

WHAT DOES THE FUTURE HOLD?

AFRY's strategic scenarios  
provide insight in a world  
driven by uncertainty

ENERGY EDITION  
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# Introduction





## Why create scenarios?

IN AN UNCERTAIN WORLD, ENERGY COMPANIES NEED TO UNDERSTAND POSSIBLE FUTURE OUTCOMES AND DEVELOP STRATEGIES ACCORDINGLY

These scenarios provide a long-term outlook of the global context to 2050. Energy companies need to understand long-term trends when defining their short- to mid-term strategies. With these scenarios AFRY aims to help companies understand major uncertainties and prepare for a range of possible outcomes.

## What are their implications?

ENERGY COMPANIES ARE EXPOSED TO FUTURE UNCERTAINTY; SCENARIO DRIVEN ANALYSIS HELPS IN IDENTIFYING IMPACTFUL MITIGATION ACTIONS

AFRY went through an exercise of identifying and creating what we see as the most relevant scenarios of the future. We've distilled what in our view are the most important conclusions for energy companies from our scenario planning exercise. In this document, we lay out the process for arriving at these conclusions.

### KEY TAKE-AWAYS FROM SCENARIOS

#### The future is inherently unpredictable

A broad range of uncertainties and external variables make the context impossible to predict. Companies need to be able to navigate in a world where "anything could happen".

#### Change is the only constant

We live in a world that is constantly changing. From geopolitical instability, to regulation, to business decisions – the world waits for no one.

#### Extremes are (really) important

Extremes may be uncomfortable, but they help companies to prepare for dramatic changes – even if they never become a reality.

### IMPLICATIONS FOR ENERGY COMPANIES

#### Robust Analytics

Knowing which levers and uncertainties are more relevant helps companies identify the areas which should be closely monitored. Understanding at the "system" level the complex interaction of those variables will only grow in importance.

#### Decision-making under ambiguity

Because the world changes so fast, we don't always have all the information available. Deep sector experience and, by extension, intuition are key in scenario planning. In addition, there is a need to constantly re-evaluate strategies to ensure flexibility.

#### Increased Resilience

Understanding the full spectrum of potential changes guides companies towards being prepared to adapt to any situation. It helps in making decisions under uncertainty; especially energy companies who by nature are exposed to a broad range of external factors.

# Dimensions of Uncertainty



## Global Trends

After thorough analysis, AFRY chose the most relevant global trends that drive the future direction of travel (impacting the energy sector in particular) in the long term. The analysis spans a broad range of dimensions, from the economy, to social changes, technological advancement, political stability, and the environment. It's impossible to predict how each of the levers is going to evolve in the future, making it necessary to be prepared for any position on the scale. These are the Global Trends levers that were chosen:



### 1 ECONOMIC GROWTH

A recession in the years following COVID and the Russia-Ukraine war caused the world's economy to shrink considerably, reducing people's per capita income. Inflation meant consumers struggled to afford basic needs. Unemployment and poverty increased in many countries.

Inflation was brought under control. The global economy grew strongly, allowing for the GDP per capita to increase considerably. Poverty was reduced.

### 2 COOPERATION BETWEEN GOVERNMENTS

Nationalism was on the rise. Many countries reduced their levels of cooperation. Some treaties and agreements were broken. Countries tended to follow their own agenda – this gave rise to more conflicts.

Cooperation between countries increased in the areas that mattered the most for global stability. Diplomacy became more and more fruitful, such that there were no major conflicts; most disputes were solved peacefully.

### 3 BREAKTHROUGH TECHNOLOGIES

Innovation stagnated. There was a reduction in new technological development; technology became harder to commercialise and more expensive.

There was a surge in innovation as companies invested in R&D at record levels. Universities invested in research which resulted in ground-breaking findings. There was a boom of new technologies – making tech affordable and widely accessible.

### 4 CONSUMER BEHAVIOUR

Consumers didn't change their consumption patterns and continue to consume at an unsustainable level.

Consumers demanded products that satisfy their needs better. One of the characteristics they demanded the most from products was sustainability.



## 5 CARBON EMISSIONS AND CLIMATE CHANGE

The world was able to reach the carbon emission goals and is now at Net Zero. The target to limit the increase of temperature of the planet to 1.5°C was achieved. Risks of natural disasters, health issues, and biodiversity and land loss were mitigated.

The world was unable to reach its carbon emission reductions targets and is far away from reaching Net Zero. The world's temperature rose consistently to an increase of more than 3°C, increasing natural disasters, health issues, and biodiversity and land loss related to and conflicts resulting from global warming.

## 6 MIGRATION

There was no mass migration due to climate factors or conflicts.

Climate change and conflict forced people to move from their homes because it was no longer possible to life there safely.

## Energy sector-specific drivers

Following the selection of the main global trends, AFRY analysed the most relevant variables shaping the future energy sector in the long term. Like global trends, these are also variables which no company can control alone. They are extrinsic to the companies in the energy sector, but have deep strategic implications on them. These variables shape the decisions that energy companies make – which means that they shape the future. These are the Energy Sector Specific levers that were chosen:



### 1 ENERGY PRICES

Energy prices decreased, making energy more easily accessible to the majority of the population.

Energy prices increased, making energy less accessible to the majority of the population.

### 2 ENERGY MIX DIVERSIFICATION

Countries were unable to transform their energy sectors, which meant they still heavily depended on fossil fuels as main energy sources. Renewables remained only a small part of the energy mix.

Countries managed to diversify their energy mix – relying more heavily on renewable energy and therefore removing their dependency on fossil fuels (i.e. the energy transition was successful).

### 3 CARBON POLICY

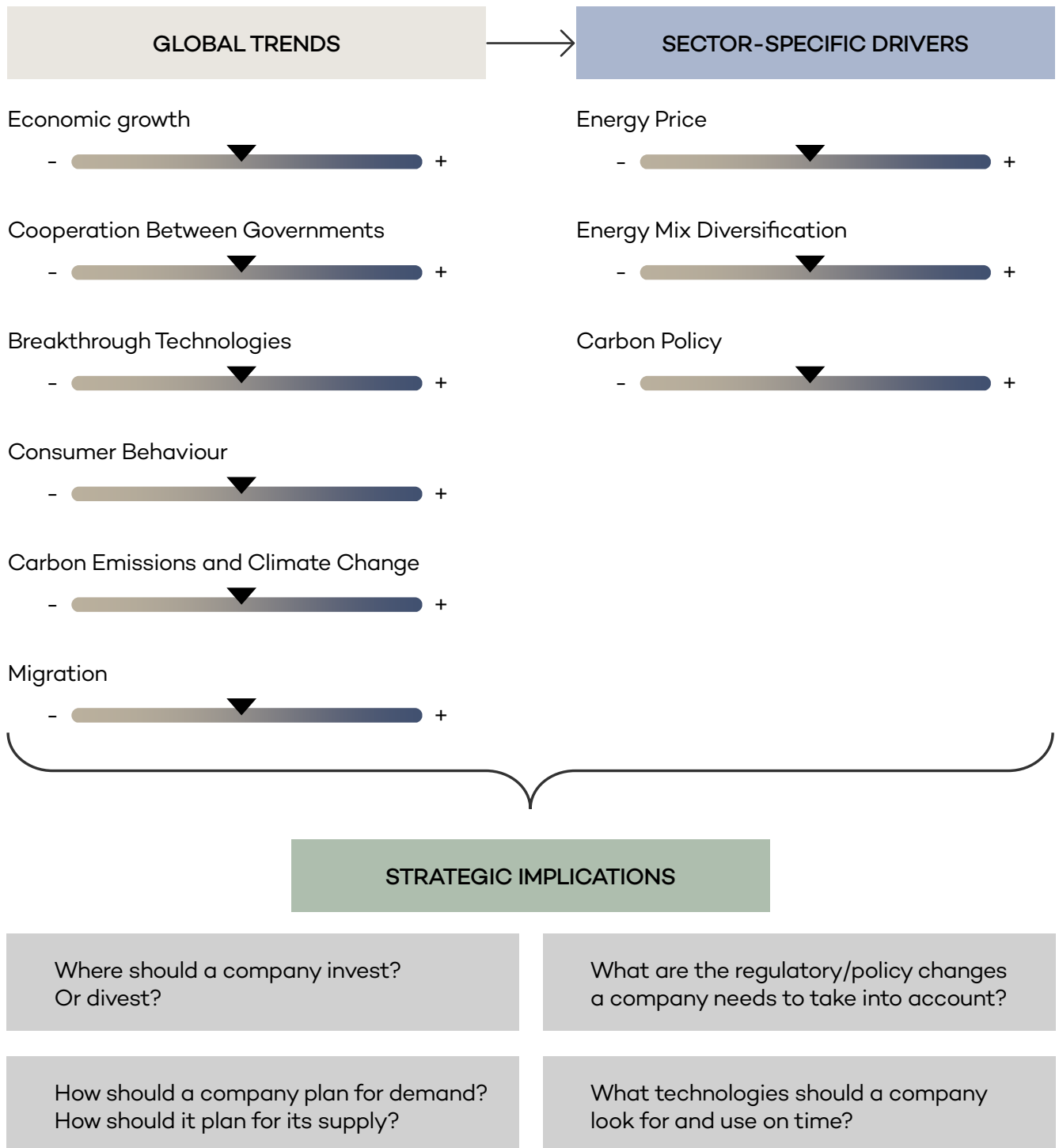
Governments repealed existing and failed to pass new forms of regulation regarding carbon emissions. The world stayed as it was. Companies did not need to pay any tax or fee related to their carbon emissions.

Governments acted on the need to have regulation on carbon emissions. The EU CBAM (Carbon Border Adjustment Mechanism) was a catalyst in driving change. Regulations mandating targets, setting penalties and introducing taxes and fees were introduced where non-existent and bolstered where existent.



## AFRY have created 4 scenarios based on these Global Trends and Energy Sector-Specific Drivers

Using the dimensions of uncertainty previously explained, AFRY moved the levers to analyse how the future could look and what the strategic implications are:



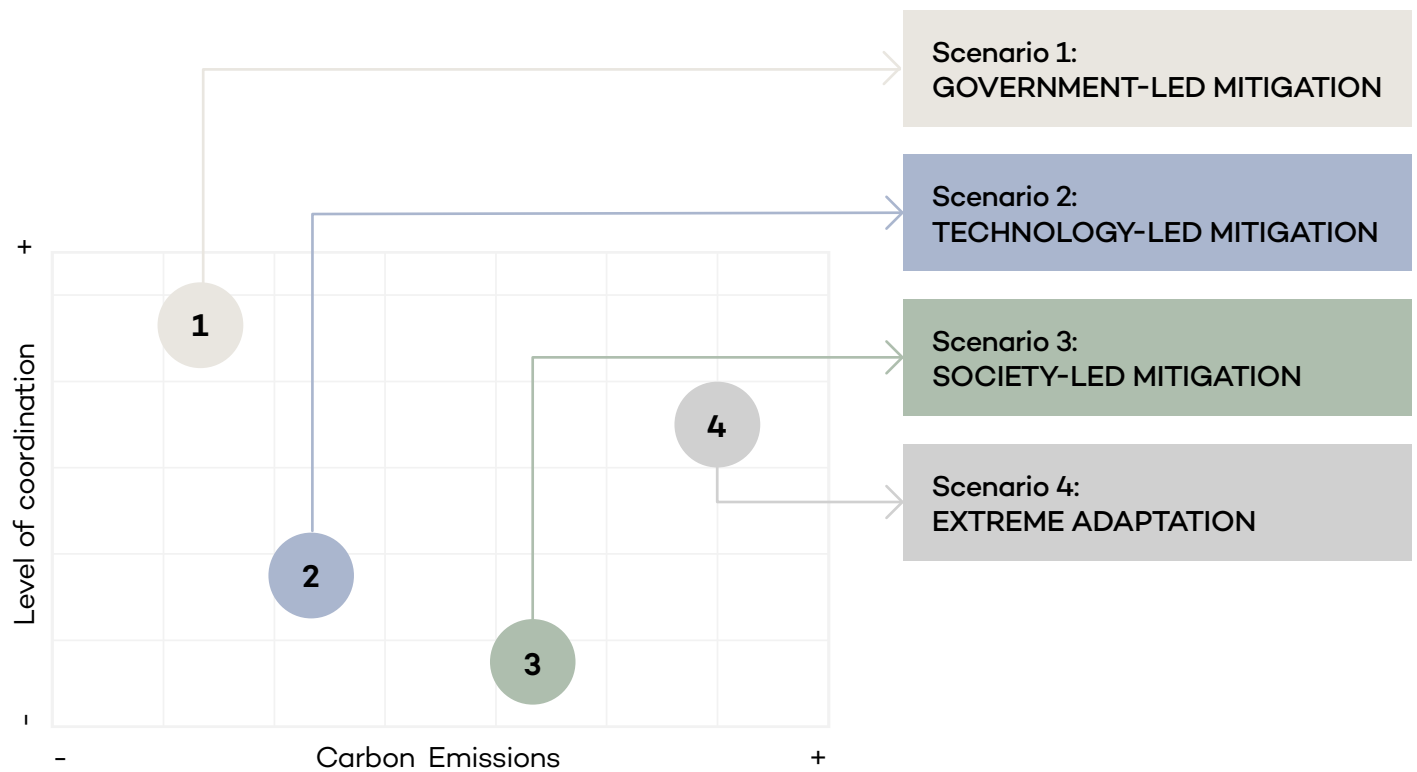
# The Scenarios



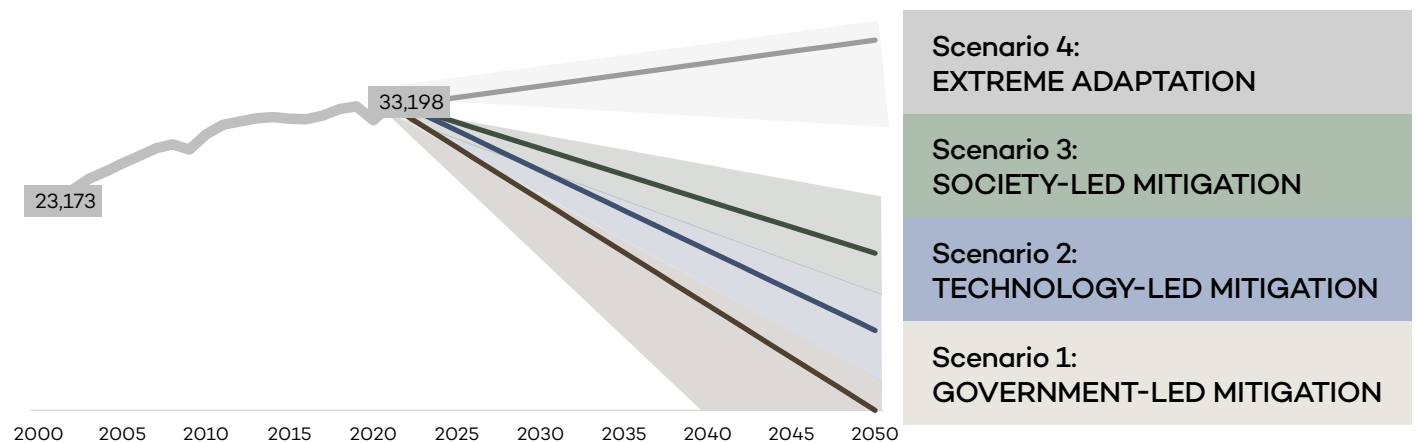
## AFRY has created 4 scenarios spanning a broad range of possible futures and outlined the different outcomes in terms of carbon emissions

After the selection of the levers and understanding the scale in which each moves, we created four scenarios. These scenarios are plausible but not exhaustive, as there are endless possibilities; they are designed to ensure companies think of themselves in different – and sometimes uncomfortable – situations. These are AFRY's scenarios:

### THE FOUR AFRY SCENARIOS



### CARBON EMISSIONS IN THE WORLD (million metric tons)

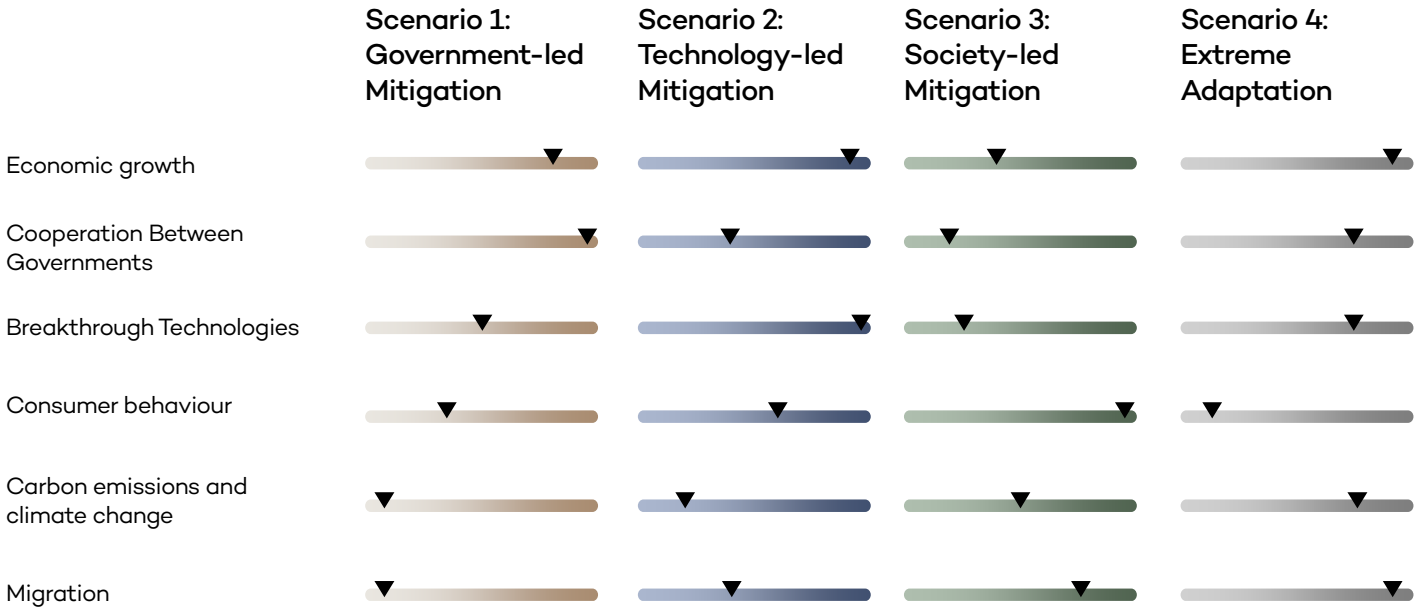


Source: Carbon Emissions in the EU (Statista 2022)

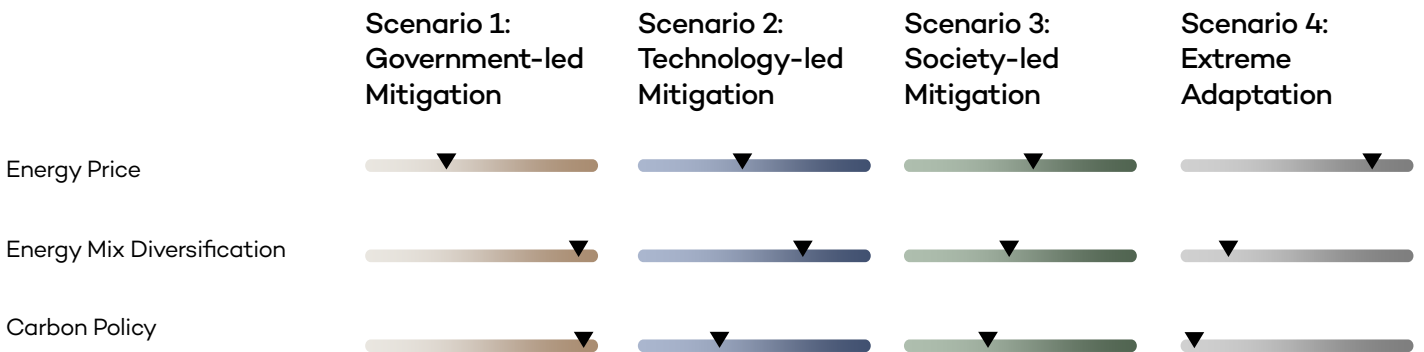


## Taking all levers into account, AFRY's four scenarios are defined as follows

### GLOBAL TRENDS



### ENERGY SECTOR-SPECIFIC DRIVERS





# Status Quo





## The world is changing and future developments are rooted in ongoing trends that have led to the status quo

### **GDP per capita**

In the early 2020s the global economy has gone from good economic growth based on the availability of cheap money to the brink of recession with high costs of living and high inflation having a direct effect in people's income. Governments introduced new initiatives to stabilize the economy, such as the IRA (Inflation Reduction Act) in the US.

### **Cooperation between governments**

Cooperation between Governments is being tested by the resurgence of nationalism and a resurgence of "West vs. East" style conflicts; the Russia-Ukraine war put a lot of pressure on the international diplomacy environment; within the European unit cooperation remains relatively strong as of the early 2020s, with initiatives such as REPowerEU.

### **Breakthrough technologies**

Technological progress has led to material decreases in the cost of renewables, continued development of battery storage technologies and initial steps to enable hydrogen to play an important role in the energy sector. But the battle is not won yet, resource and sustainability concerns especially in mining and metals bring new challenges as we attempt to scale up these technologies.

### **Consumer behaviour**

Consumers have started pushing for more sustainable products, but no widespread change towards more sustainable consumptions patterns has happened yet.

### **Physical risks of climate change and migration**

In 2022, high temperature records were broken; a trend continued from previous years. Multiple heat waves during the summer led to countries such as the United Kingdom experiencing extreme temperatures and drought. Other consequences include the forced displacement of an average of 20 million people a year from their homes due to climate change and/or regional conflicts.

### **Carbon emissions**

To avoid more physical risks due to climate change, carbon emissions reduction targets have been introduced by many countries. These targets are linked to the main goal of reducing global warming to 1.5°C by 2050 in the Paris Agreement.

### **Energy prices**

After a period of low energy prices due to the COVID pandemic, energy prices have risen as a result of increased economic activity and the Russian war on Ukraine. High energy prices has reduced the number of people with access to energy in the world because of their inability to afford it.

### **Energy mix diversification**

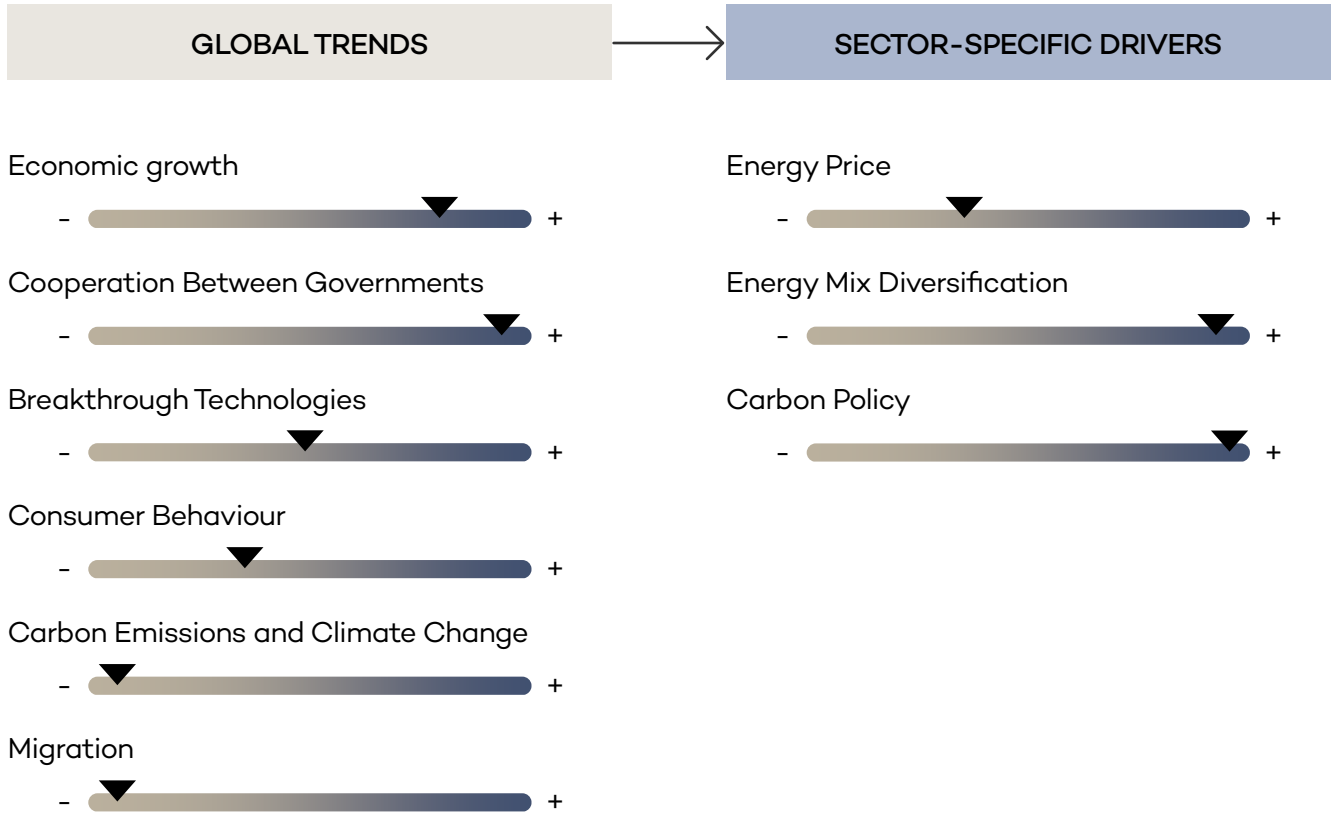
The diversification of the energy mix, in Europe, has taken large strides; renewables now make up a larger share in the energy mix and this growth trend continues globally.

### **Carbon policy**

The EU and parts of the US have introduced carbon pricing or tax regimes to reduce carbon emissions, contributing to the carbon emission reduction target introduced by some countries.

## Scenario 1: Government-led Mitigation

Governments are the leading agents mitigating climate change, they return to international cooperation and define binding global emissions reductions targets with supporting policies that lead to achieving global net-zero by 2050.



By the mid-2020's major governments around the world realised that direct intervention and a return to closer global cooperation was needed to guarantee peace, prosperity and most importantly the mitigation of climate change. They recognised that working together within a global policy framework that clearly set out actions and responsibilities was essential to mitigate climate change.

Governments worked hard on mending relationships and rebuilding trust. The hard work paid off and they ultimately managed to agree binding emissions reductions targets for each nation that were recognised as a fair distribution of the shared burden between industrial and developing nations. In line with these targets, a global carbon pricing scheme was implemented. Due to this resurgence in global cooperation between governments, the global net-zero by 2050 target was achieved on time and in line with keeping global warming to 1.5°C.

The trust built in the negotiations for developing the global policy on climate change formed the basis for successful international government cooperation in other areas. Following the global recession of the early-2020s, rebuilding economic cooperation and making sure the world returned to economic growth was just as important as reaching agreement on the way to achieve net-zero by 2050. Whilst economic growth was driven by Europe, the US and China, there was a clear focus on bringing developing countries along through increased cooperation in a wide range of international policy areas. A cornerstone of these measures was their design to support achieving the global net-zero by 2050 target.

The agreed measures created a global business environment in which companies that were part of the green economy, active in renewable energy, or developing new clean-tech solutions could more easily build global supply chains and drive global economic growth in the 2030s and 2040s. Industrial policies were introduced that steered the private sector towards sustainable business practices and reduced the harm their processes caused to the environment.

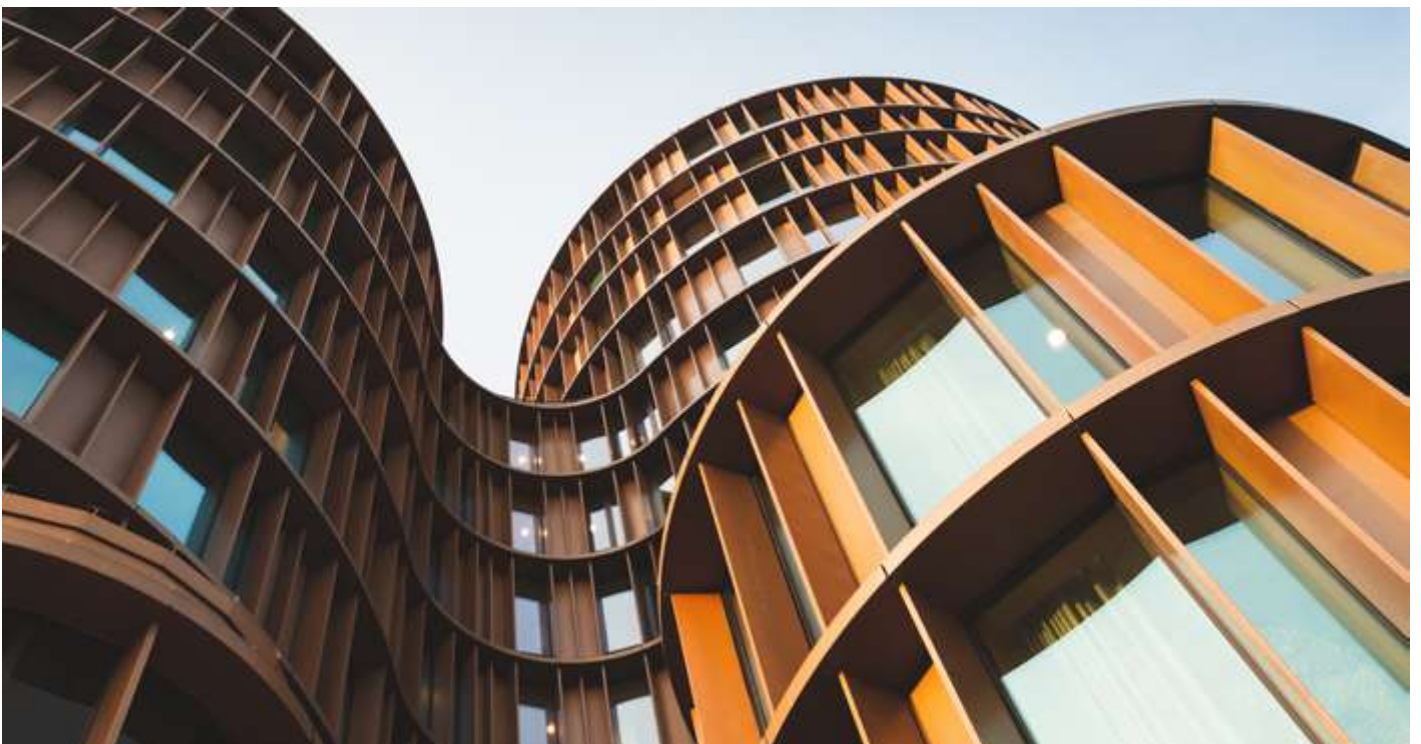
Governments realised consumer behaviour needed to change as well to support the achieving of net-zero by 2050. They cooperated in developing policies and incentives for consumers to adjust their behaviour and behave in more sustainable ways, progressing towards circular economies. Some of these measures included incentives for the electrification of transport and household heating.

In addition to economic policies and those steering consumer behaviour, governments also worked on measures to prevent loss of biodiversity, protection of existing forests and reforestation.

The efforts to distribute growth in a fair way globally and the mitigation of the negative impacts of climate change via coordinated governmental action paid off: there was a reduction in regional and global conflicts and unregulated migration driven by natural disasters and conflict decreased materially.

Energy prices peaked globally during the prolonged economic downturn in the mid-2020s which, together with the desire to diversify away from Russian gas, acted as a catalyst for deployment of low carbon energy sources. The climate and economic policies introduced in the mid-2020s led to continued deployment of renewables, electrification of heat and transport, and from the late-2030s the deployment of green hydrogen at scale. The use of coal was phased out in industrial nations by the end of the 2020s and in the 2030s in the rest of the world. In the late 2020s and the 2030s abatement technologies formed a bridge towards a low carbon electricity sector; with the switch to hydrogen, the use of natural gas in the power sector ended by the 2040s.

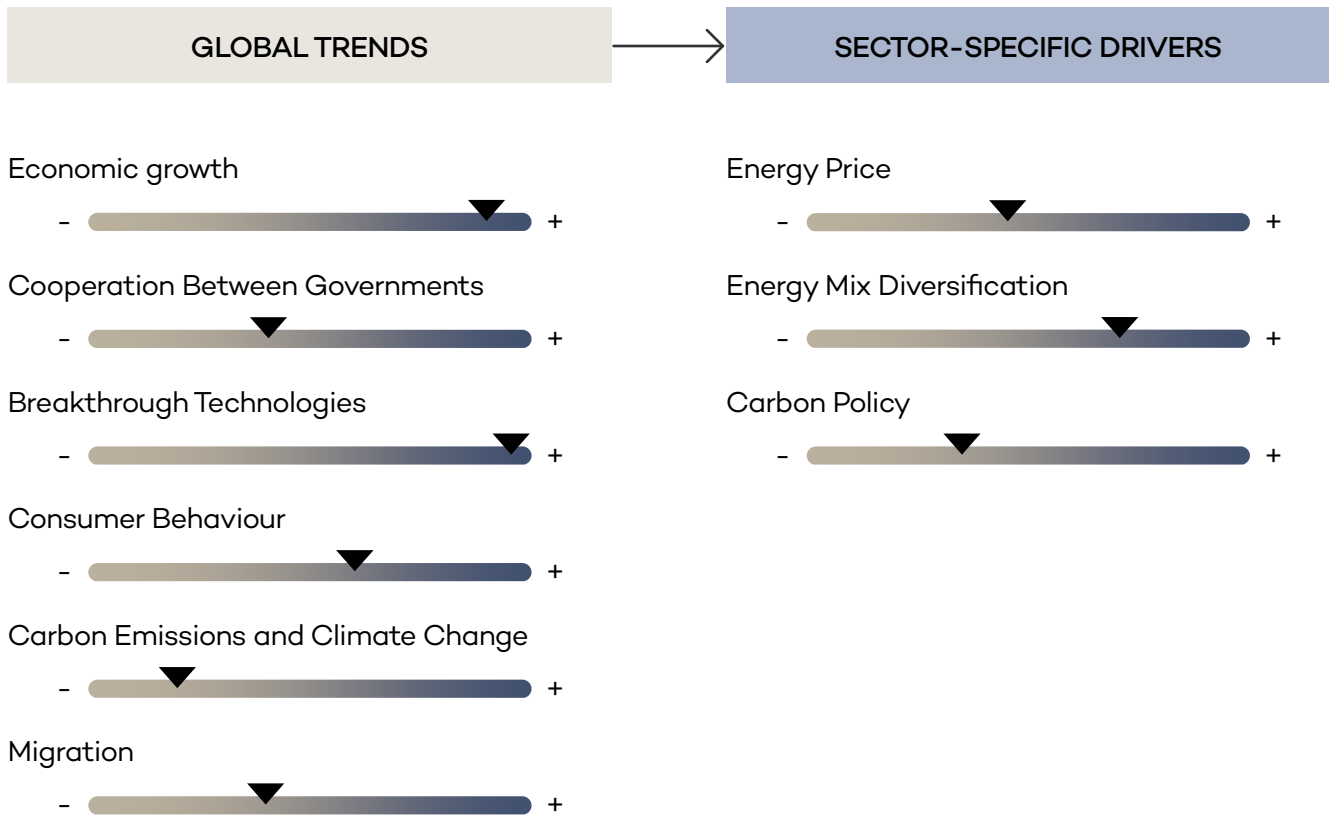
These trends continually reduced the demand for coal, natural gas and oil and in turn prices for these sources of energy. Government subsidies for new technologies and continued reductions in the cost of renewables and batteries led to electricity prices dropping to lower levels. The electricity generation mix is now dominated by renewables and green hydrogen supported by batteries and long-duration storage technologies. The dominance of low-marginal cost technologies and electrification, energy prices decreased in the 2030s and 2040s. Low energy prices helped to sustain economic growth.





## Scenario 2: Technology-led Mitigation

Technological innovation drives carbon emissions reductions and economic growth, governments cooperate internationally to support technology development and supply chains but fail to set global emissions reduction target; however, global net-zero is achieved by 2060.



During the global economic downturn that lasted from the early- to mid-2020s, most countries' governments turned inwards and focussed on national economic recovery. Prioritising national issues led to reduced focus on mending international relations and cooperating on climate change. No new binding global policy agreements for limiting climate change were developed. Emissions reduction targets were implemented at the national level with different levels of ambition and predominantly by countries which had already taken leadership in this area in the past; mostly the European Union, progressive states in the US, and environmentally conscious nations in Asia.

To achieve economic growth, technological development was needed. Governments worked closely with the private sector to develop policies and incentive frameworks that created a business environment in which innovation could thrive. Industrial nations with strong business sectors took the lead in this regard. The green economy and the renewable energy and clean technology sectors were seen as key growth sectors. Leading industrial nations set incentives for corporates to undertake R&D activities to further the development of new renewable and clean technologies and make improvements to existing ones. Cooperation between universities and corporates flourished, which further boosted the development of new technologies. Innovations that were made helped speed up the electrification of heat and transport, led to faster deployment of green hydrogen at scale, improved storage technologies, drove major progress in the development of large scale negative emission technologies, contributed to the development of a circular economy (e.g. via the development of bioplastics and biofuels), and drove reforestation.

By the late 2020s and early 2030s corporates realised that a resurgence in globalisation to integrate global supply chains was needed to produce improved and new technologies at low costs. They pushed governments of industrial nations and relevant developing countries to cooperate and create a business environment that strengthened international supply chains and trade.

This economic growth and global cooperation was followed by a long period of prosperity in the 2030s and 2040s. While industrial nations benefitted the most, experiencing increases in per capita GDP, there was also growth in developing nations driven by their role in the supply chain for new technologies.

With new technologies being available, there was some shift in consumer behaviour as companies marketed these new technologies to create consumer appetite. This applied to general goods being produced by the green economy but also to clean household energy solutions and transport.

The deployment of new technologies lead to a good level of mitigation of the negative impacts of climate change. Progress towards global net-zero by 2050 (which never became an official target) was made predominantly via the deployment of new technologies to achieve national emissions reduction targets. Technological innovations partially offset the slow pace on emissions reductions in the 2020s and early 2030s due to the lack of a global policy agreement. While good progress towards global net-zero was made, the target will be achieved with a delay by 2060.

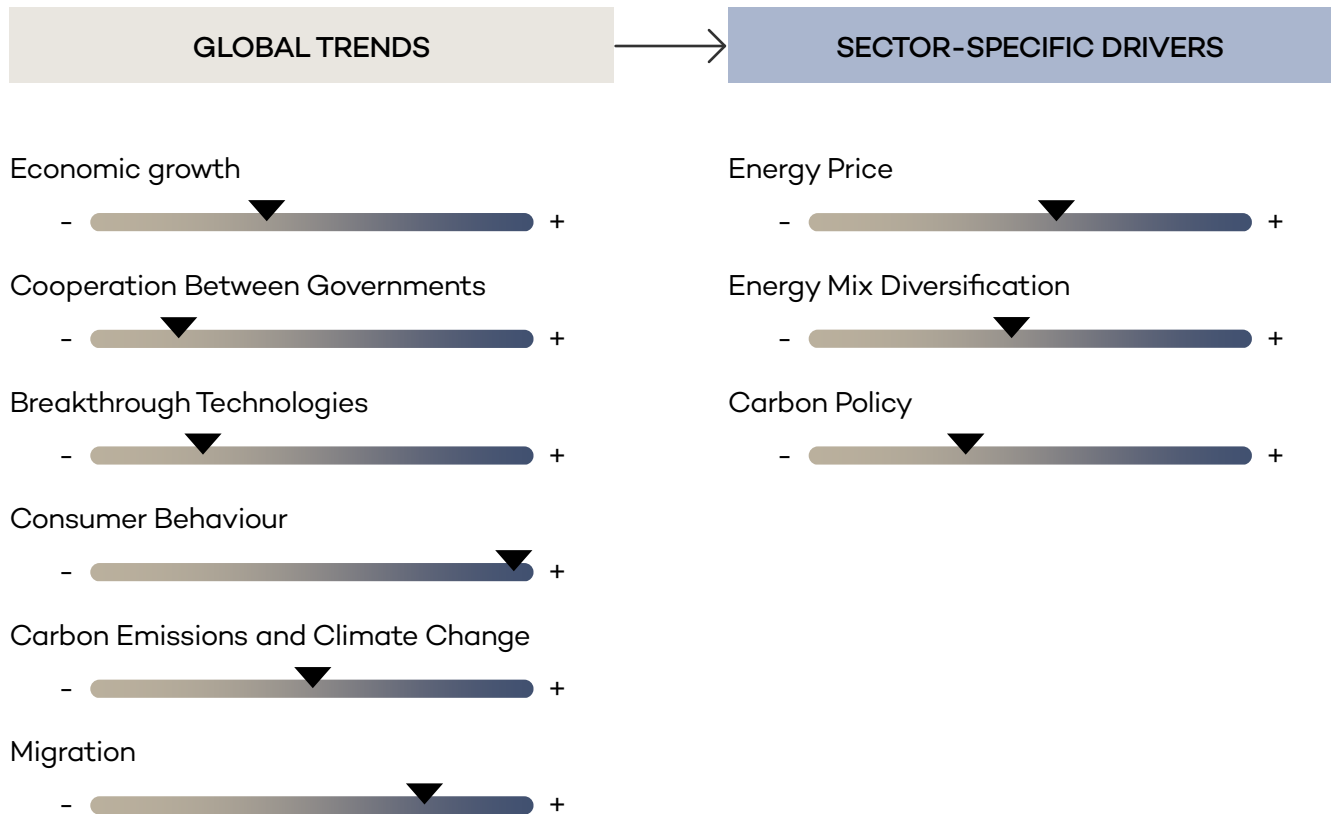
Due to economic growth not being limited to industrial nations and the good progress on climate change mitigation, there was a reduction in regional and global conflicts and only limited unregulated migration driven by natural disasters and conflict occurred.

Energy prices peaked in the mid-2020s. Compared to legacy technologies, new technologies were cleaner, more efficient and more economic. National government policy targets and the cost competitiveness of new technologies led to continued deployment of renewables, electrification of heat and transport and from the mid-2030s the deployment of green hydrogen technologies in the electricity and transport sectors at scale. Negative emission technologies were deployed at scale from the early 2040s which materially helped progress against net-zero. The use of coal was phased out in the western world by the end of the 2020s and in the 2030s in the rest of the world. With the switch to hydrogen, the use of natural gas in the power sector ended by the mid-2030s. As a result of these trends energy prices decreased in the 2030s and 2040s compared to the 2020s.



## Scenario 3: Society-led Mitigation

Governmental inaction leads to continued regional conflicts, economic hardship and accelerated climate change; pressure mounts and societies in the western world and liberal nations push governments and corporates to act; global net-zero only achieved by 2080.



With prolonged recessions throughout the 2020s, cost of living was a major concern for national governments. Regional conflicts worsened and limited cooperation between nations. Little attention was paid to climate change and no global agreements were reached. Consequently, global carbon emissions continued to rise, and the effects of climate change became much more noticeable by the late 2020s and the early 2030s.

The combination of the negative consequences of climate change, a deeper recession and higher levels of regional conflicts led to more unregulated migration during this period, with a major shift of populations towards northern Europe and North America in particular. The general economic outlook in the late-2020s was considerably more negative than at the start of the decade. Several major regional conflicts that began in the 2020s persisted well into the 2030s and beyond. Societal pressures mounted as populations in large parts of the globe became frustrated with governmental inaction on solving these issues. Eventually, unrest led to governments taking unilateral action at a national level with strong but disparate economic and climate policies implemented from the mid-2030s onwards.

With respect to carbon emissions, action was primarily driven by NGOs, consumer groups and individuals. As societal action was much harder to coordinate globally and faced harsh repercussions in authoritarian countries, it occurred mostly at the national level and predominantly in the western world and in liberal nations in the rest of the world. From the 2030s NGOs pressured national governments to set stricter national carbon emission reduction targets. Consumer groups targeted corporates to go green by becoming sustainable, reducing their carbon emissions and generally reducing the level of harm their

production processes cause to the environment. They also demanded companies develop better renewable energy and clean technologies. Consumer action was driven via social media or in the case of lack of action via boycotts and demonstrations. In addition, consumers changed their consumption patterns and took climate action in relation to the types of goods they bought, making investments to reduce emissions of their housing stock and in the electrification of heating and transport.

While there was an increase in economic activity driven by societal pressure on governments and consumer activism targeting corporates, overall global economic performance continued to underperform in the 2030s and 2040s. This led to reductions in per capita GDP in most parts of the world. The sectors that saw most growth were the green economy, the renewable energy and the clean technology sectors. However, given the continued low levels of global economic cooperation supply chains remained largely nationalised and economic growth was concentrated in industrial nations.

Limited progress was made towards global net-zero by 2050 (which never became an official binding target); however, as societal pressure on governments and corporates are maintained, it will be achieved by 2080. The comparatively slow pace in reducing carbon emissions has accelerated climate change, with natural disasters (e.g. storms, floods, fires, crop failures, etc.) ever more prevalent and loss of biodiversity, arable land and forests having progressed at an accelerated pace.

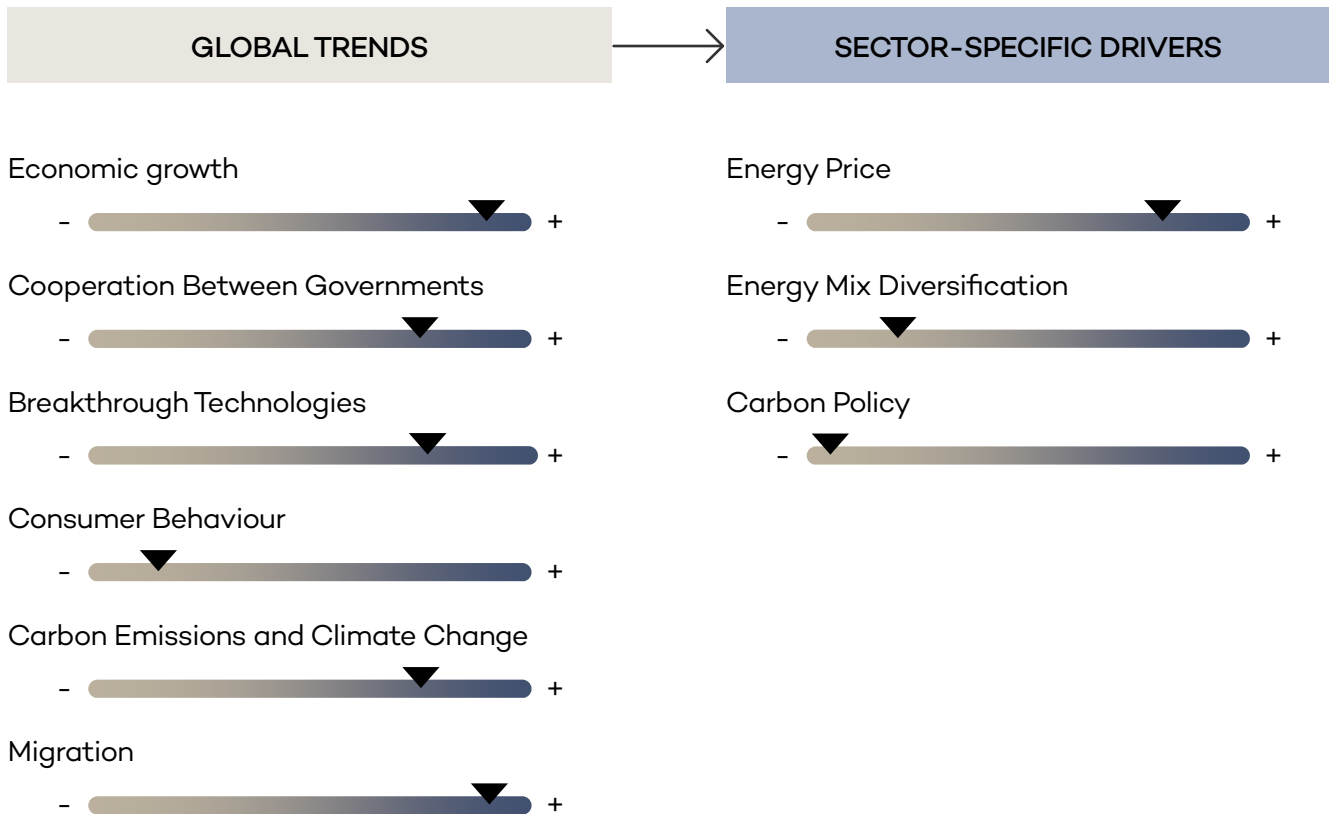
Changes to the energy mix by 2050 were largely limited to the phase out of coal – a quick win for governments facing pressure by NGOs – and continued deployment of renewables where these were economic. Some degree of electrification of heat and transport was achieved, predominantly via consumers taking action. However, pressure on corporates and governments was only successful in the western world and liberal nations elsewhere. Greater cooperation between governments and incentives for technological development would have been needed to drive more material change globally. Energy prices remain comparatively high and gas and oil still play a strong role in the energy mix in the 2050s. These factors contribute to the underperformance in terms of global economic growth.





## Scenario 4: Extreme Adaptation

Climate change is accepted as a reality and successful adaptation becomes the objective of international cooperation between governments; economies focus on growth and continue with business as usual; new industries emerge that develop adaptation technologies; net-zero won't be achieved.



By the late 2020s there was a shift in the thinking of governments, scientists and the global population as a whole. Shifts in temperature and consequences of climate change materialised much more rapidly than previously anticipated. Climate change was accepted as a reality and the focus shifted from mitigation to adaptation. The reduction of carbon emissions to fight climate change was therefore no longer seen as the highest priority. Whilst some new carbon emission reduction policies were developed, they were unambitious; however, coordinated adaptation measures were adopted, with strengthened 'loss and damage' arrangements enabling a strong international response to dealing with the effects of climate change.

As climate change accelerated in the 2020s and natural disasters (e.g. storms, floods, fires, crop failures, etc.) became more prevalent and the loss of biodiversity, arable land, and forests accelerated, there was an initial increase in unregulated migration and regional conflicts. This made global governments realise they needed to mend relationships and cooperate if humanity was to adapt successfully to climate change as well as return to peace and drive prosperity. The coordinated development of measures to adapt to climate change and mitigate its consequences, including large scale unregulated migration and rise in regional conflicts, became a priority of global cooperation.

From an economic perspective, the shift in focus had a number of positive consequences. Most countries reacted to the slowing of their economy by allowing companies to continue with "business as usual". Corporates in all sectors were able to continue using comparatively cheap fossil fuels (which were explored and produced at scale) and avoided facing costs that would have resulted from reducing

carbon emissions. While the global economy slowed in the mid-2020s, a global recession was avoided due to this.

Governments developed incentives for the development of adaption measures, which created new business opportunities from the development of technologies needed for adaptation to climate change (including technologies to protect building stock against extreme weather; infrastructure to protect against floods; cooling and sun protection technologies; water purification and recycling technologies; agricultural technologies; disease control technologies; etc.). R&D activities both in the private sector and at universities received subsidies.

These factors led to a global boom in the 2030s and 2040s with sustained global economic growth which in turn created the tax revenues needed for governments to implement adaptation policies and deploy adaptation measures.

Consumer behaviour did not have to change; it remained unsustainable from a climate change mitigation perspective as people have kept the consumption patterns of the late 2010s and early 2020s. However, sustained high levels of consumer spending provided another economic growth driver.

Policies were put in place to identify geographic areas that would experience positive impacts of climate change and to facilitate orderly migration to these areas in a peaceful way. To protect supply chains, companies moved production facilities to areas of the globe with low physical risk; largely the same areas to which orderly migration was directed, which helped economic growth. The areas that did not experience positive impacts of climate change drove overall global loss of biodiversity, loss of land for agricultural use, and loss of a large shares of the world's forests.

The cost of energy remained comparatively low in the absence of a cost for carbon emissions. The overall global energy mix has not changed much since the early 2020s. The electrification of heat and transport was only partially and inconsistently implemented. The power sector saw a continued build out of fossil-fuel fired generation capacity, alongside deployment of renewable technologies where these were economic. The anticipated move towards hydrogen as a clean energy vector did not occur. Unconventional oil and gas resources are still being discovered, though there is concern that the world will reach 'peak oil' before 2100.



# Creation of the Scenarios



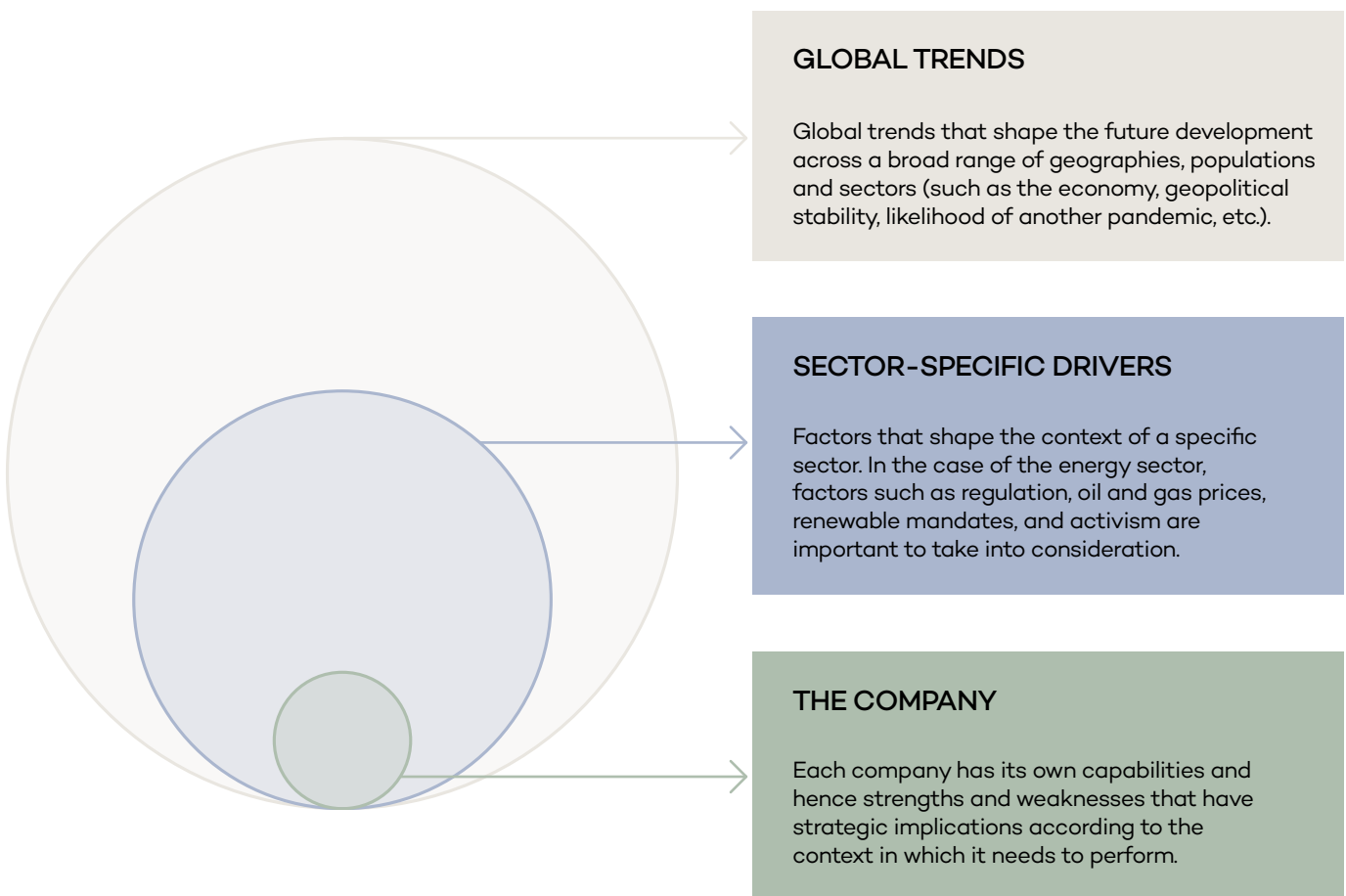
## Scenario-driven analysis enables companies finding ways to plan in an ever-changing and uncertain world

To understand the context in which a company needs to perform in the future, it needs to first look at global trends and sector-specific drivers. Companies alone have no control on how these factors evolve, and therefore need to be prepared to adapt for a wider set of scenarios.

### WHY SHOULD COMPANIES DEVELOP STRATEGIC THINKING THROUGH SCENARIO-DRIVEN ANALYSIS?

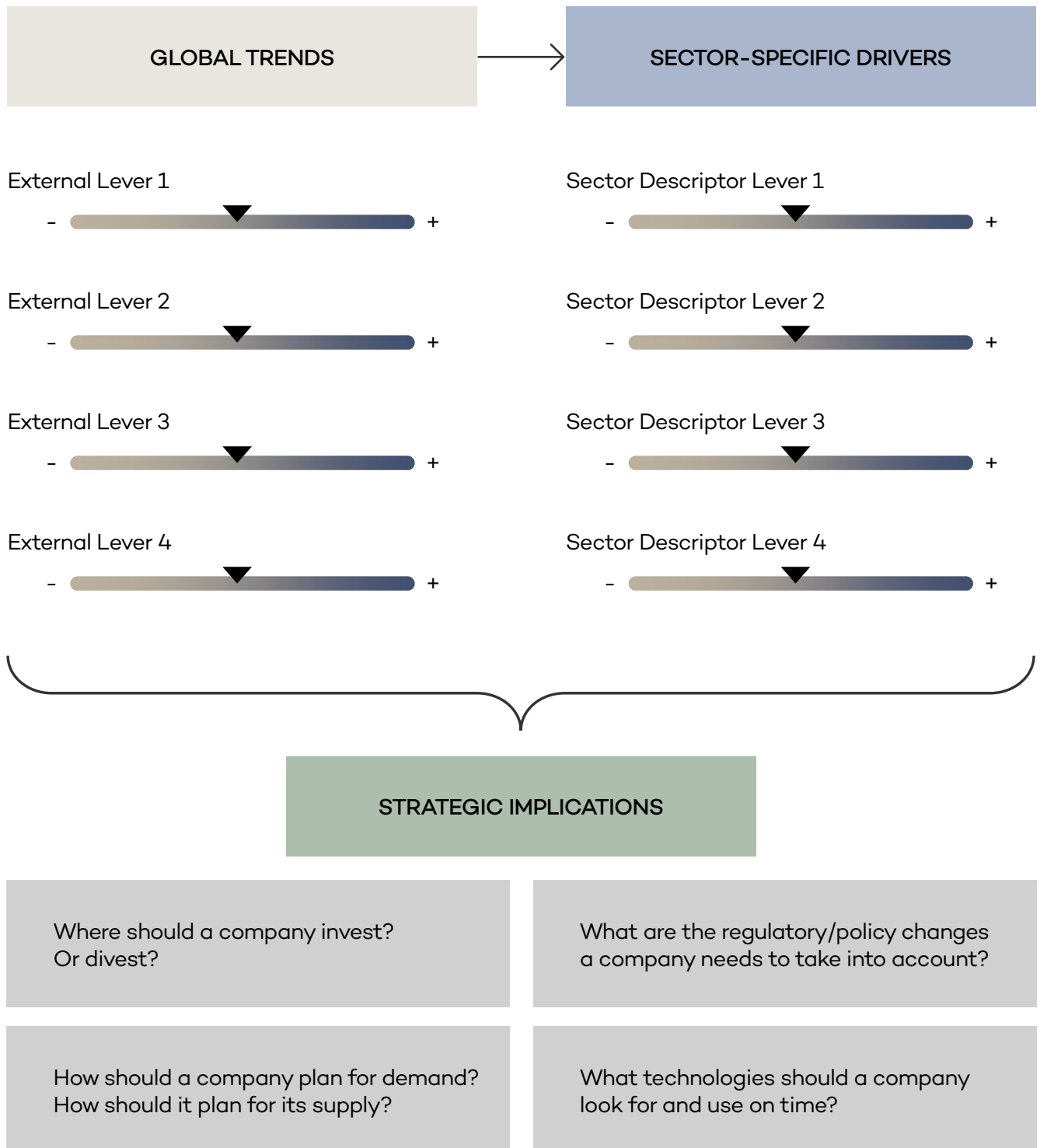
The aim is not to predict the future but rather to **make it possible to imagine multiple futures** in creative ways that heighten our ability to **sense, shape, and adapt to what happens in the years ahead**. Scenario-driven analysis doesn't help us figure out what to think about the future: it helps us **figure out how to think about it**.

By identifying the levers that **shape the environment** in which a company operates, it can devise **strategies flexible enough** to be prepared for a wider set of future changes.





## Scenario creation combines global trends and sector-specific drivers at different impact levels to create unique stories of the future



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AFRY is a European leader in engineering, design, and advisory services, with a global reach. We accelerate the transition towards a sustainable society.

We are 19,000 devoted experts in infrastructure, industry, energy and digitalisation, creating sustainable solutions for generations to come.

Making Future