

TBP01x - 1.1 - Why develop a biobased economy?

Welcome in the first lecture of this MOOC on technology for biobased products. I would like to start by investigating with you the drivers behind the transition to a biobased economy. Where do we stand now, and what do we do it all for?

What is the necessity?

There are more than 7 billion people on our planet, and this number still increases every day.

Together, we are facing a number of challenges.

We form enormous amounts of waste. Not only physical waste, but also waste that we release into the atmosphere.

A build-up of greenhouse gases induces a global climate change causing long droughts in some places and severe flooding in others.

With the ice-caps melting, you can see that this guy doesn't feel very happy anymore.

These changes in the natural world increase pressure on ecosystems, leading to a loss of biodiversity.

But despite all these changes, in the end we still want to live, have fun and innovate. We go to shops to buy food, clothes, household products, electronics.

Many of these products use scarce minerals and fossil material, while we are facing a depletion of these resources.

So where does this all bring us?

The first question we need to answer is: "Are fossil resources really running out?" So far oil production has increased steadily over the years. And based on population growth it should increase in the coming future to satisfy the needs. However, most forecast scenarios predict that there will be a decrease in oil production, resulting in a gap between supply and demand.

And if that is not a big enough driver, you could also argue that oil will become more expensive.

In this study, published by the US energy information administration, the reference case shows a steady increase in oil price in the next 30 years. But they also predicted a scenario where the price rises even faster. The third scenario shows a more constant oil price.

Of course these are merely predictions. However, the idea that the oil price will rise is by itself enough to induce change.

Then there is the climate argument. In the latest report by the IPCC, the International Panel on Climate Change, we see the contribution of different fossil resources on the concentration of CO₂ in the atmosphere.

We have just crossed the 400ppm barrier. This means that already, our atmosphere contains 1.5 times more CO₂ than before the industrial revolution. There are different scenarios for how this will affect global temperatures.

Some more frightening than others. You can argue about the exact numbers, but the bottom line is that there is a correlation between the use of fossil fuels and our climate.

There is a range of sustainable alternatives for fossil fuels. Wind and solar energy, for example, are abundant and we are becoming increasingly more efficient to use their power. However, there is one very important observation that I want to share with you.

Wind and sun provide us with energy in the form of electricity, to power our houses and electric cars. But they cannot provide us with mass, with the carbons, or organic molecules.

Carbon is essential for making tangible products such as paints, plastics and pharmaceuticals.

Currently this comes from fossil resources. You do not need to be a chemist to realize that this is where biomass can be a valuable alternative.

This brings us to the biobased economy. From a fossil based economy, where a lot of the products, energy, fuel and what we see around us is based on fossil resources, we are going to a biobased economy where we use renewable non-fossil feedstocks.

How would you define the 'biobased economy'? This definition by the European Commission resembles many definitions used worldwide.

The source of biomass, as you can see, is quite broad: land as well as aquaculture environments.

They are converted into products, energy and public goods. But how does this differ from our current oil based economy?

When oil is combusted, CO₂ sealed underground for tens of thousands of years is released into the atmosphere.

When biomass is combusted, the amount of CO₂ does not increase. This is because the living plants, in fact, extract CO₂ and convert it into oxygen and organic material, contributing to a circular economy.

The use of biomass can solve a number of problems and the drivers for this transition can be regarded from different angles. The first is an economic one. We already saw the uncertainty in the oil price.

You can address this by offering biomass as an alternative source.

Two is energy security, where uncertainty about the availability of crude oil drives decisions made by politicians. The sustainable production of biofuels from biomass can, for example, circumvent dependence on oil imports from foreign countries. Then there is the environmental driver. Studies show that the use of biomass can result in a net lowering of greenhouse gasses.

We will spend a separate lecture on how that mechanism works, because to evaluate that you need to look at the whole chain, from biomass to transport to production etcetera. Next is the demographic driver of a growing and increasingly wealthy population that requires more raw materials. Agriculture is the starting base for most people living in rural areas. Balanced rural development can position the growth of the biobased technologies and economy in a sustainable manner.

The challenge is to foster an innovative biobased economy that is technically feasible, profitable, and socially desirable. In addition to the provision of food, fiber, and energy, agriculture also contributes to poverty reduction and economic development by providing employment in and income from value chains.

Thus with food as a driver, we can add sustainable value to the food chain.

I have a very nice picture of that.

If you look at the use of biomass, and here you see an image of a corn plant, then you see that the nutritional cob can be used for food. But in fact there is lots of biomass left over, and this material can be valorised into more valuable products: biobased products like bioplastics, biomaterials and biofuels. Meanwhile, the carbon dioxide that is released is incorporated into new biomass. The important message here is that the biobased economy does not compete with food, but rather includes it.

So what is a biobased product?

According to the European Commission, these are non-food product derived from biomass (plants, algae, crops, trees, marine organisms and biological waste from households, animals and food production). Biobased products may range from high-value added fine chemicals such as pharmaceuticals, cosmetics, food additives, etc. to high volume materials such as general bio-polymers or chemical feedstocks. I am sure you all know an example of a biobased product, whether it's a bioplastic coke bottle or medicinal extracts from plants.

There are actually many examples of biobased products, which are produced on a large scale.

So what technology is needed to convert corn, sugarcane or woodchips into biobased products? The answer is biotechnology, and in the next unit I will introduce you to this topic.