**If you have some means of interacting with the outside world, like a TV, computer, or smart phone, then there’s a reasonable chance you’ll have heard about a major new publication called the Sixth Assessment Report, or AR6, published this week by the Intergovernmental Panel on Climate Change, or IPCC.**

**They’ve been releasing these climate assessment reports every seven or eight years or so since nineteen ninety.**

**The last main report, unsurprisingly titled AR5, came out in twenty-thirteen, and it was used extensively to shape the policies set out in the Paris Agreement, which was signed by more than a hundred and ninety countries in twenty fifteen.**

**The lack of subsequent climate mitigation action by the governments of those countries was so lamentable that it prompted the IPCC to really laid it on the line in a special twenty-eighteen interim report called SR15, spelling out in graphic detail the existential consequences that we and all the other species on the planet would face if we humans didn’t collectively get off our backsides and do something pretty urgently and radically to drastically reduce the amount of carbon dioxide and other greenhouse gases that our daily activities were spewing into the atmosphere.**

**That caught the attention of our wise and most excellent world leaders who all agreed it was a jolly poor show and that they would definitely have a very good look at thinking about discussing the possibility of considering some concrete actions.**

**The sum total of that response was a rise in carbon dioxide emissions of more than 2% in twenty-eighteen, followed by another 0.6% rise in twenty-nineteen. It took an unprecedented global lockdown in twenty-twenty to actually achieve a reduction in emissions of about 7%, all of which we’ve already made up for as we move towards the third quarter of twenty-twenty one. If it was a school report card, it would have a very big F minus written in red pen at the bottom of the page.**

**And now millions of people all over the planet, from California to Europe and Siberia and from Australia to China and South-East Asia are already suffering some of the consequences that the IPCC has been warning us about for decades.**

**So, where do we go from here? Have we had our final swig of whiskey at the last chance saloon or is there a chance we can somehow find a way out of this self-inflicted catastrophe?**

**Well, that’s precisely what this new IPCC Sixth Assessment report attempts to spell out for us all.**

**Again.**

**Hello and welcome to Just Have a Think.**

**I think I’ve thrown enough preamble at you, so let’s just dive straight into the report and have a look at what it’s telling us.**

**We’ll start with these two charts. The first one shows global surface temperatures, relative to the eighteen fifty to nineteen hundred levels, from 1AD to the present day, with the shaded area showing the range of variability in the reconstructions from paleoclimatic archives. You can see that the overall temperature remained remarkably stable all the way up to the start of the industrial revolution. Then it all went a bit haywire and now we’ve hit surface temperatures that are warmer than the warmest multi-century period in more than a hundred thousand years.**

**The chart on the right starts with a plot of simulated temperatures that would have occurred from eighteen fifty to the present day if we only took natural occurrences like solar and volcanic activity into account. Again, there’s a shaded area showing the range of modelling variability. The next line shows the computer model predictions of what the temperature should have been once you added in all human activity with the naturally occurring stuff.**

**And the final line represents the actual observed temperature change.**

**So, you know..it’s us!**

**And it’s clearly carbon dioxide that’s causing the majority of the heating, or what the scientists call radiative forcing, followed fairly closely by methane. These blue bars by the way, that dip into the negative or cooling zone represent aerosol particulates like sulphur dioxide that get up into the atmosphere and reduce the amount of sunlight reaching the earth’s surface. They mostly come from transport and industrial activity and ironically, at the moment they’re actually cancelling out some of the warming.**

**The IPCC found that the twenty nineteen CO2 concentration levels were higher than at any time in the last two million years, with methane and nitrous oxide levels higher than at any time in the last eight hundred thousand years.**

**Those changes have already resulted in some very unwelcome record numbers.**

**Twenty-eleven to twenty-twenty late summer Arctic Sea Ice area was smaller than at any time in the last thousand years. Since nineteen-fifty, almost all of the world’s glaciers have been retreating at rates unprecedented in at least the last two thousand years.**

**Global sea levels have risen faster since nineteen hundred than they have in any other century in at least the last three thousand years. The global oceans have warmed faster in the last century than at any time in the last eleven thousand years.**

**Extreme heatwaves have become more frequent and more intense across most land regions since the middle of last century while cold extremes have become less frequent and less severe. Some of the hot extremes of the past ten years would, according to the IPCC, have been extremely unlikely to have happened without human influence on the climate systems. And that human influence is also very likely to have been the cause of marine heatwaves doubling since the nineteen eighties, an increase in the frequency and intensity of precipitation events since the fifties as well as an uptick in the number of agricultural and ecological droughts in many parts of the world.**

**It’s also likely that our activities have increased the chances of extreme wildfires and floods like the ones we’ve been witnessing in the last few years.**

**Climate change is already affecting every inhabited region across the globe with hot extremes on the increase just about everywhere, heavy precipitation becoming more frequent across most of the northern hemisphere and agricultural and ecological droughts worsening in the mid latitudes and parts of the southern hemisphere.**

**So that’s a very quick summary of the state of our planet right now, and it’s not looking great, is it?**

**But, perhaps more importantly, what does the IPCC report tell us about our possible future world.**

**Well, based on the literally thousands of existing research papers that the report authors poured over to compile this latest assessment, they’ve been able to produce five future scenarios that they call shared socioeconomic pathways or SSPs, ranging from the whole world locking down like we did in twenty-twenty, but for about the next three decades, all the way through to everyone carrying on business as usual, resulting in global atmospheric temperatures reaching somewhere between three point three and five point seven degrees Celsius above pre-industrial levels by the end of the century.**

**The research data show that we’re now so far down the road of excessive greenhouse gas emissions that in every single one of these scenarios, even the ridiculously unlikely one where almost all modern day activities suddenly cease, global surface temperatures will continue to rise until at least the middle of this century, and global warming of one point five and two degrees Celsius will be exceeded during this century unless deep reductions in CO2 and other greenhouse gases occur in the coming decades.**

**Our scientists can now say it’s virtually certain that the land surface will continue to warm between one point four and one point seven times faster than the oceans and that the Arctic will continue to warm more than twice as fast as the global average.**

**Every one-degree Celsius of warming will intensify extreme daily precipitation events by seven percent. The proportion of category 4 and 5 cyclones is projected to increase, with higher peak wind speeds, and we’ll see a further amplification in permafrost thawing, releasing mind boggling amounts of previously locked up methane into the atmosphere. And even under the lowest SSP projection, the Arctic will become ice-free in September at least once before twenty fifty, with the likelihood that it’ll be far more frequent in the higher SSP scenarios.**

**Extreme temperature events that might have happened once a decade between eighteen fifty and nineteen are already now likely to happen every three years or so, and they’ll become annual occurrences in the highest SSP projection. A really mega extreme heatwave event with mass casualties and fatalities that might have been expected to happen perhaps only once or twice in the whole of the nineteenth century is already, now, likely to hit us once a decade, and could be happening every other year by the end of this century in the worst-case scenario. Similar thing with precipitation, with a once a decade event happening every two or three years, and with agricultural and ecological droughts, with catastrophic decadal events of the nineteenth century projected to clobber us every other year if emissions continue to rise unchecked.**

**And if that lot wasn’t enough for you, how about this one…**

**Under SSP scenarios with increasing CO2 emissions, the ocean and land carbon sinks are projected to become less effective at slowing the accumulation of CO2 in the atmosphere. That means more atmospheric CO2, which means more warming, creating one of many feedback loops. The magnitude of feedbacks between climate change and the carbon cycle becomes larger and more uncertain in high CO2 emissions scenarios too, and that doesn’t include what the IPCC describe as ‘Additional ecosystem responses to warming not yet fully included in the climate models, such as CO2 and methane fluxes from wetlands, permafrost thaw and wildfires’, all of which will further increase concentrations of those gases in the atmosphere at levels that we can’t yet predict.**

**How you doing so far?**

**We’re not finished looking at our children’s bleakly dystopian future just yet though. Because the report also finds that many changes due to past and future greenhouse gas emissions will be irreversible for centuries or even millennia. Mountain and polar glaciers are now committed to melting for decades or centuries to come. Permafrost thaw is irreversible for many centuries, the Greenland Ice sheet is virtually certain to continue melting throughout the 21st Century and even the previously presumed rock-solid Antarctic ice sheet is likely to continue losing mass.**

**It’s virtually certain that we’ll see as much as half a metre of sea level rise even in the best case SSP scenario, and possibly up to 2 metres by twenty-one hundred in the worst case. According to this 2019 study,**

**2 metres of sea level rise would leave six hundred and thirty million people living on land below projected annual flood levels, not to mention the catastrophic storm surges that would regularly wreck infrastructure and endanger lives in many coastal cities, including some of the biggest and richest like London, Miami, New York, and Shanghai.**

**And because of our lack of knowledge about the stability of the ice sheets and deep uncertainty about how quickly they may give way, the IPCC cannot rule out 5 metres of sea level rise by 2150 under a very high greenhouse gas emission scenario.**

**They also can’t completely rule out what they call low-likelihood outcomes like complete ice sheet collapse, abrupt ocean circulation changes compound extreme events and warming that’s substantially larger than the assessed very likely range – all these things, say the IPCC must be taken into account as part of policymakers Risk Assessments.**

**One of the most significant ocean circulations is The Atlantic Meridional Overturning Circulation, or AMOC, made famous in the film The Day After tomorrow. The IPCC found that the AMOC is very likely to weaken over the 21st century. It won’t have the effect that the folks in Hollywood dreamt up for the film, but it could cause significant disruptions to global weather patterns.**

**All sounds a bit apocalyptic, doesn’t it? So, what does the IPCC conclude we need to do to avoid the worst of these existential calamities?**

**Well, it won’t surprise you to learn that they tell us we need to reach a minimum of net zero CO2 emissions as fast as possible. Between eighteen fifty and twenty nineteen we humans put about two thousand four hundred billion tonnes of carbon dioxide into our atmosphere and we’re still spewing out around forty billion tonnes a year today. There’s a near linear relationship between cumulative emissions and global warming, as this chart illustrates (page 38). Every extra tonne of CO2 counts and every thousand billion tons is assessed as likely causing around half a degree of extra warming. So, as this table shows, if we’re to have an eighty three percent chance of limiting global warming to one point five degrees Celsius above eighteen fifty to nineteen hundred levels, then we’ve only got three hundred billion tons of CO2 left to play with – that’s less than eight years’ worth at today’s emission rates.**

**As in previous reports, the IPCC look to carbon removal and storage technologies as their only real solution for keeping CO2 levels below critical limits. That’s things like direct air carbon capture or DACCS, and carbon capture, utilisation and storage, or CCUS. Those technologies don’t yet exist at anything like the required scale though. Not even close – several orders of magnitude out, as the science bods would say, so as our world leaders congregate at the COP 26 climate conference in Glasgow in November this year, we need them to be making firm, binding commitments to drastically reducing fossil fuels in the transport, industry and energy sectors and pushing as hard and as quickly as possible towards the roll out of the now very cheap renewable technologies of wind and solar.**

**So, have we had our final swig of whiskey at the last chance saloon?**

**On the basis of this report, the answer is probably. COP 26 could well be our last real opportunity to reach international consensus and co-operation on a global strategy the like of which the world hasn’t seen since the end of the second world war.**

**Let’s hope they don’t mess it up, eh?**

**That’s it for this week.**

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**As always, thanks very much for watching, have a great week if you can, and remember to Just Have a Think.
See you next week.**