**“Every known climate projection, and which ones might really work.”**

**Some of the most common questions I get asked on this channel are centred around how our climate is changing, and how quickly, and what the most likely outcomes are going to be for the coming decades.**

**Now I’m not a climate scientist as you know, so I don’t have any expertise to be able to make those kinds of forecast, but there are thousands of incredibly knowledgeable and intrepid researchers around the world, seeking out more and more information in an attempt to answer those questions ever more accurately, with the help of advanced super computers running incredibly complicated climate simulations. And with processing speeds accelerating all the time and more and more data being brought forward from field research all around the world, those models are becoming ever more sophisticated.**

**But of course, nothing and no-one can predict the future with a hundred percent confidence, can they? So, the best our scientists can do is to tweak the variables in the models based on all sorts of things, from obvious stuff like projected future human greenhouse gas emissions to more elusive data like sea water salinity in the Barents Sea for example, or the level of permafrost melt in the middle of nowhere out in Siberia…**

**…you get the idea.**

**That leaves us with what can only be described as a cacophony of different pathways that look like badly cooked spaghetti on charts that grace the pages of periodic assessment reports published by the Intergovernmental Panel on Climate Change or IPCC.**

**In December 2022, scientists at the Potsdam Institute for Climate Research in Germany teamed up with the Washington Post to produce a fascinating analysis of more than twelve hundred different scenarios in an attempt to establish whether any of them might actually keep global warming below one point five degrees Celsius by the end of the century. And the conclusions were…unsettling.**

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

**Before I get into the meat and potatoes of this analysis, I must just give a huge shout out to the journalists, Chris Mooney, Naema Ahmed and John Muyskens, who worked alongside the folks at Potsdam to produce the information and graphics for the Washington Post article. I’ve left a link to the report in the description section below here and I’d encourage you to go and have a look at it if you get a chance, not only because it’s a brilliantly written and produced piece of work in its own right, but also because it contains numerous links out to other sites and scientific research papers that help explain some of their findings in more detail. And, well, because supporting good quality journalism is just a generally good thing to do in this day and age, isn’t it?**

**So, anyway, back in twenty-twenty-one, the Potsdam Institute published this paper, analysing four hundred and fourteen emissions scenarios set out by the IPCC in their twenty eighteen special report, SR15. The Potsdam team applied 5 key criteria to make their assessment:**

**Firstly, the rate of acceleration in future Carbon Dioxide Removal technologies like direct air capture, or DAC, and Bioenergy with Carbon Capture or BECCS.**

**Secondly, the rate of acceleration in future Carbon Dioxide Removal via changes in agriculture, forestry and other land use – a category that carries the catchy acronym of AFOLU in the IPCC reports.**

**Then they looked at the potential future carbon intensity of energy production, and potential changes in the global level of DEMAND for energy itself.**

**And last but not least they looked at non-CO2 emissions, predominantly focussing on methane.**

**Then, in twenty-twenty-two, the IPCC published their most up to date and comprehensive analysis of future scenarios in a typically enormous document called the Sixth Assessment, Working Group Three. That report contained no fewer than twelve hundred and two potential future pathways.**

**Now, you can clearly see that the vast majority of these spaghetti lines lead to temperature increases far higher than one point five degrees Celsius by twenty-one hundred. Many of them push up to somewhere between two and three degrees of warming, and the worst-case scenarios, where we effectively do nothing at all and continue on an ever upward emissions and consumption trajectory, take the planet’s warming up above five degrees Celsius by the end of the century. The overwhelming scientific and political consensus is that if we allowed ourselves to stray into THAT territory then it would no longer be possible to maintain global civilisation as we know it today. It’s not impossible that we might turn out to be that suicidally stupid, but for the purposes of this exercise, any pathway that doesn’t stay on or below one-point five degrees Celsius by twenty-one hundred was immediately filtered out by the** **Potsdam and Washington Post teams. That left just two hundred and thirty of the original twelve hundred and two scenarios remaining.**

**The next challenge is that some of those remaining scenarios, which were finalised in twenty-twenty-one, are already look vanishingly unlikely to happen, based on the latest data available as we enter twenty-twenty-three. Global emissions fell by about five percent during the pandemic, and there was some hope that they might continue to do so, which was a lovely idea. But as this graph, based on numbers from ‘global carbon budget data dot org’ shows, global emissions are now right back on the same trajectory that they were following prior to the lockdowns, and actually China is not yet fully out of their draconian COVID restrictions, which means we can expect to see their emissions jump up significantly this year. So, any scenarios predicting a dramatic fall in emissions by twenty- twenty-five now look hopelessly unrealistic and are therefore eliminated as well. The Potsdam team also argued that other overly optimistic developments like massive deployments of nuclear power by twenty-thirty, should also be removed. That gets us down to a hundred and twelve pathways that then fall into two distinct categories. Those that predict what’s known as a ‘high overshoot’ before temperatures drop back down again, and those that predict a ‘low overshoot’ or even no overshoot at all.**

**The trouble with the high overshoot pathways is that the world will have to spend several decades with average surface temperatures significantly higher than one-point-five degrees Celsius above pre-industrial levels, and that risks setting off some of the major climate tipping points that we’ve looked at in previous videos on this channel. If you want to know more about what those tipping points are and you’re watching on a PC or mobile device, then you can click up there somewhere to jump over to one of those videos. Suffice to say, none of them is good, and they include things like an irreversible loss of polar ice sheets that could eventually lead to several metres of sea level rise. The point being that straying way above the crucial temperature limit and sort of hoping that we might get away with it by employing some kind of as yet unproven ‘silver bullet’ technologies a bit further down the line, is arguably delusional and perhaps even disingenuous. So, unfortunately, those lines have to come out as well.**

**That leaves just twenty-six pathways that show either a low overshoot or no overshoot at all. And now we can start applying the five Potsdam Institute criteria that I mentioned earlier. When the expert researchers restricted the pathways only to those that fitted what are regarded as reasonable expectations about our ability to capture and permanently store carbon dioxide at scale, as well as reasonable expectations for the other four assessment criteria, they came to the conclusion that the world has most likely run out of any easy options to completely avoid slipping over the one point five degrees target at SOME point between now and mid-century.**

**So, that means we need to consider how we can at least stay on very low overshoot pathways, which moves us away from measures that the Potsdam team regard as reasonable and into territory that they describe as challenging.**

**Those scenarios assume that the world will roll out carbon dioxide removal technologies like DACCS and BECCS at vast scale, while at the same time achieving dramatic transformations in land use to draw even more carbon back down into the soil. And when I say vast scale, I’m talking about the removal of something like seven billion tons of carbon dioxide from the atmosphere every year by the time we reach mid-century. Right now, we’ve got the capacity to remove just over forty million tonnes each year, so we’d need to scale that up by about a hundred and sixty times, which would indeed be ‘challenging’!**

**We’d also need a fundamental transformation in energy use via a widespread global move to renewables and huge improvements in energy efficiency, resulting in an eighty percent reduction in the carbon intensity of global energy consumption by twenty-fifty. The only way we get THERE is through the near complete eradication of fossil fuel combustion in the next three decades, or preferably much sooner of course. That means a global electrification of transport and energy systems moving far more rapidly than we are right now.**

**The other option is to reluctantly accept that temperatures will significantly overshoot one-point five degrees this century, most likely getting up to somewhere around one point eight degrees during the twenty forties, fifties and sixties. One point eight degrees is the number that our political leaders managed to conjure up at COP26 in twenty-twenty-one by offering new policy proposals that would stiffen up their efforts via what are known as Nationally Determined Contributions or NDCs.**

**That level of temperature increase would still make tipping points and unexpected consequences much more likely, but the Potsdam team identified sixteen pathways that allowed for this kind of overshoot but which they considered reasonable based on their five criteria. We would still need a major ramp up in carbon dioxide removal and storage by all available methods as we hurtle towards mid-century, AND we would have left ourselves with a herculean task in the second half of the century to remove really very large amounts of carbon dioxide in an effort to pull temperatures back down below one-point five degrees by twenty-one hundred, according to the Potsdam team.**

**And of course, we’d still need a massive step forward in renewables and energy efficiency improvements to help reduce the carbon intensity of our daily lives by as much as seventy four percent by mid-century.**

**The trouble is, there’s really no sign of a genuinely globally co-ordinated effort to really achieve those goals. In fact, if anything, we’ve got conflicts, fuel crises and political polarisations all over the world that are taking us precisely in the opposite direction.**

**As the Washington Post team points out, not everybody will agree with the cut-offs imposed on these models by the Potsdam Institute researchers. Some experts, like RethinkX for example, who I featured on the channel a few months ago, are much more optimistic about technology and humanity’s ability to innovate. But other less optimistic commentators argue that it’s easy to imagine countries failing to achieve what’s necessary even to stay below two degrees Celsius.**

**What we know for sure though, is that If we’d started doing all of this back in the mid-eighties when people like James Hansen, Carl Sagan and Al Gore were setting out the size of problem in no uncertain terms to members of the United States congress, then we could have implemented extremely modest carbon reductions of only about one or two percent a year, and that would have been enough to have completely avoided the serious predicament we now find ourselves in. If you’re wondering why we didn’t do that, then I can highly recommend reading this book by Nathaniel Rich, which gives a blow by blow account of how our global leaders failed to act during that critical decade.**

**The Potsdam and Washington Post analysis can only be as good as the information it’s based on at the end of the day though. These things are only models of possible future scenarios of course, and there’s plenty of debate about the accuracy and validity of predicting the future in this way. But the science of climate change is clear and unequivocal and we’re already seeing some of the consequences of our warming atmosphere in extreme weather events all over the world. So, regardless of the accuracy of our predictions, there’s no doubt that our future way of life is in our hands, and the choices we make right now will have profound consequences for all of us in the coming decades.**

**I’m sure you’ve got your own views on all of this stuff, so as always if you’re chomping at the bit to express your opinion then why not jump down to the comments section below and leave your thoughts there. And as I said at the start of the video, do follow the link in the description to the original Washington Post article if you get a chance.**

**That’s it for this week though. A massive thank you, as always, to our amazing Patreon supporters who help me keep these videos completely independent and free of ads and sponsorship messages.**

**You can get involved in directly influencing the topics we cover on the channel via monthly content polls, and get exclusive extra content from me by visiting**

**patreon dot com forward slash just have a think**

**And if you’ve found this video useful and informative, then make sure you subscribe and hit the notification bell to stay up to date with future programs. And, if you want to learn more about the climate challenges facing us in the twenty-first century, then you might find this video useful too.**

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

**See you next week**