

BUSINESS SWEDEN



INSIGHT SERIES 2019

MATERIALS OF THE FUTURE

TRUTH 2: ENVIRONMENTALLY FRIENDLY -
SUBJECT TO RESERVATIONS?

Materials engineers are always on the lookout for the next big thing. But customers are increasingly playing an instrumental role in shaping the innovation paths and materials that transform everyday life. In collaboration with Swerea, Sweden's world-class research group, and trend analyst firm Kairos Future, Business Sweden presents a special report in nine parts about the race for stronger, lighter, more sustainable, absorbable – and fully connected materials.

INTRODUCTION:
TRENDS AND TRUTHS IN THE
MATERIALS RACE

TRUTH 1:
DRIVEN BY CUSTOMERS FROM
HEAVEN AND HELL

Demanding customers who want more and pay less are a strong incentive for rapidly developing, new and better materials. This will lead to a future with higher degrees of collaboration with customers in order to understand their needs, ideally before they are aware of them themselves.

TRUTH 2:
ENVIRONMENTALLY FRIENDLY –
SUBJECT TO RESERVATIONS?

The materials of the future are obviously designed in environmentally friendly ways with lightweight, energy saving and low-carbon emissions at top of mind, but how simple will it be to recycle them? Complex, tailor-made materials place high demands on future recycling facilities.

TRUTH 3:
IN THE SHADE OF THE FOREST

The forest is a natural source of raw materials for much of what is made using oil today. Nations rich on forests have great potential for developing new, advanced materials industries based on raw materials.

TRUTH 4:
HYPER-DESIGNED

There is no reason to believe that the trend towards more intensively designed and customised products will slow down, quite the opposite. In future, materials may even be designed all the way down to atomic level in order to meet increasingly high demands.

TRUTH 5:
CONNECTED

Sensors can already be found on many products today, but in the future they will be embedded in materials to a far greater extent as woven fibres, smart coatings, conductive nanotubes or in other forms. The materials will be able to report fractures, overheating and other issues via the Internet of Things.

TRUTH 6:
BORN AT THE CROSSROADS

It is increasingly difficult for a single party to develop sophisticated and advanced materials. The materials of the future are therefore rarely born from a single company but in the interaction between several different parties, each with their own expertise, requirements and areas of strength.

TRUTH 7:
CREATED BY NEW PIONEERS

New players from the IT and space industry, among others, are beginning to drive material developments to a larger extent. They can often afford to manage major collaborations or, if necessary, develop what they need themselves. Pioneers from other areas are entering the materials industry, both as partners and as competitors.

MATERIALS OUTLOOK 2020:
WHERE ARE WE HEADING?

Join us as we explore the seven truths about the materials race in depth.
Go to www.business-sweden.com/en/Invest/industries/new-materials

MATERIALS OF THE FUTURE, TRUTH 2

ENVIRONMENTALLY FRIENDLY - SUBJECT TO RESERVATIONS?

The materials of the future are environmentally friendly by design – lighter, requiring less energy, free from hazardous toxins and chemicals and produced in environmentally friendly ways. They are also extremely sophisticated and designed for special purposes, so that they can be optimally used for as long as possible.

Until we discard them

In a world of increasingly advanced and customised materials, ranging from custom-made alloys to composites and sandwich structures, it is becoming increasingly difficult to recycle everything we produce. In order to remove carbon fibres or metals used in advanced composite structures we need recycling technology that does not exist yet. Perhaps we need to develop completely new material recycling systems in order to manage the complex materials we use, if that is even possible.

The dilemma is this: new materials are being created faster than we can invent systems to recycle them. The survey conducted by Swerea/RISE shows that the development of new materials has accelerated faster than recycling possibilities. Almost half (45%) of respondents have seen major changes as new materials emerge in the form of alloys or composites, but fewer than four out of ten find that recycling systems have kept pace with this development.

The impact is not being felt quite yet, but if new material development continues to accelerate faster than material recycling, it could take decades before we are able to recycle the materials churned out from today's laboratories. Short product life cycles exacerbate the problem as

there is less and less time from product development to recycling – and there are no adequate recycling systems when products wear out, in some cases leaving no choice but to place valuable materials in landfill.

In addition, different industries have requirements making it harder to recycle materials from one industry to the next. Many different variants of the same material are used in order to meet changing demands and expectations. If future materials are to be properly environmentally friendly in a circular economy, both recycling and reuse need to catch up. In this context, the survey respondents appear to be hopeful.

73%

of survey respondents believe that the materials of the future will become much easier to recycle. But only half as many, 36%, took the view that materials have become easier to recycle over the last ten years.

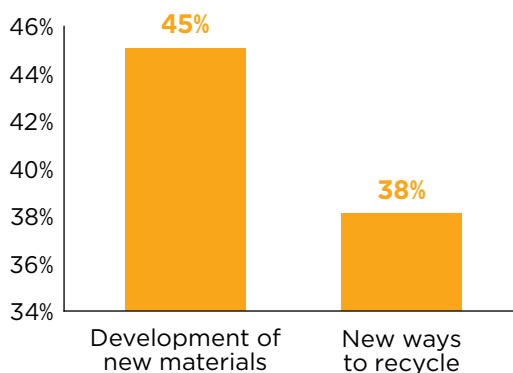


Figure 1: Percentage of survey respondents who have seen major changes in new materials development compared to development of new recycling methods.

Of all the developments observed around material and material use in the last ten years, the field of recycling has virtually stood still. The volume has increased but technologies largely remain the same. Most have not seen any changes at all and one out of five experts from the survey found that materials have become harder to recycle. If we are to take advantage of materials, we need to develop better technology, both for recycling and reuse.

Creating smart concepts that make materials suitable for a broader range of applications is one possibility, improved technology for disassembling and recycling composites is another. A third solution would be to simply to design durable products that are easy to repair and reuse over and over.

This requires an equal measure of new technology and a new business culture to make it easier for customers to arrange necessary repairs. Looking ahead, this is perhaps exactly why some experts advocate big, sweeping changes to recycling – seven out of ten believe that future materials will gradually become easier to recycle. One in five state that they will become substantially easier to recycle.

This is the single biggest difference between the past and the future – according to the survey most materials will continue to be developed at around the same rate as before. By all accounts, recyclers have their foot on the accelerator. But the trend isn't taking a clearly defined path, especially as materials continue to change in all sorts of ways.

Nine out of ten experts believe we will see more customised and intensively designed materials that perhaps cannot be used for more than one application. The question remains whether recycling indeed can catch up, even if there is a strong acceleration of efforts.



IF WE ARE TO MEET THE SUSTAINABILITY GOALS IN THE SHORT TERM, A LARGE PART OF THE SOLUTION WILL BE USING THE RIGHT MATERIALS IN THE RIGHT PLACE.

Anders Breitholtz, Managing Director,
Material Connexion Sweden

60%

of survey respondents believed that material development can strongly contribute to streamlined resources and a reduction of raw material waste.





Cotton is challenging to produce, both for the economy and the environment. The search for a good substitute has been ongoing for a long time but could be found in lyocell, a cellulose-based material. It is made from fast-growers such as eucalyptus or bamboo, and is manufactured using reusable chemicals to prevent release into the environment. The material feels cool against the skin, absorbs moisture and is durable. To date, it is often used in mixed fibres with other materials. But what other opportunities may arise in a cellulose-based future?

WASTEFULNESS IS OVER

Materials are valuable. An alternative to recycling, at least in the short term, is to be frugal with them and careful as to how they are used. Many of the survey interviews confirmed that efficient use of materials will be a key factor in future material development, partly to push prices and costs down but also for environmental reasons.

“Resource efficiency and less waste of raw materials” was considered to be the largest societal challenge that materials could help solve, through recycling or better housekeeping. Perhaps this could be a way to ensure that future materials are environmentally friendly – to simply use less of them.

The need to be prudent and cut back on material use is unmistakable within many companies and organisations, and on a global level. The blunt reality is that we are facing the risk of certain materials running out, or at the very least becoming much more expensive to recover.

Additionally, only a third of respondents in the survey believe that rare materials will be completely or almost completely substituted in the future. This can be interpreted in real terms: two-thirds of products that rely on such materials would possibly no longer be manufactured in the event of severe scarcity, or at least not with the same quality as today. Cotton and rare earth metals are mentioned as two key materials that may be in critically short supply in the future.

64%

of survey respondents considered one of Sweden's major strengths to be its leading position within environmental care, sustainability and recycling.

STRATEGIC RECOMMENDATIONS

- Companies should view recycling not as a requirement but as an opportunity. Producing easily recyclable products reduces the cost of raw materials over time. It is often worth considering doing more research on how new materials can be recycled before they are manufactured on a large scale.
- The conflict between developing specialised materials and recycling is a puzzle that all companies must solve. Consider the trade-off between them and whether there is any way in which to combine the two factors.



**EVERYTHING CAN BE RECYCLED,
IT IS JUST A MATTER OF COST.**

Christer Forsgren, Head of Technology and Environment, Stena



(RECYCLED) STEEL GAINS A FOOTHOLD

Gaining a strong position in sustainability and recycling is considered to be of high competitive value when it comes to new materials development and manufacturing. This could be a unique strength in a world where recycling is increasingly difficult as materials become more niche, specialised and complex.

The pattern here is clear. Experts are agreed that this is the way forward despite strong Swedish pride in steel and forestry. At the same time, the recovery of raw materials in Sweden is the least popular strategy in a list of twelve proposals, with only a fifth of respondents stating strong support for such activities.

YEAR 2030: NEW MATERIALS, NEW CHALLENGES

As with many materials, new composites came from space – or at least from the space industry. Materials specifically designed for rockets and satellites have filtered down into industries on Earth and the second space age has given materials a certain cool factor.

Words such as *unobtainium* ended up on everyone's lips, along with other materials used in cars, homes and refrigerators. But many of these materials were never intended for mass production and we have yet to discover a cost-effective way in which to recycle them on a large scale.

The complicated alloys of yesterday can easily be separated. But how do we recycle something that has been hardened enough to withstand the vacuum and radiation of space without damaging sensitive properties? Recycling methods are now advancing, but make no mistake – new challenges are constant and must

SPOTLIGHT ON RECYCLING

- Closed Loop Fund is an American investment fund of USD 100 million managed by companies such as Coca-Cola and Walmart. The fund is intended to improve sorting and separation of various materials in order to streamline recycling.
- One of the most expensive components in an LCD TV is the liquid crystals in the screen. As such, TVs are very complex and difficult to take apart, and nearly impossible to recycle in an efficient way even though many of the materials are precious and worth recovering.
- SanSac builds sustainable houses using composites consisting of recycled plastic with wood fibres from packaging, collected at recycling stations.

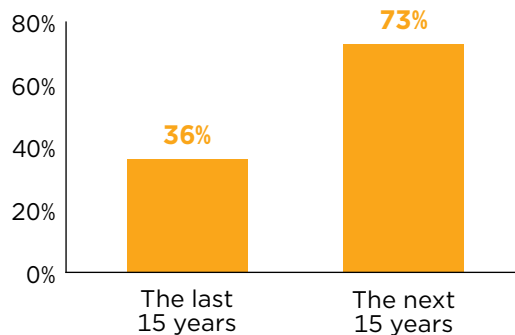


Figure 2: "Materials have become/are becoming easier to recycle". Percentage of respondents who agreed with this statement looking back 15 years and forward 15 years. More than twice as many believe materials will be easier to recycle in future.



SWEDEN – A NATION RICH IN FORESTS AND MINERAL RESOURCES

Sweden is Europe's leading mining nation and a global forest industry giant. These natural resources formed the bedrock for Sweden's industrialisation. And they remain important today. But times are changing. Digitalisation is eroding demand for newsprint and new technology is driving innovative applications for traditional metals and high-tech metals. Sweden hosts mineral deposits like graphite, lithium, rare earth metals.

The shift towards sustainable development and renewable materials is transforming the forest industry to a stronger orientation towards higher value products. Innovative companies are using Swedish wood to develop new bio-based materials such as barrier films, chemicals, carbon fibre, textile fibers and other applications with industry-changing potential.



ABOUT THE AUTHORS

Swerea: Swerea is the Swedish research group for industrial renewal and sustainable growth. Our mission is to create, refine, and convey scientific results in the areas of materials development, production and product development. We work in applied science, with extensive industrial knowledge and experience of how research results are translated into practical use. Our five research institutes exist at roughly a dozen towns in Sweden and France, and we have a network of over 700 member companies and 3,000 corporate clients. We create greater competitive power for Swedish industry. From October 1, 2018 two thirds of Swerea is acquired by RISE Research Institutes of Sweden, and one third will form a new research institute, Swerim.

Kairos Future: Kairos Future is an international consulting and analysis firm that helps companies take leaps towards the future. Through trend and scenario analysis and support in innovation and strategy, we help customers with the big picture and the direction for the future. Kairos Future was formed in 1993, our head office is situated in Stockholm and we have partners worldwide.

Business Sweden: Business Sweden helps Swedish companies grow global sales and international companies invest and expand in Sweden. We ensure that international companies can rely on our knowledge, experience and extensive network to identify new business opportunities and achieve an accelerated return on investment. Business Sweden is present in 50 of the world's most promising markets and owned by the Swedish Government and the industry, a partnership that provides access to contacts and networks at all levels.



We help Swedish companies grow global sales and international companies invest and expand in Sweden.

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