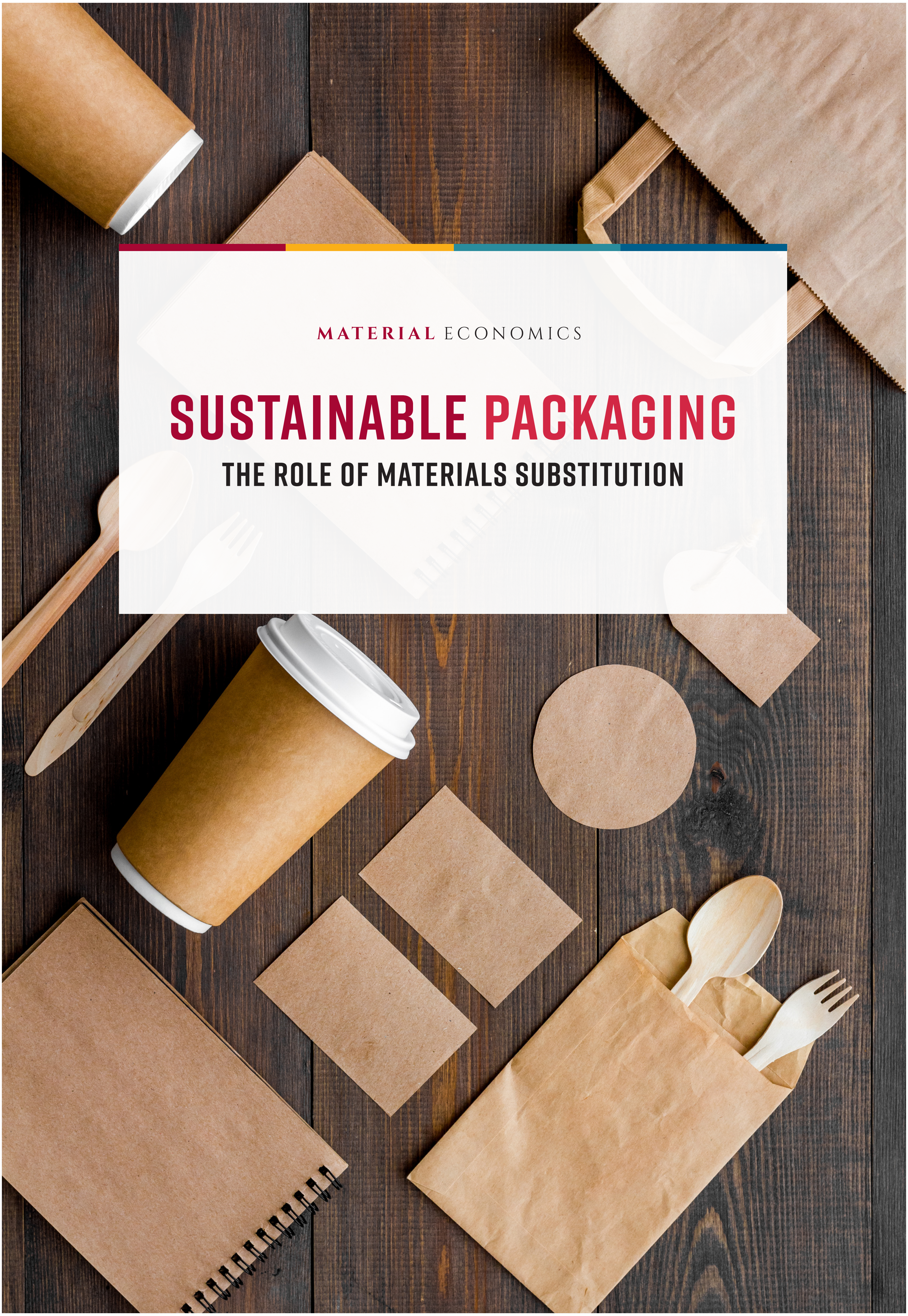
MATERIAL ECONOMICS

SUSTAINABLE PACKAGING

THE ROLE OF MATERIALS SUBSTITUTION



EXECUTIVE SUMMARY

This article summarises a study performed by Material Economics on behalf of Stora Enso, looking at the role of materials substitution in reducing lifecycle emissions from plastic packaging. The key conclusions were as follow:

- **Modern packaging solutions** are essential to efficient logistics and retailing. At the same time, there is increasing concern with the environmental impact of packaging, from littering and leakage to world oceans, to their climate impact.

- **Plastic packaging** in particular has recently been in the limelight. Plastics have many properties that are essential to packaging. However, they are also fossil materials that are challenging to fit into a future low-carbon economy. Indeed, even as other emissions falls, EU CO_2 emissions from plastics packaging are set to double to 2050 on current course, from 43 to 85 Mt CO_2 per year. While 43 Mt are just 1% of EU 2016 emissions, 85 Mt in 2050 would claim 30% of the remaining emissions, given a 95% reduction target from 1990's levels.

- **To address this,** multiple approaches are needed. Increased recycling is a necessity, but even in a stretch scenario would only solve 30-40% of the problem. Likewise, low-emitting production of plastics will be needed, but can be very resource intensive. By one estimate, making just EU packaging plastics CO_2 free would require 560 TWh, or 80% of all electricity produced from renewable energy sources in the EU today.

- **This study investigates** switching from fossil to renewable materials as a complementary strategy, one that is surprisingly absent in current discussions. Specifically, the study finds that replacing plastics with wood fibre has significant promise, for two main reasons. First, as a renewable material, fibre is much easier to render CO_2-neutral. Indeed, just current EU and industry targets would cut 65% of emissions from fibre production, whereas those from plastics fall by just 20%. Second, there is significant substitution potential. We find that 25% of current plastics use in packaging could be replaced, without significant compromise on functionality. Seen in this light, substitution would not be about replacing all plastics, but reserving their use to areas where their properties are indispensable, while turning to renewable materials where possible.

- **Companies such as** brand owners and retailers can start already now to consider materials substitution alongside recycling and other options to bring about sustainable packaging for their products. Policymakers in turn can recognise the role of renewable materials among the menu of solutions required for climate targets.

The article lays out these arguments in further detail.

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SUSTAINABLE PACKAGING – AN UNSOLVED CHALLENGE

Packaging is a major feature of all modern economies, enabling efficient logistics and preventing waste of food and other valuable goods. At the same time, packaging might be the most tangible example of a throw-away, linear economy. We generate twice our own weight in packaging waste every year – almost half a kilo of paper and board, plastics, steel, aluminium, and glass per person and day. With these volumes, making packaging sustainable clearly is imperative.

Plastics packaging in particular has generated considerable debate. The European Parliament recently voted in favour of a ban and reduction targets for a number of single use plastic products, including packaging items such as fast-food containers made of expanded polystyrene, following increasing concern about the issues of plastics waste entering the oceans. Globally, another 100 million tonnes of plastic waste is set to enter the oceans until 2025, and famously a continuation of current practices would see more plastics than fish in the world oceans by 2050. Additionally, microplastics are increasingly recognised as a concern, accumulating along food chains and posing risks to ecosystems.

Equally concerning is the climate impact of plastic packaging. Plastics are made from fossil oil and gas, and significant greenhouse gas (GHG) emissions are created both during production, and when plastics are burnt at end of life. In the EU, current practices would see net GHG emissions double, rising from 43 to 85 million tonnes (Mt) of CO_2 per year by 2050 (Exhibit 1). Most of this is emissions from production but changing end-of-life management, driven primarily by targets to phase out landfilling, will lead to increasing net emissions from incineration. As fossil materials, the incineration of plastics is an increasingly high-carbon source of energy even as the energy system as a whole needs to cut fossil fuels.

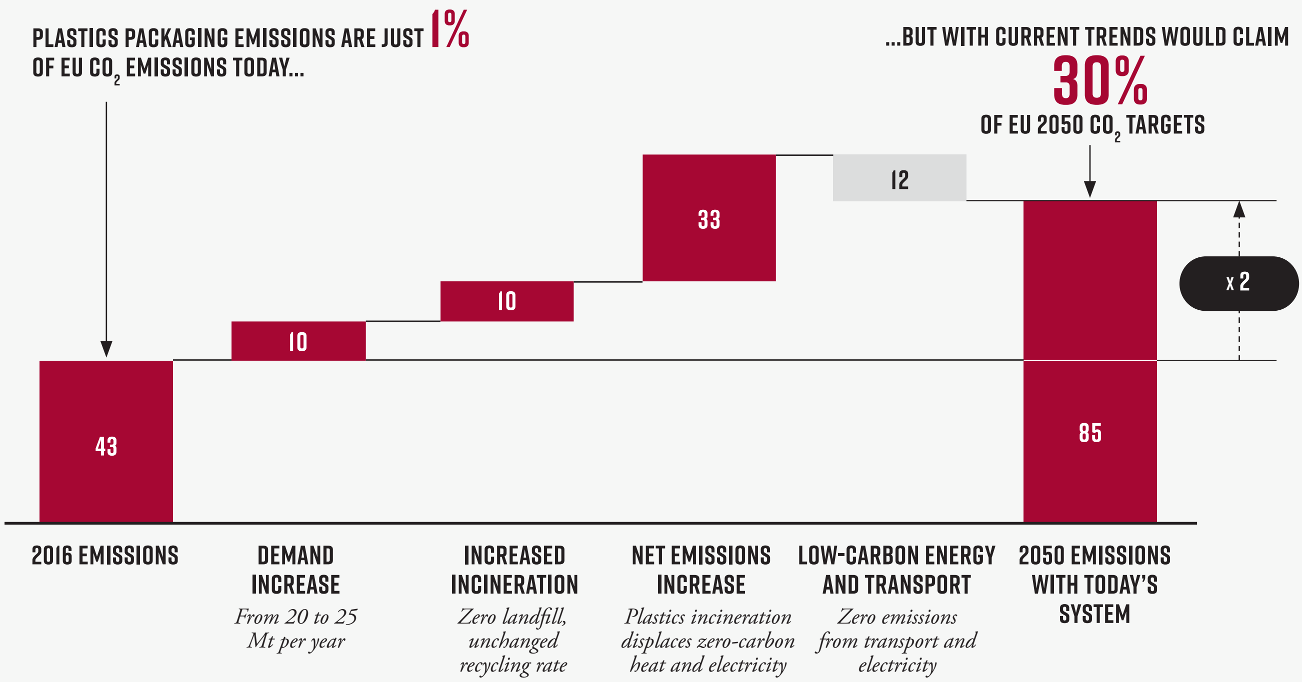
In the context of EU climate commitments, these will be large emissions. The objectives set out in the Paris Agreement imply close to zero emissions around mid-century. While 43 Mt are just 1% of 2016 EU emissions, 85 Mt in 2050 represents a full 30% of the remaining emissions, just from plastics packaging. Globally, the International Energy Agency (IEA) project that petrochemicals will make up more than a third of oil demand growth to 2030, more than transport, shipping or aviation, further adding to the challenge of curbing emissions from plastics.

These are deep dilemmas. Some properties of plastics are close to unique and doing without them is hardly an option. Instead, we need improved practices that reduce and ultimately eliminate the conflict between plastics use and environmental objectives.

Exhibit 1

BUSINESS-AS-USUAL EMISSIONS FROM EUROPEAN PLASTICS PACKAGING IN A FUTURE LOW CARBON SOCIETY

EU PLASTICS PACKAGING EMISSIONS - Mt CO_2e PER YEAR, 2016 AND 2050



SOURCES: MATERIAL ECONOMICS ANALYSIS BASED ON DATA FROM PLASTICSEUROPE (2017, 2018B), DELOITTE AND PLASTICS RECYCLERS EUROPE, EUROPEAN ENVIRONMENT AGENCY (2016, 2018), EUROPEAN UNION.

CURRENT APPROACHES ARE LAUDABLE BUT NOT SUFFICENT

Current discussions tend to focus on *increased recycling* and *decarbonised new plastics production* as the main ways to reduce CO_2 emissions from plastics packaging. These are both indispensable, and if anything current efforts need to be pushed further still. However, even with stretch assumptions about their impact, it is very hard to believe they will be sufficient to achieve Paris-compatible emission levels.

Let us first look at recycling. Mechanical recycling cuts CO_2 emissions sharply, as re-melting plastics releases only a fraction of what is created when making new plastics – and moreover avoids the end-of-life emissions. For all these advantages, a hard look at current recycling rates reveals significant limitations.

Currently, the reported EU recycling rate for plastics packaging is 40%. However, this tells us only how waste is classified, not how much useful material is actually produced. Plastics Recyclers Europe reports 'yield losses' of 40% in sorting and recycling. Similarly, recent research on waste management in countries such as Sweden and Austria show that less than half of the separately collected packaging plastics actually gets recycled.[1] Even when recycled plastics is put on the market, its quality limits the uses so that it cannot fully replace new production.

Accounting for all these factors, the *effective recycling rate,* i.e. the ability to replace the production of new equivalent plastics, is likely in the span of 10-15%, far lower than the 40% reported in official statistics (Exhibit 2).[2]

To assess the potential of mechanical recycling, we developed an ambitious scenario with 70% collection rate, halved yield losses, and very high quality to the point where recycled plastics can replace new plastics at a ratio 1:1.2. To get there requires major changes: a significant improvement of collection and sorting systems, a wholesale push towards design for recycling, a reduction of the number of different plastics used, a standardisation of additives, and regionally integrated markets for secondary plastics. If achieved, 37% of virgin plastic in packaging could be replaced with recycled content – three times the amount today. This is clearly an important contribution, but nonetheless far from the whole answer.

Given the limits to mechanical recycling, new plastics production will continue to be an important supply of packaging plastics. However, making virgin production truly CO_2-free is an extremely challenging prospect. By one estimate from the CEFIC and Ecofys 2013 roadmap for European chemistry, some 560 TWh of zero-carbon electricity would be needed just to produce the amount of plastics used in packaging. This is a staggering amount, corresponding to 80% of all the electricity produced from renewable energy sources in the EU today. With more still required for other plastics uses, and zero-carbon electricity required in everything from new steel production to electric vehicles, securing such large amounts of electricity is very challenging. It also would be costly: producing plastics would cost 70% more than it does today.[3]

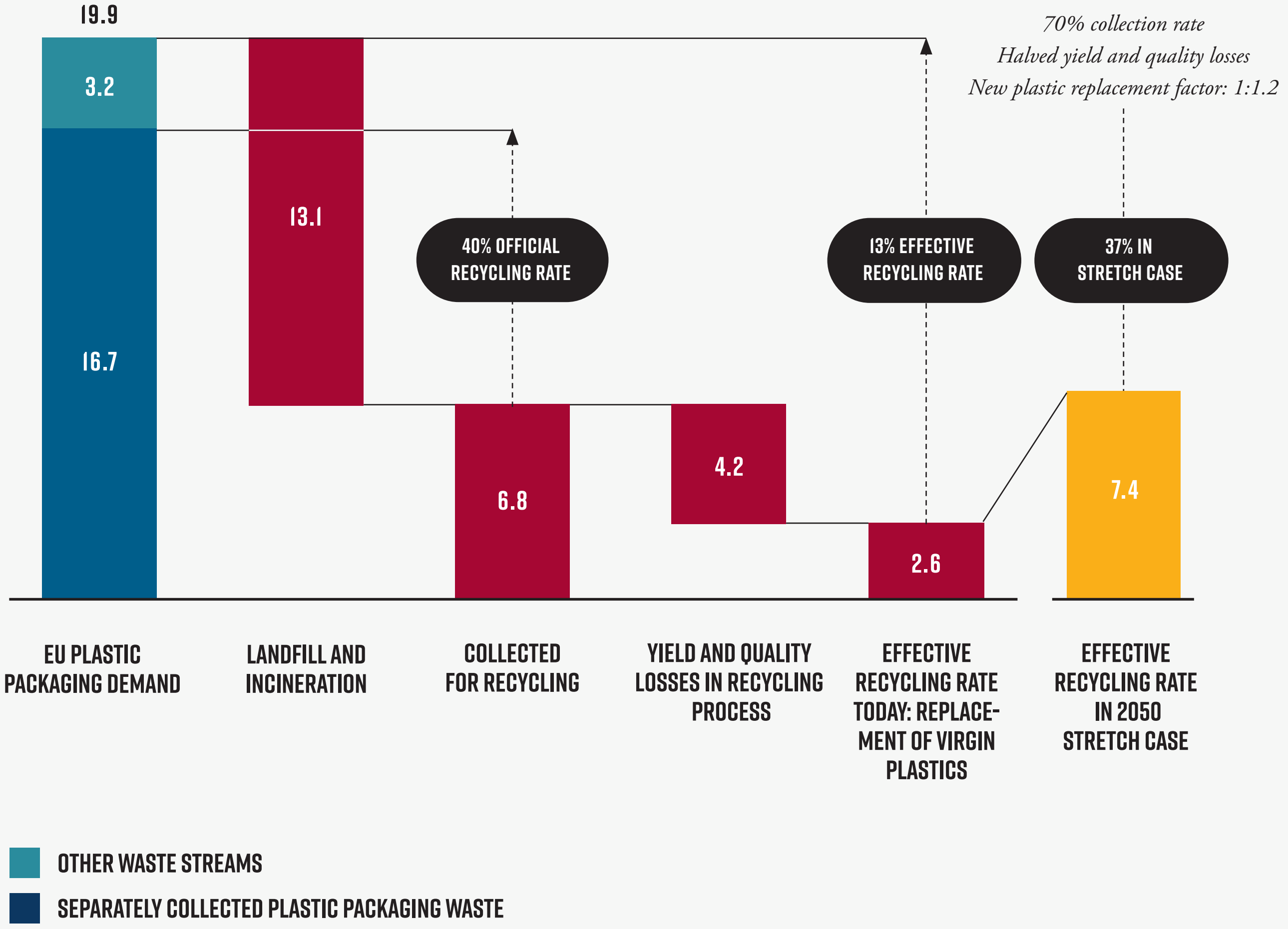
Also, there is no easy account of where the plastic feedstock would come from. It could not be mostly fossil sources, but in a zero-carbon context would have to involve chemically recycled plastics, biogenic carbon from waste or new sources, and perhaps CO_2 from other industrial processes. As one of the trickiest aspects of the transition to a zero-carbon economy, this problem has not yet been solved.

In summary, the challenges associated with recycling and low-emitting new plastics production mean that we are short of solutions. We need to consider all options to make packaging sustainable.

Exhibit 2

TODAY'S REAL RECYCLING RATE FOR PLASTICS PACKAGING

CURRENT PLASTICS PACKAGING DEMAND AND END-OF-LIFE TREATMENT IN THE EU, Mt PLASTIC, 2016



SOURCES: MATERIAL ECONOMICS ANALYSIS BASED ON DATA FROM PLASTICSEUROPE (2017, 2018B), DELOITTE AND PLASTICS RECYCLERS EUROPE, EUROPEAN UNION, SEE ENDNOTES.[4]

MATERIALS SUBSTITUTION CAN REDUCE THE CO_2 DILEMMA

Given the deep challenges of eliminating CO_2 emissions from petrochemicals and plastics, it is worth asking whether materials substitution can be part of the answer. The idea is simple: use plastics where its properties are uniquely suitable, but switch to other materials that are easier to make climate-compatible where they can provide equivalent functionality. Surprisingly, there is little information about what contribution this could make, and it plays only a marginal role in current plastics and CO_2 strategies.[5]

To start this line of enquiry, we looked at the potential to use more wood fibre in packaging, as pressed fibre, carton, or bio-composites. In a lifecycle perspective, fibre is already some 65% less emissions intensive than plastics.[6] Fibre-based products result in greenhouse gas emissions of 0.7 kg CO_2e per kg packaging material, against 2.1 kg for plastics, when using EU average values for emissions from production, transportation, and end of life management (see Exhibit 3 endnote).

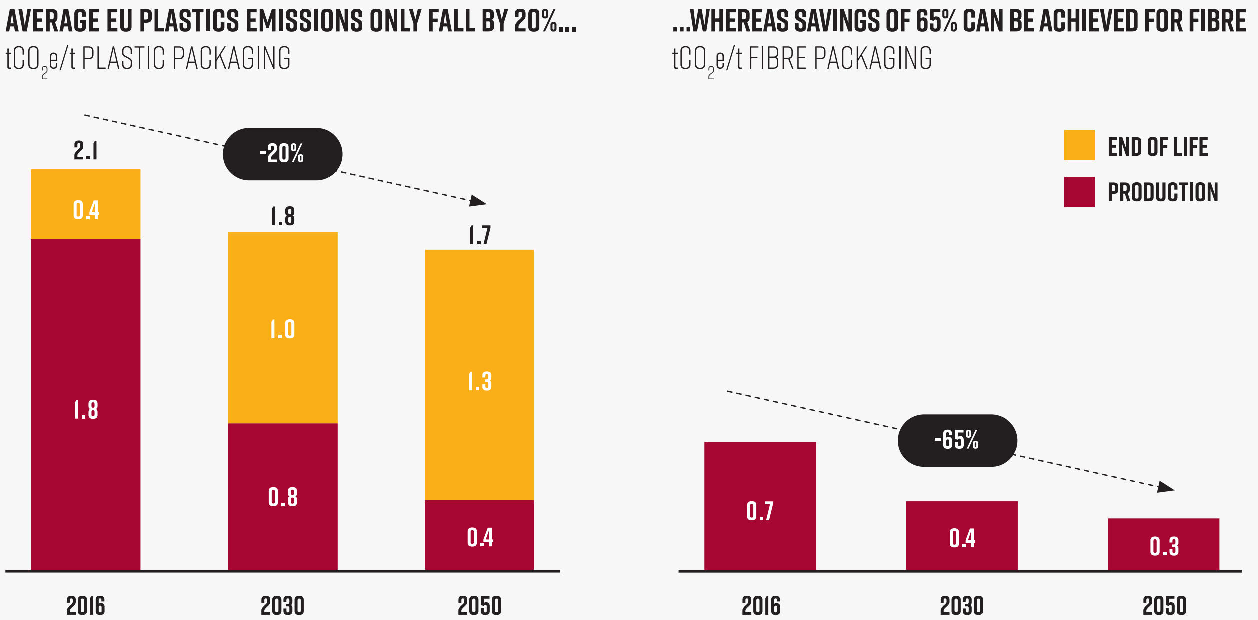
However, the real insight comes from playing the film forward to 2030 and 2050 (Exhibit 3). As the economy decarbonises, renewable materials like wood fibre develop a large CO_2 performance advantage versus fossil materials like plastics. Fibre lifecycle emissions fall by 40% by 2030, and by 2050 by as much as 65%, through EU targets for energy sector decarbonisation, reduced transportation emissions, increased recycling, reduced landfilling, and reduced production emissions as proposed in available industry 'roadmaps'.

Doing the same for plastics presents a very different picture, with much smaller net emission reductions. Production emissions could be reduced substantially, by 80% according to CEFIC's last published roadmap. However, this is counteracted by increased end-of-life emissions as landfilling is phased out and burning plastics releases significant amounts of CO_2.[7] This is a subtle but important point. Today, burning plastics for energy has relatively modest *net* emissions: while CO_2 is released, the net effect is not so large, as doing so often replaces another fossil fuel. In an increasingly low-carbon energy system, however, this logic no longer holds. Waste plastics remain a high-carbon fuel even as zero-carbon energy sources are required to meet climate targets. As a result, by 2050, emissions from plastics have fallen by just 20%, even with significantly reduced production emissions.

Simply put, reducing CO_2 emissions from fibre is easier than from plastic, even if fibre-based packaging were to require more material to provide the same functionality. This is perhaps no surprise as fibre is a renewable feedstock, recycling levels are already higher than they are for plastics, and CO_2 emissions from production largely can be addressed by switching to clean energy sources.[8] In contrast; plastic dominantly uses fossil carbon feedstock, current recycling levels are lower than for fibre; and production emissions are challenging to address, as they to some extent consist of carbon contained in the oil or gas feedstock itself.[9]

Exhibit 3

LIFECYCLE EMISSIONS FOR PLASTICS AND FIBRE PACKAGING



Most ambitious CEFIC roadmap scenario for efficiency and fuel mix gains

CEPI roadmap efficiency and fuel mix gains

NOTE: OUR PRODUCT LEVEL ANALYSIS INDICATE THAT A FIBRE-BASED PACKAGING ALTERNATIVE REQUIRE ON AVERAGE 1.5X THE AMOUNT OF MATERIAL, BY WEIGHT, COMPARED TO EQUIVALENT PLASTICS PACKAGING.

SOURCES: MATERIAL ECONOMICS ANALYSIS BASED ON DATA FROM CEPI (2017A, 2017B), CEFIC AND ECOFYS, DECHEMA, PLASTICSEUROPE (2017, 2018A, 2018B), DELOITTE AND PLASTICS RECYCLERS EUROPE, EUROPEAN UNION, STORA ENSO, BILLERUDKORSNÄS, IVL, SEE ENDNOTES.[10]

The above analysis makes clear that substitution could reduce CO_2 emissions *in principle*, but can it be done in practice – and without losing the important functionality that plastics provide? Our research suggests that around one-quarter of plastics use in packaging could be cut without significant compromise (Exhibit 4). We find that this substitution comes in two main forms: in applications that do not utilise the properties where plastics is uniquely suitable, such as transparency and barrier properties, and in applications where the plastics use can be reduced to a thin barrier while fibre comprises the bulk of the packaging material. The potential was assessed by analysing the properties required of packaging in 35 different packaging segments.

The cost of such a substitution ranges from directly cost-competitive to implying a price premium. Depending on the case, this is arguably similar to what would apply if CO_2 and other charges truly reflected the environmental effects of greenhouse gas emissions, littering, waste handling, and other externalities.

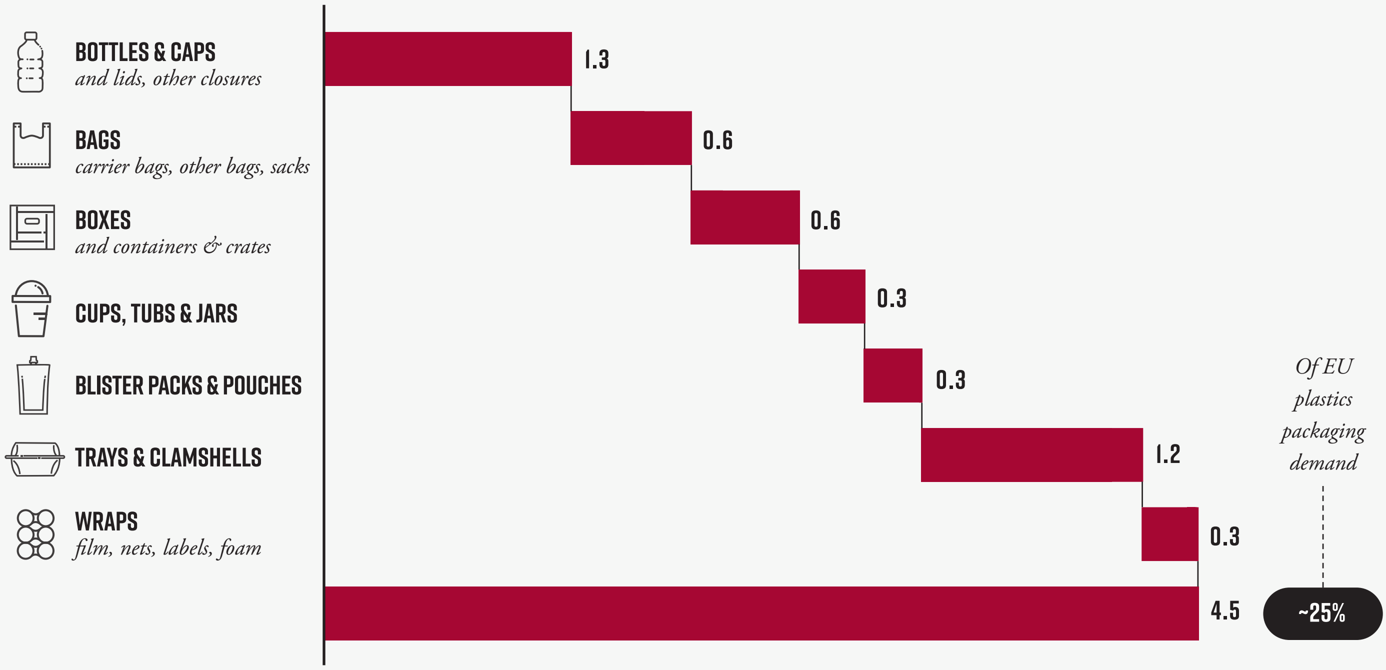
Brand owners and retailers increasingly find that their customers ask them what they plan to do about plastics packaging. For example, retailers such as Iceland and Waitrose in the UK are already making pledges to phase out some or all plastics in their own-brand packaging over the next few years. In this context, substitution to fibre could add value in terms of brand, marketing and contribution to environmental commitments, potentially offsetting some increase in packaging cost.

Looking ahead, materials development will likely increase the substitution potential further. As new material types and production technologies emerge, fibre materials will likely provide some of the functionality that so far has required plastic, glass, or aluminium. For example, micro-fibrillated cellulose can provide transparency, and fibre materials with an increasing range of barrier properties are in the innovation pipeline, as are highly formable fibre products. With this development, fibre-based substitutes without plastic barriers are increasingly achievable and has the potential to replace a larger share of packaging plastics. Such mono-material fibre packaging would also significantly improve the recyclability of fibre-based packaging, eliminating the need to separate the fibre and plastics components in the recycling process.

Exhibit 4

EUROPEAN PLASTIC PACKAGING SUBSTITUTION POTENTIAL

Mt PLASTICS PACKAGING, NET POTENTIAL



SOURCES: MATERIAL ECONOMICS ANALYSIS BASED ON DATA FROM TRANSPARENCY MARKET RESEARCH, SMITHERS PIRA, PLASTICSEUROPE (2018B), INSTITUT FUR ENERGIE UND UMWELTFORSCHUNG HEIDELBERG, HANNAY AND NAMPAY GROUP RESEARCH & DEVELOPMENT, LCA CONSULTING, POLYMER PROPERTIES DATABASE, SELKE AND CULTER, STORA ENSO, VTT TECHNICAL RESEARCH CENTRE OF FINLAND, EUROMONITOR (2013A, 2013B, 2013C), SEE ENDNOTES.[11]

Beyond this, a major question is whether it is possible to expand the use of fibre on the scale outlined above without depleting Europe's forests. Europe is currently felling 72% of the yearly net forest growth. For comparison, the fibre required to realise all of the 25% substitution potential would require an amount of fibre corresponding to 17% of today's unclaimed net growth.[12]

There are two routes to reduce this claim on forests. First, it is possible to improve resource efficiency by increasing the use of recycled fibre, improving forest yields, and increasing materials efficiency further.[13] Second, there is a 'portfolio route', rebalancing pulp use away from other products and towards packaging. If both are pursued, the substitution opportunity could in principle be sourced without making further claims on forests.

These numbers need to be set within a wider debate about the best use of bio-resources – for natural capital, fibre, fuel, and more – in the context of strongly growing global demand for paper products, falling biodiversity, and an imperative to cut GHG emissions.[14] However, given the significant challenge of achieving zero-carbon plastics, there is a prima facie case that packaging could be a high-value use of fibre in a low-carbon economy.

SUBSTITUTION AS A CONTRIBUTION TO SUSTAINABLE PACKAGING

There is no silver bullet to fit plastics use into our carbon budgets – neither recycling, clean fossil-based production, or substitution will be enough on its own. Instead, a combination of measures addressing both the use and production of plastics are necessary to curb emissions (Exhibit 5). Switching 25% of plastics would take care of 13% of emissions, slightly less but on the same order as mechanical recycling. Together with other demand-side solution strategies such as reducing over-use, design for recycling and increasing use of recycled plastics, substitution helps reduce the amount of virgin plastics that need to be produced with CO_2-free, but highly electricity intensive, technologies. Pursuing all strategies, it is possible to continue to benefit from the value that plastics provide also in a low-carbon society.

The analysis presented here is only a first look at this issue. It nonetheless identifies some clear next steps for policymakers, researchers, and companies to take:

First, companies need to better understand this opportunity. Expectations are growing on retailers and brand owners to take more responsibility for the packaging they use. Current initiatives are starting to capture many of the options available, such as sourcing recycled materials, reducing over-packaging, or switching to packaging designs that can easily be recycled. In many cases, companies can add substitution to renewable packaging materials to this list of strategies. To capture this opportunity, they need both to build their own knowledge and evaluate the value of different packaging solutions to their customers as well as their own brand and reputation.

Second, policymakers can recognise substitution as an area of policy development. Materials use, recycling, and disposal are already the subject of policies and regulations. If substitution is to play a role, it needs to be considered alongside other strategies in the search for sustainable packaging and materials use. This goes beyond packaging, of course, to areas such as construction materials. Good policy making must start from a knowledge of the full solution set, and the capacity to evaluate impacts on all different strategies to achieve objectives.

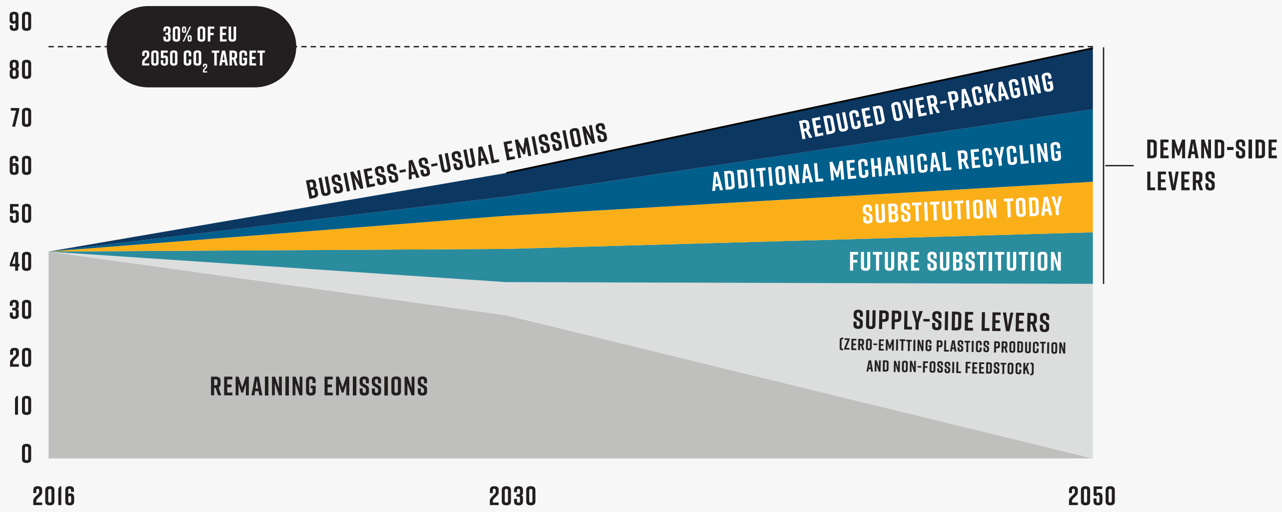
Third, there is a need for much more investigation. We believe the results of our initial analyses are convincing enough to show that substitution can contribute to some of the trickiest areas of a transition to an economy with net-zero CO_2 emissions. Although it has not been part of this study, there also may be potential to alleviate concerns about littering, microplastics, and other issues. However, more research is needed to fully understand the environmental impacts, costs, potential, and prerequisites for substitution to happen.

There is still a long way to make packaging truly sustainable, and substitution to renewable packaging materials such as fibre deserves to be part of the solution.

Exhibit 5

OPTIONS FOR REDUCING CO_2 EMISSIONS FROM PLASTIC PACKAGING

OPTIONS FOR ZERO-CARBON PLASTIC PACKAGING PRODUCTION, Mt CO_2e PER YEAR



SOURCES: MATERIAL ECONOMICS ANALYSIS BASED ON DATA FROM PLASTICSEUROPE (2018A, 2018B), DELOITTE AND PLASTICS RECYCLERS EUROPE, CEFIC AND ECOFYS, DECHEMA, EUROSTAT, SEE ENDNOTES.[15]

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ENDNOTES

[1] In Austria, 46% of separately collected waste was recycled into food-grade re-granulate, single polymer re-granulate, and mixed polymer re-granulate (van Eygen et al., 2018).

[2] See our report "Ett värdebeständigt svenskt materialsystem" (summary in English) for additional details (Material Economics, 2018a).

[3] Estimate based on an electricity price of 40 EUR/Mwh.

[4] Plastic packaging demand is estimated using packaging share of plastics converter demand according to Plastics Europe (2018). Plastics not collected (discrepancy between demand and separately collected waste) and yield losses in recycling processes are assumed to be either landfilled or incinerated according to current incineration and landfill rates. Yield losses from sorting and recycling processes are equal to 40% and plastics is assumed to be able to be recycled five times, with 80% quality remaining after each recycling process. In the stretch scenario, plastics is assumed to be able to be recycled 7 times with 85% quality remaining after each recycling process.

[5] There are few relevant studies on plastics substitution, previous studies by Trucost (2016), Franklin Associates (2014, 2018), and Denkstatt (2010) investigating plastic substitution have approached the subject from a different, and unrealistic, angle: exploring the environmental case for substituting all packaging plastics with a range of other materials. These investigations all come to the same unsurprising conclusions, substituting all plastics packaging with a combination of aluminium, fibre, steel, and glass causes significantly more CO_2 emissions than plastics. Policy largely misses the opportunity of substitution, for example, the EU Plastics Strategy mentions recycling 148 times, but never discusses substitution or switching to other materials. In conversations with policymakers, one message has been that there is a lack of knowledge and information.

[6] Lifecycle assessment (LCA) is often used to compare the environmental performance of different solutions by systematically accounting for the full environmental impact of the production, use and disposal of a product. While extremely valuable in comparing specific products or solutions, current use of LCA shows widely varying estimates depending on system boundaries, assumptions, and allocation methods. Thus, a materials-level lifecycle perspective with EU average input values was applied to be able to contrast plastic and fibre materials without getting lost in the weeds of individual product supply chains, country-differences in production, end-of-life management etcetera. Moreover, today's LCA provides only a backward-looking snapshot. Any systematic shift in the production and use of materials will take years or even decades to unfold. As such it is important to also understand how different solutions will fit into the future economy. For example, we know that today's energy and transport systems will have to change rapidly if we are to meet climate targets, something which should be taken into account when calculating lifecycle emissions. Therefore, a forward-looking lifecycle assessment was made with 2030 and 2050 scenarios based on existing EU targets and available industry roadmaps.

[7] Emissions from incineration can be as much as 2.7 kg CO_2 per kg plastic.

[8] Reported rates of fibre packaging waste collected for recycling in the EU is 85% (Eurostat, 2018).

[9] As an intermediate between mechanical recycling and new plastics production, it also is possible in principle to produce plastics by using end-of-life plastics as feedstock. Doing so could in principle significantly reduce the energy inputs needed compared to routes that rely on producing new monomers from CO_2 and hydrogen, which is the basis for the DECHEMA study. Such 'chemical recycling' has not yet been done at scale, but doubtless would be a valuable contribution to any truly ambitious emissions reduction scenario.

[10] EU average emissions from upstream, production, transport to filler, and end-of-life included. End of life emissions include methane produced by fibre in landfills and net emissions/savings from incinerating waste in CHP and at waste incineration sites. Energy contents of plastics assumed to be 45MJ/kg, emissions from incineration equal to 2.7 kg CO_2e/kg plastics. Assume 50% burned in CHP (heat and electricity) and 50% in waste incineration plants (electricity). CHP plastics thermal efficiency 70%, electricity efficiency 7%. Waste incineration electricity efficiency 20%. EU average heat and electricity efficiency based on EEA, IEA, and EU 2050 Roadmap estimates. Average EU thermal efficiency of CHP generation is 85%. To calculate emissions reductions, the following has been taken into account: decarbonised electricity generation and electrified transport (partially 2030, fully 2050), additional reductions through production efficiencies, innovation and fuel mix changes (following CEPI and CEFIC industry roadmaps), landfill bans (less than or equal to 10% in 2030, based on EU Waste Directives and 0% in 2050), ambitious increases in recycling for both fibre and plastics from improved collection rates and reduced yield and quality losses (based on EU recycling targets for 2030, 55% plastics packaging and 85% paper and board packaging collection rates).

[11] The substitution potential has been evaluated looking at the main plastic packaging segments; bags, sacks, pouches, sachets, wraps, blister packs, trays, clamshells, boxes, bottles, jars, caps, closures, cups, tubs, cans, drums, pails, kegs, intermediate bulk containers, and others, further divided into 35 sub-segments. The substitution potential was analysed for each sub-segment based on the properties and functionalities required for each sub-segment. Deep dives were carried out for the bottles, trays, boxes, and caps segments with a more detailed assessment. Net substitution potential shows the plastics reduction potential, taking into account any plastics content in the fibre-based substitute and calculated using the mass ratios of plastics and fibre-substitute per functional unit and share of plastics in fibre-based packaging (by weight). Based on our analysis, the average plastics content in fibre-based substitutes is currently 12 wt%, and the average plastics to fibre mass ratio 1.6 (including any plastics content in fibre-based packaging).

[12] According to "State of Europe's Forests 2015" (FOREST EUROPE, 2015), Europe currently fell 72% of yearly net forest growth, meaning that European forests are actually growing every year. To calculate how much of this unclaimed forest growth would be needed in a 25% substitution scenario, we first estimated the amount of forest (in m^3 sub) that would be needed to produce the corresponding fibre packaging. This was done by estimating that 1.5x (corroborated with our detailed product level analysis) the weight of fibre packaging would be needed to substitute plastic packaging, and that 4 m^3 sub pulpwood is needed to produce 1 tonne of fibre packaging (confirmed by expert interviews). Next, we assumed today's practices of recycled fibre input (54%) and that 50% of a felled tree becomes pulpwood (in solid-under-bark terms). Additionally, we accounted for the fact that only a share (0.82 in m^3 terms) of the forest can be classified as solid-under-bark (sub). From this we determined that 17% of unclaimed 'pulpwood' in the forest would be needed. Estimating what this number can reduce to after productivity improvements was done by assuming that a higher share of the forest can be used as sub wood (0.85), that only 3.5 m^3 sub is needed per tonne carton, and that recycled fibre input is 60%. Finally, we used the resulting forest needed and calculated how much paper this represents to determine the share of paper production that would need to be shifted to not fell any additional forest (5% of paper production).

[13] From 0.82 to 0.85 m3 SUB (solid under bark) per m^3 growing forest and from 4 m^3 SUB forest required per tonne carton. Reduced to 3.5 m^3 SUB after productivity gains.

[14] For example, China currently only uses approximately one third of the soft paper per person that western countries use.

[15] BAU emissions calculated as per Exhibit 3. 20% reduction in over-packaging assumed. Ambitious reductions in yield losses (50%) and improvements in collection rates (70% of waste generated) increase recycling rates, reducing share of virgin plastics needed in packaging production and incineration rates. Recycling savings includes reduced incineration for plastics that are also used for lower value applications after recycling (i.e. although recycling rate increases from 21% to 50%, share of recycled plastics in packaging production is 13% and 37% respectively as some of recycled plastics is only used for lower value applications) 25% net substitution of plastics packaging today results in ~11Mt savings when taking into account emissions from fibre and plastics in 2050, as week as plastics content in fibre-based substitutes. Future substitution increases substitution to 50% of plastics packaging. Today's substitution represents available potential with today's solutions, future substitution includes product innovation. Cleaner production gains based on CEFIC 2050 roadmap and includes production efficiencies and fuel mix change.

SUSTAINABLE PACKAGING

THE ROLE OF MATERIALS SUBSTITUTION

Disclaimer
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