

Narrative investment theme
'Transformative Bioeconomies: Towards a
materials transition that phases out fossil
feedstock'



Towards a materials transition
that phases out fossil feedstock

We use materials everyday

Materials are all around us. Just like food they are an indispensable part of our everyday life. We wear them, sit on them, drive in them and live in them. In our modern society, we use different types of materials: glass, cement, bricks, metals, etcetera. In this Investment Program we focus on a specific type of materials, the materials that are based on carbon.

Carbon-based materials are made from fossil feedstocks and biomass.

Up till now, both fossil feedstocks and biomass are the main suppliers of carbon-based materials. Presently much used biomass-based materials are cotton in textiles, wood in paper and board, and wood in building and interior applications. However, many of the carbon-based materials we have become so accustomed to, are made from fossil resources, mostly from the oil that is also used to produce petrol and diesel. Fossil feedstock-based materials are for instance polyester (in textiles and bottles) and the plastics used in packaging, automotive, and many interior products. In addition paints and glues and the composites in bicycles, wind-turbines and busses, are often of fossil origin.

We need more than a phasing-out of fossil energy

The phasing-out of fossil feedstocks as energy carriers has become a very pressing issue because we need to reduce CO₂ emissions in order to combat climate change. At the end of their life-cycle, fossil-based materials are also likely to result in CO₂ emissions, which urges us to reduce their use and impact. Phasing out fossil feedstock means that we need to find other ways to make a significant part of our materials, maybe develop new materials, and also to be more caring and aware in our attitude towards the materials we use every day. Without the abundant availability of the cheap and versatile feedstock provided by fossil oil, we are going to face a tough future to clothe ourselves and furnish our homes.

What about circularity?

Circularity is often promoted as the solution for a sustainable future; using less stuff, repairing and reusing products, and recycling as the final end-of-life step. Circularity will definitely need to play an important role, but it can by no means fulfil our total future materials demand. Part of the materials we use get lost during the use phase, due to wear and tear. Also, materials may get contaminated during their use, and they generally degrade on a molecular level during use, which makes them unfit for easy recycling. Circularity is therefore only part of the solution to our future materials use.

We have three technological pathways for making fossil free carbon-based materials

For the sourcing of fossil free carbon-based materials there are three, and only three, technological options: using biomass, applying CO₂ capture and utilisation technologies, and

using recycled materials. None of these three options alone can fulfil our future materials demand, we are going to need all three of them. In addition to producing materials in a different way, we can address sustainability challenges by being more caring about the materials we use and using less materials in general.

Many solutions are not yet mature

There are promising solutions for alternative production routes towards our materials, but they are in a different stage of development. Some of the materials based on biomass have been used for millennia (e.g. cotton, wool and wood). Others have been introduced more recently, such as bio-plastic packaging materials (made from PLA) and natural fibre reinforced composite materials. However, there also exist many options that are still in an early stage of development (e.g. building new molecules from CO₂ or recycling textiles). It will definitely take many years before they have developed into mature technologies, and many may not reach a mature stage at all, because they run into hurdles that cannot be easily tackled.

A materials transition requires changes in social systems as well

Changing our ways of producing and using materials is not just a matter of technological development; scaling up and successful market introduction asks for interaction with other stakeholders such as financiers, other companies, government and eventually also the consumer. This implies that in the transition towards fossil free materials each of us has a role to play. However, because we are often dealing with long production and value chains, it is difficult for each stakeholder to realize their potential power to change things. Changing the logic of the way in which stakeholders interact with each other in a specific sector usually also requires changes in policy, legal rules, financial (dis)incentives, organisational models and cultural norms.

A materials transitions requires collaboration and involves struggle

Successful transformation requires effective collaboration and coalition formation among those that support change in a particular direction, and it may well include struggle with those who strive to maintain the status-quo. Alternative options compete with fossil-based production infrastructures that are fully optimized, and supported by powerful companies and international lobbies. In addition, there is still considerable uncertainty and disagreement about what a fossil-free materials sector could and should look like. There are many questions that remain unanswered, and considerable tensions about how the costs and benefits of new material production systems should be distributed.

Cross-disciplinary systems research is needed

The materials transition requires a combination of (bio)chemical, technological, agronomic, ecological, social, economic, financial, policy and legal solutions, as well as insight into how to link these and bring them about. Thus, the materials transition requires a holistic system's perspective that fosters effective integration of knowledge from several fields and disciplines, including expertise and perspectives from societal stakeholders on whom transition in society eventually depends critically. As there are many unanswered questions and interdependencies between various options, there is a need to somehow collaborate in formulating questions and lines of investigation, and to ensure that new insights are relevant and become actionable for societal stakeholders.

New methods and approaches for collaboration are needed

Although cross-disciplinary research can be valuable, relevant disciplines and bodies of expertise often operate in isolation and are not connected. And even when they meet, researchers and stakeholders with different backgrounds speak different languages and frequently do not see how they can connect their expertise and/or steer their activities in directions that are useful for others. This leads to sub-optimal learning in transition trajectories, resulting in slow progress. Many of the existing methods for systems research and collaboration remain rather abstract and offer little specific guidance on how widely diverging disciplines and bodies of expertise can integrate their knowledge and collaborate effectively. Especially the translation towards a perspective of action of individual stakeholders has received little attention so far. New methods and approaches are needed to effectively link science and society in the context of transformative ambitions.

The investment theme addresses imagination, maturity and collaboration challenges

Imagination challenges: We explore the potential of new technical, nature-based and/or social-institutional principles and options that are still far from application in society, but may contribute to a materials transition in the long run. We involve various disciplines and societal stakeholders in selecting promising options.

Maturity challenges: We support already existing initiatives in society in identifying and tackling the challenges they meet in scaling technical, nature-based and social-institutional solutions that contribute to a materials transition. Thus, we support learning in these initiatives, which makes them more competitive and mature in their struggle to reduce the use of fossil feedstock.

Collaboration challenges: Overcoming maturity challenges requires ways of working, struggling and co-learning together among stakeholders, as well as constructive interaction between scientists and societal interest groups. In this investment theme we are especially interested in new methodologies, concepts, tools and modes of working that can help bridge different disciplinary and/or societal fields of experience, and/or that support decision-making and strategy development towards further investment and scaling. The methods that we develop are oriented to support systems thinking.