



EPISODE TRANSCRIPT

Alan Flanagan: Hello, and welcome to episode 446 of Sigma Nutrition Radio. I'm Alan Flanagan. I will be hosting today, joined by Dr. Niamh Aspel. In the absence of Mr. Danny Lennon. Niamh, how are you today?

Niamh Aspell: Yeah, I'm good. Danny's missed, but I think we'll we'll do okay.

Alan Flanagan: Will I think the topic of today's podcast, I think if Danny and I were here collectively, it would be hard for anyone to find the will to live potentially afterwards.

On that rather dark introduction listeners today, we are discussing how climate change. Will impact nutrient status. So not necessarily focusing on the impact of food production on climate change, although that will be a part of the discussion inherently as it is, but how might change to our climate, for example the continuing heating of the planet, impact on nutrient status, impact on food systems, impact ultimately on human diet and nutrition, and the potential influence that might have on human health and potentially disease risk and outcomes. This is obviously a topic that is going to require us to set out some operational definitions starting at the top level of climate change, discussing the evidence that we do have for climate changing, and then we'll discuss definitions around terms you'll have likely heard us discuss

before, like "food security"; what that actually means, and then discuss the evidence that's available for how some of these changes might actually impact on human diet and related health outcomes. So Niamh, I think at the outset, will you tee us up with a definition of "climate change". What do we mean by that term? And what are the outlined targets to try and meet to attenuate or offset some of the really adverse potential consequences of this change?

Niamh Aspell: So I think we're starting with the tone that we're all agreeing that climate change is happening and that it's, and it's real, because I know that there's often often dealt on that by some groups, but I think we're going with that premise for today.

But climate change, I think it's often cast as just these kind of predictions and it's like just a bit of kind scare mongering. But I think that the scientific basis is very strong and it's much broader than just the prediction type stuff. But if we were gonna go for a simple definition, I've chosen the one from the United Nations and they would describe climate change as "long term shifts or changes in temperature and weather patterns". So these shifts could be natural, so such as through different variations in solar cycle. But since the 1800's human activities have been the main drivers of climate change and they, this is due to like burning of like fossil fuels and oil. And we've seen how there's been a change in these patterns. So for example, it can be things like how much rain might fall in a year in one particular region, but it's also the change in the Earth's climate as well.

So how these weather patterns change over time. The planet's surface temperature has risen, and this is typically how they would measure it and how our goals are set there's some other metrics. But what you would look at is the average surface temperature change. And it's changed by about one degree Celsius since the late 19th century, which doesn't seem like a lot if you're talking about it in terms of, you know, how the weather might change in a day.

But when we talk about climate, it's that kind of average change over a long period of time and it's changed quite considerably. So I think the average global temperature for the last 12 months up until February of this year was somewhere between 1.2 and 1.3 Degree Celsius since the 1900s.

There is a shift there and obviously with that shift, with that kind of big change in the climate, there is going to be negative consequences or big effects to that extent as well.

Alan Flanagan: just, I think to clarify, because you know, some of the pushback that you'll tend to hear and we are obviously moving from a premise that everyone accepts this is happening, but people will talk about, "oh, well, you know, variability in the climate occurs all the time. How can we say that this is particularly deleterious?" And it's the distinction, as you said between say climate change, i.e. This long term trend emerging over decades, or obviously longer century in this case, as in terms of the example you cited of the temperature rise versus climate variability.

And we have, we obviously have variability, particularly in more temperate parts of the world where you have four seasons and stuff like that. So it's not just that. Kind of variability that we have, but actually long term changes, defined by temperature rise and changes in other patterns of whether like precipitation or occurrence of say other kind of natural events like droughts and stuff like that.

Niamh Aspell: Yeah. And I think even when we think of something, like when you hear like an average change of one degree over that over a century, essentially it doesn't seem like, like an awful amount. But if we consider say the Paris Agreement that Le it's a legally binding treaty on climate change and how we're gonna overcome this to some degree.

And the Paris agreement has established that the target is 1.5 (degrees Celcius) . That's the indicator of the point at which climate impacts will have increasing harm for people and the planet. So we're not that far away from that upper limit or that point. And, in a hundred years, that's not a lot of time if you think about it in terms of the time the earth has been here. So it's very small.

Alan Flanagan: So in, in terms of say the Paris agreement itself, setting that 1.5 target to, to limit the rise to not beyond that. I wonder if it would be helpful if you could touch on what are some of maybe the approaches that are in place either at the EU level or even you know, enshrined in things like the Paris agreement or otherwise, what are the kind of top line approaches

and measures and targets that are being recommended and how are those targets being recommended that we achieve them.

Niamh Aspell: Yeah, there's a couple. So there's obviously we want to reduce our greenhouse gas emissions and that's the thing the primary driver here. So things that have changed in terms of, from back in, when we seen changes with the industrial revolution. So we just started burning more fossil fuel, and essentially you'll see that there's trends that these impacts are, the emissions are a lot higher in countries that are probably have a higher income or more wealth than obviously more population, but there's be there's different strategies.

So there's like long and short term strategies to reach those goals. And a big part of it is infrastructure around technologies and trying to get technologies to understand where those measures are coming through. So the big focus obviously is on farming and agriculture, because that's one of primary contributions to greenhouse gas emissions. So that there's a, there's obviously quite a large push there moving away as well, then to more energy driven vehicles and using more kind of In natural sources for energy in that sense. So there's a couple of different metrics in terms of actual metrics of measuring change.

There's a lot of contention around how you might measure that if you, the data source. I know she's been on the podcast previously, Hannah Richie, I think it might have been episode 320. she is published an amazing resource on Our World In Data, where they describe all of the different metrics that can be used to estimate the changes or estimate the emission rates and which ones are more important, because obviously they'll vary greatly by the country's attributes and also regional ones. But going from that kind of Paris Agreement, they've set out, they set out plans which have changed in 2015. Again, they did another meeting last year, was it last year, this year the COP 26 meeting and each country then has gone and has to create their own climate action plan.

I know Ireland has published or the Environmental Protection Agency has recently published their most updated plan or a guide of where we currently are in Ireland. Ireland are extremely ambitious. I think the target is to reduce our emissions. Obviously there's a big focus on agriculture in Ireland in

reducing the emissions through agriculture, but Ireland has set a target of 51% reductions by 2030.

The target by the Paris agreement is 30%. We're they did an evaluation of Ireland's plan in 2019, and they showed that even if we implemented all of the end points in that plan perfectly, we'd only reduce our emissions by 28%. But then with the new government change last year, they've said, well, we're gonna add yourselves.

We're gonna actually go for 55% now. And we're nowhere near that. So they've developed some new plans and some new targets, but they haven't so far decided on how they're gonna action those. So I still think, and I think we, there has to be some consideration as well. Is that. You know, they've been dealing with another pandemic in the last two or three years.

So they ha some of their resources obviously moved away from that. But we need to get back and look at that again, which they are doing now.

Alan Flanagan: I think when this conversation occurs and people think about these changes, I think when it's, you know, that, and the targets that are being met or the aim to meet the targets, and there is this kind of focus on temperature obviously.

But what I find interesting, certainly as we maybe move on to start discussing some of the nutrition related stuff is the other impacts of this. Like, when we're talking about climate change, you know, you've got factors like potential impact of sea level rise. Which currently is a little hard to quantify as to, you know, the kind of potential magnitude of impact on food systems.

But certainly there are particular countries for example, the countries along the river deltas in Bangladesh, Pakistan, India even places like Egypt where their farming regions are going to be substantially exposed to sea level rise. You've got the impacts of more extreme weather events as well.

We were discussing this beforehand; there's evidence that there's a really quite profound differential impact of weather and climate related events on women, particularly if they're in less equitable societies, they're up to 14 times more likely to die as a result of ecological disasters; often related to gendered roles within those societies.

You know, there's the impact of potential rises in flooding. Although, my understanding is there's not necessarily that much of a trend observed that people can definitively say that there is an increased prevalence of flooding. Obviously drought then for particular regions that are quite affected by this or more prone to the affection effect like the Subar and regions and otherwise.

There's some, evidence of like how devastating an impact drought can have on crop yield and obviously that feeds into it. So the overarching umbrella term of climate change, although we discuss it, obviously in terms of the kind of metric of the change in global temperature, but the manifestation of various other aspects of that change in terms of shifts in the climate in various regions is something that can obviously have a big impact then in terms of food systems and nutritional status.

Niamh Aspell: Yeah, just like at the moment, if we observe what's happening in India, and as a really clear example, in terms of the temperatures that they are currently experiencing, I think they recorded their hottest month this year to be last month and it was up to 50 degrees Celsius. So that's had a massive impact on their crop yield then as well. So a lot of their wheat crops have been destroyed, and this comes at a time as well, where we're struggling to get global procurement of wheat as well, because of obviously the Ukrainian and Russian situation as well.

So this is driving up the price of food stuff, but it's also limiting availability as well. India have brought in a ban on exports. So whatever wheat they have at the moment it's staying within the country. So this is, internationally the price of wheat will go up, but it's more than that, obviously that then leads to food and security and food poverty, but that's one extreme in terms of the heat.

But then you'll see in, in China as well, they've reported cause they're the world's largest producer of wheat. So obviously they're gonna be much more depended on this year by other countries, because we've obviously got the pulled back from those other countries in terms of what we can get for wheat.

And they've reported their worst history because of heavy rainfall. So it's the opposite side of the scale, but it's coming from all angles in different regions

and different parts of the world. And if these are primary sources for foods, I think it was the FAO had reported in one of their recent reports in 2020 around the balance of food and where it's coming from and what we sustain ourselves on. It's something like over 70%, 76% of the world's population get most of their daily nutrients from plants. And because of these climate changes and the impacts of those with droughts and flooding, it's destroying those staple crops. And it's again, going to affect those people, mostly who are struggling already.

It's the lower middle income countries that then are either going to lose jobs, because they're not getting their crops or there's gonna be challenges there. And then again, they won't, we won't have the commodities ourselves. So there's lots of, direct and indirect consequences.

Alan Flanagan: Yes. And I think certainly one thing I think we'll circle back to maybe at the end, when we discuss potential solutions, if any, is in relation to, you know, some of the, the geopolitical aspects of this, because again, that could be a factor that plays in.

If countries start taking a look after number one type of approach to these things, it could be quite destabilizing in the long run. But so I think if we start digging into some of the. Specific aspects of the potential impact of these changes on nutrients. I think we've mentioned the word food security, a number of times.

So just to define for listeners what exactly that means. It's generally a combination of factors. Metrics are factors that are considered under the word food security and that's availability which really is what it sounds like. That's the actual physical availability, the presence of foods in the food supply in a given country.

And that's either from domestic production or imports or indeed, depending on the economic status of the country from food aid. But quite literally, it is the availability of food for individuals and then there's access, which is obviously different to availability, which is the actual ability of people and households to acquire adequate amounts of food.

And again, that could be a combination depending on the economic status of the country of domestic production, or it could just all be through,

particularly in high income countries purchasing. So there's availability access, then there's utilization. And that relates to as well, the individual's capacity to actually have food that they are capable of appropriately absorbing and metabolizing.

An example of where utilization is important would be in the prevalence of stunting in some or low middle income countries where they may not necessarily have access to some kind of either, if they're traditional vegetarian patterns dietary patterns, they may not necessarily have access to either kind of milk or dairy proteins or eggs or foods that would bolster their protein status. And often if they're relying on low yield plant proteins, exclusively in the diet that can relate to stunting. So utilization is an important factor within food security. And then the last one is stability. So that's that you've got an actual stable available an affordable food supply.

That means, and this is something that stuck with me from your talk at the conference recently, is this concept of resilience and resilience to stress testing of food supplies by, you know, obviously things like the pandemic are a recent example of that, but obviously stability in the climate context can be influenced by some of these kind of ecological disasters that we were like a flood or a drought or otherwise can impact on it.

So food security, isn't just a kind of opaque term. There are these definitions that feed into what we actually mean by the term food security. I think in terms of then taking that and moving into some of the discussions on the actual impact of nutritional status one of the analyses or a couple of the analyses that that I know you've looked at are from Samuel Myers and they've looked at how changes in the climate are going to potentially impact on nutrient availability.

I wonder if you could talk or discuss that line of research and how these kind of changes might actually impact the nutritional value of different foods.

Niamh Aspell: Yeah. They've done some really great studies. So this group they're in the planetary health in Harvard School of Public Health. But they've done a lot of modeling work on what we currently know around kind of consumption patterns. What we know about environmental changes and then looking at the impact of these environmental changes, particularly CO2 emissions, if they are elevated, on the nutrient content of certain foods.

And then They've looked at protein content of certain foods, and then they've also modeled that globally to see, okay, well, which countries are gonna be impacted the most, which countries are currently at risk. And then obviously this information then will help to, tailor some kind of plans around more targeted interventions for trying to for climate change and nutrition being of interlinked and important.

So I can talk about a couple of the, a couple of the studies you'll find with a few of their studies with the methods they've used similar method in terms of collating the data to do the modeling, but then the modeling has just looked at different outcomes. So the first study that I'll maybe chat about is the effect of the increased concentration concentrations of atmospheric carbon dioxide on the global threat of zinc deficiency.

That's a modeling study that they did previous previous to a follow up on where they look at protein. So I can maybe just go through that one a little bit more. I think this one they published in 2014, but essentially what they did was they modeled dietary intake of bioavailable zinc on different plant sources for almost all countries, 188 countries across the world.

So they, they wanted to try and understand a little bit how they increase concentrations of carbon dioxide can potentially lower the content of zinc and other nutrients. So they did some lab work on this and they have these estimates for how much it can contribute. For them to understand how the effect essentially have elevated CO₂ on zinc concentrations, they estimated the size of effect of zinc that they'd previously published in a meta analysis. This meta analysis included pooled data from lots of other studies where they had done the, these controlled kind of experiments.

So there's two; there's free air carbon dioxide, enrichment studies, and then there's open top chamber experiments. So one is like, and naturally how a plant might live. And then one that's you. Induced to these elevated exposures. And then they obviously did tests on the products to see then when, once they were once they were produced to see what the content was of zinc in the normal as they are at the moment.

And if those elevated kind of circumstances, so they have those estimates. They know they did look at phytate as well concentrations, and they found that there was only a slight change for wheat. So they've used all of the sea

tree categories of plant. So it's I'll go through them all in their differences, but they only used wheat.

They only seen the difference in, in wheat for phytate, but they have reported that as well. They've adjusted for that in some of their models, but they balance these again then against per capita, nutrient intakes for each of those different commodities across all of those countries. So to do that, they needed to use kind of food balance sheets to try and understand, you know, What foods were being consumed in cer in certain areas and at what rates and by which groups.

So they obviously had to only include countries that have collected that data, but also have collected all of the other important metrics that you would need in order to determine nutrient kind of status for the population. So all the demographic data is included there as well. So they've quite a large volume of information on this.

So the plant sources that they reported on in the food balance sheets varied across countries, but most countries had good representation for legumes and tubers and some other types of grasses. So once they model that specific data, they wanted to see what the changes were based on that, what they call face, which is the induced elevated carbon dioxide or the open top.

And they were looking at the primary group of carbohydrates. So maize, peas, rice, soya wheat, barely and potatoes. And they calculated then the mean estimated zinc availability per milligrams of a hundred calories worth of each of these food commodities. And they adjusted for the effects of things like food processing.

So actually like at the earlier stage of kind of production cycles, so things like milling and fermentation, so they have they've modeled this quite well. And then to determine the population risk of zinc deficiency, they then estimated the prevalence of in. zinc intake under each of those scenarios by comparing kind of the estimated absorbable zinc content of the national food policy with the population's estimated physiological requirements.

So that's based on all the demographic data that they had available as well. And then they took risk of an adequate zinc intake based on the food balance sheets as a proxy for the risk of zinc deficiency then within a country. So they

are, well, you know, you'd expect it from the school of public health in Harvard, but they're meticulous in terms of really describing their methods extremely well, but then covering all of the bases to the best of their ability.

If you consider the amount of data that would've been required across all of those countries, they then so there's different scenarios obviously elevated and not elevated. And then they Cal they calculated the estimated proportion of the mean physiological requirement for zinc available in the national food supply by dividing the estimated against the national foods food supply then.

So they applied those estimated average requirements in a cutoff kind of point system so that they could see the variation they wanted to see. They were assuming that there was a normal population distribution of around 25% variation within those countries. And that's what they've done in their previous analysis of global Kind of these worldwide risks of zinc deficiency, because they were trying to come up with some idea globally of what this kind of score would be.

And then they did all the regional stuff as well. I won't talk about the statistical analysis because it's quite technical. I can understand half of it and I think it's all there. If people are really interested in digging into it, but it seem, it seems like they've done a great job and it's peer reviewed.

But to get to the results. So what did they find? So they had all of these rough estimates of it's parts per million that they measure in, in terms of the CO₂ emission. So they found that when these plants were grown under open field conditions at a CO₂, that the world is expected to experience by 2050, that wheat, rice barely soy and field peas have significantly reduced zinc content. So the percentages are just under 10% less zinc for wheat, 3% for rice, barely 13% and soy 5%, peas 7%. Okay. And that's at the upper that's where we're expecting things to go to. So it's it's not like this crazy upper end scale. It's like looking at the prediction models of what we expect emissions to be at that point. We're on our way towards, and the graphs are showing us that trend is looking pretty legitimate.

That's expected to be the consequence I suppose, on, on the crops. Okay. Which is quite significant, really. If they have looked at it. So if they estimated I think the per capita, so per person, population zinc, intake varied across countries, and that's the kind of worrying bit.

So if you look, they've got some really good infographic or really good maps of kind of risk, and there was lows in some places, but then also really high intakes in other countries like Sahara in Africa, China, and where it's estimated obviously that the, a larger proportion of their diet is coming from these plants.

So wherever these places are currently experiencing deficiencies already, so they're already at risk groups, they're gonna be impacted even more without. And, you know, without what's the word I'm thinking of? Not saying effort, but without any changes without reducing their intakes or changing anything just as a proxy of what's happening to the crops, they will naturally treat no fault of their own be become even more deficient.

Alan Flanagan: Again, you like, I think a really important point that we just can't escape from, nor should we shy away from is you just mentioned the regions that are gonna be most impacted by this are regions that are already regions that are impacted by nutrient inadequacy in the diets.

And so this is not, although you know, that they're talking about the increase in a new risk of zinc deficiency. It's super imposed on areas which already have a high prevalence of nutrient insufficiency in the population and indeed food insecurity. When I saw that analysis, there was you know, in terms of the increased risk of new deficiencies in particularly Africa and south Asia.

And then there was a paper by Springman and colleagues, which looked at the, you know, health effects in and factored in regional differences and predicted again, with their modeling that you would have twice as many climate related debts with the majority associated with lack of access or reductions in fruits and vegetable consumption.

But with the majority of those debts occurring in south and east Asia, so that there's a really substantial regional and disproportionate regional impact of what we're discussing here. That's a really important part of the conversation I think when we talk about these issues.

Niamh Aspell: Yeah sorry, I think that they did... so they did report the total number of people. The total new number of people estimated to be placed at risk and they have with the models they used different guidelines to

determine the zinc status. So if they're going by one particular model, I think it's 138 million new, you know, cases of such a zinc deficiency.

And then up to the extreme of 180, if they use the IOM version of the model. But it's definitely going into looking at those other regions that when they get to the ones already affected are gonna be this much more affected. And it's all of those countries that we've mentioned earlier on in the conversation around, they also have a lot of vulnerability around their economy related to these plants and crops as well.

So their yield is worse, but then they're also very dependent on that for their nutrition as well. So they're being hit in both ways. So it's in terms of economic and health impacts it's BEC it's compounded risk and compounded impacts, which I think is the more worrying thing, but the pressure to change things I think needs to come into the United States, into Europe, into other countries, which is contributing the most to the emissions and then having more of an impact on all of these other countries that are going to be hit twice as bad as the rest of us.

Alan Flanagan: There's a really nice illustration of that point in a report that was done by the world food program in conjunction with the UK met. And they have a map of the world. It's like a heat map with population symbols. And so the two kind of markers that are being represented by the map are what they call a hunger and climate variability index.

So how much climate variability relates to the hunger in the population relates to basically nutritional inadequacy. And then how much of the percentage of that population are undernourished nutritionally. And if you look at European, north American and the Anzac like Australia, New Zealand countries, what you see is these are not only where less than 5% of the population are undernourished, but they're also the countries with the lowest hunger and climate variability index. And then the countries with the highest of both i.e. Percentage of the population, undernourished sometimes as high as 70%; between 35 and 70%, it's a fairly wide range, but are also the countries then with the highest climate vulnerability.

So that this is something that disparity, that regional disparity that you've described in terms of what are the countries and regions of the world that need to do the most substantial, heavy lifting on this? Because a common

pushback you'll see is, oh, well, you know, low middle income countries often have less regulatory standards in terms of emissions or reliance on certain industries that significant producers of carbon emissions. And there's a degree of truth in that, but it's not where the vast majority of the nutritional related contributions of climate change are derived from. And the consequent impacts of those onto these kind of low to middle income countries that already have a high percentage of the population facing a degree of malnourishment or nutritional inadequacy.

Niamh Aspell: Yeah, I think that Springman paper that you mentioned as well, they because they factored into their, they did these agri economic models where they also factored in what we have planned in terms of spanning up our kind of food availability. So what's already projected that we will do to mitigate so that our current plans to mitigate it.

So they factored that in and they still have shown that there's gonna be a massive reduction in food availability by 2050. They their model, it worked out at almost just under a hundred calories, less. So there'll be a change in relative reduction of global food availability, a hundred calories, less per person.

And again, they considered that in terms of the different, you know, due to what foods. And it was focusing entirely on foods that we need access to things like fruits and vegetables. And then they also wanted to look at changes. Maybe if we do try and reduce red meat consumption and balance all of those different scenarios out and then to project then, well, if there's a change in our diet to that sense.

So we're looking at there's obviously, if there's less food availability they've factored in, well, some people might lose some weight, which might not be a bad thing. And they've, they factored in different health diet and weight risk factors into that as well. But nowhere near to offset the actual number of people are already undernourished or risk of under nourishment who then will, you know, become more malnourished. And then it's on these foods as well that we need we need more of as well that are tightly linked to then all of the different health outcomes. So they'd model that on a couple of, I think, six of the most, what they've seen as the most important diseases, looking at the kind of literature in terms of the relationship between diet and health.

So like heart disease, stroke cancers. So I, I think that was a really stark. Study in that sense. So it's like, no matter what we're trying to do now, it's not even around making better you know, when we think about diet and health, it's like, oh, making better choices is, you know, just being told what to eat.

It's like, it's at that stage, if you look at it that a lot of people, it's not a choice of it's, what's available, like going back to the food security points, like what do we have access to what's available to us as well. And then I think now they've whatever they, I won't go into the models. It's a really good paper, but they estimated an extra over half a million climate related debts worldwide based on just entirely the contribution of these debts due to changes in diet and weight related risk factors between that and that point.

So I know a lot of these studies are kind of predictions and numbers. People maybe don't really take them in and take them on you know, well, what does that mean to me? It's like, I still have fruit and veg or whatever. So they don't really like, but it's this like what you said, it's the global consideration.

It's like, we're not all experiencing these things. Like, like exactly what COVID, we didn't all experience it equally. And we worked together in some cases to try and overcome some of the impacts, but, you know, we obviously don't want another scenario where we're overcoming these impacts all of the time, instead of proactively addressing them before we have to consistently just always react to them.

Alan Flanagan: I admire your faith in humanity.

Niamh Aspell: This is why we're balanced here. You know, I'm gonna be optimistic and you're gonna continue to say we're all gonna die.

Alan Flanagan: So to that point about, a lot of these papers are based off modeling and, people might be, if they're being, quite softest about this, the threat of this issue, you know, wave a hand and well, you know, "yeah the modelers told us this many people would die from COVID, you know, and they were wrong. So why don't I, why would I believe modelers?" yeah I think one thing that I found actually that there is, there are examples that we can point to already of actual changes as a, so for example, there was a paper published after the, one of the heat waveS in Europe, which was in 2003. And

in Italy there was a loss of corn yields of 36%. There's evidence, for example, that maize growing areas that like the vast majority, nearly like 70% of maize growing areas could have significant loss to the yield, to the of that maize with a one degree warming. And you said, you know, we were talking about this earlier.

Like, it doesn't sound like much, but we're already at that one to 1.2, threshold there's evidence that there's already been. A global reduction between 1980 and 2008 for maize and wheat respectively, which have declined by 3.8 and 5.5%. So although the magnitude of these losses may seem small.

I mean the Italy examples, probably the most traumatic there, it's not all based on modeling and predictions. There is evidence that the changes that have occurred to date where we are in 20, 22 have had impacts on on, you know, on, on the food supply. and that's really important.

And if we're thinking about, for example, how this might impact on some of the areas we're discussing. Like if you look at some examples of drought and climate disasters, again, that have occurred, not necessarily being predicted, for example, in Kenya children born during a drought phase, a drought prone period were 50% more likely to be stunted and 70% more likely to be severely stunted.

There's similar data from Ethiopia, there again, there is available evidence that these. Impacts of the climate and change taking place actually do yeah. Are taking place and are having significant adverse effects, particularly on children in terms of their health trajectories, but also evidence of the food supply already having some impacts.

Niamh Aspell: Yeah, we're seeing these events are happening, you know, it, there's a really good paper and I think more needs to be done in this way as well, to, to gain public trust and engagement or not comp well, maybe public compliance with some of the suggested kind of interventions, but there was so obviously data's been available like environmental data has been collected since like the late 1800's, obviously data practices got a little bit better. We obviously started being able to collect a lot more data from like the 1950s kind of onwards, but. Most countries have like with India as an example, again, they started rigorously collecting their atmosphere data

back in the early, like I think it was 1901. So they have that data available. There's obviously better techniques for it now, but they've been doing prediction modeling on this stuff for a long time. And there was a paper published maybe a year or two ago, maybe two years ago where they evaluated the performance. So what they know now in terms of modeling techniques, but they evaluated the performance of all these past climate projections.

And they found that these climate models that they published over the last five decades were skillful enough at predicting the subsequent global surface change was one of them surface temperature change was one of them and it was pretty much accurate. So I think the more we do, like, you know, we predict a lot of these things or we project a lot of them and there's a lot of focus now in 20 30, 20 50, but we need to always reflect on it as well to encourage people.

You know, this is what we said would happen 20 years ago. We've double checked. It's happened based on our models. We're modeling again, we feel pretty confident that these models are telling us something and, you know, models and they do. And even with COVID you have degrees of, you know, I, I dunno what they worded them.

Was it like worst case scenario models and stuff like that. But like, just even going at the least, you know, potential worst case scenario, there's still, we should take something of as an in between, or at least the, I think we all can acknowledge that there's, there is things happening in the world where we can clearly evidence that temperatures changing.

You know, if the ice caps are melting and there's droughts and fires happening, and you know, a lot of the time, these record temperatures that we're experiencing, maybe when you live in countries you know, where I'm from in Ireland you might see, oh, there's a global increase in the last 10 years of it.

Or how many years of one degree you're like, great. Like we need it. Do you know what I mean? Because that's what you experience in Ireland, but people don't think about it in terms of that this is a global average change across all countries. So there's obviously variability in that. We're not all

experiencing that one degree, some are experiencing, you know, five, 10 degree increases or changes variability.

So it's considering it in that way and looking beyond your own place.

Alan Flanagan: Yeah. Well, this is I think the challenge of trying to address this problem. I think at the one level, I, like you said, a lot of the countries that with the systems that we have contribute substantially to this overall problem are the countries where.

People are not likely to be severely impacted by it. And even if they are, they're probably, like London right now, you know, everyone's like, oh, the weather's great. It's so warm, you know? And it's like, because you're here you're not in the subcontinent experiencing and enormous surge in temperatures.

And I think part of the problem in kind of Western industrialized societies is even within society, we have such hyper individualized cultures where the, an individual and their material gratification is the immediate concern. And it's very difficult to get people to. And there's an enormous cognitive bias that humans have generally right against this kind of future proofing consideration.

And I think that creates an enormous barrier to change where you're trying to tell someone, look, not only is this going to be something that isn't likely to impact you as much as it is to impact people in other countries that are much more inequitable in their wealth distribution and otherwise, but it's not likely to be something that manifests as a positive change for 10 or 20 years.

And so there's these two massive blind spots that people have, I think, to making changes when you factor in both the lack of sense of immediacy, although it is becoming quite immediate, 2050 is not that far away. And also the kind of the types of cultures where the individual is very much the kind of deun of focus in Western industrialized countries, where it's difficult to get people to say, Hey, you're not doing this for you. You're doing this for other people. I mean, we saw this play out with COVID vaccinations, right? So there's my lack of optimism.

Niamh Aspell: Yeah with the increase in food prices that's experienced, that's been experienced globally at the moment. So maybe these are nudges to people that we are a, it is a shared system to, you know, we all are dependent on different countries for different commodities and different resources.

And we can sometimes take that for granted because it's always very available to us in the countries that we currently live in, but it's not the case everywhere. And it's starting to change now as well. And I think the, there will, there obviously is a lot of kind of policy plans to change how we structure those food systems.

But, again, with all policy plans, they take time to implement. And I think going back to that Samuel Meyers group the modeling work that they do I think is very applicable, cause it's done at a global level essentially, and we can see how we're gonna be impacted.

They've moved from just looking at zinc concentrations to maybe other nutrients that would have a, more of a kind of global impact. They've done studies on protein deficiencies in plants because plant sources are a large contribution of the protein requirements for a lot of people.

And now we're starting to see these ships when we talk about like sustainable diets, you're seeing a lot of people are moving towards plant based diets. So we, I can talk a bit about this study in relation to this. And I think it might be interesting to.

Alan Flanagan: Yeah, do. And then I think we might have a little bit of a chat about some of the, alternative food sources some of the lab grown meats and eating insects, stuff like that. So I think maybe, you know, yeah. Having established the gravity of the situation I hope for listeners. I think, yeah let's maybe have a bit of a discussion about some of the strategies and alternatives and technological developments in the food industry that, that may play a role in turning the tide in a positive sense.

Niamh Aspell: Yeah, just there's a couple of other studies that modeling studies there's things like that were being pushed towards or encouraged towards they're seeing as being like good measures, which I think they are, but there's considerations around them as well. So things like shifting towards a plant based diet.

I'll just talk briefly about this paper, but it's very similar methods that they used for their previous one. They did meta analysis on previously collected databases, different food and agree. The balance sheets, looking at demographic profiles of a country, their current food intakes and what kind of foods they're currently eating.

And again, Under the same conditions. So whether it was ambient or elevated CO₂, how would that impact the nutrient content of these plants in terms of dietary protein? So if we're gonna be shifting towards eating more plant-based foods to get some of our protein as well, then this, you know, this could be an important consideration.

So they previously shown the crops that were grown in this elevated atmosphere, concentrations contained as protein. They've shown that in, in some of their studies. So now they wanted to explore the consequence of this. So how would it play out? Based on our current predicted rises in CO₂ emissions, again, they implemented lots of modeling techniques, really detailed.

They went into some really good detail around estimating plant protein of different. Of different food types eaten within a country. They even, they, even if they couldn't get protein intake they use different nitrogen conversion factors if they were available in the data sources as well.

And then they use, they applied this thing called I haven't heard of it. You might be familiar with it in modeling, but it's a genie coefficient. It's essentially just a single number that demonstrates the degree of inequality in the distribution of income and wealth. And it's used to estimate how far a country's wealth, their income distribution deviates from the total equal distribution.

So they are factoring in these different social factors as well. And the stability of a country. They use all the raw data again from their experiments. and they come up with some kind of response ratios and standard errors for those, but they used multiple variant, Larin, linear regression models and the outcomes being the percent decrease in protein.

Depending on the growing conditions, they go into a lot of details on how they estimated average requirements, the risk of protein, deficiencies,

protein, and energy ratios. They were all built into the model. So those things have all been factored for, but they found that under elevated CO₂ rice, wheat, barley, potato protein contents decreased from between six and 14%.

So it was about 8% decrease for rice, 8% decrease for wheat, 14% for barley, and then about a 6% decrease in potato. So they. Predicted using their model across, they predicted that 18 countries might lose more than 5% of their total dietary protein, including India. So that was, I think the highest at 5.3%.

Again. So again, there's these regional, like if 5%, if we think about how you do like different assessments for like malnutrition or body mass, like 5% is a big, that's a big drop, it's a big, it's a big change. they predicted or assumed by going by today's kind of diet and level of income inequality that an additional 1.6 percent of the world's population would be placed at risk of protein deficiency because of the elevated CO₂ that we've predicted will be surrounded by us by 2050.

So that's, in addition, if you talk about India, just as one country, that's an additional 53 million people at risk globally. They put a figure of 7% decrease of protein intake predicted for plant-based diets around the world. So this isn't like discouraging in terms of like, oh, I've be, I'll go plant-based, it's gonna be less protein.

And it's like, no, we need to make sure that we sustain our crops, disease, nutrition compose as possible so that we can continue with this diet. Cause I think there, there is a shift towards okay, a little less meat and a little bit more plant. And if we do that correctly, then we'll still have adequate intakes, but we need to consider as well, the changing.

Content of these for that study, they didn't have any data on the contribution of nuts. And I don't think they had any data. They exclude, they did extreme and kind of temperate scenarios. So the extreme scenarios where that, those the scenarios where it wasn't extreme was that there was no change on nuts using that as a protein source.

But for that's a gray space next. They don't have any data on it, but I think in terms of those numbers...

Alan Flanagan: You know, it's important to consider that when we're talking about these risks of, again, in this example, protein insufficiency or deficiency in the relationship in particular that would have just stunting in low to middle income countries, as you said, like that's not an excuse for people in developed countries, where protein deficiency is not anywhere close to being an issue in the general foods that make up the typical population diet that, you know, these are completely different background contexts and populations. And so it's important that we're, precise in talking about, well, look in these countries, there is an increased risk of protein malnutrition and related stunting issues, particularly in children. But that's not a factor that's necessarily like going to impact or going to be a reason why people in developed countries say, oh I'm gonna stick to the beef min and not opt for the corn. so interestingly, if you stratify that the needs, so to speak at the level of, if we're just having that arbitrary dichotomy between kind of plant and animal there is a clear alienation that you can have based on the economic development status of the country. So in, in high income countries the evidence is overwhelming that, animal produce source foods really need to be reduced across the whole population. Whereas in certain low middle income countries, the addition of very minor amounts of animal based foods and in, in amounts that would not be incompatible with planetary health to their population diets could really bolster nutritional status. So there isn't there, there are distinct considerations based on the. Background nutritional risk profile in a population and by risk, I mean, for nutritional adequacy and the economic status of the country, that then relates to the types of changes that are likely to benefit nutritionally.

While also factoring in the kind of aim of planetary health related target goals being met on the topic of protein, some of these kind of potential alternative protein sources. Yeah. You mentioned the insects. Let's talk about the insects. What are we gonna be eating?

Niamh Aspell: There's been a really big push, obviously at the European level to, to move towards making our protein rich plant sources more robust in terms of our growth and production of them. And then also in innovative strategies, how we can use other sources that, that aren't just coming for the meats that we would typically, or the animals that we would typically eat.

And one of those are are insects, but there's at the minute in your, which is quite good. So I think they had quite a drive for this over the last, I think it's

probably the, with. Implementation of the farm to fork strategy a couple of years ago, but the under the horizon 2020 banner, they started to fund a number of different projects and consortiums to start developing some of these plant based alternatives.

There's currently four projects that I'm aware of that are running at the moment. There's one called smart protein, next generation proteins, sus chain, and profu pro future. And they all focus on validation of alternative proteins and. One of those is insect sources. So they're looking at plant based micro based ocean based. So algae is a big area at the moment, fungus based, which I think a lot of our kind of alternative proteins are already at the moment, some of the commercial kind of ones. But they're all being industrially validated and then scaled up in terms of how, like a big part of those projects. They're a big requirement of those projects is okay, great.

You can make something, but now you need to scale up what that looks like for our food system as well. And that factors in different things, obviously around, you know, manufacturing, how we balance that with other things like agriculture. So obviously there's gonna be a shift in, in certain demands and then supply obviously.

So they need to balance those things together. You'll find a lot of , I'm not so sure if it's happening as much in Europe, but in America, some of the larger farming companies are also buying in shares or creating sections of their organizations, which are developing plant-based products as well.

Because obviously there is a shift in a drive there, but at the moment in Europe, the main focus or objectives of these projects is to make sure that they're industrially validated. So they need to make sure that they can actually create them. And beyond that, then there's a lot of work I think, to do in terms of consumer acceptance of some of them.

I think there is a certain degree of people who are shifting toward towards that, but I think it's probably, you know, a still very small proportion of the population who are interested in some of the plant based proteins. There's obviously what you find as well is definitely economically driven as well because they're usually not cheap. They're usually quite expensive alternatives. And then there's a lot of work still needing to be done around. Are they adequate in terms of meeting their nutritional needs as well? So a

lot of the products that are created now, In terms of technical innovation. They're amazing. Because they've created, oh, what's that burger in the States. I can't remember it, but it's almost looks like, you know... (Alan: "Impossible Burger") yeah. It's yeah. People are like, I wouldn't believe it's not a burger. Yes. But it's like, has the, you know, the technology, I think it's soy, but they've some form of technology where they can extend the extended to be like longer fibers of the plant so almost look, you know, is comparable to fibers of the meat and stuff like that. So in terms of like food science and that development, the tech is really pushing boundaries there and creating amazing things. But then it's like, okay, but what's the nutritional composition of that burger now? Is it actually any worse or better than the traditional, you know, beef burger, obviously the, you have to weigh up those health and environmental factors. So I think there's still a lot of work to do in terms of like testing. Whether if we integrate these diets. What does that mean for our current guidelines around health?

Alan Flanagan: And there's you touched on the acceptability aspect. I mean, that, that's something that I find particularly interesting at the kind of behavior change level, because there is evidence that there is, although the actual market for meat sub are meat substitutes is now in the billions there's, there is evidence of resistance to reducing meat consumption.

And that, that relates to a bunch of different kind of, you know, associations that people have between the food. And like, for example, there is evidence that people associate the consumption of meat, men associate the consumption of red meat with masculinity, and that acts as a kind of a barrier to change.

I know it's pathetic, but. I think of one example I can think of from the UK, for example, was the REMAP trial, which was like a behavior based intervention that focused on a number of a multifactorial behavioral in intervention to try and get people with regular high red meat consumption to reduce their red meat intake and use meat substitutes.

So they were provided with like information on kind of environmental benefits and health benefits, recipes, success stories, but they were also given the meat substitutes freely. And you have to wonder how much of the outcome, so their baseline meat intake was like 130 grams a day, which is like highish. And they reduced it by like by 51% by that, but sorry, by about 63

grams, they reduced it down. By 63 grams, which was quite a big reduction after four weeks. But by week eight, which is the end of the study, that change was only like 39 grams. Right? So there was clear like erosion of the magnitude of reduction over time.

And I think that there's some interesting evidence around this area. So for example, like the rhetorical framing of health messaging, we know that in relation to obesity, for example, the way that a message is framed is a massive influence and the receptivity people have to it. And where messages are framed in relation to like, weight or losing it, there's people just check out.

But similarly here, it there's some evidence that when the message is framed in relation to like animal welfare or like health you know, this is better for your health. It's actually ineffective as a driver of consumer behavior change. And maybe that's just because like people don't like feeling like they're being called a moral inferior. And I think there's, I think there's a lot of thought that has to go into these shifts that we might want in the food supply. So you mentioned, obviously we need to think about the nutritional impact of big shifts in the population in terms of food intake and whether they'll be sufficient for nutritional adequacy, will there be more vulnerable groups than others that will likely stratify along socioeconomic lines?

As most of these things tend to do there's cost implications then of course, within that SES status implication, and then there's also then, well, if you want people to do this, how do you frame the messages and how do you go about thinking about thinking about the public health side of shifting this?

So I think there's a huge amount. That needs to be considered in terms of these potential shifts in the availability of these alternatives.

Niamh Aspell: And I think, and the narrative's kind of always changing with nutrition as well, which is I think a hard thing to get buy in from the public sometimes. But we, before we, came on air, we were talking about the lab grown meat. And I think, well, obviously that needs to just change its name to a certain degree, because I don't think that sounds very appetizing in any way, but there's lots of pros obviously in that, in terms of it's it can be tailored nutritionally, it can be tailored to whatever you want the composition to be.

So you can have different types of this lab grown meat to address different needs or different requirements. There's obviously risks around, you know, obviously, food borne diseases with meat, things like that. You can eliminate that if it's something's created in a controlled environment, but what it probably comes down to is people's understanding of what lab grown actually means.

We obviously have this kind of aversion to anything, you know, that is creating, using additives or uses, you know, certain things to in a, in its production that we're not comfortable with, that we know haven't grown in a field or haven't eaten their dinner kind of things like that. So I think there's lots of pros and cons to the different proposed alternative proteins that they've brought up.

I still think in terms of regulation, it's not regulated yet at any new level, it's still under consideration by a lot of authorities and how they'll, how they will regulate it. Even for foods and supplements at the moment, the regulatory aspect of that is very loose compared to some other industries, I suppose of things that we'd consume like pharmaceuticals or something.

But I think lab grown means it's definitely an it's early stages. And I, but I think that this is the point where we need to be though. I think we need to do a lot of that exploratory work stuff for like insects have amazing source of protein, but there's questions around. Right. Okay. Well, can everyone eat insects?

Is there a possibility of new allergies or allergies? We're not aware of, there's a lot of safety requirements on this, you know, that need to be tested, but it's good. It's I think it's all gone in the right direction and it's just, it will take a little bit of time before we, we like with algae.

I know I've worked on studies previously where they've tested the tolerability of taking algae proteins because they can be quite intolerable and hard to digest. And they're still, I think, battling and challenging with some of those things around the compositions of some of those alies to make them more palatable and to make them more tolerable.

So you're still at that kind of growth stage in that, but it doesn't mean, I don't think that they shouldn't start doing some of their kind of market research in terms of, you know, would you try this stuff if we make it, would you eat it?

You know, and it's a lot of those other organizations that are already in the marketplace that then need to get on board and adapt them because if there's trusted brands then who get involved and you're more inclined to get the consumers trust and attention, and then actually consuming them.

Alan Flanagan: We started at the outset by saying, you know, we weren't going to, well, obviously the focus was how the climate changing is impacting on diet and food security and nutritional status potentially. But then we could end up coming back around inevitably full circle to, well, how do we mitigate that change in the first place? And that does come back to more of a focus on certainly high income countries developed Western countries in terms of dietary changes. What where do we stand, do you think in terms of best evidence now, either at the level of specific foods or kind of total dietary patterns?

Niamh Aspell: Yeah. Well, I think if you're gonna talk about specific foods and I'll say as well, I eat everything. I'm not a, I'm not, plant based or vegan or against for, against anything at all, but I think it's looking at the quantities of certain foods. So I think a reduction to a certain degree in red meat is definitely positive, because we know for sure that a, you know, having livestock does significantly contribute to the CO2 emissions of a country.

So we know that we need to do something about that and that could be changing farming practices to a degree or it can be reducing the consumption of some of those foods. And I think it is important that we do that. So it's not, I don't think we need hard rules around, you know, You have to give up red meat entirely if you're going to make any contribution here whatsoever.

But I think it's small changes. You know, if you eat red meat five times a week, maybe just like change it to once a week or twice a week. Or if you make a stew type dish or something with meat in it, like put half the quantity in it and fill the rest up with chickpeas. It's like making those smaller changes and they all country, they all add up.

It's about being a little bit more aware of those things, but then it's one of the other studies was looking at the contribution of The impacts of climate change on different food commodities. And there was similarly kind of contributions of drivers in the opposite way.

So what foods are causing climate change as well? So not just the impact of climate change on nutrients, but things like obviously more processed foods, snack sweets, it's reducing those or limiting those to a certain degree as well. And then choosing foods. I think it was brought up in the Hannah, discussed it in episode three 20, where she talked about climate change and diet, but she was saying there's a significant difference in the emissions and how much red meat contributes to CO2 emissions compared to other animals, which makes a lot of sense.

So things like chicken and pork are much they're much less significant contribu. So to choose those meats instead, or to choose seafood instead decrease over consumption of total calories is always a good option if you're eating beyond your requirements which is obviously a totally different topic altogether.

But one of the good there's lots of guidelines and policies on how to, you know, eat better, eat more sustainable. I think there was one, well, there was one proposed the, each Lancet planetary health diet, which is rich in kind of plant based foods. It doesn't eliminate animal sourced protein, it doesn't eliminate dairy, but it is, you know, I think it's like if you, they similar to lots of other food guidelines that has a plate and the contribution of where your foods should come from.

And if you look at that, you'll see literally like 90% of it, there's maybe 10% contribution with dairy and animal source proteins, but it's things like whole grains, plant source proteins, and then your veggies and stuff. And it's shifting towards that. You know, if it's not like, you know, if that's what your plate looks like for one of your three meals a day, like even opportunity, you know, three to five times a day to, to do something like that.

It doesn't have to be every meal, but if it's more meals.

Alan Flanagan: Yeah. I think, you know, again, when we start getting into a discussion like this, where there's a lot of, it, you know, it sounds simple at the level of where, change. But we're also talking about change in a nutritional context.

And there are like additional assumptions in terms of people's food preparation skills, and then comes back to things like access. And I think the

reality is, and we see this now in population demographics of vegan diets or vegetarian diets, it tends to be people from wealthier social and economic strata that are more adherent to these diets overall. And there's a constellation of factors that feed into their ability to do it. And so it's always something that I end up thinking about. If we're talking about this level of behavior change, there are real potential limits to how far that can go at the individual level.

And that's the same, even if we're not discussing the planetary health context, if we're just discussing like, ultra processed foods and the prevalence in the population. So I think we're going to need, we're going to really need systems approaches to achieving this shift in the population, as well as people that have the ability and means.

To do these behavior changes themselves at an individual level, which is really important. And I guess it's at that latter level of the systems' approach, that I'd be more worried about relative inaction. You know, like you said, we have the Paris Agreement it's supposedly legally binding. It seems to only to be legally binding on paper you, the recent COP 26, nothing came out of that of substance more, more rhetoric more chin wagging and talking heads.

And we've got the same models models economically and socially that got us into this scenario are being offered to us as the solution to the very problem that they've got us into in the first place at the systems level. And I find that very. Disheartening because it's difficult to see how a model that created a problem is also the remedy to the same problem created by it.

But that's look I'll hand over to you for a more optimistic closing. Like where do you, other than the individual level stuff, like what. At the level of like the policies that are available or potentially being implemented, give you hope?

Niamh Aspell: I don't know. I think if we get, you know, the world's head, you know, in a headlock again, like we did with COVID and had absolutely no choice, but to respond and things that happen. But I think that we've learned a lot from that in terms of, do you know what we create a lot of plans.

We say a lot of things and there's always either, you know, obviously a lack of resource. To implement some of them, but sometimes a kind of just a lack of

action in case we do something that doesn't necessarily work out perfectly. Like we learn from COVID it's like, right, okay, this mightn't be perfect.

This is the best solution we have for the moment. And we're just gonna drive forward with it. We learn from it and then go on to the next one and keep refining things adapt. Going back to that resilience thing of adapting with the changes, testing new things and becoming a little bit more resilient to these shocks, like the fires and the, you know, the floods and whatever else there is.

I think there needs to be more of an emphasis on sustaining ourselves with food more locally. And I mean that in terms of a a national aspect or within Europe. So we obviously have agreements within Europe, like trade agreements. But if a lot of our produce is coming, you know, single commodities are coming from one particular country.

It's, it always places more of a risk there's there needs to be more disparity in terms of actual just access or a production in that, at that level of the food system and the food system. So complicated in terms of all of its different actors and drivers. And we definitely, one thing that we experienced in COVID is we had no choice to push all of these different groups together to talk to each other, to make the plans together.

And I think there needs to be more like co-design approaches to how we tackle this. And it's not just at the kind of government level. Obviously you'll see that there is a lot of work with NGOs and with farmers in this particular space, but there's lots of other, there's lots of other drivers, things like tech and innovation need to start really coming in and they are, you'll see that with the alternative proteins.

And then also with, you've got a lot more, you know, inform internet of things and technologies in the farming space now as well. That's making use of that data to, to track the policies. That's one thing as well. I think that, you know, Right. Okay. Let's clearly justify define what our KPIs here and a clear plan of how we're gonna implement them.

We don't need a 60 page policy document describing what the problem is. Just give us a, you know, if a 10 page work instruction as a country on how we can actually, you know, implement something. And if we can't implement the 10 points on the plan, okay, we can implement five and it's better than

just coming back in three years time and saying, oh, that plan, wasn't a great plan.

Let's make another plan. I think it needs to be a little bit more a little bit more action in that regard. and it's, it is coming from the, like the grind up as well. I think that's one thing we learn in crisis situations is it's the, like what community organizations are working things like food cloud in Ireland, the work that they do around food security, and food poverty is absolutely incredible example of that.

And I think it's more initiatives like that and more light being shot on those initiatives and more funding towards those initiatives where the motivations are for humanity.

Alan Flanagan: Yes. Actually I do have something optimistic to say.

Niamh Aspell: Oh God, hold on to your

Alan Flanagan: seats!

Well, I was just gonna when you said, you know, like the grass up, I did think of the recent Australian elections and those elections were so clearly a repudiation of the previous administration, which would be an administration that we could more liken to, the Tories in the UK, you know, a very, you know, fossil fuels, neoliberal, free market don't touch anything, you know, and we'll ride this till the planet literally combusts. And it was such a profound repudiation of that administration. And you look at some of the people that were elected and so many independents as well, and people for whom climate issues were it, obviously weren't the sole electoral issue on on, on the menu for people, but clearly played a significant role. It seems in terms of the candidates that were elected well done Australia. But I do think that still shows that, I'm, I will remain a believer in democracy you're right. I think that there, we can sometimes potentially underestimate the ability to not just vote with our feet as it relates to kind of individual choices, but actually vote at a ballot box to put in parties that might actually work for change, as opposed to just give the usual lip service.

There we go. That's me being positive for once . That was totally . I feel great about myself now. Well I think that might be a good place to wrap it up. Well,

thank you everyone for listening. I hope this has inspired you to either make some behavior change, don't jump hopefully things will be okay. But there will be show notes to come with this as always and relevant links and references. And Danny will be back with you in a couple of weeks.