CARBON TRUST

AIM HIGHER

How can business help achieve the 1.5°C ambition in the Paris Agreement?

October 2017

Particular thanks are due to the organisations and individuals that were able to participate in the process of developing this report:

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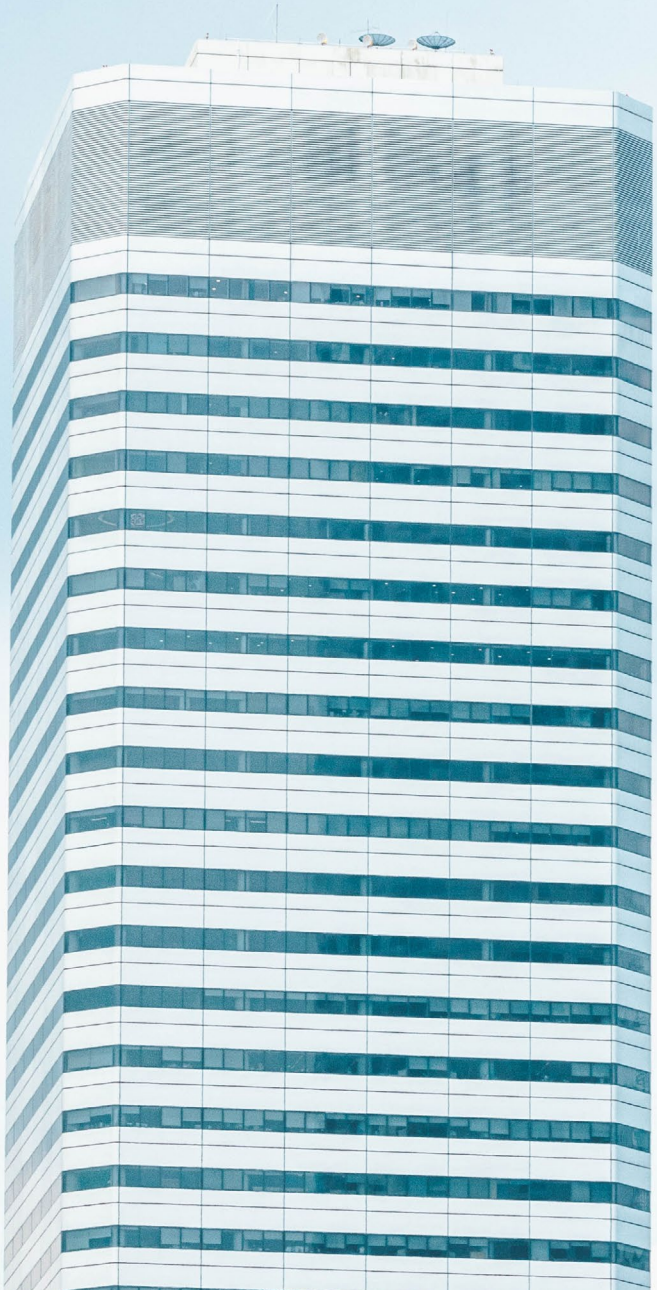


Foreword

After the Paris agreement was signed we asked ourselves, how can a company like BT play its part in delivering on the ambition to limit global warming to 1.5°C? Fortunately, after a lot of hard work with the Carbon Trust's team, we now have an answer that aligns our future business plans with the best available climate change science.

We are proud that we have become one of the first companies globally to have committed to a higher ambition science-based target. Our goal is to reduce BT's greenhouse gas emissions intensity by 87% by 2030 from a 2016/17 baseline, a level which is in line with what is required to limit global temperature rises to 1.5°C.

We want to be part of a vanguard of companies driving forward the 1.5°C agenda. We know that being ambitious can pay off. We reached our previous carbon reduction target four years early – in 2008 we thought we could achieve an 80% reduction of our carbon emissions intensity by 2020, we actually managed this by 2016. Meeting that target gave us the confidence to aim higher and lead the way, so this new target is part of our commitment to be a truly sustainable business.

Reducing our end-to-end carbon footprint has been valuable for the business, helping to deliver £221 million of energy savings since 2009/10. We are also well on our way towards purchasing 100% renewable electricity worldwide by 2020, where markets allow, without adding significant costs.

Despite all our progress to date, reaching our ambition will require changes in many areas. In the coming years we will need to adopt low carbon vehicles across our fleet of vans, cars and repair trucks, reduce the carbon intensity of our buildings, and work with our suppliers to reduce carbon emissions associated with our supply chain.

We will also focus on the impact we can have in the wider economy. We know that ICT sector products and services have a huge role to play in helping to tackle climate change and in creating a low carbon society.

In 2016/17 we estimate that our products and services enabled our customers to avoid 10 million tonnes of carbon – up 32% from the previous year. These products and services that can help reduce carbon emissions represented £5.3 billion in revenue, 22% of BT's total revenue. And we will continue to innovate in order to help our customers use resources even more efficiently and further reduce their carbon emissions.

The only way we can achieve a 1.5°C world is through collaboration and collective effort. There are really positive signs that suggest that the shift to a low carbon society is becoming unstoppable, but we need to make sure that it also happens as quickly as possible. Businesses are quickly learning how to create economic value and greater prosperity without harming the planet.

We would love to share what we have done to help other companies accelerate their efforts. We can all set the bar higher to help deliver on the Paris Agreement by aiming for 1.5°C.

Gabrielle Ginér

Head of Sustainable Business Policy, BT

Executive summary

The Paris Agreement on climate change contained the commitment to hold the increase in global temperatures to well below 2°C above pre-industrial levels. Somewhat unexpectedly, it also included a higher level of ambition to pursue efforts to limit the temperature increase to 1.5°C.

Warming has already hit 1°C above pre-industrial levels, with existing infrastructure and policies locking in future emissions. However, the best available science shows that there is still a window of opportunity to achieve a 1.5°C goal, although this will be highly challenging and require a step change in current levels of action on climate change.

From a business perspective, many companies will be negatively affected by the direct consequences of climate change, including damage to buildings and infrastructure, the disruption of logistics and supply chains, impacts on water availability and diminished agricultural productivity. They will also be affected by indirect consequences, such as regulatory and policy change, the development of disruptive technologies and business models, or shifts in customer behaviour.

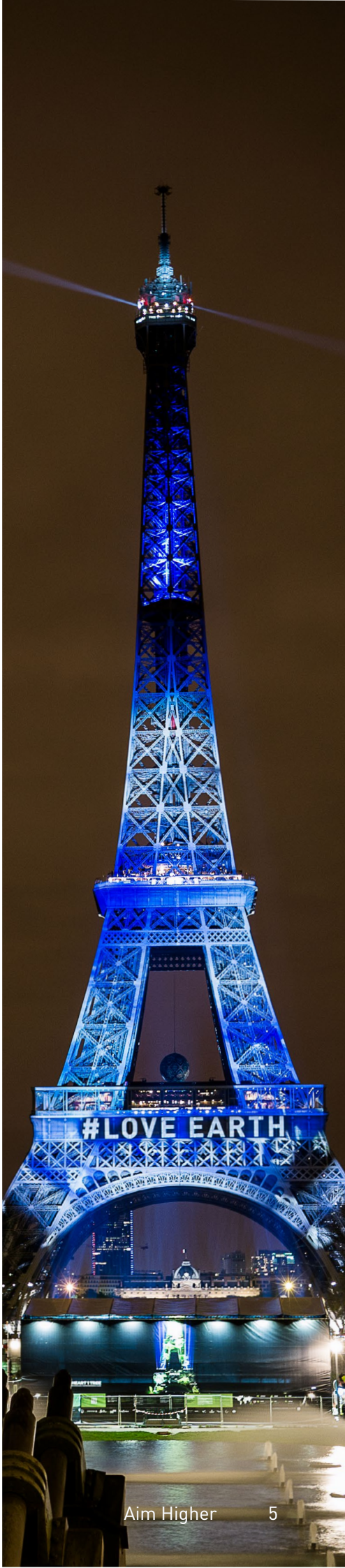
Research suggests that holding warming at 1.5°C, rather than 2°C, will materially decrease the likelihood of some of the most dangerous outcomes of climate change from occurring. This would limit the severity of impacts from drought, flood and other extreme weather events, as well as preventing major habitat loss for some plant and animal species. But this can only be achieved if there is a radical transformation of the global economy within a comparatively short period of time.

Delivering on this ambition will require global greenhouse gas emissions to peak in the near future, followed by an aggressive mitigation pathway leading towards a zero carbon world by around the middle of this century. Beyond this point, significant deployment of negative emissions will continue to be required, actively removing carbon dioxide from the atmosphere.

Businesses will have a key role to play within this transition, reducing the emissions associated with their operations and supply chains. They will also be able to access new commercial opportunities through delivering products and services that are compatible with a prosperous, zero carbon future, as well as developing and deploying the negative emissions solutions that will be required later this century.

There is only limited information available at present on the detailed sectoral pathways that lead towards stabilisation of global temperatures at 1.5°C. But over 300 businesses have already committed to science-based targets on climate change, aligning their actions with the requirements of achieving a 2°C goal. And as more information has become available on 1.5°C a small number of corporates – including Tesco, Carlsberg Group and BT – have set their own science-based goals at this higher level of ambition.

To gain a deeper understanding of how businesses will be able to support the move towards a 1.5°C world, the Carbon Trust worked with BT to host a series of events with a range of corporates and other stakeholders. Through this process and by working alongside pioneering organisations since COP21 in Paris, the Carbon Trust has identified ten key steps a business can take today to put itself onto a pathway compatible with 1.5°C.



1. **Understand your carbon footprint:** identify hotspots of emissions across the full value chain and identify opportunities for improved efficiency and cost saving.
2. **Develop a roadmap to zero emissions:** set out the practical steps required to deliver core products or services in a zero carbon future.
3. **Set science-based targets:** use the best available climate science to align emissions reductions goals with the requirements of a 1.5°C pathway.
4. **Invest in energy efficiency:** implement cost-effective opportunities to improve the efficiency of your buildings, fleet and industrial processes.
5. **Switch to zero carbon electricity:** invest in on-site renewable electricity generation and switch to electricity tariffs backed up by guarantees of origin.
6. **Move towards zero emissions transportation:** understand options for vehicles powered by non-fossil fuel sources, such as batteries, hydrogen and biofuels.
7. **Decarbonise heating and cooling:** replace existing fossil fuel sources of heating and cooling with more efficient or cleaner alternatives.
8. **Take action in the supply chain:** drive supplier emissions reductions, improving efficiency and performance, at the same time as exploring transformational changes.
9. **Use an internal carbon price:** implementing an internal carbon price can mitigate transition risks and improve decision making around investments.
10. **Introduce options for negative emissions:** explore long term potential to economically include negative emissions within a business model or supply chain.

Delivering on the higher levels of ambition within the Paris Agreement will require concerted action from every sector of society. But by committing to 1.5°C goals, businesses have the opportunity to show leadership and drive forward greater levels of action elsewhere.

A large number of companies making stronger commitments on climate change, matched with an increased level of action, has the potential to rapidly move markets. They can use their resources and influence to show that the transition to a low carbon economy is both possible and desirable, changing the attitudes of peers, competitors, policymakers and consumers.

Importantly, this should also help businesses to improve their planning and investment decisions over a long term horizon, providing cost savings today and a commercial advantage tomorrow.

Introduction

In 2015 at COP21 the 195 signatories to the Paris Agreement set the collective goal of holding the increase in global temperatures to well below 2°C above pre-industrial levels. This threshold had long been established in international climate change talks as a safe level, above which climate change becomes significantly more dangerous.

However, the final text also contained a higher level of ambition to *"pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change"*.

The inclusion of a 1.5°C ambition was largely unexpected. For many years aiming for agreement on anything more ambitious than 2°C was considered to be unrealistic by most parties to the UN Framework Convention on Climate Change (UNFCCC).

But in the run up to Paris there was considerable momentum behind securing a stronger agreement than had previously been envisaged. This was, at least in part, driven by a growing recognition that 2°C is in many ways an arbitrary target – selected primarily for reasons of political expediency, rather than being based on a genuine assessment of risks.

Most of the small island states and least developed countries represented at the climate talks already considered 2°C to be an unsafe level of warming for them. There was also clear public support for stronger government commitments from various large coalitions representing major businesses, investors, sub-national governments and civil society groups.

It was also significant that in the run up to the Paris talks, international climate action had been enshrined as one of the seventeen Sustainable Development Goals (SDGs) collectively adopted by the United Nations. SDG 13 specifically calls for "urgent action" on climate change, recognising that it is a time-bound challenge, as severe climate impacts will make several other SDGs significantly more difficult to achieve.

So at COP21 the stage was set for raising the bar beyond 2°C. A high ambition coalition was initially formed containing the European Union alongside a number of African, Latin American, Caribbean and Pacific island nations. This coalition began to push for including a reference to an aspirational goal of 1.5°C in the Paris Agreement.

During the course of the negotiations this group was subsequently joined by nations including Canada, Australia and the United States under the Obama administration,[1] taking the total coalition to over 100 countries. This helped to overcome opposition from some parties, particularly the Gulf states led by Saudi Arabia, to ensure that the final text contained explicit mention of efforts to limit warming to 1.5°C.

But despite the enthusiasm for higher ambition and increased levels of action, actually delivering on a 1.5°C emissions reduction trajectory presents an immense and immediate challenge.

Global warming has already surpassed 1°C above pre-industrial levels, with significant levels of future emissions locked-in through the inertia of existing infrastructure and policies. Some recent analysis suggests that the window for holding warming below 1.5°C is tight, where global emissions will need to peak in the near future and be followed by aggressive mitigation action.[2]

Beyond this, the precise pathways to reaching a 1.5°C world are still unclear. The Intergovernmental Panel on Climate Change (IPCC) – the expert international body responsible for providing independent advice on the science of climate change – has not yet published detailed analysis on sectoral emissions reduction trajectories likely to achieve levels of warming far below 2°C.[3]

1 The United States government under the Trump administration announced its intention to withdraw from the Paris Agreement in June 2017, attracting international opprobrium from many high ambition nations. However, shortly after this the governors of 9 US states, the mayors of over 200 cities, and leaders of over 2000 colleges, businesses and foundations pledged to continue to act in support of the Paris Agreement. For more information see: http://wearestillin.com/. The US withdrawal from the Paris Agreement still remains in doubt, as under the terms of the agreement it can only officially take effect after a waiting period that goes beyond the 2020 presidential elections.

2 Millar, RJ, et al. (2017) ***Emission budgets and pathways consistent with limiting warming to 1.5 °C***. Nature Geoscience. Available at: http://www.nature.com/ngeo/journal/vaop/ncurrent/full/ngeo3031.html.

3 A special report on the topic of 1.5°C is due from the IPCC in 2018, which will provide greater clarity on the impacts of global warming at this level, as well as details of the global greenhouse gas emission pathways that could deliver on this ambition.

Limiting warming to 1.5°C is considered to be a highly ambitious goal precisely because it will be difficult to achieve. It will require a rapid, cross-sectoral, global effort to reduce emissions. And this will include substantial, in some cases transformative, changes driven by private sector organisations, which will help create a sustainable, low carbon economy compatible with this level of warming.

There are, however, reasons for cautious optimism that this transition might be possible, especially if current efforts prove successful in getting global emissions to peak around 2020.[4]

In March 2017 the International Energy Agency found that global greenhouse gas emissions from energy use had remained flat for a third year in a row, despite economic growth.[5] This demonstrates that – to a greater or lesser extent – it is possible to decouple a growing economy from increasing levels of emissions, successfully bucking a historical trend set across almost three centuries.

There are also around 300 businesses, including some of the world's largest corporates, that have already voluntarily committed to aligning their own climate change goals and emissions reduction targets with a pathway to hold warming well below 2°C. Recently some have gone further than this, with companies including Tesco, Carlsberg Group and BT announcing that they will reduce their operational emissions at a level consistent with 1.5°C of warming.

However, uncertainties remain around the role business needs to play in delivering 1.5°C. There is a major question over whether some companies can successfully make the transition in a way that delivers genuine commercial value without a broader shift across society. And there is still no clear picture of how simultaneous changes can be made across interrelated areas such as public behaviour, technological breakthroughs and government policies.

In order to get a better understanding of the role for business in achieving a 1.5°C world, the Carbon Trust held a series of events with stakeholders from corporates across multiple industries, as well as representatives from government, academia and other associations. These events were hosted in association with BT in advance of the company setting its own 1.5°C climate change target.

This report sets out some of the findings from this process, looking at feasibility and challenges for businesses in making emissions reductions at a level compatible with 1.5°C of warming. It also summarises the difference that achieving 1.5°C might make in terms of climate impacts, which is the topic of the next section.

4 Figueres, C. et al. (2017) "*Three years to safeguard our climate*". Nature. Available at: https://www.nature.com/news/three-years-to-safeguard-our-climate-1.22201

5 International Energy Agency (2017) "*IEA finds CO2 emissions flat for third straight year even as global economy grew in 2016*". Available at: https://www.iea.org/newsroom/news/2017/march/iea-finds-co2-emissions-flat-for-third-straight-year-even-as-global-economy-grew.html.

Does half a degree make a whole lot of difference?

The projected impacts of climate change do not occur in a linear manner. Warming of 4°C is not twice as bad as 2°C – it is substantially worse than that. So whilst half a degree of difference may not sound consequential in the context of a daily weather forecast, when talking about average global warming since the pre-industrial era the difference can be highly significant.

The early impacts of climate change are already being seen today. Some regions are facing periods of high temperatures for longer durations. Others are seeing more frequent or severe incidents of drought or extreme weather and flooding. Arctic sea ice is declining at a rapid rate. And important ecosystems are showing clear signs of damage.

Many of these impacts also come with a direct economic cost already being felt by businesses. Floods disrupt supply chain logistics. Droughts reduce agricultural yields. And degraded ecosystems and bleached coral reefs affect tourism revenues.

There has been considerable study of the sensitivity of various factors to climate change at various levels of warming. However, the scenarios developed by many researchers – including those from the IPCC – have typically used 2°C as the most optimistic case, comparing it with expected impacts at higher temperatures.

But there is now a growing body of scientific literature that is looking more closely at 1.5°C scenarios. Right now considerable efforts are being put in by national governments, the IPCC, universities and other institutes around the world to better understand what the higher level of ambition in the Paris Agreement would mean.

Research to date suggests that holding warming at 1.5°C, rather than 2°C, would materially decrease the likelihood of some of the most dangerous outcomes predicted as a result of climate change. Whereas for some climate impacts the practical difference between the two levels of warming are comparatively small, with more severe consequences only occurring at higher temperatures.

Although even where expected impacts are similar at 1.5°C and 2°C, it should also be noted the risk of overshooting to more dangerous levels of warming remains a lot lower at 1.5°C. It is also important to highlight that what might appear in the abstract to be a relatively small difference in numbers, could in reality cause tens of millions of additional people to experience suffering and misery.

Certain climate impacts, such as heat extremes, crop yield reductions and water scarcity are projected to rise significantly between 1.5°C and 2°C. Furthermore, current trends suggest that the impacts associated with global temperature rise are unlikely to occur equally across the globe. Analysis has revealed that there is already considerable variation in the level of actual warming across different geographies, meaning that climate impacts will be experienced more acutely in some areas than in others.[6]

Some of the more relevant points for businesses coming from the emerging body of research on how climate impacts differ between 1.5°C and 2°C are highlighted below. A number of the key papers and reports currently available on 1.5°C can also be found in the selected further reading section at the back of this report.

Natural ecosystems

Some of the most troubling impacts from warming above 1.5°C are related to the extent of projected habitat loss and the implications this would have for biodiversity. We are already seeing the onset of a mass extinction event due to human activity.[7] Warming of 2°C and above would significantly increase the loss of key habitats for many species.

For example, whilst a temperature increase of 1.5°C would put 90% of coral reefs at risk from the sort of bleaching that has already occurred in some places, 2°C of warming would increase the proportion at risk to 98%. In practice this means that at 2°C virtually all reefs would experience irreversible degradation, but limiting warming to 1.5°C would provide a small window of opportunity for approximately 70% to survive.

6 Schleussner C-F et al. (2016) ***Differential climate impacts for policy relevant limits to global warming: the case of 1.5 °C and 2 °C***. Earth Syst. Dynam. 7, 327–351.

7 Ceballos G et al. (2017) ***Biological annihilation via the ongoing sixth mass extinction signalled by vertebrate population losses and declines***. Proc. Natl. Acad. Sci. USA. Available at: http://www.pnas.org/content/early/2017/07/05/1704949114.

Agriculture and food security

Looking at cropland availability, there is not much difference between 1.5°C and 2°C from a global perspective, although impacts are notably more severe at 3°C and 4°C of warming. However, this global picture masks a significant regional disparity.

While some high latitude regions may benefit from increased agricultural yields, an additional half degree of warming would have a significant negative impact on highly populated tropical regions. South East Asia, West Africa, and central and northern parts of South America would be likely to see sharp drops in crop yields if warming goes from 1.5°C to 2°C, particularly for maize and wheat.

As temperatures rise, droughts are also more likely to occur in many regions, including parts of Europe. This could have broad implications, for example by increasing food price volatility, or threatening food security. Knock-on consequences could range from supply disruptions and increased costs for food manufacturers and hospitality businesses, right through to riots and political instability of the sort seen during the Arab Spring.

Sea level rise

Projections suggest that at 2°C of warming sea level is likely to rise by about 50cm by 2100. Holding warming at 1.5°C would result in a sea level rise closer to 40cm. Although even this level is still likely to have devastating impacts on low-lying and island communities, such as Tuvalu, Kiribati, the Marshall Islands and the Maldives.

In many contexts 10cm may seem a relatively small difference, but here it could make a major difference for millions of people who will need time to adapt to the impacts of climate change. In particular it would reduce risks for a number of highly populated parts of South and South East Asia where communities are built around vulnerable, low-lying deltas. For example, a sea level rise of 45cm could result in a loss of 10% of the total land area in Bangladesh.

Looking out beyond 2100, temperature has a large influence on the future rate at which sea level rise will continue to occur. At a 1.5°C threshold, the projected rate is anticipated to be approximately 30% lower than that at 2°C.

Rainfall patterns and water availability

The projected changes in rainfall patterns are significant. Above 2°C of warming, climate simulations project a decrease in global freshwater availability of around 17%, which is double the loss projected at 1.5°C.

Again, reductions in precipitation will not be uniformly distributed. Some regions such as South Asia are expected to experience increased rainfall. Whereas the Mediterranean would experience an anticipated reduction in water availability of around 20% at 2°C, which is twice what would be expected at 1.5°C.

Decreased rainfall is likely to increase water stress in areas that already experience droughts. And for countries that rely on hydroelectricity as a source of low carbon power, this could cause additional disruptions. For example, the effect of climate change-related water stress on Tanzania's hydroelectric power plants is estimated to cost the nation up to 1.7% of GDP by 2030.

Extreme heat

Although it might sound obvious, one of the major consequences of global warming is that certain regions will be exposed to very high temperatures for prolonged periods.

Periods of extreme heat can pose serious risks to human health as well as economic productivity, making outdoor work impractical or dangerous. Some regions already experience these challenges in warmer months, but climate change is likely to expand the areas of the world that are vulnerable to incidents of extreme heat and extend the duration of hot periods.

Research from the Asian Development Bank (ADB) has found that the percentage of Asian land area that

would be at risk of heat extremes would almost double between 1.5°C and 2°C, from 14% to 27%.[8]

The same doubling effect occurs around the even more severe unprecedented heat extremes, from 3% to 6%.

In other regions, such heat will fundamentally change the characteristics of the natural environment and local landscape. This is already most obviously occurring in the Arctic, but studies have also found that with 2°C of warming, permafrost would be reduced by around 40% from today's levels of approximately 15 million km^2. But stabilising at 1.5°C could save an additional 2 million km^2 of permafrost, an area around four times the size of Spain, thus preventing the risk of additional release of methane trapped beneath.[9]

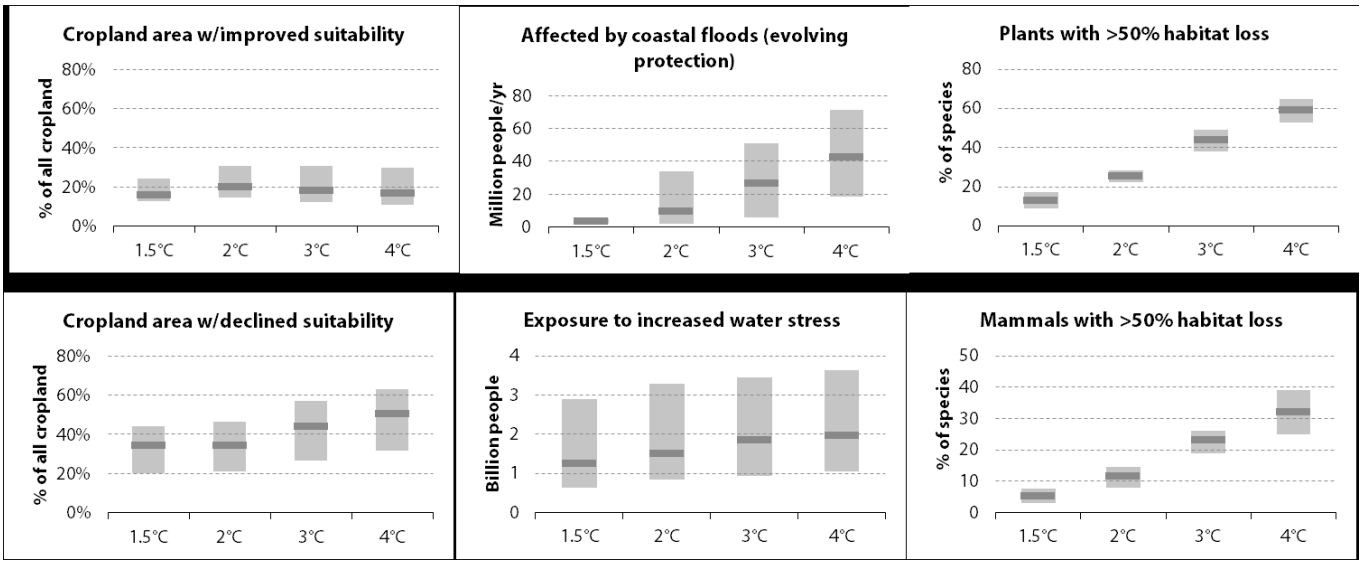
Uncertain future impacts

Despite the constantly growing body of research into climate change, current scenarios developed for study are still subject to a significant amount of uncertainty. Climate models have not yet captured the full complexity of human interactions with the climate system, with the result that the difference in impacts at different temperature thresholds cannot yet be fully understood.

It is highly likely that there will be unanticipated knock-on effects created by some climate impacts, as well as other circumstances which produce negative feedback loops. But it is difficult to predict the exact consequences of events such as droughts, coastal storm surges and wildlife extinctions in the real world. Each of these could have considerable implications for businesses, for example a major natural disaster destroying insurance markets, or a mass migration that sparks social unrest.

What is clear is that even if the world is successful in limiting warming to 1.5°C, there will still be some unavoidable and damaging environmental, social and economic impacts from climate change. But half a degree does make a difference. Aiming to hold temperature rise at this level will maximise the chances of avoiding substantially greater risks and impacts that exist at 2°C and beyond.

Figure 1. Expected climate change impacts under different warming pathways.



Source: Arnell, NW, et al. (2016) The global impacts of climate change under a 1.5°C pathway: supplement to assessment of impacts under 2, 3 and 4°C pathways. Report from AVOID2 project to the Committee on Climate Change.

8 ADB (2017) *A Region at Risk: The Human Dimensions of Climate Change in Asia and the Pacific*. Available at: https://www.adb.org/publications/region-at-risk-climate-change.

9 Chadburn SE et al. (2017) *An observation-based constraint on permafrost loss as a function of global warming*. Nature Climate Change 7, 340–344.

Is it possible to stabilise global warming at 1.5°C?

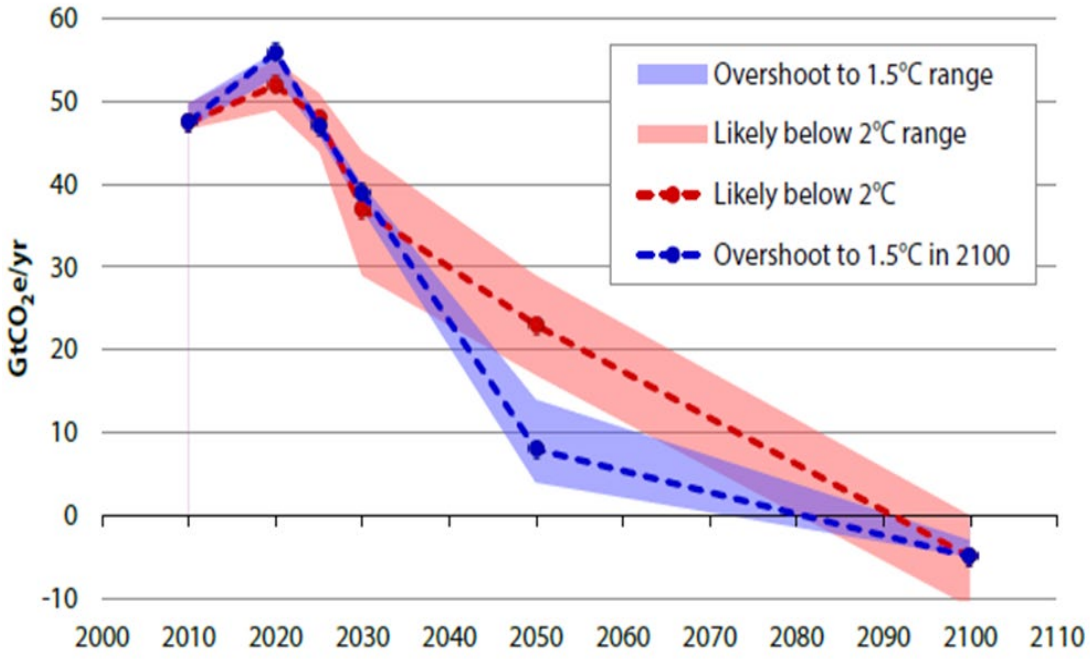
Limiting the global temperature increase to 1.5°C follows a similar pathway to what would be required for 2°C, just going a lot further and faster. It requires deeper cuts in emissions to be made sooner, with an earlier implementation of technologies and natural processes that can remove greenhouse gases from the atmosphere.

According to the United Nations Environment Programme (UNEP), even with the full implementation of national pledges made under the Paris Agreement the world is still on track for between 2.9 and 3.4°C of warming this century.[10] So even though climate impacts are a lot lower at 1.5°C compared to 2°C, global action on climate change to date is not yet close to reaching a 2°C trajectory.

Although there are indications that the pace of emissions reductions may be accelerating in some important areas, observed warming in 2016 was already 1.1°C above pre-industrial levels.[11] The window of opportunity for getting onto a pathway that can hold temperature increases at 1.5°C is therefore limited, with the need to go a long way in a short period of time.

Very broadly, climate models that describe holding temperature increases to 1.5°C require getting to net zero carbon dioxide emissions globally somewhere between 2045 and 2060, whereas plausible 2°C pathways do not reach this until between 2055 and 2075.[12] But there are still very few climate models today that are able to show how to effectively limit warming to 1.5°C. And those that do typically overshoot that temperature for a period, before stabilising at a lower temperature thanks to the use of negative emissions options.

Figure 2. Comparison of likely global emissions pathways to achieve 1.5°C and 2°C (all GHGs)



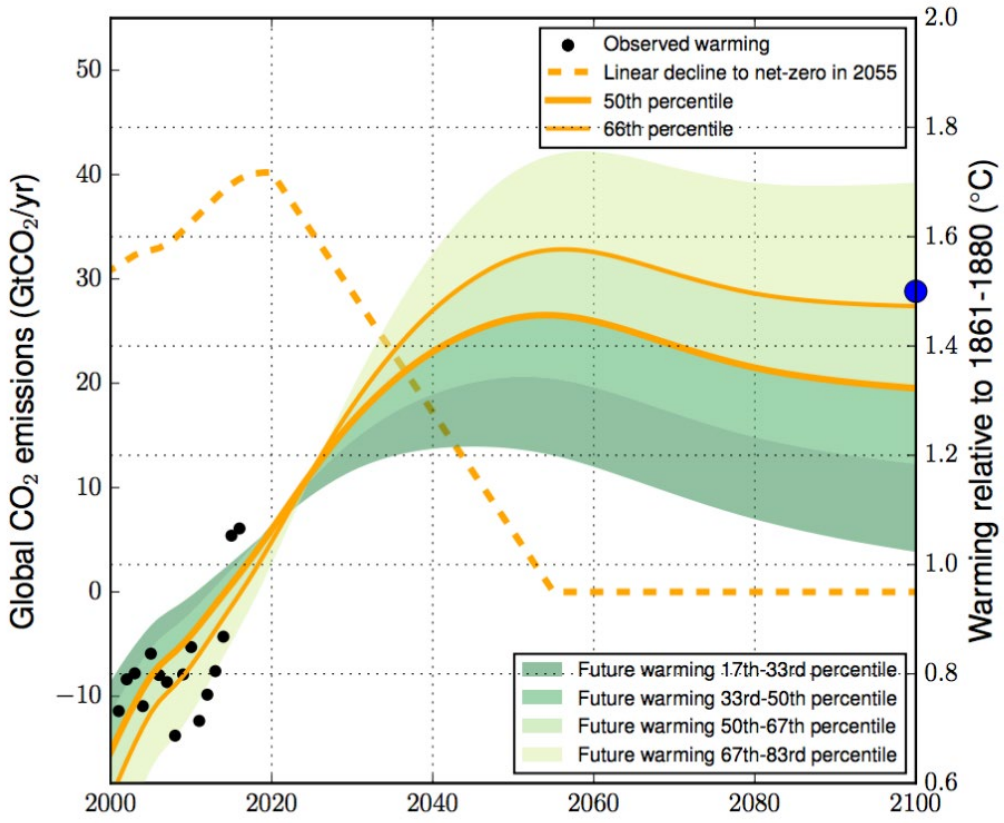
Source: UNEP (2016) The Emissions Gap Report 2016.

10 UNEP (2016) ***The Emissions Gap Report 2016***. Available at: http://www.unep.org/emissionsgap/.

11 *World Meteorological Organization (2017) "WMO confirms 2016 as hottest year on record, about 1.1°C above pre-industrial era". Available at: https://public.wmo.int/en/media/press-release/wmo-confirms-2016-hottest-year-record-about-11%C2%B0c-above-pre-industrial-era*

12 This refers specifically to CO_2 emissions, mostly from fossil fuel use. For all greenhouse gases the window would be 2060-2080 for 1.5°C and 2080-2090 for staying below 2°C.

Figure 3. Idealised mitigation trajectories for meeting a 1.5C target (CO_2 only)



Source: Richard Millar/Carbon Brief [adapted from Figure 3 of: Millar, RJ, et al. (2017)]. Available at: https://www.carbonbrief.org/guest-post-why-the-one-point-five-warming-limit-is-not-yet-a-geophysical-impossibility.

In practice, this will require significant – and in some cases radical – changes to the economy, transforming how we generate energy, use land and provide products and services.

The only existing pathways that show a strong likelihood for holding warming at 1.5°C require ambitious levels of emissions mitigation occurring as early as 2020. This would need to be well above current policy and technology trajectories.

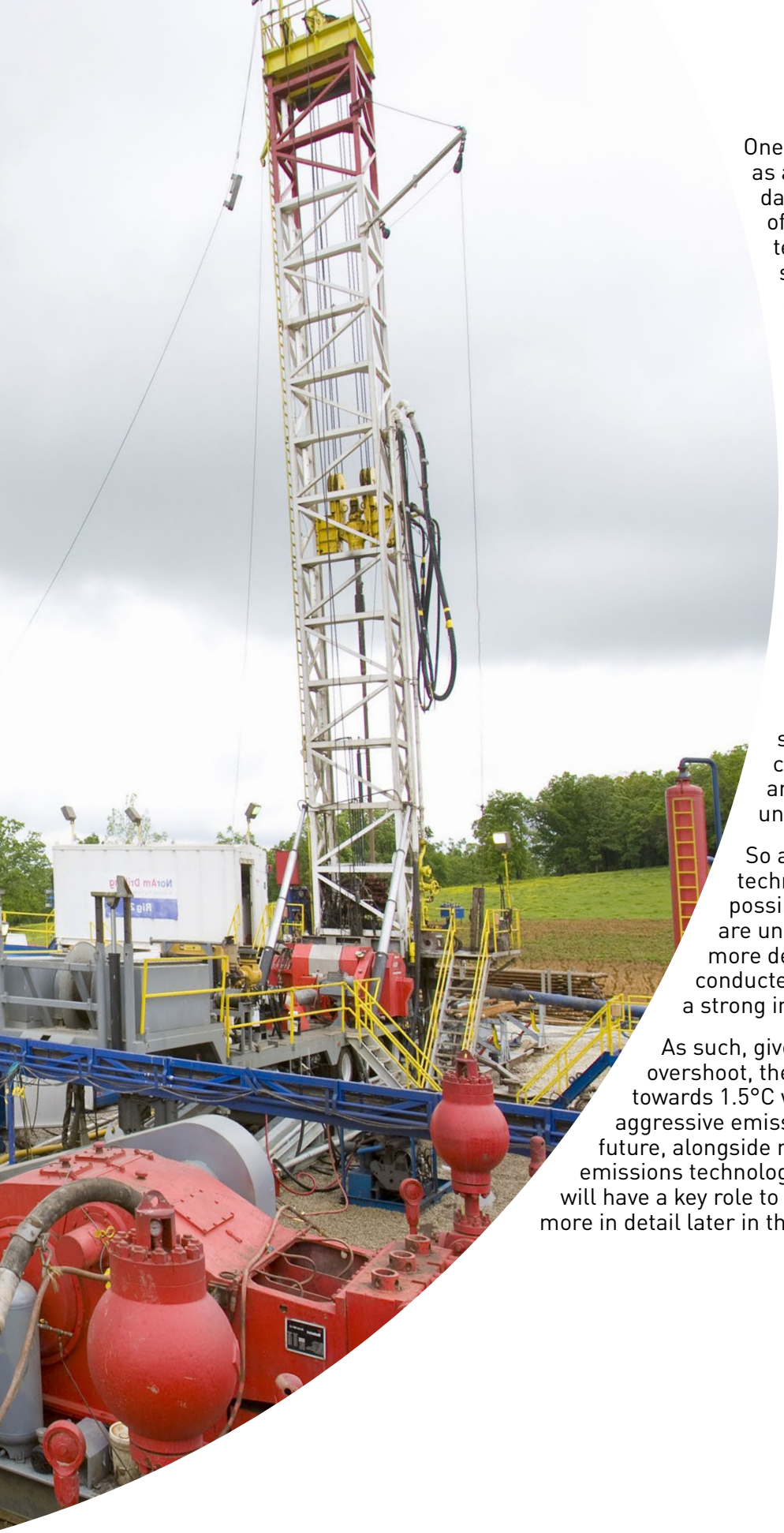
Moreover, because of the temporary overshoot of the 1.5°C temperature limit in the second half of the century, earlier and more rapid development and significant deployment of negative emissions options will be required globally before 2050. However, key technologies required to deliver this, such as bioenergy with carbon capture and storage, are some distance away from being commercially viable at scale. And the costs associated with deploying negative emissions technologies at the scale required are still highly uncertain, but would be expected to amount to several trillion dollars.[13]

The implications of a temperature overshoot on the climate system are also unknown. We do not know how far we could overshoot a 1.5°C temperature limit, or for how long, without reaching a tipping point or causing a feedback loop, which would make it more challenging to reduce temperatures effectively.[14] There are also questions over whether this would cause irreparable harm to certain geographical features or ecosystems, where damage could not be undone even if temperatures subsequently fall.

At the moment, climate models still do not reveal the thresholds at which potential tipping points or feedback loops may occur. For example, it is not clear at what point there would be irreversible melting of the Greenland ice sheet. However, one thing we do know is that this melting would result in a six metre rise in sea levels, which would submerge large parts of cities including Tokyo, Shanghai, Mumbai, New York, Miami and London. There are therefore substantial precautionary benefits from strong action on carbon emissions that keep warming as low as possible.

13 Hansen J et al. (2017) ***Young people's burden: requirement of negative CO2 emissions***. Earth Syst. Dynam. 8, 577-616.

14 For example, potential tipping points might include the release of methane hydrates from the oceans, which would lock in higher levels of warming. See Archer, D et al. (2009) ***Ocean methane hydrates as a slow tipping point in the global carbon cycle.*** Proc. Natl. Acad. Sci. USA 106(49):20596–20601.



One final option that is discussed as a last resort approach to limit dangerous warming, is the possibility of using more radical geoengineering techniques.[15] These might include spraying aerosols into the stratosphere to block sunlight, creating artificially whitened clouds to better reflect sunlight, or fertilising the oceans to promote the growth of phytoplankton at scale that draw carbon dioxide from the atmosphere through photosynthesis.

However, geoengineering approaches tend to come with much larger uncertainties, risks and potentially insurmountable practical challenges. Not least of these are the social, political and legal acceptability of deliberately taking action to affect the climate, especially when this may have substantial negative unintended consequences. The total costs and ramifications are also highly uncertain.

So although geoengineering technologies remain a theoretical possibility for meeting a 1.5°C goal, they are unlikely to be deployed without far more detailed research and trials being conducted, alongside the development of a strong international consensus.

As such, given the short timeframes before overshoot, the most likely successful route towards 1.5°C would seem to be through driving aggressive emissions mitigation in the near term future, alongside rapid deployment of negative emissions technology. This is an area where businesses will have a key role to play, a topic which is discussed in more in detail later in this report.

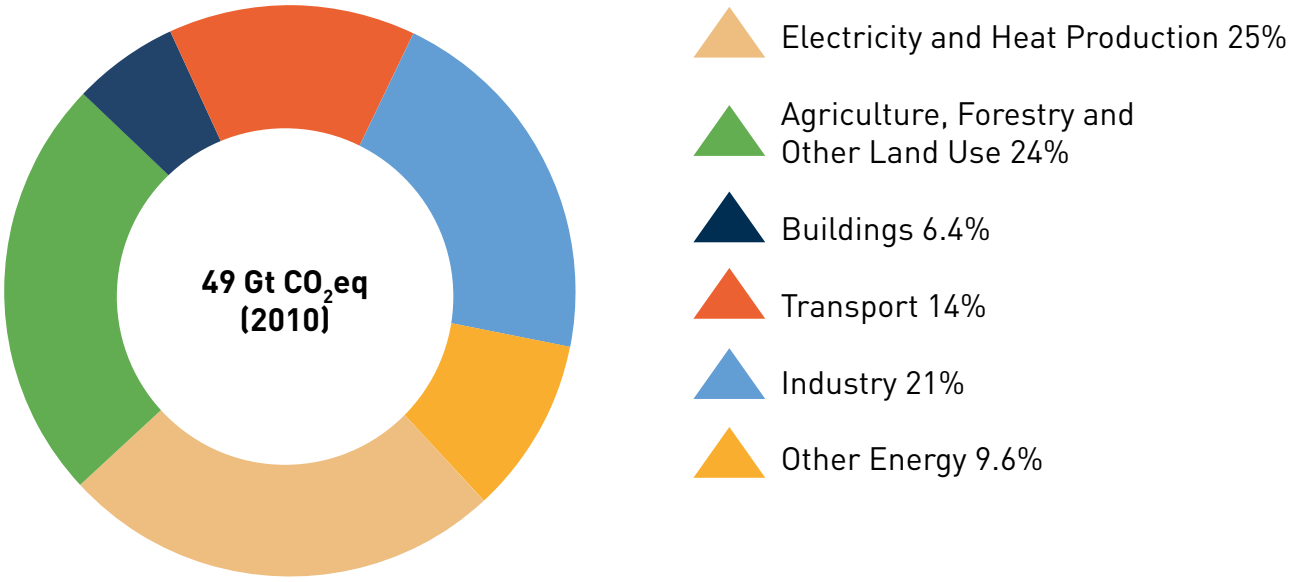
15 A good summary of the possibilities and challenges in using geoengineering from a research project by the Royal Society can be found in: Shepherd JG (2012) G*eoengineering the climate: an overview and update*. Phil. Trans. R. Soc. A 370, 4166–4175. Available at: http://rsta.royalsocietypublishing.org/content/370/1974/4166.

What is the role for business leadership in achieving 1.5°C?

In order to hold global warming at 1.5°C, businesses will need to significantly accelerate their own efforts to mitigate emissions within their own operations and supply chain. At the same time they will need to transform their own core products or services, so that they are compatible with a net zero carbon world by the middle of this century. And some companies will also have to play a key role in driving the innovation, commercialisation and deployment of negative emissions solutions.

As the engines driving much of the global economy, businesses have a huge influence on carbon emissions. Some of the sectors that can have a major direct influence include electricity and heat production, agriculture and forestry, transportation, heavy and light industry, construction and facilities management. But companies in almost every sector can have indirect influence through their procurement and use of the products and services from these sectors.

Figure 4. Global greenhouse gas emissions by economic sector



Source: IPCC (2014) Summary for Policymakers, in: Climate Change 2014, Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

The stark reality of the challenge in limiting the global temperature rise to 1.5°C is that at some time around the middle of this century there will need to be net zero carbon emissions from energy generation, industrial production and agriculture all around the world. There will also need to be zero carbon emissions from buildings and transportation. And businesses will need to figure out over the course of the next two or three decades how they can be part of this transition while also profiting from it.

The heavy lifting in this transition will not be shared equally across all sectors of the economy. For example, a professional services business in a zero carbon 2050 may operate in a way that is superficially similar to the way they do today, just with clean alternatives used for heating, cooling, electricity and transport. They can make their transition through greener procurement, as the major active changes will need to be enacted by the landlords, energy companies and transport companies they use.

However, for industrial and extractive businesses there are likely to be major, transformative changes to their operations and business models. Indeed, many companies will need to radically alter their approaches to sourcing raw materials, or how they provide products or services to their customers. And for companies that are able to help facilitate this transition, there will be exciting new commercial opportunities.

The key role for responsible businesses wanting to take a leadership role in achieving a 1.5°C world is showing that the transition is possible, taking a science-based approach to explicitly link their future activities with a 1.5°C goal.

One of the things that makes climate change an even more dangerous problem is that carbon emissions have a planetary effect, but are still mostly treated as an externality within the global economic system. It is a challenge that requires collective action, and one where individual actors do not reap the full rewards of their own carbon reduction efforts.

This situation can encourage free riding, where organisations can benefit from the emissions mitigation efforts of others without altering their own activities beyond the minimum levels required by regulation, or only acting where there are clear direct economic benefits.

For many corporates, making the business case for investment into even comparatively cost-effective carbon reduction measures still presents a very real challenge. And despite recognising and accepting the importance of taking action on climate change, a business has a responsibility to deliver on its own bottom line. Strong action today – going further and faster than governments and customers – can be seen as a potential risk or a competitive disadvantage.

Because of the extremely challenging nature of achieving 1.5°C, success is likely to depend on developing a broad consensus around strong collective action across multiple organisations and governments, each recognising the enlightened self-interest in participating in global efforts.

To some extent this is already happening. Indeed, many companies are already setting their own ambitious commitments and taking strong action in line with a 2°C trajectory. There are already around 300 major businesses that have either set, or committed to set, science-based targets to reduce emissions at this level through the Science Based Targets Initiative. And we are now seeing the first wave of companies – including Tesco, Carlsberg Group and BT – that are going public with targets aligned with 1.5°C.

These commitments move markets. They give governments the confidence to create stronger climate change regulation and bolder policies, showing that it is possible to successfully decouple profitability from environmental harm. They also provide clear signals to investors that long term investments need to be in companies and technologies that can thrive in a zero carbon economy.

But setting a target alone is no guarantee of success, especially when it is enormously ambitious. The technical and commercial challenges for businesses will be immense even at 2°C. And the ability to succeed will often depend on many external factors almost entirely outside a company's operational control. For example, most businesses will need to rely on third party innovation - potentially with public funding - to make key clean technology alternatives available at commercially affordable prices.

To explore the issues around whether it is possible for businesses to commit to 1.5°C and get a clearer picture of the barriers and opportunities, the Carbon Trust hosted two roundtable discussions earlier in 2017 with leading corporates and sector experts. Some of the key steps businesses can take to deliver on higher ambition climate change goals are discussed below, alongside some of the major external and internal challenges that came out of these sessions, as well as an additional commentary in response to more recent political considerations.

Business leadership in action

Carlsberg has a heritage going back to the early days of the industrial revolution. We are convinced that to survive and succeed in a sustainable future we need to take bold action on climate change. This is why we are working towards zero emissions at our breweries by 2030, with an interim goal of powering them 100% with electricity from renewable sources and completely phasing out coal for heat by 2022.

We are also working closely with our suppliers and customers to reduce emissions outside our direct operations, aiming for a 30% lower beer-in-hand carbon footprint. The targets in our Together Towards Zero plan are ambitious, yet we believe that it is necessary to show that a 1.5°C trajectory is possible, where our actions and investments will benefit both Carlsberg and society as a whole.

- Simon Boas Hoffmeyer, Sustainability Director at Carlsberg Group

Ten years ago we set ourselves the goal of becoming a zero carbon business by 2050. We've made huge steps forward over the past decade which are saving us around £200 million a year just from our electricity bills. But our current rate of improvement still doesn't put us on track to get to zero soon enough, so we have introduced even tougher targets to put us in line with what will be required to hit the 1.5°C aspiration in the Paris Agreement. As part of this we have committed to use 100% renewable electricity by 2030.

As a retailer we know the majority of the emissions associated with our business come from our supply chain – including agriculture emissions. To act on this, we will be working with our suppliers to encourage them to also adopt a credible, science-based approach to cutting carbon, with the goal of reducing our indirect emissions by 17% by 2030.

- Kené Umeasiegbu, Head of Environment at Tesco

At BT we are proud that we have become one of the first companies to globally commit to a higher ambition science-based target, aligned with what is required to limit global warming to 1.5°C. Of course this will be challenging, but we can now see a clear path to understand how this can be achieved in a way that is not just good for the environment, but also good for us as a business and for the wider economy. But the only way we can achieve a 1.5°C world is through collaboration and collective effort, so we would love to share what we have done to help other companies accelerate their efforts.

- Gabrielle Ginér, Head of Sustainable Business Policy at BT

10 key steps towards becoming a 1.5°C business

There is a large emissions gap between where we are today and where we need to be in order to secure a 1.5°C future. Businesses that want to support this transition will have to cross the emissions gap themselves, aiming to reach zero by the middle of this century.

In some areas businesses can bridge the gap today without commercial compromise, in some cases it can even enhance competitiveness. We are seeing the leaders make bold plans and set ambitious long-term targets, at the same time as delivering substantial emissions reductions and cost savings by deploying existing technologies.

In other cases the ability of businesses are highly dependent on external factors – for example the commercialisation of low carbon technology, stronger climate change policies such as carbon pricing, or shifts in consumer behaviour – which will influence their ability to complete the zero carbon transition profitably.

Where they are unable to make a leap, companies should look to build a bridge. This involves making as much forward progress as possible in reducing emissions, taking into account the constraints that exist within today's economy.

Below are 10 key steps identified through the Carbon Trust roundtables, where businesses can focus their efforts to show leadership, helping to accelerate the changes that will be required throughout society to secure a 1.5°C future.

1

Understand your carbon footprint

Get a clear picture of the sources of all greenhouse gas emissions across your full value chain. It is important to look beyond just direct operations, exploring indirect impacts upstream and downstream of your business, as for most companies these will far exceed direct operational impacts. This will help to identify hotspots of emissions where you should focus efforts. It will also reveal potential opportunities for improved efficiency and cost savings.

2

Develop a roadmap to zero emissions

Set out the practical steps that could be required to deliver your core products or services in a zero carbon future, including the major challenges and areas of uncertainty. Explore opportunities which exist today, as well as having a clear picture of tipping points and when it might be possible to make future changes, for example through plotting progress in the commercialisation and cost reduction of key low carbon technologies.

3

Set science-based targets

Use the best available climate science to align your own emissions reductions goals with the requirements of a 1.5°C pathway, using a methodology that is appropriate for your sector. At the same time set ambitious targets to reduce your indirect emissions. Where appropriate, you can also act as an advocate for policy changes that would support limiting warming to 1.5°C.

4

Invest in energy efficiency

Take advantage of the cost-effective opportunities to reduce your carbon emissions that exist today, for example through improving the efficiency of your buildings, fleet and industrial processes. Starting from a lower baseline of emissions should lower the total costs of making the transition to becoming a zero carbon business.

5 Switch to zero carbon electricity

Many businesses are already committing to eliminate carbon emissions from their electricity use in the near future, with examples across almost all sectors. This is primarily being done by investing in on-site renewable electricity generation and switching to electricity tariffs backed up by guarantees of origin. Look at market availability and cost implications in order to set yourself stretching but achievable interim goals.

6 Move towards zero emissions transportation

Understand your options for using vehicles powered by non-fossil fuel sources, such as batteries, hydrogen and biofuels. The right solution will depend on business need and the relative costs of making the transition. This will be limited by the pace of technology development and cost reduction by manufacturers, as well as taxation or subsidies available in different regions.

7 Decarbonise heating and cooling

Replace existing fossil fuel sources of heating and cooling with more efficient or cleaner alternatives. Consider the use of biogas or biomass, capturing waste heat, or electrifying by installing heat pumps. For cooling, commit to the use of refrigerants with lower global warming potential and look at district cooling options. And for unavoidable emissions from industrial heating processes, explore options for carbon capture and storage.

8 Take action in the supply chain

Implement interventions to drive supply chain emissions reductions. These could target incremental efficiency and performance improvements, like introducing sustainable procurement criteria. Or they could be transformational changes, such as redesigning products to use lower carbon materials. Levels of climate action will vary by region, so take a pragmatic approach to understand where you can best have a material impact.

9 Use an internal carbon price

Carbon pricing is one of the most popular policy options to drive emissions reductions through market mechanisms, with growing use around the world. With the addition of China's national trading scheme, there will be a cost attached to over a fifth of all global emissions.[16] Using an internal carbon price can mitigate risks from cap-and-trade schemes or carbon taxes and improve decision making, especially where escalating prices could affect carbon-intensive long term capital investments.

10 Explore options for negative emissions

Companies should explore whether there are potential negative emissions options they could introduce economically within their business model or supply chain over the longer term, with potential varying between sectors. Improved agricultural practices sequester more carbon in the soil. There are possibilities of introducing carbon negative industrial processes to replace those we use today in some areas, such as chemicals and cement. The use of sustainable construction materials can lock away emissions in buildings. And engineering and energy firms will also have business opportunities in commercialising carbon capture technologies. But for many companies their main option is likely to involve the purchase of negative carbon electricity.

16 World Bank and Ecofys (2017) ***Carbon Pricing Watch 2017***. Available at: https://openknowledge.worldbank.org/handle/10986/26565.

How can you build a business case for 1.5°C?

Acting in a way that is consistent with limiting warming to 1.5°C involves taking action well ahead of existing levels of regulatory risk, even in markets with stronger climate change policies.

Over the longer term it also involves committing to significant changes and making a disruptive transformation away from business as usual today. It is therefore of paramount importance to have a credible case for action, describing how it is both achievable and in the long term best interests of an organisation.

A common struggle identified by all participants at the Carbon Trust roundtables on 1.5°C was that it is difficult to secure buy-in for necessary changes at board level without a clear, detailed and convincing business case to back up new targets. And this applied even within companies which consider climate change to be a critical future challenge or commercial opportunity, making it a corporate priority.

SEEING INTO THE FUTURE

The first part of forming a credible business case is having a clearer picture of the individual risks and opportunities that a company faces as a result of climate change. This is an area where companies are expected to make significant progress over the next few years, especially because it is an issue on which governments and investors are increasing their engagement and exerting pressure.

The G20 Financial Stability Board's Task Force for Climate-related Financial Disclosures (TCFD) believes that climate risks and opportunities are systematically being underestimated and underreported, warning that this now poses a systemic risk to global financial stability. In response to this, the TCFD recommends that businesses should now use a scenario-planning approach, allowing them to develop a clear picture of what might occur in the future. And this includes looking at circumstances where the Paris Agreement's goal to limit warming to well below 2°C is achieved.[17]

For most organisations, scenarios will tend to show significant benefits from lower levels of warming, encouraging them to take a precautionary approach and advocate for higher ambition. Of course it is entirely possible for some companies to arrive at a more cynical or pessimistic conclusion from the same process.

Companies could, for example, conclude that a higher warming scenario is the most plausible outcome of global efforts to combat climate change. Or that this pathway is better for their business, so should form the basis of future plans. Indeed, the chair of the Australian oil company Santos publicly explained to shareholders at an AGM in May 2017 that current business plans are based on a 4°C scenario, which he believed was "sensible" and "consistent with good value".[18]

Although it is worth noting that this sort of approach is very much an outlier, at odds with a vast number of businesses and investors that are increasing their ambitions and accelerating their efforts to align with the Paris Agreement.[19] This is because many senior businesspeople freely admit that pursuing narrow profitability in the face of considerable social, environmental and economic harm would be an unethical stance. It could also be a risky strategy, with the potential to precipitate a significant backlash from governments and the public.

However, delivering lower levels of warming requires collective action at a global scale. This means doing the right thing, as opposed to simply saying the right thing, remains a challenge. Advocacy and consensus-building is easier than individual action, especially when that action poses a real risk to the bottom line. And for most corporates the business case for action is not yet being made in a sufficiently compelling way, allowing them to do what is necessary to put themselves onto a 1.5°C trajectory.

17 Full recommendations are available on the TCFD website at: https://www.fsb-tcfd.org/publications/final-recommendations-report/.

18 Davidson, H (2017) "Oil company Santos admits business plan is based on 4C temperature rise". The Guardian. Available at: https://www.theguardian.com/environment/2017/may/05/santos-admits-business-plan-based-4c-global-temperature-rise

19 See for example the We Mean Business Coalition (https://www.wemeanbusinesscoalition.org/) or collective commitments from businesses in the United States following President Trump's announcement of withdrawal from the Paris Agreement (http://wearestillin.com/).

TWO REALITIES

Central to the challenge faced by businesses is the need to remain competitive within an international marketplace. Investment in low carbon technologies and processes can be costly in the short-to-medium-term. This can be perceived as creating a competitive disadvantage when major competitors are not incurring these costs themselves, are not subject to similar national or regional carbon prices, or operate in less stringent regulatory regimes.

Underpinning this competitive pressure is the fact that business leaders are trapped between two realities. Although there is a general awareness and acceptance of the need to address climate change by the middle of this century, there is a dissonance created by the incentives for action that exist under current political and regulatory regimes. This often makes it difficult to both drive performance within the business planning horizon and act strongly on climate change.

Most roundtable participants admitted that their long term strategic business planning does not tend to extend far beyond a five-year time horizon. Although for some of the more capital intensive sectors this horizon could reach out as far as ten years.

Because following a 1.5°C pathway would likely require businesses to reach zero carbon at least a decade before it would be required under a 2°C scenario, this means that aiming for 1.5°C could start to impinge on existing business planning cycles. And this closes the gap between the two realities, potentially bringing forward difficult, sometimes expensive decisions.

A core part of building a business case for 1.5°C involves expanding the time horizons for decision-making, to explore how it might be possible to reconcile the two realities. This is not easy. However, a small but growing number of businesses are showing that it is genuinely possible to balance the risks of acting today against the risks or opportunity costs of not acting over the longer term. And to understand these risks and costs it is necessary to have a vision of how a company could complete the transition to a zero carbon future.

ROADMAP TO ZERO

To develop an internal business case for action companies still need to work out a clear roadmap, setting out the steps they would need to take to get to zero emissions.

With a roadmap to the final destination, the important questions become which route to take and how fast to make the journey. And this pace of decarbonisation can then be matched along a sectoral trajectory for emissions reductions, aiming to keep it in line with what the best available climate science says would be required to limit warming at 1.5°C.

It is worth noting that this trajectory may not be immediately clear for every sector, but there should be a lot more information available after the IPCC special report on 1.5°C is released in 2018. Although this in itself should not preclude most businesses from undertaking significant preparatory work today on targets that can later be refined as the science becomes more certain.

With a roadmap in place, it is possible for businesses to put in place a pipeline of emissions reduction projects in the short to medium term, aiming to make the deepest cuts that they economically can with today's technology. This might include commitments on renewable energy and energy efficient technologies, where costs have reduced significantly in recent years. For many businesses, bold investment in these areas can be very commercially attractive.

This should be joined to a series of longer term interim targets and an expected emissions reduction curve, taking into account possible future projects. This will be the area where external factors will typically need to come into play, such as regulatory and technology changes, or a growing price on carbon. This applies in areas such as transportation and heating, where lower carbon options today can be disproportionately expensive.

In many areas it is possible to make reasonable assumptions within different markets to predict where tipping points might occur. For example, France, Norway, the Netherlands and the UK have all indicated they will ban the sale of new petrol and diesel vehicles in the foreseeable future, which should encourage a comparatively rapid transition to lower carbon vehicles in Europe, whereas in developing markets the shift may be slower. But as with all assumptions, these can be revised later when new information becomes available.

But there is a difference between knowing what you need to do and making public commitments to actually accomplish it. As such it is possible to look at target setting as an iterative process, where a goal can be set over a shorter period, which can still put a company on track to deliver on a longer-term ambition.

RATCHETING UP

There was broad agreement amongst roundtable participants that one of the most successful routes to securing senior engagement for climate action was to align goals with the high level commitments in the Paris Agreement.

Businesses that want to move towards a 1.5°C pathway, but are unwilling to make commitments at present should aim to stay as close as possible to the necessary emissions reduction trajectory. At present there are hundreds of businesses across multiple sectors that are comfortable committing to science-based targets in line with a 2°C goal. And this can be a very useful jumping off point for getting to 1.5°C.

One of the key features within the Paris Agreement was the principle of getting countries to commit to their own nationally determined reductions that could be ratcheted up. There was also the use of contingent commitments depending on external factors. For example, many developing countries set both absolute and contingent national goals, where higher aspirations were based upon the receipt of international assistance.

In the same way, businesses can set 2°C as a base commitment, with the intention that they too could ratchet up their ambitions if certain external factors come to pass. This might include a levelling of the competitive playing field: for example through the harmonisation of a carbon price between regions, or government incentives that ensure businesses are not penalised in the market for taking ambitious actions.

For many companies then their major contribution to securing a 1.5°C future will be in driving reductions of greenhouse gases down to zero within a relatively quick time period. But there is an important secondary role that some companies will also need to play, that could drive exciting commercial opportunities should the right market structures be put in place to incentivise negative emissions.

NEGATIVE EMISSIONS

Nearly all the scientific literature describing likely 1.5°C pathways include a significant deployment of negative emissions options to remove carbon dioxide from the atmosphere, as indeed do many of the scenarios where global temperature rise is held at 2°C. And without radical changes to the global economy, the private sector will need to deliver a substantial proportion of these negative emissions.

Businesses therefore need to think seriously about whether they can incorporate negative emissions options within their business models, and if so how this could be done economically. But the opportunities and challenges will inevitably differ between industries and regions.

When considering the negative emissions options available to reverse the overshoot, these broadly fit within two categories: the natural and the technological.

Some of the simplest and cheapest options involve harnessing natural processes that draw carbon dioxide out of the atmosphere and store it in the land or oceans. These include afforestation and reforestation, improving soils so that they store more carbon, or restoring degraded coastal and marine habitats such as mangroves and seagrass beds.

Agriculture and forestry businesses are particularly well placed to deliver on these negative emissions opportunities. Similarly, any business which has a significant volume of agricultural or forestry products within its supply chain will be able to influence this area, for example through incentivising suppliers to manage land more sustainably.

There are also lesser opportunities within the construction and manufacturing sectors to increase the amounts of plant-based materials – such as wood and natural fibres – used in buildings and products. This effectively locks away the carbon stored within those materials for the duration of the life of the building or product.

One of the ways that companies in any sector can invest in carbon sequestration is by carbon offsetting their own impact through the purchase of certain categories of high quality carbon credits, for example

those that involve forest and mangrove restoration. This can provide reputational benefits and have a positive social impact on communities in developing countries.

But there are also negative emissions options where technologies or artificial processes can be used to accelerate or enhance the process of removing carbon from the atmosphere.

Perhaps the most commonly cited of these options is bioenergy with carbon capture and storage (BECCS). This refers to a process where plants, trees or crops are cultivated, then burnt for energy at the same time as capturing and storing the carbon emissions. This technology features prominently in IPCC overshoot scenarios, where widespread deployment of BECCS would be needed in the second half of this century. For several sectors the purchase of electricity, heat and fuel from BECCS will be their only viable option to contribute to negative emissions.

However, this technology is still a long way from full commercialisation. The first major facility to test the feasibility of this approach at scale is in Decatur, Illinois in the United States. Although behind this demonstration there is one of the largest global agribusinesses, Archer Daniels Midland, hoping to position itself to take advantage of the substantial future opportunity in producing sustainable biofuel. The company is using corn grown in the region to process into ethanol fuel, at the same time as capturing the carbon from the process and attempting to inject almost 1 million tonnes a year of CO_2 emissions into a nearby sandstone geological formation.[20]

Other alternatives for introducing negative emissions within a business model include the use of processes to directly capture carbon dioxide out of the air, then to sell the gas for other uses. This is being trialled in smaller scale demonstrations, for example in Switzerland where a company called Climeworks is using waste heat to power a plant to capture CO_2 for use in greenhouses to help grow vegetables.[21] Although it could also be used for other purposes, such as producing carbonated drinks.

There are also options that fall within the realm of geoengineering. With these options the likely opportunities for businesses will be in technological implementation of geoengineering processes on behalf of governments or international bodies.

This might include fertilising oceans with iron or nitrogen to increase phytoplankton photosynthesis and the rate at which they absorb CO_2 from the atmosphere. It could also involve seeding clouds or oceans with alkali to help dissolve atmospheric CO_2 in water, or pulverizing and spreading rocks to increase the surface area over which they take up CO_2 from the atmosphere.

The big problem with technological options for carbon sequestration is that they are still unproven at scale. There are a number of possible environmental and social implications which arise due to the large scale demand for land with BECCS. And geoengineering techniques come with high uncertainties and substantial risks from unintended consequences.

As such, most businesses looking at introducing greater levels of carbon sequestration into their business model in the near term future are likely to focus primarily on natural processes and offsetting options. However, certain sectors, particularly the energy industry and engineering firms, should explore longer term opportunities that might be unlocked should policies create a stronger private sector market for carbon removal.

POSITIVE INFLUENCE

One final, but crucial, element in building a business case for 1.5°C is in the role that companies can play in influencing the political landscape and unlocking support for stronger climate action. Attendees at the Carbon Trust's roundtable all highlighted the importance of policy and market certainty, backed up by a strong consensus on the need for rapid – and in some cases radical – change.

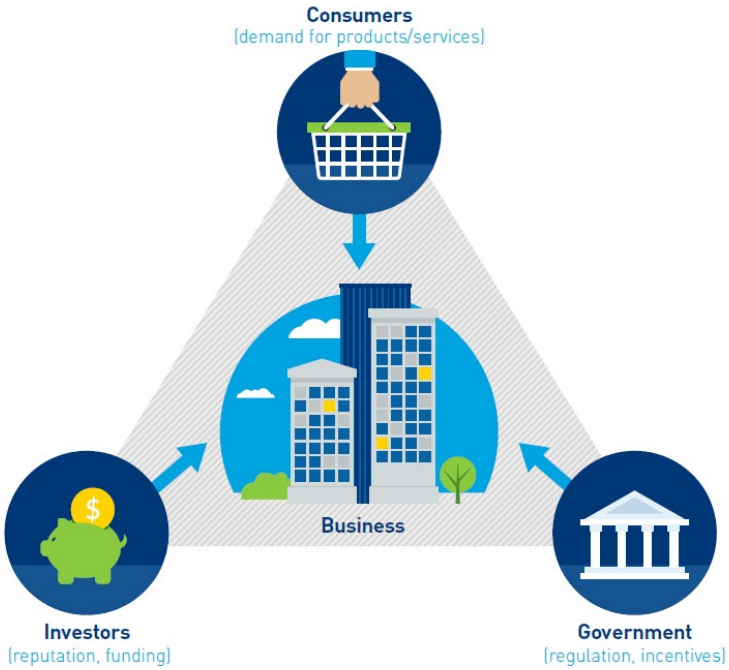
Whilst participants expressed a clear understanding of the case for action at a societal level and a desire to take greater levels of action, a common reservation was that this could not be done unilaterally or in small groups.

Success in delivering on the ambitions of the Paris Agreement is contingent on simultaneous action being taken at scale by multiple actors. And in the context of business action, there are three core groups that strongly influence business decision making: consumers, investors and government.

20 For more information on this project see the case study from the MIT Carbon Capture and Sequestration Technologies program at: https://sequestration.mit.edu/tools/projects/decatur.html.

21 Marshall, C. (2017) "In Switzerland, a giant new machine is sucking carbon directly from the air". Science. Available at: http://www.sciencemag.org/news/2017/06/switzerland-giant-new-machine-sucking-carbon-directly-air.

Figure 5. External influences on business decision making



Recognising that the drivers for action today are not strong enough to do what they believe to be necessary, businesses can play a positive role in strengthening the drivers for action. This is because these are two-way relationships where companies can have a positive influence on their stakeholder groups.

For example, businesses can shift consumer demand to lower carbon choices through the use of product or service innovation, coupled with marketing skills. And many companies are also customers of other businesses or investors in their own right, so are able to make demands on others in these contexts.

Looking at product and service innovation, certain industries have particularly strong opportunity for driving transformative change across the wider economy. For example, ICT solutions can reduce emissions and resource consumption across a huge variety of activities.[22] Similar opportunities are also available through unlocking new circular economy business models.

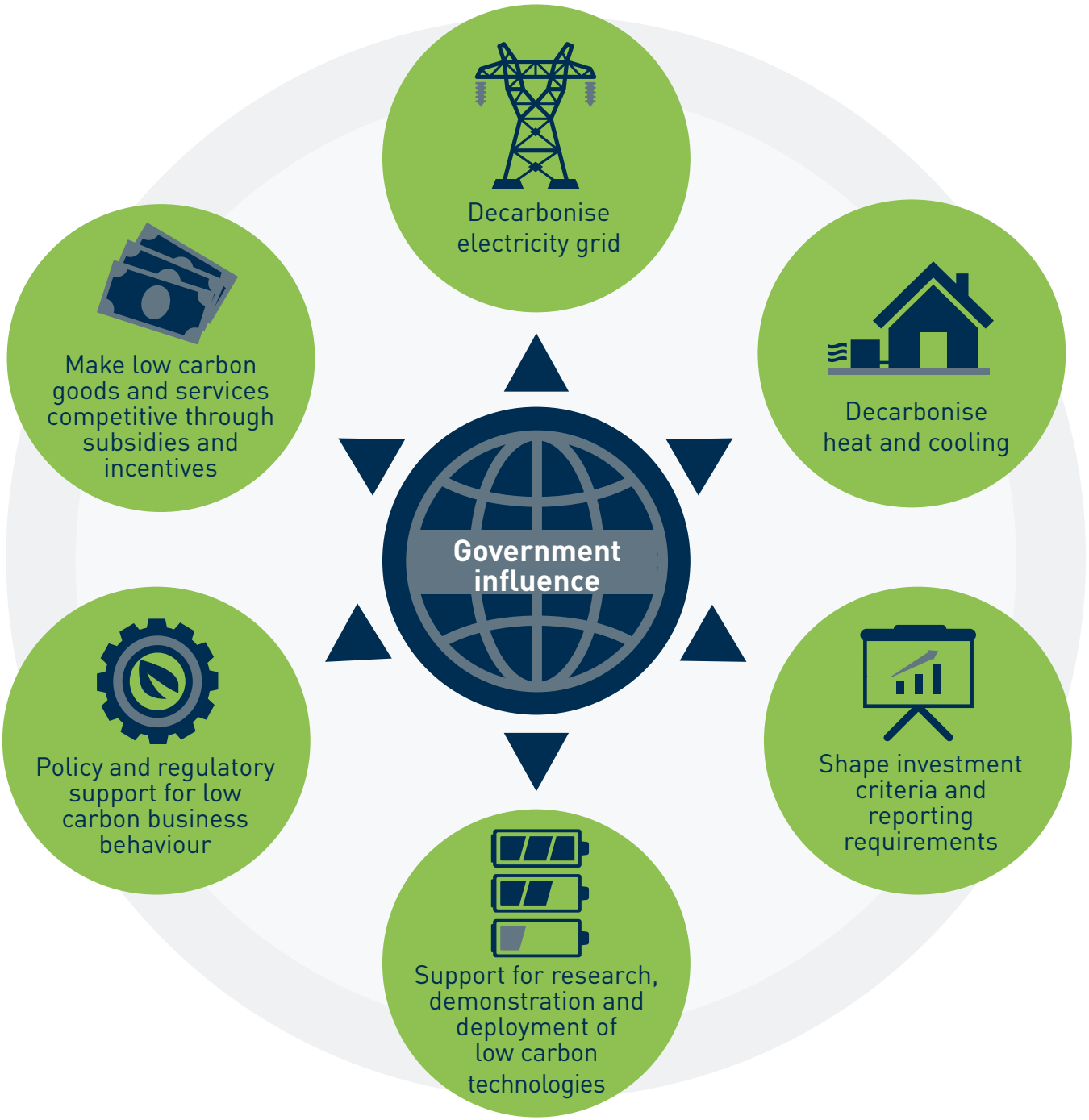
But across all sectors, companies can make public commitments or statements telling government what would be required to drive action from them, providing them with a mandate to introduce stronger climate policies. This is particularly the case when calls are made as part of a large coalition. This is significant because it gives the confidence to governments that tackling climate change can be done in a way that is good for the long term health of the economy.

Roundtable participants identified a number of dimensions where governments have an influence and where their intervention will be a crucial element in limiting warming to 1.5°C. Some of the key areas where legislation or regulation is required to unlock action or remove barriers are set out below.

22 For a more detailed exploration of this opportunity see the report from the Global e-Sustainability Initiative (GeSI) SMARTer 2030 report on what might be possible by 2030 at: http://smarter2030.gesi.org/.

Some measure of advocacy and lobbying from companies in each of these areas will be necessary to give governments the political impetus to act in a manner consistent with the Paris Agreement's higher ambition. In circumstances where business influence helps encourage stronger government action and creates a comparatively level global playing field for carbon emissions, companies that have a clear vision of what it takes to get themselves to zero carbon – and who understand their opportunities and risks in a zero carbon future – should be rewarded with a competitive advantage .

Figure 6. Identified areas where policy interventions are needed to support private sector decarbonisation



Conclusion

There are substantial benefits from limiting global temperature increase to 1.5°C above pre-industrial levels. If this goal is to be achieved then businesses will have a key role to play in driving the emissions reductions required and deploying negative emissions options. But this is likely to be an extremely challenging goal to deliver on in practice, requiring a significant rapid transformation in the global economy, with collective action from multiple actors.

Many consider the chances of limiting warming even below 2°C to be slim, making the chances of 1.5°C seem even more remote.[23] There is still comparatively little known about the exact requirements of this trajectory, but more will become clear after the IPCC special report on the topic is released in 2018. But reaching the higher ambition within the Paris Agreement should be possible in principle with rapid accelerated action to reduce emissions before the middle of this century, potentially coupled with the widespread deployment of negative emissions options.

However, despite the challenges of delivering on the goal, there are significant benefits from setting a higher level of ambition, even if aspirations on 1.5°C are not successfully achieved. The dangerous consequences of climate change become significantly more acute above 2°C, meaning that rapid action is urgent. And the lower the level at which global warming is held, the better it is expected to be for society, the environment and the economy.

There are now a number of large businesses using the best available climate science to align their own operations with the requirements of a 2°C future. A small number of leading corporates are now looking at what it would take to set that trajectory at 1.5°C. And those that set the bar at 2°C today are well placed to ratchet up their commitments to 1.5°C at a later point.

Although there remain a number of uncertainties around exact details, the big picture is clear and there is little time to waste. Today there exist tools and techniques for businesses to plot out a roadmap for what they would need to do to play their part in limiting warming to 1.5°C. However, their ability to follow that roadmap within a comparatively short time window will be constrained by external factors, such as the pace of technology innovation, infrastructure development and regulatory changes.

Business action today is not yet at a scale where it is having a sufficient impact to deliver on the required pathway. But a large number of companies making stronger climate commitments and using their resources and influence to drive change can rapidly move markets.

High quality long range planning and investment for the future should prove to be a competitive advantage for businesses, especially where strong global action is taken to tackle climate change. The corporate leaders that adopt this approach should be far better placed to mitigate the risks from regulatory change, or rapid shifts in consumer demand.

Businesses will have to play a key role in the transition to a low carbon economy. Those that align themselves today with a 1.5°C trajectory will be doing what is necessary to help accelerate the move to a sustainable future, showing genuine leadership and proving that it is possible to succeed in the longer term without causing excessive environmental harm.

23 Recent estimates put the chances of remaining below 2°C at around 5%, with 1.5°C considered to be a <1% possibility. See for example: Raftery, AE et al. (2017) ***Less than 2°C warming by 2100 unlikely.*** Nature Climate Change. Available at: http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate3352.html.

Selected further reading on 1.5°C

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Hare, B, et al. (2016) *Implications of the 1.5°C limit in the Paris Agreement for climate policy and decarbonisation.* Climate Analytics. Available at: http://climateanalytics.org/publications/2016/implications-of-the-1-5c-limit-on-austalian-climate-policy.html

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