

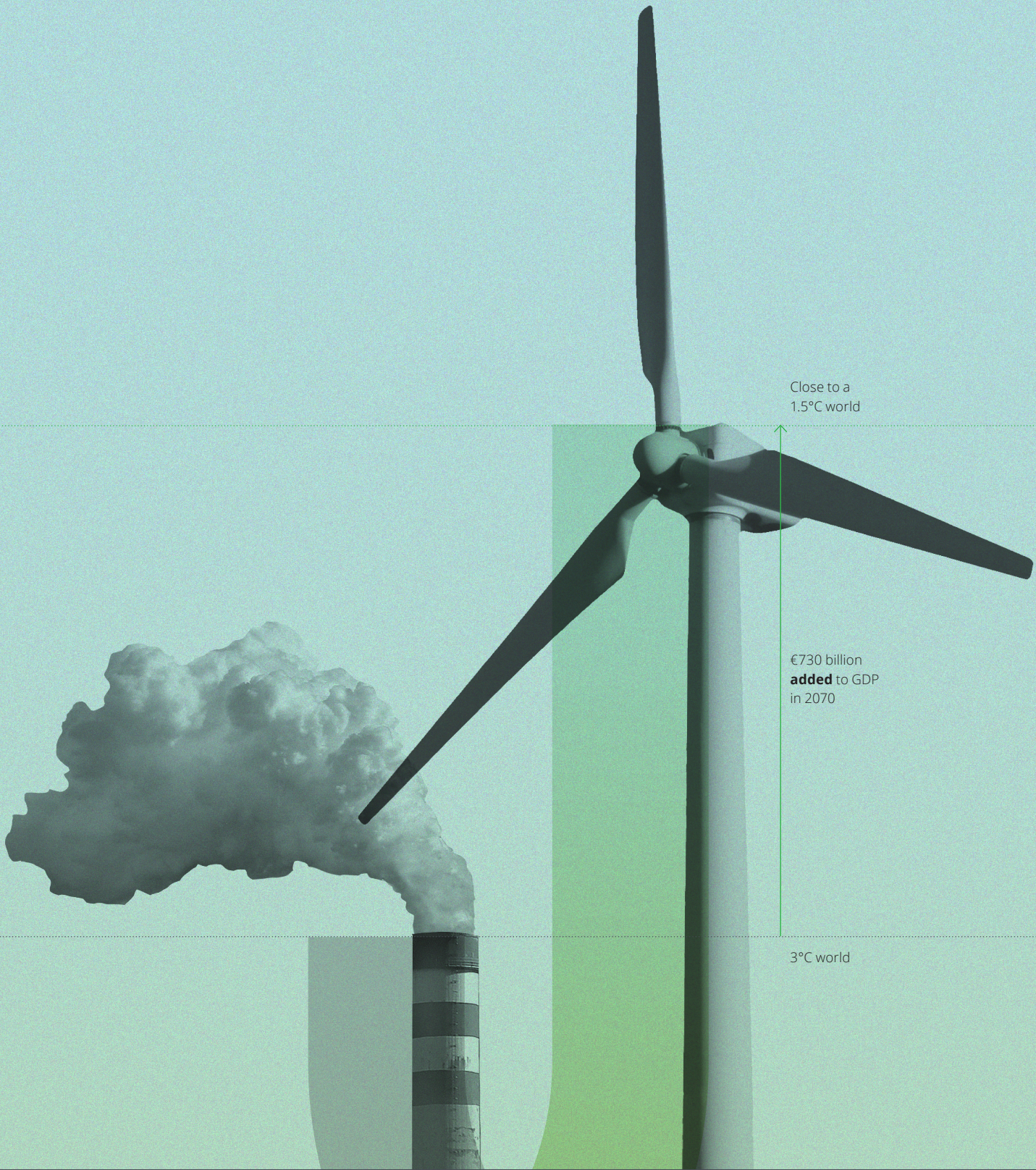


Europe's turning point

Accelerating new growth
on the path to net zero

October 2021





Close to a
1.5°C world

€730 billion
added to GDP
in 2070

3°C world

Visit www.deloitte.com/europe-turningpoint to access the individual geography reports.

Contents

Foreword	2
Key insights	4
Economics for a new climate: Notes on the analysis	8
The economic impacts of two climate change futures: Introduction	14
The costs of climate inaction for Europe	18
Opportunities for Europe in a net-zero future	22
Pathway to a climate-neutral continent	27
Regional action for a global challenge: Parting thoughts	33
Modelling climate change impacts in Europe: Supporting detail on analysis	34
Endnotes	37
Authors	40
Deloitte Economics Institute	41
Acknowledgments	41

Foreword

The future of our planet depends on the choices we make every day. Our experience of natural disasters – wildfires, droughts, floods, and record-breaking heat waves – is a stark reminder of the long-term implications our choices can have. And the pandemic has only served to reinforce that message.

As a global society, we saw our systems tested by COVID-19 in ways we never imagined possible – some of them failing us in our moment of greatest need. It has been a wake-up call, an opportunity to reset and consider the actions we need to take to protect the shared infrastructure and societal systems on which we rely.

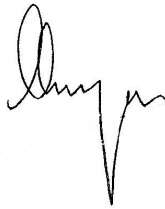
This month, world leaders will gather at the 2021 United Nations Climate Change Conference (COP26) to help decide on a path forward. As a global society, we must choose between insufficient action or bold, rapid investment in decarbonising the global economy – a monumental transformation that must be completed at an unprecedented pace. And we're going to make this choice as Europe faces a difficult energy crunch.

Transformations and transitions are always complex. This report shows the feasibility of achieving a low-emission transformation by adopting an accelerated – but carefully phased and coordinated – decarbonisation path. Using new data from the Deloitte Economics Institute's D.CLIMATE model, this report provides a compelling look at this window of opportunity, particularly for Europe. The analysis accounts for the costs of global climate change within Europe's growth projections to offer a clear picture of what the region's future economy could look like. It also projects the potential economic benefit if Europe – and the world – chooses the path of accelerated action to achieve its low-emission turning point by mid-century. These modelled futures are localised to Europe but depend on global action.

Much of Europe has what it takes to do its part. The continent has the technologies, the regulatory frameworks, and the opportunity to reach net-zero emissions now because it has been investing in clean energy for decades. The cost of transitioning Europe – which some have argued would be too high – would actually be less than 0.7 per cent of its annual GDP through 2050. Indeed, as the Deloitte analysis shows, investing in an accelerated decarbonisation transition timeline now will cost far less than if the investments are made later, particularly with regards to economic impact, potential climate damage, and an equitable transition for all European countries.

Reversing climate change is a massive undertaking. This is not something that any one sector can achieve on its own. We must work together – governments, businesses, NGOs – to develop and implement the kind of innovative solutions the job requires.

It is up to each of us to decide if we are bold enough to help lead the way.



Punit Renjen
Global Chief Executive Officer,
Deloitte



Sami Rahal
Chief Executive Officer,
Deloitte Central Europe



Richard Houston
Chief Executive Officer,
Deloitte North and South Europe

Key insights

Europe is a global leader on decarbonisation, but it needs to accelerate its progress to help prevent the worst impacts of climate change

For decades, Europe has fought to mitigate climate change across the continent and abroad. Yet global inaction and the 'locked-in' effects of climate change mean the time has passed to start isolated transitions. It is now time to accelerate worldwide systems transformations.

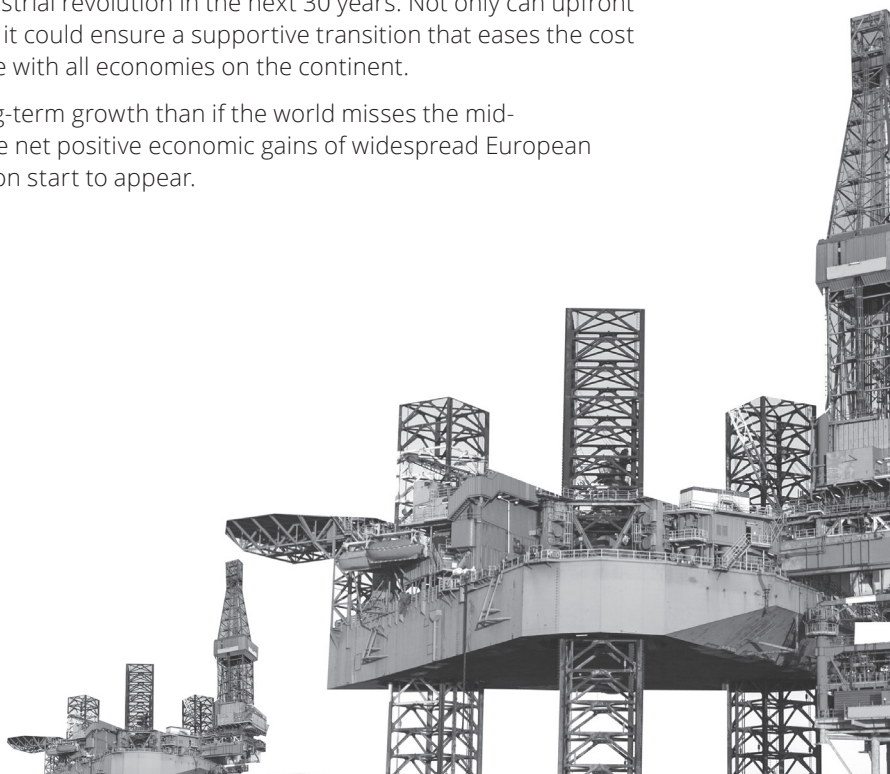
Reducing Europe's emissions will have global economic benefits because it helps limit global warming to as close to 1.5°C as possible. Science tells us that for every degree of increase in global average temperatures, there is an increase in the likelihood of worsening damage from a changing climate.¹ Deloitte's analysis shows that this results in growing economic costs and losses. If all European countries do not take part in the global effort to decarbonise by mid-century, unchecked climate change could create approximately €6 trillion in economic losses to the European continent (in present value terms²) by 2070.

In this climate-damaged future economy, there could also be 110 million fewer jobs available in Europe's economies over the next 50 years, a scenario that could diminish the region's long-term economic prospects. This makes achieving net-zero emissions by 2050 not just an aspiration, but an economic imperative for the world.

With the right transition framework, the European continent can move away from mounting climate damage towards new growth in a low-emissions economy

To avoid this future, the whole of Europe needs to do its part to transition onto a new pathway of low-emission economic growth. By getting started now, the continent can set the right direction, rate and quality of growth to achieve an industrial revolution in the next 30 years. Not only can upfront coordination speed the path to net zero, but it could ensure a supportive transition that eases the cost burden – and shares the benefits – of change with all economies on the continent.

It also sets Europe up to achieve greater long-term growth than if the world misses the mid-century 'turning point', the moment when the net positive economic gains of widespread European decarbonisation and industrial transformation start to appear.



The economic opportunities for Europe outweigh the costs to become the world's first climate-neutral continent

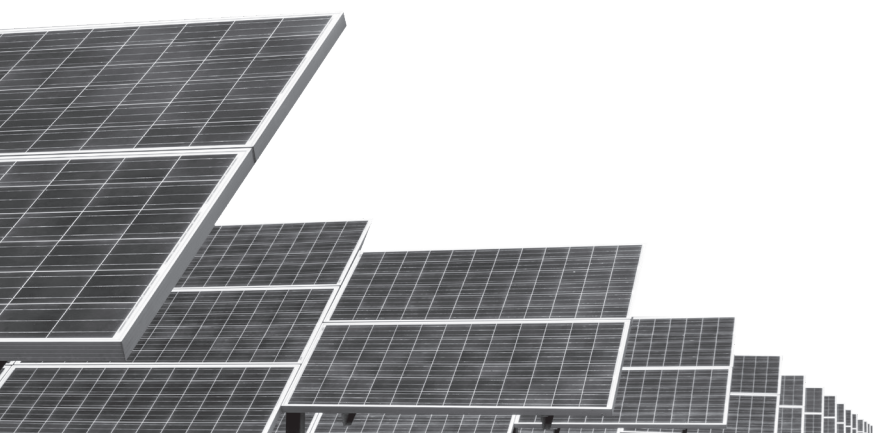
Of all the regions in the world, Europe is well positioned to achieve its own turning point by 2050. Doing so would cost 0.7 per cent of Europe's GDP, or an average of €175 billion, every year to 2050. But after the turning point, the benefit of transition would grow in every period, reaching around 1.8 per cent of Europe's GDP in 2070. Europe's economy would continue growing every year until the end of the century. At this point, global warming would have stabilised, and the continent would be enjoying the benefits of a productive, low-emissions economy.

This report outlines a model Europe can use to get the pace, scale and sequencing of reform right. The phases of decarbonisation laid out represent the economic interaction of choices, investments, technology and industrial systems, which together can create a new low-emission economy at the least cost.

Decarbonising the European continent could transform sectors and strengthen economic resilience

The transformation of Europe is an investment in emissions-free energy, mobility, industrial, manufacturing and agriculture systems. On its way to the turning point, Europe's production systems would need to rapidly scale up low-emissions technologies. What is produced and what is consumed will change. The lines between energy-producing and energy-consuming sectors will start to blur as the structure of energy markets evolve. Emerging industries will create new occupations for today's workers. A transformed European economy would also be well-positioned to capitalise on new global markets for decarbonised exports.

In 2070, this transformation could add €730 billion to Europe's economy as the world transitions away from increased climate losses. There is also evidence that the regions that take early and rapid action to establish green and low-emission production capabilities will be rewarded with more sophisticated and competitive economies in a low-emission world.



Transformations are always complex. This report shows the economic opportunity of achieving an accelerated but carefully phased decarbonisation path for the European continent.

Deloitte Economics Institute

Deloitte's model shows how every country in Europe can contribute to a climate-neutral continent

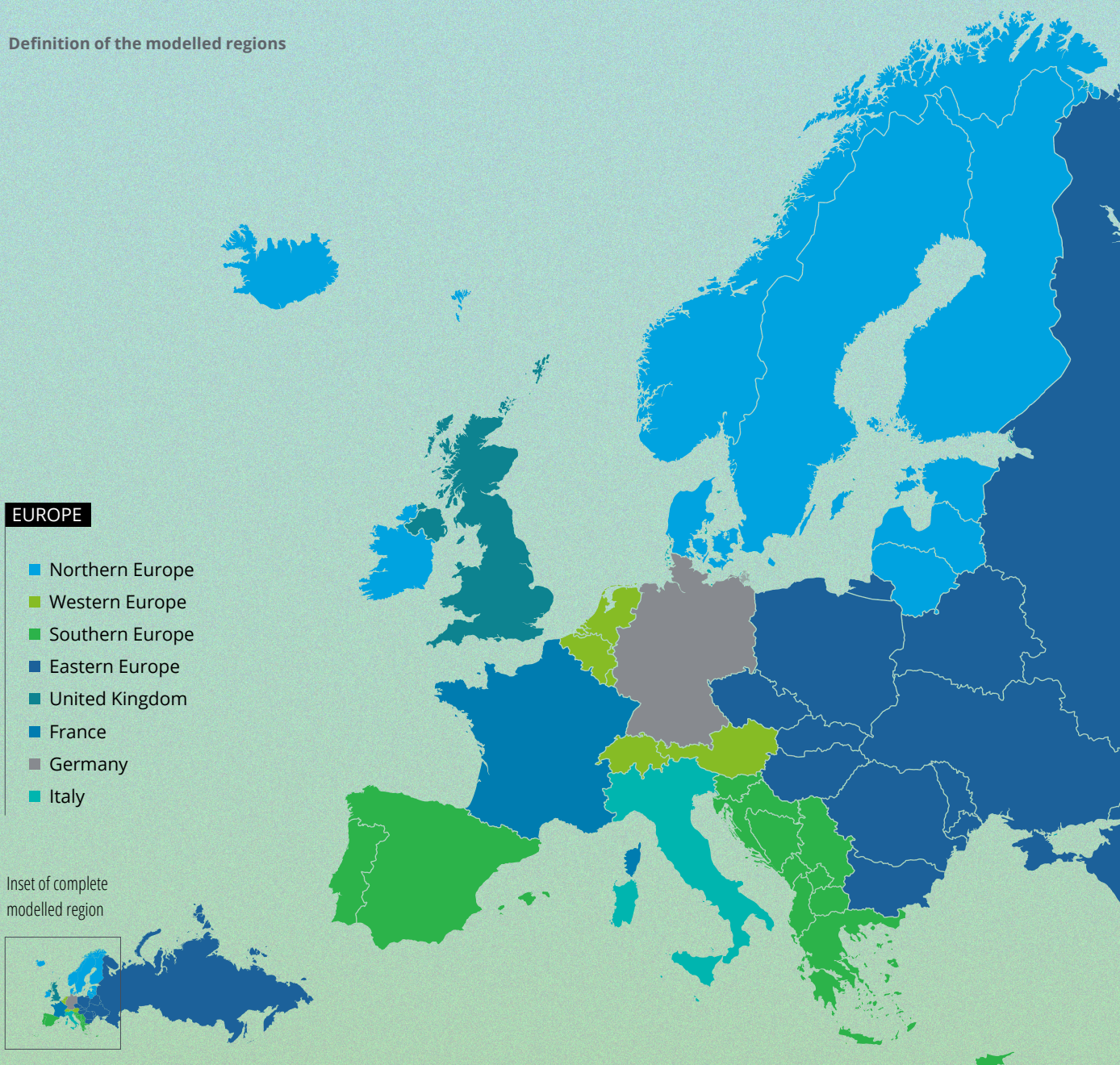
As the world accelerates climate ambition, the role of the European continent on the path to net zero is a critical one. If all of Europe can get it right, it increases the chance of the world limiting global average warming to as close to 1.5°C as possible – and at least cost to all European economies.

While this analysis accounts for the impact of climate change on all of the countries in Europe,

the European Union makes up the majority of economic activity on the continent and, therefore, the results. In 2019, EU member states generated more than 70 per cent of Europe's GDP.³

This map represents the definitions we used to analyse the data by region; the results for the United Kingdom, Germany, France and Italy are broken out from their respective regions to elucidate the unique pathways for these high-emitting countries. Deloitte has prepared country-level results for these nations to offer a closer look at those modelled trajectories.

Definition of the modelled regions



Economics for a new climate

Notes on the analysis

Since the Industrial Revolution, global economic growth has occurred in near lockstep with rising greenhouse gas (GHG) emissions. Even as the world burned fossil fuels and converted land to intensive agriculture, living standards and quality of life improved. While growth has not been constant or even, global GDP growth per person expanded at a rate of about 1.5 per cent per year from 1750 to present.⁴

This model of conventional economic growth is now running up against an overwhelming scientific consensus – and, increasingly, our own experiences – which indicates that the current system of economic production is rapidly generating untenable changes in the climate.⁵

In this report, the Deloitte Economics Institute presents analysis from the D.CLIMATE framework that models the economic impacts of climate change if emissions go largely unchecked, and what could happen – and when – if the countries in Europe transform their systems to achieve net-zero emissions with the rest of the world by 2050. This model is based on significant research on region-specific climate and economic impacts across the European continent, which are used as inputs for the model (refer to the technical appendix for more detail). Given the many uncertainties that come with modelling on a 50-year time horizon, this exercise is not a forecast or a prediction, but rather a scenario analysis to answer the question, 'What if?'

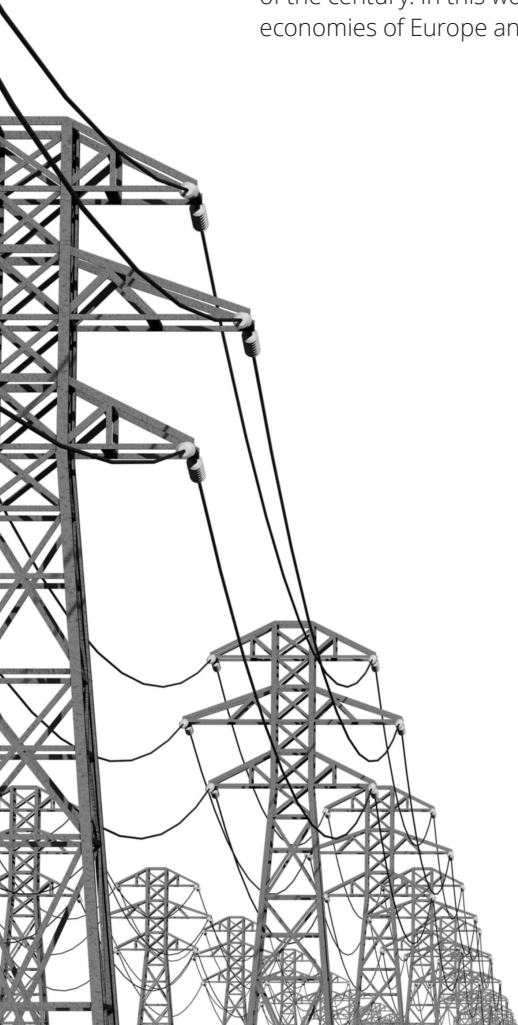
This analysis establishes a better starting point for the global discussion on climate change. Currently, climate change impacts are not typically included in economic analysis, so governments, business and pundits alike have assumed a starting point where the economy will grow unaffected by the changes to our physical environment. If we don't include climate change in our modelling, though, it's hard to understand the economic impacts of different climate policy options, such as net zero. Despite the limitations that come with any model, D.CLIMATE provides a better starting point by accounting for the inherent cost of global inaction.



The results reveal the magnitude of the challenge, as well as the choices that the world can still make to drive prosperity through a low-emission industrial revolution. The modelling also identifies the moment when the benefits of decarbonisation start to outweigh the costs of action. This is what we call the net gain or the turning point.

Throughout the report, there is reference to several assumptions, scenarios and specialised terms. The following provides a shorthand description of these ideas to support the understanding of the insights in this report:

- **Climate change is the new normal:**⁶ Unless the world takes rapid and coordinated action, an increasingly climate-damaged economy will become the new normal. When evaluating the costs and benefits of mitigation, business leaders and global decision-makers should account for the consequences of climate change. Effective global climate action requires reorienting our thinking to consider economic systems and natural systems as inextricably linked.
- **Without global action, carbon emissions and temperatures will continue to rise:**⁷ Without rapid, systemic change, the outcome would be increasing global average warming towards the end of the century. In this world, insufficient action on climate change would be the baseline path for the economies of Europe and the world (refer to the technical appendix for a detailed discussion).



In this report, the Deloitte Economics Institute presents two scenarios. The first describes what could happen if the countries of the world allow the planet to warm on a path to 3°C higher temperatures by the end of the century. The second reveals the economic opportunities for Europe if the world limits global warming to as close to 1.5°C by mid-century.

Scenario 1: We do nothing further and global emissions rise ('around 3°C world')

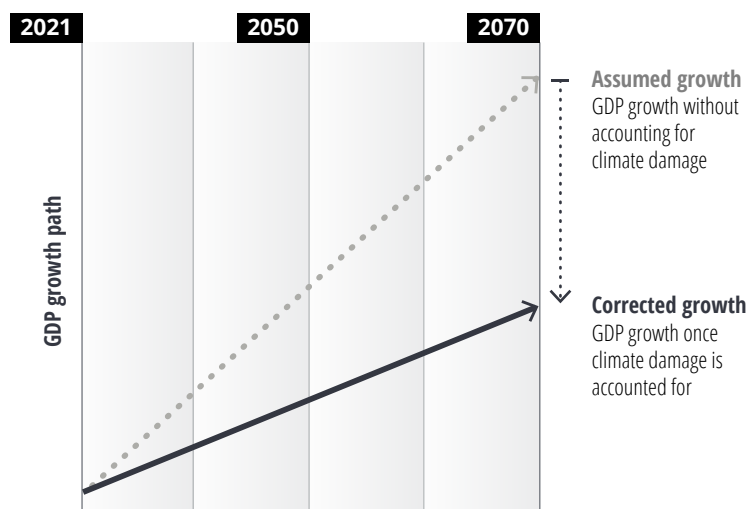
This economic path represents a future with a higher rate of global GHG emissions, where there are no significant additional mitigation efforts, and the global average temperature increases by around 3°C by 2100. This scenario reflects a widely adopted set of emissions, economic and population assumptions, referred to as SSP2-6.0. This scenario is regionalised to the European continent and the economies within it. The results of this scenario are presented as a deviation, a comparison to a world that does not have climate change impacts modelled.



Climate change will impact our economic future

This illustration demonstrates the difference between Europe's growth path if we do nothing further and what economic growth would look like if climate change didn't exist. Insofar as there is no future without climate change, the bottom line represents a more accurate baseline of future economic growth because it accounts for climate impacts such as extreme heat, sea level rise and storm damage.

The impact of accounting for climate change on Europe's growth path



Source: Deloitte Economics Institute.

Scenario 2: We act decisively to hit global net zero by mid-century ('close to 1.5°C world')

Rapid, coordinated global decarbonisation would not only make it possible for us to limit warming to close to 1.5°C – well below 2°C – but could also bring an economic and climate turning point. The turning point concept highlights that choosing transition would deliver dividends in terms of avoided costs and new opportunities. The results of this 'close to 1.5°C' scenario are presented as a deviation, a comparison to the '3°C world'.

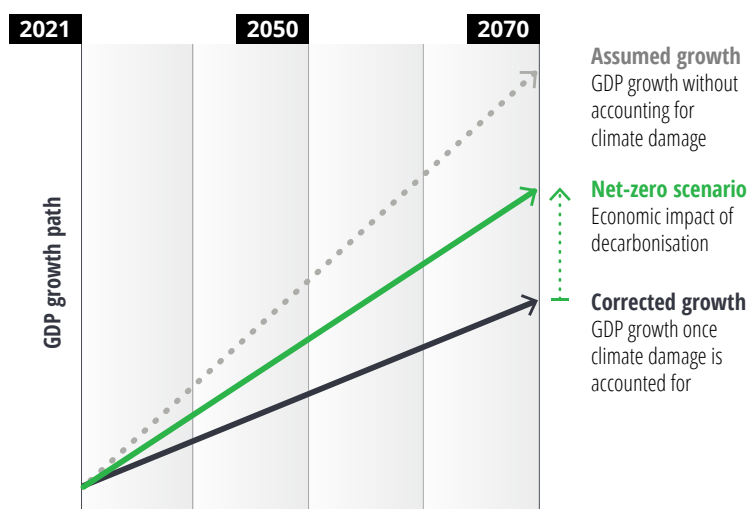
Under each scenario, the rate of economic growth is impacted (deviates from the trend) based on different climate and decarbonisation effects.



A path to net zero can create new economic benefits for Europe

The net-zero economic path depicted below shows what could happen if we act decisively to achieve net-zero emissions by 2050. Within this report, this scenario is regionalised to the European continent.

The opportunity of new economic growth under a net-zero scenario



Source: Deloitte Economics Institute.

Glossary of terms

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

Climate change: Changes in the regional and global climate brought about by increased greenhouse gas concentrations in the atmosphere.

Turning point: The economic point where the benefits of decarbonisation start to offset the combined costs of 'locked-in' climate change and the costs to transition the economy to net zero.

Net-zero emissions: A state in which GHG emissions from human activities are balanced by the emissions taken out of the atmosphere. The technical definition of this concept can be found in the technical appendix.

Close to 1.5°C world: This pathway describes a net-zero economy by 2050 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.

Around 3°C world: An economic scenario that relates to a pathway of climate inaction, where the implied temperature change is 3°C above preindustrial levels towards the end of the century.

Representative Concentration Pathway (RCP): A greenhouse gas (GHC) concentration (not emissions) trajectory adopted by the Intergovernmental Panel on Climate Change (IPCC).

Shared Socioeconomic Pathway (SSP): A set of pathways adopted by the IPCC Sixth Assessment that explores how the global economy, society and demographics might change over the next century.

Europe's turning point

Accelerating new growth
on the path to net zero



The economic impacts of two climate change futures

Introduction

Europe has not been ignoring climate change. From investing in renewable energy at scale to the European Green Deal, the region has long demonstrated its commitment to reducing emissions in line with climate science.

But more work needs to be done across the continent, and the latest science suggests there is limited time to make this transition. According to the 2021 IPCC Sixth Assessment Report (AR6), the world will exceed a best estimate of at least a 1.5°C increase in global average temperatures in the coming decades unless deep reductions in emissions occur.⁸

Already, climate change has started to show up in increasingly visible ways in Europe. Recent frost blights have caused billions in damages for winemakers in France.⁹ Sea-level rise is constantly threatening the low-lying countries of the Benelux, who are at risk despite their leading dike technology. The glaciers in the arctic regions of Scandinavia are melting. Global warming is generating heavier rainfall, increasing the risk of flooding.¹⁰ In July 2021, rivers and streams overflowed their banks across Germany, Belgium and the Netherlands, devastating lives along the way.¹¹

Based on existing levels of warming, the next 30 years will bring similar extreme weather events, but they will be more intense, and they will occur more frequently. These changes to our physical environment will put severe stress on our systems – agricultural, health care, manufacturing, infrastructure and financial. Without significant change, we're heading towards a climate-damaged global economy.

Accounting for climate inaction

Despite the urgency of acting on climate change, the cost of climate inaction rarely comes up. Instead, the debate tends to focus on how much

it will cost to change entire industries, enact a price on carbon and invest in new energy systems, while slashing emissions. Within this worldview, economies can continue to grow as they traditionally have, completely unaffected by additional emissions and climate change. This makes thwarting climate change seem too difficult, too pricey.

What this economic mindset assumes is that the status quo is somehow a less costly choice. And it is not. But until now, this 'business as usual' economic thinking has informed how most decisions and investments are made across governments and businesses alike. It's time to change that thinking.

If the economic impacts of a changing climate are left out of economic outlooks, the result is likely to be poor forecasts, poor risk management, and dangerously inadequate efforts to address the global climate crisis. A growing chorus of voices recognises this challenge. In 2020, the Network for Greening the Financial System (NGFS), a body of global central banks, released guidance on the need to solve this very issue. If we're serious about shifting the global economy towards a low-carbon footing, it's critical to understand and account for the longer-term effects of climate change on productivity, output and economic growth.

To fully assess the costs of climate action, Deloitte has developed a framework that integrates the economic impacts of physical climate change into a baseline economic trajectory. Factoring in the costs of climate change reveals the tremendous harms that could befall the economies of the world if climate change goes largely, or wholly, unchecked, as well as the significant opportunities that could arise if we transform our systems to achieve net-zero emissions by 2050. The model also identifies the turning point, or the pivotal moment, when the benefits from decarbonisation could outweigh the upfront investments.

Creating Europe's turning point

Most countries in Europe have already made considerable strides towards shifting their energy systems to renewables, thanks to supportive policies and the use of proven, mature technologies at scale.

If Europe stays on track – which actually requires it to pick up the pace – Deloitte's model shows that it will be the first region in the world to reap the benefits of decarbonisation. From this economic and climatic turning point, our model shows that Europe's economy would not only be growing but would grow more than it otherwise could if it does not act. In 2070, Europe's benefit of transition could grow to 1.8 per cent of its GDP. It would be €730 billion better off in 2070 relative to a world of inaction and this benefit could grow with every subsequent year.

If Europe carefully coordinates its transformation, it could not only prevent the worst effects of climate change, but it could actually strengthen its economy by increasing the quality of its economic growth. The transition from traditional manufacturing to modern, emissions-free production could create new value in the form of professional services, technology solutions and opportunities for industry

diversification. These forms of value could make Europe's economy more resilient, an important metric of success in a low-carbon future.

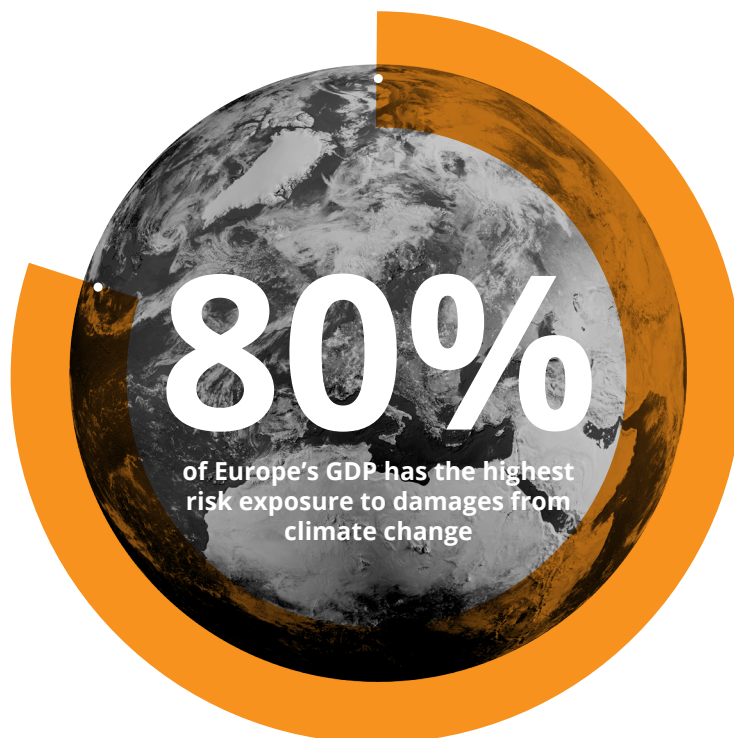
Navigating the transition

But to reach this turning point of new economic growth, the next three decades will require significant investments, rapid decarbonisation and structural adjustments. To make this change feasible, the cost of the changes needs to be acceptable to local economies.

While some critics argue that decarbonisation would be too costly, we found that the cost of the transition is not catastrophic, but manageable: Our analysis reveals that Europe can achieve this structural adjustment with a cost of about 0.7 per cent of Europe's GDP or an average of €175 billion every year to 2050.

Europe can offset these costs by carefully coordinating the sequence of choices, investments and technological and industrial changes that together will create a new low-emission economy.

Ambitious action now offers Europe the opportunity to manage and mitigate these adjustment costs, which will be much higher if the region delays and is forced into more abrupt decarbonisation later.



The turning point is when the benefits of decarbonisation start to offset the costs

This illustration shows a rapid and coordinated path to net zero, which begins with a period of structural adjustment, as Europe initiates an industrial and economic transformation. The turning point is the economic moment when the benefits of decarbonisation offset the combined costs of climate damage and the cost of making the transition.

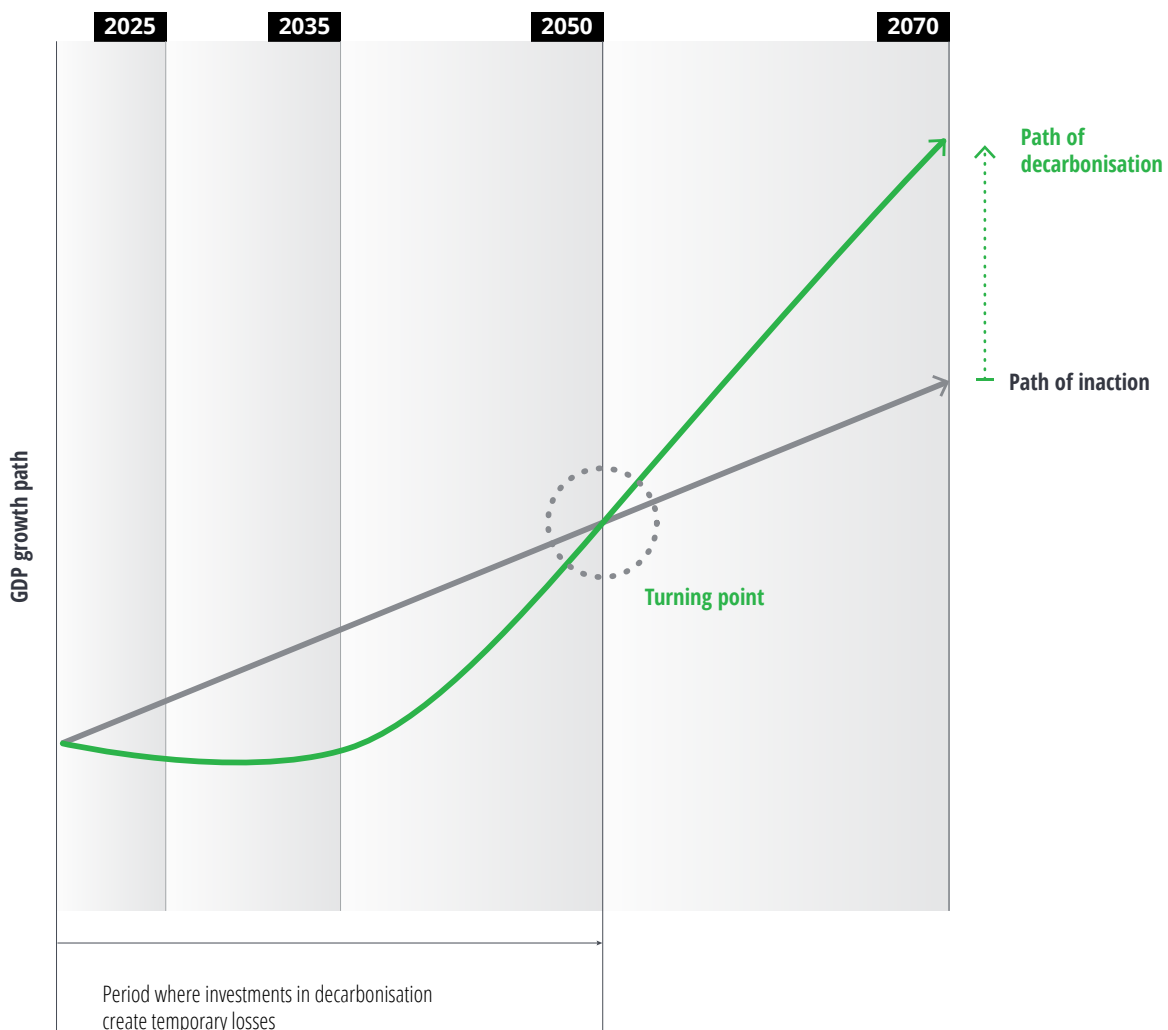
Costs:

- The inevitable costs to the economy as it moves away from emissions-intensive 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

Benefits:

- The benefit of avoiding costs from limiting global warming, instead of reaching around a 3°C increase in global average temperatures
- The benefit of a more productive and modern economy, where demand is being met as consumer and industry preferences change

Modelled economic growth to 2070 on the path to a 'close to 1.5°C world'



Source: Deloitte Economics Institute.

The scale of Europe’s decarbonisation task

While Europe has been on a path of decoupling economic growth from emissions since the 1960s (as measured by emissions intensity of GDP), it still has a long way to go.¹²

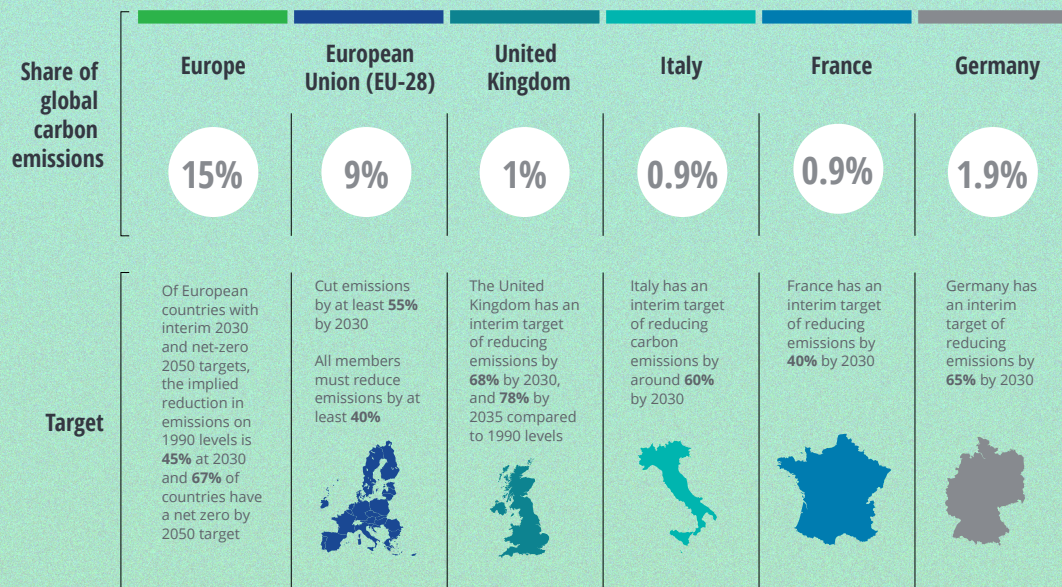
The continent still accounts for about 15 per cent of annual global carbon dioxide (CO₂) emissions today, and slightly more than 30 per cent of all CO₂ emissions since 1751.¹³ Coal, oil and gas still represent almost 70 per cent of CO₂ emissions in Europe.¹⁴ Europe has not yet fully transformed its energy systems. Although the region has reduced annual emissions by an average 85 MtCO₂ per year over the past three decades from 1990 levels, it will need to more than double this rate to achieve net-zero emissions by 2050.¹⁵

Bold climate plays are not new to Europe, however. Since 1966, Europe has accounted for 11 per cent

of the increase in renewable energy generation in the world and represented 16 per cent of total global renewable energy production in 2019.¹⁶

The rapid and large-scale deployment of wind and solar generation has helped drive down the cost of renewables globally, making them among the cheapest sources of electricity in history.¹⁷ The early subsidisation of rooftop solar in Germany significantly increased the adoption of that technology in the early 2000s, with large-scale solar representing a growing portion of the mix.¹⁸ Long associated with oil and gas production, the North Sea is becoming a hub of offshore wind generation. Italy’s largest utility, Enel, is the world’s largest private investor in renewable energy projects in emerging markets.¹⁹ Scandinavia is diversifying its fossil fuel-heavy energy sector to develop a renewable energy hub for local industry and energy exports to the rest of Europe.²⁰

Europe’s largest emitters have commitments to reduce emissions



Note: Emission shares reflect carbon dioxide emissions only, attributed to the country in which they physically occur.

Source: Our World in Data and other government sources.¹⁹

The costs of climate inaction for Europe

If Europe—and the world—doesn't take significant action to fight climate change and global emissions continue to rise with economic growth, it will result in global average warming of around 3°C by the end of the century. This is the baseline and trend outlook for Europe and the world.

According to the D.CLIMATE model, global warming of 3°C could result in economic outcomes across six impact channels: heat stress, capital damage, tourism expenditure flows, lost agricultural land due to sea level rise, agricultural yield changes and tolls on human health.

Due to its geographical diversity, each region of Europe will face a different combination of these climate-related consequences. Along the Mediterranean coast, heat will be a significant risk. In the Benelux countries, sea level rise will make some regions uninhabitable. Many of Europe's great cities, built on the banks of the Rhine, the Danube and the Seine, will be exposed to flooding.²²

In this climate-damaged world, warming could reduce Europe's economic potential. Productive capital and knowledge could be concentrated on repairing damages instead of investing in new, value-adding innovations and infrastructure. As climate change starts to affect human health, communities will become more focused on well-being than on participating in the workforce and achieving their best. Just as COVID-19 focused efforts – rightly – on mitigating the impact of the pandemic in 2020 and 2021, climate change also could divert efforts that otherwise would yield economic progress.

Rising temperatures, mounting losses

Over the next 50 years, the analysis shows that climate change-induced economic losses to Europe could total approximately €6 trillion in present value terms.²³

Europe's top five largest industries have the strongest exposure to risks from climate change due to their economic structures and their workforces. Together, private and public services, retail trade and tourism, construction and manufacturing account for about 80 per cent of GDP.²⁴

In the decade preceding 2070, Europe's economic growth trajectory could slow to around 1 per cent per year – equivalent to the average annual GDP growth in Europe from 2010 to 2020. To give this perspective, this decade included the ripple effects of the global financial crisis and the 2012 Eurozone crisis, topped with the COVID-19 pandemic.²⁵

Because climate damages will only accelerate over time, in 2070 alone, Europe faces a €630 billion loss to GDP, a loss that grows with each passing year. This impact is like losing almost the entire current economy of Switzerland each year.²⁶

The composition and quality of long-term growth could also change. Economic growth in a climate-damaged economy would be impeded by reduced productivity and a lack of new investment and innovation, which, in turn, could lead to significant losses to standards of living. In this smaller future economy, there would also be fewer job opportunities, resulting in 110 million fewer jobs in Europe over the next 50 years.

Climate change will harm the drivers of economic growth

To demonstrate the impact climate change could have on the economy, we incorporated regional climate data into the following economic factors. These factors would suffer climate damages in a 3°C world, which would impact future GDP growth.

Economic impact associated with climate change



Heat stress
Lost labour 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



Tourism loss
Disrupted flow of global currency



Agriculture loss
Reduced agricultural yields from changing climate patterns

Source: Deloitte Economics Institute.



*net present value GDP

Climate inaction would come at a significant cost to Europe

Because climate damage is expected to impact certain regions and industries more than others, there are significant differences between countries and regions.

Europe's largest emitters have commitments to reduce emissions

Regional loss to 2070 on a path to a 3°C world

Region	GDP impact 2021-2070 (€ billion, net present value)	Employment (millions) impact 2021-2070
Northern Europe	-350	-4
Eastern Europe	-70	-5
Southern Europe	-1,480	-39
Western Europe	-650	-7
France	-1,340	-19
Germany	-730	-10
Italy	-1,220	-21
United Kingdom	-280	-4

Industry loss in GDP to 2070 on a path to a 3°C world

Industry	GDP impact 2021-2070 (€ billion, net present value)
Public and private service sectors	-3,120
Manufacturing	-1,300
Retail and tourism	-690
Construction	-390
Transport	-260
Clean energy	-170
Natural resources and mining	-100
Conventional energy	-90
Water and utilities	-60
Agriculture	50

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

Differing impacts across Europe

If Europe's modern economic story is one of integration and growth, unchecked climate change could shift the region's economic story to one of fragmentation and decline.²⁷

There are significant regional variations in the modelled impacts of climate change in Europe, particularly along the North-South divide. The Mediterranean countries could experience twice the GDP impacts as their northern counterparts. Countries such as Italy and those in Southern Europe (including Spain, Portugal and Greece, among others) could encounter the largest negative effects, with potential economic losses topping 3 per cent of GDP by 2070 due to lower labour productivity and greater exposure of their capital stocks to the physical impacts of climate change.

Warmer temperatures in this region would deteriorate job markets over the long term.

The labour forces of Italy and Southern Europe could have 60 million fewer jobs over the next 50 years as a result of climate change. This would represent 55 per cent of Europe's total jobs lost due to unchecked climate change.

Europe doesn't face the most extreme direct physical climate risks relative to other regions of the world, but if decarbonisation efforts don't accelerate, economic activity all over the world will be at risk. According to the Deloitte Economics Institute's analysis, the Asia-Pacific region is estimated to face damages of up to \$96 trillion over the next 50 years – putting the assets and operations of European multinationals at risk in these locations.²⁸ Global trade and investment would be impacted by climate damage in other regions, thereby compounding the impacts for Europe.

Europe doesn't face the most extreme climate risks relative to other regions of the world, but if decarbonisation efforts don't accelerate, economic activity all over the world will be at risk.

Opportunities for Europe in a net-zero future

If Europe chooses the path of decisive decarbonisation today, it could achieve in just 30 years what has taken centuries of industrial evolution to accomplish. After reaching its turning point in 2050, Europe could start to enjoy the net positive economic gains of a modern, productive and emissions-free economy. This would be an incredible feat.

In its first net-zero decade, Europe could experience an increase in GDP driven by growth in the major economies of Germany, Italy, France, the United Kingdom and Southern Europe. In 2070, Europe's net benefit of transition could grow to 1.8 per cent of GDP. It would be €730 billion better

off in 2070 relative to a world of inaction and this benefit would grow with every subsequent year.

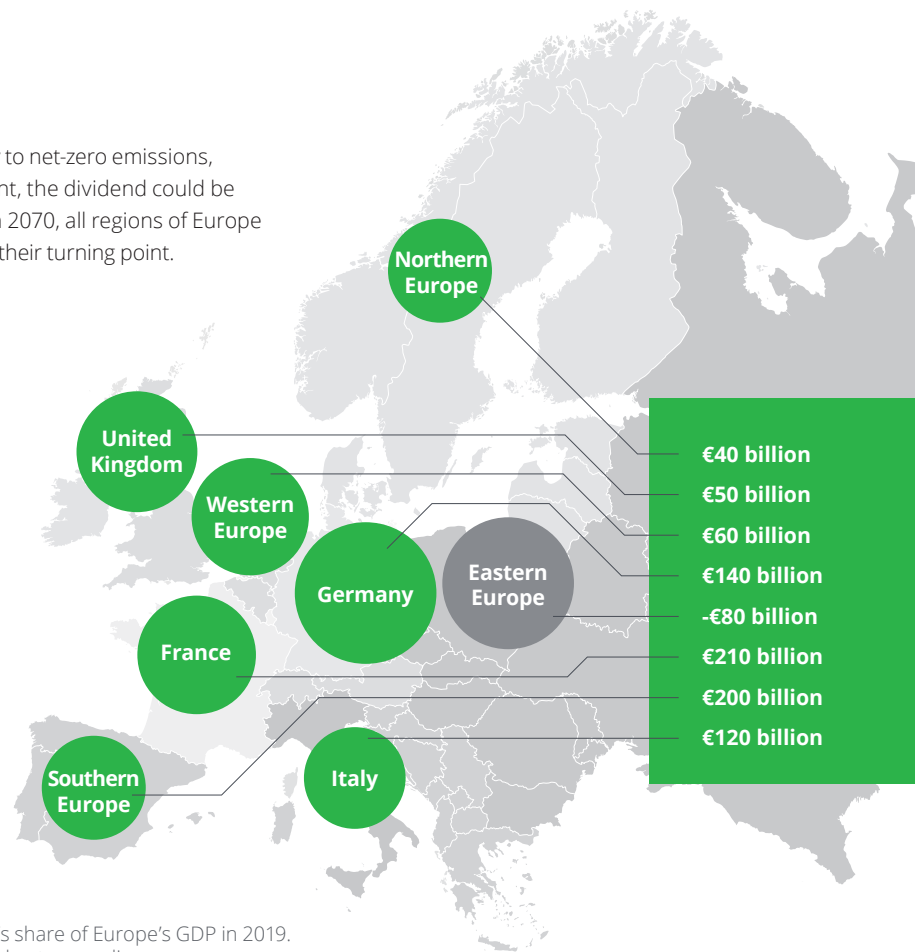
In a net-zero economy of 2070, Europe could have 5 million more workers than it would in a climate-damaged, emissions-intensive world. Job growth and new occupations could be created by emerging clean energy, the growth of the hydrogen sector and the expansion of modern manufacturing. The United Kingdom, Germany, France, Italy and Southern Europe all could be early leaders in job creation by Europe's turning point. By 2050, the size of their workforces could be 0.5 per cent larger on average compared to their workforces in a 3°C world.

If Europe chooses the path of decisive decarbonisation today, it could achieve in just 30 years what has taken centuries of industrial evolution to accomplish.

A net-zero economy could create widespread gains

Each economy in Europe has a different pathway to net-zero emissions, but when the continent reaches the turning point, the dividend could be significant. By the end of the modelled period in 2070, all regions of Europe could be growing and many could have reached their turning point.

Regional economic gain to GDP in 2070 in a 'close to 1.5°C world' (compared to a 3°C world)



Note: The size of each bubble reflects that country's share of Europe's GDP in 2019. These regional impacts do not sum to €730 billion due to rounding.
Source: Deloitte Economics Institute.

Eastern Europe has a different net-zero timeline

The results for Eastern Europe warrant a separate discussion as it would be the only region not to reach its turning point by 2070. According to the analysis, in 2070, Eastern Europe's low-emission economy will be €80 billion lower on a close to 1.5°C path than it would be on a path of inaction. That said, Eastern Europe could still be on track to reach its turning point by the end of the century. Despite this longer transition, the region could still benefit from decarbonisation and global net-zero emissions.

Eastern Europe's path to net zero looks different because its climate, economy and institutions

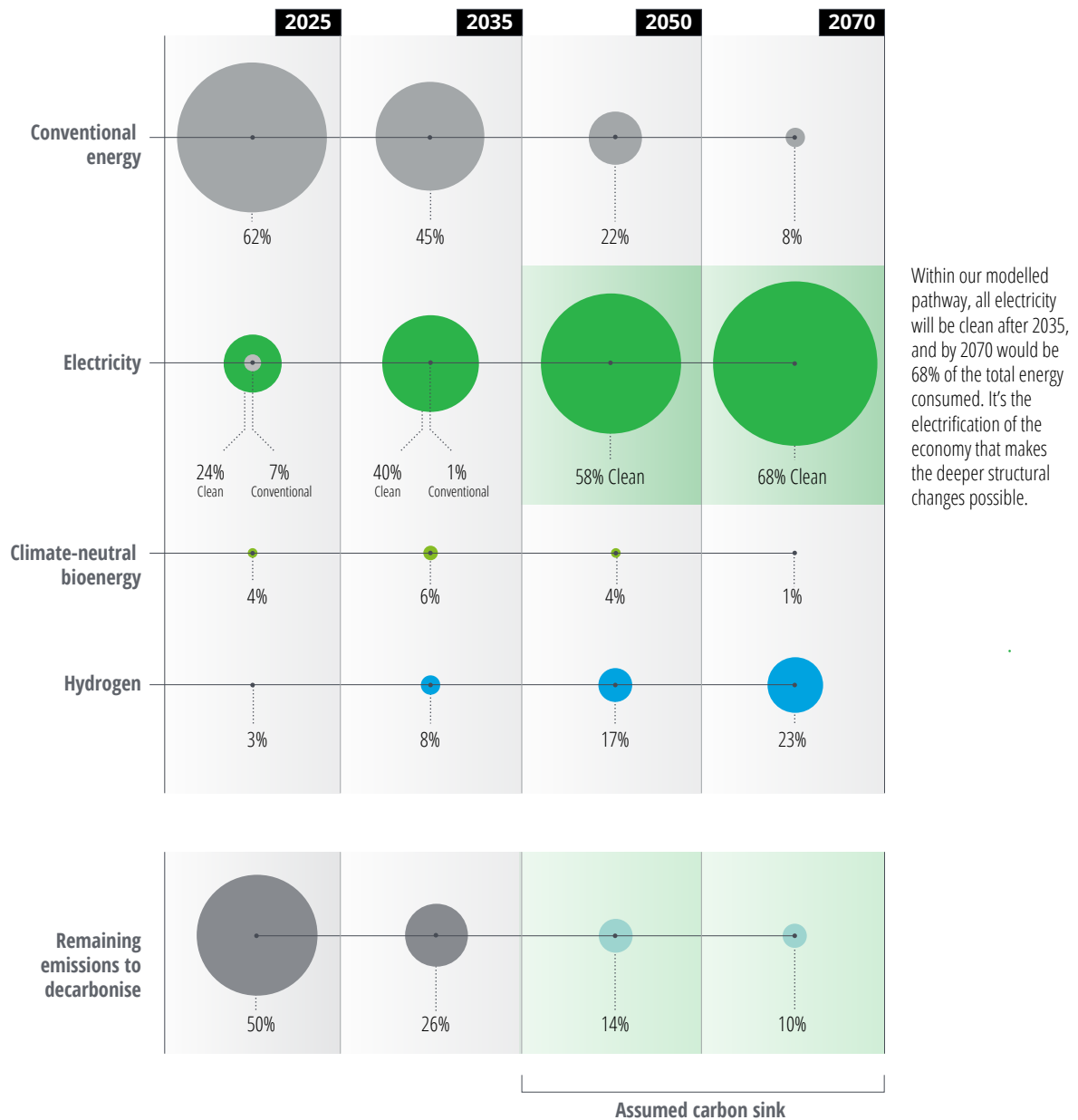
differ significantly from the other seven modelled regions on the continent. It is relatively less affected by the damages of warming due to its cooler climate, so it has fewer early gains from avoided climate damage. The region's economies also need more time, on average, to create the industries and opportunities to support future growth. And this region contains the fewest number of EU member states of any region, which means it sets policy differently from the rest of the continent.

Note: Eastern Europe includes the following countries, in order of economic size: Russia (51 per cent of Eastern Europe GDP in 2019), Poland (18 per cent), Romania (7 per cent), Czechia (7 per cent), Ukraine (5 per cent), Hungary (5 per cent), Slovakia (3 per cent), Belarus (2 per cent), Bulgaria (2 per cent) and Moldova (0.4 per cent).

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

A transition in the energy mix towards clean energy sources is a fundamental driver of Europe's decarbonisation. On the modelled pathway, Europe would rapidly replace conventional energy from now until 2035 with clean energy sources. The growing share of electricity in the energy mix – the electrification of the economy – drives deeper changes. Green hydrogen plays a key role in decarbonising industrial processes.

On a net-zero pathway, Europe's energy mix would rapidly shift towards clean sources



Note: Due to rounding, percentages may not equal 100%.
Source: Deloitte Economics Institute.

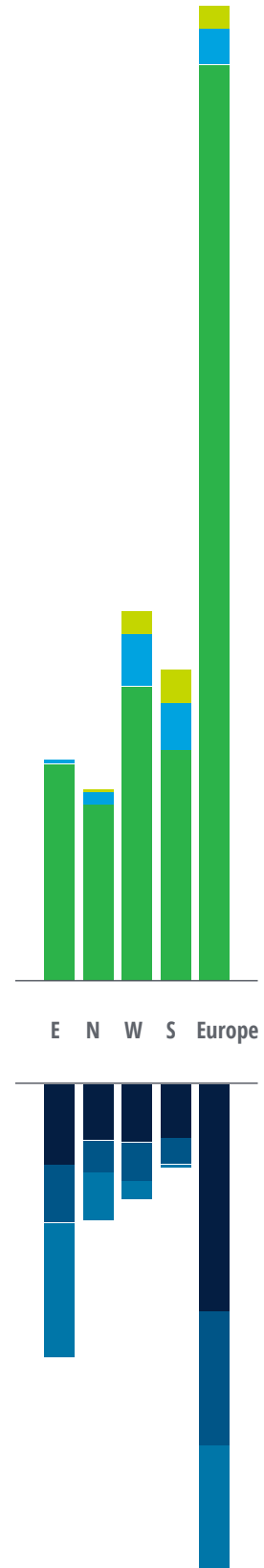
Shifting the composition of Europe’s economy could create the benefits of net zero

In 2020, clean and new energy sectors could drive net economic benefits across Europe, as some industries grow and emerge while others adjust to a net-zero normal.

Impacts of Europe’s decarbonisation on industry sectors in 2070

Growing industries	Region				
	E	N	W	S	Europe
■ Clean and new energy sectors	324	263	440	345	1,372
■ Public and private service sectors	5	18	77	69	53
■ All other growing industries	0	3	34	49	34
€ billion, gross value added					

Adjusting industries	Region				
	E	N	W	S	Europe
■ Conventional energy sectors	-120	-83	-86	-80	-339
■ Natural resources and mining	-86	-47	-57	-38	-200
■ All other adjusting industries	-200	-71	-26	-4	-189
€ billion, gross value added					



Source: Deloitte Economics Institute.

Exporting net zero to the world

Europe's economies are some of the most integrated within global value chains – imports and exports are worth as much as 90 per cent of the region's GDP²⁹ – making its most trade-exposed industries a key to an effective and competitive transition. By making strategic choices to reach its turning point now, Europe can both chart a more prosperous path towards a low-emission future and catalyse efforts in other parts of the world via trade and investment.

As Europe moves towards its turning point, the structural adjustments required will create disruptions in emissions-intensive industries across Europe and the world. When planning for these structural adjustments, the countries that emphasise not just the magnitude but the

'quality' of economic growth will be more resilient to these disruptions. The countries that choose to increase their complexity by creating competitive advantages could experience higher growth. Europe is already home to some of the world's most complex economies.³⁰ And it is this economic complexity that strongly positions Europe for a low-emission transformation.

Measures of 'green' economic complexity – activity related to the greening of economies – show that Germany, Italy, and France are three of the highest-ranking countries in the world in the production of green goods.³¹ Coming from a strong starting point, the sooner Europe accelerates its expertise and comparative advantages in industries for a low-emission future, the sooner it could improve economic resilience and position Europe to meet the demands of a net-zero world through trade.

Countries that choose to increase their complexity by creating competitive advantages could experience higher growth.

Pathway to a climate-neutral continent

In the modelled scenario, clean energy (primarily renewables such as wind and solar) underpins the early and rapid transition, including the significant expansion of 'green' hydrogen via electrolysis to support harder-to-abate industries. This transition takes time but results in 100 per cent clean electricity by 2050. Alongside the shift to renewables, electricity storage and transmission

infrastructure would need to develop together with the generation component of the sector.

These early investments in hydrogen production could provide a clean fuel source to aid in the transition and support energy security on the continent. Green hydrogen could fulfil about 17 per cent of the energy mix in Europe by 2050 (see the technical appendix).³²

There are new drivers of economic growth in a low-emission future

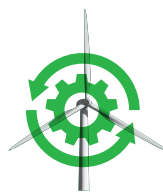
The D.CLIMATE model of a 'close to 1.5°C world' incorporates a number of levers that could create growth in a low-emission future. If the world accounts for climate damage and increases its ambition to act, it would create an impetus to change. That price signal could accelerate decarbonisation across all economic systems. Energy systems could rapidly transform, and conventional fuels could become increasingly uncompetitive due to technological improvements. As this transition takes place, governments could invest in creating jobs and economic opportunity alongside industry to minimise the disruption. See the technical appendix for more details on the mechanisms that drive decarbonisation to reach Europe's turning point.

The drivers of economic change from decarbonisation in a 'close to 1.5°C world'



Change is valued

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



Energy transforms

- Renewable and clean electricity transform Europe's energy system
- As renewables become cheaper, there is substitution in favour 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

Europe's turning point

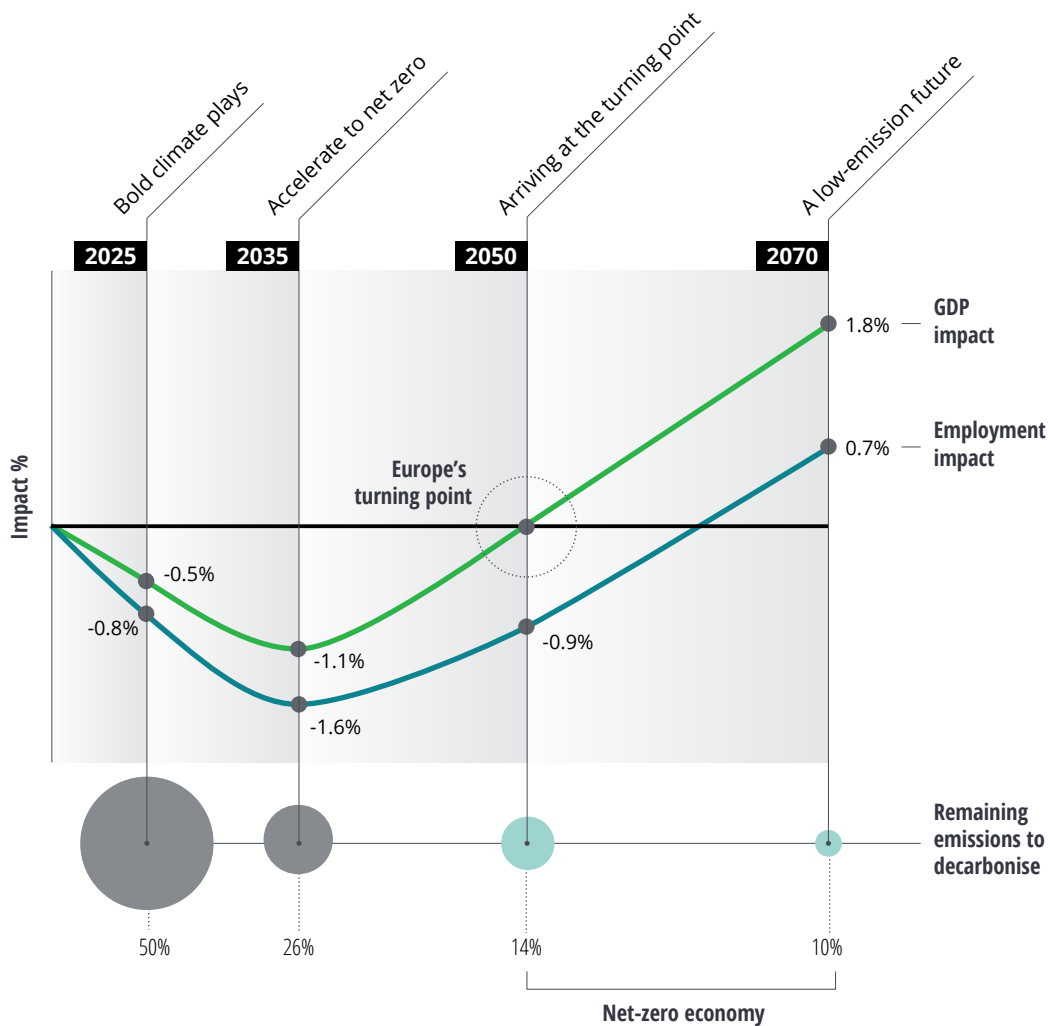
To aid the interpretation of the modelling results and to explain how Europe could achieve a low-carbon system transformation by 2050, the Deloitte Economics Institute has outlined four phases of structural economic change: bold climate plays, accelerate to zero, arriving at the turning point and a low-emission future.

These four phases are narratives that synthesise the combined impacts of different actions and targets, taking place at different points in time. They include several core features spanning production systems, policy, finance and consumer behaviour. The economic gains of decarbonisation occur in sectors and industries that will be the future of Europe's global competitive advantage.

Once Europe achieves its turning point, the net gain will offset the economic cost to get there

A rapid and coordinated path to net zero for all of Europe features four phases of decarbonisation, beginning with a period of structural adjustment. If Europe accelerates action on climate change in the next five years, it could help limit global warming over the next 50 years, allowing the continent to enter its first net-zero decade better off for transforming.

Economic impact of Europe's decarbonisation pathway



Source: Deloitte Economics Institute.

Bold climate plays: From 2021 to 2025

Europe's first phase of structural economic change begins now. Indeed, the next few years will be pivotal for accelerating technological innovation and creating the market conditions that can deliver decarbonisation at scale.

If the electricity-generation sector undergoes a rapid transformation, clean electricity generation technologies such as solar, wind and hydro could become a larger share of Europe's production, while fossil fuel sources decline. This would involve a rapid deployment of mature technologies, an acceleration of existing project commitments and a substantial uptick in plans for future projects. The construction sector could benefit from the ensuing investment in the development of new infrastructure for the generation, transmission, storage and use of clean electricity.

The rapid growth in these sectors, along with the emergence of hydrogen and biofuel sectors, could add an average of 1.8 million jobs per year. This shift would create pathways for workers from more fossil fuel-reliant industries and could minimise the decarbonisation transition's overall impact on employment – a critical goal of a smooth transition. There could also be an increased demand for government services workers in the first five years of the transition period, as planning and public-private cooperation accelerate.

The decarbonisation transition will require an immense mobilisation of public and private capital in Europe and abroad. Globally, the International

Energy Agency estimates that a net-zero transition over the next decade will require €1.3 trillion per year of investment in electricity generation, up from an average of €0.4 trillion over the past five years.³³ The next five years will be crucial to creating the conditions for this unprecedented level of investment to take place.

The EU Green Deal investment plan was designed to deliver on these objectives.³⁴ It is expected to require €1 trillion spent over ten years. Roughly half will come from public funds, and the rest from mobilising private investment. Accessing private finance for projects and investments will become easier over time, as the price of emissions rises and covers a wider range of goods and services.³⁵ The expanded coverage of the European Emissions Trading System will have the effect of making projects attractive to private finance, prompting supply chains to transform and putting in place the foundation for a structural shift to limit global average warming to as close to 1.5°C.

As it makes these shifts, Europe will need to consider how the transition will affect the competitiveness of trade-exposed industries. Within the EU, at least, measures that level the playing field for emissions-intensive industries across borders via carbon prices and tariffs will be an important consideration.³⁶

In this first decade of the transition, the economic impact would be marginal by design: Coordinated and rapid transition prevents extreme disruption to the growth trajectory, with a reduction in Europe's GDP of just 0.5 per cent in 2025 as ambition and the pace of change pick up.

Bold play

Top industry performers in 2025

Industry	Industry output gain	Employment gain
Clean and new energy	€160 billion	+1.8 million jobs
Agriculture	€9 billion	+300,000 jobs

Source: Deloitte Economics Institute.



**Accelerate to zero:
From 2025 to 2035**

This next decade would be the time when the hardest shifts in industrial policy, energy systems and consumer behaviour would take place.

Sectors such as clean energy and electricity generation could surge ahead, as early investments from the previous decade start to pay off. Between 2025 and 2035, Europe can make great progress in decarbonising its electricity system by increasing the share of clean electricity from 78 per cent to 98 per cent in the scenario. While industrial processes and transportation (including air travel) will likely continue to rely on some fossil fuels until 2035, these sectors are expected to become more energy- and emissions-efficient.

Although different industries and regions would transform at different paces, some economies could start enjoying the results of earlier bold climate plays within this decade. In countries such as Germany, France and Italy, the construction sector could benefit from early investment in renewables because there is likely to be an immense demand for physical infrastructure in the form of new offshore wind farms, utility-scale solar and energy-efficient transformations of the building stock.

Southern Europe could also benefit because timely investment in decarbonisation could help the region avoid more significant climate damage and the region also could have a chance to establish an early-mover advantage in clean technologies.

Regions and industries with a greater dependence on fossil fuels today would face steeper costs of transition if they don't progress at the same pace. Investing in both easier-to-abate and harder-to-abate sectors at the same time would be critical: If Europe doesn't accelerate the investment in hard-to-abate regions and industries (for example, construction and industrial processing), then it will likely increase the transition costs for the easier-to-abate regions and industries as well. A failure to coordinate and accelerate the transition across the continent, therefore, risks a higher cost burden on all European economies.

Because this would be the decade of hard structural changes, growth would be affected by pressures on particular sectors. The economy would still be growing, but Europe would have a reduction in GDP of just 1.1 per cent in 2035 as it works through the transition.

To ensure a just transition for all places and sectors, Europe would need to design social support systems, as envisioned by the EU Green Deal.³⁷

Top industry performers in 2035

Industry	Industry output gain	Employment gain
Clean and new energy	€510 billion	+4.9 million jobs
Agriculture	€20 billion	+530,000 jobs
Water and utilities	€1 billion	+5,000 jobs

Source: Deloitte Economics Institute.

Arriving at the turning point: From 2035 to 2050

This is the phase when the hard work could start to pay off. As it approaches the mid-century mark, Europe could reach its turning point, avoiding the worst effects of a 3°C world and realising the economic dividends of systems-level transformations. At this point, the decarbonisation of Europe's industries would be almost complete, the cost of low-emission technologies would be decreasing and net economic gains would be shared more widely. These efforts would also ensure that global warming remains on a path as close to 1.5°C and well below 2°C.

France could be one of the earliest countries to reach its turning point, as it not only realises economic dividends from climate action, but also limits economic losses from a higher-emissions pathway. By 2035, France's economy could be better off after a net-zero transition than it would

be in a world without climate action, both in terms of GDP and employment. Its GDP would be an average 0.8 per cent larger every year than under a 3°C world between 2035 and 2050. Even France's most emissions-intensive sectors could reach their turning point, thanks to early investments in alternative energy. The transportation industry could also be emissions-free.

Italy and the United Kingdom would reach their turning points about ten years later. Like other European countries, the construction industry in Italy and the United Kingdom would benefit not only from a transformation of energy systems and the required infrastructure development, but also from the broader electrification of the economy. The rise of the clean energy industry during this phase would be a major driver of employment because of its relatively intense labour needs. Travel and tourism could give an additional boost to employment in Italy and in the United Kingdom, the latter of which could reach its turning point around 2050.

Top industry performers in 2050

Industry	Industry output gain	Employment gain
Clean and new energy	€1.2 trillion	+7 million jobs
Construction	€25 billion	+70,000 jobs
Water and utilities	€20 billion	+500,000 jobs
Agriculture	€5 billion	+18,000 jobs

Source: Deloitte Economics Institute.



A low-emission future: Beyond 2050

From 2050 onwards, the economies of Europe and the world could be at net-zero emissions, making it possible to limit global average warming to well below 2°C by the end of the century. By this time, Europe's economic structures could be radically transformed, underpinned by a series of interconnected, low-emission systems spanning energy, mobility, manufacturing, agriculture, food and land use. For EU members, the Green Deal should have supported a decoupling of economic growth not only from emissions, but from resource consumption more broadly through a focus on a circular economy that recycles more and reduces waste.³⁸

From 2060 onwards, the low-emission future could be benefitting almost every region and industry

in Europe, thanks to growth in the services sector, which is the largest industry in many European countries. A thriving service sector across Europe in a low-emission economy could represent the future of work and provide new employment opportunities across a range of emerging fields.

By 2070, almost all regions and industries could be net winners; Europe could have an average annual increase to GDP of almost 1.8 per cent. Industries such as transportation, retail trade and tourism could grow sustainably in this future economy. Take transport, where mature clean hydrogen sectors continue to grow significantly to 2070 as a key source of energy for the economy. For retail and tourism, avoiding the worst effects of a 3°C world especially supports economic gains.

Top industry performers in 2070

Industry	Industry output gain	Employment gain
Clean and new energy	€2.4 trillion	+7 million jobs
Public and private services	€115 billion	+1.6 million jobs
Construction	€50 billion	+600,000 jobs
Water and utilities	€40 billion	+1 million jobs
Retail and tourism	€25 billion	+800,000 jobs
Transport	€20 billion	-400,000 jobs

Source: Deloitte Economics Institute.

Regional action for a global challenge

Parting thoughts

Climate change is taking place, and those changes in our physical environment will have an increasingly direct impact on our lives. The disruption that one powerful storm causes today could become the norm for storm damage in a climate-changed future, where these types of events will be more intensive and will occur more frequently. This damage will interrupt business operations, put strain on local and regional governments and harm human life. All that comes at a significant cost.

Because uncontrolled global warming is dangerous for our economies and societies, we must work together to prevent it. Unfortunately, the conversation we are about to have at COP26 does not leave a lot of room to manoeuvre. At this late stage, we now have to solve for 50 years of postponed action.

These first steps will be the hardest ones.

Across Europe, across industries and across the globe, there will be major changes taking place to how people get around, what kinds of jobs they can do and how the businesses where they work create value. In some regions, entire industries are at risk. There may be years when the unavoidable effects of our already changed climate will make some question whether what we're doing is even working. There may be those who will say that the price is just too high.

Yes, there is a real cost to change. Whether we are building clean energy sources, developing a carbon trading scheme or funding the transformation of emissions-intensive industries, these economic investments will take time to yield measurable growth. But the benefits will likely accrue on a local level immediately. Construction workers could feel the impact of the new jobs building offshore wind farms. Public service workers would be actively managing the system change. Former fossil fuel workers could find use for their skills in new industries. Capital markets could support the transformation of the energy industry, driving the benefits throughout the economy. This is to say, like all good investments, the hard work pays off.

Yet even if Europe takes bold and collective action, it needs to be responsive to what's going on in other parts of the world. That's because the built-in assumptions about the outcomes of Europe's decarbonisation depend on the efforts of all the regions of the world. This will require Europe to confront aspects of its regional politics that may otherwise impede regional cooperation.

COP26 is the start of that conversation. If we act with purpose in the next decade, we can turn the course of economic history.

Modelling climate change impacts in Europe



Modelling climate change impacts in Europe

Supporting detail on analysis

D.CLIMATE process

To quantify its conclusions, the Deloitte Economics Institute modelled the economic impacts of a changing climate on long-term economic growth using the following 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 2100.³⁹ The socioeconomic pathway, SSP2, is the 'middle of the road' among five broad narratives of future socioeconomic development that are conventional in climate change modelling. The climate scenario, RCP6.0, is an emissions pathway without significant additional mitigation efforts (a baseline scenario).⁴⁰ This results in a projected emissions-intensive global economy.⁴¹

2

Increased atmospheric GHGs cause average global surface temperatures to continue rising above preindustrial levels. 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 (MAGICC).⁴² (Note that present-day temperatures have already risen more than 1.0°C above preindustrial levels.)

3

Warming causes the climate to change and results in physical damage to the factors of production.

The D.CLIMATE model includes six types of economic damage, regionalised to the climate, industry and workforce structure of each defined geography in Europe. 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.

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 a baseline that includes climate change damage. Scenarios can also include policy actions that either reduce or increase emissions and global average temperatures relative to the current SSP2-6.0 baseline view.

This modelling framework involves significant research on region-specific climate and economic impacts across Europe, which are used as inputs for the D.CLIMATE model (refer to the technical appendix for more detail).

Sector groupings

Sector name	Subcomponents
Agriculture	Agriculture and fishing Forestry
Natural resources and mining	Coal Oil Gas Other mining
Manufacturing	Food manufacturing Light manufacturing Heavy manufacturing
Conventional energy	Coal Gas Oil Other emissions-intensive energy Gas manufacture, distribution Electricity: Transmission and distribution
Clean and new energy	Nuclear Wind Hydro Solar Hydrogen Bioenergy (carbon-neutral)
Water and utilities	Water and utilities
Construction	Construction
Retail and tourism	Retail trade Accommodation, food and service activities
Transport	Transport Water transport Air transport Warehousing and support activities
Public and private services	Communication Financial services Insurance Real estate activities Business services Recreational and other services Dwellings Public Administration and defense Education Human health and social work activities

Source: Deloitte Economics Institute.

Endnotes

1. IPCC. (2021) *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.
2. Total net present value of deviation loss to GDP in Europe over the period to 2070 at a 2 per cent discount rate. Refer to the technical appendix for a discussion on the selection and application of the discount rate.
3. GDP measured prepandemic and refers to World Bank estimates.
4. Bank of England, "How has GDP growth changed over time?," 2019, <https://www.bankofengland.co.uk/knowledgebank/how-has-growth-changed-over-time>; Economic growth as measured by GDP, and improved standards of living as measured by increase in GDP per person.
5. IPCC, *Sixth assessment report*, 2021, <https://www.ipcc.ch/assessment-report/ar6/>.
6. Ibid.
7. Ibid.
8. Ibid.
9. Economist, "Climate change is affecting wine flavours," July 15, 2021, <https://www.economist.com/europe/2021/07/15/climate-change-is-affecting-wine-flavours>.
10. Warren Cornwall, "Europe's deadly floods leave scientists stunned," *Science*, July 20, 2021, <https://www.science.org/news/2021/07/europe-s-deadly-floods-leave-scientists-stunned>; Holly Else, "Climate change implicated in Germany's deadly floods," *Nature*, August 26, 2021, <https://www.nature.com/articles/d41586-021-02330-y>.
11. Kate Abnett and James Mackenzie, "Floods lay bare Europe's 'gigantic task' in averting future climate damage," Reuters, July 20, 2021, <https://www.reuters.com/business/environment/floods-lay-bare-europes-gigantic-task-averting-future-climate-damage-2021-07-20/>.
12. Hannah Ritchie and Max Roser, "CO₂ and greenhouse gas emissions," Our World in Data, August 2020, <https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions>; Pierre Friedlingstein et al., "The global carbon budget 2020," *Earth System Science Data* 12, no. 4 (2020), <https://doi.org/10.5194/essd-12-3269-2020>.
13. Current share based on 5.4 Gt CO₂ and 36.4 Gt CO₂ emitted by Europe and world, respectively, in 2019. Cumulative share since 1751 based on 525 Gt CO₂ and 1,652 Gt CO₂ emitted by Europe and world, respectively. For more details, see: Ritchie and Roser, "CO₂ and greenhouse gas emissions."
14. According to the International Energy Agency (IEA), coal, oil and gas represented 3.7GT of CO₂ emissions in 2019 in Europe. See: IEA, "Global CO₂ emissions in 2019," February 11, 2020, <https://www.iea.org/articles/global-co2-emissions-in-2019>; Ritchie and Roser, "CO₂ and greenhouse gas emissions"; Friedlingstein et al., "The global carbon budget 2020."
15. According to Our World in Data definition of the Europe region (including Russian Federation), in 1990, CO₂ emissions were 8011MT and in 2019, 5449MT. A reduction of 85MT CO₂ per year is the straight line level reduction per year between these two levels. See: Ritchie and Roser, "CO₂ and greenhouse gas emissions."
16. In 2019, renewable electricity generation was 153TWh in Europe and 963TWh globally. Ritchie, H. and Roser, M. (2020) 'Energy; Our World in Data, "Table: Annual change in renewable energy generation, 2019," accessed October 7, 2021, <https://ourworldindata.org/grapher/annual-change-renewables?tab=table>.

17. IEA, *World energy outlook 2020*, October 2020, <https://www.iea.org/reports/world-energy-outlook-2020>.
18. *Economist*, "How governments spurred the rise of solar power," January 7, 2021, <https://www.economist.com/technology-quarterly/2021/01/07/how-governments-spurred-the-rise-of-solar-power>.
19. *Economist*, "The bottlenecks which could constrain emission cuts," June 12, 2021, <https://www.economist.com/briefing/2021/06/12/the-bottlenecks-which-could-constrain-emission-cuts>.
20. *Economist*, "Plentiful renewable energy is opening up a new industrial frontier," May 15, 2021, <https://www.economist.com/europe/2021/05/15/plentiful-renewable-energy-is-opening-up-a-new-industrial-frontier>.
21. Friedlingstein et al., "The global carbon budget 2020"; Climate Action Tracker, "Country overview," accessed October 7, 2021, <https://climateactiontracker.org/countries/>; Climate Change Committee, *Sixth carbon budget: The UK's path to net zero*, December 2020, <https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf>; European Commission. (2020). NECP Factsheet: France.; European Commission. (2021). 2030 Climate Target Plan; Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, "Climate action plan 2050 – Germany's long-term low greenhouse gas emission development strategy," accessed October 7, 2021, <https://www.bmu.de/en/topics/climate-adaptation/climate-protection/national-climate-policy/climate-action-plan-2050-germanys-long-term-low-greenhouse-gas-emission-development-strategy>; European Parliament, "Climate action in Italy: Latest state of play," June 2021, [https://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_BRI\(2021\)690663](https://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_BRI(2021)690663).
22. L. Feyen et al., *Climate change impacts and adaptation in Europe: JRC PESETA IV final report*, European Commission, 2020, <https://publications.jrc.ec.europa.eu/repository/handle/JRC119178>.
23. Total net present value of deviation loss to GDP in Europe over the period to 2070 at a 2 per cent discount rate. Refer to the technical appendix for a discussion on the selection and application of the discount rate.
24. Modelling from Deloitte Economics Institute based on 2020 industry shares of economic output for these sectors.
25. World Bank, "GDP growth (annual %)," accessed October 7, 2021, <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>.
26. International Monetary Fund, *World economic outlook*, April 2021, <https://www.imf.org/external/datamapper/datasets/WEO>.
27. Heather Grabbe and Stefan Lehne, "Climate politics in a fragmented Europe," Carnegie Endowment for International Peace, December 18, 2019, <https://carnegieeurope.eu/2019/12/18/climate-politics-in-fragmented-europe-pub-80616>.
28. Measured in US\$; Pradeep Philip et al., *Asia Pacific's turning point: How climate action can drive our economic future*, Deloitte, August 2021, <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/gx-tp-asia-pacific-turning-point.pdf>.
29. World Bank, "Trade (% of GDP)," accessed October 7, 2021, <https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS>.
30. Deloitte Access Economics (2021), *Australia remade: A country fit for the age of disruption, Building the Lucky Country: Edition 8*
31. Penny Mealy and Alexander Tetlyboym, "Economic complexity and the green economy," *Research Policy* (2020), <https://www.sciencedirect.com/science/article/pii/S0048733320300287?via%3Dihub>.

32. The energy mix in this context is measured as total final energy consumption.
33. IEA, *Net zero by 2050 – A roadmap for the global energy sector*, May 2021, <https://www.iea.org/reports/net-zero-by-2050>.
34. *Economist*, "What is the European Green Deal?," June 1, 2021, <https://www.economist.com/the-economist-explains/2021/06/01/what-is-the-european-green-deal>.
35. Paolo D'Aprille et al., *Net-zero Europe: Decarbonisation pathways and socioeconomic implications*, McKinsey & Company, November 2020, <https://www.mckinsey.com/~media/mckinsey/business%20functions/sustainability/our%20insights/how%20the%20european%20union%20could%20achieve%20net%20zero%20emissions%20at%20net%20zero%20cost/net-zero-europe-vf.pdf?shouldIndex=false>.
36. European Commission, "Carbon border adjustment mechanism: Questions and answers," July 14, 2021, https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3661.
37. The European Union Green Deal proposes the Just Transition Mechanism as central policy for achieving this objective. See: European Commission, "The Just Transition Mechanism: Making sure no one is left behind," accessed October 7, 2021, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en.
38. The circular economy is a model of production and consumption that involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended; European Parliament, "Circular economy: definition, importance and benefits," March 3, 2021, <https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits>.
39. IPCC-adopted emission scenarios vary widely, depending on socioeconomic development and climate mitigation policy settings. SSP2-6.0 is chosen as one of the most frequently used 'baseline' scenarios in the literature. It describes an intermediate baseline scenario as it carries historical social, economic and technological trends forward and includes no specific or significant climate mitigation policy effort, making it an appropriate baseline for reference. For more detailed description of SSP2-6.0 and rationale for its adoption, see the technical appendix.
40. Intergovernmental Panel on Climate Change, "Annex II: Climate system scenario tables," accessed October 7, 2021, https://www.ipcc.ch/site/assets/uploads/2017/09/WG1AR5_AnnexII_FINAL.pdf.
41. Preindustrial is defined in IPCC assessments as the multicentury period before the onset of large-scale industrial activity around 1750.
42. The associated climate data (such as annual temperature increases and atmospheric concentrations) is 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.

Authors

Pradeep Philip | pphilip@deloitte.com.au

Pradeep Philip is a partner and leads Deloitte Access Economics in Asia Pacific. With deep expertise in economics and proven leadership experience, Pradeep has operated as a senior government bureaucrat at the highest levels of public policy. Pradeep is a Partner in the Deloitte Economics Institute.

Claire Ibrahim | cibrahim@deloitte.com.au

Claire Ibrahim leads analysis in the Economic Strategy and Public Policy team and has expertise in microeconomic analysis, economic scenario modelling and public policy reform agendas. Claire uses economics to answer how structural change impacts society – leading projects across governments, the private sector and major institutions. Claire is a Director in the Deloitte Economics Institute with expertise in climate economics and analysis using D.CLIMATE.

Cedric Hodges | chodges@deloitte.com.au

Cedric Hodges is a Director and leads the Computable General Equilibrium (CGE) modelling team at Deloitte Access Economics and across the Deloitte Economics Institute. This modelling team has completed analysis across the world on issues spanning the public and private sectors. Cedric specialises in climate economics and integrated assessment modelling using D.CLIMATE.



Dr. Pradeep Philip

Partner,
Deloitte Economics Institute
pphilip@deloitte.com.au



Claire Ibrahim

Lead Director,
Deloitte Economics Institute
cibrahim@deloitte.com.au



Cedric Hodges

Lead Director,
Deloitte Economics Institute
cehodges@deloitte.com.au

Sustainability Leaders

Nicolas De Jenlis, Partner, Sustainability Leader, Deloitte Central Europe

Sandra Heuts, Partner, Sustainability Leader, Deloitte North and South Europe

Olivier Jan, Partner, Sustainability Leader, France

Marie Georges, Partner, Sustainability Leader, France

Thomas Schlaak, Partner, Sustainability Services Lead, Germany

Franco Amelio, Partner, Sustainability Leader, Italy

Tim Archer, Partner, Sustainability Leader, UK

Hannah Routh, Partner, Sustainability Leader, UK

Deloitte Economics Institute

The pace and scale of global economic, social, environmental, and digital disruption is rapid, and we all now operate in a world that we no longer readily recognise. This creates a need to understand how structural economic change will continue to impact economies and the businesses in them, and the livelihoods of the world's citizens.

In pursuit of economic prosperity, progressive organisations need future-focused, trusted advisors to help them navigate complexity and deliver positive impact. The Deloitte Economics Institute (the "Institute") combines foresight with sophisticated analysis to shape and unlock economic, environmental, financial, and social value. Connecting leading global insight and local knowledge with an independent perspective, the Institute illuminates future opportunities and drives progress.

The Institute's economic rigour comes from its cutting-edge analytic tools; experience working with businesses and governments; and the expertise of Deloitte firm practitioners who help shape public policy, deliver business insights, and inform investment strategy. The Institute shares practical policy, industry know-how, and evidence-based insights to help businesses and governments tackle the most complex economic, financial, and social challenges.

With **more than 400 economists practicing in Deloitte firms across Asia-Pacific, the Americas, and Europe**, the Institute's depth and breadth of experience is matched by a strong understanding of trends in global economies and their effect on business. Its dedicated team of economists works closely with the Deloitte network's industry leaders across the globe to apply economic thinking and commercial acumen to everyday business problems.

The Institute prides itself on rigorous qualitative and quantitative analysis, and is supported by proprietary and specialist models refined over many years. The Institute's highly qualified economists practicing in Deloitte firms have a strong reputation for objectivity and integrity. All client services offered by the Institute are performed by practitioners at Deloitte firms.

For more information on the Deloitte Economics Institute, please visit the website:
www.deloitte.com/deloitte-economics-institute

A special thanks to the following individuals who provided the support to make this report possible:

Josh Appleton Miles
 Mairead Davis
 David O'Callaghan
 Adam Davey
 Hom Pant
 Djauhari Pambudi
 Morgan Richards
 Lucy Mraz

Aneesha Singh
 Karli Jeffery
 Sam Marginson
 Hugo Bailly
 Rokhaya Dieye
 Edoardo Palombo
 Jack Buckley
 Sylvia Yoon Chang

Richard Horton
 Blythe Hurley
 Elizabeth Payes
 Jim Slatton
 Rupesh Bhat
 Dillip Podar
 Emma Downey



General use restriction

This publication contains general information only, and none of Deloitte Touche Tohmatsu Limited, its member firms, or their related entities (collectively the "Deloitte Network") is, by means of this publication, rendering professional advice or services. Before making any decision or taking any action that may affect your finances or your business, you should consult a qualified professional advisor. No entity in the Deloitte Network shall be responsible for any loss whatsoever sustained by any person who relies on this publication.

About Deloitte

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited ("DTTL"), its global network of member firms, and their related entities (collectively, the "Deloitte organization"). DTTL (also referred to as "Deloitte Global") and each of its member firms and related entities are legally separate and independent entities, which cannot obligate or bind each other in respect of third parties. DTTL and each DTTL member firm and related entity is liable only for its own acts and omissions, and not those of each other. DTTL does not provide services to clients. Please see www.deloitte.com/about to learn more.

Deloitte is a leading global provider of audit and assurance, consulting, financial advisory, risk advisory, tax and related services. Our global network of member firms and related entities in more than 150 countries and territories (collectively, the "Deloitte organization") serves four out of five Fortune Global 500® companies. Learn how Deloitte's approximately 345,000 people make an impact that matters at www.deloitte.com.

This communication contains general information only, and none of DTTL, its global network of member firms or their related entities (collectively, the "Deloitte organization") is, by means of this communication, rendering professional advice or services. Before making any decision or taking any action that may affect your finances or your business, you should consult a qualified professional adviser.

No representations, warranties or undertakings (express or implied) are given as to the accuracy or completeness of the information in this communication, and none of DTTL, its member firms, related entities, employees or agents shall be liable or responsible for any loss or damage whatsoever arising directly or indirectly in connection with any person relying on this communication. DTTL and each of its member firms, and their related entities, are legally separate and independent entities.