Freya and Rosie's Common FAQs for Outreach Events – February 2022

Contents

1. How have emissions changed in my lifetime?

CO2 is now 50% higher than pre-industrial as of 2021, and this has increased dramatically in recent years. If you are 30, more than 50% of carbon emissions since the pre-industrial (1751) have been emitted in your lifetime. In you are 50, it's about 75%, and if you are 85, it's 90%. (great graphic to illustrate this – Twitter: @neilrkay).

Even if we were to stop all emissions today, we would not prevent some changes. However, the sooner we cut emissions, the smaller the changes will be.

Also check out Q17. If we stopped emitting carbon today, how fast would the world stop warming?

2. Are we going to see really hot summers in the UK in future? What about other extremes?

Climate change has made years like 2018 30 times more likely. This means that by the middle of the century, every other summer might be like 2018. If we continue on a high emissions scenario, we might see 40°C hit every 3 to 4 years in the UK (currently the probability is 1/100).

We are going to experience changes to the hydrological system as well as to temperatures. Extended periods of extreme winter rainfall are now 7 times more likely.

Met Office breaks record climate extremes down by month and country on this website.
WMO has some more global stats here.

Look at most recent State of the Climate report. Was an event record breaking? How many similar have there been before?

Recent events as at August 2021
First extreme heat warning issued by Met Office
Fifth warmest July on record (with heatwave mid July)
Northern Ireland broke its all-time temperature record with a figure of 31.3°C recorded at Castlederg on 21st July
Scotland and Northern Ireland were also far drier and sunnier than average for July
Floods swept across the southeast of England in July
Severe floods around the world - Germany and Belgium - over 180 people killed in flash floods, submerged homes in India and flooded subway train carriages in China

Nikos Christidis a Met Office climate attribution expert - "Without human-induced climate change, it would have been almost impossible to hit such record-breaking mean June temperatures in the Western United States as the chances of natural occurrence is once every tens of thousands of years.

"In the present-day climate getting an extremely hot June is common and is likely to occur twice in three decades. However, an analysis from many computer models suggests that by the end of the century these extreme temperatures are more likely than not. Human influence is estimated to have increased the likelihood of a new record several thousand times." Press release here.

In a worst case scenario, storms that stall over Europe could become as much as 14 times more common in 2100 than they were at the start of this century (Fowler, GRL). Slow-moving storms can overwhelm a region's river system leading to devastating flood events.

3. Don't future warm summers sound nice for the UK?

Heatwaves in summers through the next summers could lead to various problems for the UK such as:

Power outages due to demand for cooling, reduced capacity from power network due to e.g. power cables sagging in the heat and drought affecting water available for cooling power infrastructure.

Cancellations of events due to impacts on public health (we see increased deaths during heatwaves), shut down of outdoor industries such as building.

Line speed limits on railways cause disruption on roads, heavy traffic particularly toward coastal regions.

The UK Climate Change Risk Assessment provides more details on risks to the UK.

4. What impacts of climate change are there going to be for business and industry?

Increased heatwaves & Prolonged drier periods > health, more water demand, farming disruption and cancelled events > insurance claims, changes to agricultural patterns.

Extremes – wildfire, flooding, drought.

Extreme rainfall & Sea level rise : Flooding > disruption to infrastructure and supply chains, increased insurance claims.

Potential opportunities for UK business include less energy demand for heating, increased UK tourism, changes in growing season, development of new technologies and investment and business opportunities.

Check out the Met Office video: climate risks and opportunities for business leaders

5. What's this heat dome thing I've been hearing about?

Heat domes happen when an area of high pressure stays over a large part of a region for days, or even weeks. Instead of the weather patterns moving on, the circulation locks into place for a while, trapping hot air, and causing extreme heatwaves.

The area of high pressure keeps pushing the warm air down, which forces it together and causes it to heat up more, heating the ground. The ground dries out, and this means the ground also heats up more too. Fires are very easily started and spread in these hot, dry conditions.

We are seeing these heat domes appear in areas that do not usually see such extreme heat, and we've already seen north America heat up in extraordinary fashion earlier this year. In the UK, we've had record breaking temperatures last month with Northern Ireland reaching a record temperature of 31.3°C and the Met Office issued our first extreme heat weather warning as well.

Some of the extreme heat events we are seeing are likely caused by climate change because our models show that the chance of events like the heat dome in north America happening in June without any of the oil and gas burning that humans have done over the last couple of centuries are 1 in 10s of thousands, so very rare. Now, these events happening in June might happen a couple of times in a few decades, so still quite rare for us to see, but actually the chance of them happening has increased by thousands of times. These very extreme heatdome patterns might happen every other year by the end of the century unless there is fast action to reduce future greenhouse gas emissions.

To find this out, climate attribution scientists basically run the same models lots of times in two different ways – with one set of simulations having the emissions from human activities like burning fossil fuels, and the other simulations without those emissions in. Although extreme events are seen in both models, they are much more common in the models which include the greenhouse gas emissions and therefore we can tell that climate change has made those extreme events more likely.

6. What about that crazy flooding that happened in Europe and London in July 2021?

There was extreme flooding in Europe in July 2021. Belgium exceeded its national record rainfall, with 270 mm falling in 2 days. Most of Europe saw levels of between 100 and 150 mm a day, the equivalent of two months of rainfall falling over two days. The storm was slow moving, and the rain fell onto already saturated soils which made the impacts more severe. Climate change is projected to make these events more frequent for two reasons: 1) as temperatures rise, the air will be able to hold more water (7% more per K) 2) increase in slow moving storms – these happen due to weakening of the jet stream. Still uncertain about these projections but simulations show slowing of these high-level winds due to the decreased temp gradient between poles and equator. These high intensity, slow moving events are projected to become 14 x more frequent by the end of the century under RCP8.5.

Check out: rapid attribution study linking the European summer floods to climate change.

The flash floods in London in July 2021 were caused by thunderstorms. This type of event is projected to increase in the future. Events where rainfall exceeds 30 mm/hr, which is the threshold

for a flash flood warning, are projected to double by 2070's under RCP8.5 and a 1 in 100 year event will increase by 28%.

In the heaviest rainfall events in the UK, we are seeing 17% more rain falling than before climate change (in the last decade, compared to thirty-sixty years ago). These types of heavy rainfall event are projected to become more common in the future

7. How can we tell whether these events are caused by humans or by natural variability?

We conduct some analysis called 'event attribution' to tackle this question. We run the same models twice – with one set of simulations having the emissions from human activities, and the other doesn't. Although extreme events are seen in both models, they are more common in the models which include anthropogenic emissions. We can look at the difference between the two models to understand how human emissions have caused extreme events to happen more often. Attribution studies can take a long time because there a lot of model simulations that need to be performed to be able to make confident attribution, but once these simulations have been performed already, we now have scientists working very fast on rapid attribution studies so they can tell us within days/weeks of an event occurring whether it was more likely to happen under climate change.

8. Can we measure the climate changing?

We can already measure the climate is changing. The average global temperature has increased by 1.2°C since the 1900's. According to the UK 2020 State of the Climate report, 2020 was the third warmest year on record, and the top 10 warmest years have all occurred since 2002. 5 of the 10 wettest years have occurred since 2000. In terms of local rainfall extremes, the measurements are still not detectable from the variability but future projections suggest these will increase in the future.

As well as increasing temperatures on land, we measure lots of other ways that the climate is changing: Arctic sea ice, sea level rise, melting glaciers and ice sheets, and warming oceans.

9. How are we currently modelling future climate scenarios?

We currently model future climate scenarios using climate models, which are very large computer programmes containing lots of equations that represent our best understanding of how the planet works. CO2 is now 50% higher than it was before we started burning oil, coal and gas in large amounts. The carbon dioxide and other greenhouse gases in the atmosphere result in global warming and cause changes to how the Earth's ocean and atmosphere behave, so as carbon dioxide is projected to increase into the future, we project certain changes to the Earth system, and climate impacts such as more severe and frequent heatwaves, droughts, and flooding.

10. What are these scenarios all about? Is RCP 8.5 realistic?

As we don't know how much CO_2 and other greenhouse gases will be emitted in the future, we don't know what the climate forcing will be. So, the approach the climate science community takes is to look at several possible future worlds, and these are what we call scenarios. RCP 8.5 is a high-end scenario, where we continue to use a lot of fossil fuels, and leads to 3 - 5°C warming by 2100

(depending on the model) - however this is the level of warming that current climate policies do still have us on track for.

The IPCC AR6 report features a lot of analysis on temperature outcomes – 1.5°C, 2°C, 3°C, 4°C – rather than solely focusing on emissions scenarios. This is helpful, as high sensitivity and carbon cycle feedbacks can potentially result in 3°C or 4°C warming under a moderate emissions scenario.

UNEP Emissions Gap Report 2020 finds that the world is still heading for a temperature rise in excess of 3°C this century – far beyond the Paris Agreement goals of limiting global warming to well below 2°C and pursuing 1.5°C. There are many benefits to limiting global warming to 1.5°C, compared to even half a degree higher. Limiting global warming to 1.5°C would require a massive transformation of all parts of society to rapidly reduce emissions.

11. Can we make it to 1.5°C or 2°C? Are we too late?

The most recent IPCC report, AR6, argues that we will most likely pass 1.5C sometime in the early 2030's. Those ranges are similar to numbers calculated by Copernicus (interactive tool). These exceedance dates are nearly a decade earlier than the best estimate from 2018 IPCC special report. The world is likely to pass 2°C somewhere between 2040s and early 2050's but there are wide uncertainties reflecting the differences across models.

12. How has the global climate changed over the last century?

Since the beginning of the Industrial Revolution, the average temperature of the planet has risen by around 1°C. Sea level has risen by 16cm (about the height of a pint glass) over the same time period. These number are averages, meaning some areas of the planet have experienced warming at a greater rate, such as the Arctic, which has warmed at two to three times higher than the global average. Future projections estimate warming will be between 1.5 and 5°C by the end of the century and sea-level rise will be between 50 and 80 cm (height of a chair and a table respectively) so the changes projected for the next century are larger than the changes we have seen in the last century.

13. Doesn't the climate always change? How does current change compare to long-term global climate change?

A temperature increase of 1°C over the last century might seem like a slow temperature increase, but when we put this into the context of long term climate changes, it's very rapid. The climate has changed naturally over geological time periods due to natural changes in the earth's system such as the tilt of the earth on its axis and the level of volcanism. However, these changed have occurred much slower than today. For example, ice ages lasted about 11,000 years, and the most geologically rapid warming event which happened 56 million years ago, is thought to have occurred ten times slower than the warming we're experiencing today. Scientists can run models only using natural drivers of climate change and although we do see some changes in climate, we cannot reproduce the observed climate record over the past century without taking into account human emissions. In fact, the latest AR6 report found natural forcings alone would have led to a flat or slightly cooling temperatures.

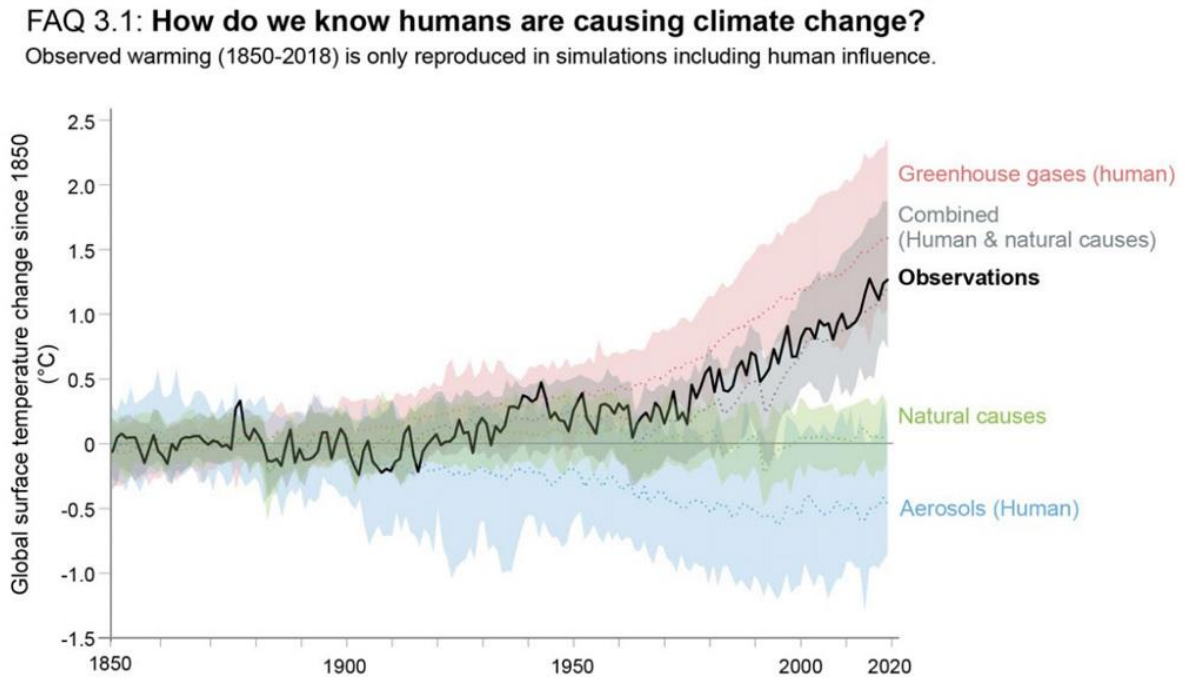

Figure 1: IPCC 2021 FAQ Figure 1

14. Do we need to worry about human habitability? How will this change in the future?

Humans regulate their body temperatures via evaporation. When we sweat, heat is carried from the body to the surface of the skin where it evaporated and dissipated the heat into the air. Evaporation can happen easily if the air is dry even if it's very warm, but this isn't the case when it's humid. When the air is really humid, evaporation can't happen anymore and you just get hotter and hotter. The humidity of air is measured using 'wet bulb temperature' which measures the temperature at which water stops evaporating off a wet thermometer bulb. If the air is really humid, evaporation will no longer cool the bulb and it just gets hotter. The human body can only survive to a wet bulb temperature limit of 35°C but serious impacts start to occur at 26°C. You probably haven't worried about this before because it hasn't been an issue but now many places humans currently live on the planet are on their way to becoming functionally uninhabitable by humans.

In a recent study, weather station data from 1979-2017 identified 250 past occurrences of wet-bulb temperatures above 33°C. The areas experiencing these wet bulb temperatures were primarily concentrated in coastal areas near high ocean surface tempeartures and intense continental heat, such as coast SW North America (e.g. California and SE Arizona), South Asia, and the coastal Middle East.

15. What's the best that could happen and what's the worst that could happen?

Best – rapid action toward net zero, stabilisation of climate between 1.5 and 2°C globally.

Worst – coinciding tipping points and large regional climate changes, globally over 5°C leading to high mortality and mass migration.

16. Why are we planning for 2100? It's so far away!

A baby born today who reaches the average life expectancy for the UK (81) will be 79 years old in 2100. The changes that we are modelling for are the conditions that that baby will experience in their lifetime.

17. If we stopped emitting carbon today, how fast would the world stop warming?

If we were to completely stop emitting CO_2 suddenly, then the global temperature would stop rising more-or-less straight away. But there are other aspects which would continue to change such as sea-level rise which will carry on for centuries even if global temperature stays the same. This is because glaciers don't melt straight away and keep on melting for a while.

Of course we can't just stop suddenly like this – we have what we called "committed emissions" – things like power stations we've already built which aren't ready to turn off yet, or not everyone has electric cars yet. So there is a long period of time to actually transition to zero emissions. A bit like steering the Titanic – we need action now to allow us to steer a safe course in the future.

A world of constant emissions is not the same as a world of net zero. If we stop emitting CO2, the concentration of CO_2 in the atmosphere will decrease as some will be taken up by the land and oceans, stabilising at a lower level. A world of constant emissions would keep CO2 where it is today. This would require us to emit ~ 30% of current emissions and would cause the world to continue to warm by 0.3°C by 2200.

More information can be found here.

18. How fast is sea level rising and why should we care about it?

Global sea level has increase by about 17 cm since the start of the 20th century. Global sea level is currently rising at 3 cm per decade. Although 3 cm a decade doesn't seem like a lot, the hazard can be amplified during storm surge events (especially when these coincide with high spring tides). There is much more water available which could cause more damage to coastal settlements. Sea level is predicted to rise by up to around a metre by 2100, but the amount depends on where you are and what future climate change we experience.

More than 600 million people (around 10 per cent of the world's population) live in coastal areas that are less than 10 meters above sea level. Nearly 2.4 billion people (about 40 per cent of the world's population) live within 100 km (60 miles) of the coast.

19. Will we have 'Day after Tomorrow' if the Gulf Stream turns off?

The evidence is that there has been a slight weakening of the overturning circulation in the Atlantic which the Gulf Stream is part of, however the Gulf Stream is also a wind driven current which will remain on our rotating planet in its current tectonic configuration even if the overall overturning circulation were to change. The weakening of the Atlantic meridional overturning circulation ('AMOC') is projected to continue under climate change, but it is a noisy circulation which frequently changes so long-term changes are difficult to detect in the limited observational period. However, scientists think it is very unlikely that AMOC will switch off in this century, however, if it did change behaviour substantially for a long period of time, the changes to our weather and climate, especially

in western Europe, could be quite large, so it's an active research area and is considered as a potential 'Tipping Point' for substantial global climate change. Overall, we expect there to be warming due to climate change in western Europe in the future, with a weakening AMOC/Gulf Stream perhaps causing us slightly less warming than we might otherwise expect.

Here are some Met Office and Carbon Brief links for more information.

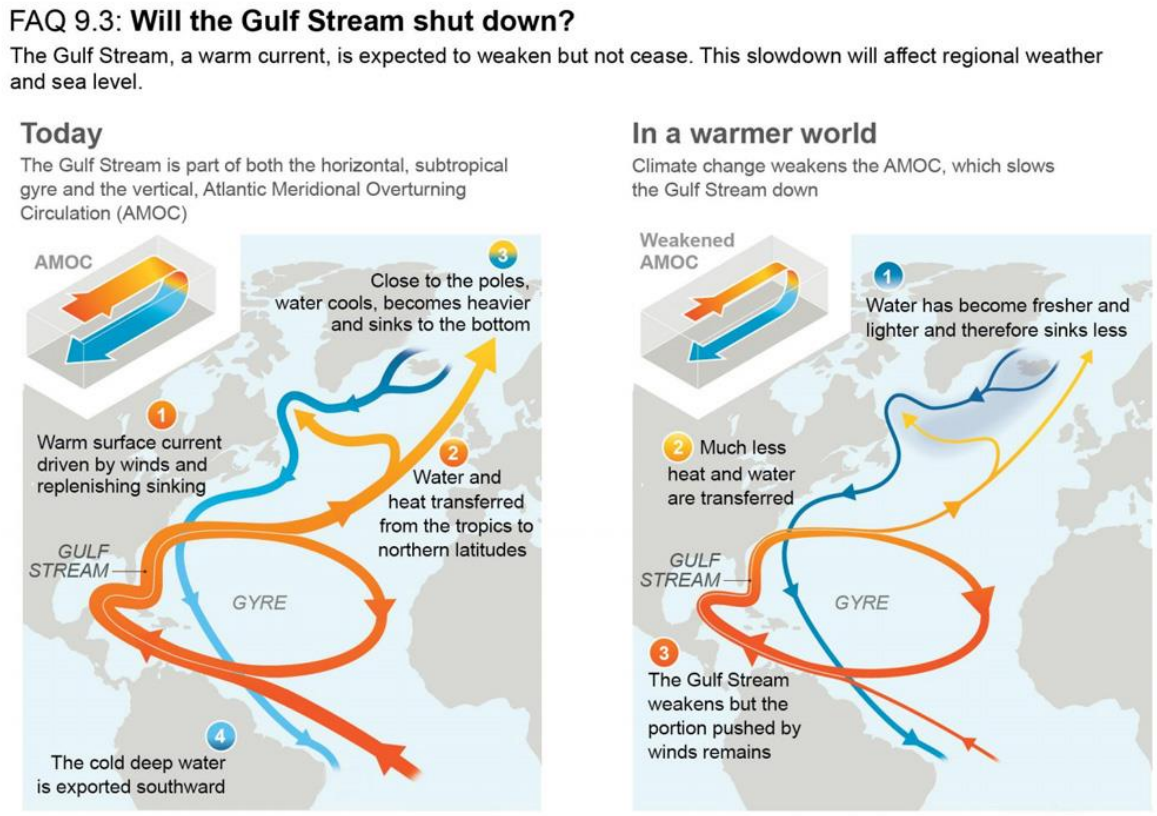

Figure 2: IPCC 2-21 FAQ 8.3 Figure 1

20. Are the oceans going to go acidic?

About 30% of human emitted carbon dioxide has dissolved into the ocean. This carbon dioxide reacts with the water to form carbonic acid. This increases the amount of hydrogen ions, which lowers the oceans pH. Although it's called ocean acidification, the pH will lower from 8.1 (current) to 7.8 (future) so it won't actually be acidic, just more acidic than now. Ocean acidification also lowers the concentration of carbonate ions in the seawater and these are the building blocks organisms use to build their calcium carbonate shells. When there is less carbonate, it takes more energy for organisms to build their shells which might affect their development.

21. Will we lose all the coral?

Coral reefs are found in warm, tropical waters. When the waters get too warm, the coral expel the symbiotic algae that live on them, and which give the coral their colour. This means the remaining coral looks white in colour or 'bleached'. The algae photosynthesise, making the food for the coral so without them, the coral cannot survive. Coral reefs are at threat from a range of factors including

increased temperatures, pollution, and overfishing. We need to tackle all these issues to ensure coral reefs will survive into the future.

22. What should the government do about climate change?

Globally need to recognise the urgency of climate change, and to minimise impacts, we need to act fast globally. In the UK, we do have some leading legislation which provides a framework for assessing how well prepared the UK is for climate change and prolonged heat periods, and the recent third Climate Change Risk Assessment showed there is a big gap between the climate risks that the UK is facing and the efforts needed to address those risks, and those risks are growing with time, and will cost more to address in future.

More detail: The latest Climate Change Risk Assessment (CCRA) is conducted independently from government, and involves over 400 people from over 130 organisations. The assessment identifies 61 risks and opportunities from climate change, the majority of which are risks, and most of which have high urgency scores for requiring more actions. They have also highlighted 8 risk areas on which progress not been made and require the most urgent action.

The risks from climate change have increased in the last 5 years, but adaptation measures have not kept up, meaning there is now further to go to prepare for future climate change.

We are fortunate and privileged that we do have the resources and opportunity to be able to act on climate change in the UK.

There are examples of great working going on at local government level (e.g., examples from local area – check before your engagement event).

A report by the CCC (Climate Change Committee), the UK's independent adviser on tackling climate change, says... (cite relevant resources, some other recent ones below)

- Net Zero
- Preparing for climate change – 2019 progress report
- Individual Action from CCC

People are willing to make change, governments need to create the conditions under which lifestyle changes are possible (Climate Outreach)

23. What about nuclear?

This is often a sensitive topic, but you could express your personal view (making it clear that it is your personal view). For example, you could acknowledge that if used nuclear needs to be implemented carefully to limit exposure to waste products, but that you think it might be needed to enable net zero.

24. What about carbon capture and storage?

General consensus is that some kind of carbon capture and storage will be required to meet net zero. The government supports new innovation into carbon capture and storage technologies.

25. What about geoengineering?

Geoengineering is the deliberate large-scale manipulation of climate. Geoengineering technologies are increasingly part of conversations about the appropriate global response to climate change and plans to meet the goals of the Paris Agreement, alongside reductions in greenhouse gas emissions.

Current research suggests that, while such schemes could be effective in reducing climate change, they could also have significant drawbacks. The type and scale of the drawbacks depend on the type of geoengineering.

Impartial research is needed to further understand geoengineering, alongside mitigation measures, to ensure any future discussion of options to tackle climate change is based on the best available evidence and information. The Met Office and academia have a role to play in undertaking this impartial research.

26. What can individuals do to try and tackle climate change?

- Globally households account for 2/3rd of global GHG emissions – lots of scope to make changes around our homes!
- Limiting warming to 1.5C will mean profound changes to people's lives on a range of issues such as diet, personal travel, and home heating (Climate Outreach).
- The high impact items for people are around their **transport, diet and their consumer choices:** from choices around public transport or electric vehicles, reducing meat and dairy consumption, and using renewable energy to power the home / moving away from gas cooking and gas boilers, towards electric options, and heat pumps or other low carbon heating systems. There are lots of low-cost ways to save energy too, and some can save you money, such as reducing food waste. (BEIS slides)
- Households in the **top 10% of income earners globally use 45%** of all energy for **land transport** and **75%** of all energy used for **flying**. These households will need to make a major contribution to reducing emissions (Climate Outreach).
- Changes need to take place in a broader context that enables them to take action. This includes the physical environment, cultural conventions, social norms, income levels and access to resources (Climate Outreach).
- Climate communicators are seen as more convincing, and their advice more likely to be acted on, if they themselves pursue low-carbon lifestyles (Climate Outreach).

Sector and examples	Median emissions reduction potential (per person per year, min – max)
Transport	
Avoiding one long-haul return flight	1.9 tCO2e (0.7 – 4.5)
Shift to active travel (e.g. walking, cycling)	0.8 tCO2e (0 – 2.8)
Replace petrol/diesel car with electric vehicle	2.0 tCO2e (-1.9 – 5.4)
Food	
Sufficiency (eating only what is needed, reducing waste)	0.3 tCO2e (0 – 1.3)
Shift to vegetarian diet	0.5 tCO2e (0 – 1.5)
More regional/local food	0.5 tCO2e (0 – 1.1)
Residential	
Use of domestic renewable electricity	1.5 tCO2e (0.3 – 2.5)
Refurbishment and renovation	0.9 tCO2e (0 – 1.9)
Home heating using heat pumps	0.9 tCO2e (0 – 1.8)

Figure 3 https://cast.ac.uk/wp-content/uploads/2021/01/CAST-Briefing06.pdf

27. Should we all go vegan?

- Going vegan can reduce emissions by up to 90%. You could:
- Reduce number of days you eat meat (try new foods, eat more plants – have a lower C footprint than meat). If everyone in the US did not eat meat or cheese for one day a week, it would be equivalent to taking 7.6 million cars off the road! (Climate Outreach)
- Shop local (support local farmers and reduce food miles)
- New technologies exist and may become widely available in future to grow low carbon meat in labs.

28. How can we convince our friends to act on climate change?

Social science research suggests that people are influenced by the positive changes they see around them, so simply making changes yourself and talking about the positive impact you are making can be really helpful. Making people feel guilty, or being 'doom-ist' can often be counter-productive.

29. What risks to the built environment will changes in climate bring?

Climate change is, and will continue to bring, more extreme hot weather in summer, so more frequent heatwaves and overheating, especially in urban environments. Climate change has made very hot summers like 2018 30 times more likely. This means that by the middle of the century, every other summer might be like 2018.

Droughts are likely to become more severe particularly in the east of the UK, but because when rain does come, we expect more intense rainfall events then we are also likely to see flash flooding

which, as we've seen in summer 2021, severely affected the built environment through transport impacts (e.g., flooding of railway stations) and disruption to other critical services such as healthcare. Flood related disruption from rainfall is compounded near the coast, due to sea level rise. Sea level rise also means that storm surges are more likely to cause damage to the built environment near the sea or on estuaries. Adaptation methods to protect built infrastructure such as the Thames Barrier will become ever more important, and the Met Office plays an important role in providing up to date climate information about sea level rise to the Thames Estuary 2100 project.

30. Can our cities cope with a changing climate?

Urban areas are predicted to become home to 2/3rd of global population by 2025. Cities are influenced by their surroundings, e.g., cities in the mountains will be impacted by the mountains, but they can also influence their surroundings, e.g., urban heat islands – which makes temperatures increase more in the day, and fall less at night. Cities can enhance weather hazards and increase the exposure to hazards because of the high density of people. Increased heat in cities linked to global warming may cause more heat-related deaths in cities, and will cause increases in energy demand linked to the need to cool the environments. Increased heat can also increase the faults on transportation links such as trains, and this in turn may cause more pollution. Adaptation and planning, involving wide ranges of stakeholders, can help ensure cities are resilient to future change e.g., cooler regions in the city can be generated by green areas within the cities (which has co-benefits).

High resolution convective permitting simulations will improve our understanding and prediction of extreme events, particularly in urban areas. These simulations have a much finer grid than typical climate model simulations (they are more like the resolution used for daily weather forecasts) and are thus very expensive to run for long periods of time (so for decades into the future instead of the days-weeks we run forecast models for). These models predict that we are going to see intense rainfall which can cause flash flooding, like we have seen recently in Germany.

31. What were the main takeaways from CCRA3 for the urban environment (CCC)?

The third UK Climate Change Risk Assessment (CCRA3, 2021) said progress with adaptation policy and implementation is not keeping up with the rate of increase in climate risk, with sufficient adaptation underway for only 4 out of 61 risks and opportunities, and no plans in place at all for a further 7. The CCRA3 said that two of the risks which require more planning most urgently are the risks to health, wellbeing and productivity from increased exposure to heat in homes and other buildings, and the risk of climate-related failure to the power system.

32. Did COVID stop the build up of CO2 in the atmosphere?

Imagine the amount of CO_2 in the atmosphere is like water in a bathtub. The pandemic just slowed down the flow of water into the bath a little, rather than reducing the amount of water that was already in the bathtub. The COVID pandemic has highlighted how much work we need to do to both reduce the CO2 that we are adding to the atmosphere and trying to find methods to reduce the amount of CO2 that is already in the atmosphere.

33. What have we learnt from Covid?

Covid-19 has given us an insight into role that government and society can play in driving extensive, rapid changes in lifestyles and social norms. The response to the pandemic has demonstrated the deep interconnection between 'system change' and 'behaviour change'.

Humans have a tremendous capacity to innovate.

We have made lots of potentially positive changes going forward in many workplaces – ability to work from home more, not need to travel extensively, better remote working. This may make meetings more inclusive for people who traditionally don't have the capacity to travel.

If people want to limit travel to save emissions, there is added incentive to invest in local areas. For example, especially in cities and urban areas, park areas can help with biodiversity and provide trees for shade and waterways for cooling.

34. Why do you have such a power hungry supercomputer at the Met Office?

To run our state of the art models requires a lot of computer power (our current computer in Exeter can perform 16,000 trillion calculations per second! And it has 2PB of memory, equivalent to ~1 million iPhones), but our weather and climate forecasts are really important in helping us help you to stay safe and thrive. We are taking lots of steps as an organisation to reduce our carbon footprint, including a roadmap to net zero, which will require changes to our buildings, travel and even more changes to how we work.

35. How will the new Met Office supercomputer help us prepare for climate change?

The Met Office has joined forces with Microsoft to build the world's most powerful weather and climate forecasting supercomputer. It will be in the top 25 supercomputers in the world and will be twice as powerful as any others in the UK! The new supercomputer will be used to increase the precision and accuracy of modelling. This will be done by running an increased number of model scenarios, and including environmental and social data so that the forecasts of risk will be improved. This information will help to inform policy in the UK and internationally as the world works towards net zero targets by 2050. The supercomputer will also drive innovation as climate and computer scientists work together to solve problems, ensuring that the UK stays at the forefront of supercomputing and data technologies.

36. How can Improving our climate change modelling improve future climate risk assessment?

Climate change modelling provides a very important part of future climate risk assessment, but future projections cover a range of scenarios because models have biases (or aren't perfect) which we aim to constantly reduce as we better understand how the earth system works, but also because future projections depend on future human behaviour. Therefore, the constant cycle of revising future scenarios to provide a suitable range of possibilities, as happens in the Coupled Model Intercomparison Project which underpins the International Panel of Climate Change (IPCC reports), is very important to keep future climate change risk assessments up to date.

37. Is the UK doing enough for climate adaptation?

The risks from climate change have increased in the last 5 years, but adaptation measures have not kept up, meaning there is now further to go to prepare for future climate change. The earlier actions are taken, the less the overall cost of action will be.

38. How can climate mitigation and adaptation work together?

Climate mitigation and adaptation are intrinsically linked and overlap in many cases, with some examples of action covering both mitigation (reducing emissions) and adaptation (adjusting to cope with climate impacts) (e.g., food system changes, increasing education, or integration of urban forests). In the latter example, an urban forest, or extension of tree covered parkland in an urban area, could help by removing some carbon dioxide from the atmosphere, but also providing by soil covered areas within the urban environment which could help with drainage, help absorb heat and provide areas of shade for comfort and leisure in hot weather.

39. What is the National Adaptation Programme?

The national adaptation programme is a requirement under the under the 2008 Climate Change Act, which sets out what government, businesses and society are doing to be more climate ready. Prepared every five years, the 'NAP' is the blueprint which guides government action to address the increasing risks from climate change, and the last one was created in 2018 for 2018-2023, and aims to communicate the climate risks facing the UK and to present a programme of action to address the risks.

40. Aren't we on track for net zero now?

Governments have set net zero goals, and we have signed Paris Agreement to try to stabilise at 1.5°C degrees, however current policies could end up on 3 /4°C or more.

4°C global warming could still happen on our current trajectories, and we could experience even higher warming, particularly if tipping points in the climate system are reached.

41. Do you still have hope for the future?

Here in the UK we have policy toward net Zero and the CCRA provide a roadmap for the actions which need to be taken under the Climate Change Act to tackle climate change.

Recent responses to COVID-19 demonstrates that societies can react to risk quickly and take unprecedented steps to reduce risk, and historically in times of immense threat innovation can be driven forward remarkably (e.g., over WW2) and thus we may see mitigation and adaptation action increase fast when leaders demand it.

Don't think of change as negative, think about win-win situations. For example, if we encourage more active travel, people will be fitter and healthier, air quality will improve and communities will become be more connected, reducing inequalities and access to facilities. If people eat local produce, there will be more connection to the farmers and local community, as well as reducing food miles. Envisioning the future can be exciting and inspiring – let's make positive change for all.

42. Is population growth the cause of climate change?

Climate change isn't caused by population growth. It's caused by greenhouse gas emissions from burning fossil fuels, which has various climate impacts such as more common and severe heatwaves and drought.

[link back to questions on how to reduce C emissions]