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SEB Sustainability Training on Climate Change

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Imagine Sahara.
Annual average temperatures over 29 degrees Celsius. Only fifty years from now, if we don't cut our emissions of greenhouse gases substantially, one third of the world population could be living in areas with Sahara-like temperatures, covering one fifth of the Earth's land surface *(Xu et al. 2020).*

That is a future no one wants. The world's nations agreed in Paris 2015 to act decisively and limit global warming to well below 2 degrees above pre-industrial levels *(United Nations 2015).*

We can all contribute to the sustainability transformation needed. But this work needs to be based on the best available science, so that we know what we are doing, and so that we act on what truly matters.

In this talk I will condense decades of research and present the latest findings, to equip you with the knowledge that everyone should have about climate change.

First of all, climate change is already affecting both people and nature.

It's difficult for science to attribute a specific weather event to climate change, but we can conclude that the number and intensity of extreme events are increasing as a result of global warming.

Here are some examples from the United in Science report of 2020:

Hurricane Harvey, one of the most devastating hurricanes on record, caused more than 125 billion dollars in losses when it hit the Houston area in the US in 2017. Human influence increased the amount of rainfall associated with this hurricane by about 15%.

During the East Africa drought of 2016/2017, 6.7 million people in Somalia were food insecure. This drought was strongly influenced by warm sea-surface temperatures in the western Indian Ocean, amplified by global warming.

Of course, drought and heatwaves substantially increase the risk of wildfires. The three largest economic losses on record from wildfires all occurred in the years 2016-2020. The abnormal heat in January to June 2020 was at least 600 times more likely as a result of human-induced climate change, leading to unprecedented wildfires in the Arctic region.

In Eastern Australia, more than 10 million hectares were burnt. The likelihood of the weather conditions that led to those wildfires has increased by at least 30% since 1900.

We are also losing species and ecosystems at an alarming rate, undermining the life-support systems we all depend upon.

And all of this is happening already at a global warming of 1 degrees Celsius compared to pre-industrial times (IPCC 2018). One degree might not sound much, but this is a global annual average, which is not evenly spread across the planet. The warming is faster over land and by the poles – the Arctic is already 4 degrees warmer (NASA GISS).

Let's look at the change in temperature since the last ice-age. We are here.
And this is where we are heading, if all countries do everything they have promised so far to do to curb emissions (IPCC A1B scenario). Fulfilling every promise would lead to 3-4 degrees average warming by the end of the century (Climate Action Tracker 2019), a temperature that the Earth hasn't experienced in 3 million years (Burke et al 2018).

What would that mean? A sea level rise of at least 60 centimeters, maybe even 1.3 meters (IPCC 2019), flooding coastal cities and islands, and threatening salt intrusion in ground water. Ecosystems like coral reefs will collapse, and new diseases are expected to emerge.

Drought, heatwaves and melting glaciers would affect access to water and food, increase fires, and make many places inhabitable for people. We do not know how people would respond to such a world, but conflicts and large migrations are not unlikely.

To get a feeling for the magnitude of a 3 degree change, note that three degrees colder means ice age.

In this picture, I would also like you to notice the stability of the period in which our civilizations have developed – a geological epoch called the Holocene. This is the kind of climate that we know we can thrive in. And now we are putting it at risk.

But, hasn't the climate always changed?

Let's go a bit further back in history and have a look.

A key driver behind this warming was discovered already in the 1800's – CO2 in the atmosphere cause a greenhouse effect, which is amplified by our emissions.

In this chart we see global average concentrations of CO2 in the atmosphere over the past 800,000 years (Our world in data 2020. Source: EPICA Dome CO2 record (2015) and NOAA (2018).

The periodic fluctuations in CO2 concentrations we see coincide with the onset of ice ages (low CO2) and interglacials (high CO2). These fluctuations are caused by changes in the Earth's orbit around the sun and the tilt of the earth axis, called Milankovitch cycles. Over this long period, atmospheric concentrations of CO2 did not exceed 300 parts per million (ppm).

But with the Industrial Revolution and the rise of human emissions of CO2, we see a rapid rise in global CO2 concentrations. For the first time in over 800,000 years, concentrations did not only rise above 300ppm but are now well over 400ppm, levels not seen in 3 million years (Willeit et al. 2019).

In a business-as-usual scenario, we are heading for concentration levels between 750 and more than 1300 ppm by 2100 (IPCC 2018)

It's not only the level of CO2 in the atmosphere that matters, but also the rate of change. Historical changes occurred over centuries or even thousands of years. It took us only a few decades. In fact, half of the emissions occurred after 1990. This gives species, planetary systems, ecosystems and us much less time to adapt.

So, where do emissions come from?

This is the CO2 concentration 1850 (Global Carbon Project 2019). Our burning of fossil fuels and production of cement have added an equivalent of 207 ppm. Our land use (industrial agriculture and forestry) have added another 96.

But as you can see in this picture, only about half of these additions have ended up in the atmosphere. Oceans have absorbed 25 %, vegetation on land have absorbed 30%, and they continue to do so.

Our living planet has acted as a buffer, maintaining the stability of the Holocene climate. But we now see signals that this capacity is threatened.

I will never forget the moment when a colleague of mine came into the office, with the results of his research group's latest analysis. His face was grey as he showed them to us, asking, "How do we share these numbers with the world without causing panic?". What they had found was indicating that so called tipping elements could be triggered by global warming, and further accelerate it out of our hands. The results were eventually published.

What I will show you now is very new research from the frontiers, and follow-up studies might come to nuance this picture, but because of the severity of the consequences, we need to take these mechanisms into account.

Earth system scientists have so far found 15 elements on the planet that help regulate the climate, either by cooling it like the ice on the North and South poles, or by absorbing the greenhouse gases, like the forests. But now, nine of these now show signs of weakening, and if they are pushed too hard, they can tip from stabilizing the climate, to accelerating the warming (Lenton et al. 2008, 2019).
Let's start in the Arctic. Ice is white and reflects heat, but when it melts it becomes darker and absorbs more heat.

The increasing melting affects the Atlantic circulation, which in turn affects rainfall patterns.

Forests like the Amazon absorb carbon dioxide, but when they dry up they can catch fire and release that stored carbon into the atmosphere, causing even more warming. In the Amazon, this development is accelerated by producers of soy and beef, who clear the forest for farming. Another group of colleagues traced the money behind these activities, and found a handful of large institutional investors to be involved.

In a way, they hold the key to our future in their hands, through their choice to fund these activities or not. Because at a certain tipping point, the Amazon loses its capacity to create its own rain, and slowly but surely turns into a Savanna, releasing carbon into the atmosphere instead of absorbing it.
Recent studies show that 40% of the forest is now in a state where it could become a savanna (Staal et al. 2020)

The boreal forests and peatlands here in the North are equally important. The 2020 fires in the Arctic region released 244 megatonnes of CO_2 (Copernicus Atmosphere Monitoring Service, 2020). And when the permafrost melts, it releases methane, which is another potent greenhouse gas, accelerating the warming.

So, these elements are approaching tipping points and they might trigger each other. We are probably not there yet, but this a risk we face unless we bend the curve of emissions and stop the erosion of critical ecosystems very soon.

So, what can we do about this?

First, let me emphasize that stopping human development is not an option. As we all know, in spite of the fantastic progress of human development, many people still don't have access to basic resources.

1/10 in the world live in extreme poverty (UN SDG report 2020) experience severe food insecurity (UN SDG report 2020)
and lack electricity (UN SDG report 2020)

1/4 lack basic sanitation (UN SDG report 2020)

And almost half of the world population are still not connected to the internet (UN SDG report 2020)
When the covid-19 pandemic hit in the beginning of 2020, causing planes to stay on the ground, factories to stop and people to stay at home, some people saw this as a chance for the climate to recover. But the daily emissions only dropped by 17%, back to the emission levels of 2006, with negligible effects on the rate of global warming. And as we speak, emissions are on the rise again (Le Quéré et al. 2020).
So what we need to do instead, is to shift our economy so that it meets the needs of all within the capacity of the planet.

We need renewable energy, sustainable food systems, fossil- free transports, and green buildings. We need circular industries and we need to restore our ecosystems.
And we need to move fast.

As a rule of thumb, the world needs to half emissions every decade, and richer countries need to go faster. This is the Roadmap to rapid decarbonization.

Because If we are to stay at the 1.5°C threshold (as agreed in Paris), and minimize risks of accelerating warming through these tipping elements I described, the atmosphere can absorb no more than 420 gigatonnes (Gt) of CO2, as concluded by the IPCC in 2018. Since around 42 Gt of CO2 is emitted globally every year, this budget would be used up in less than ten years.

Instead of waiting years to act and then drop directly to zero, professor Johan Rockström with colleagues (Rockström et al 2017) suggest that we follow a Carbon Law Path, halving emissions every decade. This idea was inspired by Moore's law observing that computer capacity doubles every two years. Compared to that, the carbon law is actually pretty slow.

At the same time, we need to turn agriculture from a source into a sink, maintain the natural carbon sinks, and develop new ones. To date, no artificial carbon sinks are able to remove carbon from the atmosphere at the necessary scale to fight global warming, which is why we need to maintain the Earth's capacity of carbon sequestration.

Luckily, it is technically and biophysically possible to do follow the Carbon Law. The exponential roadmap report investigates existing, scalable solutions to achieve the first halving. In sector after sector, it is within reach. In the meantime, we can develop the solutions needed for the second halving.

Energy supply – let's look at the energy sector first, responsible for 18.5 billion tons of emissions. There is no room in the budget for investments in new carbon dioxide-emitting energy systems. But wind and solar are on an exponential trajectory and are now cheaper than fossil fuels in many places, enabling the first halving, together with more efficient use of energy.

Industry – here, the first halving would be achieved by shifting to more efficient material use, recirculation and better management of refrigerants.

Let's look at the potential of *nature based sinks* – with reforestation, biochar and improved agricultural practices nature could help us store up to 9 billion tonnes of CO2 annually.

Food consumption – finally, shifting to plant-based diets and reducing food waste would ensure that a growing world population get the food they need while emissions decrease.

And this shift can in many cases generate economic growth and create jobs.

The global economic benefit of a low-carbon future is estimated at 26 trillion dollars by 2030 compared with staying on the current high-carbon pathway (The New Climate Economy 2018).

In Sweden, GDP has increased about 50% since 1990. At the same time, emissions from production in the country have decreased almost 40%, and even emissions from consumption have fallen, by 20% (Our world in data 2020).
However, it is all about the content of economic growth. See here, how emissions fell during the financial crisis, only to bounce back as soon as the economy recovered. It is particularly important after a crisis, to really build back better and invest in a better future for all.

To conclude,

- Humans are changing the climate – through burning of fossil fuels and land-use

- The preconditions for our civilization are at risk – we are approaching tipping points
- Basic human needs are not yet met – stopping human development is not an option
- All of humanity can thrive within the capacity of the planet, and the shift is technically and biophysically possible.
- Important steps are already being taken, but we need to accelerate the transformation
- The decisions we take now will influence the generations to come – it is up to us to create the future we want and we are all needed in this journey.

Our generation can make or break the sustainability transformation.

Thank you!