**Klipp:** There is a heat wave of historic proportions occurring in the arctic right now.

**Klipp**: Millions of people here in Europe have been sweltering in this summer’s second extreme heat wave.

**Viktor:** The last decade was the warmest in human history.

**Klipp**: When we talk about global warming it is no longer in the future, in fact it is already here. Many parts of the world are burning up.

**Klipp**: A heat wave in Pakistan is blamed for more than 800 deaths and a state of emergency has been declared, army doctors have moved into local hospitals.

**Klipp:** The roads are melting.

**Torill:** It was like an Olympics where all the participants were doped.

**Klipp:** Records fell like dominoes today.

**Klipp:** Germany is at 42.6 C, and the temperatures continuing to rise.

**Klipp:** They are expecting the highest ever temperature recording in the south of France. It could reach 45 degrees.

**Viktor:** And it is everywhere. From Australia, to Asia, America and Europe.

**Klipp:** The Netherlands 40.4, Belgium 40.6.

**Klipp:** The temperature has crossed 50 degrees in Chiru.

**Klipp:** Everyone is at risk, including young healthy people.

**Torill:** And the Arctic.

**Klipp:** The heatwave has lit a match to the arctic.

**Klipp:** A region that is already the fastest warming place on earth due to the buildup of greenhouse gasses.

**Klipp:** The WMO is seeking to verify a new temperature record, north of the arctic circle. This is a reported 38 degrees C.

**Klipp:** The worst is still to come.

**Viktor:** The 2000's were the warmest so far and the 2020's will be even warmer. This extreme, global heat is the clearest sign that something is really wrong with the world.

**Mark**: Yes absolutely.

**Viktor:** The 20th century was the warmest yet and the 2020s will be even warmer. This extreme global heat is the clearest sign that something is really wrong with the world.

**Mark**: Yes absolutely.

**Viktor:** This is Mark Lynas, author, activist and climate adviser for the Climate Vulnerable Forum, which represents the 48 countries in the world that will be hardest hit by climate change.

**Mark:** Increased length and amplitude of heatwaves is probably the most predictable and easily comprehensible consequence of the climate emergency.

**Torill:** Even today, some countries are at the limit of what people can do. In August last year, 52 degrees were measured on the streets of Baghdad.

**Mark:** The Middle East is one of the first places that are going to become biologically uninhabitable.

**Torill:** In an article in the Washington Post, journalists in Baghdad describe how their scarves in synthetic material melt in the heat, how door handles give them blisters on their hands, and videos show how a primitive sprinkler system was set up across the streets to spray water on those who dare move outdoors. This, writes the Washington Post, is a snapshot of what awaits the rest of the world in the future.

**Watson:** There is no question that there will be more heatwaves, hotter heatwaves, and more frequent in the future.

**Viktor:** This is Robert Watson, former head of the UN's climate panel at the IPCC, in an interview with France24 from 2019.

**Watson:** We certainly have to act. Global emissions literally have to peak now and we have to be carbon free by 2050. But I see no evidence that governments around the world are willing to make the hard decisions that are needed. I think we are on a pathway to a 3 – 3.5-degree world, not a 1.5 to 2-degree world.

**Torill:** We have done several sections on global warming in the past. We have talked about the consequences: about forest fires, food shortages, water shortages, rising sea levels, species death. But we have not yet talked about the heat itself: about how it will affect our cities, our infrastructure and, above all, our bodies.

**Viktor:** So, in this section we are going to go to the core of the climate crisis – the coming heat and what it will mean for us and for the rest of the world. We will also try to find out what is really the difference between the different climate scenarios: what is really the difference between 2 degrees and 4 degrees, for example.
 **Torill:** And then we'll take a new look at what we can actually do about this.
 **Viktor:** The first thing we need to make clear to ourselves is that we are already living in the midst of global warming. With our emissions, we have today, according to the world meteorological organization WMO, already warmed the earth 1.2 degrees above normal temperature. And the planet reacts the way we knew it would.

**Guterrez:** The state of the planet is broken.

**Viktor:** This is UN Secretary-General Antonio Guterrez in a speech from the 3rd of December 2020.

**Guterrez:** Humanity is waging war on nature. This is suicidal. Nature always strikes back, and it is already doing so with growing force and fury.
 **Viktor:** We see the consequences outside our windows and hear about them daily on the news. But when it comes to the heat, it is clear that we, especially we Swedes, still have a foot left in the old world; the world where we hope for hot summers with sun – the world where we can still call a heat wave beautiful weather.

**P4 Upland:** It's nice and wonderful, this is what we long for all winter.

**Viktor:**This is from a survey P4 Upland did during the heat wave 2018.

**P4 Upland:** Everyone gets so much happier, I do not know, it's just great atmosphere, there is so much sunlight too. It's really fantastic, although it's hard, you want this. It's the best there is, that's it.

**Viktor:** But that beautiful weather is also terribly destructive, with such power and mortality that no other natural phenomenon comes close to, it is not something we need to imagine as something that awaits in the future, not even here in Europe. It has already been shown in practice.

**Brian:** How many people remember the heatwave in Europe in 2003?

**Viktor:** This is Brian Stone, professor of urban planning at Georgia Tech, in a lecture at the University of Arkansas in 2015.

**Brian:** Anyone remember hearing about this? Really just a few hands. This was the deadliest natural disaster in the developed part of the world ever. This was about 10 weeks of really hot weather in western and northern Europe and a lot of people succumbed to the heat.

**Viktor:** Many people in this case mean 70,000. 70,000 people died of the heat in Europe at the end of the summer of 2003. And one of the hardest hit countries was France.

**BBC**: In a period of six weeks from late July to the end of august over 15,000 people were killed in France by heat exhaustion, dehydration and heat stroke.

**Viktor:** In just one night, 3,000 people died in Paris alone. There are more deaths than all the victims of the attacks on the World Trade Center and the Pentagon in the United States on September 11th. In a BBC documentary from 2007, a French doctor tells about what happened.
 **BBC:** The famous black Monday when around 3,000 people died in Paris over one night. Never under the second world war did so many people die one night in Paris, even during the bombings. We were dealing things on such a scale, Paris had never had so many victims in one go.

**Viktor:** In houses and apartments lay dead people and swelled up in the heat. The mortuaries were not enough. Bodies were allowed to be stored in cold rooms or buried in unmarked graves pending identification.

**BBC:** What you see over there are the Zinc Rouges. In Paris, people were baking in there. The police were opening doors only to find corpses behind them. They no longer had anywhere to put the bodies. It was absolutely appalling.

**Viktor:** I remember very well what I did in the summer of 2003. I had just taken a driving license, I was at the Roskilde Festival. It was wonderful weather. I remember the Iraq war, the great power outage in the United States, the images of the Manhattan skyline silently extinguished. But I do not remember that 70,000 people died at home. And I do not seem to be alone in not remembering what happened.

**Brian:** Very few people have even heard of this. I can’t find a book written in any language about this. This is the deadliest weather-related disaster in a developed part of the world. 70,000 people, that’s a lot of people dying in one summer. This tells us a lot of where we are going, but we are not aware of it. So that is an acute vulnerability.

**Viktor:** I called Brian to talk about a lot of things, but also to ask... Why do we not remember this?

**Brian:** Well, there are two reasons that explains why it is not an event that many people recall. One is that it is hard to see heat mortality when it happens.

**Viktor:** The people who are hit hardest by heat waves are children, the elderly and people with underlying diseases such as diabetes, heart disease and so on. And when these people die during a heat wave, the heat is usually not written down as the cause of death, Brian says.

**Brian:** You know we have specific metrics we use to classify death. It is a bit morbid but by the time a body makes it way to the morgue or the hospital, the core body temperature will likely have cooled down. And so, if you don’t have a core body temperature that can be recorded at the hospital for example, then you will not be classified as a heat stroke victim. And so, in the immediate aftermath of a heatwave, we know that many people have died but we will not know how many people died as a product of the heat.

**Viktor:** And this was exactly what happened in France in 2003. Despite the fact that employees at the overcrowded mortuaries alerted early on what was happening, the whole disaster flew under the radar at first. Even when it was no longer possible to deny the number of dead, the government long claimed that it had nothing to do with the heat. And it was only in retrospect, through studies of excess mortality, that one could really understand what had happened.

**Brian:** And so that number you cited – 70 000 deaths – we really did not know that number until probably a year after the 2003 heatwave event. So that’s part of the issue.

**Viktor:** The other thing that makes us not remember this is that heat waves, as Thomas Jones wrote in an article in the London Review of Books, are much less dramatic than, for example, an earthquake, or a hurricane or a terrorist attack. We get no dramatic drone images of the devastation and the dead often remain unknown and faceless. Many victims in France were old people who were never identified and allowed to stay in their unmarked graves. Heat waves, writes Thomas Jones, refuse to personify.

**Torill:** In 2003, through our emissions, we had doubled the risk of such a heat catastrophe, and even then, almost 20 years ago, the projections showed that we were fast on our way to a world where this happens almost constantly.

**BBC:** By the 2040s the temperatures we saw in 2003 would be an average summer.

**Torill:** The mass death in 2003 could thus have been the alarm clock that made us take the climate crisis seriously. But as Stephen Belcher, head of research at the British Met Office, tells us in a clip from the BBC 2018, we did nothing about it, and the projections have now been confirmed by reality.
 **BBC:** And actually, we are right on track. If you look at temperatures across Europe, they are tracking that projection that by 2040s – 2003 temperatures, we are looking like they will be normal.

**Brian:** So, we are already experiencing catastrophic climate change that is episodic, and increasingly it will no longer be episodic, it will be routine. So, this event that resulted in 70,000 deaths, will be a very routine event and unfortunately, I think we will see that death toll eclipsed here, I would speculate, in the next 5-10 years.

**Viktor:** When you live as far north as we do, especially I who live in Umeå, it is easy to dismiss the threat from the heat. One might think that we have such a low average temperature that we have a buffer, but the fact is that we in the north are in many ways more vulnerable. Why is it like that?

**Torill:** We'll be getting to that soon, but first we need to talk about what's really going on with our bodies when the temperature rises around us. As you know, we humans have a steady internal temperature of about 37 degrees, and to feel good we must maintain it regardless of external circumstances.

**Karin**: We have a very narrow temperature range, mammals usually have it.

**Torill:** This is Karin Lundgren Kownatski, investigator at SMHI's center for climate adaptation, and their sector manager for care and health.

**Karin**: So, when it goes over these intervals, then like the body begins to lay down, and then it is above all the internal organs that are damaged and begin to lay down quite simply.

**Torill:** And exactly how narrow is the range our bodies can handle?

**Karin:** If you have a rise in deep body temperature up to 39 degrees, it is not that dangerous, but then it can go pretty fast. And most of the time you do not have time for yourself either, and then it is everything from being able to get a headache, feeling bad to being able to die.

**Torill:** This sounds like a pretty big disadvantage for us as a species – but fortunately, evolution has equipped us with an absolutely fantastic ability to regulate our internal temperature.

**Michael:** Humans have an exceptional capability to protect against rises in body temperature or minimize heat storage when preforming physical work in hot environments.

**Torill:** This is Michael Sawka, Professor of Environmental Physiology at Georgia Tech, from a lecture entitled The Unique Properties of Human Skin.

**Michael:** This great thermoregulatory capacity probably provides several selective advantages.

**Torill:** Michael Sawka believes that we are so good at handling heat compared to other animals, that our hunter-gatherer ancestors could be out collecting food during the hottest hours of the day, when predators had to stay in the shade. We could also hunt other, larger animals until they collapsed due to heat exhaustion.

**Michael:** And thus, then became food for the hunters.

**Torill:** And the organ that made this possible is our skin, and specifically our skin's amazing ability to 1) dilate the blood vessels and thus emit heat radiation and 2) sweat something so incredibly much.

**Michael:** Generally, it is not unusual if you are doing sustained hard work in the heat that you have a sweat rate of 1 to 1.5 liters per hour.

**Torill:** When the sweat then evaporates, the air closest to the skin cools down, the blood becomes colder and the body maintains its optimal temperature.

**Michael:** If that sweat evaporates they can have tremendous amounts of evaporative cooling, and this is why they can live in environment is higher than their skin temperature.

**Viktor:** So... as long as we can sweat and drink a lot of water, replace salt and other things that we sweat out at a furious rate, and that you protect the body from strong sunlight – then we can survive quite extreme temperatures. We have learned that the hard way through thousands of years of evolution.

**Torill:** Oh, this sounds very positive, that we humans seem to have a fantastic ability to adapt to a warmer world. But…

**Viktor:** But what?

**Torill:** There is a catch. A catch that makes large parts of the world actually on a steady course to simply become uninhabitable – where the heat will be so extreme that it is physically impossible for us to adapt.

**Elfatih:** We have done a series of three papers in the last few years.

**Torill:** This is Elfatih Eltahir, professor of hydrology and environmental engineering at MIT.

**Elfatih:** The first paper looked at the region around the Persian Gulf, the second paper looked at the region of India and Pakistan, and the third paper looked at Eastern China – the area called the North China Plain.

**Torill:** In three articles published in the prestigious scientific journal Nature, Elfatih Eltahir and his colleagues show that our emissions, if they continue, will make all these parts of the world physically uninhabitable for the human species within this century. And that's a big deal.

**Elfatih:** The area we identified in northern India in Pakistan and Bangladesh is occupied by about a billion people, so many people live there. One billion. And people who are in generally poor, with GDPs in order of 500 to 1,000 dollars.

**Torill:** The articles thus show that over a billion people risk, in the coming decades, ending up in a seat where even those who are young, healthy, and athletic risk dying within hours of pure heat... How can it happen when we people still seem to be so good at dealing with heat?

**Elfatih:** You know everyone in Sweden and around the world when they think of global warming they think of temperature, and this is the regular temperature they hear in the news everyday

**Klipp:** But now up to 20 degrees here too...

**Elfatih:** When we come talk about heatwaves and impact on human bodies as a result of global warming, we have to think about this different variable which is the wet bulb temperature, which is usually not what people are familiar with.

**Torill:** Wet bulb temperature – or in Swedish, wet temperature. It is measured by placing a wet cloth over the thermometer, is almost always lower than the usual temperature, and what it represents is a combination of heat and humidity. Why is it important in this context? Well, that reminds me of our amazing ability to sweat.

**Sawka:** People do report in the literature 2.5 to 3.5 liters per hour, I assume it is possible for a very extreme athlete for a short period of time

**Torill:** But sweat cools us by evaporating and thus cooling the air closest to the skin – just as the wet cloth cools the thermometer when the water in it evaporates. So, what the wet temperature represents is really at what temperature it is possible to cool a surface by evaporation. If it is 40 degrees hot outside but the wet temperature said 25 degrees, well then, we can cool the air closest to the skin and thus the skin to 25 degrees by sweating. If the wet temperature starts to creep upwards, the skin's ability to cool the body also decreases, and this is very dangerous.

**Elfatih:** Because live human bodies generate heat and that heat needs to be discharged to the air surrounding our human bodies.

**Torill:** Everything we do, even if we do nothing, our heartbeat, everything that happens in our brains, our breaths, our digestion. Everything uses energy that is converted into heat and that must be released.

**Elfatih:** And for that heat to be discharged the temperature of the inner body has to be larger, significantly larger, than the temperature of the skin temperature of the human body.

**Torill:** If the wet temperature begins to approach our inner body temperature, there is nowhere for that heat to take the road – not even if we sit in the shade and do nothing, and instead our inner temperature begins to rise, and we begin to simmer alive in our own bodies.

**Elfatih:** And that’s the mechanism by which human health and human survival gets impacted.

**Torill:** What has been calculated in articles published by Elfatih is that wet temperatures in these regions – parts of India, Pakistan, the Persian Gulf, and Northeastern China – could reach 35 degrees if emissions continue. At such temperatures, young, healthy strong people die in the shade within hours:

**Elfatih:** The assumption is about six hours.

**Torill:** But 35 degrees wet temperature is extreme, so extreme that it has never been measured so far in a six-hour period.

**Elfatih:** The maximum ever observed for a six-hour period is maybe around 30-31 degrees.

**Torill:** But the heat can be life threatening at much lower temperatures.

**Elfatih:** For many people, especially elderly people, you don’t need to get to those high levels. When temperature conditions are very uncomfortable, like here in Boston in July and August, the wet bulb temperature would be 23-24.

**Viktor:** Online you can check which wet temperatures are measured all over the world, and I went through the record summer 2018 in Sweden and the highest rating I could find was 26 degrees. And that summer many died, even here.

**Karin:** I think the public health authority estimates that there were about 700 people who died, due to the heat.

**Viktor:** At first, I thought this was so strange. How can hundreds of people die in Sweden when the normal temperature is at a level that would be seen as comfortable in other parts of the world? But it only indicates the role of moisture.

**Karin:** The humidity actually plays the most role for the heat balance, up to 70%, so if it is very humid it is very difficult for the body to maintain a heat balance.

**Viktor:** Sweden has an average humidity of about 80% while a much warmer country like Sudan where Eltahir comes from has a humidity of 30%…

**Eltahir:** Human bodies living in desert conditions, they will suffer from very high temperatures, but their bodies, if they drink enough water, their bodies will sweat significantly and will cool their temperature to quite tolerable ranges.

**Torill:** But humidity is only part of the equation. Another very important part of our ability to cope with high temperatures is our behavior. And in Sweden we are very bad at heat.

**Karin:** We die earlier than in other countries, we are starting to faint and we do not know how to behave.

**Torill:** In Sweden, SMHI goes out and warns of heat waves if the normal temperature rises above 25 degrees, far from the temperatures of 40-50 degrees that are worrying in many other countries. And it is simply because the studies show that this is when we begin to die.

**Karin:** Heat exposure looks much worse in countries in the south, but at the same time there is an increased sensitivity in Sweden and people start dying much earlier than they do in the south. I do not think there is any awareness of how dangerous heat actually is, and that it goes downhill quickly.

**Torill:** What, then, is it, in concrete terms, that we should be aware of? What do we in Sweden have to learn now that the earth is warming up and we too will have to deal with extremely high temperatures?

**Viktor:** Yes, Karin has some concrete tips... but first we will find out what it is like in countries that are already extremely hot.

**Ruth:** The middle of the summer in the Middle East, certainly in a place like Cairo, kind of becomes like the middle of winter in Northern Europe.

**Viktor:** This is Ruth Michaelson, a Middle Eastern fellow for The Guardian, among others. Almost ten years ago, she moved from Berlin to Cairo.

**Ruth:** So, when I think about when I lived in Berlin, you were tooling up with buying particular clothes and thinking tactically for dealing with extreme cold. In the Middle East it is the opposite, and the middle of the summer when it is very hot becomes kind of like a dead zone, where you are thinking about how to avoid the extreme temperatures outside.

**Viktor:** Just as in Sweden you cannot go out in the winter with bad clothes and think that you will not freeze to death, so you cannot go out in the summer in Egypt without thinking first.

**Ruth:** You needed to think about shade and hydration in a very deliberate way. You had to plan ahead for how your body temperature would change, and you could not just assume that it’s going to be fine, and you’ll work it out.

**Viktor:** Ruth tells how she used to come home from work for the first time in Egypt, completely dizzy and nauseous, but pretty quickly learned how to prepare to stay out.

**Ruth:** I would do things like take ice packs with me, taking enough water, and I became very dedicated, like I think many Egyptians are, to the rehydration salts that they make there.

**Viktor:** But, Ruth also had the privilege of actually being able to escape the heat with the help of air conditioning.
 **Ruth:** And of course, there are literally millions of people who don’t have the means to avoid outdoor temperatures throughout the year. And that is very much a class difference.

**Viktor:** And what do those people do?

**Ruth:** The classic is to take a very shallow dish of water, put it next to an electric fan, so that the fan will blow a very fine mist of cool water over you.

**Viktor:** However, Egypt is not the worst affected in the Middle East. It is the Gulf states: Dubai, Abu Dhabi, Bahrain, Oman, Kuwait that are the worst off today, and they will be the first states to become uninhabitable by the rising heat. Because, even though it is a desert landscape, it is actually very humid there.

**Eltahir:** Is very hot and humid, and to a large degree the temperature of these towns and cities is connected to the water of the gulf itself. And the gulf is a shallow water body and the temperature of it goes very high.

**Viktor:** So, fiery desert states right next to a shallow and very warm sea that easily evaporates…

**Eltahir**: So, if you go in places like Dubai and Abu Dhabi, Doha, these are places next to the gulf, and those conditions even today are very uncomfortable.

**Viktor:** Before the oil boom of the early and mid-20th century, many of the Gulf states consisted mostly of low clay houses, and were designed with the normal heat in place then. The oil that was discovered has not only changed the earth's climate and turned up the thermostat in these countries, but it has also led to the clay cities being demolished and replaced by glittering metropolises with large highways and steel and concrete skyscrapers.

**Ruth:** The other thing you see is a fondness for fully glazed buildings, so buildings made entirely out of glass – which of course is a complete nightmare in terms of regulating the temperature.

**Viktor:** This change in the urban landscape has become possible, and continues to be possible even in deadly temperatures, by relying on constant, maxed out AC everywhere.

**Ruth:** There is such a point of pride made of air conditioning that the AC is sometimes left to be incredibly cold.

**Viktor:** When Ruth lived in a hotel in Kuwait, the indoor temperature was often around 16 degrees, while it was 45 degrees outside.

**Ruth:** I mean I took jumpers with me and I also wrapped myself in the bed spread, I was freezing and I could see condensation on the windows.

**Viktor:** Everywhere, in all environments, she saw adaptation through AC.

**Ruth:** I went into a coffee shop and at one side they had a kind of outdoor terrace area where you could sit and enjoy your coffee with a view.

**Viktor:** But what looked like a large outdoor terrace was actually... indoors.

**Ruth:** It was entirely enclosed in a glass cube that was air conditioned. And there was something that felt very much dystopian, sort of a concession to how bad the temperatures there can get.

**Viktor:** And there are almost no limits really, for what you can do as long as you have AC. In Qatar, the football stadiums before the World Cup are designed with individual AC for each place, and on the shopping streets you run air conditioning that blows cold air outdoors so that it is possible to walk around.

**Torill:** And in Dubai there is even a ski resort with two lifts and five slopes – indoors – where the temperature is kept at a comfortable minus two degrees.

**Ruth:** The problem is extreme, and the solutions are extreme.

**Viktor:** But, I started thinking about one thing when Ruth was talking about this. I live in northern Sweden. Here it is not possible to be out for a long time in the winter without freezing to death. If I look around the neighborhood where I live, every other house has glazed patios with heat lamps. Inside the city, a kind of indoor square has been built with a glass roof that is kept heated even when it is minus 30 outside. Who are we to call the yellow countries' AC dependence dystopian or extravagant?

**Ruth:** I totally agree. I totally agree with that perspective. I think that there are some stereotypes of waste, but in the west, we are just as guilty of that.

**Torill:** So, does that mean we should learn from the Gulf states? Is AC the solution to our warmer world – even here in Sweden?

**Karin:** No! No!

**Torill:** Karin Lundgren Kownatski again…

**Karin:** Certainly not that we should be doing AC in the whole community.

**Torill:** According to a report from the International Energy Association, IEA, which came a few years ago, today there are over one and a half billion AC plants in the world. 90% of households in the US and Japan have AC, but only 8% have the 3 billion people living in the warmest countries in the world.

**Ad:** Presenting the 5-in-1 Cruze AC. It cools, heats, dehumidifies, purifies, and deodorizes. Cruze, get a good night’s sleep. Cruze.

**Torill:** And AC already accounts for 10% of the world's electricity consumption, generating emissions of 2 billion tons of carbon dioxide annually. Usage is expected to increase extremely much as the earth warms. In 2050, it is estimated that as many as five or six billion AC plants will be in operation and that air conditioning will be what requires the most electricity in the whole world after industry.

**Ad:** KELVIN! Tested for 960 hours of non-stop cooling, Kelvinator – ready for anything.

**Torill:**So, the hotter it gets, the more we use AC, the more carbon dioxide we emit, the hotter it gets, the more we use AC and so on in a kind of nightmare spiral that spins faster and faster and faster.

**Ad:** Hi everybody and welcome to another your best digs review. My name is Daniel and today we are going to talk about the best portable AC.

**Viktor:** But emissions are not the only problem with relying on AC.

**Karin:** You create a dependence on electricity and the energy system can be very easily overloaded when everyone turns on their AC. When it stops working, you have designed buildings that have large windows to the south, then it can be very dangerous. You can create very dangerous environments.

**Viktor:** And it is not just congestion that can affect the electricity grid during a heat wave. The physical infrastructure is also directly affected by the heat. A report from the Swedish Civil Contingencies Agency entitled "The impact of heat on society" says about everything from broken cold chains to grocery stores and solar curves on railways that cause trains to derail to increased aggression among people in hot environments.
 **Torill:** But most critical of what we are talking about here is that the heat has a direct impact on our electricity networks.

**[Video Clip]: Cut children's advertising for nuclear power:** Have you ever thought about how obvious we think it is that there is power when we start the TV?

**Torill:** Such an effect can be caused by the water that cools our nuclear power plants becoming too hot.

**Klipp:** This is Ringhals, one of the world's largest nuclear power plants

**Torill:** Reactor 2 at the ring neck, for example, was made so that it would shut off if the water temperature reached 25 degrees, the report states…

**Klipp:** The cooling is done with water from the sea, this is the water that is usually called the cooling water.
 **Torill:** And what was the highest measured temperature of the cooling water before the reactor closed a year ago? 24.5 degrees.

**Klipp:** What if we suddenly got no power? If everything turned black. So boring.

**Torill:** Then the heat causes power lines to expand – both in the ground and in the air. And this leads to a greater risk of power outages. Wires start to hang down over vegetation and there is an overhang.

**Torill:** The conductivity itself gets worse if the wires and transformers risk overheating and simply laying down.

**Brian:** This is probably the greatest growing threat to populations in the US.

**Karin**: It is a country where you air-condition everything, and if you then get a power outage, it becomes very dangerous.

**Viktor:** Brian Stone has researched what would happen to different cities in the United States if the power went out during a heat wave. The more AC, the greater the disaster.

**Brian:** If you have a combined heat wave and black out event, in Phoenix for example, you could have potentially a million people get sick and die. And so that is a climate driven health threat on an order of magnitude that we’ve never seen or contemplated in the US. And there are other parts of the world that are even more vulnerable to this.

**Viktor:** Kuwait, for example, if the current runs on a hot summer day.

**Ruth:** That would be deadly. That is a deadly level of heat potentially, even at night. It is almost unfathomable to think about. Really... the level of destruction something like that could cause.

**Viktor:** Increasing AC use in Sweden and getting us used to being able to control and set the temperature in our homes is thus perhaps the worst thing we can do to adapt to climate change. But what should we do instead?

**Karin:** There are lots of other solutions, and then I have looked a lot at the personal level and what strategies can be used there.

**Viktor:** Step one is to simply become aware that heat is dangerous and adapt their behavior to the temperature.

**Karin:** Studies have shown that applying good recovery strategies, drinking water, spending time in the shade can make a huge difference to your health. So, it's like the first step really. Then after that you can systematically cool down parts of the body, neck, hands and feet for example. It can be very effective in getting rid of heat.

**Viktor:**And AC has a role, for example in hospitals and some nursing homes, says Karin. And in the future, perhaps also as special rooms, systematically scattered in cities, where people can go if it gets too hot. As a shelter, against the heat.

**Karin:** So that not everyone, like everyone else, cools down their homes with air conditioning, but that you have a place where you can go that is air conditioned, within a tenant-owner association, or within a residential area, for example.

**Torill:** When it comes to urban planning, there is actually a lot you can do to bring down the temperature without AC – and it has to do with the somewhat strange fact that cities are much warmer than areas around them.

**Brian:** You have something you call the urban heat island effect.

**Torill:** The urban heat island effect.

**Brian:** And that is a physical phenomenon through which cities modify their own temperatures, and that is almost always in the direction of enhanced warming.

**Torill:** This is the subject that Brian Stone is an expert on. Among other things, he has written the book The City and the Coming Climate and is researching how cities can be designed to be cooler. But... what is it that makes cities warmer than the countryside?

**Brian:** Essentially when we create a city, we modify the physical landscape. In my part of the world, in the southeastern US, that means we are removing tree canopy.

**Torill:** Trees cool their surroundings. Partly through the shade from the foliage.

**Brian**: But also, through evapotranspiration, so the release of water.

**Torill:** Just like us humans, when we sweat.

**Brian**: So, when trees transpire, when they release water it cools the air around them.

**Torill:** The more a city grows, the more trees tend to disappear, and the fewer trees, the warmer it gets. Then it continues...

**Brian**: Then we come in and we pave over the landscape with streets and parking lots and buildings, and that greatly enhances the capacity of that landscape to absorb and retain heat.

**Torill:** Dark asphalt, tarred roofs, concrete buildings – all this absorbs the heat and keeps it. And in especially large cities, the high-rise buildings help to capture the heat as in a valley.

**Brian:** We sometimes describe this as downtown urban canyons where you have high vertical surfaces from large buildings. That will trap outgoing radiation from the surface and that will increase warming.

**Torill:** The fourth and final major cause of hot cities is what we humans do in them.

**Brian:** So, any time we drive a vehicle we release a great deal of heat energy.

**Torill:** And all the AC appliances that are on hand spin in the homes, yes, they may cool the inside but they heat the outside.

**Brian:** AC in buildings mechanically removes heat energy and injects it into the atmosphere.

**Torill:** The size of the effect varies, of course, between cities, but it is not uncommon for a city to be up to 10 degrees warmer than its surroundings, says Brian. But even inside the city, the temperature can vary greatly depending on the number of trees, roads and houses.

**Brian:** So, if you have a large urban park for example, that can be almost as cool as a rural area. And so, you have hotspots within a city, so your location within a city can really drive your exposure to the heat island, and also your vulnerability to heat illness.

**Torill:** Cities make up only about 1 percent of the earth's land area, and in climate context, Brian says, temperatures measured in cities are counted as statistical deviations. But since more than half of the earth's people live in cities, we must consider the extra heat increases of cities in the consequences of global warming.

**Brian:** It is reasonable to assume that whatever the global effect is, the urban effect will probably double it. That is what we see in the US. That heat islands tend to double the background global warming effect, if that makes sense.

**Torill:** And this is awful on the one hand. This means that the majority of the world's population lives on the percentage of the surface that is twice as hot from global warming. But on the other hand, it is actually hopeful...

**Brian**: Because so much of that warming is driven by the physical character of the city itself, that empowers cities and city governments and even residents of cities to take action that can physically and directly cool down the environment.

**Torill:** Global warming requires global efforts. But this extra warming in cities, cities can fight completely on their own by planting trees, creating more parks, painting the roofs white, changing how to build houses, closing roads and so on, says Brian.

**Brian:** So as one example, in my own city of Atlanta, Georgia in the US, if we were to aggressively try to manage the urban heat island effect through tree planting and using more highly reflective building materials, we could fully offset what we think is the projected increase in heat mortality in Atlanta over the next 50 years.

**Viktor:** But when I asked Elfatih Eltahir about this, he was skeptical. The trees may cool to the usual temperature, but since they do this by releasing water, it can become more humid and then you can instead get an increase in the wet temperature.

**Eltahir:** Yes, in term of temperature greening of cities could have a positive impact, but in term of the wet bulb temperature that is not necessarily the case.

**Viktor:** Anyway: everyone we talked to agreed that we need to find strategies to deal with the warmer climate around the world: it's bad today and it's getting worse and worse with each passing year. But how bad will it be? How many degrees will we reach and what will be the consequences?

**Mark:** Yeah, so my most recent book is called Our Final Warning – Six Degrees of Climate Emergency.

**Viktor:** It was to find out that I contacted Mark Lynas.

**Mark:** Actually, it was a sequel to a book called Six Degrees that I published in 2007.

**Viktor:** Almost a decade and a half ago, he wrote a book that went through what climate research showed would happen when the earth warmed.

**Mark:** Basically, it is going through the degrees: 1 degree, 2 degrees, 3 degrees, 4 degrees, 5 degrees, 6 degrees, looking at what the consequences for planet earth would be if we allowed it to heat up by that amount.

**Viktor:** The reason he published a sequel last year is partly that so much new research has been published, but also that we are now actually living in the future that the first book described.

**Mark:** One degree was in the future then, and now it is the present. So, we’ve actually moved forward a chapter or a degree. So, some of the projections or predictions that were made then are now testable.

**Viktor:** And how well does today's reality agree with the first book's hypotheses?

**Mark:** Well... some are considerably worse.

**Viktor:** He takes the coral reef as an example. In 2007, we worried that warmer seas would lead to coral bleaching that could kill reefs.

**Mark:** That was sort of projected to happen annually by between 2030-2050 in a 2-degree world, now it is happening annually already on the great barrier reef. So back to back severe bleaching episodes for the last several years. And those have destroyed over half of the coral reefs now.

**Viktor:** Another example is the hypothesis that one degree of warming would mean more destructive hurricanes and tropical storms.

**Mark:** So, this last year in the Atlantic basin there were more storms than they had names for so they had to move into the Greek alphabet, because they got right through the Latin alphabet. Which is really quite extraordinary. There were times where you could look at the satellite pictures and there would be 4 or 5 named storms, all churning away in the tropical Atlantic at the same time, so really quiet off the scale.

**Viktor:** We now know what 1 degree means in practice. Unfortunately, it is not so simple that you can double it and get 2 degrees: the damage increases rather exponentially and at 2 degrees: which we are estimated to be able to reach within 10 years if the emissions continue, the Arctic will be ice-free and much of what we took up in other dystopia episodes will begin to be our reality, says Mark. Tens of millions of people will be fleeing famine and fire, and small island nations will be submerged.

**Mark**: That’s why when I am working with the president of the Maldives, we have to keep saying that we have to get into the 1.5 pathway because ultimately with even 2 degrees the Maldives will not survive.

**Viktor:** But up to 2 degrees we will still be able to adapt, in one way or another, says Mark. At three degrees it will be difficult, and 4 degrees he does not think humanity will be able to cope.

**Mark:** The 4-degree world is a planet where I don’t think civilization can continue in its current form. It is not a world which could support 9 to 10 billion people with rainfed arable agriculture. The bread baskets would effectively burn and turn to dust. It is not a world where there is sufficient fresh water.

**Viktor:** A four-degree warmer world is also the one that Eltahir talked about earlier. That over a billion people are affected by a heat that is simply impossible to survive.

**Mark:** It is a world where large areas of the Middle East, North Africa, China, South Asia, East Asia become biologically uninhabitable because they are past that thermal tolerance threshold for humans.

**Viktor:** In his review of Mark's book in the New York Review of Books, reviewer Bill McKibben’s stays here, at 4 degrees. He writes, quote:

"I'm not going to care so much about Lynna's description of what happens at five degrees or six. It is not that it is far-fetched – it can happen, especially if humanity does not change course – it is that it becomes pornographic. If we ever get even close to those levels, the living will really wish they were dead”.

But I, who had not had time to read the book, became curious...

**Mark:** Well, one of the things I found quite peculiar was that…

**Viktor:** The computer models that go through the consequences for the earth in detail at 2,3 and 4 degrees do not exist in the same way for 5 and 6 degrees, according to Mark, so instead you have to look at the research that exists about the earth's geological history.

**Mark:** So the original 6 degree kind of worst case scenario was based on the end of the Permian, which was about 252 million years ago which was a period of time when huge volcanic intrusive eruptions across what is now Siberia intruded into coal seams and basically vaporized a lot of fossil fuels.

**Viktor:** In any case, it is one of the latest theories in research.

**Mark:** And that pumped up atmospheric CO2 and led to 6 degrees of very rapid warming and there was associated with that the mass extinction of about 90% of the life on earth.

**Viktor:** Emissions of greenhouse gases during that mass extinction 250 million years ago are believed to have happened very quickly, just as Mark says, but then people talk about fast in a geological perspective. The emissions that we humans are causing right now on earth are happening much, much faster.

**Mark:** Yes, that is true. We are emitting carbon into the atmosphere at least in an order of magnitude, 10 times, probably more, faster than was associated with the worst mass extinctions in earth’s history. These volcanic eruptions released a lot of CO2, but over millennia. We are doing potentially a trillion tons over a hundred years. And that has probably never happened in the history of the earth.

**Viktor:** And should the temperature rise rapidly to 6 degrees, complex beings that humans would not survive.

**Mark:** But I also wanted to understand if we could destroy life completely, and basically turn the planet into Venus with a run-away global warming effect.

**Viktor:** And would that be possible? Do we humans have the power to destroy all life on the planet? According to Kate Adamala, the astrobiologist we spoke to in the section on extraterrestrial life, the answer was no. But Mark is unsure…

**Mark:** If you burn all of the fossil fuels you could probably do it. If you very quickly put a huge amount of greenhouse gas into the atmosphere, tip the planet into a really extreme greenhouse state, then you can basically boil off the oceans and get all that water into water vapor which is another greenhouse gas, that goes into the atmosphere, and you lose hydrogen from the top of the atmosphere into space, and you eventually become a dead, hot planet, which is more or less what happened to Venus. So, if you really wanted to destroy life on earth in its entirety, that would probably be the way to do it.

**Viktor:** But so far Mark – or anyone else really – does not think it will work…

**Mark:** You can more or less discount the 5- or 6-degree warmer world. And I don’t think that could happen. Maybe in a world that was entirely run by Donald Trump and Jaer Bolsonaro.

**Viktor:** But even then, it would require a very large and dedicated effort to reach 5 or 6 degrees, says Mark. In 2016, Donald Trump went to the polls to crush what he called the "war on coal" and promised more and larger coal power plants – but he failed.

**Mark**: The market has not pushed that way in the US. Clean power has become cheaper than dirty power and the Trump administration has not been able to turn the clock back on the sunset of the fossil fuel age however hard it has tried.

**Viktor:** So, what do we have for the probable span of future worlds during our lifetime? In his book, Mark writes that our current path risks taking us to 2 degrees already this decade and four degrees already in 2075 – thus potentially during our lifetime. But – a sign of how quickly things can change is that the information in the book is already out of date today.

**Mark:** There is actually a useful website called the climate action tracker…

**Viktor:** Climate Action Tracker is a kind of ongoing scientific analysis of what is being done to reduce emissions in the world. Based on the prevailing climate policy in the countries of the world, you get a projection of where we will be in the year 2100.

**Mark:** And they have actually revised that downwards.

**Viktor:** Something seems to have finally started to move in the world. Based on new policy decisions in the countries of the world, our future during this century is between: 3.9 degrees at worst and 2.1 degrees at best. And as the famous German climatologist John Schellenhuber said: The difference between the two is human civilization. When we reach the upper part, it's over, but the lower part is still a world we could adapt to. What is it that makes it now within reach?

**Torill:** Well, that most of the world's largest economies have promised to be fossil – free within a few decades.

**Mark:** Even China. Xi Jinping announced 2060 as their net zero goal. European countries 2050 thereabouts. The Biden administration has said 2050 as well. So most of the major emitting economies are now looking at 2050 as a sort of net zero date.

**Torill:** And if the countries keep their promises, then we have a chance, says Mark Lynas.

**Mark:** That is a very different kind of planet from the worst-case scenario which would have seen increasing emissions right across the rest of the century. So, if this happens we can get at least in striking distance of 2 degrees.

**Torill:** An illustration of how much has actually changed in a very short time is the transformation of the British Prime Minister Boris Johnson. Just five years ago, he wrote in The Telegraph that the fear of global warming was primitive and without any grounding in science. And about the fact that our emissions drive warming, he wrote, quoting: "We humans have become so vain and self-loving that we truly believe that the fate of the planet lies in our hands." Final quote. Now, just before Christmas 2020, it sounded different.

**Boris:** My message to you all is that together we can use scientific advances to protect our entire planet, our biosphere against a challenge far worse, far more destructive than even than coronavirus. And by the promethean power of our invention we can begin to defend the earth from the disaster of global warming. Together we can reduce our emissions, we can radically cut our dependence on fossil fuels, we can change our agricultural practices and in short, we can reverse the process by which for centuries humanity has been quilting our planet in a toxic tea koozie of greenhouse gasses.

**Torill:** In the UK, petrol and diesel cars will stop being sold within 10 years, the investment in wind power will quadruple and half a billion pounds will be spent on developing new nuclear power plants. All of this has caused Johnson's climate-denying supporters around the world to lose their temper.

**Sky:** What on earth has happened to Boris Johnson, this is the so-called conservative party – the party of Margaret Thatcher.

**Torill:** This is the host of the Australian Sky News who interviews the British columnist Brendan Oneill.

**Sky:** What has happened to this bloke.

**Brendan:** Boris is becoming a bit of a disappointment in recent months. His backtracking on his climate change skepticism. He wants to get to zero carbon, and he wants to lecture Australia about winding down its industry, it is very disappointing. I think that power has gone to his head and he is being sucked into to the conformist political view.

**Torill:** And how in the world did this really happen?

**Mark:** Well in the same President Obama used to oppose gay marriage, but society changed. I think it is the same process that has happened. That most political parties and most world governments now accept that we have to do this.

**Viktor:** But society does not change automatically. Our values, whether it is same-sex marriage or the climate, are not on a long conveyor belt that is steadily and by itself pushing towards better times. And I know Mark Lynas does not believe that either. Because when I did a little background check on him, I discovered something very interesting from his past.

**Mark:** I have done a lot of different things.

**Viktor:** In the mid-90s, he was deeply involved in an activist group that opposed genetically modified crops. Through direct action, they tried to get people so negative about GMOs that politicians would ban them.

**Mark:** We had several tactics. One was to demonize them in the public sphere and make people scared of them. The other was to destroy the crops in the ground and to go out in night and the daytime and just trash them. Destroy the experiments, chop the fields up, everything like that.

**Viktor:** Mark and the other Anti-GMO activists were incredibly successful. People began to be afraid of genetically modified crops, politicians knew where the wind was blowing, picked up the activists' arguments and regulated GMOs extremely hard.

**Mark:** That was incredibly successful, everyone still things GMOs are a bad thing and almost none of it is grown in Europe. So, huge success for direct action.

**Viktor:** And a huge setback for science, for starving people and for our ability to deal with the consequences of climate change.

**Viktor:** Um… Eh… how do you feel about being eh…

**Viktor:** It was a bit hard to ask the question...

**Viktor:** Partly responsible for Europe’s anti-GMO stance today?

**Mark**: I have changed my mind a 100% on the GMO thing, so I now look back on our success as a failure. Because we blocked a technology which could save lives in a very direct sense, if you look at nutritionally enhanced crops like golden rice, and can also be an important part of the adaptation to climate change by having more drought resistant or thermally tolerant crops, none of which can be done now because everyone is terrified of GMOs. And yes, I am partly responsible for that. I have made my apologies and my life’s work and life’s hope during the last decade is to try to be part of a more pro-science green movement.

**Torill:** But the frightening example from Mark's past really only shows that activism is a value-neutral tactic that can have a completely decisive effect on which path society takes – for better or worse.

 **Mark**: Activism at its best changes what is possible to vote for. You can change the window of what is politically possible, the Overton Window it’s called, and if you drag that in the right direction you make it possible for political parties to do much more radical things than was conveyable before you did your actions.

**Torill:** And Mark believes that good, well-thought-out actions from groups such as Fridays for Future and Extinction Rebellion have contributed to a change in the climate issue, even like Boris Johnson. But he is very critical of less well-thought-out actions.

**Mark:** The last thing that XR did here in the UK was targeting the press, the media

**Torill:** The reason was, according to Mark, that they did not think that the media companies reported fairly on the climate threat.

**Mark:** They closed down the printing presses for some of the newspapers. Not only did that alienate the journalists as a whole, because no journalist is going to stand up for closing down a printing press. It also left them accused of censorship and anti-freedom.

**Torill:** If you do actions in the wrong way without thinking about how they will be received, you risk having the exact opposite effect, says Mark.

**Mark:** Some of the actions they did like stopping the tube trains in London... At the time of the morning they were doing it was mostly working-class people going to poorly paid jobs. And it just didn’t look good, because they were sort of middle-class hippies stopping working class people from getting to work. So direct action really is theatre, it is drama, and it has to look right, it has to feel right to be effective.

**Viktor**: Fourteen years ago, the UN Climate Panel IPCC published its fourth report on climate change. When the British author John Lanchester, as you heard in the section on China, wrote about the report in the London Review of Books, the first line read, quoting: "It is strange and striking that climate activists have not yet committed any terrorist acts." Lanchester's point was that the IPCC's report was so terrible that it could drive anyone to anything, if they really understood the magnitude of what was happening.

**Mark:** Fortunately, that has not happened. If there is one thing that would be absolutely guaranteed to backfire it is any kind of use of violence. It is always, always counterproductive.

**Viktor:** The most important thing you can do as an individual, according to Mark, is something much more conventional.

**Mark**: So even as an individual, I would say the most important thing you can do as an individual to vote for a party which promises to implement emission reduction policies.

**Viktor:** And then preferably in the form of concrete bills.

**Mark:** There is a lot of grumbling now in the UK about, they are not going to let us buy nice petrol cars anymore? That kind of stuff. But when it is done and the laws are in operation everyone will do it, it then becomes socially unacceptable not to. And in fact, you get punished, that is what laws are for.

**Torill:** But Ruth Michaelson, for example, is skeptical of politicians who promise action, at least if the action is several years in the future.

**Ruth:** The timeline is really important. So, it matters whether politicians are saying, well we will do it by 2050 – at which point it is too late. We will do it by 2030, okay that is better but that is still 10 years and we are already starting to see the effects of fossil fuels right now.

**Torill:** Politicians, Ruth believes, must show that they are serious by clubbing and implementing decisions now – not just handing over the implementation to someone else in the uncertain future.

**Ruth**: That requires a certain kind of political will, to take difficult but necessary decision in the short term, rather than kicking the can down the road to your potential successor that will have to deal with that.

**Viktor:** So, our fight against climate change must be waged on two fronts. In the political sphere we must train ourselves so that we can vote for the politicians who are best for the climate, we must also help to educate others and try to steer public opinion to a place where the politicians in power dare to make the difficult decisions as quickly as possible.

**Torill**: The second front is our preparation for the coming heat. We simply have to start equipping our communities, our buildings, our workplaces, our homes and our infrastructure for a warmer world, and not pretend that we can solve everything with more AC.

**Karin:** We are not prepared. But we start well, I think the experience from the summer of 2018 still plays a big role. That we start developing action plans and such. But at the same time in terms of population... a lot depends on how you behave, and the Swedish population is not really there.

**Viktor:** Right now, perhaps the most important thing we can do is to change our minds. On the one hand, to really realize that the world and the climate we live in have already changed forever and that nothing will ever be the same again.

**Brian:** If you are under the age of 35 for example.

**Vikto**r: Brian Stone again.

**Brian:** You have never experienced a global climate that is normal, but you have been raised in a culture that does not recognize that. So, we need to 1) accept that the climate is irrevocably changed, it has changed in a way that is threatening to us. And we need to allow ourselves to experience some grief for that lost world. And we need to plan our day to day lives and our futures to anticipate an unstable and increasingly dangerous climate.

**Viktor:** The second thing we need to understand is that it is actually we who decide. What we do this year, 2021, and the rest of the decade will determine whether humanity can continue to live on earth. If we do not understand it, and just continue as usual, what we are experiencing right now will be the beginning of the end.

**Brian:** It is very comforting to categorize or compartmentalize climate change as a future phenomenon. And we really no longer have that luxury. It is the principal theme and challenge of our lives moving forward, and so I encourage people to not only take it seriously but to fully educate yourself on it and examine how you need to structure your lives to cope with it.

**Viktor**: You have listened to P3 Dystopia with me Viktor Hariz.

**Torill:** And me Torill Kornfeldt

**Viktor:** A list of sources is available at sverigesradio.se/dystopia and if you want to discuss this or other sections, you can come to our Facebook group P3 Dystopia after-talk. This episode was written and produced by me with the help of Torill in December 2020 and was recorded in January 2021 here on Swedish Radio Västerbotten in Umeå... Sound fixing and mastering was handled by Björn Nitzler.

See Ya!