

## GETTING TO NET ZERO

**Nancy:** If you're listening to this, you probably already know the bad news: the planet is warming up really fast because we humans are burning fossil fuels.

They're called fossil fuels for a reason: Pretty much all the oil and gas we use today comes from microscopic algae and plankton that died and settled on the seafloor during the Jurassic period.

Add heat, pressure and 100 million years or so and voila! Petroleum!

But when we burn it, we're releasing all the CO<sub>2</sub> these microscopic organisms stored in their bodies 100 million years ago. It's like mining the products of photosynthesis from millenia past.

Now, all the CO<sub>2</sub> and other greenhouse gasses we produce from burning fossil fuels are wrapping the Earth in an ever thickening blanket. You know this. The more CO<sub>2</sub> we release, the more heat from the sun is kept from escaping to the atmosphere. It's a pretty simple equation.

Still, you have to admit, the petroleum age been a great ride. Modern economies are pretty much all built on the many useful products humankind has engineered using natural gas, oil and their cousin, coal.

But now things have to change. Fortunately, it's not hopeless — but it is urgent.

**AHS:** If we want to maintain warming lower than 1.5 degrees, or constrain it to two degrees, we really need to start curbing emissions now.

**Nancy:** I'm Nancy Bazilchuk, and you're listening to 63 Degrees North, an original podcast from NTNU, the Norwegian University of Science and Technology.

Today, I'm going to look at climate change and what the Intergovernmental Panel on Climate Change, the IPCC, says we can do about it.

Anders Hammer Strømman, a professor in NTNU's Industrial Ecology Programme who was one of the lead authors in an IPCC report released in April and who you heard in the introduction, will be our guide.

We'll talk about why cutting carbon emissions quickly is a little like skiing up a big mountain, how battery companies need to come clean when it comes to how they make their products, why some version of a home office could be good for the planet, and why your individual choices can actually make a difference.

But first, a little background.

That 1.5 or 2 degrees C warming that Anders mentioned? Ideally, we wouldn't be warming the planet at all. But that ship has already sailed. So 1.5 degrees C is what scientists say should be our target, if we want to avoid major problems and upheavals from climate change. It's also what the nations of the world agreed to in 2015, at a meeting in Paris where they also agreed to take action to cut emissions. Two degrees will mean more flooding, more droughts — but it's better than where we're headed now, unless we do something.

The IPCC report from April that Anders was involved in was the third of three reports from a broad international group of scientists who have assessed and summarized the best research on climate change.

The first report, from Working Group I, looked at the physical basis of climate change. It was released in August 2021. Bottom line, the report said that humanity was “unequivocally” to blame for major and “unprecedented” changes to the climate that were already being observed and felt. Some of these changes – like the melting of polar ice – were rapidly becoming “irreversible”.

The next report, from Working Group II, looked at what climate change will actually do to the planet's ecosystems and humanity. It was released in February this year. Its news was somewhat eclipsed by the war in Ukraine, but it basically said: You can run, but you can't hide.

Everywhere on the planet is going to be affected by climate change. There will be heatwaves, droughts and floods, landslides and species extinctions, and there will be more of them. Sea level is going to rise. That led António Guterres, the UN secretary general, to say

**AG (clip from YouTube):** “I have seen many scientific reports in my time, but nothing like this. **Today's IPCC report** is an atlas of human suffering and a damning indictment of failed climate leadership.”

**Nancy:** Yup, pretty grim. But those two reports set the stage for the report we'll look at today, from Working Group 3.

It was published on April 4 this year, and described a huge range of options that countries can enact to cut greenhouse gas emissions. That's the good part.

Although it gave policymakers lots of tools, it also found that nations weren't moving fast enough, and that unless we act really fast, global average temperatures could

rise by as much as 3C. That would truly be catastrophic— some estimates say this much warming would cause sea level to rise by 2 meters by the end of this century.

Here's Antonio Guterrez again:

**AG:** The jury has reached a verdict. And it is damning. This report of the Intergovernmental Panel on Climate Change is a litany of broken climate promises. It is a file of shame, cataloguing the empty pledges that put us firmly on track towards an unliveable world.

We are on a fast track to climate disaster. Major cities under water. Unprecedented heatwaves. Terrifying storms. Widespread water shortages. The extinction of a million species of plants and animals. This is not fiction or exaggeration. It is what science tells us will result from our current energy policies.

We are on a pathway to global warming of more than double the 1.5°C limit agreed in Paris. Some government and business leaders are saying one thing, but doing another. Simply put, they are lying. And the results will be catastrophic. This is a climate emergency.

**Nancy:** So on that cheery note, let's get down to business. First of all, why is it so urgent that we act now? What's at stake? Well, it comes down to something called net zero. Net zero is kind of what it sounds like. It means cutting greenhouse gas emissions to as close to zero as possible. Anders explains.

**AHS:** It's only until we reach Net Zero co2 emissions that the temperature will stabilise.

Because if we think of air pollution, for example, we are used to thinking of emissions as something that during the pandemic transport stopped in the big metropolitan areas. And you could see basically the air clearing and emissions went away, right? But that's not how it is with CO2. CO2 is a very long lived greenhouse gas. And in principle, when we take fossil carbon and combust it and put it into the atmosphere, we make a permanent change to the atmospheric concentration. And it will last for 1000s of years.

So the point is that how much we emit until we get to net zero determines the warming level. And it's only when we get to net zero that we actually stop warming. It's not when we get to net zero, the warming will return to the pre-industrial level. No, no, it will remain at that level where we stop emitting.

**Nancy:** So barring the use of technologies that can suck CO2 out of the atmosphere, once we put CO2 into the atmosphere, we're committed. We can't put this genie back in the bottle. So that's one good reason to get moving, now.

But Anders says there's another issue when it comes to emissions and timing. We know we have to cut emissions. And right now, if nations cut what they've pledged to cut under the Paris Agreement from 2015, global emissions will rise by 14 PER CENT. But the sooner we start cutting, the easier it will be to make the cuts. Like the good Norwegian he is, Anders uses skiing as an analogy to explain why.

**AHS:** The clear insight is, the more we emit and keep going upwards, the steeper it will be going downwards.

So if you take your skiing analogy .... if we had done our job and started curbing emissions in the 1990s when we already knew that global warming was an issue, you'd be going up a steep mountain slope and you could be skiing down on cross country skis.

Now you can probably get up using randonee skis with skins. But you probably would need some proper Alpine downhill skiing boots to be able to ski down, and for 1.5 degrees, you might need climbing equipment for some of those steps.

So we're putting ourselves into a bit of a tricky situation and the gradient of our reduction is quite steep.

But we also say it's doable, right, we do have options that can do it. And that's the positive side and it can be done, but then we can't keep climbing upwards, we really need to get going downwards.

**Nancy:** Not only that, it's not just Norwegians on skis! Everyone faces the same steep slope for cutting emissions.

**AHS:** It's everybody going downhill at the same time. And that means it needs to be done in a coordinated manner, right? So we don't trip each other, and someone falls, right, because then everybody needs to also get down. And that goes for all sectors, but also countries. And I think the report does a good job in pointing out the importance of getting economies in transition and developing countries also to join, they need to be part of that. Because if we can't bring them on board, it doesn't help if Norway succeeds, right. Sweden, and the EU — everybody needs to succeed for the temperature to stabilize.

**Nancy:** The report that Anders was part of also makes it clear that we have to start right now, and get emissions down immediately.

**AHS:** The majority of scenarios, they really start curving down now, but at latest 2025, so it's not by 2025 that we need to get emissions down. And we need to cut them quite a lot, 43% for the one and a half degree warming level by 2030. And by a quarter for two degrees. And I think there are different trajectories that can be

prescribed to take us towards, you know, different warming levels. But the key insight is that it's the sum of emissions until we get there that determine the warming level we land on.

**Nancy:** Now the reasons for the urgency are clear. How are we going to fix this? I'm not going to go through all the different chapters from the 3675 (authors apology: the latest version is actually 2913 pages)— but trust me, there's plenty to work with. What we can do, though, is look more closely at the chapter that Anders was one of the lead authors on — Transport.

**Nancy:** First thing: ELECTRICITY! Anders says in the nearly 10 years since the last version of this IPCC report, things have changed quite a bit when it comes to transport.

**AHS:** If you look back at the 5th Assessment Report, which came out in 2013, really, electrification wasn't seen as one of the major options. Now, this is the option within land transport that has the greatest potential to offer a substantial mitigation for transport.

**Nancy:** But it's complicated. Electric cars. Check. We know we can do that. Even Ford, the American automobile manufacturer, is coming out with an electric pickup truck. That will really change the American landscape — and it matters because Americans drive the most per capita of any people on the planet — according to the Federal Highway Administration, more than 21000 km per year. By contrast, Norwegians drive about 12000 km per year.

But it's not just cars that we use for transport. What about trucks? Airplanes? Boats? Anders says there are low-carbon options for all of these, but that it's still too early for him and his co-authors to be able to look into their special IPCC crystal ball and see what the future holds.

**AHS:** Is electrification going to continue to expand to other modes? Or where is the interface, when there are two alternative options such as hydrogen-based fuels, and also sustainable biofuels?

**Nancy:** Another issue Anders and his colleagues looked at was batteries. If we're going to electrify more and more cars, we need to be thinking very carefully about how batteries are made — and also where the power to charge them is coming from.

**Anders:** Well, the the technology, in terms of batteries is really mature now, and we're seeing a significant ramp up. And also the costs are coming down. So two things we need to do for electrification of transport, to really maximise this mitigation potential is, first of all, we also need to get going with the deep decarbonisation of the power sector. Because if electricity isn't decarbonized, then then it doesn't help,

then also with a very fast growing battery industry, we need to make sure that it doesn't only fulfill the job of providing the batteries for the cars, or other applications, but it also that we develop that sector in a sustainable manner.

**Because we don't we don't get many shots of getting this right.**

**Nancy:** Part of this relates to something called the circular economy. In the old days, we'd get raw materials, make something and then once it reached the end of its useful life, we'd dispose of it somehow — in a landfill, or burn it in an incinerator or whatever. But now we know that this has to change. In a circular economy, we share, lease, reuse, repair and refurbish and recycle all we can, for as long as we can. Anders says battery production poses challenges this way.

**Anders:** The supply of these needs to be done sustainably and we need to also make sure that we can recycle these battery packs and reuse them. So basically, the circular economy related aspects need to be taken into consideration, and that needs to go into the design of the batteries and the vehicles as a whole. So it's not per se a production capacity constraint, it's rather making sure we get it done in the right way. And that we don't, you know, in the interest of speeding up mitigation efforts, cut a few corners that turn out to be costly down the road.

**Nancy:** Anders and the other IPCC authors say society already has lots of tools that can help make this kind of green growth happen.

**ASM:** Well, the report broadly speaking points to that we have successfully implemented legislation and policy packages that have resulted in reduced emissions or curb their growth.

These include more general tools like quotas and also more specifically taxes, but also regulations like building standards, and also emission requirements for vehicles, and energy efficiency measures for the for ships or vehicles, for example. So there are lessons learned from those aspects, which can be transferred to the battery industry and set requirements related to recyclability, or, broadly speaking, the amount of recycled content that should be able to be extracted from the battery packs at the end of the cycle.

**Nancy:** But here there are some potential pitfalls, where battery makers and other industries can claim they clean, green and part of the transition to a greener economy when in fact... maybe they're not.

**Anders:** This is an area where also the industries that are now saying they are a part of the green shift. ...

**Anders:** So I think the first thing is basically reporting schemes to get an understanding of the level of both energy and material efficiency in these industries. So that we can actually monitor if they're taking us in the right direction or not. The claim of being green or the perception of being green, should not be sufficient, right. It should actually be documented and not through I'd say not through third party consultants who do this on the side, like a secret, you know, but it should be done openly out in the public.

**Nancy:** There's also an interesting section on how individuals can cut their own carbon footprints, and how society can make this easier. I was surprised by this. Even though I make decisions based on climate impacts — from cutting most meat from my diet and cycling to work — I've often thought the real change has to come at the governmental level. But now the need for change is so urgent, the IPCC report leaves no stone unturned. Here's how Anders explained it.

**Anders:** if we all look at our, our individual footprint rising, and you try to compare with all the things that have to come about globally, it's easy to think that it doesn't matter that much what I do. But if you know, for example, think a bit about all the people that commute to and from work in London and New York or Delhi for that case, surely everybody can't be driving their own cars, that doesn't work out, that we have realized for some time. So we need public transport. But then, you know, if there's not that many who's travelling, we don't need all that infrastructure. And there you have this concept like teleworking, which is not the same as home office. But it's basically about facilitating that. We'd have hubs of offices around the city and the ability to basically do remote work closer to your home, perhaps in walking distance from the kindergarten and or your house, or at least a very short commute, compared to the two hour commute in and out of London. That would save time, it will probably, be welfare gain for many families. It will also reduce the energy demand for transport and also the need for infrastructure to do that.

**Nancy:** So society would play a part here, too, in restructuring work situations to reduce the need to commute so much. Anders says it doesn't have to be everybody working at home all the time either.

**Anders:** if you could cut travel demand in London and New York — if everybody had teleworking one day a week, you know, that's 1/5, and then you can start doing the numbers. And it can become significant in overall also, particularly in congested cities, where it's difficult to develop new infrastructure. And also if you now look at the emergence of new cities, in developing countries and emerging economies, you can design urban systems like that with that in mind.

**Nancy:** So bottom line? I wondered what Anders thought about the likelihood of us succeeding. He started this process of working with the IPCC report in 2019. He's

looked at all the science that says HOW we save ourselves from broiling to a crisp. But does that mean we can and will make the shift?

**AHS:** We know the contours of how a zero emission power system looks like, how we can bring down emissions in transport and also what needs to be done in industry. So It's not that we don't know what to do, it's rather we need to come to agreement of getting started and how to do it and how to share the costs. And not at least, as I said, action across all sectors, but also across all countries and the real importance of bringing the developing and emerging economies with us in this transition.

**AHS:** We have options across all sectors that can allow us to cut emissions in half by 2030. And I think we really now just need to make the work to jointly to make that happen.

**Nancy:** Are you hopeful?

**ASH:** Yes, but I'm I'm concerned, because we haven't really seen the push for the changes. And you mentioned Norway, as an instance. I'm sort of missing the transparent debate about the future of the oil and gas sector in Norway, because that clearly needs to be discussed.

And it's big, it needs to be done in a manner which is not too polarized, but basically where we can sit down and discuss how can we ensure that we have an industry in a way which we can generate value, and and generate workplaces in the future? And how do we make that emerge strongly and be part of the transition, because surely, if we now are serious about reaching one half or two degrees C as targets, there are businesses that are going to be around which are going to be successful in that. And I think each country needs to ask itself and its business — How can I be part of that solution? And only if you're part of the solution to bringing the emissions down, you basically have a viable business in some decades.

**Nancy:** I'm Nancy Bazilchuk, and you've been listening to 63 Degrees North, an original podcast from NTNU, the Norwegian University of Science and Technology. If you want to know more about the IPCC report, check out our show notes. Thanks for listening.