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The turning point

A new economic climate in the United States

January 2022

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Foreword

If not for a global pandemic, 2021 might be remembered as the year climate change became a reality for many Americans. As wildfires ravaged California, the drifting smoke created a haze on the other side of the continent. A historic heatwave gripped the Pacific Northwest, killing hundreds. Meanwhile, the "megadrought" across the West reduced Lake Mead to historically low levels, threatening the fresh water supply for millions of people. And then, in late August, a Category 4 hurricane hit the Gulf Coast. After plowing through New Orleans and surrounding areas, it traveled north along the Atlantic coast, bringing torrential rains to New York City that submerged cars, rushed into low-lying apartments, and turned subway stairwells into raging streams.

When we now chat with friends and neighbors about the severe weather we've been having, we're talking about a changing climate. Sixty percent of US respondents in an October 2021 Deloitte survey indicated they had experienced at least one climate-related severe weather event in the last six months.[1] And the climate science shows what we've seen so far is likely a mere preview of what's to come.

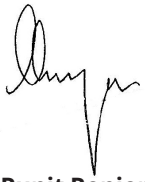
But now is the time to turn ambition into action. We can act, collectively, to avert the worst impacts of climate change. Doing so will mean nothing less than a transformation of the United States and global economies. The world's current system of economic production is creating untenable changes to our physical environment,[2] so we need to create a new model for economic growth.

In this report, the Deloitte Economics Institute presents a portrait of a future the US could create if it uses this valuable window of opportunity to rapidly decarbonize its economy. Using new data from the Deloitte Economics Institute's in-house integrated climate and economic *D.Climate* model, the analysis reveals the costly consequences of insufficient action, as well as the choices the country can still make to drive prosperity through a low-emissions industrial revolution. The result could be a more dynamic, resilient economy. And the benefits would accrue to every region in the US and globally.

Importantly, this report also demonstrates that the costs of this transformation—an oft-cited barrier—could actually be relatively modest, as compared to the consequences of insufficient action. And the US has everything it needs to rapidly begin this transformation today.

As the scale of these changes across our climate system is unprecedented,[3] our response should be commensurate with the need. Every corner of the economy will be impacted, and every organization and individual has a role in remaking the systems that underpin modern life. As we head into a new era, we are faced with a choice: Do we commit to a prosperous, decarbonized future for the US or do we continue to allow climate change to damage our growth?

The choices we make today will define our future.



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Glossary of key terms

The following references and terms are defined for specific purposes in this report.

Climate change: A persistent change in the state of the climate that can be identified and is brought about by increased greenhouse gas (GHG) concentrations in the atmosphere. "Locked in" climate change refers to the likely unavoidable impacts of continued global warming already ensured due to historical emissions.

Turning point: The point in time at which the economic benefits of decarbonization start to exceed the combined costs to transition the economy to net zero and the costs of "locked in" climate change.

Net-zero emissions: A state in which GHG emissions from human activities are offset by the emissions taken out of the atmosphere. The detailed definition of this concept used in the study can be found in the accompanying technical appendix to this report.

Around 3°C world: A scenario pathway (Scenario A) that reflects no further significant climate change mitigation action, where the temperature change is around 3°C above preindustrial levels toward the end of the century.

Close to 1.5°C world: A scenario pathway (Scenario B) in which global average warming is limited to well below 2°C and as close to 1.5°C as possible, compared with preindustrial levels. This reflects a global net-zero economy by 2050.

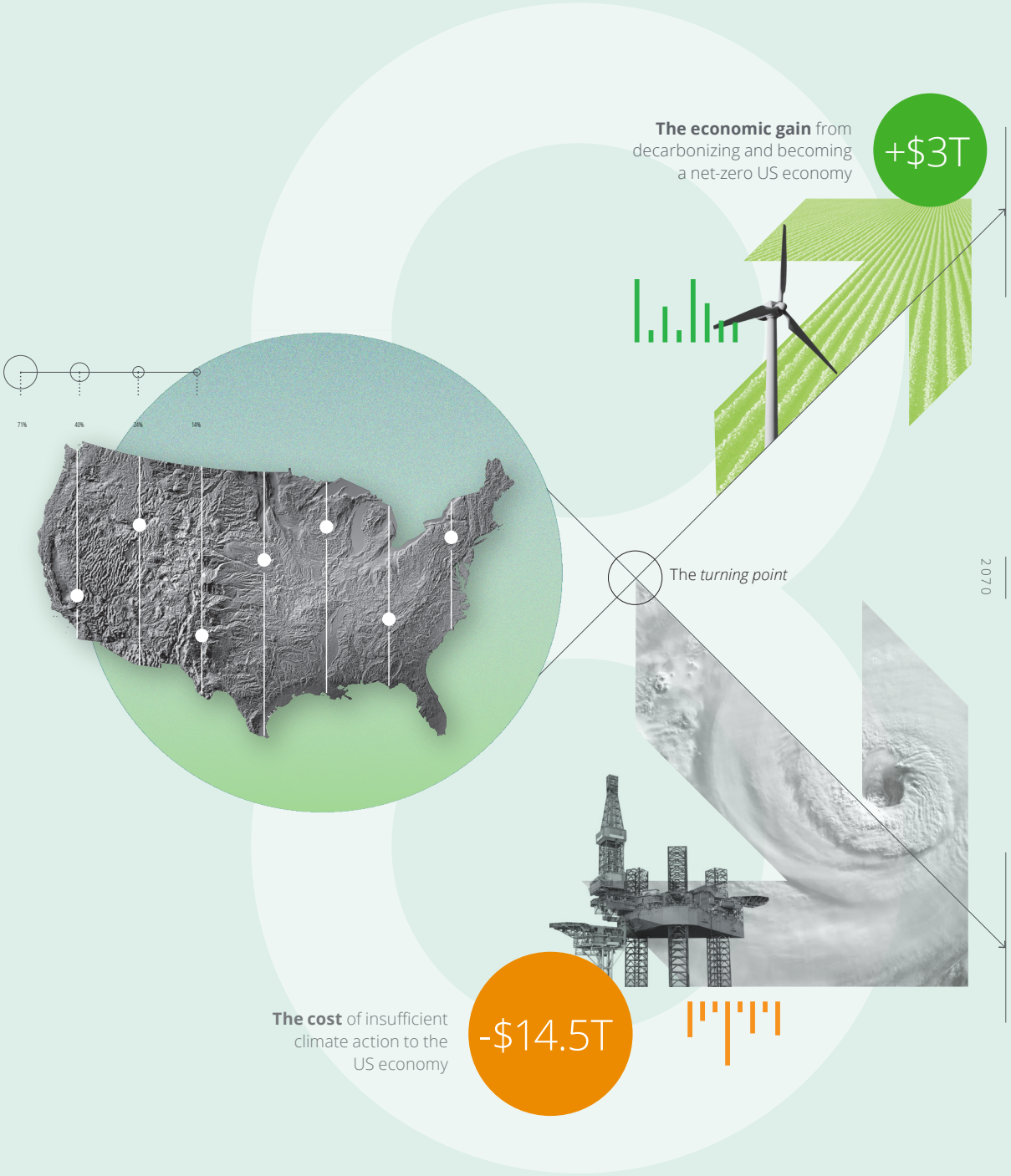
Representative Concentration Pathway (RCP): Scenarios reflecting long-term concentration levels that include time series of emissions and concentrations of the full suite of GHGs (and other relevant variables such as aerosols, gasses, and land coverage).

Shared Socioeconomic Pathway (SSP): A set of pathways that explore alternative socioeconomic futures. Combined with RCPs, SSPs provide the framework for climate impact and economic analysis.

A detailed technical appendix developed by the Deloitte Economics Institute accompanies this report. The technical appendix details the assumptions, parameters, and limitations of the economic analysis throughout this report and can be accessed at: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/about-deloitte/us-the-turning-point-us-tech-appendix-january-2022.pdf

Executive summary

Economic impacts of different climate paths



Note: Figures reflect present-value GDP impacts ($USD, trillion) to 2070.
Source: Deloitte Economics Institute

Executive summary

The United States is the world's largest economy, the second-largest emitter of greenhouse gas (GHG) emissions, and the country responsible for the largest share of historical emissions.[4] Because of its unique position in the global economy, the US can help lead the transition to a low-carbon future. But absent the US, there is almost no feasible path for the world to reach net zero. And if the world does not act with serious intent, every industry, region, and community will feel the increasingly severe consequences of that choice.

Yet most economic models still don't depict the significant—and growing—costs of climate change on the US economy.[5] This means decision-makers are not able to fully assess the consequences of their policy choices or investment opportunities because the traditional models suggest that limited climate action is somehow the less costly choice for economies. It is not.

It's time to change our understanding of the economics of the status quo.

In this report, the Deloitte Economics Institute presents a different view of the economic future for the US, based on economic modeling from Deloitte's Regional Climate Integrated Assessment Computable General Equilibrium Model (D.Climate). By explicitly accounting for the impacts of climate change on future productivity, economic output, and growth, the result is a new starting point that makes the costs and benefits of climate policy responses and investment decisions easier to see. Deloitte's analysis also shows how the US can rapidly shift its economy onto a dynamic, productive, and decarbonized growth pathway to achieve net-zero emissions by midcentury.

The following summarizes the key insights from this analysis. The accompanying technical appendix to this report provides detail on the climate science and other core assumptions that inform the results.

D.Climate: Modeling the economic impact of climate change scenarios

To model the economic impacts of a changing climate on long-term economic growth, the Deloitte Economics Institute uses the following summarized (five-step) process:

1

The model projects economic output (as measured by GDP) with emissions reflecting a combined Shared Socioeconomic Pathway (SSP)-Representative Concentration Pathway (RCP) scenario, SSP2-6.0, to the year 2100.[6] The socioeconomic pathway, SSP2, is the "middle of the road" among five broad narratives of future socioeconomic development that are conventional in climate change modeling. The climate scenario, RCP6.0, is an emissions pathway without significant additional mitigation efforts (a baseline scenario).[7] This results in a projected emissions-intensive global economy, while accounting for the current state of emissions efficiency and improvements in technology occurring in the global economy.

Unchecked climate change is a costly choice for the US economy

Over the past 50 years, the US has suffered a total of $1.4 trillion[8] in economic losses due to weather, climate, and water hazards.[9] This figure represents more than one-third of the cost of all global economic losses due to disasters, and the cost is expected to grow even higher going forward. In 2021 alone, there were 20 separate billion-dollar weather and climate disasters in the US.[10] While pathways for the climate and economies are never linear, climate science and Deloitte's analysis show that an increase in global average temperatures results in an increased loss in economic potential for the US.

If global average warming reaches around 3°C by century's end, Deloitte's analysis indicates that economic damages would grow and compound, affecting every industry and region in the country. Failing to take sufficient action could result in economic losses to the US economy of $14.5 trillion (in present-value terms[11]) over the next 50 years. In this climate-damaged future, the economy would lose nearly 4% of GDP[12]—$1.5 trillion in 2070 alone.

The economic futures of Americans today will be deeply disrupted by a changing climate. In dollar terms, the economic impacts represent a lifetime income loss of nearly $70,000 (in present-value terms[13]) for every working American today, the equivalent of losing an entire year's income for a median US household today.[14]

But the US can avoid this dismal economic outlook. Deloitte's analysis shows that if the country (along with the world) moves toward rapid decarbonization, it could avoid much of these economic losses and take advantage of entirely new economic opportunities that are likely to emerge.

D Climate: Modeling the economic impact of climate change scenarios (continued)

2

Increased atmospheric GHGs cause global average surface temperatures to continue rising above preindustrial levels.[15] In the SSP2-6.0 baseline scenario, global average temperatures increase more than 3°C above preindustrial levels by the end of the century according to the Model for the Assessment of Greenhouse Gas Induced Climate Change (MAGICC7).[16] Noting that present-day temperatures have already risen more than 1°C above preindustrial levels.

3

Warming causes the climate to change and results in physical damage to the factors of production in economies. The D.Climate model includes six types of economic damage, regionalized to the climate, industry, and workforce structure of each defined region in the model. These damages capture the trend or chronic impacts of global mean surface temperature increases. The approach does not explicitly model individual acute economic shocks driven by extreme climatic events, such as specific natural disasters, although these are implicitly captured in an increasing trend of climate change damage if temperatures rise.

Decarbonization could catalyze transformational growth in the US economy

To avoid significant economic losses, the US needs to make bold investments in a new economic and industrial framework, founded on a clean energy system. This net-zero economy would give rise to a new mix of technologies and processes spanning industrials, transportation, food, and beyond. By accelerating decarbonization, the US could complete a total industrial revolution in just 30 years, a feat that could deliver net economic gains by the late 2040s.

This once-in-a-generation transformation could result in $3 trillion (in present-value terms) added to the economy over the next 50 years. By 2070, US GDP could be 2.5% larger annually than it would be under a climate-damaged outlook. In 2070 alone, the economic gain could amount to $885 billion added to the economy annually. This gain is the equivalent of adding more than the combined current annual revenue of Amazon, Alphabet, and Microsoft to the economy in just one year.[17]

The research demonstrates that investing in an accelerated decarbonization timeline now will cost far less than if the investments are made later—in terms of the economic impact, the potential climate damage, and the shared gains of transition for all regions, industries, and workers across the US.

D Climate: Modeling the economic impact of climate change scenarios (continued)

4

The damage to the factors of production is distributed across the economy, impacting GDP. Any change in emissions (and, correspondingly, temperatures) over time results in a change to these impacts and their interactions. The economy impacts the climate, and the climate impacts the economy.

5

The key variables of time, global average temperatures, and the nature of economic output across industry structures combine to offer alternative baseline views of economic growth. Specific scenario analysis is then conducted, referencing this baseline, which includes climate change damage. Scenarios can include policy actions that either reduce or increase emissions and global average temperatures relative to the SSP2-6.0 baseline view.

This modeling framework involves significant research on region-specific climate and economic impacts across the US, which are used as inputs for the D.Climate model. The technical appendix has additional detail on this model, the modeling process, and how this research compares to other relevant economic modeling exercises. Accessed at: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/about-deloitte/us-the-turning-point-us-tech-appendix-january-2022.pdf

An early and managed transition to net zero costs less, supports industry transformation, and creates jobs

Key to realizing this economic success will be managing the pace of change during the transition period. If the US coordinates and sequences its efforts in the right way, it could deliver a lower-cost transformation that supports those who are adversely affected in the short term, while delivering an economy that benefits all Americans in a low-emissions future.

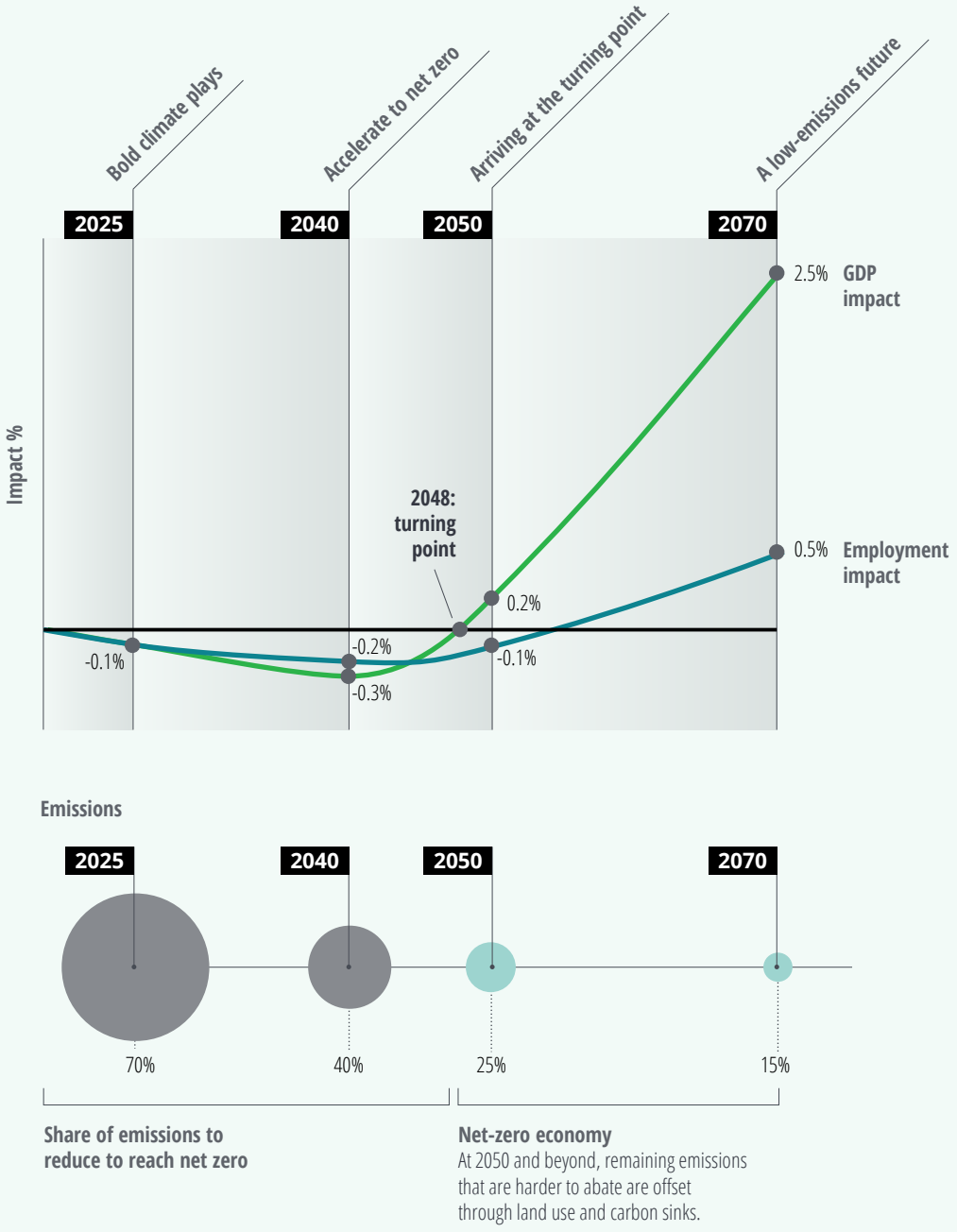
In its first net-zero decade, there would be GDP growth across all modeled regions of the US. And getting there may be less costly than many people think. Deloitte's analysis shows that the net cost of the transition could be just 0.1% of GDP per year on average to 2050, or an average economic cost of around $35 billion annually. This relatively small economic cost accounts for the disruptions and value creation that will take place as the economy decarbonizes. This economic cost is an investment that could transform the US into a more vibrant, resilient, competitive, and sophisticated economy.

During the transition period to 2050, the regions and industries that most depend on high-emissions economic activity would naturally experience higher costs. The Southwest and the West, for example, would have above-average transition costs due to their exposure to locked-in climate damages and the structure of their economies. But while their initial costs may be marginally higher, Deloitte's analysis shows that these regions and their industries could ultimately have the greatest economic gains in a net-zero future. Other regions, such as the Southeast, would experience an average cost of change of just 0.04% to GDP during the transition period to 2050, ultimately gaining the highest net economic return in 2070—a 4% increase to GDP.

The pathway to a low-emissions future economy will rely on the alignment of federal goals with state flexibility; a sequenced investment in the structural transition of assets and technologies; and the creation of new markets and business models that enhance US competitiveness globally. By choosing to move away from a climate-damaged economy, the US economy can achieve an unprecedented industrial and economic transformation of historic importance.

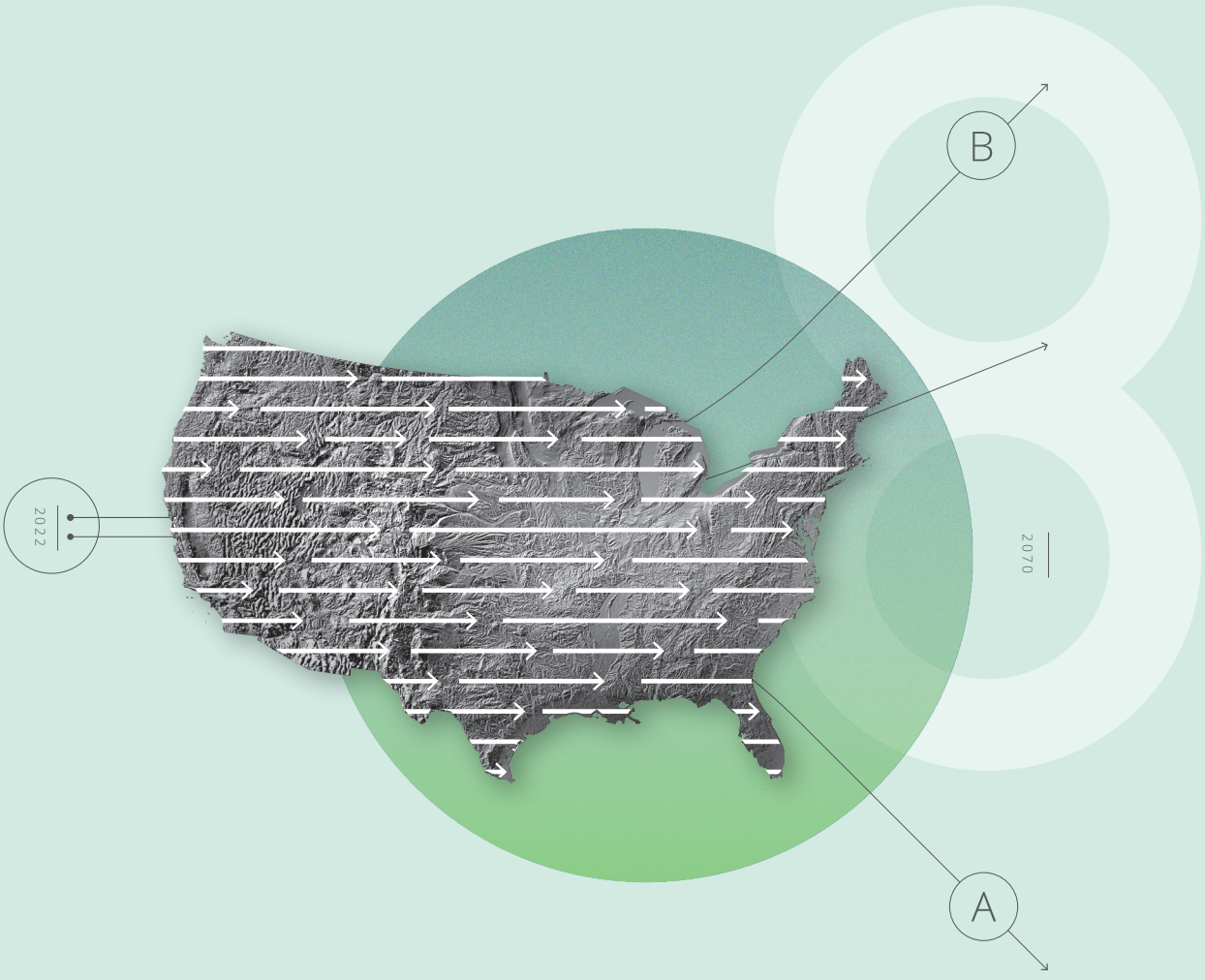
Economics is on the side of a low-emissions future. Opportunely, the US has the technology, capital, infrastructure, and skilled labor needed not only to make this transition possible, but to do so at the lowest possible cost. As industry and financial markets continue to reallocate capital toward decarbonization, the US economy can accelerate to net zero and unlock the economic opportunity that comes with it.

FIGURE 1. Greenlight for industrial transformation and growth
Economic impacts on the path to a net-zero economy



Note: GDP and employment impact measures reflect a deviation as a result of the close-to-1.5°C world scenario. This scenario is referred to as Scenario B and is detailed in the following section of the report.
Source: Deloitte Economics Institute

Economics for a new climate



Economics for a new climate

A guide to the modeling in the report

Climate change has already started, and it will continue to worsen unless global economies collectively act to stop it.[18] Climate-related disasters like wildfires, storms, droughts, and floods are hard to predict, difficult to manage, and expensive to mitigate. And those costs are growing.[19]

If an economy affected by climate change is the reality, then these costs should be reflected in how decision-makers evaluate their choices. Yet most economic projections today still reflect an assumption that the economy can continue to grow the way it traditionally has, generating GDP growth through emissions-intensive means of production. In the face of climate science, it's time to consider the full costs of the emissions-intensive system of production on the economy.

In this report, the Deloitte Economics Institute presents a new economic baseline that explicitly quantifies the impact unchecked climate change could have on the US economy, its regions, and its industries. The results are based on economic modeling from Deloitte's D.Climate. The accompanying technical appendix provides detail on the model.

With this trajectory as the baseline outlook for growth, Deloitte then modeled what could happen if the US—in concert with the world—rapidly transforms its economic systems to achieve net-zero emissions by 2050. The modeling not only demonstrates the size of the opportunity for the US economy, but also identifies the moment when the net gains from transforming to a low-emissions economy outweigh the cost to change. This net gain to the economy is what we call the *turning point*.

There are many uncertainties that come with modeling a 50-year time horizon, which only increase when incorporating the impact of a changing climate and the world's response to it. As such, the results in this report are not intended as an economic forecast, but rather are offered as an economic *scenario analysis* designed to answer, "What if?"

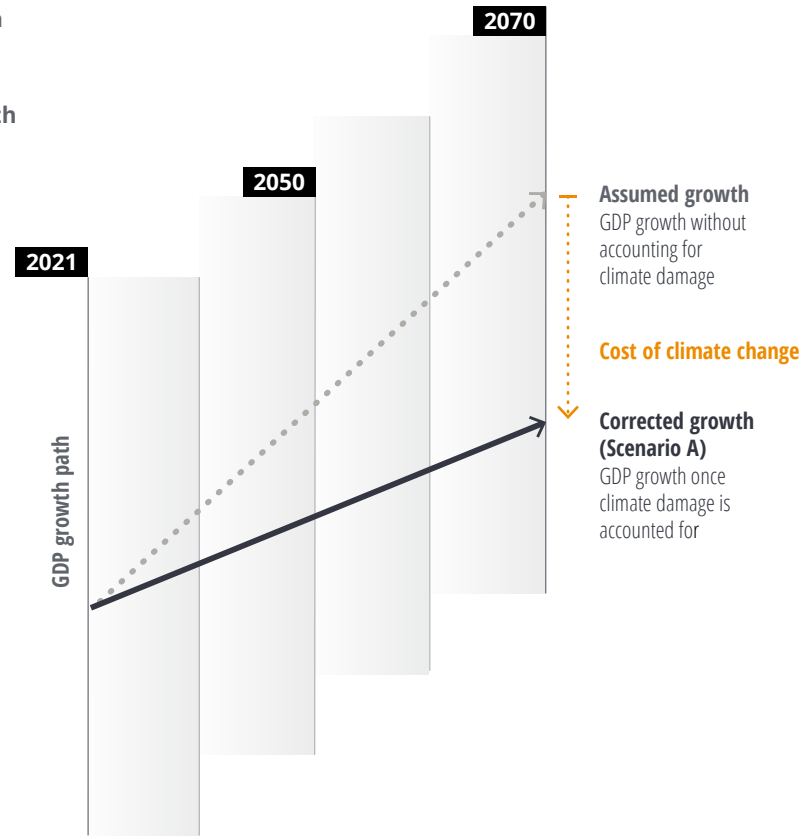
In the chapters that follow, Deloitte outlines two scenarios: "What if we choose to allow global GHG emissions to rise (and the planet continues to warm)?" Scenario A and "What if the US (alongside the world) rapidly decarbonizes to reach net zero by midcentury?" Scenario B. The technical appendix provides more detail on the following two scenarios.

Scenario A

What if we choose to allow global GHG emissions to rise (and the planet continues to warm)?

Summary of Scenario A: This economic path represents a future with a higher level of global GHG emissions, where average temperatures increase around 3°C by 2100. This scenario reflects a commonly adopted set of assumptions used in climate change economic modeling. In this study, the scenario is referred to as SSP2-6.0, or a 3°C world. A 3°C world is not the most extreme climate scenario. It reflects no further significant mitigation action taken from today, with emissions and temperatures continuing to rise.[20] This scenario and the climate impacts are regionalized to the US. The results of this scenario are presented as a deviation from (or in comparison to) a world that does not have climate change impacts modeled. This scenario represents the cost of insufficient action on climate change and is adopted as the new baseline.

FIGURE 2. This illustration depicts the impact of accounting for climate change on the growth path for the US



Note: Illustrative depiction of alternative levels of trend economic growth.
Source: Deloitte Economics Institute

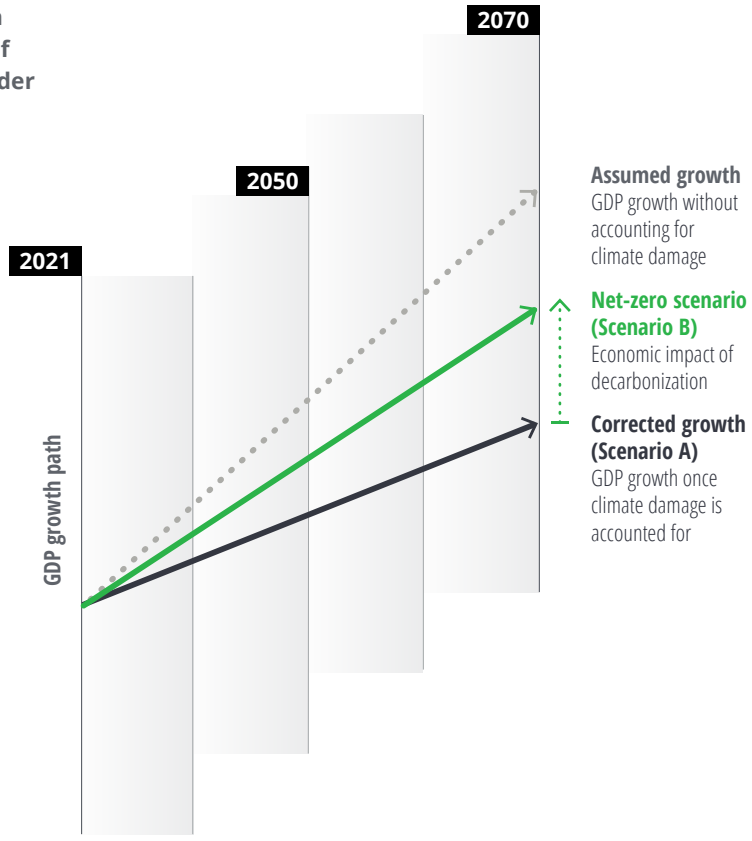
Scenario B

What if the US rapidly decarbonizes (alongside the world) to reach net zero by midcentury?

Summary of Scenario B: This economic path represents a sequencing of efforts—by government, business, and citizens—to achieve global net-zero emissions by 2050. This scenario limits warming to as close to 1.5°C as possible—well below 2°C. The pace and scale of effort required to decarbonize the US on this path is applied to each distinct modeled region. The results of this *close-to-1.5°C world* scenario (Scenario B) is presented as a deviation from the 3°C world pathway (Scenario A).

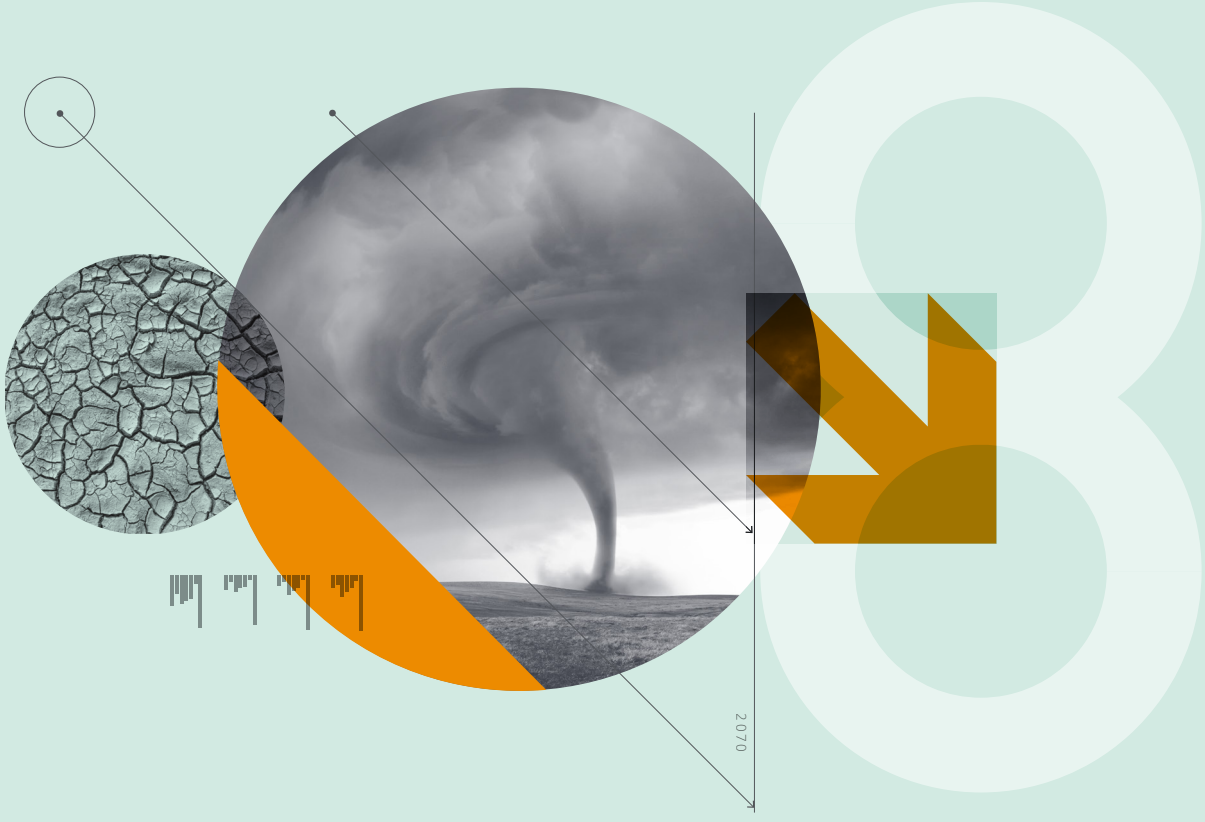
This analysis is consistent with, and reflects, the latest climate science and incorporates leading economic modeling techniques. Like all models, there are simplifications. The macroeconomic analysis here looks at the trends of change and does not focus on nonlinearities and potential climate tipping points. It is also not a model of US political processes, or firm-level decision-making, and does not provide detailed discussion of state-versus-federal-level policy, for instance. That said, the research provides a critical corrective to the economic discourse around climate change and can be used by leaders to make better-informed decisions about the costs of climate inaction and action.

FIGURE 3. This illustration depicts the opportunity of new economic growth under a net-zero scenario



Note: Illustrative depiction of alternative levels of trend economic growth.
Source: Deloitte Economics Institute

The costs of insufficient climate action on the US economy



The costs of insufficient climate action on the US economy

If the US—and the world—doesn't take further significant action to slow climate change soon, and global emissions continue to rise, it will result in global average warming of around 3°C by the end of the century in the modeled Scenario A.[21] This is the economic baseline and trend outlook for the US and the world.

The D.Climate model looks at how global warming of 3°C by the end of the century could affect US economic growth via the factors that drive economic production. Key economic damage occurs due to heat stress, sea level rise, damaged capital, human health impacts, lost tourism, and reduced or disrupted agricultural yields (Figure 4). Refer to the technical appendix for a detailed discussion on the climate damages.

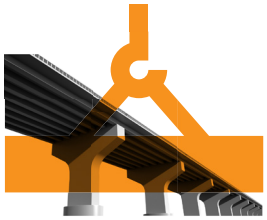
Over the next 50 years, climate change-induced economic losses in the US could total approximately $14.5 trillion in present-value terms,[22] according to the analysis.

Climate damage to the US economy could cost $14.5 trillion over the next 50 years.

FIGURE 4. Economic impact associated with climate change

Heat stress
Lost labor productivity from extreme heat

Sea level rise
Lost productive land, both agricultural and urban



Damaged capital
Stalling productivity and investment

Human health
Increased incidence of disease and mortality

Lost tourism
Disrupted flow of global currency

Agriculture loss
Reduced agricultural yields from changing climate patterns

Source: Deloitte Economics Institute

In a climate-damaged world of 2070, the US would lose nearly 4% of GDP[23]—or $1.5 trillion—in that year alone.

The losses to the US would rapidly increase and compound as temperatures continue to rise. The US economy would be smaller and less productive, and there would be fewer job opportunities. Over the next 50 years, nearly 900,000 job opportunities would disappear on average, every year, due to climate damages. In 2070 alone, insufficient climate action would result in more than 2 million fewer jobs across the US.

This would deeply disrupt the economic futures of Americans today. In present-value dollar terms,[24] the economic losses represent a lifetime income loss to every working American today of nearly $70,000,[25] the equivalent of losing an entire year's income for a median US household today.

Climate change will impact every region of the country, but some areas will suffer more significant damage

Not all regions in the US will experience climate change in the same way, but every region would pay a high economic price if the US and the world do not take sufficient action to combat climate change. The West risks wetter winters, drier summers (and with them come heat waves, droughts, and increased wildfires), as well as sea level rise,[26] which could cost an average of 1% of the region's GDP, every single year, over the next 50 years.

Rising temperatures would also affect agricultural yields. In the Greater Rockies and some parts of the West, changing rainfall patterns and warming could actually benefit agriculture, but those gains to the country would be offset by agricultural losses in the southern and eastern regions of the country.[27]

In the Northeast, the greatest impacts would come from sea level rise. In the Southeast and the West, extreme heat would pose a significant risk for heatstroke and other associated health impacts. Together with fire-related smoke and more pollen in the air, heat stress would exacerbate chronic health conditions such as asthma, for example.[28]

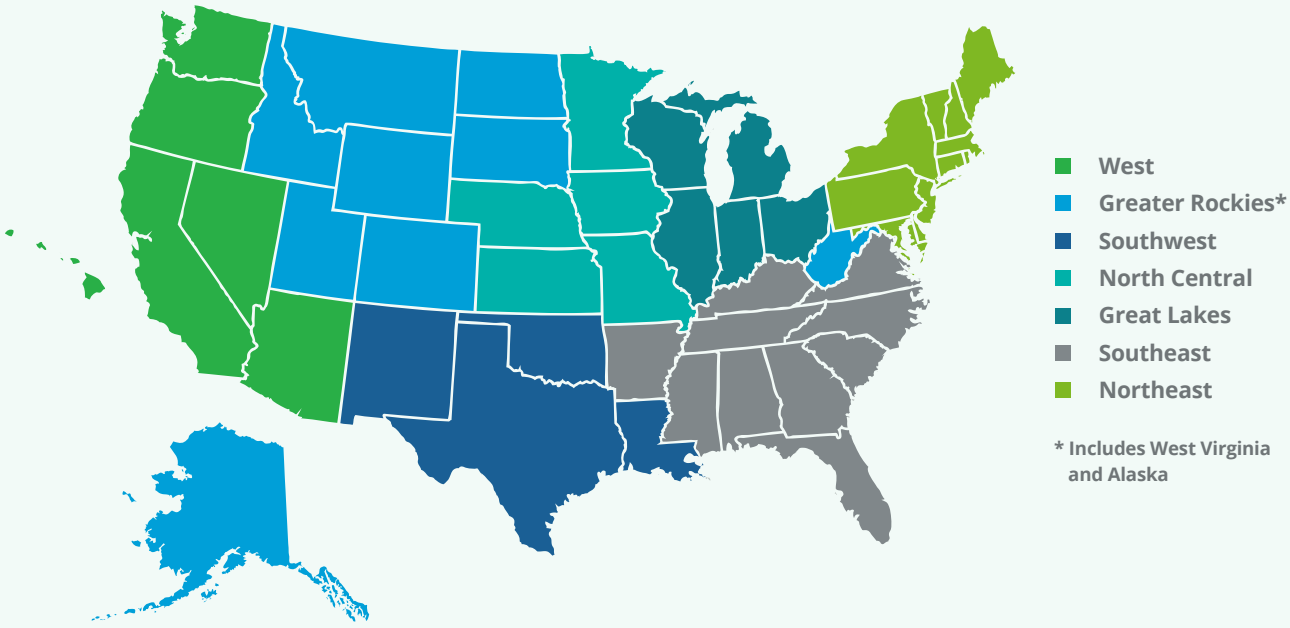
Note: Present-value GDP loss to 2070 due to insufficient climate change action (Scenario A).

Modeling climate change impacts across the US

To demonstrate how these impacts would play out on a regional basis, Deloitte broke the US into seven regions for modeling in D.Climate. While most regions represent a contiguous collection of states, some do not follow an intuitive grouping due to differences in climate or industrial structures. West Virginia, for example, has an economic structure more broadly aligned to economies in the Greater Rockies, rather than its surrounding states. As such, it has been included in the Greater Rockies regional grouping, despite being geographically separate.

The technical appendix provides detail on the approach to defining regions and how global and regional climate data is used to determine how climate change could economically impact each region.

FIGURE 5. Definition of the modeled regions



Source: Deloitte Economics Institute

The energy powerhouses of today—those that most rely on fossil fuel extraction and production—would particularly suffer from unchecked climate change. Rising sea levels, record heat, heavy precipitation, and unprecedented extreme weather disasters increase the physical challenges to extraction operations.[29] Insufficient action could impose economic losses in the Southwest of more than 5.5% of the region's GDP—or nearly $350 billion, in 2070 alone.

While all regions of the country would suffer from climate change, the severity and the cost of that damage would differ vastly. The Southeast, for example, would be particularly hard hit. With a geography that encompasses such diverse landscapes as mountains, coastal plains, and fast-growing metropolitan areas, the combination of extreme heat and rising sea levels would have a significant impact on the Southeast region's physical and economic environment.[30]

Unchecked climate change could impose economic losses on the Southeast of more than $5 trillion, in present-value terms over the next 50 years.[31] In 2070 alone, this loss would constitute 7.5% of the region's GDP—or more than $500 billion. This would cost the Southeast more than 335,000 job opportunities each year, on average, over the next 50 years, with the greatest losses occurring in manufacturing, retail and tourism, and the public and private services industries.

These regional losses felt across all regions in the US reflect the compounding impacts of a warming world and a changing climate. Doing nothing further to curb rising temperatures means that already hot days would get even hotter.[32] Higher temperatures would interfere with people's health and reduce the productivity of the workforce.[33]

While all regions of the country would suffer from climate change, the severity and the cost of that damage would differ vastly.

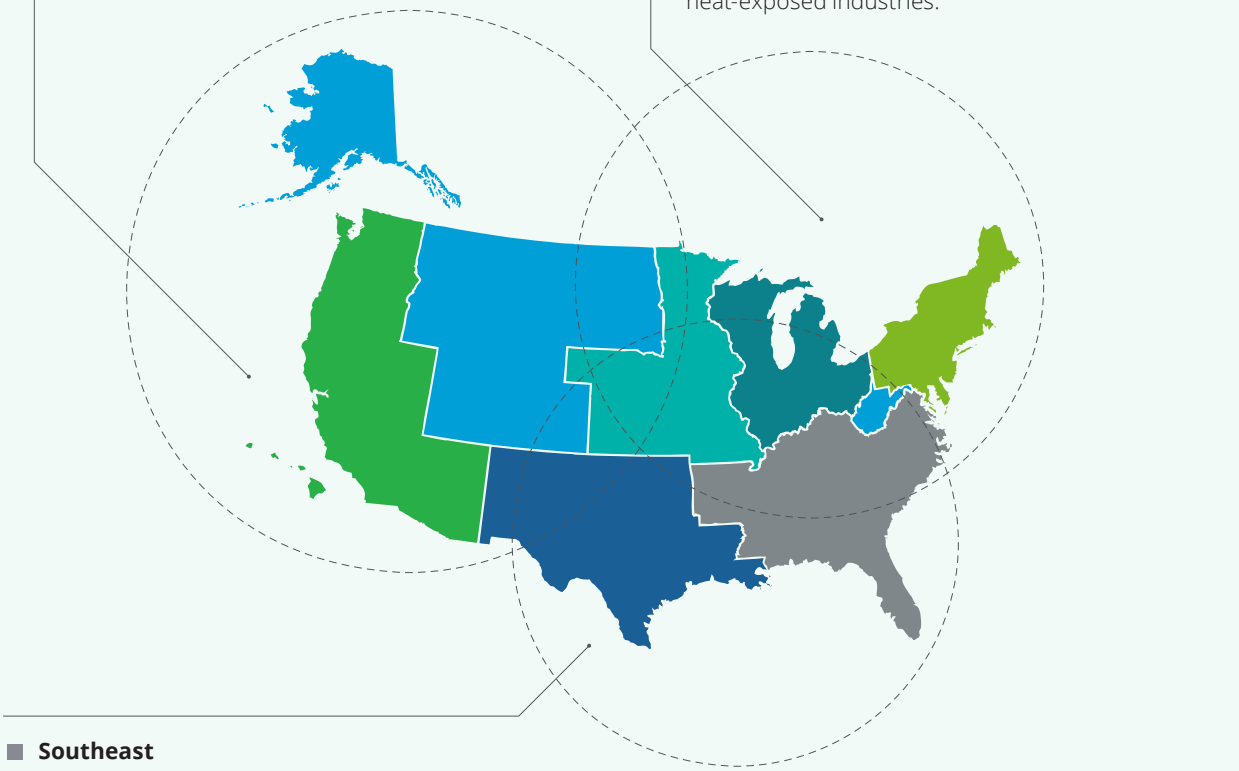
FIGURE 6. Insufficient climate action would come at a significant cost to the US (Scenario A)
These examples illustrate the types of climate impacts.

West
Greater Rockies

Wildfires threaten critical infrastructure and changing precipitation patterns, and warmer weather threatens the agriculture industry and workers more exposed to heat.

Northeast
Great Lakes
North Central

Sea level will rise, agricultural yields will fall, severe weather events will damage capital infrastructure, warmer winters will disrupt winter tourism seasons, and hotter summers will put pressure on workers and heat-exposed industries.

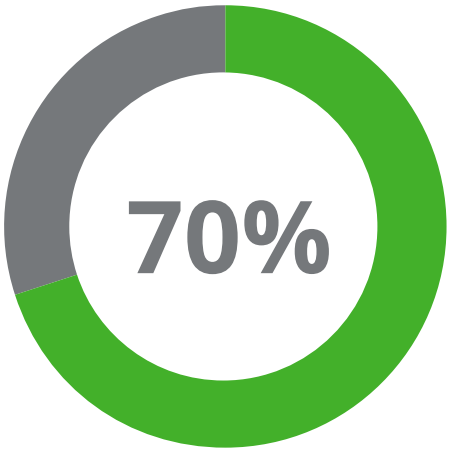


Southeast
Southwest

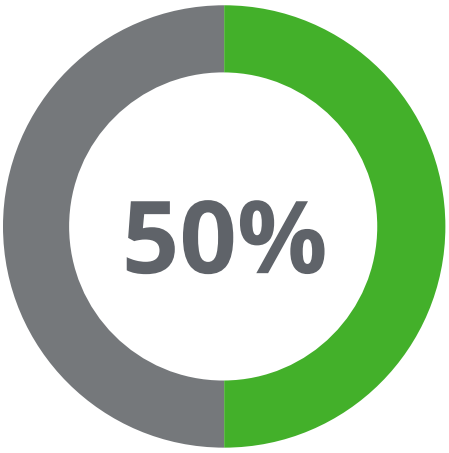
These regions will bear the brunt of economic impacts from increasing frequency and severity of severe weather events; hurricanes, flooding, tornadoes, and tropical storms. Heat stress will be a significant drain on labor productivity. An expanded range of tropical, mosquito-borne diseases could become more prevalent. Rising sea levels and floodways will only increase the severity in urban cities.

Region	NPV loss in GDP ($USD, billions, 50 year loss) to 2070	GDP (%) deviation impact in 2070	Employment (thousands) impact in 2070
West	-1,565	-2	-245
Greater Rockies	-155	-0.8	-15
Southwest	-3,120	-5.5	-430
North Central	-805	-3.5	-85
Great Lakes	-2,025	-4	-240
Southeast	-5,125	-7.5	-825
Northeast	-1,510	-2.5	-245
US	**-14,500**	**-4**	**-2,080**

Note: Numbers may not add to reported US total due to rounding.
Source: Deloitte Economics Institute



70% of US GDP suffers the highest climate damage



50% of the US workforce is employed in the highest climate-damaged industries

Source: US Bureau of Labor Statistics employment benchmarking; Deloitte Economics Institute analysis

The industries that contribute the most to GDP today are also the most exposed to climate damage

On an industry level, the US could face staggering economic losses because the largest contributors to current economic growth are also highly exposed to climate risks. Private and public services (such as defense, retail, science and technology, telecommunications, hospitality, education, health care, and business services), and manufacturing alone make up over 70% of GDP. These service and manufacturing sectors are highly exposed to climate change due to their reliance on large workforces, their assets, and their exposure to global trade disruptions.

Extreme heat would reduce productivity in industries that rely on people power, such as the service sectors, retail and trade, and construction. Labor productivity would be further undermined by a reduction in the number of viable outdoor working hours, a decrease in workers' basic comfort, and new physical limits to even routine tasks.[34] In the public and private service sectors, heat stress and human health impacts from climate change would reduce productivity, which would in turn significantly impact regional economies that depend on employment in these sectors.

Industries that rely on continued investment and assets, such as industrials and manufacturing, automotive and transportation, and construction, would also be hit hard. As storms, flooding, fires, and other natural disasters increase in frequency and intensity, businesses and governments would be forced to invest in repairing damage and adapting infrastructure—siphoning capital away from new technologies, knowledge, and resources. The losses in long-term productivity growth would be significant, and those losses would ripple through the global economy due to the integration of the US into international value chains.

Because climate change is a global issue, global trade, investment, and migration flows would be impacted by worsening physical damage around the world. In the Asia Pacific region, for example, Deloitte estimates that climate damages could total $96 trillion over the next 50 years if insufficient action is taken to decarbonize global economies.[35] Within this context, global supply chain disruptions would be a given. This would impact the US economy due to its high exposure to such climate risks: US exports to the Asia Pacific region currently account for more than 60% of overall US exports, and imports from the same region account for nearly 70% of overall US imports.[36]

The industries that make up the US economy

The industrial structure of a region's economy determines the direction, type, and quality of its economic growth. Its industrial base drives the amount of emissions a region produces from economic activity and the composition of its job market. In this study, industries tell the story of how the economy responds to both a changing climate and decarbonization.

In this analysis, Deloitte has modeled the US as 11 industries, each with its own economic pathway. Each industry represents a collection of sub-industries that are combined to present results at this higher level (Figure 7). The analysis captures how each individual industry contributes to GDP. The detailed industry definitions are provided in the technical appendix, with a stylized summary of what types of economic activity is included in each industry provided below. The economic results in this study are reported in relation to these industries.

FIGURE 7. Industry loss to 2070 on a path to a 3°C world (Scenario A)

Modeled industry	Types of activity in the modeled industry *Examples provided are non-exhaustive*	Economic impacts of insufficient climate action	
		GDP impact 2021-2070 ($USD, billions, net present value)	Employment (thousands) impact in 2070
Service sectors (private)	Defense services, engineering, entertainment, financial services, health, legal services, media and insurance, private education, professional and scientific services, real estate, social services, technology services and telecommunications	**-4,810**	**-695**
Government services	Education, defense services, government services (local, state, and federal), health and social services, and public administration	**-3,030**	**-620**
Manufacturing	Chemicals, clothing, electronics, food processing, machinery, minerals and metals, pharmaceuticals, plastics, textiles and vehicles	**-2,880**	**-440**
Retail and tourism	Accommodation and food services, retail trade	**-1,715**	**-265**
Construction	Commercial and residential construction development and operations, infrastructure and roads	**-865**	**-80**
Transportation	Air freight and warehousing, automotive and transit, freight, shipping and support activities	**-250**	**-15**
Resources	Coal mining, oil and gas extraction, and other mineral mining	**-230**	**-5**

Note: Numbers may not add to reported US total due to rounding. Industry loss reflects the loss in industry value added.
Source: Deloitte Economics Institute

Modeled industry	Types of activity in the modeled industry *Examples provided are non-exhaustive*	Economic impacts of insufficient climate action	
		GDP impact 2021-2070 ($USD, billions, net present value)	Employment (thousands) impact in 2070
Clean energy	Biofuels, green hydrogen, hydropower, nuclear, and renewables (e.g., wind, solar, geothermal), and their use in clean electricity	**-200**	**-10**
Conventional energy	Coal products, fossil fuels and gas distribution and their use in electricity, and petroleum	**-160**	**-5**
Water and utilities	Drainage, natural gas, power supply utilities, sewage and water supply	**-160**	**-15**
Agriculture	Agriculture, fishing and forestry	**-10**	**60**

Note: Numbers may not add to reported US total due to rounding. Industry loss reflects the loss in industry value added.
Source: Deloitte Economics Institute

FIGURE 8. Regional industry loss to 2070 on a path to a 3°C world (Scenario A)

Regional GDP impact, 2021-2070 ($USD, billions, net present value)							
	West	Greater Rockies	Southwest	North Central	Great Lakes	Southeast	Northeast
Service sectors (private)	-695	-20	-845	-245	-605	-1,700	-705
Government services	-300	-50	-550	-180	-425	-1,145	-380
Manufacturing	-255	-95	-670	-205	-535	-875	-245
Retail and tourism	-165	40	-430	-90	-230	-750	-90
Construction	-95	-20	-190	-45	-120	-320	-75
Transport	-10	35	-115	-15	-25	-160	30
Resources	-5	-35	-175	-1	-5	-5	-5
Clean energy	-25	-20	-40	-15	-45	-40	-20
Conventional energy	-15	-1	-60	-5	-20	-50	-15
Water and utilities	-10	-2	-35	-10	-25	-60	-15
Agriculture	10	10	-15	5	5	-20	1

Note: Numbers may not add to reported US total due to rounding. Industry loss reflects the loss in industry value added.
Source: Deloitte Economics Institute

The economic gains from reaching the turning point

The economic gains from reaching the turning point

Just as the costs of climate damage would be dramatic, so, too, would the economic benefits created by the global industrial revolution required to limit global warming to as close to 1.5°C as possible (Scenario B). If the US chooses this path of decarbonization, it could reach its turning point by the late 2040s. This once-in-a-generation transformation could yield a $3 trillion gain to the economy (in present-value terms) over the next 50 years.[37]

And the ambition is increasingly evident. Analysis of existing targets and new ones made around the COP26 Climate Change Conference shows that if they are met on time, they could potentially hold the rise in global temperatures to 1.8°C by the end of the century.[38] This would get the world close to what is required and would constitute a big step toward holding global warming below 2°C.

However, realizing such ambition would still require the US to complete an industrial revolution in less than 30 years. Existing industries would have to transform into a series of complex, interconnected, emissions-free systems. It would also require advances in negative emissions and major changes in energy, mobility, systems, industrial and manufacturing, agriculture/food systems, and land use.[39]

Yet this could be accomplished at a more manageable cost than many may think. In the Deloitte-modeled Scenario B, transforming the US economy could cost just 0.1% of GDP, or an average of about $35 billion, every year to 2050. This net cost captures the enormous investments that will lead to value creation in the economy, as well as the disruption to activity in other parts of the economy. This analysis also accounts for the costs of locked-in climate damages, even as the world reaches net zero. And despite these upfront costs of the transition, choosing this path would allow regions and industries to see dividends from this change by midcentury.

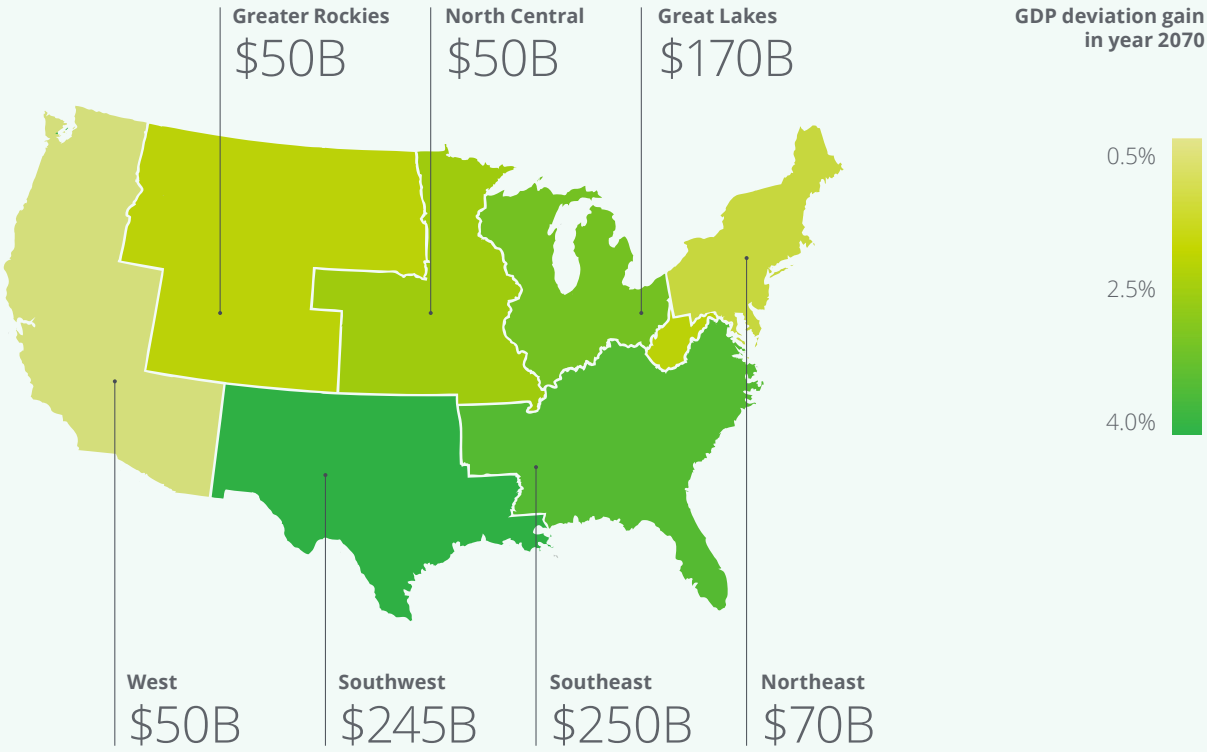
Decarbonization could drive a new era of economic growth

In Scenario B, by 2070 US GDP could be 2.5% larger annually than it would be if climate change continues unchecked. This economic gain amounts to $885 billion being added annually to the economy in 2070 alone. For perspective, this would be the equivalent of adding more than the combined current annual revenue of Amazon, Alphabet, and Microsoft to the economy each year.[40]

In this productive, dynamic, low-emissions economy, the US could have nearly 1 million more jobs by 2070 than it otherwise would have, compared to a world where climate change goes unmitigated. Many of these new jobs would be created by the rapid expansion of advanced manufacturing and private-sector services, including telecommunications and media, financial services, scientific, technology, and professional services. Other jobs—including entirely new kinds of work—would be created by expansion in clean energy sectors such as renewable energy and green hydrogen.

And the regions hardest hit by unchecked climate change would have the most to gain: The Southeast, for example, could gain more than 400,000 jobs annually by 2070 on a low-emissions pathway.

FIGURE 9. Regional economic gain to GDP ($USD, billions, in 2070) in a close-to-1.5°C world (Scenario B), compared to a 3°C world (Scenario A)

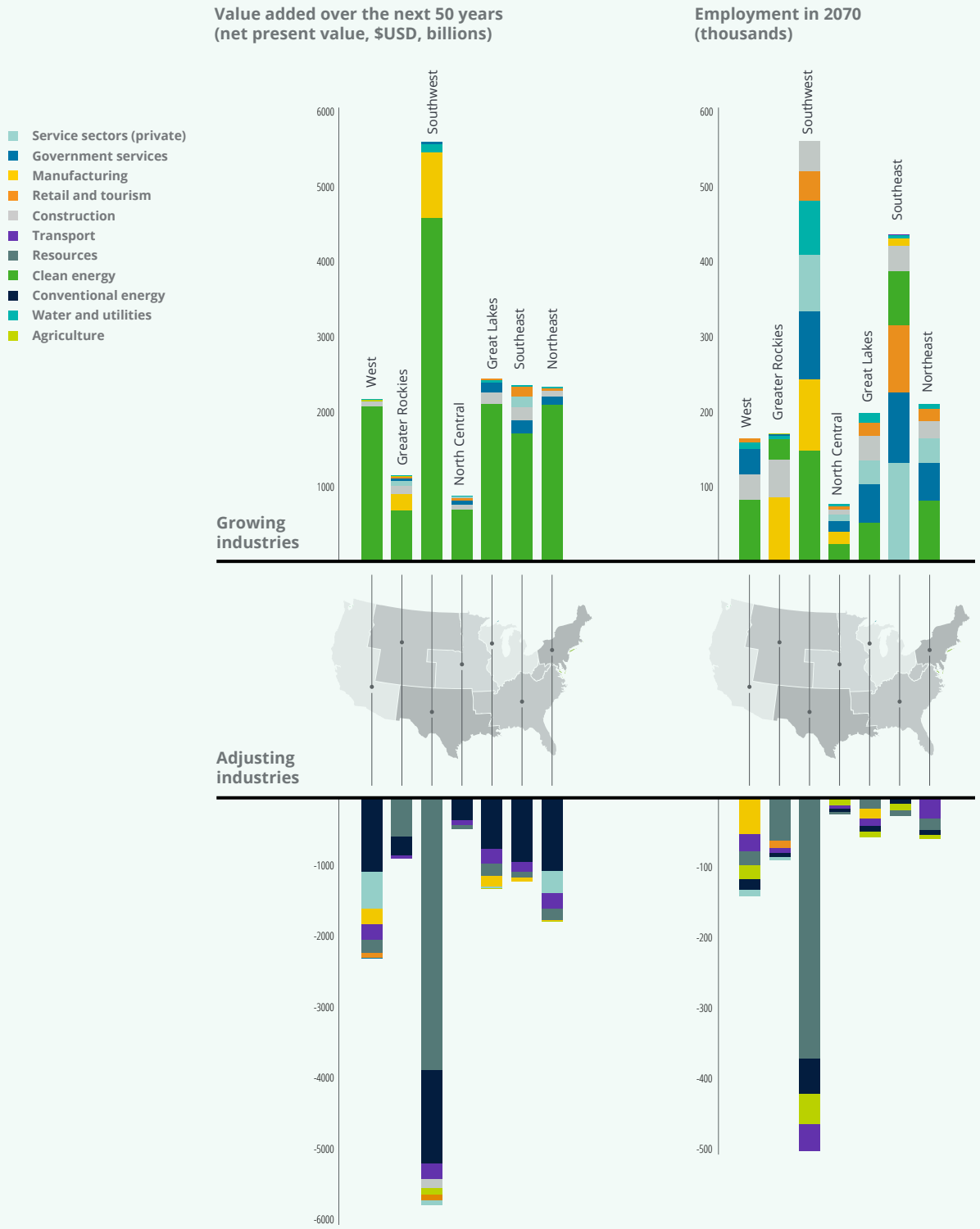


Relative size of today's economy across each modeled region (Real GDP, 2019)

	Relative size of the economy
West	
Northeast	
Greater Rockies	
North Central	
Great Lakes	
Southeast	
Southwest	

Note: Numbers may not add to reported US total due to rounding.
Source: Deloitte Economics Institute

FIGURE 10. Impacts of the US decarbonization by industry and region in 2070 (Scenario B)



Note: Numbers may not add to reported US total due to rounding.
Source: Deloitte Economics Institute

Once the US reaches its economic turning point, the gains from decarbonization would pay off

To realize long-term, low-emissions growth, the US would need to make a substantial upfront investment, a cost that would temporarily affect economic performance. As the benefits of decarbonization start to occur, however, the D.Climate model shows that the economy could reach a point when the benefits of decarbonization would start to exceed the initial costs. This is the net economic gain of the transformation, or the turning point.

The timing of the turning point would be different for every region of the US. The pace of the accrued gains would depend on a region's current economic structure and how that is impacted by decarbonization. It also greatly depends on how climate change affects these regions as the world warms by at least 1.5°C by 2050, due to historic emissions.

The economies with higher transition costs and higher climate impacts from unavoidable warming will typically experience their turning point later than others. On the other hand, economies that are further along in their progress toward lower emissions and are less exposed to global warming could have an earlier economic turning point. For the US, that turning point would come before midcentury, around 2048. The US could then enter its first net-zero decade in a stronger economic position than it otherwise can if it does not decarbonize to its turning point.

The turning point is when the benefits of decarbonization start to exceed the costs

Figure 11 (next page) is a conceptual illustration that shows a rapid and coordinated path to net zero, which begins with a period of structural adjustment, as the US initiates an industrial and economic transformation. The turning point is the economic moment when the benefits of decarbonization exceed the combined costs of climate change and the cost of transitioning.

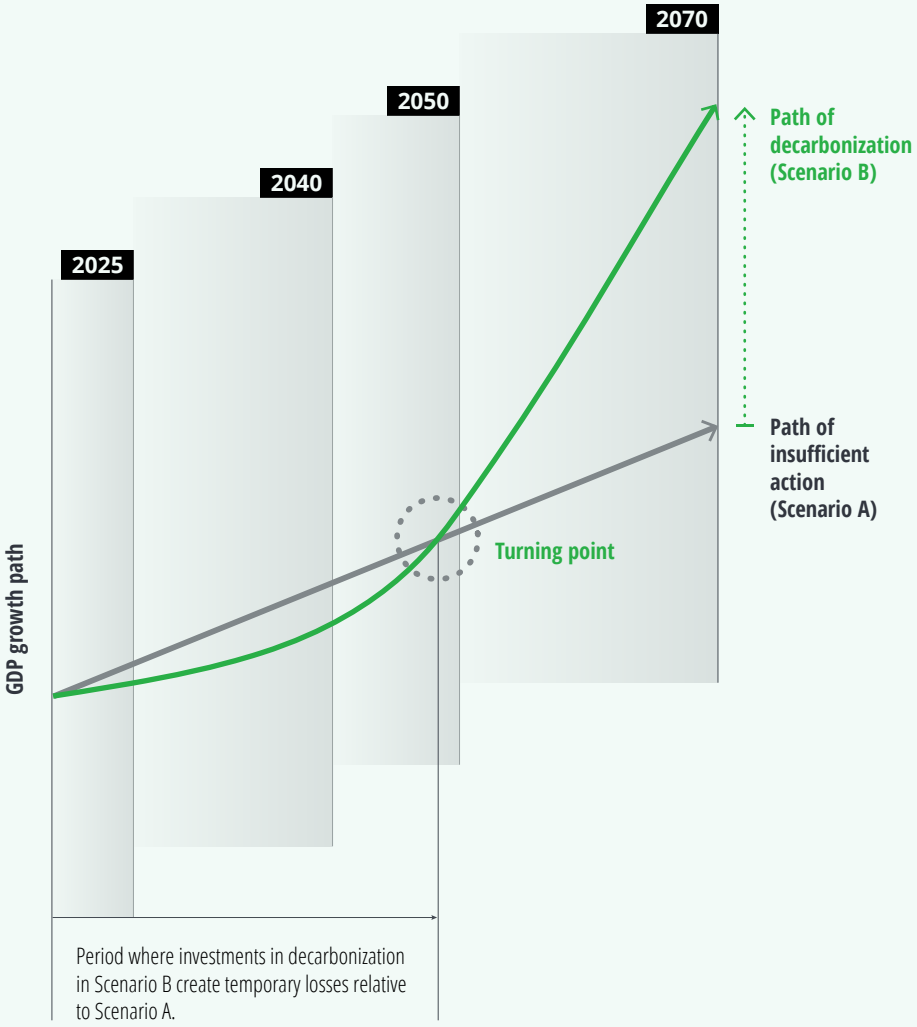
Costs:

- The inevitable costs to the economy as the US moves away from emissions-intensive activity (for example, the costs for businesses as they transition to decarbonized activity)
- The cost to the economy from global warming of at least 1.5°C, even with strong global action to reach net zero by 2050 (for example, the costs of the unavoidable damages of continued global warming already ensured due to historical emissions)

Benefits:

- The benefit of avoiding costs from limiting global warming, instead of reaching around a 3°C increase in global average temperatures (for example, the benefits of avoiding increased climate damages and natural disasters)
- The benefit of a more productive and modern economy, where demand is being met as consumer and industry preferences change (for example, the dividends of investing in the skills, technology, and innovations required to decarbonize)

FIGURE 11. Reaching the turning point on the path to a close-to-1.5°C world (Scenario B)



Note: Illustrative depiction of the level change (deviation) to economic growth due to alternative paths.
Source: Deloitte Economics Institute

To decarbonize its economy, the US needs to transform its energy mix and the systems that support and rely on it

The analysis shows how the US could shift the broader economy onto a decarbonized pathway by rapidly decarbonizing its electricity systems, electrifying current daily processes and industrial activities, and switching to new clean fuel sources. Each stage of change represents the interaction of the choices, investments, and technological and industrial shifts that would drive structural change in the US economy.

While Deloitte's modeling accounts for systemic decarbonization across all areas of the economy—including agriculture, energy-intensive industry and transport, the analysis shows a rapid switch to cleaner energy sources is crucial to the pace and scale of the effort. This substitution of energy creates the market incentives for investment and deployment of technologies that would enable broader decarbonization and ensure that no place or sector is left behind. Under the modeled Scenario B, advances in scaling renewable energy (primarily wind and solar) could underpin the early and rapid transition, and enable the electrification of other parts of the economy, such as passenger vehicles and home heating and cooling.[41]

Increasing electrification across the economy would, in turn, unlock further growth potential across the economy in resources, transport, and manufacturing. The rapid transition to renewable electricity generation and the enabled electrification of industrial and other processes would take time, but could allow the US to generate nearly 100% of its electricity from clean sources by 2050. In this modeled economywide energy mix, "green" hydrogen, for example, could make up around 10% of total final energy demanded in the US by 2050. The technical appendix provides a detailed discussion of the energy mix and benchmarking of the results in the decarbonization scenario.

A significant expansion in green hydrogen, and other technology advances such as carbon-capture sequestration and reuse, and direct air capture, could support harder-to-abate industrial processes. In this future, the sooner the US workforce re-skills and the sooner both existing and emerging low-emissions supply chains scale up, the sooner the US could benefit from increased supply and falling costs.

The rapid transition to renewable electricity generation and the enabled electrification of industrial and other processes would take time but could allow the US to generate nearly 100% of its electricity from clean sources by 2050.

The shift would require significant acceleration of current efforts—Deloitte research indicates most US investor-owned utilities are aiming for net zero only by 2050.[42] Close collaboration between the public and private sectors will be needed to retrain workers in high-emissions industries, and to support job transitions in some cases. If executed with care, these actions could create jobs and minimize the dislocative effects that this historic shift could create.[43]

FIGURE 12. The modeled process of adjusting to decarbonization
The drivers of economic change from decarbonization in a close-to-1.5°C world

Change is valued

- Decarbonization policies and investments in new technologies accelerate
- The coverage and the value of explicit and implicit carbon prices rise
- Consumer behavior changes

Energy transforms

- Renewable and clean electricity transform America's energy system
- As renewables become cheaper, there is substitution in favor of renewable power
- Economies have cheaper and cleaner energy and more productive economic output from it

Fuels switch

- The electrification of industries and households increases
- Energy-producing and energy-consuming sectors more closely integrate value chains

Just transition

- Early policy decisions, social supports, and industry investment ensure no place or sector is left behind
- Strategic economic policy meets the challenge and creates demand for disrupted workers in new jobs

Source: Deloitte Economics Institute

Decarbonization could do more than just grow the size of the US economy; it could create better quality growth, too

Regardless of action or inaction economies typically grow in absolute level terms in the long term: More people means more consumption and more production to generate economic activity. For economies to be better off, however, they must produce higher-quality growth. The definition of higher "quality" refers to improvements in standards of living, human health and well-being, and environmental conditions (including emission reductions).[44] Quality also refers to the types of economic activities that are taking place.

If the US decarbonizes its economy, it would benefit from more than just growth in the size of the economy; it would see an improvement in the quality of that growth. By making strategic choices now, the US can chart a more prosperous path toward a low-emissions future.

By investing in the skills, technology and innovations required to decarbonize can spur such higher-quality growth. On a decarbonization pathway, the US could spark the creation of new industries, and the transformation of existing industries into sophisticated, interconnected parts of a low-emissions global economy.

A new energy mix could power new economic activity during the net-zero transition

A transition in the energy mix toward clean energy sources is a fundamental driver of decarbonization in the US. In Scenario B, the US would rapidly replace conventional energy from now until 2050 with clean energy sources. The growing share of electricity in the energy mix—the electrification of the economy—drives deeper changes. Green hydrogen plays an increasing role in decarbonizing industrial processes.

FIGURE 13. On a net-zero pathway, the US energy mix would rapidly shift toward clean sources

Within the modeled pathway, nearly all electricity will be clean after 2040, and by 2070 would be 62% of the total energy consumed. It's the electrification of the economy that makes the deeper structural changes possible.

Note: Numbers across the energy mix may not add up to 100% due to rounding.
Source: Deloitte Economics Institute

The economic phases of decarbonization to reach net zero

The economic phases of decarbonization to reach net zero

A positive economic outcome is only possible if the US coordinates and sequences its decarbonization efforts to achieve net-zero emissions by 2050 and limit warming to as close to 1.5°C—well below 2°C (Scenario B).

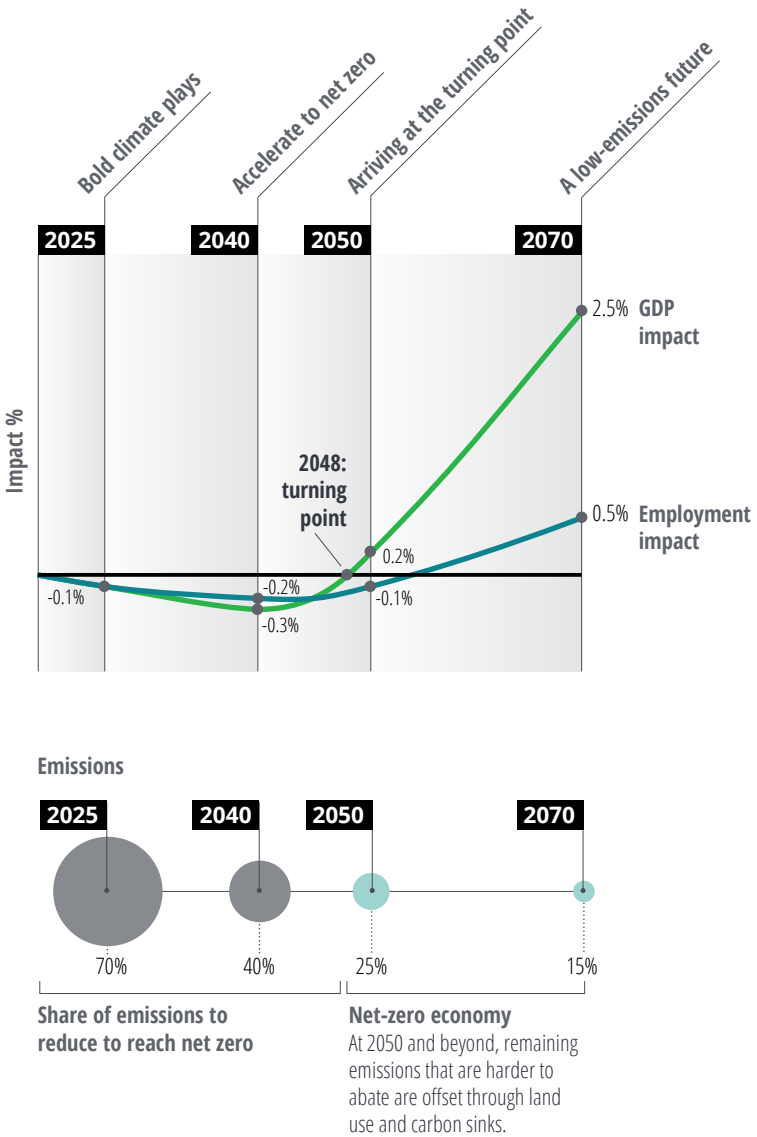
The rapid shift to clean energies and new technologies would create significant—but required—disruptions in emissions-intensive industries and for the businesses, workers, and consumers that rely on them.

However, with the right economic framework the US could transition its economy in a way that eases the cost burden—and shares the benefits—of change with all industries and regions across the country. By setting the proper direction, rate, and quality of growth, the US can not only chart a more prosperous path toward its own low-emissions future but also help catalyze efforts across the world.

Deloitte's modeled net-zero transformation of the US economy—and the rest of the world—reflects the crucial interplay of systems change and enabling decisions in the US as it decouples emissions from economic growth.

The discussion on the following pages provides the contours for how the US economy could evolve through four phases of decarbonization. Even within the single economic and emissions scenario described here, there are countless decisions that would be made by national and local governments, firms, and consumers that could profoundly shape the nature and trajectory of the path to net zero for the US.

FIGURE 14. Greenlight for industrial transformation and growth
Economic impacts on the path to a net-zero economy



Note: GDP and employment impact measures reflect a deviation as a result of the close-to-1.5°C world scenario (Scenario B).
Source: Deloitte Economics Institute

Phase I: Bold climate plays
from 2021 to 2025 (Scenario B)

If the US takes this path, the next few years could be used to coalesce the critically needed forces to create the market conditions to deliver decarbonization at pace and scale.

During this period, US governments at all levels would need to focus on setting the framework for the transition: setting regulation and policy; investing in research and breakthrough innovations; rapidly deploying and scaling advanced technologies; and accelerating critical infrastructure programs. The policies that are set in the next few years will determine the outcome of the next decade, where the race to achieve net zero at the least cost will be run.

In only a few years, the US could completely transform the electricity generation sector. Under an evolving regulatory, tax, and policy environment that facilitates decarbonization, clean electricity sources like solar, wind, and hydro could rapidly replace fossil fuel power. By 2025, more than 50% of the electricity in the US could be fueled by clean energy sources (a pace that exceeds the current plans of many major US utilities, according to separate Deloitte research).[45]

Battery storage would be critical on this transition path to clean electricity as it supports the overall reliability and resilience of the grid. Storage capacity is already growing dramatically as costs continue to fall, making this a realistic option in the near term, but cost only matters if the largest power markets across the country are connected.

To decarbonize by 2050, the US would need to triple its investments in transmission infrastructure, amounting to an estimated $360 billion, according to a leading analysis of pathways to net zero in the US.[46] Constructing new assets and upgrading existing assets could allow the massive amounts of renewable energy that would be coming online across regions to connect.[47] Investment in transmission infrastructure could lower costs to businesses and households, too.

These foundational shifts would trigger big changes within the business community. Companies would likely use this time to build more sustainable operations, to transition to lower-emissions production methods, to accelerate market innovations, to pursue new financing and investment, and to even transform existing business models. Consumer demand for new energy-efficient goods and services is likewise expected to grow—a shift that could reinforce the market opportunities of a new low-emissions economy.

As the government ramps up its investments and policymaking, there would be growth in new jobs in the public services sector within the first five years of the transition due to catalytic investments. The construction industry could also see growth from the demand for new infrastructure to support clean energy generation, transmission, and storage.

In the early phases of decarbonization, the economic costs of transition would be more prominent by design: The bold plays of this period would be intended to send signals to markets that change is here. The impact of this first half decade of rapid decarbonization on the US economy would still be marginal, with an average annual reduction in GDP of just 0.05% as it lays the groundwork for accelerated change.

FIGURE 15. Industry performance from bold climate plays
Economic and employment impacts in 2025

	Value-added gains ($USD, billions)	Employment gain (thousands)
Clean energy	50	70
Agriculture	1	7
Manufacturing	1	0
Water and utilities	0	0
Construction	0	-4
Government services	0	5
Retail and tourism	-1	-2
Transport	-1	-4
Service sectors	-10	-70
Conventional energy	-20	-25
Resources	-40	-100

Note: Numbers may not add to reported totals due to rounding.
Source: Deloitte Economics Institute

Phase II: Accelerate to net zero
from 2026 to 2040 (Scenario B)

This is the period when the hardest shifts in industrial policy, energy systems, and consumer behavior would occur, as regional economies, businesses, and industries begin to see the consequences of the earlier bold climate plays.

As businesses and customers start to pay more for emissions-intensive products, services, and energy, there would be incentives for companies to produce new lower-emissions options. Capital markets could eagerly fund investment in low-emissions technologies, such as hydrogen, sustainable biofuels, carbon capture and storage, and technologies not yet thought of. Additional funding could further accelerate the rapidly expanding share of electric vehicles in the US.

The government and private sector could work together to fast-track innovation and create opportunities for the country to seize in a globally decarbonizing economy. Clean energy technology could also be readily available at a lower cost than fossil fuels, which could serve to further accelerate its deployment and increase the spillover benefits of cleaner, cheaper energy.

Thanks to these structural shifts, the share of clean electricity in the total energy mix could more than double over this period, growing from less than 15% of all consumption in 2025 to nearly 35% by 2040. By the end of this phase, nearly all electricity could be generated through clean energy sources, growing from just nearly 55% in 2025 to just under 100% by 2040.

By 2040, investments in the scale, scope, and deployment of new technologies for long-duration energy storage and transmission could reduce the cost and reliability of renewable power. Boosting the availability of energy storage would give consumers and businesses access to clean electricity when they need it the most, such as during outages, or when the sun isn't shining. It would also smooth out demand, reduce price spikes for electricity consumers, improve the reliability of the grid, and integrate generation sources.

Over this 15-year period, the price of renewable energy would continue to fall, and uptake would continue to increase. Fossil fuels would likely continue to make up the majority of the total energy supply (beyond electricity) across the economy, but ongoing investment in new industrial processes could help smooth the transition away from fossil fuels through 2040 and to a net-zero energy mix in 2050.[48]

As the economy accelerates to net zero during this period, the economic costs of transition would increase as investments drive changes in energy generation, displacing existing production systems with new, low emissions-intensive capital and operating systems. The economic impact of these 15 years could result in an average annual reduction of just 0.2% of GDP.

Decarbonization can create new jobs in clean energy and even manufacturing

In the fast-growing clean energy sector, about 320,000 new jobs could be added annually to the US economy in 2040, relative to a world of insufficient climate action (Scenario A). The combined transformation of the energy industry and the growth of advanced manufacturing combined could create an average 260,000 new jobs annually, every year over these 15 years.

In a coordinated and efficient decarbonization pathway, the right investments and policies could also make it possible for low-emissions manufacturing to emerge as a competitive industry in the US. A growing domestic manufacturing industry could help the country overcome expected global supply chain disruptions for critical components required for the clean energy transition, such as wind turbines, solar PV panels, and batteries. All of this would benefit the construction industry, too. By 2040, low-emissions advanced manufacturing could be adding nearly $14 billion annually to the US economy and creating nearly 100,000 jobs annually, compared to a Scenario A baseline.

This overall boom in employment could create new opportunities for workers and communities that currently depend on fossil fuel–reliant industries and minimize the net impact on employment losses and gains.

FIGURE 16. Industry performance from accelerating to net zero
Economic and employment impacts in 2040

	Value-added gains ($USD, billions)	Employment gain (thousands)
Clean energy	320	320
Manufacturing	15	95
Construction	3	10
Agriculture	2	10
Water and utilities	2	10
Retail and tourism	-6	-5
Government services	-6	-10
Transport	-10	-35
Service sectors	-55	-215
Conventional energy	-160	-115
Resources	-175	-380

Note: Numbers may not add to reported totals due to rounding.
Source: Deloitte Economics Institute

Phase III: The turning point
from 2041 to 2050 (Scenario B)

This is the phase when the hard work of structural change pays off. At this point, the system-level decarbonization of America's regions and industries would be almost complete, the cost of low-emissions technologies would be lower, and the net economic gains would start to be shared more widely.

Starting in 2040, the costs of the transition would fall each year until 2048, when the US reaches its turning point. This is the moment when the net benefits of creating a low-emissions economy exceed the economic costs to do so. Low-emissions systems within and between countries would continue to strengthen from here, accelerating the transition past its most economically challenging point.

Reaching the turning point would require executing a transition to a net-zero economy that shares the benefits equitably across society. For most regions in the US, this enormous industrial transformation would take about 20 years (by 2044), but for those that depend on fossil fuel reliant industries, the transition will be longer and more costly.

The economies of the West and Southwest regions, for example, would require until after 2050 to reach their turning points, due to the importance of oil, gas, and coal mining in these areas (for example), as well as the locked-in damages to the physical climate. While those regions could ultimately enjoy the greatest economic gains in a net-zero economy, public policy and private-sector investment should be deeply attentive to the needs of impacted communities to usher them through the change. In these regions, both mitigation and adaptation to ensure resilient economic growth will be key.

The expansion of the clean energy industry—and its spillover benefits—in this phase would also be a major driver of economic growth and employment. Across the regions that reach their turning point during this phase, the construction industry would benefit from the demand for new development to support the transformation of the country's energy systems. The transformation of the power and utilities sector would likewise create economic gains and jobs.

As economies across the US reach a stage of near complete electrification, consumer and business spending can more readily flow to other parts of the economy, such as retail and tourism, and health and education services.

The impact of the climatic and economic turning point, leading to a prosperous and competitive modern economy, is annual gain in GDP of 0.2% by 2050 to the US economy.

FIGURE 17. Industry performance from the turning point phase
Economic and employment impacts in 2050

	Value-added gains ($USD, billions)	Employment gain (thousands)
Clean energy	640	460
Construction	25	150
Manufacturing	15	25
Water and utilities	10	40
Government services	10	55
Agriculture	-5	-20
Retail and tourism	-5	20
Service sectors	-55	-165
Transport	-60	-100
Resources	-250	-490
Conventional energy	-275	-125

Note: Numbers may not add to reported totals due to rounding.
Source: Deloitte Economics Institute

Phase IV: Low-emissions future
from 2050 onwards (Scenario B)

By 2050, the US economy could achieve net-zero emissions, and the economic systems of production would make it possible for the world to limit global warming to close to 1.5°C—well below 2°C. By the late 2050s, every region of the US could reach the turning point, resulting in even higher net-positive economic outcomes.

At this point, the US economic structures would be radically transformed, underpinned by a series of interconnected, low-emission systems spanning energy, mobility, manufacturing, and food and land use. The energy mix would be dominated by low- or zero-emission sources across every market, with green hydrogen and negative-emissions solutions, both natural and technological, playing prominent roles.

The growth of decarbonized industry, along with the avoided impacts from global warming could fuel economic growth and jobs in the service sectors. This would encompass both government and private sectors, such as finance, science, technology and professional services, recreational services, and retail and tourism.

Even the regions that most rely on fossil fuel extraction and production today would experience the net benefits of the transformation by the late 2050s. The Southwest would continue to be an energy powerhouse, fueled by clean energy industries. By 2070, this southern energy hub could be adding nearly $500 billion a year to its economies from clean energy industries—more than double the economic dividend of any other region in the US. This region could achieve an annual 4% gain to GDP by 2070, compared to a path of insufficient action.

By 2070, the Southeast would reap the greatest benefits in the public and private services sectors, due to avoided climate damages—both in terms of economic dividends and employment. The region and its sectors would also benefit from investments in the new skills and technologies that underpin the transformed low-emissions economy. The Southeast could go from being the region with the most to lose under a climate-damaged outlook, to one with the most to gain in a net-zero economy.

The energy, industrial, and consumer transitions required for the US to remain globally competitive as the world decarbonizes are complex by nature, requiring significant investment and policy guidance. But from 2050 on, the country could be operating as a modern, competitive, productive, net-zero economy, without the added costs of increased damage from climate change.

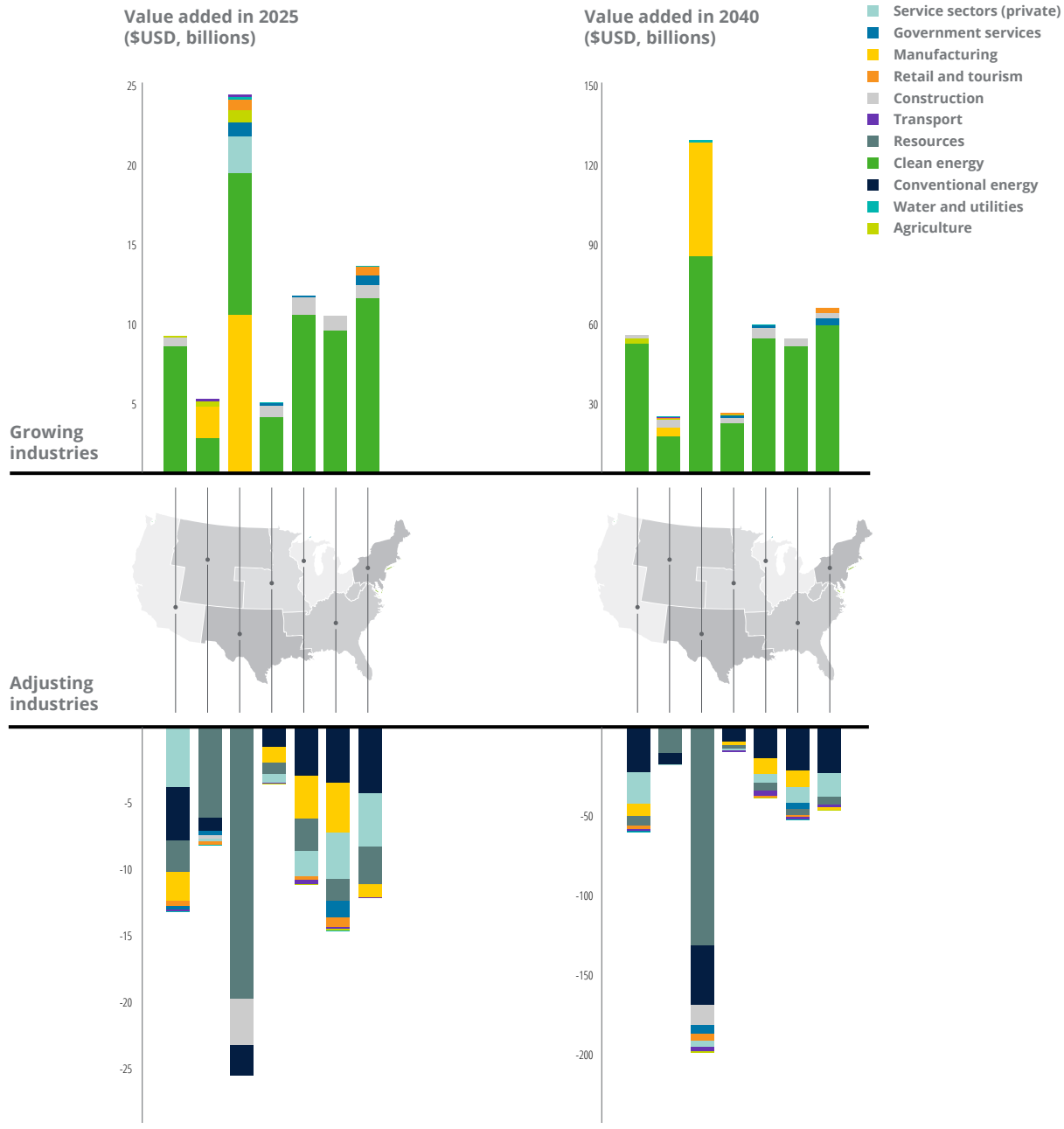
FIGURE 18. Industry performance from a low-emissions future
Economic and employment impacts in 2070

	Value-added gains ($USD, billions)	Employment gain (thousands)
Clean energy	1,215	475
Government services	135	325
Service sectors	125	260
Manufacturing	105	135
Construction	70	215
Retail and tourism	60	160
Water and utilities	30	110
Agriculture	-15	-90
Transport	-115	-115
Resources	-290	-490
Conventional energy	-435	-95

Note: Numbers may not add to reported totals due to rounding.
Source: Deloitte Economics Institute

Phases of decarbonization to net zero

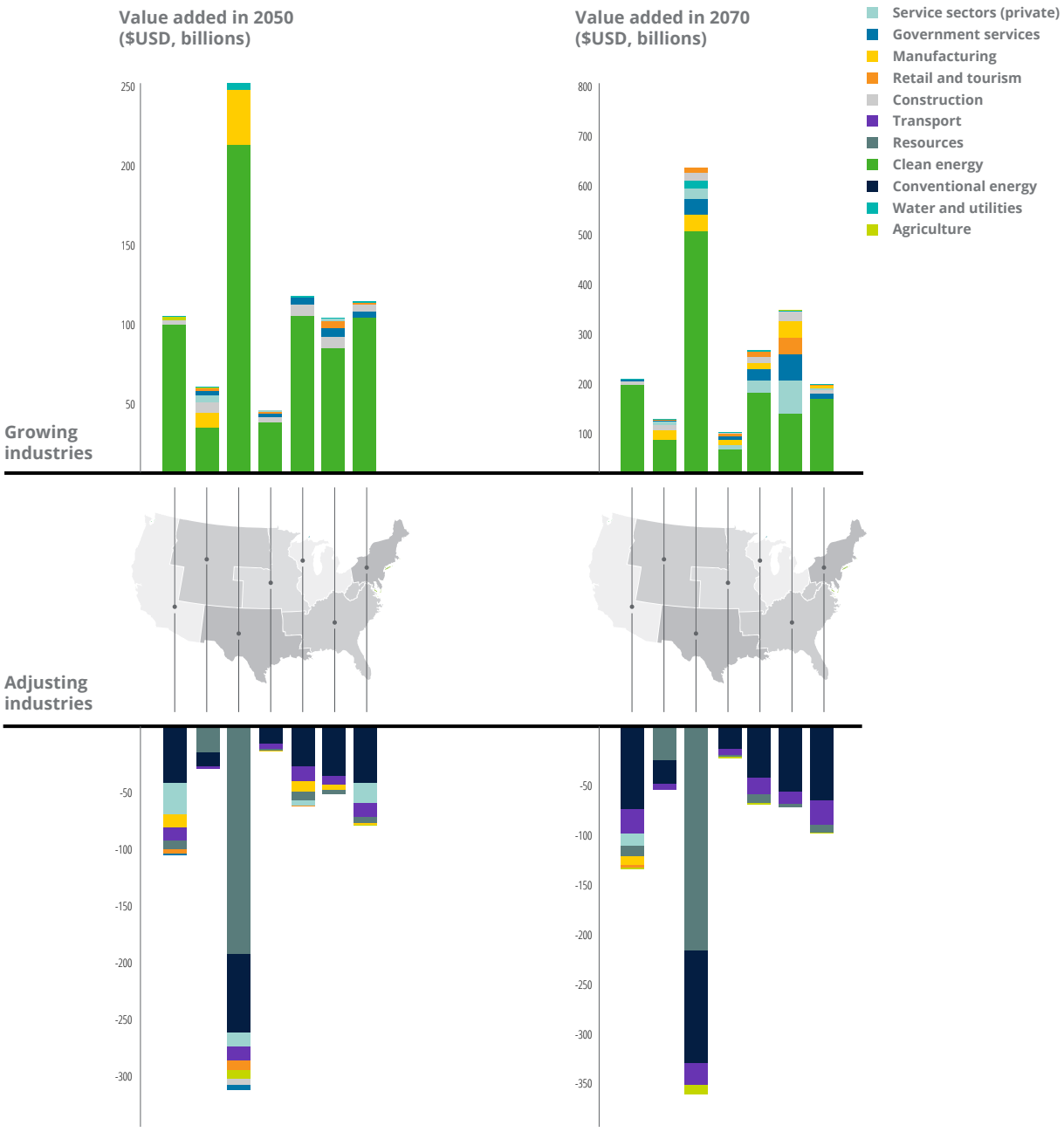
A shifting industry composition in the US economy creates economic benefits



Note: Numbers may not add to reported totals due to rounding.
Source: Deloitte Economics Institute

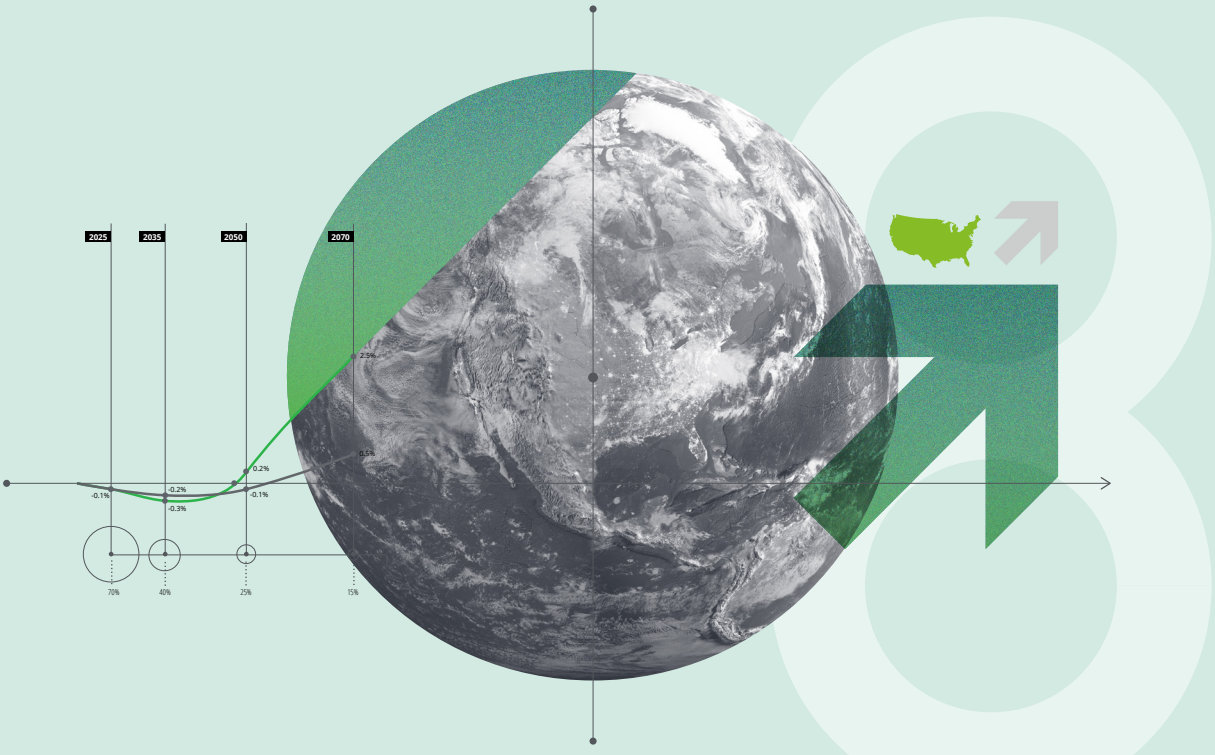
Phase III: **2050**

Phase IV: **2070**



Note: Numbers may not add to reported totals due to rounding.
Source: Deloitte Economics Institute

Greenlight for growth



Greenlight for growth

Parting thoughts

Change is inevitable, but the direction and rate of change is not preordained. It can create disruptions, it can come with costs, but it can also be managed with thoughtful purpose. This is the choice facing the US economy today.

Economic and scientific evidence confirm that the US economy, like the global economy, is at a crossroads. The production system for the goods and services we enjoy—the economic engine for global growth—is no longer tenable because it is based on an energy system that is changing the climate, damaging economies, and disrupting livelihoods. Future economic prosperity will require the US to make a purposeful change in how Americans power their homes and businesses, how industry produces goods, the way people and goods get transported, and how land and food production is managed.

Faced with this evidence, it's incredibly costly for the US to choose inaction or insufficient action (Scenario A). This cost is felt in every region, industry, and community across the US economy. Not only would inaction expose the US to more severe damages from a changing climate, but it would significantly diminish the country's economic potential, damaging the pillars of economic competitiveness, innovation, and productivity it is known for today.

Making the right choice is critical.

Creating a globally competitive, low-emissions US economy will require no less than an industrial and technological revolution in under 30 years. This report concludes that such a revolution is not just an economic necessity but also possible and economically affordable.

The US has the technology, capital, infrastructure, and skilled labor needed to not only make this transition possible but make this transition least cost. And in getting the pace, scale, and sequencing of the net-zero transformation effort right, the size and productive capacity of the US economy can grow. After reaching its economic and climatic turning point before 2050, the US economy could generate economic gains that exceed the transition costs and could grow more than it would if it remains on a path of insufficient action.

The past two years have shown what collective effort can do—a pandemic is being fought by developing vaccines in record time—but the experience has also shown how, if divided, there can be stumbles in meeting the challenge.

Deloitte's analysis highlights that there are some hard economic truths to overcome in meeting the challenges of climate change and decarbonization, and any policy or investment choice will not be without risk or elements of uncertainty. But just as the science and economics on climate change are more certain with each passing year, so, too, are the science and economics that point to a path of economic growth and shared prosperity from a low-emissions economy.

Economics is on the side of a low-emissions future. As governments, industry, and financial markets continue to reallocate capital toward decarbonization, the US economy can accelerate to net zero and unlock the economic opportunity that comes with it.

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16. The associated climate data (like annual temperature increases and atmospheric concentrations) are estimated using MAGICC as described in Meinshausen et al. (2011) and Meinshausen et al. (2020) and configured by Nicholls et al. (2021). See the technical appendix for further detail.
17. Annual revenue (12 months ending September 30, 2021) of Amazon is $458 billion. Annual revenue (12 months ending September 30, 2021) of Alphabet (parent company of Google and several former Google subsidiaries) is $239 billion. Annual revenue (12 months ending September 30, 2021) of Microsoft is $176 billion. Sourced from Macrotrends, *Revenue & Profit,* accessed December 2021; and Bloomberg Markets, accessed December 2021.
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