Flanders
State of the Art

10 NEW MESSAGES ABOUT CIRCULAR ECONOMY AND CLIMATE

VERSION 2021

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10 NEW MESSAGES ABOUT CIRCULAR ECONOMY AND CLIMATE

INTRO

The latest climate report from the UN climate panel IPPC[1] from 2021 sounds the alarm: global warming is going faster than expected, is wide-spread and is intensifying. The IPCC writes that we will in any case experience an increase of one and a half degrees, even though, in the Paris climate agreement of 2015, it was agreed to keep the increase "far below two degrees", and preferably to one and a half degrees. The report also states that human beings are responsible for global warming, and that it is caused by the massive emission of greenhouse gases.

That is why it is so important to reduce our fossil emissions as rapidly as possible and to switch to a more sustainable society.

At the end of June 2021, the European Union decided, in the European Climate Act, to toughen Europe's climate targets as part of the Green Deal. The aim in the updated ambition 'FitFor55'[2] is no longer 40% less net emissions of greenhouse gas by 2030 but 55% less compared to the level of 1990. This is necessary if Europe wants to be climate neutral by 2050. For Belgium, this means a toughening of the current reduction target of 35%.

For several years, the Public Waste Agency of Flanders, OVAM, has been studying the link between greenhouse gas emissions and how we deal with materials[3]: The high demand for energy in our society is, to a large extent hidden in the way we use materials. We can only achieve our ambitious climate targets if we also succeed in a transition to a green and circular economy. That is why the circular transition is included as one of the transversal measures in the Flemish Energy and Climate Plan (VEKP) 2021-2030[4].

CORE MESSAGE

This brochure builds further on the OVAM publication about the circular economy and climate[5] from 2018. The goal is to substantiate further the link between the circular economy and climate change with evidence from a number of recent studies commissioned by OVAM. Here we focus mainly on how circular economy strategies can contribute to reductions in greenhouse gas emissions and material use in various **systems of need** (food, consumer goods, housing and mobility).

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As a guideline, the VEKP 2021-2030 states that the material footprint of Flemish consumption must reduce by 30% by 2030.

The new evidence in this brochure confirms that transitioning to a climate-neutral economy and to a circular economy are closely **linked**. The potential contribution by the circular economy to the climate challenge is clear. For example, two thirds of Flanders' territorial greenhouse gas emissions are material-related. Furthermore, there is a clear link between the carbon footprint and the material footprint of the consumption by Flemish households.

[1] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press
[2] https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541
[3] https://ovam.be/afval-materialen/materiaalbewust-ontwerpen-produceren-en-aankopen/link-tussen-materialenbeleid-en-klimaatbeleid
[4] https://www.energiesparen.be/vlaams-energie-en-klimaatplan-2021-2030
[5] OVAM (2018). 7 messages about the circular economy and climate change. Brochure.

Both Flanders' material and carbon footprint are **too high** to be sustainable. Four systems of need (mobility, food, housing and consumer goods) are responsible for the largest share of both the carbon footprint and the material footprint. That is why we studied the impact of a number of circular strategies in these systems of need. The impact on material use and emissions differs according to the circular strategy that is applied in the calculation. A general finding is that scenarios combining different strategies have the largest impact.

In addition, it appears that the intended **energy transition** in Flanders is only possible if we deal with the necessary materials for renewable energy generation in a circular manner. The effect of circular strategies is also dependent on a region's characteristics. In the case of Flanders, with its open economy, the positive effects of circular scenarios in the Flemish production are largely felt in the footprint of other countries. Finally, we show that the use of recycled materials in the production process leads to reductions in greenhouse gas emissions compared to production based on primary materials.

POLICY IMPLICATIONS

The focus of the current Flemish environmental policy concentrates mainly on the environmental impact **within** Flanders, such as Flanders' territorial greenhouse gas emissions or the extraction of minerals in Flanders. A large proportion of the raw materials to meet our needs comes, however, from abroad so that the associated environmental impact is also situated **outside** Flanders.

If Flemish policy wishes to promote the circular economy, the focus must be broadened to the Flemish environmental impact beyond production activities in Flanders. Efficient material and waste management by Flemish companies is only part of the solution. Circular economy strategies among both producers and consumers can achieve considerable gains for the environment and the climate. These large environmental gains will be mainly achieved abroad in reduced raw material extraction. In Flanders, the environmental impact may even increase slightly due to local transport and recycling activities. It is therefore important that environmental policy does not focus exclusively on local greenhouse gas emissions and raw material extraction.

In the case of Flanders, with its **open economy,** it is to be expected that the positive effects of circular scenarios in the Flemish production are largely felt in the footprint of other countries. The gains achieved will have only a limited impact on our own footprint. Our domestic production only has an impact on Flanders' footprint if the supply chain of the finished product is also situated in Flanders. Since global warming is a global problem, we also benefit from the reduction of emissions in other countries.

If we are to lower Flanders' footprint, the **consumption perspective** is thus just as important as the production perspective. In a circular economy, the Flemish consumer makes use of circular strategies such as product-service combinations, the sharing economy, purchasing products with a long lifespan, etc. The producer also plays an important role in the consumption perspective by designing and marketing more circular products.

The **material footprint** of Flemish consumption explicitly shows the pressure Flanders exerts on worldwide natural resources. A target for Flanders' materials footprint, just as the targets for greenhouse gas emissions, must give direction to policy. Flanders' material footprint greatly exceeds sustainable levels at present. Flanders is aiming at a reduction of 30% in the material footprint of Flemish consumption by 2030 (VEKP 2021-2030) and a reduction in the order of 75% by 2050 (Beleidsnota Omgeving 2019-2024).

In order to reduce the material footprint of our consumption, policy should best focus on housing, food, mobility and consumer goods. 89% of the Flemish households' material footprint is caused by these consumption domains. The transition to a sustainable use of materials demands extremely close **collaboration**. This is the focus of Circular Flanders, whereby a public-private partnership is aiming to accelerate the transition. Six work agendas are being put together for this around the topics: circular construction, chemicals/plastics, bio-economy, food chain, water recycling and the manufacturing industry [6].

By focusing on mobility, food, housing and consumer goods, both the material footprint and the carbon footprint will be lowered. For both footprints of Flemish consumption are strongly intertwined. Areas of consumption that demand a high level of raw materials also cause the emission of large amounts of greenhouse gases. Circular economy is thus one of the key elements for achieving the climate targets.

Food

The circular strategies 'alternative diet' (reduction in meat consumption and an increase of, amongst others, fish and vegetables) and 'reduction of food waste' both result in reductions in greenhouse gas emissions and material use. Avoiding food waste is a policy priority of OVAM. The new OVAM action plan 'Food loss and biomass (waste) streams circular 2021-2025' proposes that the entire

[6] https://vlaanderen-circulair.be/nl/topics

chain should, by 2025, achieve a 30% reduction in food waste compared to 2015 through prevention of waste, reprocessing it as food or high-quality valorisation. The donation of food surpluses via the food-bank, social organisations and so on remain important, but prevention and valorisation actions are foreseen throughout the entire chain (from producer to consumer).

Textiles

Reuse, recycling and high-quality local production of textiles could ensure a reduction in the extraction of primary raw materials abroad and the associated greenhouse gas emissions. During the 'Circular fashion and textiles Round Table', organised by OVAM and Flanders DC in 2020, the sector took a closer look at the conditions and the bottlenecks for making the textile chain more circular.

Messages were framed that can help feed the European debate. In addition, direction was given to the actions that OVAM will develop in the years ahead. In 2021, the European Commission published a route map for its European strategy for sustainable textiles that will be launched in early 2022.

Mobility

The specific emission reduction target for passenger transport in the VEKP 2021-2030 is 50% compared to 2005. Achieving this climate target by 2030 demands a combination of measures, of which each measure, in itself, must be highly ambitious: more carsharing and far fewer car kilometres and a fleet that consists of many green vehicles (electric or fuelled by hydrogen). If we want to accelerate the pace of replacing the existing fleet with electric cars in their current composition, we will need a lot of Li-ion batteries. This could lead to a scarcity of a number of these materials, such as cobalt, copper, lithium and nickel. Reuse and recycling of batteries and innovation in vehicle technologies are indispensable in the switch to electric mobility.

Buildings

Energy loss and energy consumption in buildings are falling sharply under the impetus of energy performance legislation. Thanks to this, heating of buildings is causing decreasing CO_2 emissions. But the materials required for energy-efficient buildings themselves cause an **environmental impact** throughout their entire life-cycle. The optimisation potential of buildings is great and must be unlocked in order to meet the Flemish and European aims for the reduction of greenhouse gases.

This applies to the optimisation based on the material-related impact as well as for the optimisation based on the energy-related impact. Ideally, both aspects should be addressed simultaneously. Certainly for renovations, considering the major renovation efforts that must be delivered in the years ahead.

Energy transition

The energy transition exerts considerable additional pressure on the raw material reserves to which Flanders is "entitled". The demand for raw materials can act as a significant brake on achieving the energy transition. This energy transition will have to continue after 2030 in order to achieve a climate-neutral energy production in 2050 (European target). A continuous monitoring of the pressure on materials is therefore important. OVAM can make substantial contributions to closing the cycles for critical materials that are present in large quantities in sustainable energy technologies (e.g. solar panels, converters, wind turbines and batteries). Furthermore, these materials have a high recycling efficiency. A correct collection and recycling can considerably ease the future pressure on primary extraction of these materials.

READING GUIDE

Below, we formulate 10 new messages that illustrate how the circular economy can contribute to addressing the climate challenge. Each message begins with the core idea of the message. In addition, we state the perspective used in the study on which the message is based. We make a distinction in this between the following perspectives: territorial (emissions and material use in Flanders), consumption footprint (worldwide emissions and material use caused by the Flemish consumption) or both. Then the message is briefly explained by means of an important graph or table taken from the study. For readers who would like to delve deeper into the topic, we refer, in the 'want to know more' section to the full report of the study and to other publications connected to the topic.

Message 1:

TWO THIRDS OF THE FLEMISH TERRITORIAL GREENHOUSE GAS EMISSIONS ARE MATERIAL-RELATED

In a nutshell:
Two thirds of Flanders' territorial greenhouse gas emissions are material-related. This highlights an enormous potential for circular strategies to reduce material use and the associated emissions.

Perspective: territorial

Commissioned by OVAM, the Flemish Institute for Technological Research (VITO) calculated an update and refinement of the share of Flanders' material- and energy-related emissions that are caused by the consumption, production and waste disposal in Flanders (the **territorial greenhouse gas emissions**). For this, the OECD methodology from 2012 was followed. Previously the first tentative calculations had shown that in 2014 around two thirds of the gross domestic energy use in Flanders could be attributed to material-related processes[7]. These results for Flanders were comparable to those of the countries that were analysed in the OECD report.

The study offers various ways of dividing Flanders' territorial greenhouse gas emissions into various process-related categories of emissions, which could be material-related or energy-related. The starting point was the 2012 OECD report, where a generic method was developed and applied to Germany, Slovenia, Mexico and Australia. The redistribution of the German data into the seven process-related categories was initially adopted and applied to the Flemish data. The share of material-related emissions amounted to 53% in 2016.

The allocation of the Flemish emissions to the seven categories was further refined, based on Flemish data sources such as the Energy Balance for various fuels and electricity and the COPERT and EM-MOS model for transport. This refinement led to an increase in material-related emissions to 66% (see Figure 1).

The method was repeated for 2017 and 2018, whereby respectively 66% and 67% of the total greenhouse gas emissions were material-related. The share of material-related emissions remains fairly constant over time.

[7] OVAM, (2018.), 7 messages about the circular economy and climate change. Brochure.

A different calculation according to the method of the 'use table' for 2016 led to similar figures, which indicates a certain robustness of the results.

The high share of material-related emissions indicates the potential of circular strategies in the Flemish economy (through recycling, reuse, eco-design, etc.) for avoiding materials and the associated emissions.

On the other hand, Flemish and international targets concerning a climate-neutral energy supply lead to an increase in the materials used, through the construction of necessary infrastructure, and to a decrease in the energy-related emissions thanks to renewable energy and electrification of, say, mobility.

As a result, we expect that the relative share of material-related emissions will rise in the future, although the total emissions may decline. If Flanders becomes fully carbon neutral by 2050[8], virtually all territorial emissions will be material-related.

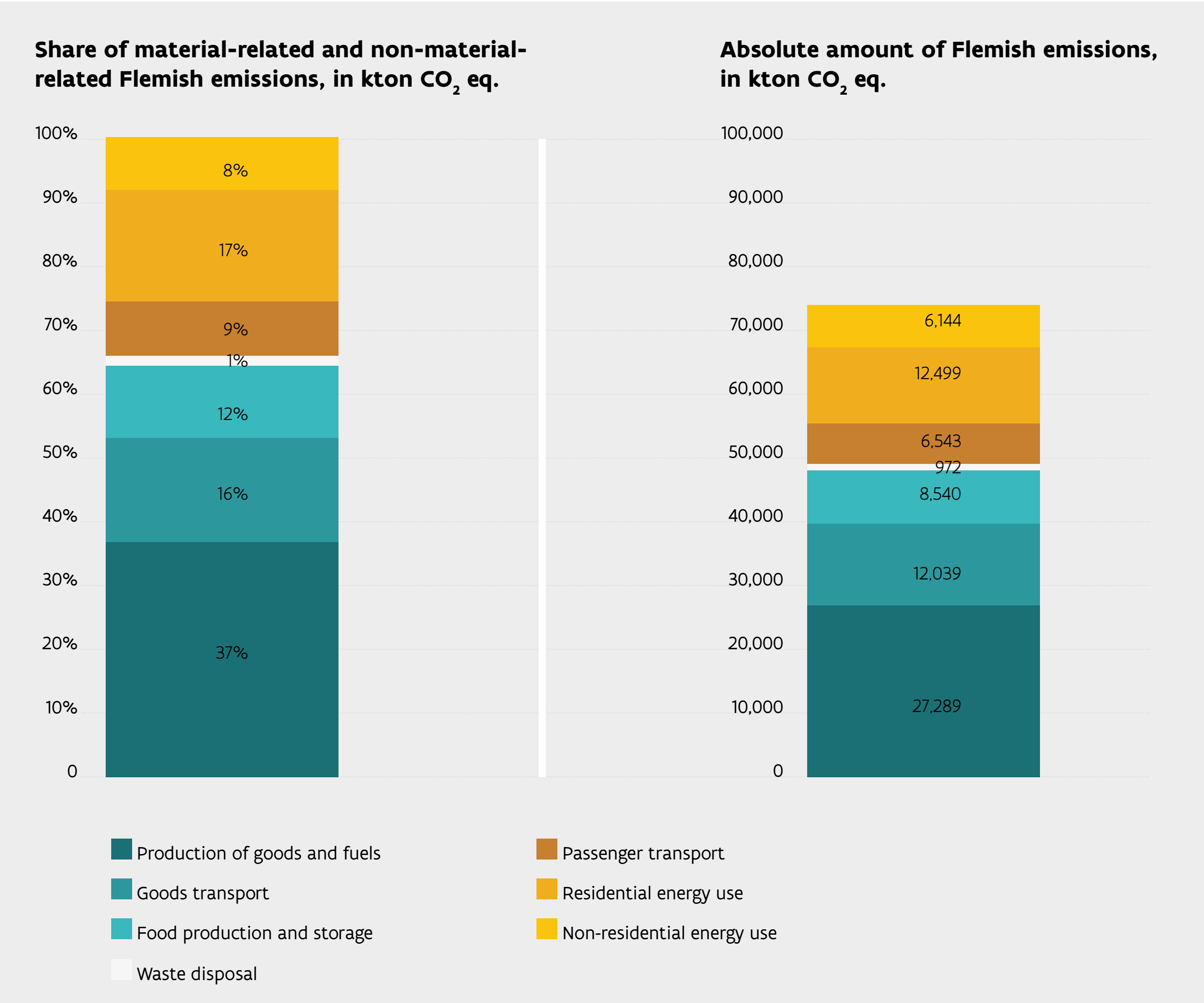

Figure 1: Refined Flemish territorial emissions broken down by material- and non-material-related categories in 2016 in absolute amounts (right) and expressed as a percentage of total emissions (left). Broken down by OECD category with green being material-related and orange non-material related (in kton CO_2 eq.).
Source: Borms, Vercalsteren & Christis (VITO), 2021

[8] Carbon neutrality means that a balance is reached between the amount of carbon (CO_2, greenhouse gases) that are emitted and the amount of carbon that is removed from the atmosphere by nature or technologies.

WANT TO KNOW MORE?

OECD (2012). Greenhouse gas emissions and the potential for mitigation from materials management within OECD countries. Environment Policy Committee, Working Group on Waste Prevention and Recycling.

Borms, L., Vercalsteren, A. & Christis, M. (VITO) (2021). Het aandeel van materiaal- en niet-materiaal-gerelateerde emissies in Vlaanderen. [The share of material and non-material- related emissions in Flanders]. VITO studie in opdracht van de OVAM.

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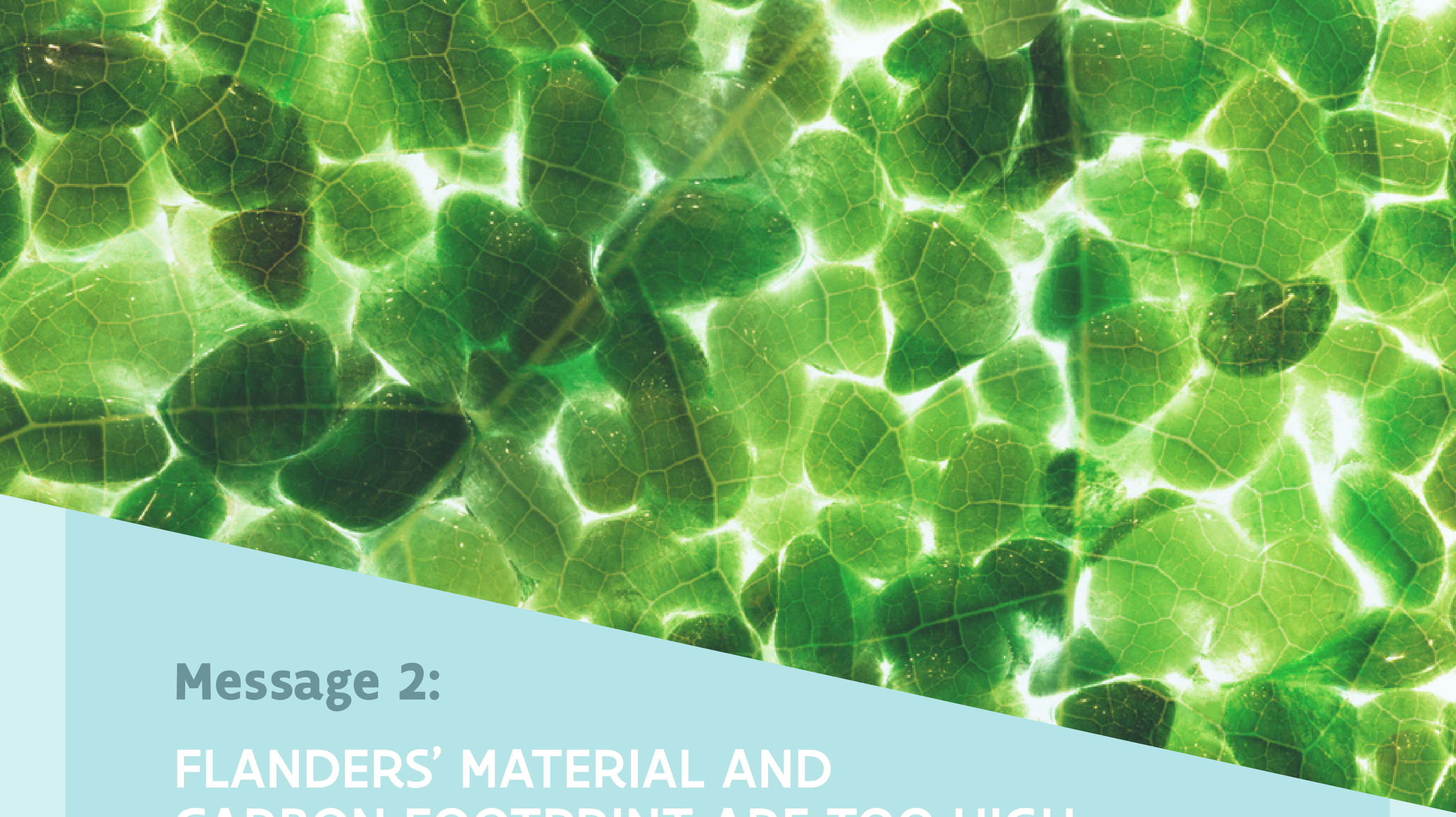
Ellen MacArthur Foundation & Material Economics. (2019). Completing the picture. How the circular economy tackles climate change.

Material Economics. (2018). The circular economy - a powerful force for climate mitigation.

Circle Economy. (2021). Circularity Gap report 2021, Solutions for a linear world that consumes over 100 billion tonnes of materials and has warmed by 1-degree. Circle Economy.



Message 2:

FLANDERS' MATERIAL AND CARBON FOOTPRINT ARE TOO HIGH TO BE SUSTAINABLE

In a nutshell:
Flemish consumption causes material use and emissions of greenhouse gas worldwide that drastically exceed the planetary limits.

Perspective: consumption footprint

The UNEP International Resource Panel (IRP 2014) estimates the sustainable consumption of primary raw materials at approximately 7 tonnes per person per year. This is perhaps an over-estimation of the sustainable level since the IRP assumes a similar access to primary raw materials for everyone in the world, without increasing the annual extraction of raw materials.

Flanders' material footprint is the total primary raw materials that are mined worldwide for final consumption in Flanders (the primary material use).

In order to determine the material footprint according to the Eurostat methodology (RMC), more than 9,000 trading streams were converted to extracted raw materials using fewer than 200 coefficients. The material footprint is thus an estimation. It is more important to monitor the trend than to evaluate the absolute value of each year.

Flanders' material footprint amounts to 191 million tonnes or 29.1 tonnes per capita in 2018. The raw material use of the Flemish consumption is thus much higher that what is sustainable according to the IRP.

The material footprint of Flemish consumption is not only too large, but also shows an increase. The material productivity, measured as the size of the economy (GDP) compared to the material footprint (RMC), shows no clear trend. This means that the material footprint increases as much as our economic growth, and that's exactly what we want to avoid.

Alongside the calculation using the Eurostat methodology, the material and carbon footprint were studied using an alternative method: the **Flemish environmental input-output model** (IO model). The calculation with the IO model is more complex, but it provides insight into the importance of various production sectors and areas of consumption in the material footprint.

According to the IO model, Flanders' material footprint in 2016 was 180 million tonnes or 27.9 tonnes per capita. More than half of Flanders' material footprint is linked to households' consumption of goods and services. The material footprint, calculated using the IO model, is in line with the RMC calculated with the Eurostat methodology.

The Flemish Department of Environment & Spatial Planning also calculated Flanders' carbon footprint using the IO model. The Flanders' carbon footprint includes all greenhouse gas emissions that arise worldwide as a consequence of Flemish consumption.

At 14.2 tonnes CO_2 eq. per capita, our carbon footprint in 2016 was also too high. To limit the average global temperature increase to 2°C, global greenhouse gas emissions must be reduced to an average of 2 tonnes per capita by 2050.

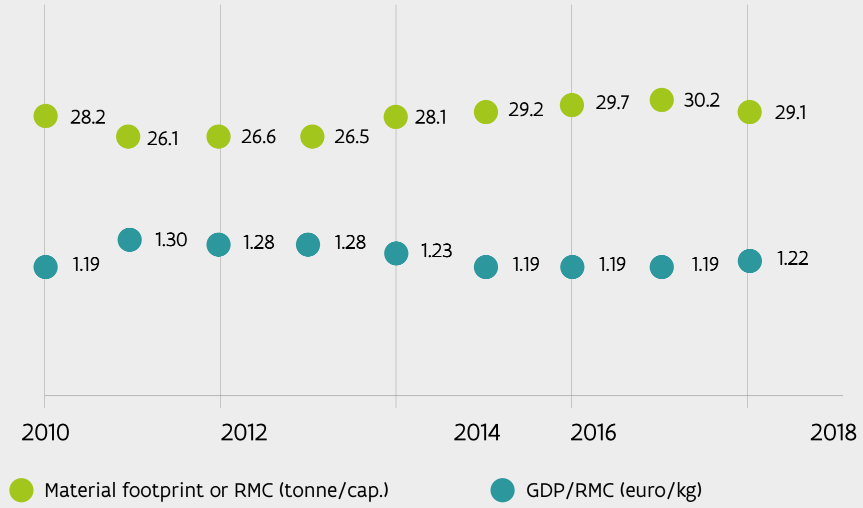


Figure 2: Moving average of the material footprint or RMC (in tonnes/capita) and GDP/RMC (in euro/kg) according to the Eurostat methodology (EW-MFA). Source: Christis & Vercalsteren (VITO), 2020

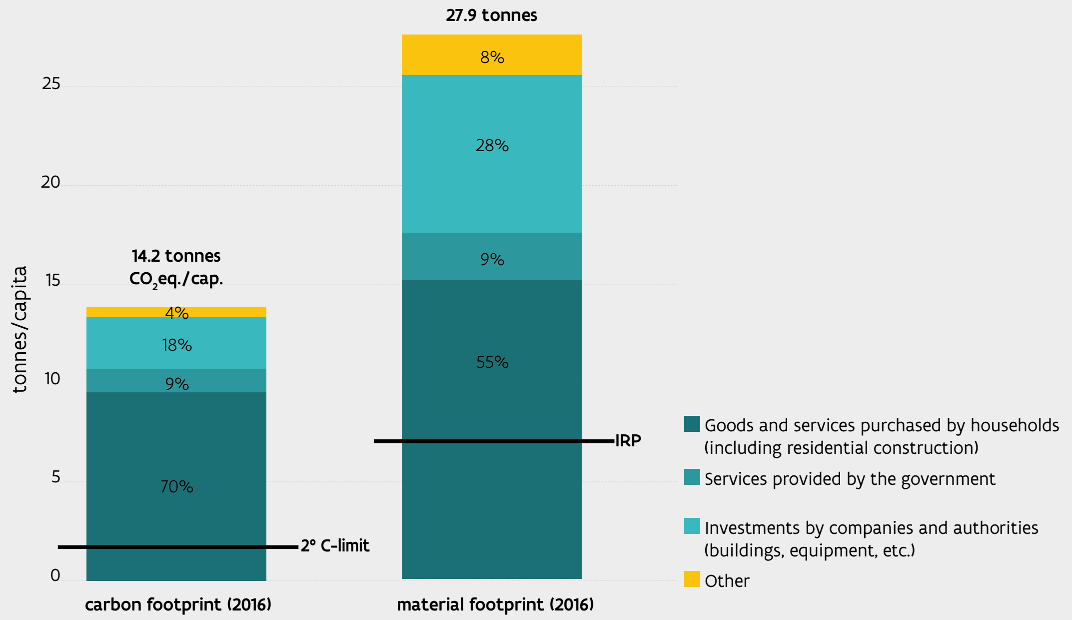


Figure 3: Carbon and material footprint of the Flemish consumption in 2016 per demand category according to the Flemish IO model. Source: Departement Omgeving, 2021 & Christis, Borms, & Vercalsteren (VITO), 2021

WANT TO KNOW MORE?

Departement Omgeving (2021). Koolstofvoetafdruk van de Vlaamse consumptie, update 2010-2016. [Carbon footprint of Flemish consumption, update 2010-2016]. VITO in opdracht van het Departement Omgeving.

IRP (2014). Managing and conserving the natural resource base for sustained economic and social development. A reflection from the International Resource Panel on the establishment of Sustainable Development Goals aimed at decoupling economic growth from escalating resource use and environmental degradation.

Christis M., Borms L., & Vercalsteren A. (VITO) (2021). Materialenvoetafdruk van de Vlaamse consumptie, update 2010-2016. [Materials footprint of Flemish consumption, update 2010-2016]. VITO studie in opdracht van de OVAM.

Christis, M. & Vercalsteren A. (VITO) (2020). Macro-economic material flow indicators for Flanders 2002-2018. CE Center publication N° 11. VITO in opdracht van Steunpunt Circulaire Economie, OVAM & EWI.

OVAM Circulaire materialenverhaal 'De materialenvoetafdruk van de Vlaamse consumptie is te hoog om duurzaam te zijn'. ['The material footprint of Flemish consumption is too high to be sustainable'].

OVAM Circulair materialenverhaal 'De Vlaamse kringloopeconomie vertaalt zich nog niet in een verlaagde materiaalimpact'. ['The Flemish circular economy does not yet translate into a lower material impact'].

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Message 3:

MOBILITY, FOOD HOUSING AND CONSUMER GOODS REQUIRE THE MOST MATERIALS AND PRODUCE THE MOST EMISSIONS

In a nutshell:
more than ¾ of both the material and the carbon footprint are caused by 4 areas of consumption (food, housing, mobility and consumer goods).

Perspective: consumption footprint

The material and carbon footprint of Flemish household consumption can be broken down into different **areas of consumption** (see figure 4). 60% of Flemish households' material footprint is linked to food (excluding alcoholic beverages and catering), mobility and housing (including investment in housing). More than 70% of the Flemish households' carbon footprint is also linked to the same three areas of consumption.

Consumer goods (clothing and footwear, furnishings and household appliances, miscellaneous personal items, etc.) account for 18% of the material footprint and 12% of the carbon footprint.

This figure clearly shows the clear **correlation** between the carbon and the material footprint, which means that the material and carbon footprint are strongly interconnected. Areas of consumption that demand considerable raw materials (mobility, food, housing and consumer goods) also give rise to considerable greenhouse gases.

Circular economy is thus one of the key elements to achieving the climate targets. By focusing on mobility, food, housing and consumer goods, both the material footprint and the carbon footprint can be lowered. That is why, in the following messages, we discuss the potential of a number of circular strategies in 4 systems of need (food, textiles (as part of consumer goods), mobility and housing).

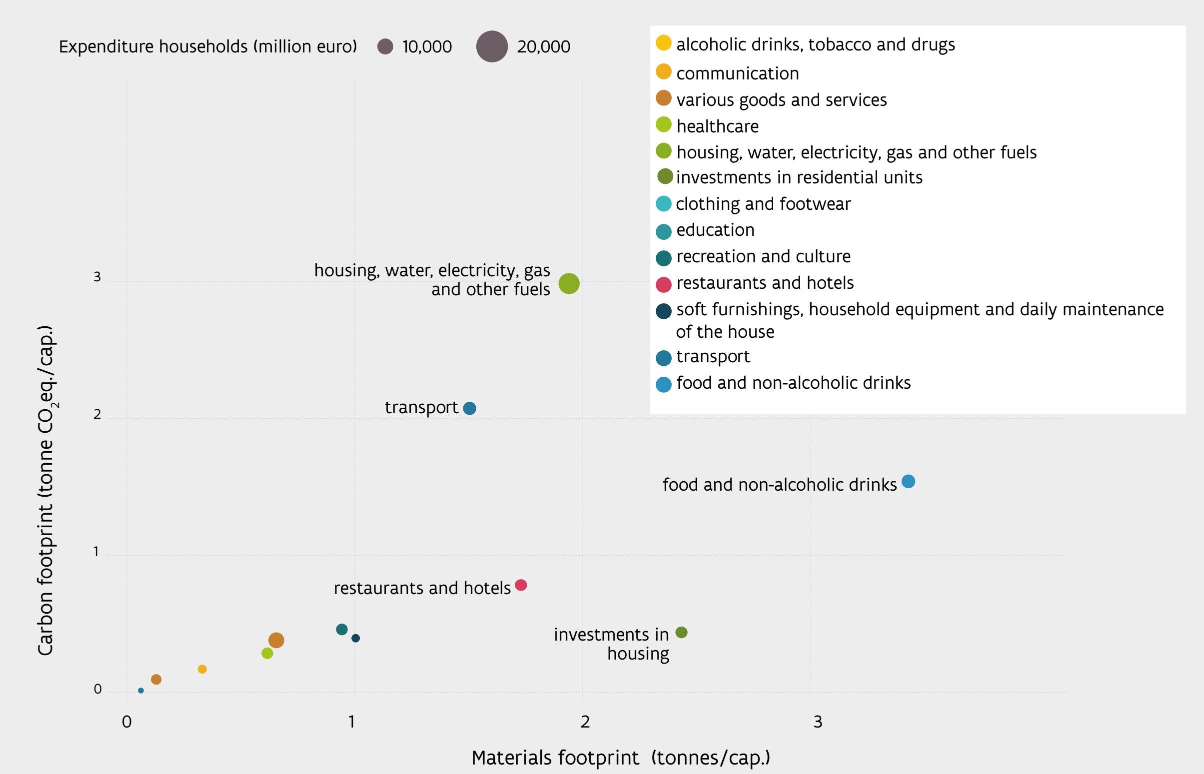

Figure 4: Flemish households' carbon and material footprint in 2016 per area of consumption according to the Flemish IO-model. Souce: Departement Omgeving, 2021 & Christis, Borms, & Vercalsteren (VITO), 2021

WANT TO KNOW MORE?

Circle Economy. (2021). Circularity Gap report 2021, Solutions for a linear world that consumes over 100 billion tonnes of materials and has warmed by 1-degree. Circle Economy.

Departement Omgeving (2021). Koolstofvoetafdruk van de Vlaamse consumptie, update 2010-2016. [Carbon footprint of the Flemish consumption, update 2010-2016]. VITO in opdracht van het Departement Omgeving.

Christis M., Borms L., & Vercalsteren A. (VITO) (2021). Materialenvoetafdruk van de Vlaamse consumptie, update 2010-2016. [Materials footprint of the Flemish consumption, update 2010-2016]. VITO studie in opdracht van de OVAM.

OVAM Circulair materialenverhaal 'De materialenvoetafdruk van de Vlaamse consumptie is te hoog om duurzaam te zijn'. ['The material footprint of the Flemish consumption is too high to be sustainable'].

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Message 4:

CIRCULAR STRATEGIES REDUCE THE MATERIAL AND CARBON FOOTPRINT OF OUR FOOD CONSUMPTION

In a nutshell:
a combined strategy of an alternative diet and 30% less food waste reduces the material footprint of the food consumption in Flanders by 8% and the carbon footprint by 6%.

Perspective: consumption footprint

OVAM commissioned a study into the degree to which circular strategies could lower the climate and material impact of Flanders' system of need 'food'. The study investigated 3 circular food scenarios from the consumption perspective. An important note is that the modelled scenarios are not necessarily realistic scenarios. The calculation of the effects of the scenarios gives an insight into the possible contribution of several circular strategies to reduce the carbon and the material footprint.

In the first scenario, the Flemish people opt for an **alternative diet.** This means a decline in the consumption of meat products (-58%), high-sugar products (-19%) and oils and fats (-18%) in exchange for more vegetables (+56%), fish (+33%), fruit (+25%) and bread and cereal products (+16%). In comparison with the current food system, this scenario would lead to an overall reduction in the carbon footprint of food of 6% (with rebound effect[9]) and to a reduction of the material footprint of 7% (with rebound effect).

The **'short chains'** circular strategy translates into a scenario in which exclusively European products are consumed. Non-European imported products are replaced by local varieties, without taking into account seasonal purchases. Local refers to comparable products from Flanders, the rest of Belgium, the Netherlands, Germany and France. The 'short chains' scenario gives no clear results.

[9] If a scenario results in a rise or decline in the total spending, this can lead to a rebound effect. The reduced or additional expenditure should be compensated by an increase (or decrease) of the expenditure in other areas of consumption. In this study, the choice was made to calculate this rebound effect in line with the change in expenditure of an increase (decrease) to a higher (lower) income decile.

The influence of the scenario on the carbon footprint in the areas of consumption of 'meat products', 'milk, cheese and eggs', 'vegetables', 'fruit', 'sugar, jam, honey, chocolate and confectionery', 'foods (other)' and 'non-alcoholic drinks' is not clear. The carbon footprint only lowers in the areas of consumption of 'bread and cereal products' and 'fish and shellfish'.

The **'less food waste'** circular strategy translates into a scenario in which the consumption of food is reduced per household.

A more efficient purchasing behaviour with less food waste is reflected in reduced consumption. In line with the target set by the Flemish Government, this scenario opts for a 30% reduction in household food waste. By reducing food waste, the carbon footprint of food is 2% lower (1% with rebound effect). It is striking that the decline of the carbon footprint is largely achieved in Europe. The material footprint also declines by 2% (1% with rebound effect).

The carbon footprint of the combination of 2 strategies (alternative diet and less food waste) is 6% lower (with rebound effect) than that of the current food system, the materials impact is 8% (with rebound effect) lower.

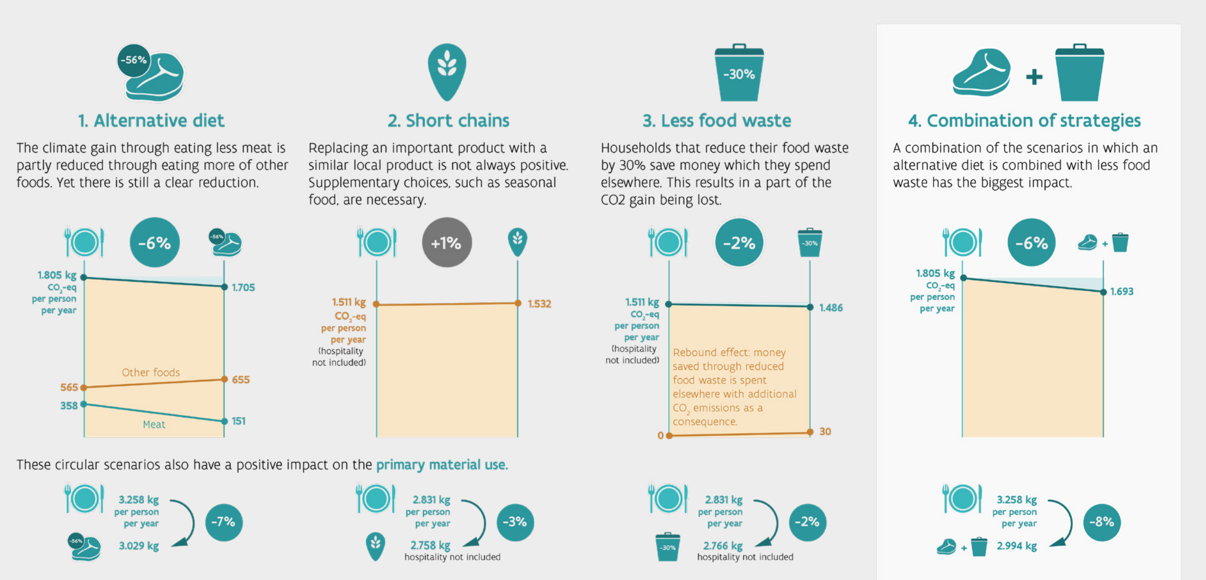

Figure 5: Impact of 3 circular scenarios and a combined scenario on the carbon footprint and the material footprint of Flanders' food consumption. Source: Christis, Breemersch & Vercalsteren (VITO), 2019.

WANT TO KNOW MORE?

Ellen MacArthur Foundation & Material Economics. (2019). Completing the picture. How the circular economy tackles climate change.

Christis, M., Breemersch, K. & Vercalsteren, A. (VITO). (2019). Circulaire economie en de Vlaamse klimaatdoelstellingen. Voedings- en textielsysteem. [Circular economy and the Flemish climate targets. Food and textile system]. VITO studie in opdracht van de OVAM.

Message 5:

CIRCULAR STRATEGIES REDUCE THE MATERIAL AND CARBON FOOTPRINT OF OUR TEXTILE CONSUMPTION

In a nutshell:
a combined strategy (clothing consisting of 50% recycled fibres, produced locally and lasts three times longer and partly consumed via a leasing model) reduces the material footprint of Flanders' textile consumption by 53% and its carbon footprint by 32%.

Perspective: consumption footprint

Circular strategies can reduce the climate and material impact of Flanders' textile consumption. The focus here is on the consumption of clothing, footwear and household textiles. OVAM commissioned a study of **3 circular textile scenarios** from the consumption perspective.

In a first scenario, a portion of textile consumption is via a **leasing** model, which extends garments' lifespan.

The leasing pattern differs depending on the user's age category. For babies and toddlers, all clothing, footwear and household textiles are leased. For children and adults, part of the consumption of clothing and footwear is provided by classic means (purchased), the rest (50% for children and 40% for adults) via leasing. Household textiles (e.g. bed linen, table and toilet linen) used by adults and children will simply be purchased. Reuse means that the consumption of clothing in Flanders will naturally decline.

This means that the material footprint of clothing declines by 22%, primarily (85%) outside Europe. The carbon footprint of clothing also declines overall by 16%. The leasing services and activities (i.e. home delivery, cleaning and repair services) in Flanders will, however, lead to an increase in greenhouse gas emissions within Flanders.

A second scenario looks at the impact of the recycling of textile fibres.

Specifically, it is assumed that for both clothing and household textiles, half of the textile fibres used could be replaced by textile fibres recycled in Europe. The production of the clothing still takes place at the same geographic locations as those in the current textile system. For the consumer, nothing else changes: both the total expenditure on textiles and the way in which clothing is purchased, remain unchanged. As a result, the carbon footprint of clothing is lowered by 8%. This is largely due to a lower demand for energy. Thanks to the lower demand for primary materials in the early parts of the clothing production chain, the material footprint for clothing is lowered by 11%.

The impact of this scenario is primarily located in the rest of the world. That is where 87% of the reduction of greenhouse gas emissions and 89% of the reduction of material use takes place.

A third scenario looks at **local and high-quality production.** Clothing and footwear are produced by local manufacturers (15% Flemish production; 10% by manufacturers in the rest of Belgium; the remainder by European manufacturers), who supply high-quality products that can be used up to three times longer, but also cost up to four times as much. This situation leads to the largest decline in the carbon footprint of clothing (-25%).

Since this clothing is to have a longer lifespan, the demand for materials declines and the material footprint almost halves. The decline in greenhouse gas emissions and material use is primarily achieved in the rest of the world. On the other hand, both footprints increase in Flanders and Europe due to increased production.

Finally, all these textile scenarios were **combined**. In this combined scenario, the global decline of greenhouse gas emissions caused by clothing is 32%. The materials footprint declines by 53%.

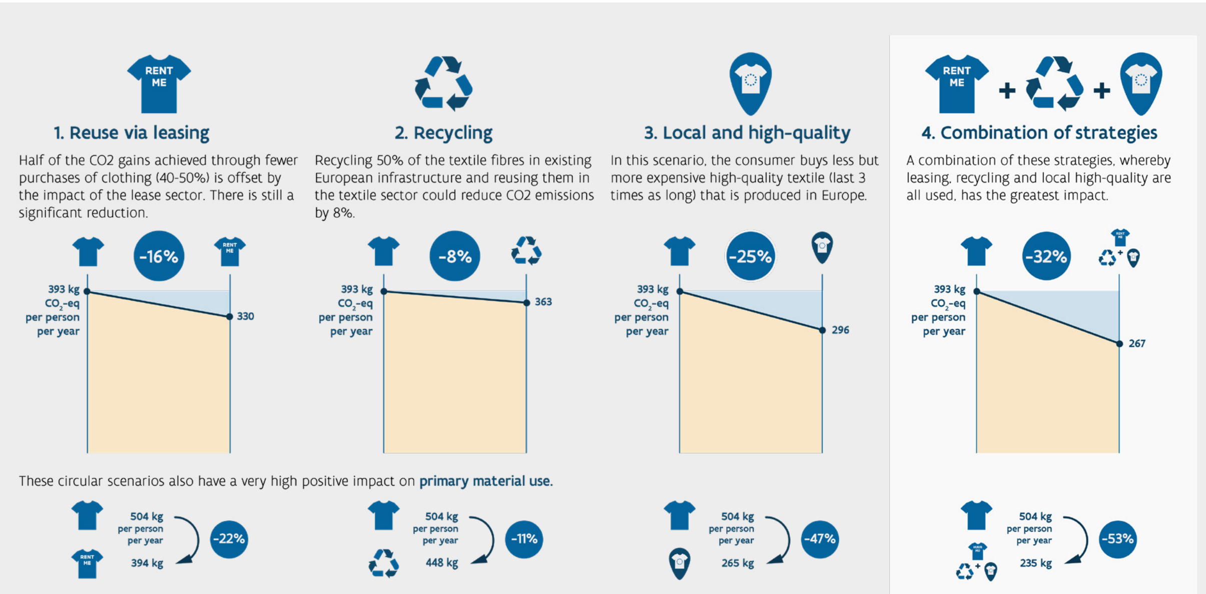

Figure 6: Impact of 3 circular scenarios on the carbon footprint and the material footprint of Flanders' textile consumption. Source: Christis, Breemersch & Vercalsteren (VITO), 2019.

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Message 6:

CIRCULAR STRATEGIES REDUCE THE GREENHOUSE GAS EMISSIONS OF OUR MOBILITY

In a nutshell:
achieving the climate target for passenger transport by 2030 demands a combination of measures each of which must, in itself, be highly ambitious: more carsharing, far fewer car kilometres and a fleet that consists of many green vehicles (electric or fuelled by hydrogen).

Perspective: territorial

With the Flemish Energy and Climate Plan (VEKP) 2021-2030, Flanders commits to a 35% reduction of greenhouse gases by 2030 compared to 2005 in the sectors that do not belong the European Emissions Trading Scheme (ETS). The specific reduction target in the VEKP for passenger transport is 50%.

OVAM commissioned an analysis of various future scenarios for the car fleet to see how the climate target can be achieved, taking into account the stock of materials in our economy:

- BAU (business as usual) – continuation of the current trends: more cars, more kilometres, slightly more electric cars;
- EV – rapid transition to electric vehicles: from 2030, all new cars are electric, more cars, more kilometres;
- DEV – combination of carsharing and electric vehicles: by 2030, 55% of new cars are electric, 40% autonomous vehicles (no driver) of which 25% shared vehicles, more cars, more kilometres;
- H2 – rapid transition to hydrogen cars: by 2024 more electric cars as in the EV scenario, from 2025, more new cars using hydrogen, from 2030, all newly-purchased cars run on hydrogen, more cars, more kilometres;
- MVP – far fewer journeys: 40% fewer kilometres compared to 2015, fewer cars, more alternative transport, no rise in carsharing, slightly more electric cars;
- DV – far more carsharing and shared use of vehicles: a very large proportion of carsharing and a doubling of the average occupancy (in 2015 on average 1.33 persons in a car), enormous boost in the number of shared cars, far fewer cars, slightly more electric cars, the same number of kilometres for journeys made by car;

- Combination of DEV and DV: faster introduction of electric cars, from 2030, 55% of all new cars are electric, more shared cars, doubling of the average occupancy, more cars, more kilometres;
- Combination of DEV and MVP: faster introduction of electric cars, from 2030, 55% of all new cars are electric, more shared cars, 40% reduction of journeys made by car, fewer cars.

The scenarios without a combination of policy measures (EV, H2, MVP and DV) are extreme scenarios whereby extreme use is made of one policy measure. These scenarios cannot be achieved in practice but do make the effect of the individual measures clear.

Of the scenarios with one measure, only the MVP and DV scenarios (considerably fewer journeys by car and with many shared cars) achieve the target of a 50% reduction of the territorial CO_2 emissions in Flanders produced by cars. The scenarios with only a transition to electric (EV) or hydrogen cars (H2) are a step in the right direction but have insufficient effect by 2030. After all, by 2030, not all the vehicles with combustion engines will have been replaced. In addition, electric cars and the production of hydrogen use energy. The model takes into account the emissions from energy production according to the current energy mix.

To achieve the climate target for passenger transport by 2030 therefore demands a **combination** of measures, of which each measure, in itself, must be highly ambitious: more carsharing and far fewer car kilometres and a fleet that consists of many green vehicles (electric or fuelled by hydrogen).

If we want to accelerate the replacement of the current car fleet with electric cars with batteries in their existing configuration, we will need an enormous number of Li-ion batteries and this could cause scarcity with regard to a number of these materials, such as cobalt, copper, lithium and nickel. Reuse and recycling of batteries and innovation in vehicle technology are both indispensable in the transition to electric mobility.

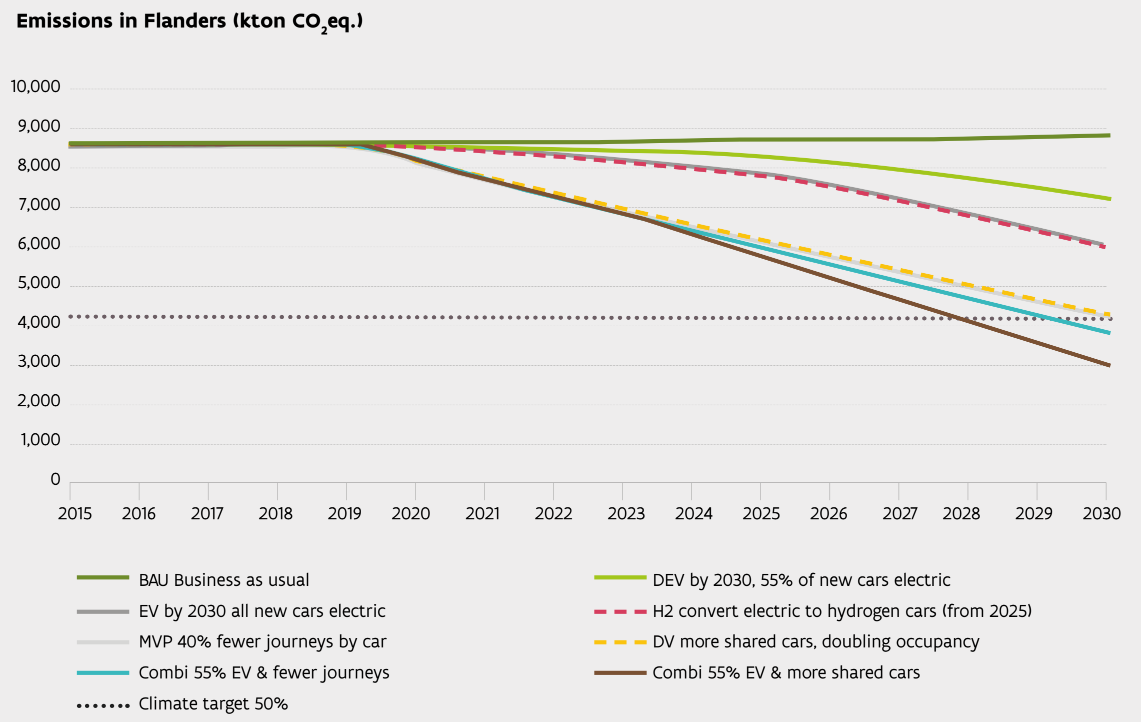

Figure 7: Greenhouse gas emissions within Flanders related to the use of passenger vehicles according to 8 mobility scenarios (in kiloton CO_2 eq.). Source: Dams & Van der Linden (VITO), 2020.

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Message 7:

CIRCULAR STRATEGIES REDUCE THE USE OF MATERIALS AND THE EMISSION OF GREENHOUSE GASES IN OUR BUILDINGS

In a nutshell:
optimising the choice of materials in buildings can strongly reduce the material and energy impact of our housing.

Perspective: not applicable

OVAM has commissioned calculations on how the impact of material and energy use can be reduced simply by making different choices (of materials). For this, various optimisation strategies were tested to demonstrate that there are different ways of lowering the impact. In reality, a contractor, for example, will not always be prepared to adapt the type of construction.

The analysis of the cases in this study are based on the life-cycle analysis in TOTEM. **The TOTEM tool** (**T**ool to **O**ptimise the **T**otal **E**nvironmental impact of **M**aterials) allows an optimum to be sought between energy and material impact. In this way, a choice can be made during the design of the building for materials that benefit that optimum.

This analysis does not yet take into account the potential for reuse of materials to give them a new life. This circularity criterion was integrated in TOTEM in 2021. The optimisation exercise can be strongly influenced by taking this criterion into account.

The total environmental impact (expressed in € /m² gross floor surface area) consists of:

- environmental impact due to energy loss during the use of the house (greenhouse gas emissions);
- environmental impact due to the use of materials during the entire life cycle: extraction of raw materials, processing of raw materials to construction materials, installation on the construction site, maintenance and replacement of materials, transport and demolition and waste processing (all impact categories: greenhouse gas emissions, acidification, car-cinogenic properties, eco-toxicity, etc.).

One of the cases in the study looked at the choice of materials for a new apartment building. The type of construction remained unchanged: both variants are based on brickwork. Six materials were, however, replaced (virtually) by other materials. This optimisation can reduce the material-related impact by around 30% (see Figure 8).

If account is also taken of energy consumption, a reduction can be achieved of 15% of the total impact (due to material and energy consumption) (not on the figure). It also transpired that finishing materials (such as paint) make a significant contribution to the impact and thus play an important role in the optimisation.

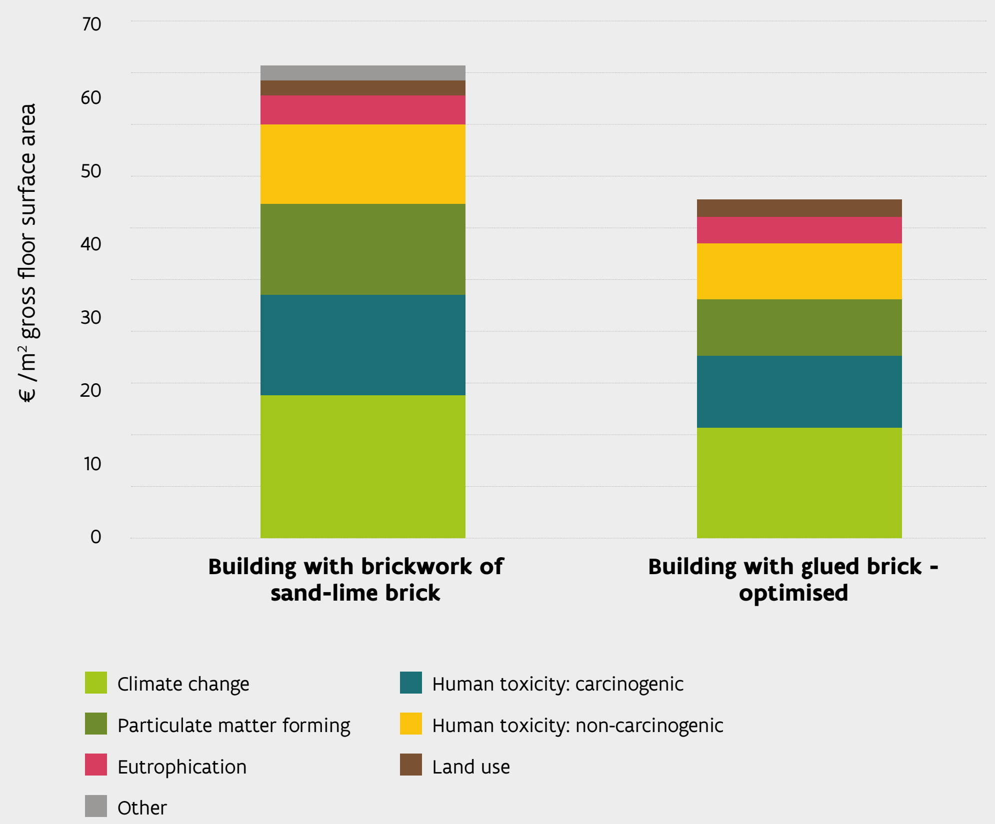

Figure 8: Comparison of the material-related environmental costs of the initial (left) and optimised (right) version of a new apartment building (construction type: brickwork) - optimisation of the choice of materials. Source: Delem, Janssen, Vrijders & Wastiels (WTCB), 2020.

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Message 8:

A CIRCULAR ECONOMY IS ESSENTIAL FOR THE ENERGY TRANSITION

In a nutshell:
the Flemish energy transition demands more materials than Flanders, based on its population, is 'entitled' to. Moreover, the worldwide extraction of the necessary materials puts pressure on the environment and climate. Recycling of materials from the urban mine can offer a solution here.

Perspective: not applicable

An energy transition is essential to reach Flanders' climate targets. The Flemish Energy and Climate Plan and the 2019-2024 Flemish coalition agreement laid out the outlines for the energy transition between 2020 and 2030. Central to this Flemish energy transition are a further expansion of the offshore turbine park, the increase in solar panels and the roll-out of storage systems for energy.

Commissioned by OVAM, VITO has investigated the demand for metallic elements necessary for the Flemish energy transition in the period up to 2030.

We based this on the composition and lifespan of the various sustainable energy technologies: solar panels, converters, wind turbines and batteries. Here we use the results for **silver as an example.** The report studied an additional 16 metallic elements.

Although silver is also used in other electrical and electronic applications, the demand for silver for sustainable energy technologies by 2030 (133 tonnes) was already more than a quarter of Flanders' reserve budget[10] (452 tonnes)

Since the energy transition will, of course, continue after 2030, the reserve budget will come under pressure under the current technology.

If the materials are optimally collected and recycled, almost all the silver can be recycled. Yet only a fraction of this silver can be recovered by 2030, taking into account the lengthy lifespan of these sustainable energy technologies. The broad range of applications, however, implies a high stock of these materials in the **'urban mine'.** That can considerably alleviate primary extraction as long as there is proper collection and recycling.

[10] Flanders' reserve budget consists of the reserves in silver available worldwide for Flanders based on Flanders' population.

The demand for materials also goes hand in hand with additional worldwide extraction, which in turn **exerts pressure on the environment and the climate.** Furthermore, declining ore concentration requires more energy for the extraction of raw materials.

Nor should we forget that 2030 is just an intermediate staging post. The ultimate European target is a climate-neutral energy production in 2050. Efforts will also be necessary after 2030.

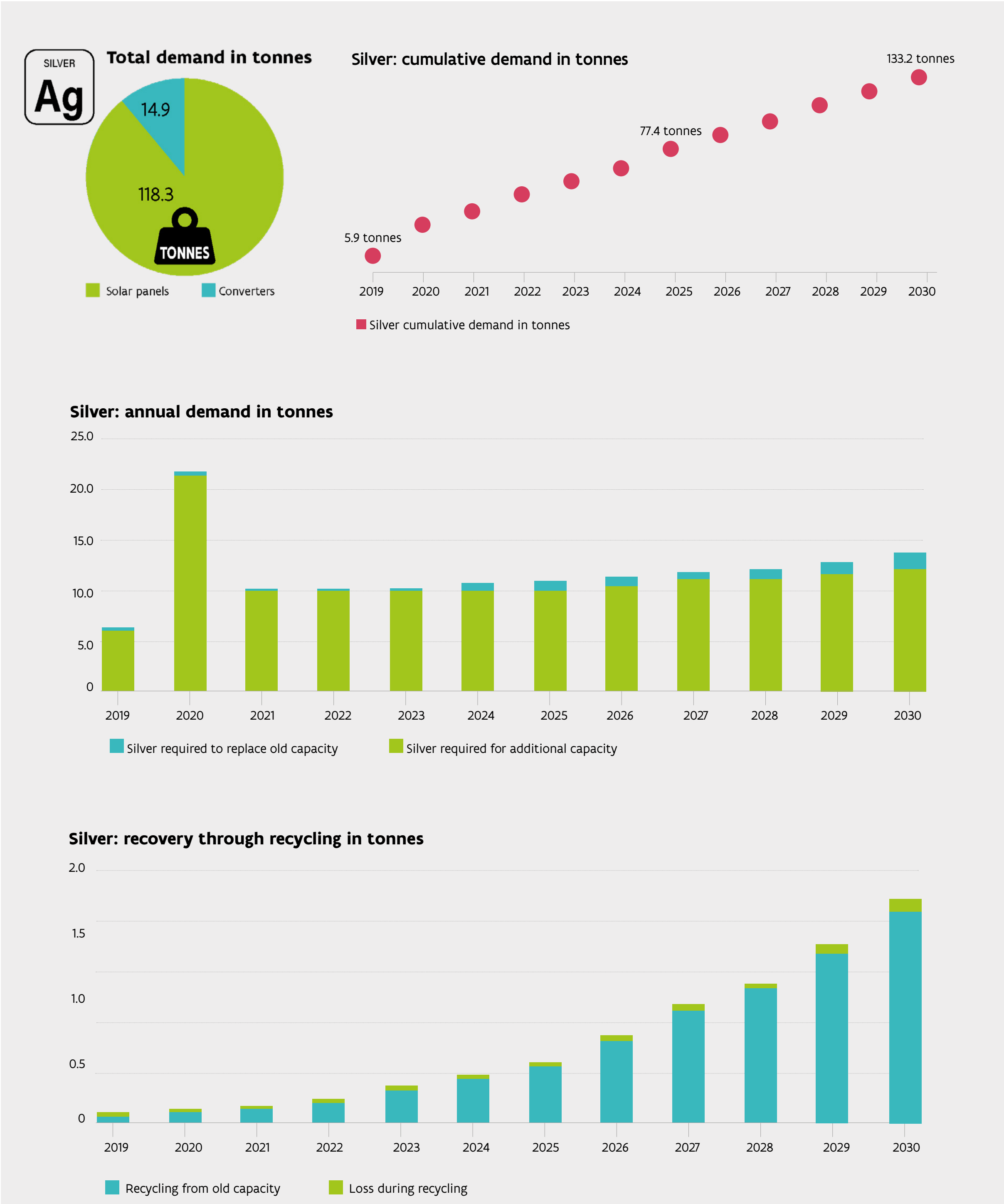

Figure 9. Silver in sustainable energy technologies until 2030 according to the Flemish energy plan: total demand until 2030, cumulative demand, annual demand and recovery with recycling after end-of-life. Source: Breemersch, Vercalsteren, Mantels & Rommens (VITO), 2020

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Message 9:

THE OPEN FLEMISH ECONOMY INFLUENCES THE EFFECT OF CIRCULAR STRATEGIES ON MATERIAL USE AND EMISSIONS

In a nutshell:
circular changes in the Flemish production structure result in a lower use of materials in global production networks and also in fewer emissions during extraction outside Flanders. Due to the open character of the Flemish economy, these strategies have only a limited impact on emissions and material use in a territorial perspective.

Perspective: territorial and footprint

Commissioned by OVAM, VITO carried out a macro-economic study into the impact of circular economy strategies on material use and greenhouse gas emissions in the Flemish economy. The study is based on a reference scenario in 2030 and calculates the impact of 3 circular scenarios relative to this reference scenario.

The **reference scenario** uses the economic structure of the Flemish economy in the year 2015. With an eye on a time horizon of 2030, two major changes were implemented in the Flemish economy.

On the one hand, an economic growth by 2030 in both investments and consumer spending. On the other hand, reducing the emissions of the energy-intensive industry and the electricity sector by means of the Emission Trading System (ETS) by 43% by 2030 compared to 2005 **in compliance with the current climate targets.**

The main changes in the 3 **circular scenarios** are:

- Scenario 1 - Flemish companies use 25% fewer materials (both raw materials and basic materials, both energy and non-energy materials) by focusing on technological alternatives. The assumption is that consumers will not change their behaviour.
- Scenario 2 - Flemish companies replace 25% of the primary materials with recovered materials (both reuse of materials and the use of recycled materials). Here again, the focus is on the producers; consumption by households remains unchanged.
- Scenario 3 - Flemish consumers will make use of their purchases for longer before replacing them. The lifespan of consumer goods is extended.

This means that 25% fewer purchases are needed for all products with a long lifespan[11]. This scenario shifts the focus from the supply side to the demand side, although driven by initiatives from both companies and consumers.

More efficient material use (scenarios 1 and 2) in the Flemish **production structure** leads to a lower primary material use throughout global production networks. Yet the effect of this can hardly be found in the territorial primary material use. Changes in the input structure of Flemish material-intensive sectors of industry thus have little effect on the Flemish material extraction. We do observe, however a decline of the **material footprint** as a result of the lower demand for materials from abroad.

The demand for materials (e.g. steel, aluminium) by Flanders is lower, but the extraction of primary materials is located **outside** Flanders. Also, the majority of Flemish products are exported, which largely causes a decrease in the **footprint** of products exported by Flanders. Thus, in the first scenario the carbon footprint of Flemish export decreases by 4% and the material footprint by 16% compared to the reference scenario. A lower material footprint of export products implies a lower dependence on raw materials which is an important economic benefit.

In scenarios 1 and 2, we do not see any major changes in the emissions compared to the reference scenario. This is because we started from the purchasing structure of the Flemish companies. The activities that were reduced or replaced (production of primary materials) mainly take place abroad. In scenario 2, the greenhouse gas emissions in the recycling sector increase more than the decrease of emissions achieved in other sectors (e.g. metal production, extraction), which causes a slight global increase.

Changes in the **consumption structure,** with a focus on reduced material use (scenario 3) also lead to lower primary material use throughout the global production networks. If households are encouraged to adopt consumption patterns that are less material intensive, the results show a decline in both the territorial material use and the material footprint of Flemish consumption.

	Greenhouse gas emissions (% change compared to reference scenario)	Primary materials (% change compared to reference scenario)
Scenario 1: Flemish companies use fewer materials		
territorial perspective	-%	-2%
footprint perspective	-2%	-8%
footprint of export	-4%	-16%
Scenario 2: Flemish companies replace primary materials with recovered materials		
territorial perspective	+2%	+1%
footprint perspective	-%	-4%
footprint of export	+1%	-7%
Scenario 3: Flemish consumers will make use of their purchases for longer before replacing them		
territorial perspective	-%	-13%
footprint perspective	-3%	-12%
footprint of export	-%	-%

Table 1: Impact of 3 circular macro scenarios on greenhouse gas emissions and primary materials from 3 perspectives (territorial, footprint and footprint of export). Source: Borms, Christis & Vercalsteren (VITO), 2021

An additional explanation for the limited effects is that the **model used** (the Flemish IO model) assumes that the structure of the economy does not change. The circular scenarios that we model assume a similar economy that uses different (or fewer) materials or produces products that only enter the waste phase later (lifespan extension).

The modelling of complex circular (macroeconomic) scenarios, whereby the economic structure changes (e.g. other business models), is a challenge for a future study.

These results are comparable with studies in other countries. An important difference is that, in them, use is made of a scenario for material efficiency that combines the three separate scenarios in this study.

The decline in greenhouse gas emissions of other countries, such as the Netherlands, France, Finland, Sweden and Spain varies between 3 and 10%. These results are roughly in line with the results of this study.

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Message 10:

RECYCLED MATERIALS ARE LESS CARBON INTENSIVE THAN PRIMARY MATERIALS

In a nutshell:
production with secondary materials reduces greenhouse gas emissions in comparison with production based on primary materials. The use of secondary materials in the production process can be limited by technical options as demonstrated in the case of glass products.

Perspective: consumption footprint

Production with secondary materials reduces the CO_2 intensity of production with primary materials by 79% for steel, 89% for plastics and 93% for aluminium (Material Economics, 2020). Calculations by OVAM based on the Ecolizer, but only taking into account the climate impact (in kg CO_2 equivalents), lead to similar conclusions. For plastics, the use of recycled materials lead to reductions in CO_2 equivalents of 59% to 91%. For textiles, the reductions vary from 14% to 74%. Secondary steel reduces the CO_2 equivalents by 67% and for non-ferrous materials we see reductions of 88% to 99%.

Commissioned by OVAM, VITO developed a reproducible methodology for analysis with regards to **secondary material flows.** The methodology calculates the possible global environment gain in terms of greenhouse gases through an extra use of secondary materials. For this we define three scenarios:

1. Current situation in which both primary and secondary materials are used;
2. Linear production in which the input is limited to only primary raw materials;
3. Recycling economy (circular scenario) with a maximum secondary material input.

A case was elaborated around the **use of glass fragments in the production of glass products.**

The environmental gain can be explained in a two-dimensional graph with the dimensions of global greenhouse gas emissions and the use of primary materials (see Figure 10). Scenario 2 - linear production - results in the highest carbon footprint and material footprint. By setting both values as equal to 100%, we can express other results relative to this.

Scenario 3 - recycling economy - estimates the greenhouse gas emissions at 89% compared to the scenario of linear production. The material footprint of the recycling economy is still 45% of the footprint in the linear production scenario. This scenario is indicated by the blue globe in Figure 10.

In comparison with the linear production, the current situation (scenario 1) has a carbon footprint that is 2% lower and a material footprint that is 12% lower. The current situation is indicated by the full blue rhombus in the figure. Note: the linear production already contains the internal reuse of glass fragments.

A scenario with a linear production without the internal reuse of glass fragments would have a larger footprint, which would increase the difference in footprint compared to the current situation.

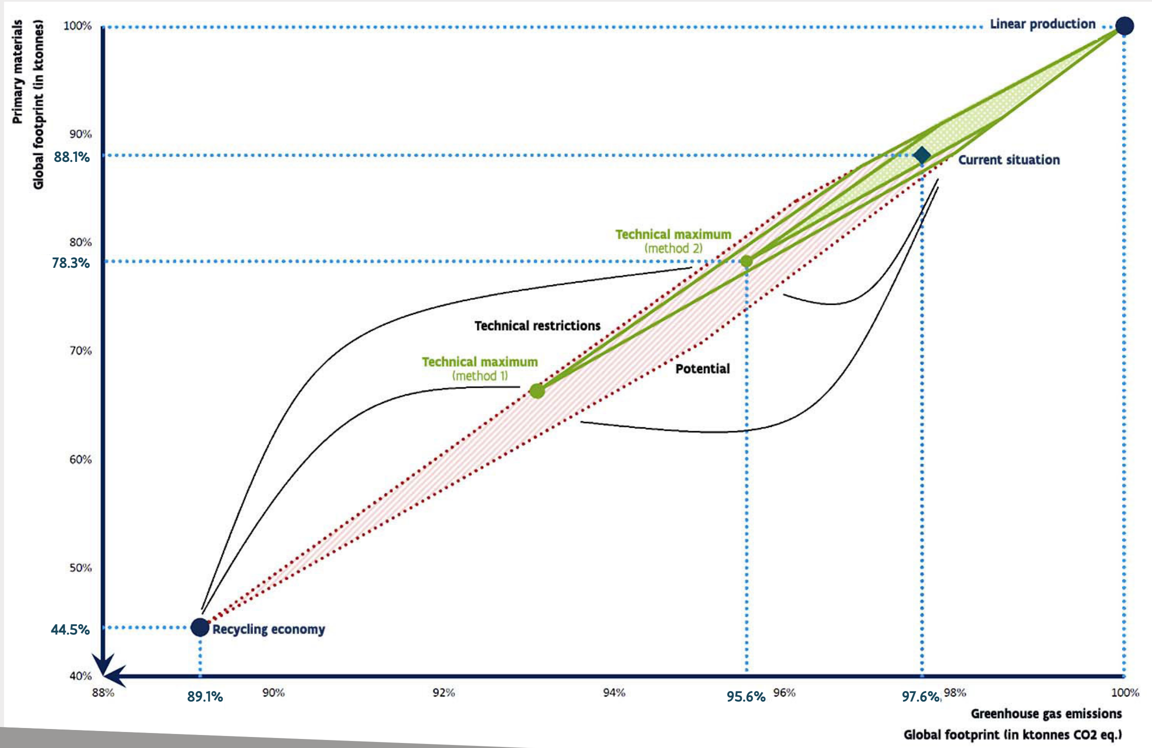

Figure 10: Summary of the potential of secondary materials (glass fragments) on the carbon footprint and material footprint in Flemish final consumption (2010). The full potential is reflected by the red area.
The potential taking into account the technical restrictions (methods 1 and 2) is limited to the green area. Source: Christis, Van der Linden, Vercalsteren (2018)

The use of glass fragments is technically restricted, which means that the recycling economy scenario cannot be considered realistic. The technical maximum was calculated using 2 methods. With method 1, the maximum ratio between production of flat glass on the basis of primary raw materials and production on the basis of secondary raw materials was set at 60/40.

For hollow glass, this maximum ratio is 20/80 and for technical glass is it 10/90. The technical maximum using methode 2 estimates the use based on the difference between the current use of glass fragments and the maximum use described in the literature. The assumption is that the use of glass fragments in flat glass production can be increased by 10% compared to the current situation.

For hollow glass and technical glass, we have set the assumption at an increase compared to the present situation of 30% and 20% respectively.

The determination of the technical maximum influences the potential. The potential of both the carbon footprint and the material footprint is halved in method 2 compared to method 1.

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