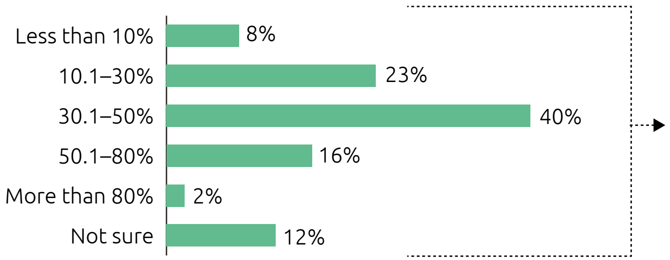
Climate tech will help organizations achieve close to 40% of their decarbonization goals

Our research shows that, on average, executives expect climate tech to contribute **37%*** of their organization's decarbonization or net zero goals (see Figure 3). The remaining 63% will depend on measures such as reducing energy and material usage, driving behavioral change to reduce demand, and switching to less-extractive business models.

FIGURE. 3

Climate tech is key to achieving nearly 40% of organizations' decarbonization or net zero goals

WHAT IS THE ESTIMATED CONTRIBUTION OF CLIMATE TECH TO HELPING YOUR ORGANIZATION ACHIEVE ITS OVERALL DECARBONIZATION OR NET ZERO GOALS?



On average, executives expect climate tech to help their organizations achieve

37%

of their decarbonization or net zero goals.

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,189 organizations that track the contribution of climate tech towards achieving their overall decarbonization or net zero goals.

Estimate based on the perception of surveyed executives

Awareness of the worsening climate crisis and stricter regulations are the top two drivers of investment in climate tech

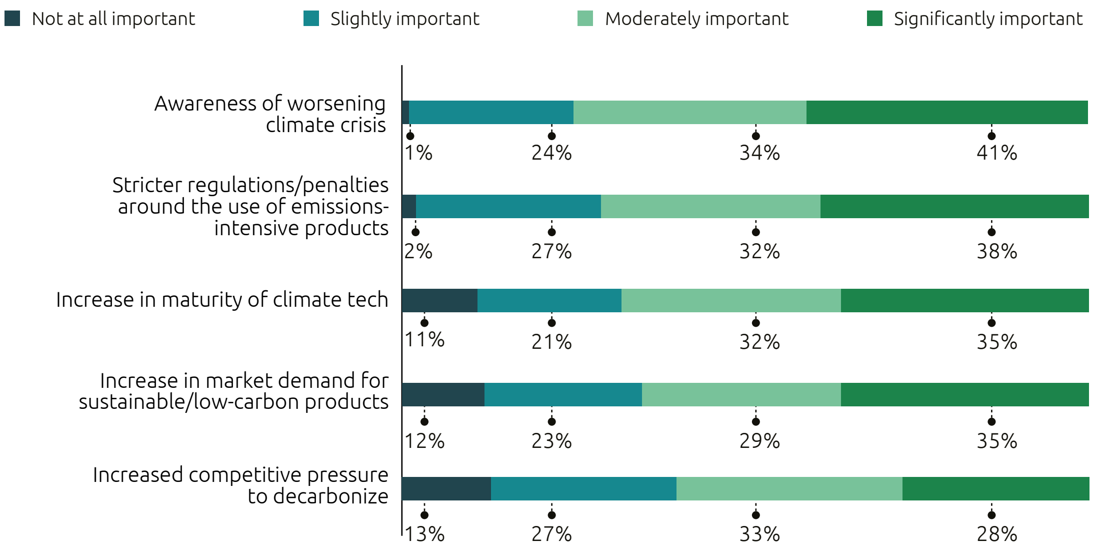
Overall, 65% of organizations plan to increase investment in climate tech in the next two years. Figure 4 shows the top five drivers of investment, with awareness of the worsening climate crisis coming top.

FIGURE. 4

Three-quarters of organizations are increasing investment in climate tech amid awareness of the worsening climate crisis

WHAT IS DRIVING THE INCREASE IN YOUR ORGANIZATION'S INVESTMENT IN CLIMATE TECH?

Top five drivers based on the percentage of executives who rate them either as "moderately important" or "significantly important"

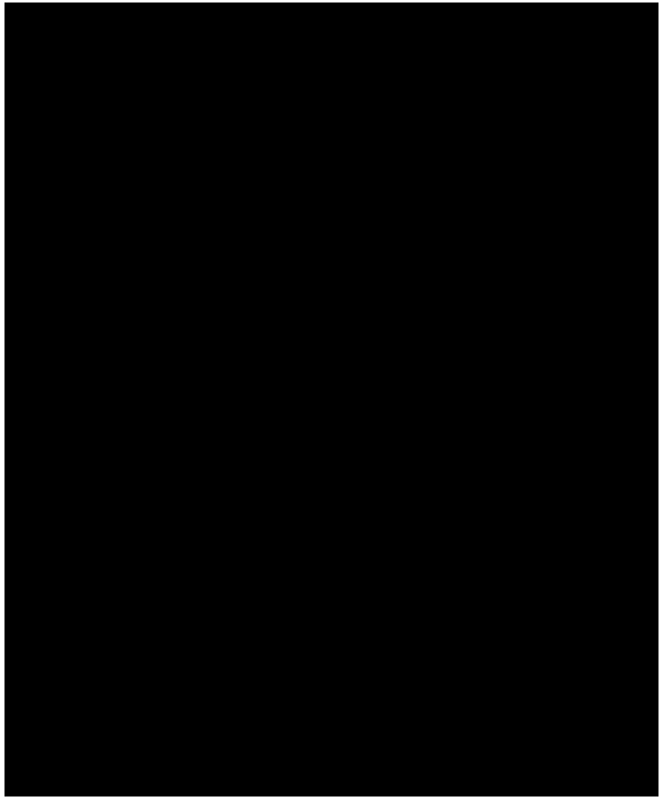


Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=877 organizations that plan to increase investment in climate tech in the next two years.

There are a variety of technologies that could play crucial roles in decarbonizing the energy, transport, industry,buildings, agriculture, and waste management sectors.

1. ENERGY

- **Solar PV and wind.** Renewables such as solar PV and wind will be vital pillars of decarbonization efforts. In its 2023 NZE Scenario (which sets out a pathway for the energy sector to reach net zero by 2050), the IEA estimates that solar PV and wind will contribute 25% of emissions reductions in the energy sector in 2022–50.[9] The cost of producing electricity from solar and wind energy fell substantially in 2010–20 (the cost reduction for utility-scale solar PV was 85%; onshore wind, 56%; and offshore wind, 48%), making them increasingly competitive with or cheaper than fossil fuels in many parts of the world.[10] The majority of energy and utility firms in our survey view solar (57%) and wind (66%) as priorities.



- **Energy storage and grid-modernization technologies.** The effective deployment of renewables relies heavily on grid-scale energy storage and grid-modernization technologies, which are crucial to addressing intermittency and ensuring a stable and reliable supply of renewable power. According to IEA estimates, installed grid-scale battery-storage capacity must increase 35-fold from 2022 to 2030 for the energy sector to reach net zero.[11] Further, investment in grids must nearly double from current levels of around $300 billion annually to around $600 billion annually by 2030, with a focus on digitalization and modernization to support the expanding role of electrification across economies[12]

85%

reduction in cost of electricity from utility-scale solar PV in 2010–20

2. TRANSPORT

- **Electric vehicles (EVs).** EVs powered by low-carbon electricity have the potential to rapidly reduce land-transport emissions. Studies have shown that lifecycle emissions from EVs are 50–70% lower than those from internal combustion engine (ICE) vehicles and are likely to decrease further as battery technology improves and electricity grids decarbonize.[13] In the IEA's NZE scenario, electrification is pivotal to decarbonizing the road transport sector (which includes cars and vans, buses, and heavy trucks), and represents three-quarters of the sector's energy consumption in 2050.[14] The increase in global battery production has led to substantial reductions in the unit costs of lithium-ion EV batteries (by almost 90% from 2008 to 2022), driving rapid growth in EV adoption. In 2022, EVs accounted for 14% of total car sales, more than 10 times their share in 2017.[15] The world's major automakers are planning to spend nearly $1.2 trillion on EV development and production by 2030.[16] In our survey, 80% of automotive organizations are prioritizing EVs as a key lever of decarbonization.

  However, growing EV battery demand is driving up demand for critical minerals, leading to supply chain constraints and raising environmental concerns due to the mining and extraction of these minerals. In addition, the disposal of lithium-ion batteries is a hazardous process: a study from Australia found that 98.3% of lithium-ion batteries end up in landfills, increasing the likelihood of landfill fires that can burn for years.[17] Battery-recycling technologies are crucial for safer disposal of batteries and for the recovery of battery materials for reuse. French battery manufacturer Verkor, for instance, is partnering with battery-recycling startup Mecaware to test an innovative battery recycling technology to extract battery metals (using captured CO_2 instead of acids) at lower costs and without generating a polluting discharge.[18]

80%

of automotive organizations are prioritizing EVs as a key lever of decarbonization

- **Alternative fuels.** Alternative fuels have a critical role to play in industries such as aviation and shipping, which account for 2.5%[19] and 3%[20] of global emissions, respectively, and are challenging to electrify. SAF is a critical lever of decarbonization in the aviation industry, especially in the near term given the lack of other viable alternatives, with the potential to deliver 65% of the industry's emissions cuts towards net zero by 2050.[21] ***"SAF reduces CO_2 emissions by up to 85% and possibly more over the fuel's life cycle, offering the greatest potential to decarbonize aviation over the next 30 years,"*** confirms Boeing Chief Sustainability Officer Chris Raymond.[22] Seventy-eight percent of aviation firms in our survey view SAF as a priority climate tech. Both Boeing and Airbus have committed to delivering commercial aircraft that are capable of running on 100% SAF by 2030.[23]

  In the shipping industry, renewable methanol has the potential to reduce CO_2 emissions from container ships by 60–95%.[24] Green methanol is a priority for 68% of shipping firms in our survey. Major shipping firms such as Maersk, COSCO and CMA CGM have placed orders for green methanol-fueled vessels.[25] Anthony Akerman, Senior Director at Maersk, says: ***"Green methanol is the only readily available solution at this time. We aim to operate a significant proportion of our fleet using green methanol by the end of 2030."***

  Low-carbon hydrogen also holds potential as an alternative fuel in long-haul aviation, international shipping, and heavy-duty trucking.

78%

of aviation firms in our survey view SAF as a priority climate tech

3. BUILDINGS

- **Energy efficiency.** Buildings account for 30% of global final energy consumption and 26% of global energy-related emissions.[26] With increasing demand and stricter regulations, the use of energy efficient buildings technologies (e.g., energy-efficient HVAC systems, appliances, and lighting) is accelerating. Nearly seven in ten construction companies (68%) in our survey view energy efficiency as a priority. The IEA estimates that energy consumption in buildings will need to reduce by around 25% and fossil fuel use by more than 40% to be in line with the NZE scenario.[27]

- **Heat pumps.** Heating in buildings accounts for 10% of CO_2 emissions globally. Heat pumps powered by low-carbon electricity are three-to-five times more energy efficient than gas boilers and are one of the most promising climate solutions for decarbonizing commercial and residential buildings. The adoption of industrial heat pumps offers significant near-term emission-reduction opportunities for the food, paper, and chemicals industries, with the ability to address nearly 30% of their combined heating needs.[28] In the past few years, global heat pump sales have grown at double-digit rates. However, they are currently used to meet only about 10% of heating needs globally, highlighting the need for a substantial increase in deployment levels.[29]

4. INDUSTRY

- **Low-carbon hydrogen.** Low-carbon hydrogen holds significant mitigation potential for industries with limited opportunities for electrification (e.g., steel) and traditional hydrogen end-use industries that use gray-hydrogen for feedstocks (e.g., chemicals, fertilizers, and petroleum refining). Considering its range of applications, hydrogen could contribute 10% of emissions reductions and 12% of final energy demand by 2050.[30] Nearly seven in ten (68%) steel companies in our survey view low-carbon hydrogen as a priority.

- **Carbon capture, utilization, and storage (CCUS).** In hard-to-abate sectors that have limited decarbonization alternatives, CCUS technologies can play a critical role.

In the cement industry, for instance, which accounts for 8% of global emissions,[31] about half of CO_2 emissions arise from the chemical process involved in cement production, which is difficult to eliminate. A recent study showed that CCUS has the highest potential of all mitigation options for the cement industry.[32] Heidelberg Cement is setting up the world's first cement plant with a full-scale carbon capture facility in Brevik, Norway, which will be operational by 2024.[33] Holcim plans to invest CHF2 billion ($2.2 billion) in CCUS technologies by 2030 to capture more than 5 million tonnes of CO_2 each year.[34] CCUS also has a key role to play in the steel industry. Nearly two-thirds of cement (66%) and steel (68%) companies in our survey view CCUS as a priority.

5. AGRICULTURE

- **Precision agriculture.** By facilitating more carefully targeted application, precision agriculture techniques help curb the excessive use of synthetic nitrogen fertilizers and pesticides that damage soil health and exacerbate climate change. Synthetic nitrogen fertilizers are responsible for 2.1% of global greenhouse gas emissions.[35] The Plant Protection Optimization with Precision Farming (PFLOPF) project in Switzerland aims to reduce the use of plant-protection products by at least 25% using precision-farming technologies such as map-based tools for disease monitoring, spot-spraying systems (that have shown a 60% reduction in plant-protection product usage in initial evaluations), and autonomous vehicles for weed removal.[36] Nearly half (48%) of food and beverage firms in our survey view precision agriculture as a priority climate tech.
- **Synthetic biology.** Synthetic biology, which involves the application of engineering principles to redesign organisms for useful purposes, offers innovative methods of addressing climate change and its impacts. For example, synthetic biology techniques are being applied to develop alternatives to palm oil, which is a major driver of deforestation in the tropics.[37] US-based biotech startup C16 Biosciences is developing a sustainable palm oil alternative using a naturally occurring yeast microbe and fermentation processes.[38] Another US-based biotech startup, Kiverdi, has developed a synthetic palm oil using carbon captured from the atmosphere.[39]
- **Alternative proteins.** Alternative proteins such as lab-grown meats, plant-based meat substitutes and insect proteins also have a key role to play in helping reduce the impacts of traditional livestock farming. US-based food-tech startups Upside Foods and Good Meat recently received regulatory approvals for the production and sale of lab-grown meat.[40]

6. WASTE MANAGEMENT

- **Plastic recycling.** Plastics account for 3.4% of global GHG emissions currently,[41] and could represent 10–13% of the entire remaining carbon budget by 2050.[42] Only 9% of plastic waste is recycled globally.[43] Synthetic biology techniques can be used to develop bacterial enzymes that degrade PET-plastic, a significant pollutant. Estimates indicate that manufacturing PET from enzymatic recycling could reduce GHG emissions by 17–43% from levels seen through the use of virgin PET. Carbios, a French startup, is developing an enzymatic recycling process using bacteria to break down PET-plastics. Partner brands include PepsiCo and Nestlé.[44]

FIGURE. 5

The role of key climate technologies in helping organizations decarbonize

ENERGY

Solar PV and wind

Projected to contribute **25%** of emissions reductions in the energy sector in 2022-50.[9]

Energy storage and grid modernization

Grid-scale battery storage capacity needs to increase **35-fold** and investment in grids needs to nearly double by 2030.[11,12]

TRANSPORT

Electric vehicles (EVs)

50–70% lower lifecycle emissions than ICEs.[13]

Alternative fuels

SAF can cut **65%** of the aviation industry's emissions by 2050 and **renewable methanol** can cut up to **95%** of emissions from container ships.[24]

BUILDINGS

Energy efficiency

68% of construction companies in our survey view energy efficiency as a priority climate tech.*

Heat pumps

Met around **10%** of the global building heating needs in 2022, about half of what is needed in the Net Zero Emissions (NZE) scenario by 2030.[27]

INDUSTRY

Low-carbon hydrogen

68% of steel companies in our survey view low-carbon hydrogen as a priority.*

CCUS

Around **two-thirds** of cement and steel companies in our survey view CCUS as a priority.*

AGRICULTURE

Precision agriculture

48% of food and beverage firms in our survey view precision agriculture as a priority.*

Synthetic biology

42% of food and beverage firms in our survey view synthetic biology as a priority.*

Alternative proteins

62% of food and beverage firms in our survey view alternative proteins as a priority.*

WASTE MANAGEMENT

Plastic recycling

Manufacturing PET-plastic from enzymatic recycling could reduce GHG emissions by **17–43%** from levels seen using virgin PET.[42]

- **On track:** If recent trends continue, in 2030 this area will comfortably be in line with the IEA's NZE by 2050 Scenario.
- **More efforts needed:** Recent trends are positive and generally on track to meet the IEA's NZE by 2050 Scenario. However, progress must be faster, as a continuation of recent trends without any acceleration would still fall short.
- **Not on track:** Recent trends are either in the wrong direction or substantially insufficient to get on the IEA's NZE by 2050 Scenario trajectory by 2030. This does not exclude the fact that there may be positive developments on certain aspects or in certain regions; however, a step-change in effort is needed at global level.
- **No information available.**

Source: Legend for "On track", "More efforts needed", "Not on track": IEA, Tracking Clean Energy Progress 2023," July 2023.
*Capgemini Research Institute, Climate Tech Survey, August September 2023; N=50 executives each from the construction, steel, cement, and food and beverage sectors.

"Our core priority is to transition towards regenerative agriculture. There is a huge opportunity to use technologies such as precision farming to help achieve this goal."

CRISTINA MACINA
Corporate Affairs and Sustainability Director at Nestlé UK and Ireland

"Green methanol is the only readily available solution at this time. We aim to operate a significant proportion of our fleet using green methanol by the end of 2030."

ANTHONY AKERMAN
Senior Director at Maersk

02 COST IS A MAJOR OBSTACLE FOR CLIMATE TECH ADOPTION

Most executives expect product costs to increase due to adoption of climate tech

Close to eight in ten (77%) of executives suggest that product costs are likely to increase due to climate tech adoption (see Figure 6). For example, the cost of low-carbon cement produced using carbon capture is estimated to be 75–140% higher than conventional cement; [45] steel produced using low-carbon hydrogen is estimated to cost 20–30% more than steel produced using conventional methods;[46] sustainable aviation fuel is estimated to cost 123% more than jet fuel.[47]

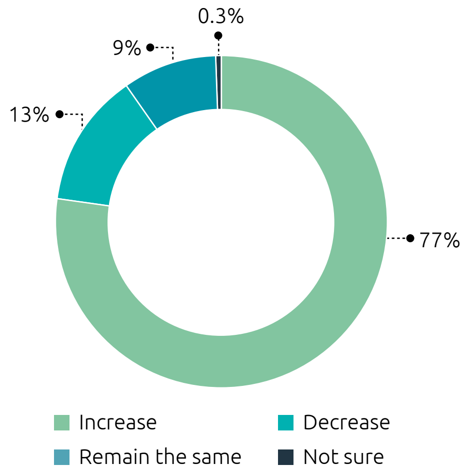
Anthony Akerman, Senior Director at Maersk, underlines the high cost of climate tech adoption in the shipping industry: ***"It's not the technology that's going to hold us back, but the money that needs to be spent. Green methanol comes with a huge premium and is much more expensive than regular bunker fuel. There are some very progressive clients who are willing to pay a premium for this fuel, but not all are. We will have to really struggle to get to a point where green methanol will be cheaper than fossil fuels."***

Holcim's Jesus Subero highlights the cost challenges for the cement industry: ***"The biggest pillar of decarbonization in the cement industry is carbon capture, which is extremely expensive, both in terms of capex and opex. The cost of manufacturing cement will be significantly impacted by carbon capture – the capex is very high as you need to build a carbon-capture plant."***

FIGURE. 6

Most executives expect product costs to increase owing to climate tech adoption

IN GENERAL, WHAT DO YOU FEEL WOULD BE THE IMPACT OF ADOPTING CLIMATE TECH ON YOUR ORGANIZATION'S PRODUCT COSTS?



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations.

Organizations are unwilling to accept a significant green premium for climate tech adoption

On average, the increase in product cost due to climate tech adoption (the "green premium")[48] that organizations are willing to accept is ~9%.

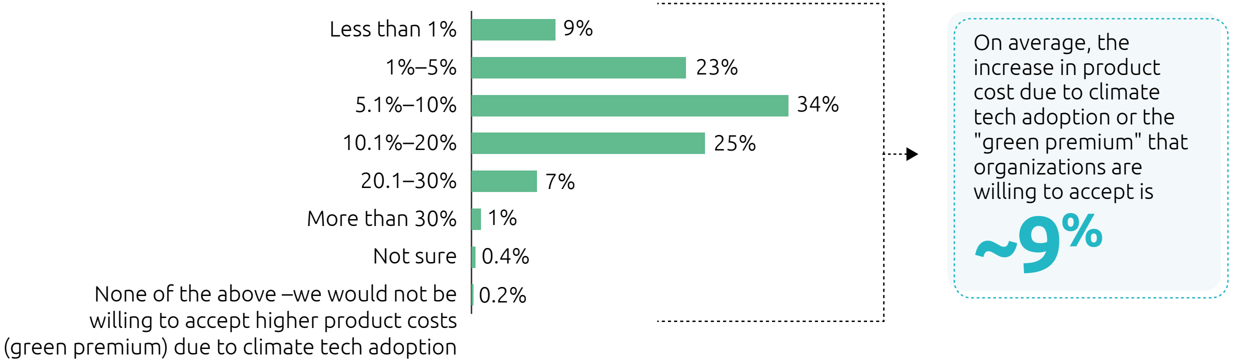
~9%

Average increase in product cost due to climate tech adoption ("green premium") that organizations are willing to accept

FIGURE. 7

The average green premium that organizations are willing to accept is ~9%

WHAT IS THE INCREASE IN PRODUCT COST DUE TO CLIMATE TECH ADOPTION (ALSO REFERRED TO AS THE "GREEN PREMIUM") THAT YOUR ORGANIZATION MIGHT BE WILLING TO ACCEPT?



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations.

However, existing premiums for clean solutions are often significantly higher than what organizations are willing to accept (see Figure 8). While the green premium is already at acceptable levels for solar-powered electricity and heat pumps for new constructions (the negative premium implies that the cost of these sources is lower than that of coal-powered electricity and gas boilers, respectively) or is close to acceptable levels in the case of EVs and low-carbon plastics produced using CCUS, it is much higher for low-carbon cement using CCUS, SAF, and green methanol.

77%

of executives expect product costs to increase due to climate tech adoption

FIGURE. 8

Green premiums for select product categories

CLEAN/LOW-CARBON PRODUCT	CONVENTIONAL ALTERNATIVE	ACTUAL GREEN PREMIUM* (difference in cost between clean/low carbon product versus conventional alternative)	ACCEPTABLE GREEN PREMIUM** (industry average)
Solar electricity	Coal-powered electricity	(-38%)[1]	8.3%[1]
Heat pump – new constructions (in the US)	Gas boiler	(-16)-(-27)%[2]	8.8%[2]
EVs	Internal combustion engine	13%[3]	9.2%[2]
Low-carbon plastics using carbon capture	Conventional plastics	9-15%[4]	9.5%[4]
Low-carbon steel using carbon capture	Conventional steel	16-19%[5]	10.9%[5]
Low-carbon steel using low-carbon hydrogen	Conventional steel	20-30%[6]	10.9%[6]

(Continue on the next page...)

CLEAN/LOW-CARBON PRODUCT	CONVENTIONAL ALTERNATIVE	ACTUAL GREEN PREMIUM* (difference in cost between clean/low carbon product versus conventional alternative)	ACCEPTABLE GREEN PREMIUM** (industry average)
Heat pump – replacements (in the US)	Gas boiler	35-56%[7]	8.8%[7]
Low-carbon cement using carbon capture	Conventional cement	75-140%[8]	9.9%[8]
SAF	Jet fuel	123%[9]	10.4%[9]
Green methanol	Bunker fuel	340%[10]	9.4%[10]

Source:
*Data on actual green premium:
1 Global levelized cost of solar electricity (average of tracking and fixed axis PV – 46$/MWh) versus global levelized cost of coal-powered electricity (74$/MWh). Source: BloombergNEF, "Cost of Clean Energy Technologies Drop as Expensive Debt Offset by Cooling Commodity Prices," June 2023.
2 Cost of heat pump – new constructions (in the US) versus cost of gas boiler (this excludes the green premium for electricity). Source: Breakthrough Energy, "The Green Premium," retrieved from https://breakthroughenergy.org/our-approach/the-green-premium/
3 Average of total cost of ownership of EVs (Chevrolet Equinox EV, Volkswagen ID.4 Pro 82kWh RWD EV, Ford Mustang Mach-E Premium EV, Ford F-150 Lightning EV) versus average of total cost of ownership of comparable ICEs (Chevrolet Equinox RS ICE, Volkswagen Tiguan SE ICE, Ford Edge ST-Line ICE, Ford F-150 ICE). Source: Environmental Defense Fund (EDF), "Electric Vehicle Total Cost of Ownership Analysis," July 2023.
4 Cost of 1 ton of low-carbon plastics using carbon capture versus 1 ton of conventional plastic. Source: Breakthrough Energy, "The Green Premium," retrieved from https://breakthroughenergy.org/our-approach/the-green-premium/
5 Cost of 1 ton of low-carbon steel using carbon capture versus 1 ton of conventional steel. Source: Breakthrough Energy, "The Green Premium," retrieved from https://breakthroughenergy.org/our-approach/the-green-premium/
6 Cost of low-carbon steel using low-carbon hydrogen versus conventional steel based on H2 Green Steel estimates. Hydrogen Insight, "'Our hydrogen-based green steel could be cost-competitive with dirty equivalents within ten years. Here's how'," November 2023.
7 Cost of heat pump – replacements (in the US) versus cost of gas boiler (this excludes the green premium for electricity. Source: Breakthrough Energy, "The Green Premium," retrieved from https://breakthroughenergy.org/our-approach/the-green-premium/
8 Cost of 1 ton of low-carbon cement using carbon capture versus 1 ton of conventional cement. Source: Breakthrough Energy, "The Green Premium," retrieved from https://breakthroughenergy.org/our-approach/the-green-premium/
9 Cost of 1 ton of SAF versus cost of 1 ton of jet fuel. Source: International Air Transport Association (IATA), "Sustainable aviation fuel output increases, but volumes still low," retrieved from https://www.iata.org/en/iata-repository/publications/economic-reports/sustainable-aviation-fuel-output-increases-but-volumes-still-low/#:~:text=During%202022%2C%20the%20average%20SAF,price%20of%20conventional%20jet%20fuel
10 Cost of green methanol versus cost of bunker fuel. Hellenic Shipping News, "Switch to green e-methanol would raise bunker costs by 340%," April 2023.
**Data on acceptable green premium - industry average: Capgemini Research Institute, Climate Tech Survey, August–September 2023;[1]N=149 executives from the energy and utilities industry;[2,7] N=50 executives from the construction industry;[3] N=149 executives from the automotive industry;[4] N=50 executives from the plastic industry;[5,6] N=50 executives from the steel industry;[8]N=49 executives from the cement industry;[9] N=50 executives from the aviation industry;[10] N=49 executives from the shipping industry.

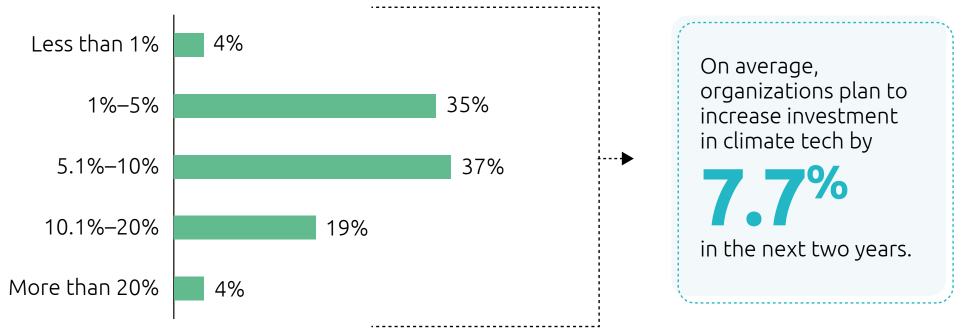
Corporate investment in climate tech is sluggish

In our previous research on corporate sustainability trends, we found that corporate investment levels in sustainability remain insufficient. Average annual investment in environmental sustainability initiatives and practices across industries represents only 0.92% of total revenue, up from 0.91% in 2022[49]. In comparison, according to Gartner, marketing budgets were equivalent to 9.1% of annual revenue on average in 2023.[50]

FIGURE. 9

On average, organizations plan to increase investment in climate tech by 7.7% in the next two years

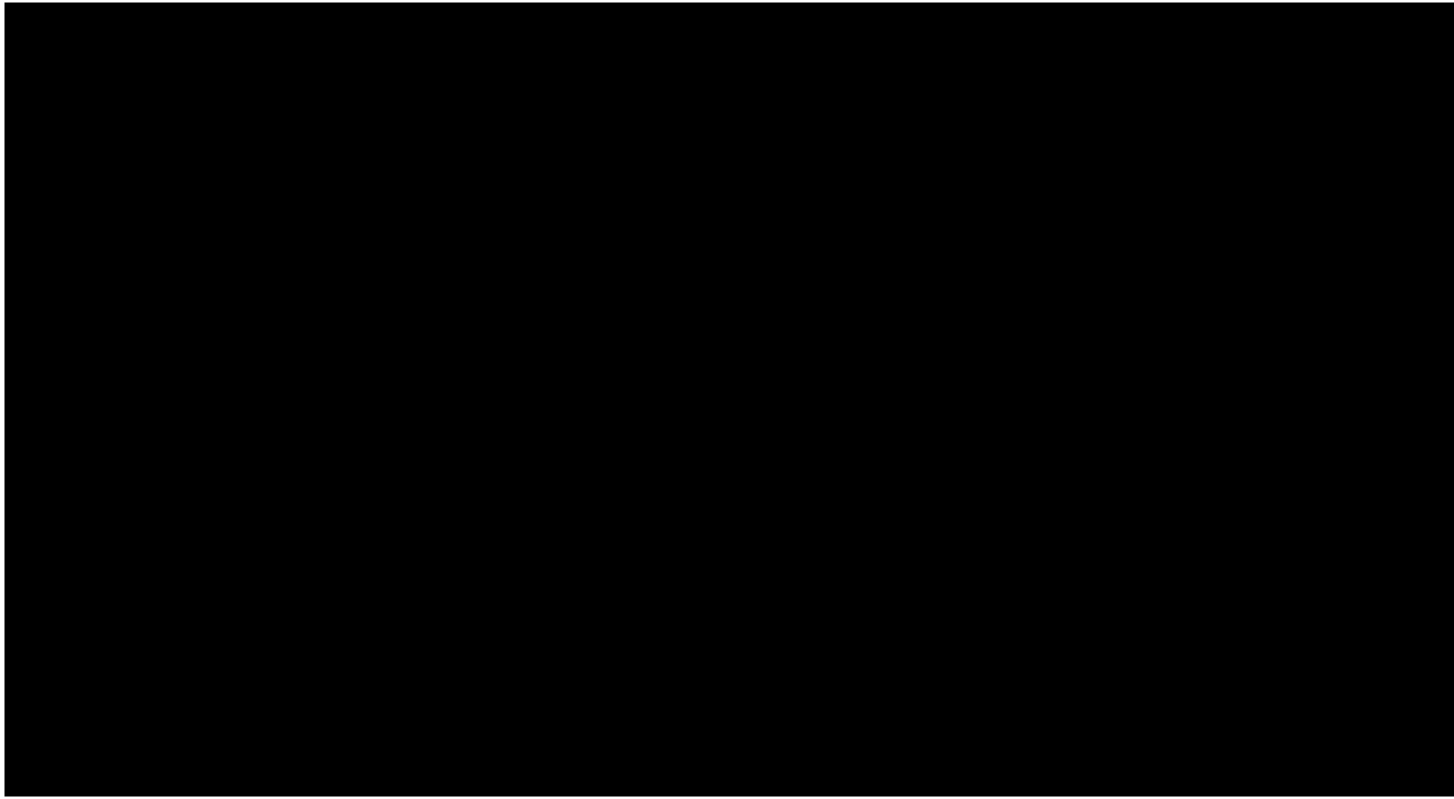
WHAT IS THE PERCENTAGE INCREASE IN INVESTMENT THAT YOUR ORGANIZATION PLANS TO MAKE IN CLIMATE TECH IN THE NEXT TWO YEARS?



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=877 organizations that plan to increase investment in climate tech in the next two years.

In our current research, we found that on average, organizations plan to increase investment in climate tech by 7.7% in the next two years. Given the low initial investment base for sustainability (of which, climate tech is a subset) and the scale of increase needed in investments, this anticipated increase is inadequate. For example, as the IEA highlights, overall clean-energy investments must grow from $1.8 trillion in 2023 to $4.5 trillion in the early 2030s for the energy sector to achieve net zero emissions by 2050.[51]

Corporate investment contributes to reducing green premiums by enabling climate technologies to scale and driving down production costs. The low levels of investment are therefore a cause for concern.



03 DIGITAL TECHNOLOGIES ARE KEY TO ACCELERATING ADOPTION OF CLIMATE TECH AND DRIVING DOWN COSTS

The majority of surveyed executives across sectors believe that data and digital technologies (such as AI, digital twins, and blockchain) have an important role to play in accelerating the adoption of climate tech. (see Figure 10).

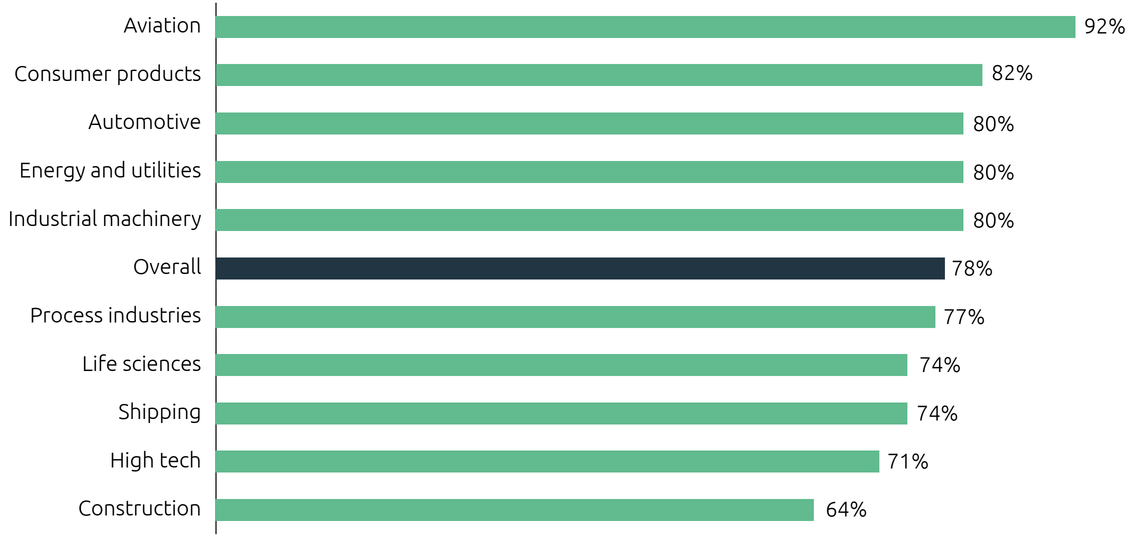
78%

of executives say that data and digital technologies will play an important role in accelerating climate tech adoption

FIGURE. 10

Nearly eight in ten (78%) executives say that data and digital technologies will play an important role in accelerating climate tech adoption

PERCENTAGE OF EXECUTIVES WHO SAY THAT DATA AND DIGITAL TECHNOLOGIES WILL HAVE AN IMPORTANT ROLE IN ACCELERATING THE ADOPTION OF CLIMATE TECH



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations.

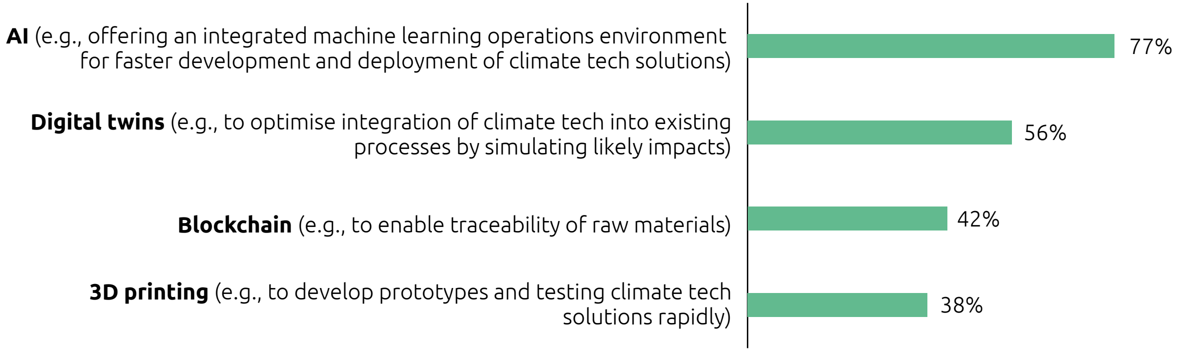
AI is the most promising technology for accelerating climate tech adoption – 77% of surveyed executives say that AI will have a high impact on accelerating the adoption of climate tech, followed by digital twins (see Figure 11).

FIGURE. 11

Most executives say that AI will have a high impact on accelerating the adoption of climate tech

TO WHAT EXTENT CAN THE FOLLOWING DIGITAL TECHNOLOGIES ACCELERATE THE ADOPTION OF CLIMATE TECH?

Percentage of executives who say the following technologies will have a high impact on accelerating the adoption of climate tech



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations.

Below, we explore the role of digital technologies in advancing climate tech adoption by enhancing R&D processes and scaling deployments.

ENHANCING R&D PROCESSES

AI has the potential to significantly enhance R&D processes for climate tech development. For example, General Motors has invested $60 million in Mitra Chem, a Silicon Valley-based battery-materials startup, to accelerate the commercialization of affordable EV batteries in the US using Mitra Chem's AI-powered platform. The platform synthesizes novel battery-material formulations, reducing costs, extending battery lifespan, and shortening R&D timelines by over 90%.[52]

Generative AI enables organizations to speed up R&D for climate tech by facilitating the rapid generation of novel ideas and concepts and collaborative innovation. More than eight in ten (82%) executives say that generative AI will have a high impact on accelerating the adoption of climate tech. UK-based AI startup Orbital Materials is building a tailored material science generative AI model that generates 3D structures of new carbon-neutral materials based on specified criteria. Jonathan Godwin, CEO at Orbital Materials, says, ***"At the moment, it's very difficult to design something to specification. You have a list of materials that you can use. What we're going to be able to do is create a far wider variety and actually try to bring materials to market very, very quickly."***[53]

3D printing also offers opportunities to improve R&D processes for climate tech. Researchers at Stanford University recently developed a 3D-printed optical concentrator for solar panels. This pyramid-shaped device, called axially graded index lens (AGILE), was found to increase the energy-collection capacity of a solar panel, while reducing the cost of production.[54]

SCALING DEPLOYMENTS

The use of AI, machine learning and digital twins have a pivotal role to play in scaling climate tech deployments by optimizing product performance and streamlining testing and implementation processes. For example, wind turbine manufacturer Siemens Gamesa is collaborating with technology company NVIDIA to develop a digital twin platform to optimize wind farm layouts, boosting energy output and reducing operating costs.[55] Digital twins are also being applied to reduce testing time for wind turbines. A publicly funded Danish research project launched in March 2023 aims to use digital twin technology to digitize large-scale test benches, to reduce manual workflows and increase the efficiency of the testing process. The project is expected to reduce testing time for wind turbines by 20%, leading to a shorter time to market for larger and more reliable turbines, as well as reduced testing costs.[56]

In the UK, the publicly funded HyAI project is trialing the use of an AI platform at the European Marine Energy Centre's (EMEC, a non-profit that offers testing facilities for clean-energy technologies) hydrogen production plant at Orkney, Scotland. The platform integrates data on weather patterns, renewable energy availability and electricity prices to optimize hydrogen production and storage in real time. Initial results indicate that HyAI lowered hydrogen production costs and reduced stress on the power grid. Corinna Jones, Head of Hydrogen Innovation at National Grid Gas Transmission, a UK-based utility and HyAI project partner, says: ***"Data analytics will play a vital part in the transition of the UK's energy network. There is ever increasing complexity associated with managing the network as a whole system, and a greater reliance on renewable energy sources."*** [57]

Blockchain is integral to ensuring transparency across technology supply chains and fostering trust among stakeholders. These elements are crucial to driving investments in climate tech and scaling deployments. Nobian, a Germany-based chemicals company, is piloting blockchain solutions for the certification of green hydrogen to ensure traceability across the value chain. In the automotive industry, Ford is engaged in a pilot project with Everledger, an Australia-based blockchain platform provider, to develop a battery passport solution for EV batteries (battery passports are digital systems that record data across the battery lifecycle). The project is aimed at establishing transparency across the EV battery supply chain and ensuring responsible use and recycling of batteries.[59]

More than seven in ten organizations have already realized cost advantages from using digital technologies to accelerate the adoption of climate tech

Our research shows that digital technologies have helped 71% of organizations bring down climate tech adoption costs. In the steel and cement industries, this proportion is even higher, at 78%. The results of an EU-backed project to optimize the design of offshore wind farm foundations showed that digital twin technology, for instance, can guide design modifications to reduce the weight of steel used in the foundations by up to 30%, resulting in significant cost savings.[60]

Digitalization is also playing a crucial role in helping Swedish green steel manufacturer H2 Green Steel lower the cost of low-carbon hydrogen production. H2 Green Steel is using a data-driven approach and software tools to optimize the configuration of hydrogen plants (based on factors such as location, output requirements, and access to renewable electricity), with the goal of achieving the lowest possible cost of hydrogen production.[61]

78%

of executives say that data and digital technologies will play an important role in accelerating climate tech adoption

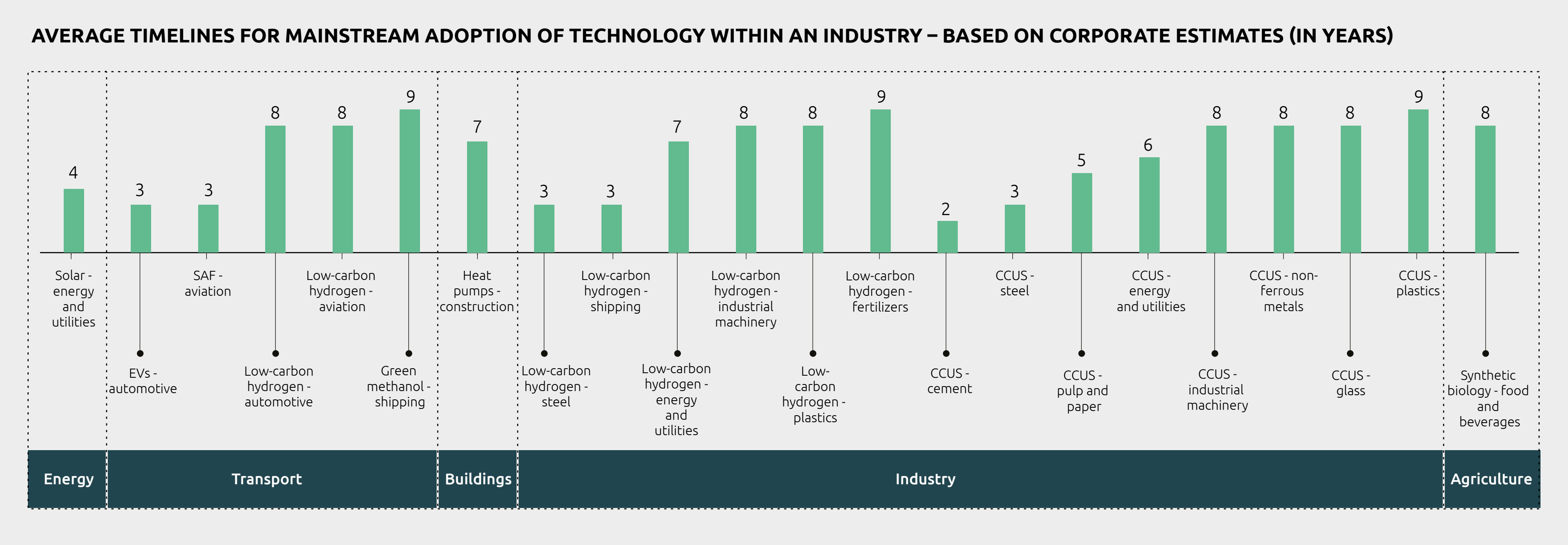
04 DESPITE THE CHALLENGES, THERE ARE POCKETS OF RAPID PROGRESS

For technologies where the green premium has decreased significantly, such as solar PV and EVs, adoption of the technology is expected to accelerate. According to corporate estimates, mainstream adoption of solar in the energy and utilities sector will occur within four years, while EVs will reach mainstream adoption in the automotive industry in three years (see Figure 12).

However, rapid progress is also expected in areas where green premiums remain significant. For example, surveyed executives from the cement industry believe that carbon capture will reach mainstream adoption in their industry in two years; executives in the steel and shipping industries see low-carbon hydrogen reaching mainstream adoption in their industries in three years; and aviation executives believe that SAF will reach mainstream adoption in their industry within three years (see Figure 12). This could be attributed to a lack of viable alternatives for decarbonization in these industries, leading to a broad consensus (e.g., CCUS in the cement industry, SAF in the aviation industry, and low-carbon hydrogen in the steel and shipping industry).

FIGURE. 12

Timelines for mainstream adoption of select climate technologies



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023, N=150 executives each from the energy and utilities, automotive and industrial machinery sectors; N=50 executives each from the food and beverages, aviation, shipping, construction, steel, cement, plastics, fertilizers, pulp and paper, glass, and non-ferrous metals industries.

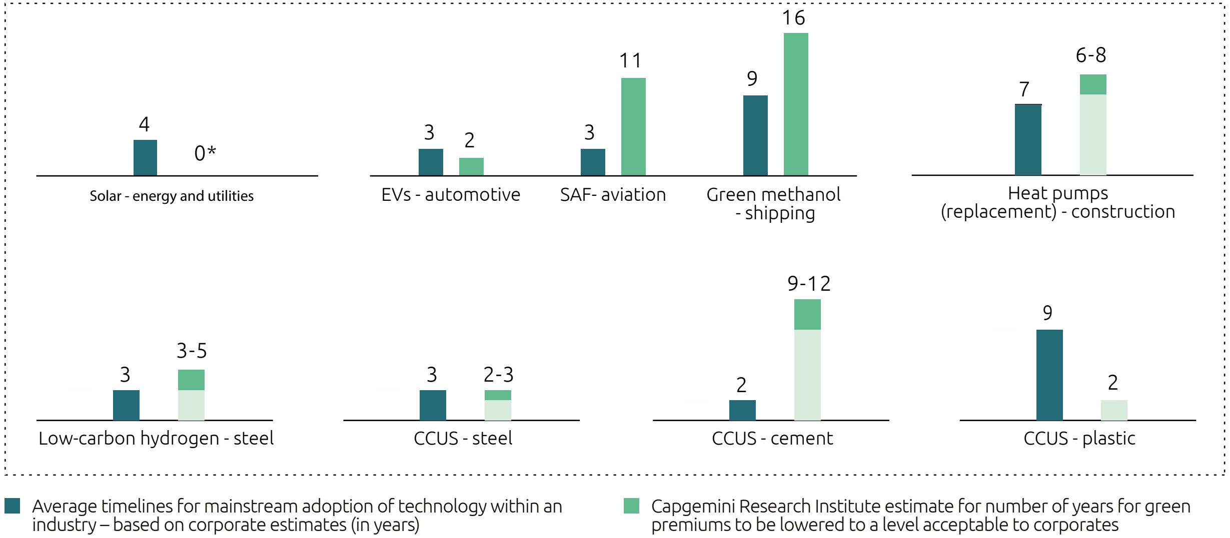
Figure 13 illustrates a comparison between the anticipated timeline for mainstream adoption of specific technologies, as perceived by surveyed executives, and the estimated timelines for reducing green premiums to acceptable levels. To estimate the timeline for the reduction in green premiums, we used the rate of decline observed in the cost of solar PV modules from 2008 to 2020, which had a CAGR of 21% (for a detailed explanation of the calculation methodology, please refer to the Appendix). For green premiums to decline at this rate, however, investments in the technologies will need to be on a par with that for solar, or even higher for technologies that require a more complex production/implementation process (e.g., carbon capture and hydrogen).

As Figure 13 shows, in some cases (e.g., EVs) the difference between the timelines for mainstream adoption and cost reduction is minimal. This alignment suggests a smooth transition. In other cases (e.g., SAF, green methanol, and CCUS for cement), the timeline for cost reduction significantly exceeds the timeline for mainstream adoption. This gap points to a more challenging transition owing to the higher costs of these technologies, despite the industry's optimistic outlook on their adoption.

FIGURE. 13

Comparison of timelines for mainstream adoption and cost reduction for select climate technologies

TIMELINE FOR MAINSTREAM ADOPTION AND COST REDUCTION (IN YEARS)



*Solar-powered electricity has, on average, reached cost parity with coal-powered electricity. The global levelized cost of solar electricity ($/MWh) is lower than the levelized cost of coal-powered electricity.
Source: Corporate estimates for average timelines for mainstream adoption: Capgemini Research Institute, Climate Tech Survey, August–September 2023, N=150 executives from the energy and utilities sector; N=150 executives from the automotive sector; N=50 executives each from the aviation, shipping, construction, steel, cement, and plastic industries.
For the calculation methodology for Capgemini Research Institute estimates for number of years for green premiums to be lowered, please refer to the Appendix.

Increased public funding, private financing from VCs and financial institutions, as well as corporate initiatives such as long-term offtake agreements, are key to boosting production and driving cost reductions. Below, we examine key trends in each of these areas that point favorably towards climate tech costs declining:

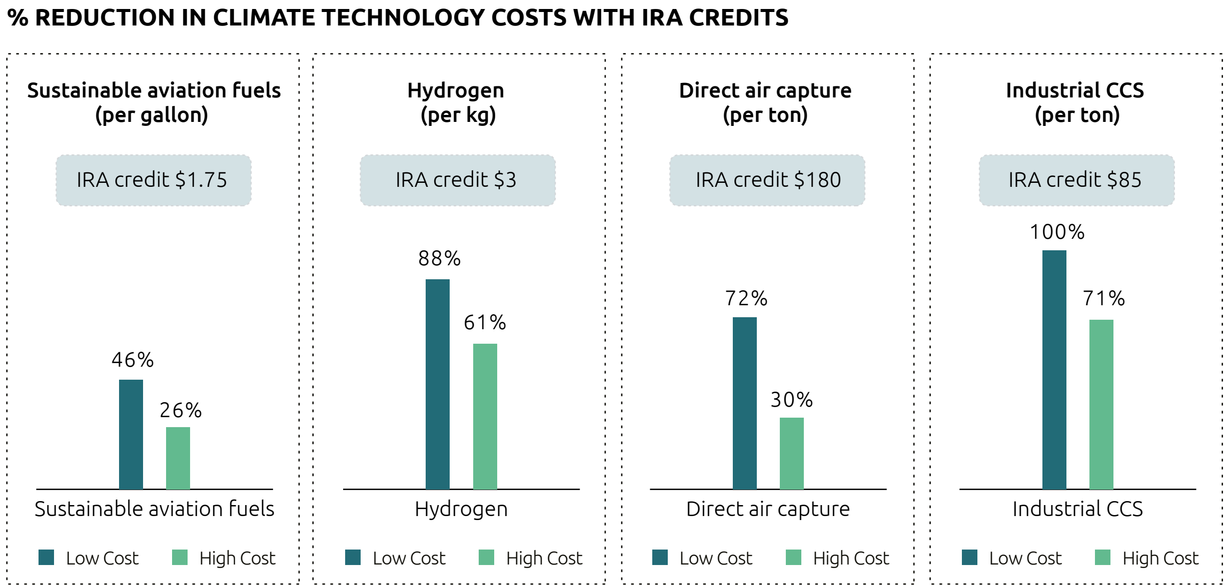
1. GOVERNMENT SUPPORT

Government interventions in terms of more supportive regulations, greater incentives, and more extensive taxation will play a key role in reducing the green premium for climate tech and driving adoption (the US IRA, for instance, offers $369 billion in grants, loans, and other incentives; estimates from CTVC, a climate tech data provider, show that incentives provided by the IRA may decrease climate tech costs by 40% on average [see Figure 14]).[62] Incentives are expected to lead to a 50% surge in new EV passenger car sales in 2023,[63] and secure cost parity of long-haul electric trucks with diesel trucks as early as 2025.[64]

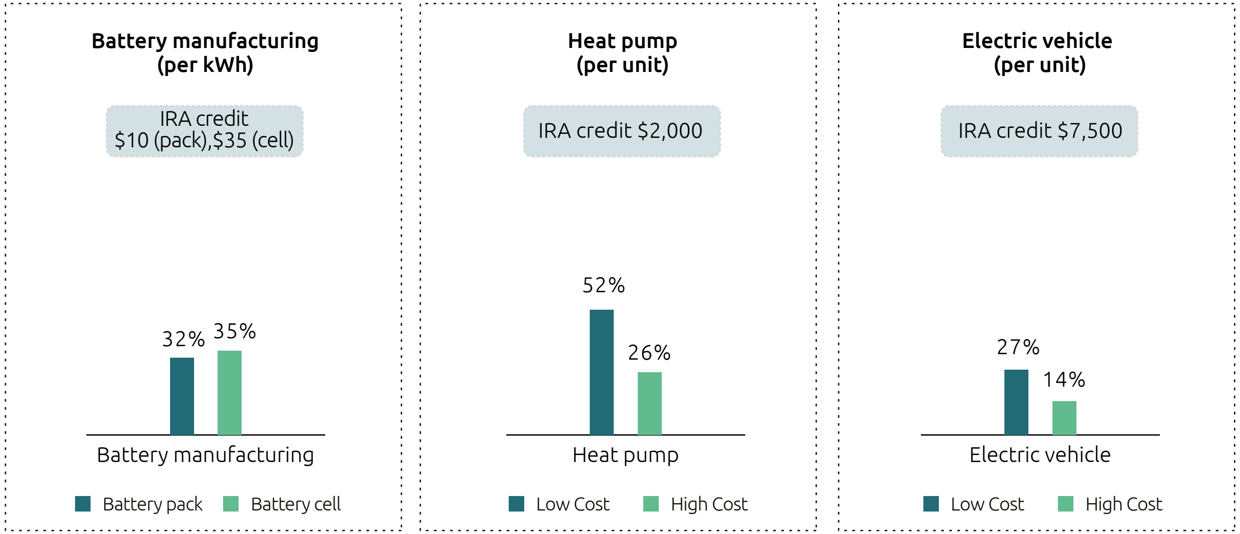
Similarly, the European Commission is offering significant public funding and incentives to boost climate tech as part of its European Green Deal regulatory framework. In the period 2021–27, the EU plans to allocate €578 billion (32.6% of the total EU budget) to climate spending, through

FIGURE. 14

IRA tax credits decrease climate tech costs by 40% on average



Source: CTVC, "IRA and the new capital cost of climate #114," June 2023.



Note: In Figure 14, "low cost" and "high cost" refer to varying technology cost assumptions. E.g., in the case of low-carbon hydrogen produced using solar energy, the low cost scenario represents a cost of $3.39 per kg of hydrogen and the high cost scenario represents a cost of $4.92 per kg in 2030. The IRA tax credit of $3 per kg reduces costs by 88% in the low cost scenario and by 61% in the high cost scenario, as indicated in the figure.

various innovation funds. Further, in November 2023, the European Parliament passed the Net-Zero Industry Act (NZIA) to boost domestic manufacturing of strategic climate technologies that are deemed essential to achieving the EU's decarbonization targets, and include solar, wind, battery storage, hydrogen, and carbon capture, among others. The EU has also strengthened and expanded its Emissions Trading System and introduced a Carbon Border Adjustment Mechanism (CBAM) to level the playing field for climate tech.[65] The CBAM is an import tax imposed on carbon-intensive products such as iron and steel, cement, fertilizers, electricity, and hydrogen, making climate tech a more economically attractive proposition.[66]

2. INCREASE IN CLIMATE TECH FINANCING FROM VCS AND FINANCIAL INSTITUTIONS

Global climate tech VC funding grew to a record $70.1 billion in 2022, an 89% increase on 2021.[67] While it declined by 40% in the first half of 2023 amid economic uncertainties (compared with a 53% decline in overall VC funding), recent trends show signs of growing momentum. Global climate tech VC funding for Q3 2023 reached $19.5 billion, equaling the combined climate tech VC funding for Q1 and Q2.[68] Our survey also indicates that VC interest in funding climate tech will grow gradually in the next two years. While 37% of surveyed VCs say they plan to increase investment in climate tech in 2023, this proportion rises to 48% for 2024 and 56% for 2025 (see Figure 17).

In addition to VC funding, climate tech is attracting financing through instruments such as green bonds and loans. For example, in the first half of 2023, green bonds and loans raised almost $350 billion, compared with less than $235 billion of oil-, gas-, and coal-related financing.[69] Our research reflects this strong interest. As Figure 17 shows, close to half (47%) of asset-management firms and banks in our survey planned to increase climate tech financing in 2023, with nearly as many (46%) planning to do so in 2024, growing to 53% in 2025.

FIGURE. 15

The climate tech capital stack

	GRANTS	CATALYTIC CAPITAL	VENTURE CAPITAL	VENTURE DEBT	COMMERCIAL DEBT	PROJECT FINANCE
EXPECTED RETURN RANGE / IRR	0%	0 - 10%	30%+	5-25%	5 - 15%	3 -15%
DILUTION / OWNEWSHIP	N	Y	Y	N	N	N
COMPLEXITY	HIGH	LOW	MED	MED	HIGH	HIGH
STAGE	ALL	EARLY	EARLY GROWTH	EARLY	GROWTH	GROWTH

Source: CTVC, "The Climate Capital Stack."

Christophe Defert, Head of Climate Technology Investments at HSBC Asset Management, says: ***"The challenge with climate tech is that the underlying technologies can be quite complex and diverse. They range from very capital-intensive, deep tech, hard technologies, all the way to the more traditional scalable software solutions. So, being able to allocate the right type of capital to the right technology is very important. Traditional venture capital can struggle to create returns from capital-intensive climate technologies, so there is growing recognition of the need for grants and catalytic capital, especially in the early stages, as well as other forms of capital such as venture debt, project finance, and commercial debt as the technologies mature."***

Jenna Nicholas, Head of Investments and Acquisitions at One Planet Group, a US-based impact investment fund, adds: ***"Being able to tap into different sources of capital is very important for capital-intensive climate tech projects. In the US, for example, the Inflation Reduction Act provides significant amounts of capital, some of which is focused on hardware. Private equity and infrastructure funds are also being set up with the mandate to focus more on hardware investments. We are seeing a lot of capital-intensive climate tech companies with blended capital structures, comprising VC capital, grants from government and philanthropic organizations, and low-cost loans."***

3. CORPORATE PURCHASE COMMITMENTS

Corporate purchase commitments provide a clear demand signal to developers and producers of climate tech, driving investment and economies of scale. For example, amid a lack of green fuels in the shipping industry, Danish shipping company Maersk placed orders for 25 ships that run on green methanol,[70] to incentivize fuel producers to ramp up green methanol production. Jim Hagemann Snabe, former Chairman at Maersk, describes the company's approach: ***"We're trying to break the chicken and egg problem: that nobody will build green vessels if there's no green fuel—and nobody will build or produce green fuel if there are no vessels using them. And so we said, 'Well, if we create the demand, we break this vicious circle."***[71]

Platforms such as the First Movers Coalition harness the collective purchasing power of multiple organizations to scale critical emerging climate tech. The coalition comprises 88 top global corporations and non-profits who have made a total of 113 demand commitments across eight hard-to-abate sectors. For example, companies in the aviation industry have committed to purchasing SAFs, while, in the shipping industry, companies have committed to suppliers that operate vessels running on near-zero fuels.[72]

Julien Burdeau, Group Decarbonization Director at French mining and metallurgical company Eramet, says: ***"The main hurdle with climate tech adoption for process industries is that it is a long and capex-intensive process. The required investments are high, while the returns are uncertain. You sometimes need to restructure your industrial setup completely. What would help speed up adoption is having more certainty in the revenues that can be generated from these investments. Long-term offtake agreements will help reduce the risk attached to the adoption of these technologies, considering the level of capex required."***

"The challenge with climate tech is that the underlying technologies are quite complex and diverse. They go from very capital-intensive, deep tech, hard technologies, all the way to the more traditional scalable software solutions. So, being able to allocate the right type of capital to the right technology is very important. Traditional venture capital can struggle to create returns from capital-intensive climate technologies, so there is growing recognition of the need for grants and catalytic capital, especially in the early stages, as well as other forms of capital such as venture debt, project finance, and commercial debt as the technologies mature."

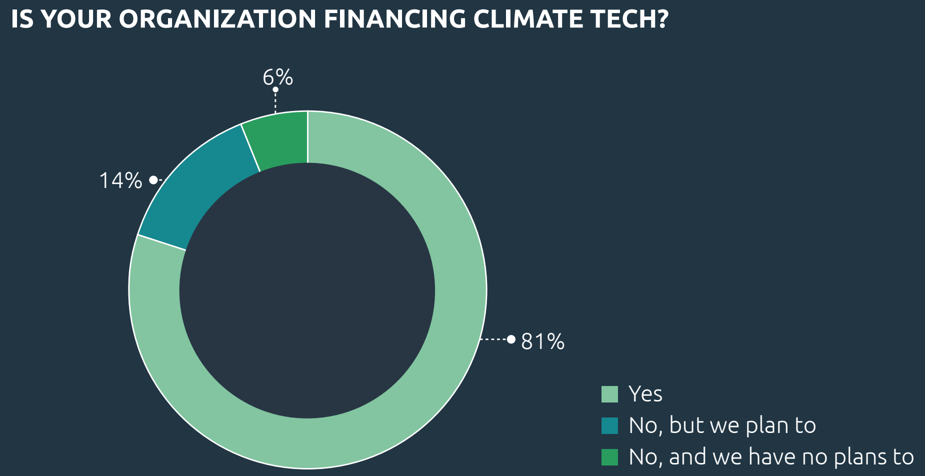
CHRISTOPHE DEFERT
Head of Climate Technology
Investments at HSBC Asset Management

CLIMATE TECH FINANCING IS A KEY PRIORITY FOR VCs AND FINANCIAL SERVICES ORGANIZATIONS

The vast majority (81%) of surveyed VCs and financial services firms are already financing climate tech (see Figure 16) and 64%* say that climate tech financing is a priority for their organization.

*Excluding VCs investing solely on climate tech.

FIGURE. 16
More than eight in ten VCs and financial services firms are already financing climate tech



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=500 VCs and financial services firms (including 28 VCs that are investing solely in climate tech).

The proportion of organizations that plan to increase climate tech financing is set to grow in the next two years.

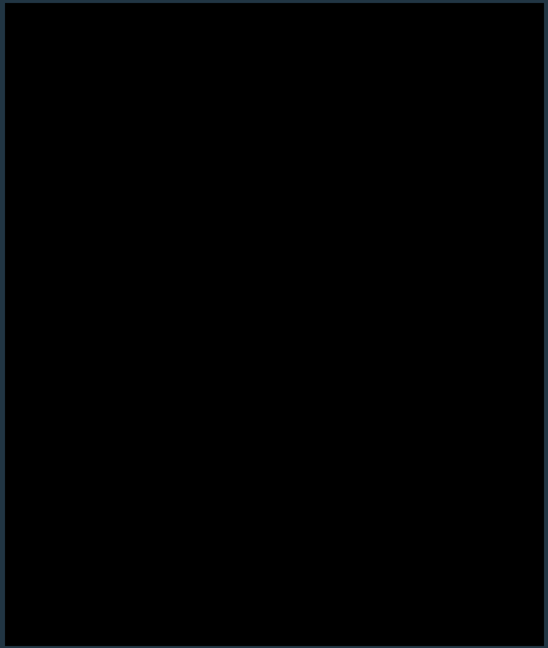
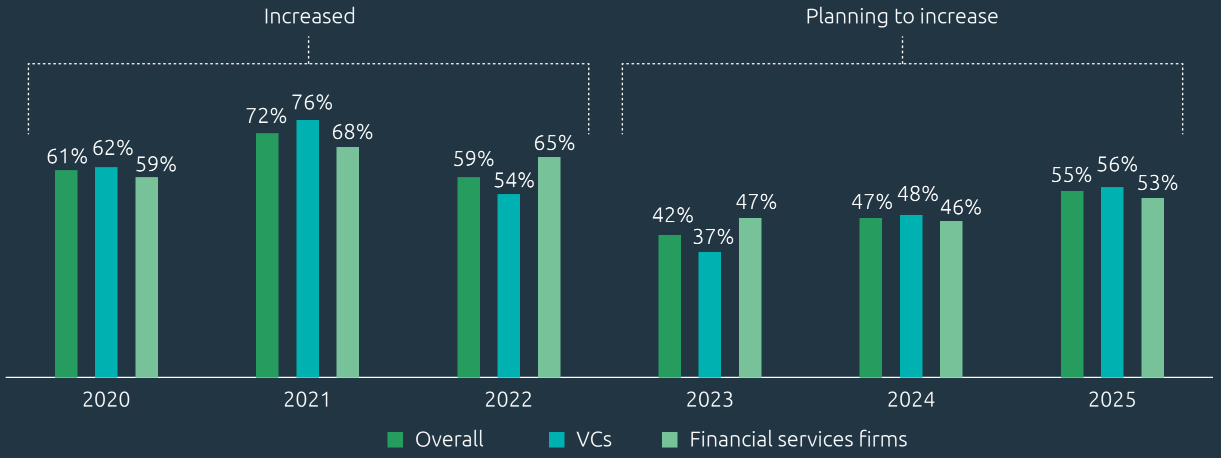


FIGURE. 17

42% of VCs and financial institutions say their organization will increase climate tech financing in 2023, with the proportion growing steadily in the next two years

% OF ORGANIZATIONS THAT INCREASED OR ARE PLANNING TO INCREASE INVESTMENT IN CLIMATE TECH



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=number of VCs and financial institutions that were financing climate tech in 2020, 2021, and 2022, and those who plan to do so in 2023, 2024, and 2025. N=201 in 2020, N=264 in 2021, N=318 in 2022, N=358 in 2023, N=409 in 2024, and N=414 in 2025.

The technologies that are likely to attract the most financing from VCs and financial institutions in the next 3–5 years include EVs and decarbonization software.

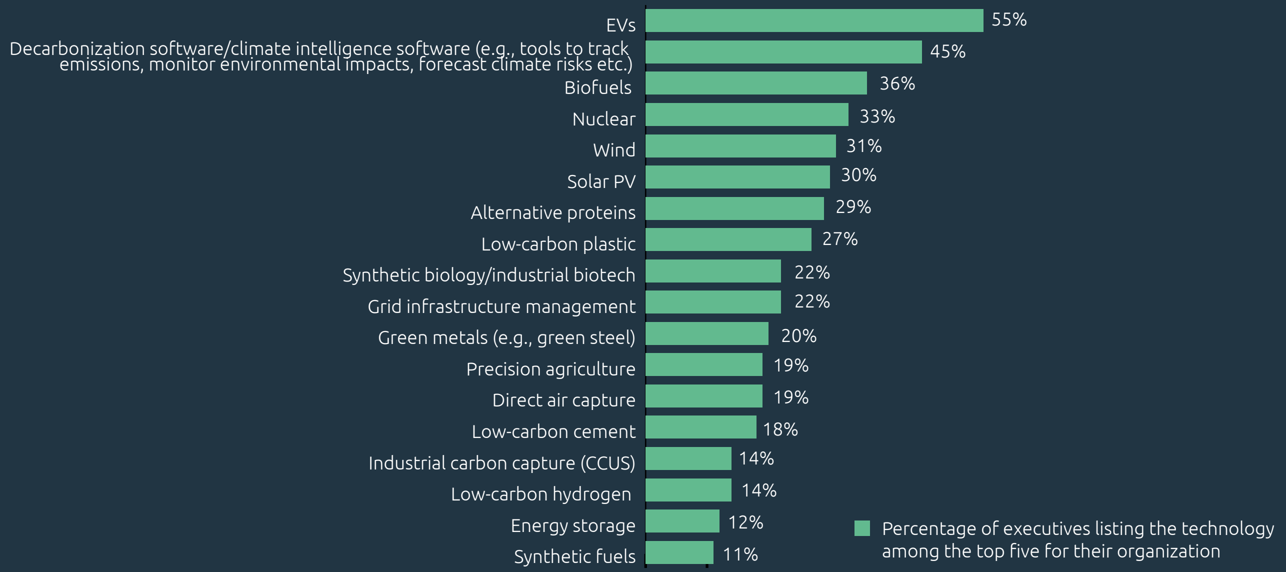
81%

of surveyed VCs and financial services firms are already financing climate tech.

FIGURE. 18

The majority of VCs and financial institutions plan to finance EVs in the next 3–5 years

WHICH OF THE FOLLOWING CLIMATE TECHNOLOGIES IS YOUR ORGANIZATION PLANNING TO FINANCE IN THE NEXT 3-5 YEARS?



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=450 VCs and financial services firms that are planning to finance climate tech in the next 3–5 years

Further, as Figure 19 shows, the proportion of asset portfolios allocated to hardware-based climate tech projects is expected to grow from 45% currently to 63% in the next 5–10 years.

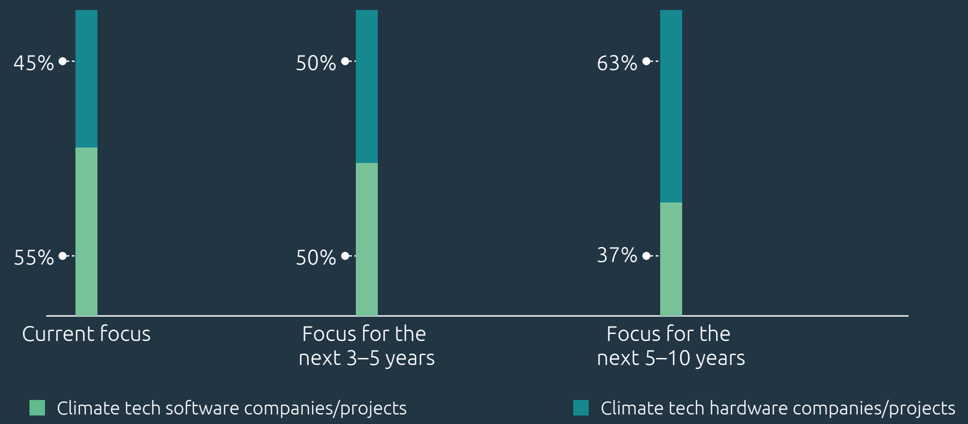
63%

Estimated proportion on asset portfolios allocated to hardware-based climate tech projects in the next 5–10 years

FIGURE. 19

Climate tech asset portfolios are expected to tilt towards hardware-focused climate tech projects in the next 5–10 years

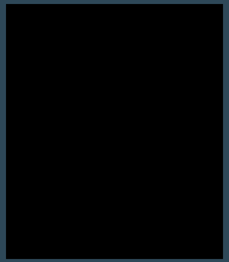
DISTRIBUTION OF CLIMATE TECH ASSET PORTFOLIO BETWEEN SOFTWARE AND HARDWARE-BASED CLIMATE TECH PROJECTS/COMPANIES



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=403 VCs and financial services firms investing in climate tech startups currently, N=450 VCs and financial services firms planning to invest in climate tech startups in the next 3–5 years; N=430 VCs and financial services firms planning to invest in climate tech startups in the next 5–10 years.

DEFINITION OF CLIMATE TECH FINANCING/FUNDING:

The term climate tech financing/funding used in the survey refers to primary investments and financial instruments supporting the development and adoption of climate tech and related infrastructure. Our definition covers a broad range of financial instruments, including lending and investment products. Examples of these instruments include green bonds, green loans, sustainability-linked bonds or loans, venture debt, and equity.



"Being able to tap into different sources of capital is very important for capital-intensive climate tech projects. In the US, for example, the Inflation Reduction Act provides significant amounts of capital, some of which is focused on hardware. Private equity and infrastructure funds are also being set up with the mandate to focus more on hardware investments. We are seeing a lot of capital-intensive climate tech companies with blended capital structures, comprising VC capital, grants from government and philanthropic organizations, and low-cost loans."

JENNA NICHOLAS
Head of Investments and Acquisitions at One Planet Group, a US-based impact investment fund

THE CRITICAL ROLE OF ECOSYSTEMS IN ACCELERATING CLIMATE TECH ADOPTION

72%

of surveyed executives say that greater collaboration between regulators, governments, and industry stakeholders is critical to accelerating adoption of climate tech

The complexities of climate tech adoption – such as lowering the green premium, building infrastructure, accelerating innovation, driving standardization, and developing skills – require collective action. More than seven in ten (72%) surveyed executives say that greater collaboration between regulators, governments, and industry stakeholders is critical to accelerating adoption of climate tech, while 54% emphasize the importance of agreement among competitors on the way forward among industry competitors.

The examples below illustrate the role played by ecosystems in accelerating climate tech adoption:

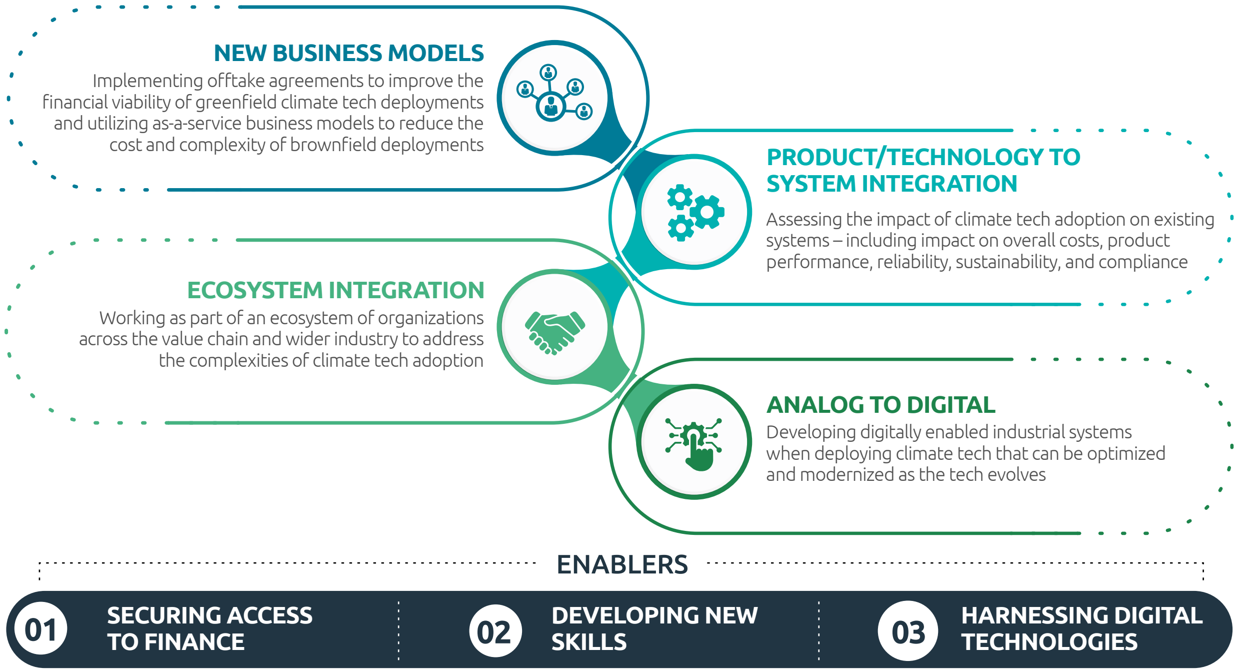
- Platforms such as the First Movers Coalition enable organizations to benefit from collective purchasing power in their industry.[73]
- In 2019, French shipping group CMA CGM launched the Coalition for Future Energy in Transport and Logistics, now renamed New Energies, to accelerate the development of sustainable mobility solutions such as green hydrogen, biofuels, and zero-emission vehicles. The coalition taps into the collective capabilities of global organizations such as Airbus, PSA International, Carrefour, Crédit Agricole CIB, ENGIE, Faurecia, Michelin, Schneider Electric, Total, and Wärtsilä.[74]
- The US government is providing $7 billion in funding for the H2Hubs program to set up seven regional clean hydrogen hubs around the country that will create networks of hydrogen producers, consumers, and local connective infrastructure to help decarbonize sub-sectors such as heavy industry (steel and cement production) and heavy-duty transportation.[75]
- The European Battery Academy (EBA), launched with support from the European Commission, seeks to address the shortage of skills in the European battery chain. The academy aims to train, reskill, and upskill nearly 800,000 workers across Europe by 2025, while reducing training costs and increasing the efficiency and quality of training for member organizations.[76]
- The MIT Climate & Sustainability Consortium (MCSC) is an academia–industry collaboration that aims to significantly accelerate the implementation of climate solutions in areas such as maritime shipping, air transportation, and heavy-duty trucking.[77]

05 RECOMMENDATIONS

In this section, we explore critical actions that corporates should take to accelerate the adoption of climate tech. As Figure 20 illustrates, these include four key shifts in perspective and practice, enabled by measures such as securing access to finance, building skills, and harnessing data and digital technologies.

FIGURE. 20

Actions to accelerate climate tech adoption



Source: Capgemini Research Institute analysis.

ACTIONS:

I. **New business models.** Innovative business models are the key to making climate tech adoption financially viable. H2 Green Steel's Swedish plant demonstrates an innovative business model for greenfield climate tech deployments. H2 Green Steel has signed offtake agreements in advance with multiple companies across industries such as automotive, commercial vehicles, white goods, furniture, and industrial equipment, ensuring guaranteed demand when the plant becomes operational. Offtake agreements reduce market uncertainties and financial risks linked to climate tech projects, increasing their attractiveness to investors and lenders. The plant is also being built close to sources of cheap renewable power to reduce production costs for green hydrogen (required to produce green steel). These elements (guaranteed demand and lower production costs) have supported H2 Green Steel in making a business case for its plant, enabling it to secure equity and debt financing from multiple sources.[78]

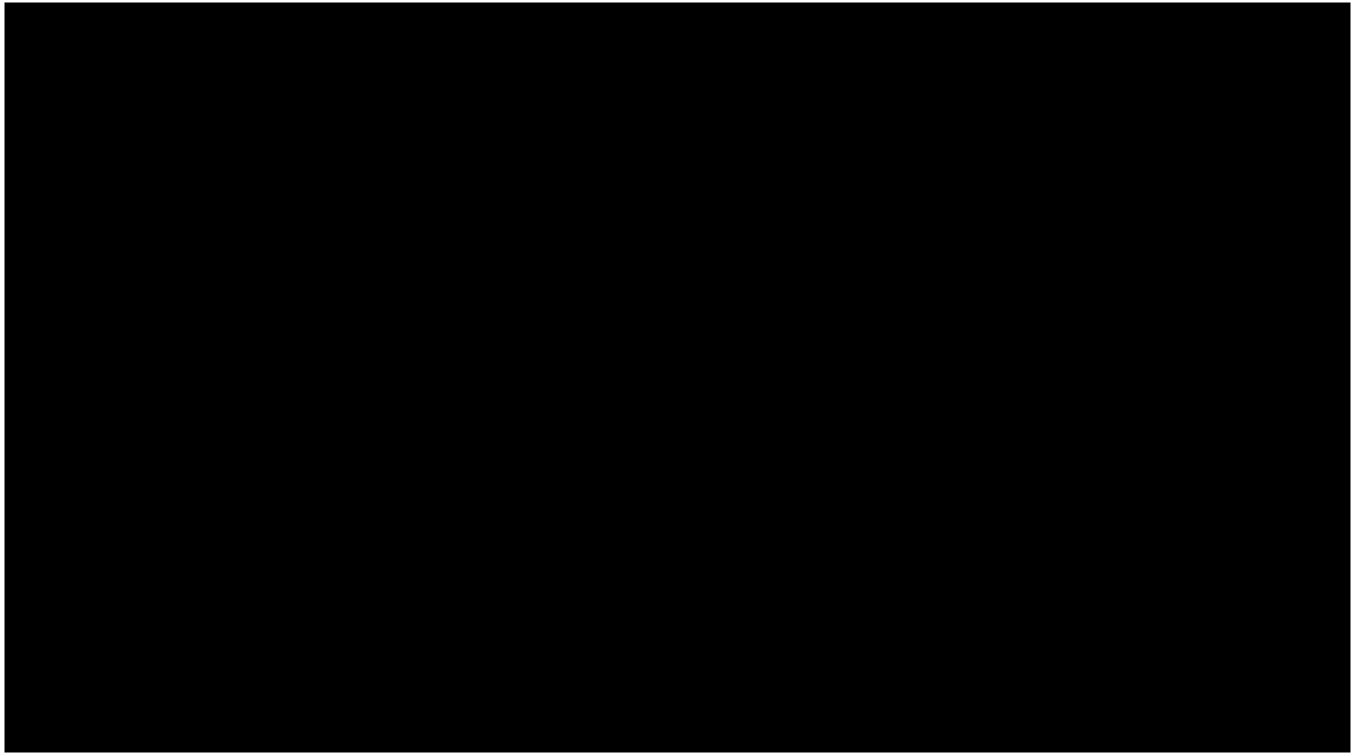
Brownfield climate tech deployments pose additional challenges, as Diego Pavia, CEO, KIC InnoEnergy, highlights: ***"The need for a tremendous transformation of manufacturing processes remains the biggest challenge in brownfield projects,"*** he confirms. 'As-a-service' business can help reduce the costs and complexities of brownfield deployments. For instance, Norway-based Aker Carbon Capture, formerly a division of Norwegian energy solutions provider Aker Carbon Capture, formerly a division of Norwegian energy solutions provider Aker Solutions, offers Carbon-capture-as-a-Service to its customers. As part of the offering, Aker Carbon Capture commissions the carbon capture plant, operates it, and handles the transportation and storage value chain, charging customers a fee per tonne of CO_2 captured (eliminating the need for upfront capital investment and simplifying operations from the customer's end).[79]
Moving forward, as-a-service business models could also cover organizations' overall decarbonization requirements, providing access to climate tech without requiring upfront capital expenditure or significant operational effort.

II. **Product/technology to system integration.** From the outset, organizations must consider the alignment and integration of climate tech with existing systems. It is critical to have a clear understanding of the impact of climate tech adoption on overall costs, product performance and reliability, sustainability, and compliance factors. This entails modelling scenarios and running simulations that assess these impacts and feed into the organization's climate tech adoption strategy, de-risking investments.

III. **Ecosystem integration.** Accelerating climate tech adoption hinges on collective action. Organizations will need to shift from working individually to working as part of an ecosystem of organizations across their value chain and wider industry. This will entail identifying and participating in existing ecosystems and initiating ecosystems where there is a structural vacuum. Ecosystem members can then work closely with a broad group of stakeholders including industry peers, academics, startups, regulators, and non-governmental organizations (NGOs).

Eramet's Group Decarbonization Director Julien Burdeau says: ***"I strongly believe that most of the challenges related to climate tech adoption are transversal to an industry. It is crucial for players within the same industry to organize and to create the right framework for efficient cooperation on topics like, for instance, carbon capture."***

IV. **Analog to digital.** Industrial systems such as power plants, energy infrastructure, and steel plants must be digitally enabled by design when deploying climate tech, so that they can be optimized and modernized as the tech evolves. For instance, in transitioning steel plants to green steel production using low-carbon hydrogen, digital enablement becomes crucial, given the long operational lifespan of a steel plant. In the context of EVs, the ability to deliver over-the-air (OTA) software updates is critical to ensuring that EV performance, efficiency, and mileage can be improved over time without requiring hardware upgrades. Digital enablement is also crucial to enabling energy-storage systems to engage effectively with power markets.



ENABLERS:

I. **Securing access to finance.** Organizations should tap into growing sources of public and private funding (government grants, subsidies, and tax credits; VC funding; debt financing) to fast-track the development and deployment of climate tech. Designing and scoping projects for eligibility for funding is key.

A senior executive at a US-based energy company comments ***"There is a lot of funding available for climate technologies and it can be accessed by progressively demonstrating the viability of a technology. The first step is to test the technology in a lab, which goes a long way in getting funding from the Department of Energy. Various research organizations and academic institutions have test labs where companies can test technologies. If testing is successful in the lab, the next step is to test the technology in the field – that's another threshold event that allows for further infusion of capital, because it shows the company's seriousness in taking a risk and testing the technology in their own operations."***

II. **Developing new skills.** Developing and deploying climate technologies will require new skillsets. Organizations will need to partner with startups and academics to access new skills as well as invest in reskilling and upskilling programs for employees. In the shipping industry, for instance, a study by the Maritime Just Transition Task Force estimates that as many as 800,000 seafarers would require additional training on alternative fuel technologies by the mid-2030s to support the drive for decarbonization. The study points towards the need for an immediate ramping up of training infrastructure.[80]

Enel has set a target of upskilling and reskilling 70% of its employees before redeployment from coal plants between 2023 and 2025.[81] The organization is also investing in skill-development programs to support the wider renewables supply chain. In 2022, Enel launched the Energy for Growth training program in partnership with ELIS, a non-profit, to meet its suppliers' skill requirements. The program was initially designed to train 5,500 new smart grid operators over two years but has now been extended to train more than 2,000 professionals in the implementation of new solar PV power plants, wind power stations, and energy-storage facilities.[82]

III. **Harnessing digital technologies.** Digital technologies such as AI, digital twins, and 3D printing can significantly enhance innovation processes and reduce the costs of climate tech adoption. For instance, Holcim, GE and COBOD (a 3D construction printing specialist) are jointly developing wind turbines with 3D printed concrete bases that can reach heights up to 200 meters, helping generate more than one-third more energy from a single tower. Edelio Bermejo, Holcim's Head of Global R&D, highlights the potential of the technology in accelerating the clean energy transition: ***"Projects that would have been impossible yesterday are now a reality."***[83]

"I strongly believe that most of the challenges related to climate tech adoption are transversal to an industry. It is crucial for players within the same industry to organize and to create the right framework for efficient cooperation on topics like, for instance, carbon capture."

JULIEN BURDEAU
Group Decarbonization Director at French mining and metallurgical company Eramet

In discussion with **Diego Pavia, CEO, KIC InnoEnergy**

[redacted]

DIEGO PAVIA
Diego Pavia, CEO,
KIC InnoEnergy

HOW CAN ORGANIZATIONS FOSTER THE DEVELOPMENT OF CLIMATE TECHNOLOGIES?

- Diego Pavia: *In my opinion, winning climate technologies will be those that enable demand to be electrified, hydrogen in hard-to-abate industries such as steel, fertilizers, ammonia for maritime transport, and eSAF for aviation; batteries and energy storage in transforming the electricity system; heat pumps to electrify heating and cooling in industrial and residential environments; renewables – including innovative areas such as tidal and wave; and grid-management solutions, because there will be a need for very strong grids and strong deployment of large volumes of storage to tackle the challenge of intermittency.*

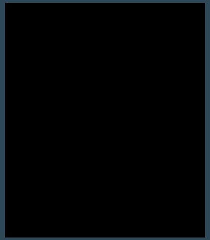
WHICH CLIMATE TECHNOLOGIES HAVE THE HIGHEST MITIGATION POTENTIAL?

- Diego Pavia: *Organizations should not only look at the green premium of the intermediate product but of the end-product. For example, while green steel has a high green premium as an intermediate product, when it is used to manufacture a car, it only adds a fraction of that green premium to the final cost of the car. So, it is important to look at the end product and to then design innovative business models such as offtake agreements to minimize risk. In the case of H2 Green Steel's plant in Sweden, for example, the order book is already full to 2030 owing to offtake agreements with several industry players such as car manufacturers, shipping firms, and construction companies.*

STABLE REGULATORY REGIMES AND UNIFIED POLICY FRAMEWORKS ARE THE BEDROCK OF ACCELERATED CLIMATE TECH ADOPTION

As Figure 21 shows, 66% of executives say that a stable regulatory regime is critical to accelerating adoption of climate tech. Other regulatory aspects, such as a unified policy framework across regions, visibility of upcoming regulations, and standardization of carbon pricing across regions, are also keys to stepping up adoption.

In the shipping industry, for example, regulatory clarity around fuels and technologies will drive long-term investment in technology and training. In July 2023 the International Maritime Organization's (IMO) Marine Environment Protection Committee (MEPC) laid down guidelines for lifecycle analysis of marine fuels to assess related emissions more accurately. Such guidelines are essential to providing clarity around the benefits of various fuel options and in determining the shipping industry's future training needs.[84]



“We need standardization and transparency with clear criteria for decision making; a common approach and framework to choose the right technology stack for the project, supported by an effective cost-benefit analysis in the short and medium term.”

RICARDO PÉREZ SÁNCHEZ
Head of Global Sustainability Adoption at Enel Grids

FIGURE. 21
Two-thirds of executives say that stable regulatory regimes are critical to accelerating the adoption of climate tech

% OF EXECUTIVES WHO RATE THE FOLLOWING FACTORS AS CRITICAL TO ACCELERATING THE ADOPTION OF CLIMATE TECH IN THEIR INDUSTRY

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations.

ORGANIZATIONS MUST USE CLIMATE TECH RESPONSIBLY

Climate tech need to be used wisely and responsibly to avoid any unintended negative consequences such as environmental damage (for instance, arising from mining of critical minerals or improper waste management). However, current levels of awareness are low:

- Only 34% of surveyed executives say their organizations have a high level of awareness of potential negative environmental and social impacts of climate tech adoption.
- Only 23% say their organizations are working on addressing potential negative environmental and social impacts of climate tech adoption (e.g., ensuring responsible sourcing of materials, considering human rights concerns, and mitigating environmental impacts across supply chains).

Enel, for instance, is ensuring that responsible use of materials is designed into its climate tech projects. Its 3SUN Gigafactory in Catania, Sicily is built on circular practices such as increasing the use of recycled materials and reducing energy and resource consumption.[85] Eliano Russo, Head of Enel Green Power's 3SUN Gigafactory, says: ***"Sustainability is key to everything we have been doing to date, from sourcing materials such as cement and iron, to grinding, excavating, and recovering materials. We are also embedding circularity principles; we use materials that are already recycled in the construction phase. We reused excavated ground as the foundation of this factory. We minimize consumption of water and electricity. Everything is finalized to create a real connection with the local environment and minimize the impact of what we are building here."***[86]

Conclusion

As the IPCC makes clear in no uncertain terms, the time to act is now. Organizations must take decisive action on climate change within this decade to ensure that we use the narrow window of opportunity to limit global temperature rise to 1.5°C. Accelerating the adoption of climate tech is critical to mitigating the impact of climate change, as well as other environmental challenges. The cost of delayed action is significant and will undermine organizations' competitiveness in the long term.

However, it is key to note that climate tech should not be viewed as a silver bullet. Addressing the climate and ecological crisis requires systemic change that goes beyond the use of technology. A shift in mindset towards increased sufficiency and a pivot towards non-extractive business models are at the core of the transformation required to bring corporate activity – and humanity – back within planetary boundaries.

Research methodology

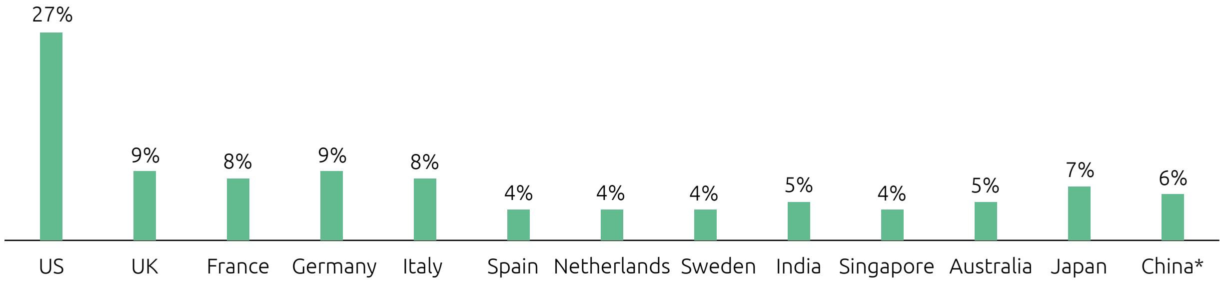
The objective of this research was to examine the role of climate tech in helping organizations mount an effective response to the climate and ecological crisis; the challenges impeding climate tech adoption; and strategies for accelerating adoption.

Survey of executives from large corporates

We surveyed senior 1,350 executives (director-level and above) from large organizations that have plans to decarbonize or reach net zero. The global survey took place in August and September 2023 and covered 13 countries in North America, Europe, and Asia-Pacific, across 16 industries.

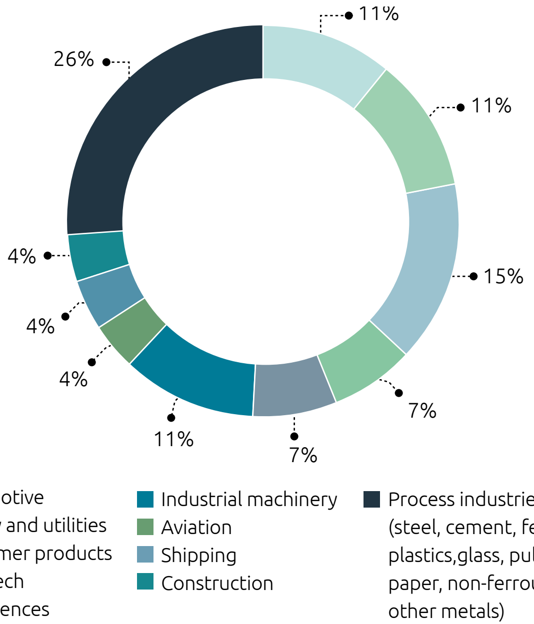
The distribution of respondents and their organizations is provided in the following figures.

ORGANIZATIONS BY COUNTRY



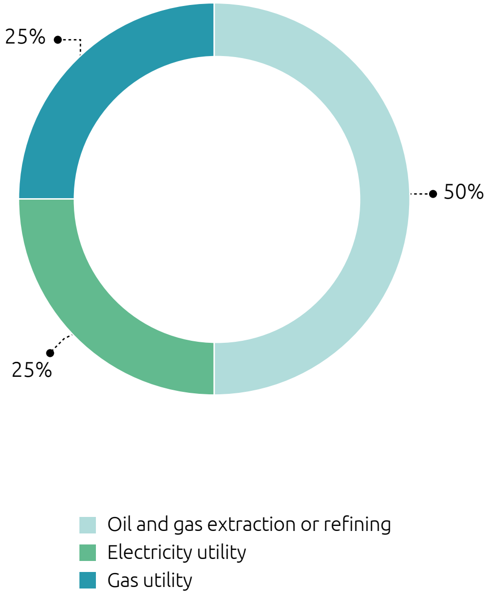
**Only organizations within the process industries sector were drawn from China.*
Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations.

ORGANIZATIONS BY SECTOR



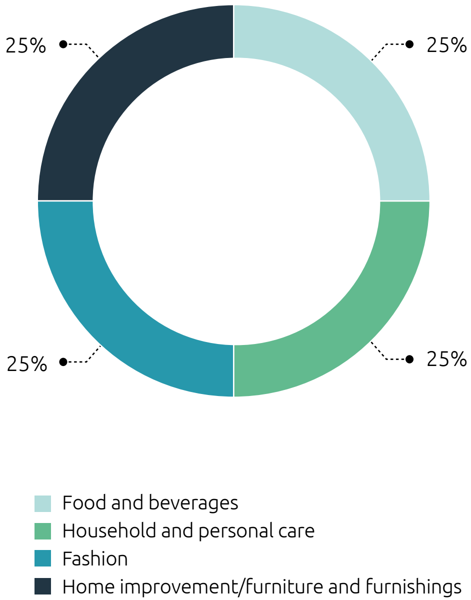
Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations.

ORGANIZATIONS BY SUB SECTOR – ENERGY AND UTILITIES



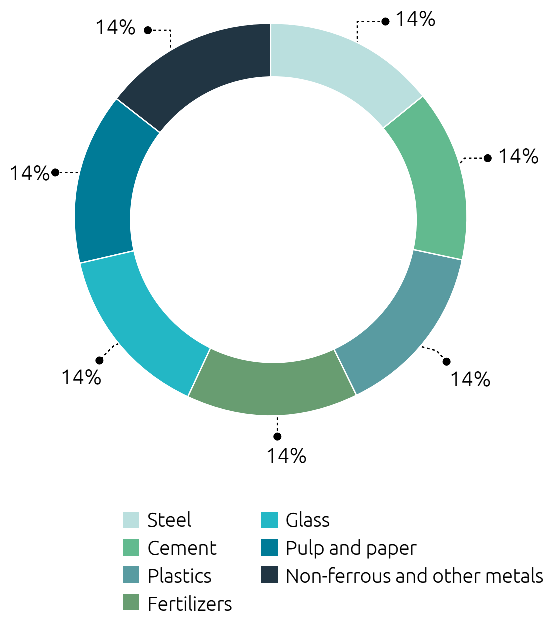
Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=150 energy and utilities organizations.

ORGANIZATIONS BY SUB SECTOR – CONSUMER PRODUCTS



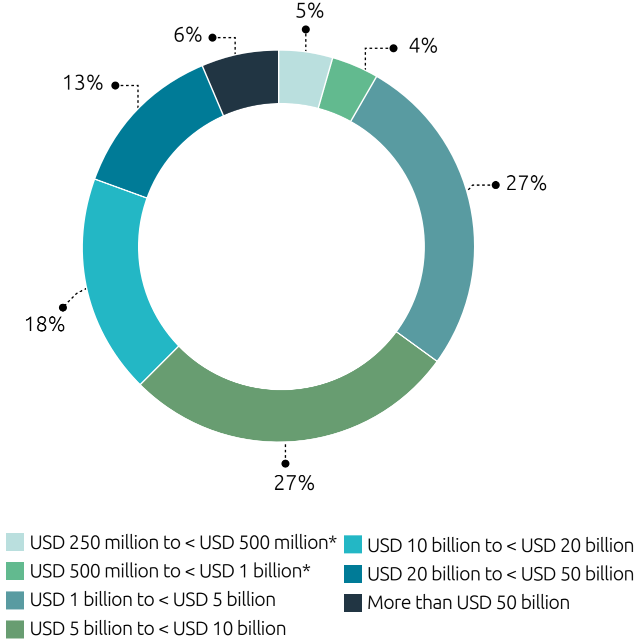
Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=200 consumer products organizations.

ORGANIZATIONS BY SUB SECTOR – PROCESS INDUSTRIES



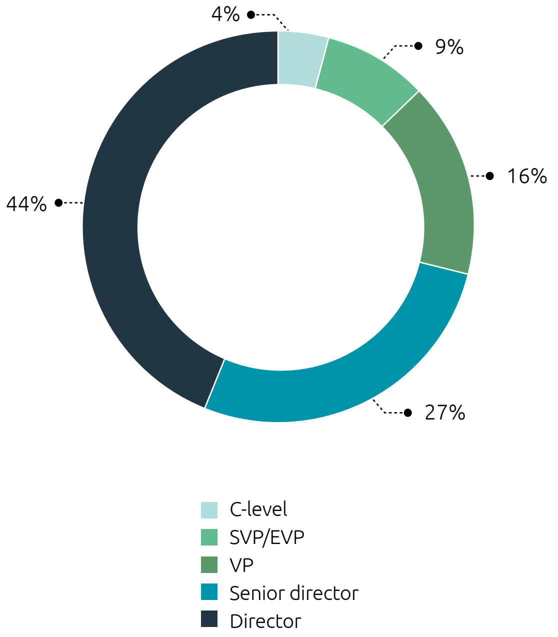
Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=350 organizations from process industries.

ORGANIZATIONS BY ANNUAL REVENUE *(All industries)*



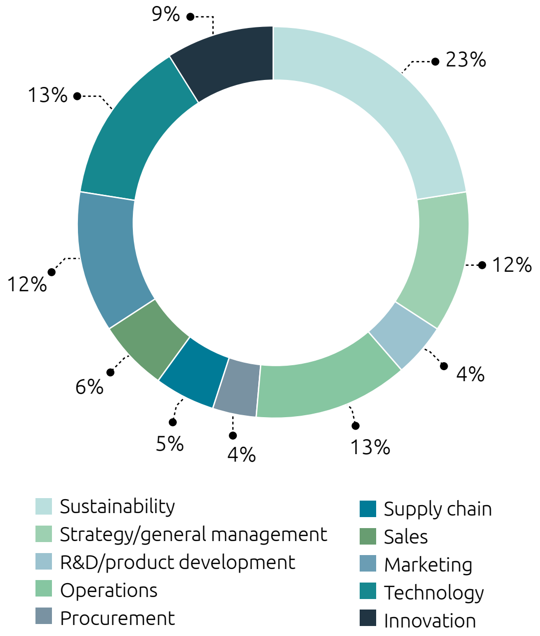
**Only organizations belonging to process industries fall under these revenue brackets. All other organizations have annual revenue exceeding $1 billion.*
Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations with N=350 organizations in process industries

RESPONDENTS BY DESIGNATION



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations.

RESPONDENTS BY FUNCTION



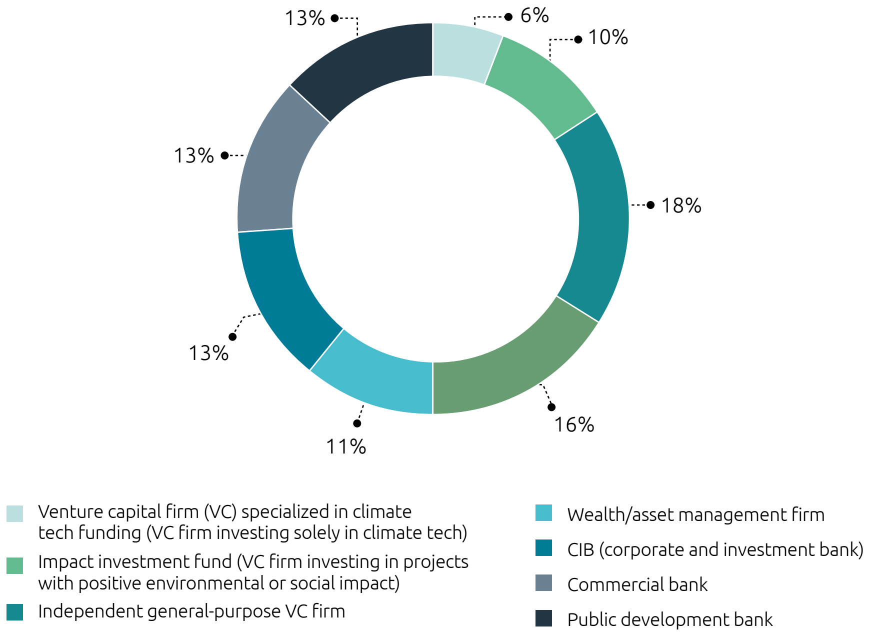
**Percentages may not add up to 100 due to rounding.*
Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=1,350 organizations.

Survey of executives from venture capital firms and financial institutions

We also surveyed senior executives from 500 venture capital firms and financial services organizations to understand their investment plans in relation to climate tech.

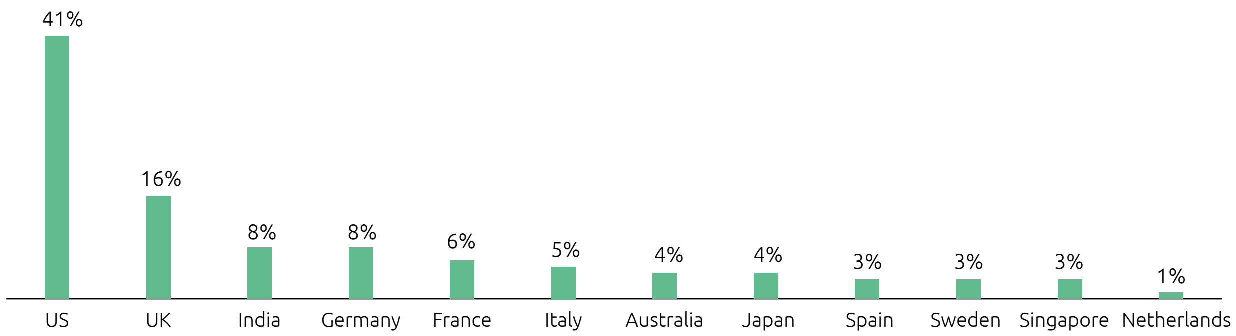
The distribution of respondents is provided in the following figures.

VCs AND FINANCIAL SERVICES FIRMS BY CATEGORY



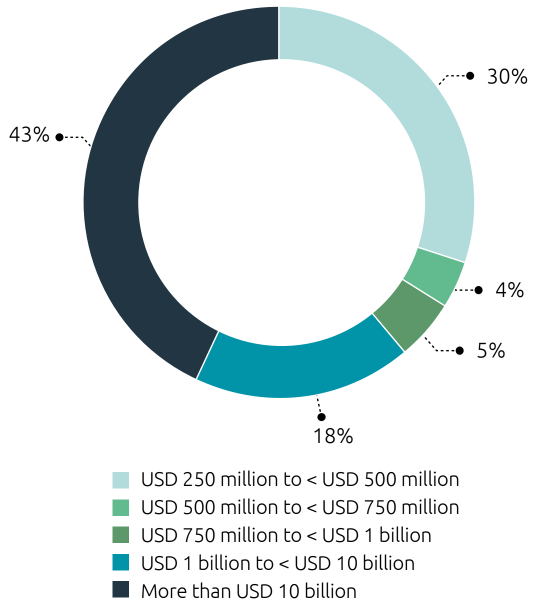
Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=500 VCs and financial services firms.

VCs AND FINANCIAL SERVICES FIRMS BY COUNTRY



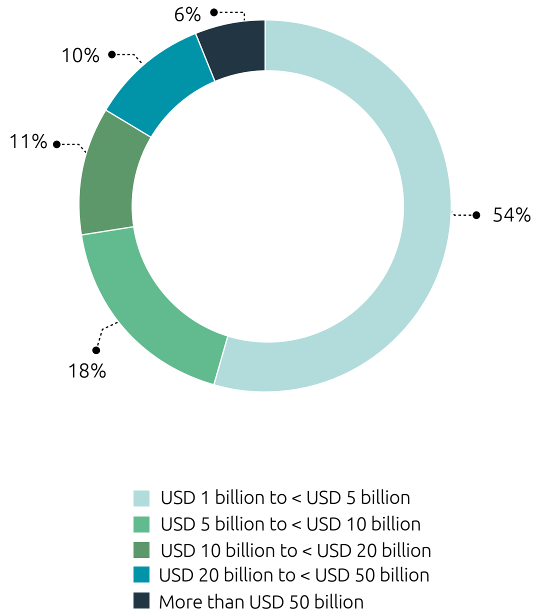
Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=500 VCs and financial services firms.

VCs AND WEALTH/ASSET MANAGEMENT FIRMS BY ASSETS UNDER MANAGEMENT (AUM)



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=305 VCs specialized in climate tech funding, impact investment funds, independent general purpose VC firms, VC firms that are part of a financial services firm, and wealth/asset management firms.

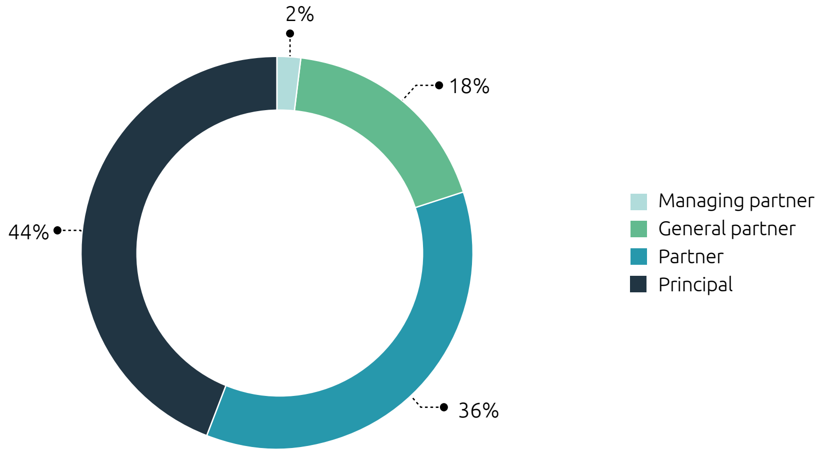
BANKS BY ANNUAL REVENUE



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=195 corporate and investment banks (CIBs), commercial banks, and public development banks.

RESPONDENTS BY CURRENT JOB ROLE OR TITLE

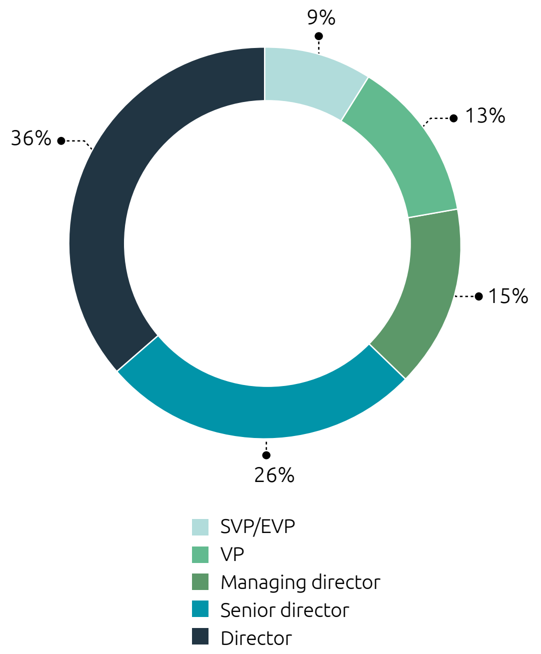
Includes respondents from specialized climate tech VC firms, impact investment funds, general purpose independent VC firms and VCs that are part of financial services firms



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=250 respondents from specialized climate tech VC firms, impact investment funds, independent general purpose VC firms, and VC firms that are part of financial services provider firms.

RESPONDENTS BY CURRENT JOB TITLE/ROLE

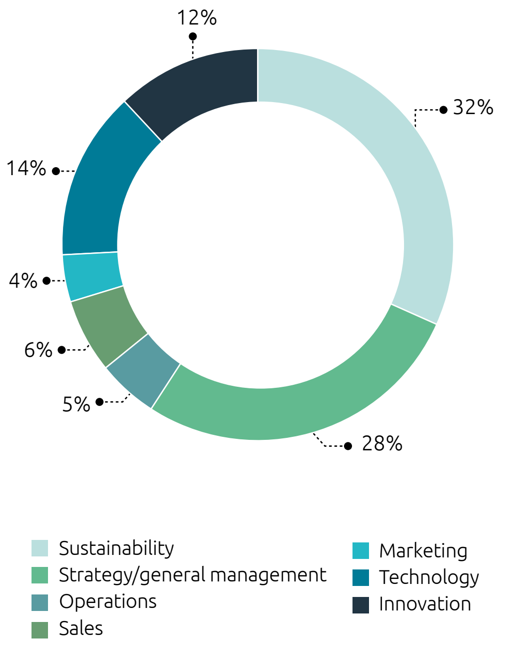
Includes respondents from wealth/asset management firms, CIBs, commercial banks and public development banks



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=250 respondents from wealth/asset management firms, corporate and investment banks (CIBs), commercial banks, and public development banks.

RESPONDENTS BY FUNCTIONAL AREA

Includes respondents from CIBs, commercial banks and public development banks



Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=195 respondents from corporate and investment banks (CIBs), commercial banks, and public development banks.

In-depth interviews

We complemented the surveys with in-depth interviews with 17 senior industry executives and experts.

The study findings reflect the views of the people who responded to our online questionnaire for this research and are aimed at providing directional guidance. Please refer to the methodology for details of respondents and get in touch with a Capgemini expert to understand specific implications.

Appendix

Calculation for the number of years for green premiums to be lowered to a level acceptable to corporates

For this analysis, we compared the current green premium for select climate tech such as solar, EVs, low-carbon hydrogen, CCUS, heat pumps, SAF, and green methanol with the average green premium that corporates in our survey are willing to accept (the green premium refers to the difference in cost between low-carbon products and their high-emitting alternatives – i.e., the additional cost of adopting climate tech – as shown in the table below). We then calculated the number of years that it will take for the current green premium for each of these climate technologies to reach the acceptable level. To do so, we assumed that the current green premiums would reduce at the rate at which the cost of solar PV modules has fallen between 2008 and 2020 – i.e., at a CAGR of 21% (see table below). For instance, SAF has a current green premium of 123% (i.e., it costs 123% more than its traditional alternative, jet fuel), and, as per our survey, the aviation industry is willing to accept a green premium of 10.4% to adopt SAF.

Based on the assumption that the cost of SAF will fall at the same rate as solar PV modules (i.e., 21% per year), it will take 10 years for the cost of SAF to reduce to a level acceptable to corporates (from 123% to 10.4%).

[Note: For the purposes of our calculations, we assumed that the cost of all technologies declines from 2023 at the rate at which the cost of solar technology fell between 2008 and 2020. However, this is dependent on the technologies receiving the same level of financing and policy support as solar technology in the years to come.]

SOLAR PV MODULE COST – RATE OF REDUCTION IN COST/WATT FROM 2008–20

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Solar ($/ Watt)	3.5	2.4	2.2	1.7	1.0	0.9	0.9	0.8	0.7	0.6	0.4	0.3	0.2
CAGR	(21%)												

Source: Solar PV module cost - IEA, "Evolution of solar PV module cost by data source," retrieved from https://www.iea.org/data-and-statistics/charts/evolution-of-solar-pv-module-cost-by-data-source-1970-2020.

NUMBER OF YEARS FOR GREEN PREMIUM TO BE LOWERED TO A LEVEL ACCEPTABLE TO CORPORATES

Clean/low-carbon product	Conventional alternative	Actual green premium* (difference in cost between clean/low carbon product versus conventional alternative)	Acceptable green premium** (industry average)	Rate at which green premium will drop (assuming solar average)***	Estimated number of years for green premium to be lowered to a level acceptable to corporates
Solar powered electricity	Coal powered electricity	(-38%)[1]	8.3%[1]	21%	0
EVs	Internal combustion engine	13%[2]	9.2%[2]	21%	2 years
Low-carbon plastics using carbon capture	Conventional plastics	9-15%[3]	9.5%[3]	21%	2 years
Low-carbon steel using carbon capture	Conventional steel	16-19%[4]	10.9%[4]	21%	2-3 years
Low-carbon steel using low-carbon hydrogen	Conventional steel	20-30%[5]	10.9%[5]	21%	3-5 years

Data on actual green premium:
[1] Global levelized cost of solar electricity (average of tracking and fixed axis PV – 46$/MWh) versus global levelized cost of coal-powered electricity (74$/MWh). Source: BloombergNEF, "Cost of Clean Energy Technologies Drop as Expensive Debt Offset by Cooling Commodity Prices," June 2023.
[2] Average of total cost of ownership of EVs (Chevrolet Equinox EV, Volkswagen ID.4 Pro 82kWh RWD EV, Ford Mustang Mach-E Premium EV, Ford F-150 Lightning EV) versus average of total cost of ownership of ICEs (Chevrolet Equinox RS ICE, Volkswagen Tiguan SE ICE, Ford Edge ST-Line ICE, Ford F-150 ICE) Source: Environmental Defense Fund (EDF), "Electric Vehicle Total Cost of Ownership Analysis," July 2023.
[3] Cost of 1 ton of low-carbon plastics using carbon capture versus 1 ton of conventional plastic. Source: Breakthrough Energy, "The Green Premium," retrieved from https://breakthroughenergy.org/our-approach/the-green-premium/
[4] Cost of 1 ton of low-carbon steel using carbon capture versus 1 ton of conventional steel. Source: Breakthrough Energy, "The Green Premium," retrieved from https://breakthroughenergy.org/our-approach/the-green-premium/

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Clean/low-carbon product	Conventional alternative	Actual green premium* (difference in cost between clean/low carbon product versus conventional alternative)	Acceptable green premium** (industry average)	Rate at which green premium will drop (assuming solar average)***	Estimated number of years for green premium to be lowered to a level acceptable to corporates
Heat pump – replaements (in the US)	Gas boiler	35-56%[6]	8.8%[6]	21%	6-8 years
Low-carbon cement using carbon captures	Conventional cement	75-140%[7]	9.9%[7]	21%	9-12 years
SAF	Jet fuel	123%[8]	10.4%[8]	21%	11 years
Green methanol	Bunker fuel	340%[9]	9.4%[9]	21%	16 years

[5]Cost of low-carbon steel using low-carbon hydrogen versus conventional steel based on H2 Green Steel estimates. Hydrogen Insight, "'Our hydrogen-based green steel could be cost-competitive with dirty equivalents within ten years. Here's how'," November 2023.

[6]Cost of heat pump – replacements (in the US) versus cost of gas boiler (this excludes the green premium for electricity. Source: Breakthrough Energy, "The Green Premium," retrieved from https://breakthroughenergy.org/our-approach/the-green-premium/

[7]Cost of 1 ton of low-carbon cement using carbon capture versus 1 ton of conventional cement. Source: Breakthrough Energy, "The Green Premium," retrieved from https://breakthroughenergy.org/our-approach/the-green-premium/

[8]Cost of 1 ton of SAF versus cost of 1 ton of jet fuel. Source: International Air Transport Association (IATA), "Sustainable aviation fuel output increases, but volumes still low," retrieved from https://www.iata.org/en/iata-repository/publications/economic-reports/sustainable-aviation-fuel-output-increases-but-volumes-still-low/#:~:text=During%20 2022%2C%20the%20average%20SAF,price%20of%20conventional%20 jet%20fuel

[9]Cost of green methanol versus cost of bunker fuel. Hellenic Shipping News, "Switch to green e-methanol would raise bunker costs by 340%," HYPERLINK "March"April 2023.

***Data on acceptable green premium - industry average: Capgemini Research Institute, Climate Tech Survey, August–September 2023;[1]N=149 executives from the energy and utilities industry; [2]N=149 executives from the automotive industry; [3]N=50 executives from the plastic industry; [4,5] N=50 executives from the steel industry; [6] N=50 executives from the construction industry; [7]N=49 executives from the cement industry; [8]N=50 executives from the aviation industry;[9] N=49 executives from the shipping industry.*

****Rate at which cost of climate technologies will drop (assuming solar average) – solar PV module cost evolution.*

PRIORITY CLIMATE TECHNOLOGIES BY SECTOR

AUTOMOTIVE	% of executives that rate the technology as a high priority for their organization
EVs	80%
Global vehicle energy efficiency (reducing vehicle weight/increasing fuel efficiency to reduce emissions)	72%
Next-generation battery manufacturing (development of scalable manufacturing processes for next-generation batteries/gigafactories)	32%
Battery recycling	43%
Battery second life (repurposing batteries for other applications such as stationary energy storage, rather than recycling or disposing them)	17%
Low-carbon hydrogen (fuel cell vehicles)	41%
Biofuels (liquid fuels for ICEs)	66%
Biogas/biomethane (gaseous fuels for ICEs)	16%
E-fuels (electrofuels or synthetic fuels for ICEs)	29%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=150 automotive organizations.

ENERGY AND UTILITIES	% of executives that rate the technology as a high priority for their organization
Solar PV	57%
Wind	66%
Niche renewables (e.g., geothermal, tidal, hydro)	66%
Biofuels	60%
Biogas	31%
Low-carbon hydrogen	22%
Nuclear	61%
Grid-scale energy storage	39%
Grid infrastructure management	63%
Energy-efficient technologies (use of energy-efficient equipment or smart energy management systems)	71%
Industrial carbon capture (CCUS)	36%
Direct air capture	9%
Carbon removal through biochar	13%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=150 energy and utilities

FOOD AND BEVERAGES	% of executives that rate the technology as a high priority for their organization
Synthetic biology/industrial biotech	42%
Precision agriculture	48%
Alternative proteins	62%
Energy-efficient technologies (use of energy-efficient equipment or smart energy management systems)	68%
Waste-management technologies	64%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 food and beverage organizations.

HOUSEHOLD AND PERSONAL CARE	% of executives that rate the technology as a high priority for their organization
Synthetic biology/industrial biotech	34%
Energy-efficient technologies (use of energy-efficient equipment or smart energy management systems)	66%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 household and personal care organizations.

FASHION	% of executives that rate the technology as a high priority for their organization
Synthetic biology/industrial biotech	46%
Energy-efficient technologies (use of energy-efficient equipment or smart energy management systems)	62%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 organizations from the fashion industry.

HOME IMPROVEMENT/FURNITURE AND FURNISHINGS	% of executives that rate the technology as a high priority for their organization
Synthetic biology/industrial biotech	28%
Energy-efficient technologies (use of energy-efficient equipment or smart energy management systems)	72%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 home improvement/furniture and furnishing organizations.

HIGH TECH	% of executives that rate the technology as a high priority for their organization
Energy-efficient data centers	64%
End-of-life management of electronic devices (tech to define new engineering processes to reuse and recycle)	86%
Energy-efficient technologies (use of energy-efficient equipment or smart energy management systems)	78%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=100 high tech organizations.

LIFE SCIENCES	% of executives that rate the technology as a high priority for their organization
Synthetic biology/industrial biotech	58%
Energy-efficient technologies (use of energy-efficient equipment or smart energy management systems)	58%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=100 life sciences organizations.

INDUSTRIAL MACHINERY	% of executives that rate the technology as a high priority for their organization
Industrial process electrification	57%
Low-carbon hydrogen	41%
Industrial carbon capture (CCUS)	43%
Energy-efficient technologies (use of energy-efficient equipment or smart energy management systems)	67%
Waste-management technologies	64%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=150 industrial machinery organizations

AVIATION	% of executives that rate the technology as a high priority for their organization
Energy-efficient aircraft	68%
Hybrid electric aircraft	46%
Sustainable aviation fuels (biofuels designed for aviation use)	78%
Low-carbon hydrogen	28%
Synthetic fuels	18%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 aviation organizations.

SHIPPING	% of executives that rate the technology as a high priority for their organization
Energy-efficient ships	62%
Wind-assisted propulsion systems (technologies such as sails and wind capture devices that use wind energy to propel ships, in order to reduce fossil fuel consumption)	50%
Low-carbon hydrogen (alternative fuel)	72%
Ammonia (alternative fuel)	14%
Methanol (alternative fuel)	68%
Onboard carbon capture (technologies that capture carbon dioxide emissions from a ship's exhaust and store them onboard in storage tanks. The stored carbon dioxide is later offloaded at ports for disposal)	42%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 shipping organizations.

CONSTRUCTION	% of executives that rate the technology as a high priority for their organization
Energy-efficient building solutions (HVAC systems, water heating, electrification, appliances, lighting)	68%
Energy storage	14%
Heat pumps	44%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 construction organizations.

STEEL	% of executives that rate the technology as a high priority for their organization
Low-carbon hydrogen for energy	68%
CCS: Pre-combustion carbon capture (within process) or Oxy-fuel combustion	50%
CCS: Post-combustion carbon capture using amines	68%
Switching to biomass or waste for energy	80%
Switching to electrification (for energy)	60%
Waste heat recovery	68%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 steel organizations.

CEMENT	% of executives that rate the technology as a high priority for their organization
CCS: Post-combustion carbon capture using amines	66%
Switching to biomass or waste for energy	26%
Waste heat recovery	62%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 cement organizations.

PLASTICS	% of executives that rate the technology as a high priority for their organization
Low-carbon hydrogen for feedstock	34%
CCS: Post-combustion carbon capture using amines	38%
Switching to biomass or waste for energy	26%
Switching to biomass or waste for feedstock	42%
Switch to electrification (for energy)	40%
Waste heat recovery	68%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 plastics organizations.

FERTILIZERS	% of executives that rate the technology as a high priority for their organization
Low-carbon hydrogen for feedstock	22%
Switching to biomass or waste for energy	60%
Switching to biomass or waste for feedstock	24%
Switch to electrification (for energy)	56%
Waste heat recovery	52%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 fertilizers organizations.

GLASS	% of executives that rate the technology as a high priority for their organization
CCS: Post-combustion carbon capture using amines	34%
Waste heat recovery	64%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 glass organizations.

PULP AND PAPER	% of executives that rate the technology as a high priority for their organization
CCS: Post-combustion carbon capture using amines	34%
Switching to biomass or waste for energy	54%
Switching to electrification (for energy)	20%
Waste heat recovery	66%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 pulp and paper organizations.

NON-FERROUS AND OTHER METALS (E.G., ALUMINIUM, COPPER)	% of executives that rate the technology as a high priority for their organization
CCS: Post-combustion carbon capture using amines	38%
Waste heat recovery	58%

Source: Capgemini Research Institute, Climate Tech Survey, August–September 2023; N=50 non-ferrous and other metals organizations.

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	Sustainable technology	We enable your IT department to champion sustainability through both Green IT and IT for Green initiatives that reduce the digital and technological impact, embrace sustainable technologies, improve services and employee experiences, and spark culture change by engaging IT and employees alike, all while measuring your progress and its impact.
MONITOR AND REPORT	**ESG management and reporting**	We go beyond carbon and mandatory reporting to help you measure your commitments, monitor your progress, identify quick wins and impactful transformation opportunities, unlock value, and provide transparency to consumers, citizens, shareholders, and regulatory bodies by securely harnessing the power of data across your entire ecosystem to create environmental and social impact while improving your ESG performance and bottom line.

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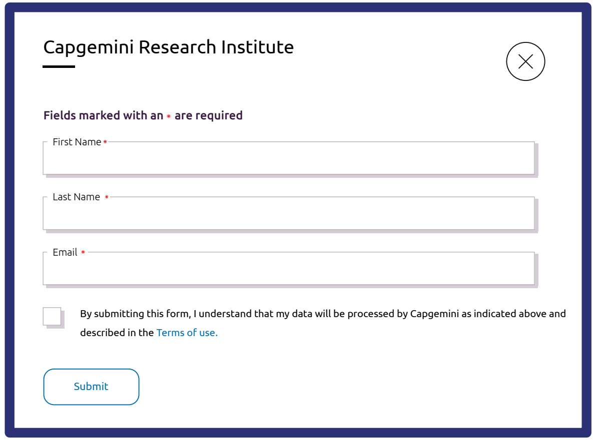
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