PBL Netherlands Environmental Assessment Agency

INTEGRAL CIRCULAR ECONOMY REPORT

Assessment for the Netherlands 2025

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The Integral Circular Economy Report for the Netherlands was produced in the framework of the Work Programme on Monitoring and Evaluation Circular Economy, 2019–2024. The Work Programme is a collaborative effort of several knowledge institutes under the direction of PBL Netherlands Environmental Assessment Agency.

The Dutch Government is pursuing to achieve a fully circular economy by 2050. The aim of the Work Programme is to monitor and assess the charted path towards 2050 and to provide the government with the knowledge required to design and adjust policies. Further information on the Work Programme on Monitoring and Evaluation Circular Economy can be found at https://www.pbl.nl/monitoring-circulaire-economie.

The full Dutch report was drawn up with input from the knowledge institutes that take part in the Work Programme on Monitoring and Evaluation Circular Economy:

- Statistics Netherlands (CBS)
- CPB Netherlands Bureau for Economic Policy Analysis
- Institute of Environmental Sciences (CML)
- Netherlands Enterprise Agency (RVO)
- National Institute for Public Health and the Environment (RIVM)
- Rijkswaterstaat – Ministry of Infrastructure and Water Management (RWS)
- Netherlands Organisation for Applied Scientific Research (TNO)
- Copernicus Institute of Utrecht University (CC)

Colophon

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Foreword

The Netherlands is highly dependent on the import of material resources. We not only import oil and natural gas from abroad, but also metals and critical raw materials including cobalt and lithium. All these material resources are crucial to keep the economy going.

As such, the Netherlands is particularly vulnerable to developments on the global stage. The associated consequences and risks are becoming increasingly pressing. The war between Russia and Ukraine has led to price increases for oil, gas, and numerous other material resources and products in Europe and the Netherlands. In 2024, we saw several Dutch recycling companies for plastics fail because they could not compete with cheap virgin plastics from outside Europe. Furthermore, the Netherlands is almost entirely dependent on China for the refining of critical raw materials; the recycling of these materials in Europe is still in its infancy. On top of that it is the question to what extent the American import tariffs will lead to a long-term trade war, with higher prices and a geopolitical fight for material resources as a result.

It is therefore not surprising that the Netherlands wants to limit these risks and ensure that material resources remain available and affordable. The Dutch national government is therefore striving for a circular economy; in other words, an economy where products, material resources, and raw materials are used as long as possible and, after use, are recycled in a high-quality manner. This way, significantly fewer new material resources will have to be extracted and imported.

Additionally, a circular economy contributes to reaching global climate and nature targets. Material resource use, after all, has significant negative consequences for climate change and biodiversity and places pressure on air, soil, and water quality.

The circular economy also offers opportunities for businesses and the Dutch economy. There is a reason why Mario Draghi, former President of the European Central Bank, identifies realising a circular economy as one of the pillars to strengthen the competitiveness of the EU. The Netherlands already has a relatively large number of circular businesses and know-how and therefore has a favourable starting position.

How the Netherlands intends to shape and accelerate the transition to a circular economy is outlined in the National Circular Economy Programme 2023-2030 (NPCE). At the request of the Dutch Cabinet, the Netherlands Environmental Assessment Agency (PBL) follows this transition and reports on it every two years in the Integral Circular Economy Report (ICER). Here, we look at the developments in the use of material resources and their effects, but also at actions and tools which governments, businesses, and citizens can apply to help realise a circular economy.

The ICER 2025 indicates that there are several promising initiatives in the field of the circular economy, but that it is not going so well with the transition itself. Indeed, material resource use has actually increased between 2020 and 2022, as have the supply risks of the most critical raw materials. Moreover, there are no strong markets for many circular products. These negative trends can be reversed with concrete and ambitious policy on both national and European level.

The ICER brings together a lot of research. Just as with previous editions, the ICER 2025 is the product of a collaboration with, and input by: CBS (Statistics Netherlands), CPB (Netherlands

Bureau for Economic Policy Analysis), CML (Institute of Environmental Sciences, Leiden University), RIVM (national Institute for Public Health and the Environment), RVO (Netherlands Enterprise Agency), RWS (Rijkswaterstaat), TNO (Netherlands Organisation for Applied Scientific Research), and the Copernicus Institute (Utrecht University). These organisations also contribute to the multi-year Knowledge Programme Circular Economy, which is coordinated by PBL.

This report offers a broad knowledge base for the societal and political debate about the transition to a circular economy. The ICER provides tools for governors, politicians, and policymakers to strategically guide production and consumption processes. Together with this publication, a website will be launched with more in-depth information and lots of facts and data. I am convinced that all this knowledge can help with the actualisation of the National Circular Economy Programme. With many thanks to our partners who collaborated on this ICER and who continue to work with us in further developing knowledge on material resources and the circular economy.

Prof. Dr. Marko Hekkert

Director PBL


Recycle
NSave
Recycle
NSave

Summary

Every two years, PBL publishes an Integral Circular Economy Report (ICER) at the request of the Dutch government. In this report, we provide an overview of the state of affairs concerning the circular economy transition in the Netherlands. As such, the ICER provides a knowledge base for the societal and political debates around this transition. To this end we delve into the use of material resources and its effects, the progress of the transition to a circular economy in society, and the development of circular economy policy. This report also offers guidelines to promote the necessary acceleration of the transition. We therefore pay particular attention in this ICER to the use of policy instruments to speed up the transition to a circular economy.

Material resource use has increased in the Netherlands, but so have supply risks

A circular economy is significantly more efficient with its material resources than is the case in the Netherlands today. This is crucial, since global climate and nature targets are not achievable without reducing the use of new material resources. A high resource use makes the Dutch economy vulnerable, particularly because a strong dependence on a limited number of countries for the supply of critical raw materials.

The Netherlands Environmental Assessment Agency (PBL) notes that, despite the potential advantages of a circular economy, the urgency to efficiently handle material resources in the Netherlands has been lagging behind other societal challenges, such as housing and the energy transition. Particularly in the case of plastic recycling, we see that businesses collapse due to competitive pressure of low fossil fuel prices from, especially, China and the United States. The demand for new material resources therefore keeps growing. Furthermore, consumers are open to the idea of circular behaviour, such as repairing goods or buying refurbished products, but, in practice, this has hardly led to more circular consumption patterns.

With a continuation of current developments concerning material resource use in the Netherlands and circular economy policy, it is extremely unlikely that the national target of halving the amount of primary abiotic resources by 2030 will be achieved. As a matter of fact, material resource use in 2022 has only increased compared to 2020 levels. Supply risks of the most critical raw materials in the Netherlands have also increased over the past decade. This predominantly affects the manufacturing industry and, there, sectors such as machine construction, transport, and electronic devices.

Committing to circular solutions now offers opportunities for the Dutch economy

The Netherlands has a good starting point for a circular economy. There is a great deal of knowledge and expertise, including in the areas of recycling, innovative product design, and new revenue models, to name a few. This offers Dutch businesses opportunities in terms of export. The coming years, it is expected that there will be a significant increase in material and resource use for housing and in the energy transition. It is very important to include circular strategies in the large, planned investments for these societal challenges and to manage a long-term perspective for material resources. This includes setting requirements for the design of wind turbines to enable reuse and recycling, and splitting or 'topping up' (adding an extra floor) to existing houses. Hence, in the long term, fewer material resources will be needed and the Netherlands will therefore become less dependent on other countries. However, there has to be sufficient capacity for the recycling of critical raw materials, since this hardly takes place at the moment.

Recommendations for policymakers to speed up the circular economy (CE)-transition

The biggest obstacle to speed up the transition to a circular economy is the lack of markets for circular products. Ambitious policy aimed at all circular strategies, on both a national and European level, is therefore needed to promote circular innovations and activities. Many existing policy instruments mostly intervene at the back end of the production chain, such as waste collection and recycling. Earlier on in the chain there are potential policy options that still have to established, such as putting rules in place for design and reuse. To speed up the transition to a circular economy, it is necessary to further develop and implement the plans for targets, policy instruments, and steering of the National Circular Economy Programme (NPCE). PBL offers the following recommendations to policymakers:

1. Keep committing to ambitious European CE-policy to realise a level playing field for Dutch businesses, particularly new policy following the EU Circular Economy Action Plan, the development of the Right to Repair directive, and the further implementation of legislation for specific products within the Ecodesign Regulation.
2. Make better use of existing national instruments, such as extended producer responsibility (EPR) and circular procurement by governments. Set dynamic requirements that go further than just waste collection and recycling, for example. These requirements, which will become stricter over time, can be aimed at reuse, high-quality use of recyclate, and the use of fewer material resources per product.
3. Focus on the development of policy instruments with potentially large environmental effects. This includes a European tax on primary fossil fuels for plastics, for instance, but also increased procurement in the case of ground, road, and hydraulic engineering, and an operational subsidy for circular measures to reduce the price difference between Dutch recyclate and primary material resources (comparable to the successful Dutch subsidy scheme for the energy transition SDE+(+)).
4. Reinforce the existing management model for a circular economy by making clear, binding agreements between ministries, decentralised governments, businesses, and societal organisations concerning roles, responsibilities, and achieving targets.

FINDINGS

Findings

Current trends indicate the necessity of a circular economy

Using significantly fewer material resources is becoming more and more urgent

Global resource consumption, from extraction to refining to product, is the cause of 60% of global greenhouse gas emissions and the cause of 90% of biodiversity loss. It is expected that global resource use, without additional policy, will grow another 60% between 2020 and 2060. Global climate and nature targets are therefore not achievable without drastically reducing resource use. There are long global production chains, from extraction to finished product; therefore the consumption of material resources by Dutch businesses and consumers cannot be seen as separate from global resource issues.

Due to ongoing geopolitical developments, the future availability of material resources is not guaranteed. Related to these developments are price fluctuations and disruptions in the production chains, which can be disadvantageous for citizens and businesses. The war between Russia and Ukraine has consequences for the availability and affordability of oil and natural gas in the Netherlands and other EU countries. For many goods, moreover, such as chips for computers and materials for renewable energy, there were steep price hikes and long delivery times, while demand only keeps increasing. Because so many material resources come from outside the EU, and mining and refinery of critical raw materials is concentrated in a handful of countries, Europe and the Netherlands are particularly vulnerable.

The necessity to use significantly fewer material resources, and to use them more efficiently, is very important, especially when taking into account environmental, economic, and geopolitical considerations. This is precisely what a circular economy is aimed at. Through smart product design, fewer (harmful) material resources are needed, or repair is easier because of circular product design. Product design also contributes to a longer lifespan of products and parts and makes high-quality recycling easier to realise. Because of the application of these circular strategies, fewer new material resources are needed across the whole lifespan of products. Committing to these and other circular strategies is therefore crucial, also for products already on the market. The more businesses operate in a circular manner, the more future proof they become.

Dutch resource use increased between 2020 and 2022; it is partly because of this increase that it is extremely unlikely that the 2030 target will be reached

There is an increase in total Dutch material resource use in 2022 relative to 2020, the year the previous ICER reported on. For material resource use by the Dutch economy, this concerns an increase of 3% and an increase of 2% for domestic use. The 2020-2022 increase concerns both direct use of material resources within the Netherlands as well as material resource use throughout the entire production chain (resource footprint). A comparison of these two years is difficult, since the Netherlands consumed significantly fewer fossil fuels in 2020 due to COVID-19 lockdowns. Material resource use in 2022, on the other hand, was strongly influenced by higher prices for energy, food, and other products due to the war in Ukraine.

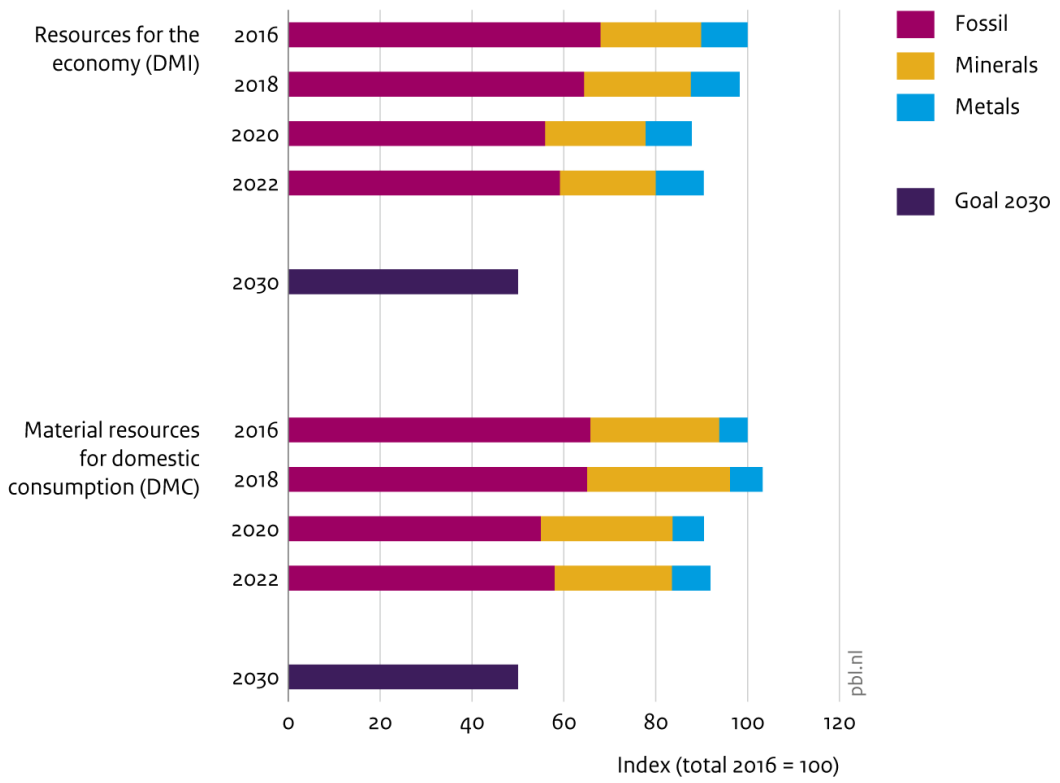
Alongside the total amount of material resources, consumption of primary abiotic resources (fossil, metals, minerals) also increased between 2020 and 2022. In 2022 (relative to 2016, the start of the National Circular Economy Programme, or NPCE), there was a decrease in direct use of primary

abiotic resources in the Netherlands. This concerns a decrease of 8% for domestic use of material resources, and a decrease of 10% for the whole Dutch economy. This decrease appears to be incidental, however, considering the higher prices for energy and other products since the war in Ukraine in 2022. For metals, for example, there was a steep increase in use between 2016 and 2022. This was mostly caused by an increase in the use of metals in electronic machines and (household) devices.

Additionally, it is the expectation that resource use will only keep increasing in the coming years in relation to the product groups we have analysed in this ICER: plastic packaging, housing, and renewable energy technologies. Considering all developments, it is extremely unlikely that the current policy target will be reached of halving the amount of primary abiotic resources in 2030 relative to 2016 levels (see Figure B.1).

Figure B.1

Abiotic resource indicators



Source: CBS 2024

The global environmental effect footprints (greenhouse gas emissions, land use, and biodiversity), that are caused throughout the whole production chain by Dutch production and consumption, have decreased between 2016 and 2021. All three environmental footprints for production and consumption have decreased in this period between 2-7%. For greenhouse gas emissions, this is mainly due to the, albeit incidental, lowered transport movement because of the COVID-19 lockdowns and, therefore, a significantly lower use of fossil fuels. This decrease can also be explained by an increase in renewable energy technologies and the use of more biomass in the energy sector, which means fewer fossil fuels are needed.

An increase in supply risks for the Dutch economy

For many material resources, half-finished products, and fully finished products, the Netherlands remains dependent on other countries for import. In the case of metals and critical raw materials, the Netherlands is even fully dependent on foreign countries. The supply risks of the most critical raw materials, such as those used in industrial sectors important for the Dutch economy (e.g. manufacturing), have increased over the past ten years. This is particularly the case for the machine construction sector, but also transport and electronics. Increasing supply risks are predominantly evident for critical raw materials that are being applied in (car) catalytic converters, magnets, electric vehicles, wind turbines, and batteries. Examples include platinum-group metals, germanium, and light and heavy rare earth metals that mostly originate from countries with increasing political instability, or where extraction and refining occur in one country, such as China.

The European Critical Raw Materials Act (CRMA) and the Dutch National Resource Strategy are both aimed at improving the security of supply of critical raw materials. Circular strategies, such as recycling, can be very valuable in reducing these supply risks. Currently, however, hardly any recycling of critical raw materials is happening in either the Netherlands or Europe. To expand the availability of such materials, attention is needed for circular design, reuse of parts, and a realisation of high-quality recycling infrastructure for critical raw materials, to name a few examples.

Recycling remains the dominant circular strategy

Currently, excepting that of critical raw materials, recycling is still the dominant circular strategy applied by Dutch governments and businesses. High-quality recycling, however, is lagging behind such as using recyclate in the same new products. As such, plastic packaging is only made of 7% recyclate. This is worrisome, since the use of recyclate is crucial to using fewer new material resources.

Additionally, the amount of recycled material available is not sufficient to fulfil the expected demand for material resources. For a fully circular economy, then, all circular strategies are needed, including lifespan extension of products and parts through repair and reuse, substitution of resources by biofuels, and using fewer new material resources.

Most available financial resources for the CE-transition in the Netherlands are still dedicated to recycling and R&D, and less so to other circular strategies that would help businesses with market formation. The available public resources for a circular economy have increased over the past few years, from 295 million Euros in 2020 to 496 million Euros in 2022. Furthermore, employment and activities in the circular economy increased between 2020 and 2022. Because the total Dutch economy was growing faster than the circular economy, the circular share in the total economy has slightly decreased. This is a decrease of employment in the circular economy of 4.3% to 4.1% between 2020 and 2022. The added value decreased from 4.4% to 4.2%.

There remain persistent obstacles in the transition to a circular economy

There are various persistent obstacles that make the transition to a circular economy more difficult. Here, we highlight several. Because environmental damage is not or is insufficiently priced, and laws and legislation remain tailored to a linear economy, there is an uneven playing field for circular businesses. As such, Dutch plastic recycling is under immense pressure because of the low fossil fuel prices from countries like China and the US. This means that keeping the existing recycling capacity in the Netherlands is not guaranteed.

Moreover, the CE-transition is battling various chicken-egg problems. Medium and small businesses, for example, are having a hard time getting bank financing for circular business cases, mostly because, as of yet, there is no track record for this new activity. Another problem is that a large offer of circular products is lagging behind, which makes it relatively expensive and difficult for consumers to purchase circular products. The demand for circular products, therefore, remains relatively small, which means it is hardly attractive for businesses to scale up capacity to increase circular production. The Dutch national government can play a role in solving this problem, for example with new laws and legislation that mandate using a secondary material or by increasing governmental circular procurement.

Up until now, it has been difficult to get a better understanding of the materials used in the composition of products. With an eye to reuse and high-quality recycling, however, this is necessary. The difficulty in getting the right information is partly due to the complexity of international production chains. For example, in the case of plastic packaging and electronics, it is often unclear which harmful materials are included in products, while it also appears to be difficult to get a proper understanding of the production chain using accurate data. For example, there is only limited data available about the lifespan of products. On a national level, there is some data available in the context of extended producer responsibility (EPR). This data is not publicly accessible, however, and is primarily aimed at waste collection and recycling. The challenge is to include data about design and materials used in the composition earlier on in the production chain. That way, businesses can take responsibility for the entire chain. A product passport, for example, is one solution to make information more transparent.

Consumers want to, but circular choices are often too expensive or too complicated

Over the past few years, consumption behaviour has hardly become more circular. Each year, more new products are purchased and there is no noticeable increasing trend in the purchase of second-hand products. The purchase of new products is partially driven by trends, but also by the growing offer of cheaper products of lower quality. Alongside fast fashion, for example, we now also have fast furniture. For various products there are also increasingly shorter lifespans. The majority of Dutch consumers are open to a large number of circular behaviour patterns, such as repairing goods or buying refurbished products. However, practical objections and higher costs do withhold consumers from actually consuming in a more circular fashion.

Governments and businesses can promote circular behaviour by making it cheaper and easier for consumers to make a circular choice. Up until now, influencing consumers occurs mostly through information (e.g. product labels and campaigns) and through pricing policy for selected products (e.g. deposits on bottles and a recycling contribution on electronic goods). Alongside information and pricing, repair is also needed to facilitate circular behaviour, as well as a longer legal warranty on products. Additionally, adjustments in the physical consumption environment are important, adjustments that would facilitate choosing a circular option, such as offering second-hand goods alongside new products in a shop. Finally, it is necessary to commit to a reduction of non-sustainable behaviour, such as the free returns on goods ordered online that are then destroyed.

Committing to a circular economy offers opportunities

A circular economy offers opportunities for Dutch businesses and the economy

Compared to other countries, the Netherlands has a good starting position for a circular economy, offering opportunities for Dutch businesses. Indeed, the Netherlands has had, for years now, one of the highest recycling percentages in Europe. It was also one of the first countries with a government-wide approach to get to a circular economy. Furthermore, there are a relatively large number of circular businesses active and for them, as well as for the Dutch economy on the whole, committing to circularity offers opportunities.

In a recently published report, the Italian economist Mario Draghi points to the circular economy, in combination with lowering current energy prices in the EU and a carbon-neutral economy, as one of the crucial domains for reinforcing the competitive capacity of the EU. By leading with circular products and services, innovative businesses have the advantage on (international) competition. In the Netherlands, there is plenty of knowledge and expertise already on various aspects of the circular economy, including waste collection, recycling, innovative product design, and new revenue models. This can contribute to the Dutch economy if this knowledge, these experiences, and these products are exported by successful businesses. For a further advancement of circular innovations and activities, however, ambitious policy is necessary, on both a national as well as a European level.

Coupling the circular economy to the energy transition and the housing challenge is crucial

At the moment, big investments are taking place in the Netherlands to solve the housing shortage, to taper off of natural gas, and to roll out renewable energy technologies such as wind, solar, and batteries on a large scale. In practice, however, it appears that circular solutions for climate and housing ambitions are still left unused, which means opportunities are being missed. For example, the solutions for the housing crisis are aimed at new construction and less so at circular strategies, such as splitting or topping up existing houses. These strategies could become part of the solution because they require far less material use.

In the case of renewable energy technologies, the focus lies mostly on an as high as possible energy production for as low as possible costs, rather than on more efficient material use. With an eye to current geopolitical challenges, however, it is crucial that critical materials in renewable energy technologies are used as long as possible. At the moment, the design for reuse in the case of wind turbines hardly plays a role, for example. Moreover, the permit period for windfarms is shorter than the economic and technical lifespan of the wind turbines themselves.

By including circular strategies in the already planned investments for housing construction and renewable energy technologies, we can avoid a waste of material resources and the related environmental effects both now and in the future. At a later stage, fewer new materials are needed, and future costs can be saved on, for example by taking into account material use of the entire lifespan of products when planning investments.

Stronger policy is needed to speed up the CE-transition

The development of NPCE plans has hardly led to more concrete targets and policy instruments

The National Circular Economy Programme 2023-2030 (NPCE) is aimed at accelerating and scaling up the transition to a circular economy in the Netherlands. It contains, among other things, a framework for targets, proposals for more binding policy, and a selection of priority product

groups. The programme has a structural function and provides an overview of policy options to realise circular ambitions.

Since the NPCE was published in 2023, Dutch ministries have worked on further developing these plans. Up until now, however, this has hardly led to more concrete results. Indeed, no new quantitative targets have been established for the circular economy, while such targets, on a national level and for product groups, could help spur parties into action. Additionally, the available material resources for the circular economy are restricted by the national budget of the Ministry of Infrastructure and Water Management (IenW) and will drastically decrease after 2026 and 2027.

Even though some necessary outlook studies for more binding policy have been conducted over the past two years, and an EPR has been established for textiles, hardly any other additional standardisation and pricing policy instruments have been established on a national level. It is necessary to also implement the other outlook studies named in the NPCE and to realise additional standardisation and pricing policy. This is crucial to make circular production and consumption the norm rather than the exception, and to thereby speed up the transition to a circular economy.

Speeding up the CE-transition requires a mix of policy instruments

Policy instruments can be implemented at various places in the production chain (see Figure B.2 below for several relevant examples). This includes operational subsidies for circular production processes, circular procurement, deposits, a tax on waste materials, recycling requirements, and recyclate requirements. It is noticeable that current policy instruments mostly intervene at the back end of the production chain, while policy options that intervene earlier on still have to be established. In general, for each product group a mix of policy instruments will be needed to mobilise all participants in the production chain. For example, a tax on fossil fuels will mostly have an effect on primary industry and less so on the consumer, while deposits and repair vouchers are primarily aimed at the consumer.

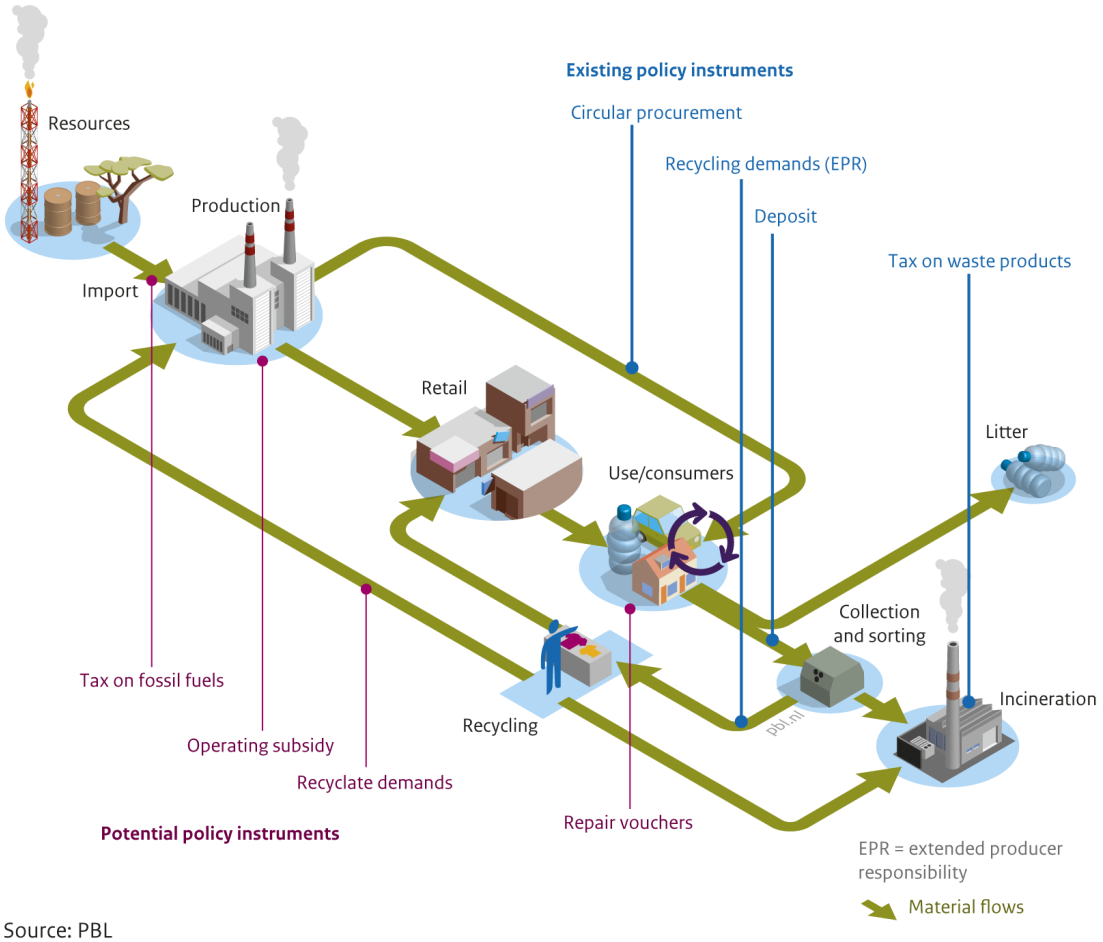
Circular economy policy by the EU is crucial for a fully circular Netherlands

Out of all existing policy instruments, standardisation instruments are predominantly established at EU level, which are then primarily aimed at producers. As such, there are various binding agreements at EU level that are important for a circular Netherlands. These agreements ensure an equal playing field, which can benefit leading circular businesses in the Netherlands. This includes agreements such as the Right to Repair directive and the tightening of the Ecodesign Regulation. With the Right to Repair, sellers are obligated to restore defective devices during the warranty period, if the customer requests so within a reasonable time frame and for a good price. The Ecodesign Regulation ensures the possibility of setting requirements on recyclability, reusability, and lifespan extension. Additionally, it also prescribes a minimum share of recyclate in products and prohibits harmful materials.

The challenge here lies in implementing the regulation for different product groups over a short time period. The Netherlands benefits from strong European CE-policy to realise circular ambitions and to ensure an attractive and level playing field for Dutch businesses. By preparing for and pre-sorting EU policy on time and proposing good examples of national instruments, there will be a bigger chance that European policy takes the direction and at the speed which benefits the Netherlands most.

Figure B.2

Relevant instruments in the policy mix for a circular production chain



Source: PBL

Focusing on further dynamic requirements for EPR and circular procurement offers many opportunities

Important policy instruments that have been established at a national level are primarily aimed at the end of the production chain and the removal of waste, such as a ban on landfilling and a levy and tax on waste.

The NPCE has big hopes for the expansion of EPR and circular procurement by governments. Here, it is useful to set dynamic requirements that can be tightened over time and that go further than just collection and recycling. These requirements should be aimed at reuse, use of recyclate, and an overall reduction in resource use. This is possible, for example by using the efforts by leading businesses as a benchmark for the future of the whole sector. By periodically tightening the requirements for circularity, innovation and environmental gains can keep being stimulated and promoted. Where not possible to include such requirements in EPR systems, it is advisable to apply additional policy instruments to promote innovation.

Considerable environmental benefits are feasible with the instruments adapted in the NPCE and additional circular options

On the basis of a selection of 55 of the policy instruments included in the NPCE, we made an estimation of the possible effects of Dutch production and consumption on greenhouse gas emissions. This estimation indicates that the total, annual global climate profit of these circular instruments is estimated at 3.9-6.9 megatonnes CO_2-equivalents in 2030. The largest potential

climate effects can be expected of the lifespan extension of products, and by circular procurement in the field of ground, road, and hydraulic engineering. Because a large share of the NPCE still concerns adopted and proposed policy, the eventual effects are very dependent on the further development, implementation, and establishment of the policy instruments in question. If the other NPCE proposals are also developed further, the total climate profit caused by the programme can be even higher than the bandwidth estimated above.

Alongside the 55 policy instruments in the NPCE for which we made an effect estimation, there are additional policy options with potentially significant environmental effects, such as operational subsidy for circular measures. Here, for example, the existing pricing difference between Dutch plastic recyclate and the low prices for primary material resources used for plastics can be bridged. Other options with potentially significant environmental effects include a European norm for sustainable carbon in the chemical industry (through biofuels, recyclate, or captured CO_2), the pricing of fossil fuels applied in non-energy use (e.g. plastics), and measures that stimulate the consumption of plant-based proteins while making the consumption of meat and dairy less attractive.

Further development of proposed and possible additional policy instruments is still necessary. That way, it is possible to get a better understanding of the expected effects for the environment and the economy as well as a better understanding of the acceptability by citizens and businesses. This enables better informed choices about accelerating the transition to a circular economy. Here, it is useful if policymakers first choose policy instruments which have the largest expected potential environmental effects.

Firm management by the Dutch national government is needed, with sufficient mandate for those parties involved

To speed up the transition to a circular economy it is not only necessary that the targets and policy instruments in the NPCE are further developed, but also that the existing management model is reinforced. As the ministry responsible for circular economy policy, the Ministry of Infrastructure and Water Management (IenW) can steer on clear, binding agreements between ministries, decentralised governments, businesses, and societal organisations, particularly agreements about roles, responsibilities, and the reaching of targets.

Over the past few years, there has been an approach with transition teams – consisting of people in the government, businesses, and societal organisations – and covenants. This approach brought parties together who were motivated to contribute to the CE transition. The transition teams have set up concrete projects and various covenants have led to concrete points of interest for policy. Building on established networks, experiences, and knowledge is valuable. The NPCE has indicated that it is important that, alongside current leading innovative circular businesses, also the large group of existing linear businesses should be considered, to ensure a better and broader representation of the entire community. It is, however, not yet fully developed, policy-wise, what the step from the so-called frontrunners to the rest of the community will look like. The NPCE has explicitly foreseen a role here for the transition teams, but the teams have repeatedly emphasised they need more capacity and material resources to fulfil this role.

Earlier on, transition brokers made the difference in many of the covenants named above. Transition brokers can, per region or per product group, with the right mandate and fitting material resources, potentially also fulfil a role in speed up the CE transition. To do so, it is necessary that

circular activities increase and that the market for circular products expands. As such, changes are needed to existing laws and legislation, for example concerning the end-waste status and the design of products. Additionally, other types of financing will be needed, as well as changes in consumer behaviour and sufficient knowledge (exchange) about the circular economy.

To conclude: acceleration means action is needed now

The transition to a circular economy is urgent because of increasing supply risks and environmental effects. For the time being, however, the progress of the transition remains limited in resource use, the transition process, and applied policy. For a circular economy, a collective commitment is needed by governments, businesses, and consumers alike. This is a complex societal challenge, one for which drastic changes are needed in the production and consumption of goods and services. This will involve multiple generations. Alongside promoting circular activities, this explicitly concerns phasing out linear activities.

For the acceleration of the transition to a circular economy, a clear and collective picture is in any case needed of the urgency of circular resource use, but also what opportunities this can offer the economy and the living environment. Establishing concrete targets for relevant product groups is valuable in making the challenges more manageable. Experiences and results y leading parties can help to arrive at an ambitious but realistic speed. Above all, the acceleration of the transition requires an adjustment of the rules, including changes to existing laws and legislation and new types of financing. As such, the steps towards a circular economy already taken can grow out into a new normal.

FULL RESULTS

FULL RESULTS

1 Introduction

1.1 Purpose and structure of the report

Every two years, the Integral Circular Economy Report (ICER) provides an overview of the state of affairs concerning the transition to a circular economy in the Netherlands. This objective, independent information is intended as a knowledge base for the societal and political debate on this transition. On the basis of that knowledge, in the ICER we provide recommendations to accelerate the transition. The information in this report offers governors, politicians, and policymakers guidelines to govern on production and consumption processes with policy where necessary.

This is the third time we publish an ICER. It contains specific parts that also recur in this third edition, including the use of material resources and its effects, the progress of the transition process to a circular economy in the Netherlands, and the developments in the field of circular economy policy.

In comparison to previous editions, several things are different. This publication is more concise than both previous ICERs of 2021 and 2023 (Hanemaaijer et al. 2021 and 2023). To still provide an as complete as possible overview of the transition to a circular economy, we will often refer to the new ICER website in this publication for more information (in Dutch). This site contains more data and information about material resources and their effects in the shape of so-called physical and transition indicators. Moreover, the website also features notes with more extensive justification of some key messages from the ICER 2025.

Furthermore, starting with the ICER 2025, each ICER will now delve more deeply into one specific topic. In this ICER, we pay special attention to the theme of governance and the use of policy instruments to accelerate the transition to a circular economy. The final chapter is dedicated entirely to this theme.

The ICER is part of the cycle of national and circular economy policy
PBL writes the ICER at the request of the Dutch government; it is therefore part of the annual policy cycle of circular economy policy in the Netherlands. The National Circular Economy Programme 2023-2030 (NPCE) formulates that the ICER is an important source of information to learn about and manage the transition, and to actualise the policy programme for the first time in 2025 (IenW et al. 2023).

The content of this report is primarily derived from knowledge developed in the Work Programme on Monitoring and Evaluation Circular Economy 2023-2024 (PBL 2023). This programme was executed by PBL at the request of the Ministry of Infrastructure and Water Management in collaboration with several research institutes. The ICER is therefore a PBL product made in collaboration with: Statistics Netherlands (CBS), Institute of Environmental Sciences at the University of Leiden (CML), the Netherlands Bureau for Economic Policy Analysis (CPB), the Copernicus Institute of Sustainable Development at the University of Utrecht, the National Institute for Public Health and the Environment (RIVM), the Netherlands Enterprise Agency (RVO), Rijkswaterstaat (RWS), and the Netherlands Organisation for Applied Scientific Research (TNO). For

an overview of all products of this Programme, please visit the PBL website (link to the webpage Work Programme).

1.2 Why is a circular economy necessary?

In the current 'linear' economy, many material resources are used, which has a significant impact on the environment. The extraction of material resources and the processing of materials, semi-finished, and fully finished products all significantly contribute to climate change, biodiversity loss, and pollution of soil, air, and water. Additionally, the dependence on material resources leads to geopolitical and economic tensions. The war between Russia and Ukraine, for example, has had significant consequences for both the availability and affordability of natural oil and gas in the Netherlands and other European countries. For many other goods, including chips for computers and resources needed for renewable energy, the prices and supply times have increased, leading to increasing worries about the timely availability and affordability for businesses, citizens, and policy. Europe and the Netherlands are particularly vulnerable because many products and material resources they consume come from outside of the EU. Mario Draghi expressed such worries in a report he wrote at the request of the European Commission, in which he argued for a carbon-neutral and circular economy to reduce current energy prices and reinforce the competitiveness of the EU (EC 2024).

The necessity to carefully deal with material resources is therefore evident and that is exactly what the transition to a circular economy is aimed at. Using fewer resources, and using them more efficiently, spares the environment and will also make Europe and the Netherlands significantly less dependent on import. Other strategies to reduce geopolitical tensions surrounding material resources and reducing dependence on other countries include importing from multiple different countries (diversification) and shifting part of the extraction and refinery process to Europe itself. To meet these necessities, there is more policy attention for material resources and the circular economy in the Netherlands and the EU. At EU level, this is the Circular Economy Action Plan, while the Dutch Critical Raw Materials Act is aimed at improving the security of supply of such materials. This is evident from the ambition to achieve a fully circular economy by 2050, as established in the National Circular Economy Programme (2023-2030), as well as the target to increase the security of supply of critical raw materials as established in the Dutch National Raw Materials Strategy (IenW et al. 2023; EZK et al. 2022).

1.3 What is a circular economy?

A circular economy is centred around the significant reduction and more efficient use of material resources to lower negative environmental risks and supply risks

When using the term 'material resource use' in this report, we explicitly mean the extraction of material resources and their subsequent processing into materials, semi-finished, and fully finished products. This extraction and refinery process is paired with environmental effects (climate change, environmental pollution, biodiversity loss) and risks in the security of supply. By committing to a more circular consumption of material resources, we can mitigate these negative effects and risks (see Figure 1.1 below).

A reduction and more efficient use of material resources is possible by applying various circular strategies (and underlying R-strategies in Dutch). These strategies are a component of both the

previous ICER and the NPCE. In general terms, more efficient material resource use can happen in four ways (Bocken et al. 2016; Hanemaaijer et al. 2023; IenW et al. 2023):

- *Narrow the loop*: Using fewer material resources by abstaining from products (*refuse*), sharing products (*rethink*), or manufacturing them more efficiently (*reduce*).
- *Slow the loop*: Extending the lifespan of products and parts through *reuse*, *repair*, and *remanufacturing*.
- *Close the loop*: Removing any leakages and undesirable materials through high-quality recycling and the use of secondary materials, so only non-renewable waste is incinerated or landfilled.
- *Substitute*: Substitution of finite resources by sustainably produced, renewable resources (e.g. bio-based resources) or alternative primary material resources with a lower environmental pressure.

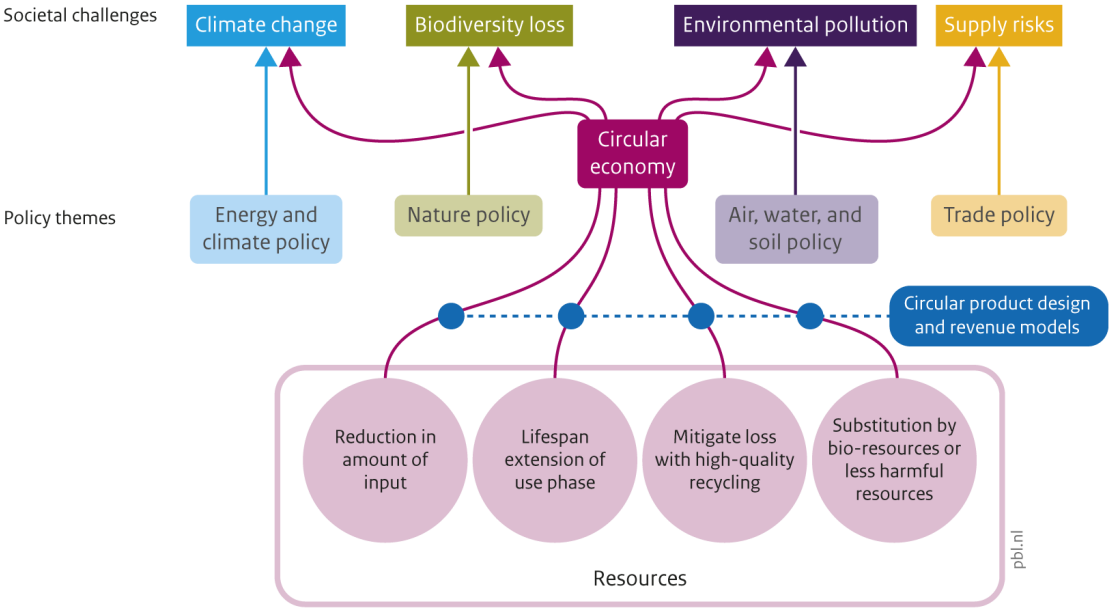
To realise a fully circular economy, it is necessary to significantly reduce and more efficiently use the available material resources. To do this, all four circular strategies will be needed. In other words, these four strategies are not mutually exclusive but are complementary to each other. When thinking about and implementing these strategies, then, attention should be paid to internal coherence between strategies and what specific possibilities are available for the various product groups. The design of products and revenue models largely determines whether the various circular strategies can even be implemented.

Circular strategies can offer additional points of connection relative to existing policy to combat climate change, protect biodiversity, tackle environmental degradation and pollution, and reduce risks in security of supply. A circular economy is aimed at effects throughout the whole production and consumption chain as well as across the entire product lifespan.

A circular economy also offers opportunities for businesses and the Dutch economy on the whole. By pioneering with circular products and services, innovative businesses have a competitive edge, offering them more potential to grow. The available knowledge on and expertise with various aspects of the circular economy in the Netherlands – including waste collection, recycling, innovative product design, and new revenue models – can all contribute to the Dutch economy if these are successfully exported. Capitalising on these opportunities is not guaranteed, however, as the existing economy is still primarily geared towards linear entrepreneurship and circular choices often do not seem to align well with current behaviour and wishes of the people. Indeed, citizens generally strive for convenience and comfort and, after all, buying new products is not demanding, while repairing and sharing products does require extra effort (Hekkert 2022).

Figure 1.1

Positioning of the circular economy relative to societal challenges and other policy themes



Source: PBL

1.4 Reading guide

In this ICER, we first outline the global issues around material resource use in Chapter 2, which will form the relevant context for Europe and the Netherlands. In Chapter 3, we then discuss the trends in material resource use and the associated environmental and socio-economic effects. Chapter 4 is dedicated to the progress of the transition process to a circular economy.

The final chapter, Chapter 5, is reserved for the theme we want to highlight in this ICER. There, we address the policies that governments employ the promote the transition to a circular economy. We pay special attention to the theme of governance and policy instruments to facilitate the transition, asking ourselves, what are the policy entry points in terms of instrumentation and associated governance to accelerate the transition to a circular economy?

In addition to national trends and circular policies, we also focus on three specific product groups in this ICER. One reason for doing so is that circular strategies particularly target products and product groups can vary significantly. This can involve both the materials used and the product's lifespan, as well as the organisation of the product chain and possibilities for policy-driven management. The three product groups are residential housing construction, renewable energy technology, and plastic packaging (see Chapter 4). These are three priority groups in the NPCE but have significant differences.

2 Global resource issues

Key takeaways

- International climate and nature targets cannot be achieved without a significant reduction in and more efficient use of material resources. The global extraction of resources and their processing into products is the primary cause of global environmental changes. In 2020, global resource use was responsible for 60% of worldwide greenhouse gas emissions, 55% of air pollution, and 90% of biodiversity loss and water scarcity. Without additional policies, global resource use is expected to increase by another 60% between 2020 and 2060.
- A fair distribution of the benefits and burdens of global resource use requires high-income countries to focus policies not only on production but also on consumption. Additionally, attention is needed for the socio-economic implications of policies; in other words, a 'just transition'. High-income countries consume, on average, six times more resources per capita than low-income countries and are therefore responsible for ten times more climate impacts. Due to international trade, some of these environmental impacts generated by high-income countries actually occur in low- and middle-income countries, such as the drastic local effects of mining.
- The EU and the Netherlands are vulnerable to supply risks, as many products and material resources come from outside the EU. Concerns about supply risks for critical resources have increased over the past two years, primarily due to a growing global demand for these resources and a growing reliance on a limited number of countries where extraction and/or processing takes place. For instance, the refining of rare earth metals largely occurs in China.

Material resource use in the Netherlands cannot be viewed independently from global resource trends. The extraction and processing of resources, the production of semi-finished products, and the processing of discarded products all occur in global value chains. The Netherlands is highly dependent on the import of resources, materials, and semi-finished products, and also exports many goods, making it essential to have insight into international trends and developments. In this chapter, we therefore briefly address global resource demand and related environmental and socio-economic impacts; the distribution of the benefits and burdens between countries related to material use; and international geopolitical challenges regarding supply risks. We explicitly focus on those challenges related to critical raw materials due to the local effects of mining and increasing concerns about the timely delivery of these resources for critical sectors.

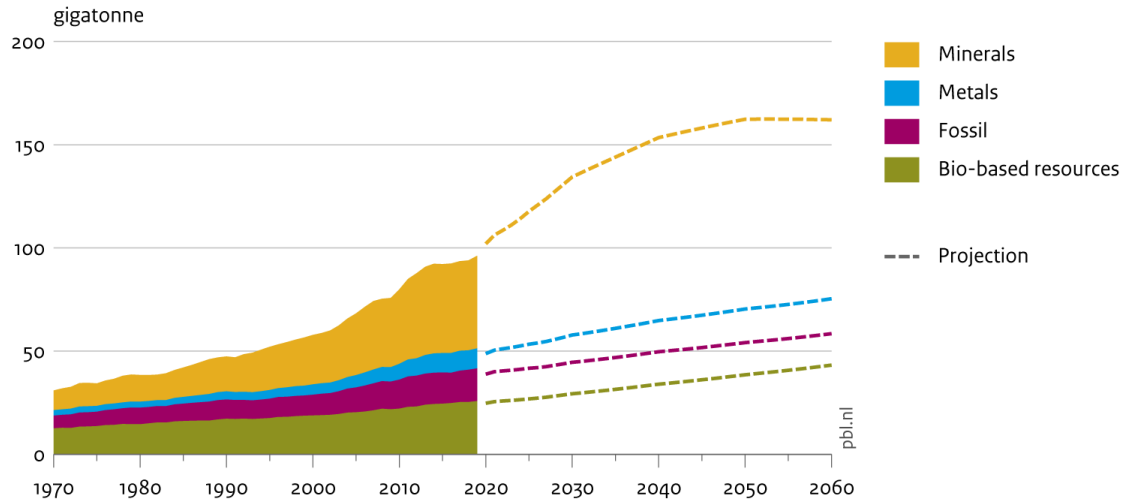
2.1 Global resource use and effects

Global resource use, expressed in gigatonnes per year, has more than tripled over the past 50 years. The largest growth can be attributed to construction, infrastructure, and mobility, particularly in rapidly developing countries. This increase mostly involves primary resources, especially minerals – such as sand, gravel, and concrete – and metals. The global share of secondary materials has actually decreased over the last five years (Circle Economy 2024), mostly because many resources are actually locked in buildings and infrastructure for long periods of time. Moreover, the demand for resources has risen more sharply than the availability of secondary materials, and not all secondary materials are actively being recovered. Without additional policy, the growth in total

resource use is expected to continue, with an anticipated increase of yet another 60% between 2020 and 2060 (see Figure 2.1). The largest increase is expected in rapidly developing countries (UNEP 2024a). The vast majority of the resources include primary resources and materials.

Figure 2.1

Global material resource use



Source: UNEP 2024

The global amount of waste is also expected to increase significantly over the coming decades. For instance, nearly a doubling of the amount of urban waste is expected between 2020 and 2050 (UNEP 2024b). In 2020, almost 40% of waste was incinerated or landfilled without proper control. Since the largest increase in urban waste is expected in rapidly growing economies where existing waste management cannot keep up, this percentage is only expected to increase further. This not only has negative effects on people and the environment, but this also results in the loss of many valuable resources stored in the waste.

Climate and nature targets cannot be achieved without more efficient use of material resources

Material resource use – meaning the extraction of resources and their processing into materials, intermediates, and products – is the main cause of global environmental changes. Six of the nine planetary boundaries have already been crossed, including those related to climate change, biodiversity loss, and chemical pollution (Richardson et al. 2023). In 2020, global resource use was responsible for 60% of global greenhouse gas emissions, 55% of air pollution, and 90% of biodiversity loss and water scarcity (UNEP 2024a). The environmental pressure will only continue to increase with rising resource use (UNEP 2024a; Circle Economy 2024).

The use of resources ultimately stems from people's needs for food, housing, energy, mobility, and so on. Particularly the resources required for the food supply (including animal feed), construction, household energy use, and mobility contribute significantly to global environmental pressure (UNEP 2024a). In 2022, these collectively accounted for approximately 70% of global greenhouse gas emissions. Households, mobility, and construction contributed the most to particulate matter concentrations and related health effects, while the food supply was the main cause of water scarcity and biodiversity loss.

Because of the significant role of material resource use in global environmental pressure, internationally agreed climate and nature targets cannot be achieved without focusing on a reduction in and more efficient use of resources – alongside climate, energy, agriculture, and nature policies (UNEP 2024a). This could be achieved with a circular economy, for example by using fewer primary resources, using products for longer, deploying secondary materials with a high quality, and using materials that have a lower environmental impact. In addition to changes on the production side, this will also require changes in consumption and behaviour.

2.2 Distribution of benefits and burdens

There are significant local effects because of mining, which increase with metal extraction

Due to the rising global demand for metals for use in infrastructure, housing, and mobility, as well as for the energy transition and digitalisation, mining activities are expected to increase significantly. These mining activities primarily occur outside of the EU. Although it is anticipated that, in the long term, less mining will be needed for energy production because of the energy transition (less coal will be used and more metals will be recycled) (Nijnens 2023), this does not necessarily mean that pollution and deforestation from mining will decrease. Many metals required for the extensive scaling up of renewable energy technologies are found in vulnerable areas and their extraction is associated with high environmental pressure (De Haes & Lucas 2023). As many high-grade ore reserves are already being used or have been used, mining is shifting to lower-quality ores, which require more energy, water, and polluting chemicals, and which generate more waste to extract the same amount of metal.

There is limited visibility on the negative local effects of mining. Mining often does not form part of the formal economy in low-income countries, meaning informal mining activities fall outside of oversight and statistics. Additionally, since critical resource chains are often not transparent, it is equally unknown where the resources for specific products are extracted (De Haes & Lucas 2023). As a result, these negative local effects are often not included in the calculated footprints of products.

Mining is a significant source of income for large groups of people but poses substantial risks, to both the environment but also in terms of human rights and working conditions. This includes land dispossession, violence against local communities, unsafe working conditions, child labour, and low wages. More than 50% of mining areas essential for the energy transition are located in regions inhabited by indigenous peoples (Owen et al. 2023). Additionally, the mining industry is one of the most dangerous sectors work in worldwide, regardless of the country (RMF 2021). Because of low environmental standards and poor working conditions, negative health effects occur, especially in low-income countries, both due to direct exposure to hazardous substances and indirectly through the consumption of food grown on polluted land. At least 23 million people live in watersheds affected by potentially dangerous concentrations of toxic waste that have entered the water from past and current metal extraction activities (Macklin et al. 2023).

There are also significant environmental effects on a local scale. Mining activities are increasingly expanding into areas with rich biodiversity; nearly a third of the world's forests are directly or indirectly affected by mining, especially in the Amazon, the Congo Basin, and in Southeast Asia (Sonter et al. 2018). A large portion of water-intensive mining activities also takes place in regions experiencing water stress, such as Sub-Saharan Africa and the Andes region in South America. Additionally, mining is associated with major negative effects for land and soil. Fertile soil is

permanently removed, and heavy metals and mining waste further contaminate the soil through air, surface, and groundwater. It is estimated that nearly one million square kilometres of land worldwide is covered with mining waste (Lottermoser 2010), which is a larger area than is covered by urbanised land globally.

A fair distribution of the benefits and burdens of material resource use also demands policy aimed at consumption in rich countries

High-income countries consume approximately six times more material resources per head of the population than low-income countries. Moreover, high-income countries are responsible for ten times the climate effects per head of the population than low-income countries (UNEP 2024a), while low- and middle-income countries play an important role in global value chains, especially as producers of material resources (e.g. through agriculture and mining), half-finished, and fully finished products. This means that a large part of the environmental impacts that go hand in hand with production and consumption in high-income countries, actually takes place in low- and middle-income countries. Because of the significant differences between countries, the International Resources Panel of the United States has pointed to the necessity for a fairer distribution of the benefits and burdens of material resource use; in other words, a *just transition* (UNEP 2024a).

An absolute decrease in material resource use, particularly in high-income countries, and the related decrease in environmental pressure, would give space for the necessary growth in material resource use in low-income countries. In the latter, many minerals and metals are still needed for the construction of houses, roads, and energy infrastructure. Such an absolute decrease requires high-income countries, like the Netherlands, to not only make policy aimed at reducing negative environmental impacts in the production chain, but to also make policy aimed at consumption to effectively curb the growing demand for material resources.

Attention is also needed for the socio-economic implications of policy for low-income countries (Lucas et al. 2022; Ashraf et al. 2024). This includes, among other things, the co-creation of policy and additional policy aimed at improving living conditions and creating valuable work. A share of the employees in a linear economy might, potentially, have to find different work in a circular economy because certain activities or sectors might disappear. These listed aspects may play a role in low-income countries, but equally so in Europe and the Netherlands.

2.3 Supply risks

Growing concerns about the availability of specific material resources

While most material resources are not expected to be physically depleted in the short term – given reserves and estimated stocks of metals and materials (De Haes & Lucas 2023; USGS 2024) – there are increasing global concerns about the availability and timely delivery of specific resources. This is especially true for material resources deemed critical due to their significant economic importance, such as those needed for digitalisation, electronics, electric vehicles, and renewable energy technologies like wind turbines and solar panels. Examples include copper, lithium, cobalt, and rare earth metals. The EU and the Netherlands are vulnerable to supply risks because many products and material resources are sourced outside the EU.

Such concerns about supply risks have various causes. Firstly, there is an expected sharp increase in the demand for critical raw materials for the energy transition (IEA 2024) while their supply cannot

always be expanded as quickly. Opening new mines and scaling up existing ones involves long lead times, often around 10 years. Delays in delivery can affect the pace of the energy transition and therefore the approach to climate change.

Secondly, there is a strong dependency on a limited number of countries where extraction and/or processing takes place. For example, more than 60% of global cobalt extraction occurs in the Democratic Republic of the Congo, whereas the refining of rare earth metals and graphite takes place almost exclusively in China; for other metals like copper and lithium, this is approximately 65% and 75%, respectively (IEA 2024). This makes the EU and the Netherlands vulnerable to geopolitical tensions where access to critical resources becomes a part of power politics (WRR 2024).

Thirdly, there are significant concerns about the negative socio-economic and environmental effects of material resource production, such as mining, which are often greater than anticipated (see also section 2.2). This creates tension between improving supply security on the one hand and addressing the negative effects of resource production on the other. Addressing these negative effects generally leads to higher costs.

To manage supply risks while equally considering the negative effects of resource extraction, the EU has introduced the Critical Raw Materials Act and the Netherlands has adopted a National Raw Materials Strategy (for more, see Chapter 5).

3 Dutch material resource use and effects

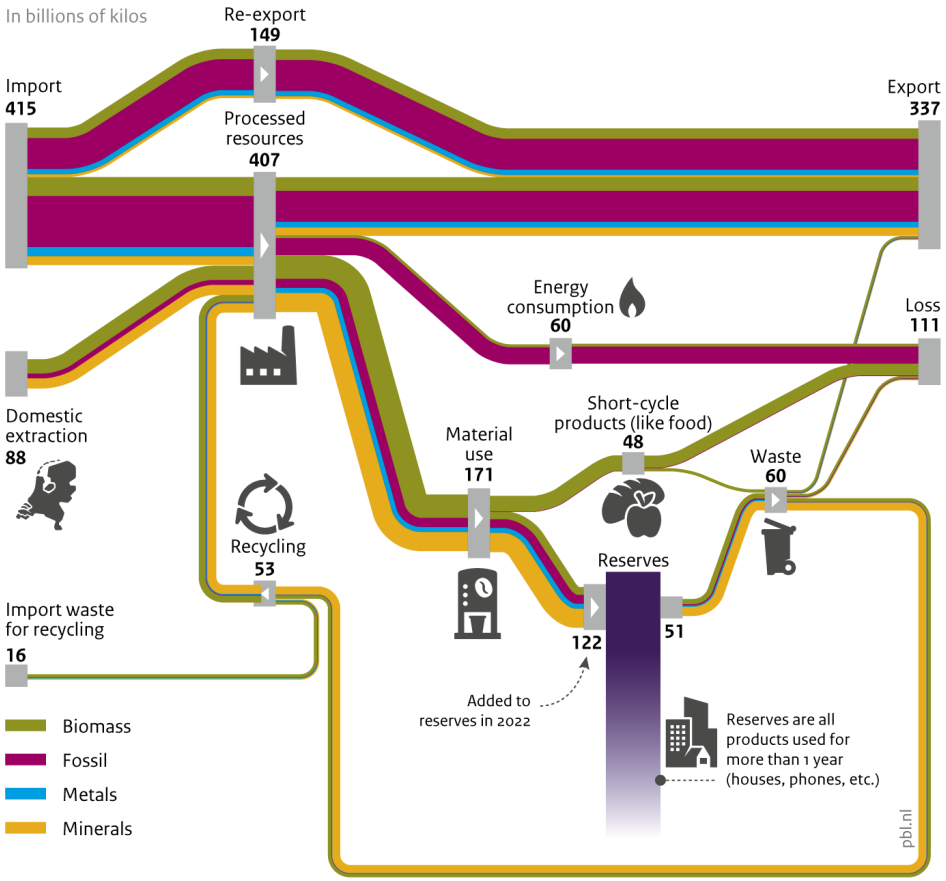
Key takeaways

- In 2022, following a dip in the COVID year 2020, Dutch material resource use has once again increased slightly. For resource use by the Dutch economy this concerns an increase of 3%, and for domestic use of resources by Dutch households, businesses, and governments this concerns an increase of 2%.
- Compared to 2016 (the start of the government-wide Programme Circular Economy), there is a noticeable decrease in material resource use. There is an 8% reduction in material resources for domestic use and a 10% reduction for the entire Dutch economy. However, this decline seems mostly incidental, largely due to significant price increases in fossil fuels and other resources caused by the war in Ukraine. Additionally, the use of minerals like sand, gravel, and concrete has decreased, particularly in ground, road, and hydraulic engineering. Conversely, the use of bio-resources and metals has increased significantly since 2016.
- Material resource use across the entire production chain, also known as the resource footprint (which also accounts for resource use abroad), has increased since 2016. This applies to the entire Dutch economy and Dutch consumption. This is mainly due to the significant increase in the metals and minerals footprints.
- Over a long period, especially since 2009, there has been a decrease in abiotic resource use, while the economy has consistently grown. This means that Dutch resource productivity has improved, which can largely be explained by a shift of resource-intensive industries to foreign countries and because all sectors have become more efficient in production. Additionally, during this period, there has been a slight substitution of primary abiotic resources with bio-resources and secondary materials.
- The sale of new goods continues to increase, yet there is hardly any increase in the use of reused goods. Moreover, the lifespan of various products is decreasing. This is partly related to the so-called 'throwaway society', where there is a trend towards producing increasingly cheaper, low-quality products that are difficult to repair.
- With current trends in material resource use, it is highly unlikely that the halving target for primary abiotic resources by 2030, relative to 2016, will be achieved. The product group analyses conducted for this ICER confirm this picture. Without additional policy, the demand for material resources in plastic packaging, residential housing construction, and renewable energy technology will actually increase.
- The environmental effects throughout the global production chain – or the environmental footprints – have slightly decreased in 2021 compared to 2016. The footprints of greenhouse gas emissions, land use, and biodiversity due to Dutch consumption have shrunk more than those footprints due to Dutch production. The effects on land use and biodiversity largely occur outside of the Netherlands.
- The supply risks of the most critical resources have increased over the past 10 years, especially for the manufacturing industry and, therein, the machinery industry, the transport equipment industry, and the electronics industry. These sectors are of increasing economic importance to the Netherlands. The increasing supply risks are mainly caused by geopolitical developments

and less so by supply, demand, and chain delivery issues. Circular strategies (e.g. differently designed products, reuse, recycling) can be of great value in reducing these increasing risks.

Figure 3.1

Resource streams Dutch economy, 2022



Source: CBS 2024

In this chapter, we address the developments in Dutch material resource use and its environmental and economic effects. We outline the state of affairs in material resource use and the progress of the four so-called circularity levers in the National Circular Economy Programme (NPCE). That is, how things are going with: reducing primary abiotic resource use (*narrow the loop*), replacing primary abiotic resources (*substitute*), the use phase of products (*slow the loop*), and trends in recycling and waste processing (*close the loop*). Then, in the second part of this chapter, we describe the environmental effects of Dutch material resource use and address the supply risks of these resources.

3.1 Trends in Dutch material resource use

The Dutch economy involves substantial resource streams (see Figure 3.1 and *the resource flow indicator*). One characteristic of the Dutch economy is that the Netherlands imports a relatively large amount of material resources; it imports about five times as much as it extracts from its own territory. A significant portion of these imports consist of fossil resources such as crude oil and natural gas. Domestic extraction primarily involves biomass (mainly in the form of food), sand, and gravel, particularly for construction, and to a lesser extent domestic crude oil and natural gas.

The total import of material resources has increased by approximately 11% compared to the previous ICER (reference year 2020), mainly due to a larger volume of re-exports. Re-export involves goods that enter the Netherlands and leave again in (virtually) unprocessed form. This means that the Netherlands has become an even larger transit country. In addition to re-export, a significant portion of the material resources processed in the Netherlands are also exported; this consists of half of all fossil products (petroleum products) and a large portion of food and luxury goods.

In the following sections, we will discuss developments in material resource use, grouped according to the four so-called circularity levers of the NPCE.

3.1.1 Lever 1: reduce material resource use

In the previous decade, the level of material resource use has remained almost unchanged (CBS 2024a). This applies to both total resource input for the entire Dutch economy as well as the resources needed for total domestic use by businesses, consumers, and governments. For the resource input for the Dutch economy, this includes all material resources that are imported and extracted domestically, then used after processing in the Netherlands, plus those that are exported after processing. This is referred to as DMI (Direct Material Input). For domestic use, it involves all resources used solely within the Netherlands, excluding those that are exported. This is known as DMC (Domestic Material Consumption).

In the COVID year 2020, which the previous ICER reported on, there was a noticeable dip in material resource use. In 2022, total resource use increased once more (see Figure 3.2, Table 3.1, and the *resource use indicator*). There was a 3% increase in DMI, and a 2% increase in DMC compared to 2020. Material resource use was, however, still lower in 2022 than in 2016. While total resource use decreased between 2016 and 2022, there was an increase in the use of metals and bio-resources during that period. We compare material resource use in this ICER with the year 2016 because the government-wide Programme Circular Economy was launched that year.

In the government-wide programme, the Netherlands set itself the target to use 50% fewer primary abiotic resources (fossil, minerals, metals) by 2030 compared to 2016 (Infrastructuur en Milieu & Economische Zaken 2016). For the rest of this section, we focus on the feasibility of this target, given the trends we observe in the use of metals, minerals, and fossil resources (trends in bio-resources will be discussed in a later section).

Primary abiotic resource use has increased again

The use of primary abiotic resources (fossil, minerals, metals) has slightly risen in 2022 compared to 2020 (see Figure 3.2 and Table 3.1). This slight increase is true for both DMI (+3%) and DMC (+2%). However, relative to 2016, material resource use in 2022 has decreased. The decrease in 2022 relative to 2016 constitutes -10% for DMI and -8% for DMC. In the following section, we will focus exclusively on domestic use (DMC) of the three abiotic resources, partly because the trends in DMC and DMI are consistent with each other.

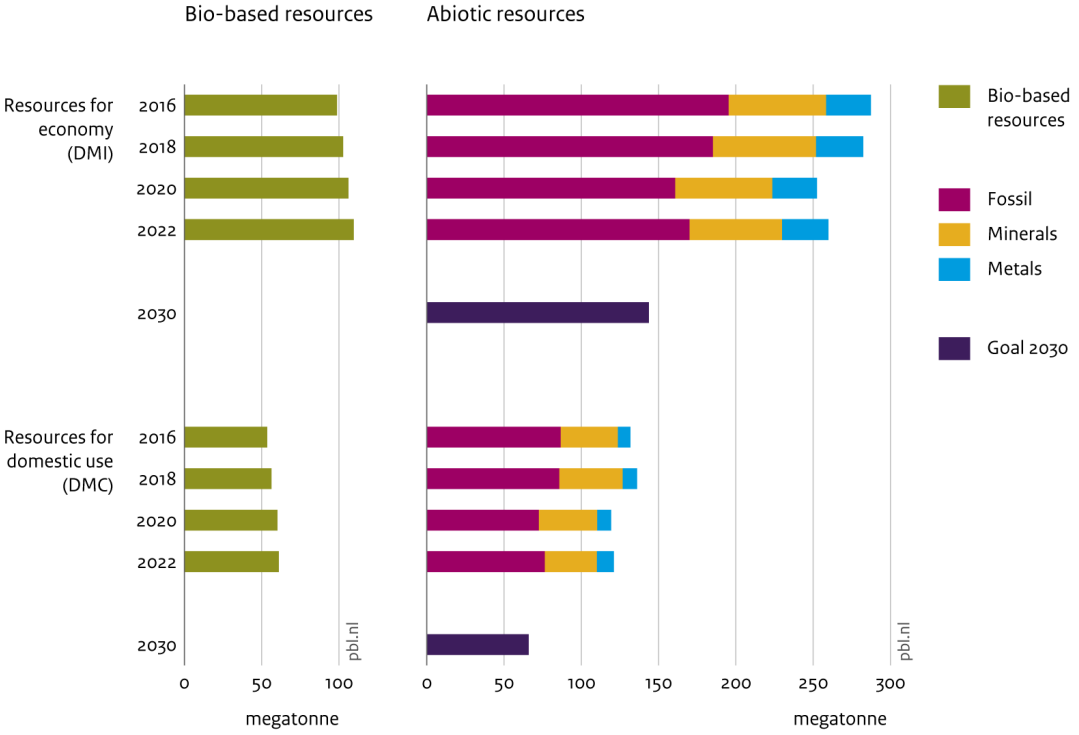
The decrease in primary abiotic resource use in 2022 relative to 2016 was primarily caused by a decrease in fossil fuel use. Domestic use of fossil fuels has, admittedly, increased in 2022 by 6% relative to 2020, but this is still 13% below the level of 2016 (CBS 2024a). This is mostly related to a significant decrease in Dutch natural gas consumption in all sectors (at least -20% relative to 2016), which is a consequence of the war in Ukraine and associated price increases of that year (CBS

2024b; CBS 2025a). Additionally, there was a fierce decrease in the extraction of natural gas on Dutch territory, which in 2016-2022 decreased with 66% (CBS 2025b). The discontinuation of natural gas production on Dutch territory was, however, mostly compensated by both increased import from abroad (primarily LPG) and less export to abroad (especially to Belgium and the United Kingdom). From the amount of natural gas left over after extraction, import, and export, the Netherlands has used natural gas but also stored much more natural gas than in 2016.

Domestic use of minerals in 2022 relative to both 2020 and 2016 has decreased with 11% and 9%, respectively, the main reason being that less sand and gravel have been used, which are necessary for the production of concrete mortar for use in construction (CBS 2025a). This is noticeable because, since 2016, more new homes have actually been built each year and the number of building permits issued increased between 2019 and 2022 (CBS 2024c; ESB 2023). The decrease in mineral use over the past two years is due to a significant decrease in the use of concrete in ground, road, and hydraulic engineering projects (CBS 2024a).

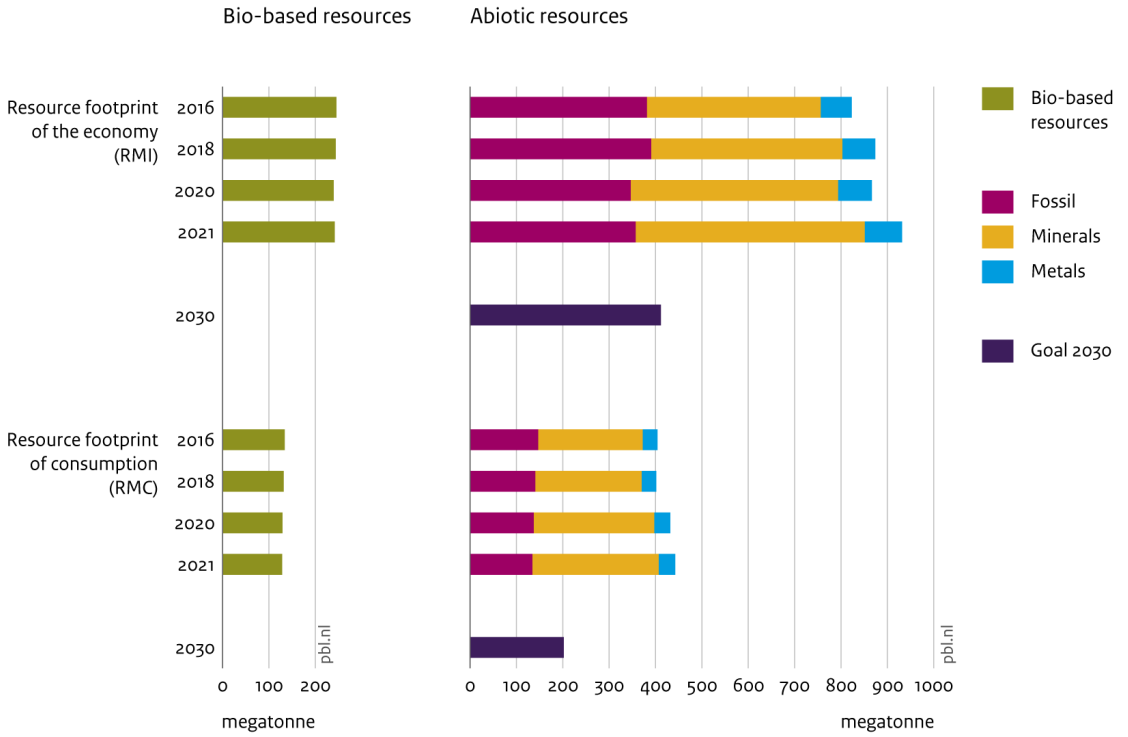
Figure 3.2

Material resources for economy and domestic use



Source: CBS 2024

Figure 3.3
Material resource footprints of economy and consumption



Source: CBS et al. 2025

Table 3.1
Dutch indicators material resource use in 2016, 2018, 2020, and 2022

Indicator	Scope 2016	Scope 2018	Scope 2020	Scope 2022[7]	Trend 2020 – 2022[7]	Trend 2016 – 2022[7]
Material resources for the total economy, DMI[1] (Mton)	386	385	359	369	+3%	-4%
Of which abiotic[2] (Mton)	287	282	253	260	+3%	-10%
Material resources for domestic use, DMC[3] (Mton)	185	193	180	182	+2%	-2%
Of which abiotic (Mton)	132	136	119	121	+2%	-8%
Material resource footprints of the economy, RMI[4] (Mton)	1069	1118	1106	1173	+6%	+10%
Material resource footprints of consumption, RMC[5] (Mton)	538	534	561	571	+2%	+6%
Material resource productivity (GDP in Euro$_{2021}$ constant prices/kg DMC)	€4.38	€4,43	€4,67	€5.14	+10%	+17%
Share bio-based resources (bio-based resources in Mton/ DMI in %)	26%	27%	30%	30%	+ 0% punt	+ 4% point
Share secondary materials, CMUR[6] (Kilo secondary/DMI in %)	12.7%	12,7%	12,9%	13,0%	+ 0.1% punt	+ 0.3% point

Source: CBS 2024a; indicators material resource use, material resource footprint, and share secondary material use.

1) *Direct Material Input (DMI) in this ICER is the total input (domestic extraction + import) of material resources for the Dutch economy, excluding re-export and the use of waste in the Netherlands. The import contains both primary as well as secondary resources.*
2) *This concerns the three material resources excluding bio-based resources: fossil, minerals, metals.*
3) *Domestic Material Consumption (DMC) is defined in this ICER as domestic use of material resources in the Netherlands; in other words, domestic extraction + import, excluding all export.*
4) *Raw Material Input (RMI) is the material resource footprint of the entire Dutch economy; in other words, the footprint of Dutch consumption and production.*

5) *Raw Material Consumption (RMC) is the material resource footprint of Dutch consumption. Despite the fact that RMC and DMC both have a 'c' for consumption, they concern different parts of the material resources in the economy. The RMC is about material resources for end users in the Netherlands, while DMC concerns material resource use in the Netherlands that is not exported.*
6) *For the calculation of the Circular Material Use Rate (CMUR), with the total input of material resources we mean the total input of primary plus secondary material (including recycled waste from domestic and foreign territory).*
7) *For material resource footprints we take 2021 as reference year instead of 2022. The data about direct material resource use (DMI and DMC) is more accurate than the data on material resource use in the chain (RMI and RMC). The additional calculations needed for material resource in the chain, on the basis of data coming from outside of the Netherlands, makes the outcomes more uncertain.*

In contrast to the aforementioned resources (fossil and minerals), domestic use of metals in the Netherlands has increased significantly in recent years. In 2022, approximately one-third more was used than in 2016, and there is a rise of over 20% compared to 2020 (CBS 2024a). For metals, the Netherlands is entirely dependent on imports from abroad and on recycled metals from its own economy. At the sectoral level, it is evident that more metals have been used in recent years in the sectors that manufacture electrical machines and (household) appliances, while metal use in the construction sector has also slightly increased.

Material resource footprints have grown despite the COVID lockdowns, mainly because of increased mineral use in the supply chain

These developments in direct material resource use do not, however, tell the whole story. A reduction in material resource use in the Netherlands could indicate that certain activities, which require a lot of resources, have actually relocated to foreign countries and the final product is subsequently imported into the Netherlands. It is therefore important to also look at material resource use across the entire supply chain: from extraction, processing, and production inside and outside the Netherlands to consumption in the Netherlands. In other words, it is important to examine the material resource footprint of the Netherlands. In previous ICERs, we also reported on material resource footprints, but these underestimated the extent of the footprint. Due to adjustments in the calculation method and the source data used, this ICER reports a material resource footprint for Dutch consumption that is four times higher than the ICERs from either 2023 or 2021. The new calculation uses more reliable data for the specific Dutch situation, including import from mining. For further explanation, please refer to the Dutch background notice (see CBS and PBL 2025).

Both the material resource footprint of the whole Dutch economy (Raw Material Input, RMI) and the Dutch consumption footprint (Raw Material Consumption, RMC) show that more material resources were used across the entire supply chain in 2021 than in previous years (see Figure 3.3 and Table 3.1, as well as *the resource footprint indicator*). For these footprints, the reference year is 2021 instead of 2022, because more recent data were not available at the time of writing this ICER. The increase is particularly notable because 2021 was a year with global COVID lockdowns and disrupted international trade. The mineral and metal footprints have especially grown, while those of biomass and fossil resources have decreased. The increase in the metal footprint aligns with the rising trend in Dutch metal use mentioned above, while the increase in mineral use occurs because significantly more minerals from non-EU countries are used in the supply chain for the Netherlands. This often involves low-income countries where resource intensity (in kilogrammes per Euro) is generally much lower.

Decoupling of material resource use and GDP since 1996

Material resource use in the economy does not change that rapidly, which is why we not only look at developments since 2016, but also at long-term resource trends and how they relate to economic development. Between 1996 and 2022, abiotic domestic resource use in the Netherlands has decreased by approximately 15% (CBS 2024d). From 1996 to 2009, the level remained nearly constant (with peaks and troughs), but, from 2009 onwards, we notice a declining trend. This decrease is evident even when disregarding the COVID years 2020 and 2021 as well as the year 2022 (higher prices due to the Russia-Ukraine war): in 2019, primary abiotic resource use was also lower than in 2009 (about 9%).

The decline since 2009 can partly be attributed to the substitution of abiotic resources with biotic resources, and partly to the substitution of abiotic resources with secondary material. Biotic resources, or bio-resources, refer to both food and animal feed as well as bio-resources used as biofuels and raw materials for the chemical industry.

The share of bio-resources in total domestic use in the Netherlands has increased from about a quarter in 1996 to a third in 2022. This is likely due to the energy transition rather than an increase in bio-resources for material production. Since 2009, there has been a continually increasing use of biomass in power plants, partly due to incentive measures (especially the Dutch SDE+(+) scheme; CBS 2021; Strengers, Elzenga & Hekkenberg 2020). Additionally, since 2007, there has been a blending obligation in effect in the mobility sector stemming from European policy on biofuels (RWO 2014). More recent developments in the substitution of abiotic resources are discussed in the following section.

The noticeable decrease in abiotic resource from 2009 to 2022 is accompanied by a 15% increase in gross domestic product (GDP) in the same period. This indicates a decoupling between GDP growth and the amount of material resources used. In other words, Dutch material resource productivity for domestic use (GDP per unit of abiotic resource used) has increased (see also Table 3.1). There are several reasons for this increase. Firstly, there is the relocation of resource-intensive industries from the Netherlands to foreign countries and a larger share of more service-oriented sectors in the Dutch economy, which use fewer resources per unit of GDP. Additionally, resource productivity can increase when the Netherlands generates relatively more GDP from exporting goods. Indeed, a decrease in domestic use can also be the result of an increase in exports. A third possible cause for this increased resource productivity is that the Netherlands has become more efficient in using material resources across sectors. At present, it is not possible to precisely determine the contribution of each explanation; more detailed data at a lower aggregation level (sectoral) would be required for this.

Domestic resource use per person in the Netherlands remains one of the lowest in the EU

In 2022, the EU-27 used nearly 3% more material resources (about 14.2 tonnes per capita, DMC) for domestic use than in 2020 (about 13.8 tonnes per capita; European Commission 2024; see also *resource use indicator*). According to European statistics, the Netherlands used approximately 10.0 tonnes per person in 2022 and 9.8 tonnes per person in 2020.

Thus, Dutch material resource use per person in 2022 is about 30% lower than the EU-27 average; only Italy and Spain use less. There are two general explanations for this relatively low use in the Netherlands. First, the high population density allows for more optimal use of infrastructure, resulting in lower resource use per person, particularly in the transportation sector. Secondly, the

Netherlands has the highest recycling rate in the EU, which means it needs to import and extract fewer resources domestically for its own use.

The Netherlands does, however, score less favourably when looking at resource use of the entire economy (DMI) per capita. Indeed, here, the Netherlands requires about 19% more resources than the EU-27 average (*see resource use indicator*). This is mostly related to the high share of re-export in the Netherlands, which is incorporated in European statistics in total material resource input.

Finally, material resource use is relatively low in the Netherlands when considering material resource use per person *throughout the whole chain* (RMC): the Netherlands uses 18% less than the weighted average of the EU-27 (*see resource footprint indicator*). This is also the case when looking at material resource use across the entire supply chain for Dutch production (expressed in tonnes per Euro of GDP), where the Netherlands is approximately 11% below the EU average.

Reduced consumption is essential, but purchases of most new consumer products are increasing

One of the driving forces behind Dutch material resource use is the way the population consumes. Consumer demand influences not only what and how companies produce, but also how much. Changes in consumption are therefore crucial to achieve a circular economy. Consumers can contribute to reducing resource streams in various ways, such as sharing products (like cars or tools), purchasing products that require fewer resources, or reducing overall consumption. In particular, consumers can reduce environmental pressure by reducing products and services that require resources with a high environmental impact, such as car use, air travel, animal-based food, and non-renewable energy (IPC 2022; Creutzig et al. 2022; Ivanova et al. 2020; IGES et al. 2019).

Since 2016, the consumption of new products per capita has steadily increased year by year (except for 2020) (CBS et al. 2024a). Dutch citizens mostly spend more money on consumer goods such as new clothing, electronics, and interior design (CBS 2023). Between 2016 and 2022, the amount of electrical and electronic equipment (EEA) brought onto the market has more than doubled (CBS et al. 2024b). This primarily concerns an increase in solar panels, small appliances, laptops, screens, and monitors. These rising trends in consumption are consistent with economic growth and the faster growth in purchasing power compared to the prices themselves (CBS et al. 2024c; RLI 2023). Expenses on transportation, on the other hand, have continuously remained at the same level since 2000 (CBS 2023).

The Dutch Transition Agenda for Consumer Goods ('Transitieagenda Consumptiegoederen') has calculated what is needed to halve the environmental impacts of consumer goods, such as textiles and electrical appliances. These calculations indicate that not only is a different style of consumption necessary to halve these impacts, but so is a decrease in consumption in general (less linear, more circular) (New Economy 2022). If we assume a continuation of this trend of consistently increasing consumptive expenses of the past 20 years, then a halving of various environmental effects is out of reach – even with ambitious improvement of circular design, extending the lifespan of products, and improved collection and increased recycling.

It is extremely unlikely that we will reach the halving target of 2030

Based on the trends mentioned in this section about resource use and consumption, it is extremely unlikely that the current halving target for primary abiotic resources in 2030 will be reached (this target is incorporated in the government-wide Programme Circular Economy) (*click here for more information on the feasibility of this target,* in Dutch). Compared to the previous ICER, the Netherlands

has actually fallen further behind; most material resource indicators have risen, while the target has come two years closer. This is the case for direct use of material resources, material resource use in the whole production chain, DMI, and DMC. Moreover, the observed decrease in direct material resource use in 2022 compared to 2016 is mainly caused by non-structural developments. Previous research has already indicated that the Netherlands, on the basis of adopted and proposed policy, is expected to use just as many material resources in 2030 as in 2022, albeit with a slight shift away from fossil fuels towards bio-resources (De Koning & Van der Voet 2022). The analyses in this ICER for the three product groups (plastic packaging, renewable energy technology, and residential housing construction) confirm this picture; without additional policy, there will be a rise in demand for material resources for all three product groups (see Chapter 4).

3.1.2 Lever 2: substitution

The Netherlands remains a frontrunner in secondary material use

The substitution of primary abiotic resources is possible by replacing them with biotic resources (bio-resources), and by replacing primary with secondary resources. The share of secondary material use in a given economy is expressed by the Circular Material Use Rate (CMUR), or the percentage of secondary material in total material use (including bio-resources) (Koch et al. 2020). In order to effectively compare countries with each other on an international scale, the CMUR is based on domestic use (excluding export and re-export). For the year 2022, the Netherlands reached a CMUR of 27.5% (European Commission 2023), which is significantly higher than the EU-27 average of 11.5% in 2022. For comparison, Belgium was next on the list with a CMUR of 22.2%, followed by France with 19.3%.

On a national level, the CMUR is expressed as the share of secondary material in the total use of materials in the Dutch economy (including export). In 2022, this share was approximately 13% (see Table 3.1). This has remained relatively stable over the years (*see indicator secondary material use*). The share of minerals other than metals is particularly large; of all minerals used in 2022, 32% consisted of secondary material. The secondary materials for minerals primarily originate from construction and demolition waste, which is then used as sub-base in the construction of new roads. In the case of biomass and metals, the secondary material use is 17% and 11%, respectively, while the share of secondary material in total fossil resource use is the smallest at 1%. For the latter, secondary fossil material consists of the use of recycled plastic in the plastics industry.

Alternative CMUR: excluding material resources used as food or for energy

In the calculations of the CMUR, we considered total material resource use, hence including bio-resources consumed as food and fossil fuels. Since recycling after human consumption or use as fuel is virtually impossible, it is worthwhile to also calculate a CMUR that excludes these two applications. Not included in the analysis, however, is the fermentation of food waste for the production of green gas or use as fuel (e.g. cooking oil).

This alternative CMUR results in a larger share of secondary materials in total Dutch resource use: approximately 21% in both 2021 and 2022 (CBS 2024e). This analysis also shows that 14% of primary biotic resources are used as materials for, for example, wood in construction, and therefore not as food or energy. For fossil resources, 25% of the primary resources are used for material applications like plastics.

Since 2016, there has been an increase in the share of bio-resources
The use of bio-resources in 2022 has increased compared to both 2020 and 2016 (see Figure 3.2 and Table 3.1). The share of bio-resources in the total of material resources used in the Dutch economy (DMI) has stayed the same in 2022 relative to 2020: approximately 30%. For the share in total domestic use (DMC), it was 34% in both years. There is, on the other hand, a noticeable increase in 2022 when compared to 2016, considering the share of bio-resources was 26% in total material resource use, and 29% in domestic use. This is primarily due to an increase in the import of bio-resources (CBS 2025a). About a quarter of this increase in imports is due to the rise in the import of crops, especially grains; a quarter is due to increased imports of meat and dairy; and more than a quarter is due to increased imports in products made of bio-resources, such as beverages and paper. The remaining quarter is because of increased wood imports, which are largely used for co-firing in biomass power plants for energy production.

For the transition to a circular economy, it is relevant to know whether the use of bio-resources increases in e.g. the use of wood for construction or bioplastics. There appears to be no significant increase in the use of wood in the construction materials industry or the construction sector, however. Additionally, bioplastics in plastic packaging currently account for less than 1% of the total amount of resources needed for plastic packaging (see Chapter 4).

3.1.3 Lever 3: lifespan extension

To reach circularity, upon processing material resources into products, it is important to use them as long as possible; in other words, extend their use phase and lifespan. This strategy is also known as *slow the loop*. In this section, we describe the current trends in this field.

Hardly any increase in reuse; lifespan extension of products is partially decreasing
We can hardly speak yet of *slow the loop*. The majority of purchased products in the Netherlands are new and not reused or revised/refurbished, with the exception of products with a long lifespan and high economic value such as houses or cars. Approximately 3% of purchased clothing is second-hand, and the share of second-hand or revised furniture and smartphones is around 10% (Milieu Centraal 2023a; Koch & Vringer 2023). The number of second-hand products has decreased in 2022 compared to 2021, with the only exception of textile. For the latter, the amount has actually slightly increased, especially via online platforms (Rijkswaterstaat 2024a; Royal Haskoning DHV 2024).

As of yet, there is no complete overview of the lifespan trends of products. Many studies are either dated, based on a limited number of data points, or limited to a specific country. The available information does mostly point to a declining trend in lifespan for some consumer products. For example, the lifespan of furniture has mostly halved over the past 40 years (Intven et al. 2022). Additionally, Norwegian research has shown that the lifespan of washing machines and ovens in the 1990s and 2000s significantly declined (Krych & Berg Pettersen 2025). Considering the international market for these products, it is likely the Dutch situation does not deviate much. This declining trend in lifespan does not, however, automatically apply to other researched products like telephones, refrigerators, or dishwashers (Krych & Berg Pettersen 2025; Wieser 2017).

Lifespan is limited because of declining quality, technological developments, and consumer wishes
There are various reasons for the ever-shorter lifespan of products. Firstly, there is the quality and repairability of products. RLI (2023) identified a trend for continuously cheaper, low-quality products as a consequence of the so-called 'race-to-the-bottom'. Indeed, 38% of smartphones, 30% of televisions, and 23% of laptops already show technical problems within the first year

(Consumentenbond 2021). The repair of defective products is often technically impossible or simply more expensive, or it requires more effort than simply purchasing a new product. Around a quarter of products cannot even be repaired, when parts are not available or too expensive or because the product cannot be opened up (Repair Café 2023). Poor repairability does not, however, automatically mean a shorter lifespan, because better repairability can also come at the expense of a product's durability (Leiden-Delft-Erasmus Centre for Sustainability 2023).

Technological progress can also lead to a decline in the lifespan of electric and electronic appliances. In the case of smartphones and laptops, for example, lifespan can be hindered by continuous software upgrades, which could result in appliances becoming incompatible (European Commission: Joint Research Centre et al. 2020; Wodaisky & Cetinkaya 2021). As such, from 2025 onwards there is the risk that one-fifth of all laptops become completely redundant when support for Windows 10 ends (Canalys 2023). Additionally, the need for new features appears to play an important role in the replacement of electronic appliances like smartphones and televisions (Magnier & Mugge 2022).

Social-cultural and psychological factors also play a critical role. For example, the choice to replace old products is mostly influenced by the following: observed aging (the personal valuation of the extent of signs of wear and tear), mental discarding ('time for something new'), and status (Makov & Fitzpatrick 2021; Van den Berge et al. 2021; RLI 2023; Leiden-Delft-Erasmus Centre for Sustainability 2023). As it stands, 54% of smartphones, 58% of clothing, and 62% of furniture in the Netherlands is replaced before they are even defective, usually because consumers want a new product or a more modern design (Milieu Centraal 2023b). This behaviour is mostly driven by quickly changing trends in fashion (fast fashion, fast furniture), which leads to plenty of potentially still fully functioning furniture and clothing to land in the incinerator, without them ever being reused as valuable product. Large shares of clothing are even destroyed without ever having been worn: in Europe, 20% of clothing ordered online is returned, of which a third is directly destroyed (EEA 2024). This is part of the reason why 4-9% (circa 264 – 594 kilotonnes) of clothing that is brought on the market in Europe is destroyed without ever having been worn. This percentage is slightly lower in the Netherlands; in 2019, 1% of all clothing brought on the market was fiberised or incinerated (Rebel 2020). Finally, for many still functioning electronic appliances, it is the case that they quickly get stowed in a cupboard or drawer at home and are never or hardly reused (Balde et al. 2022).

3.1.4 Lever 4: reuse of stock and waste recycling

When a product lands in the end-of-life phase and neither of the previous levers can be applied, then it is important to recycle with as high a quality as possible. This means that discarded plastic packaging can once again be used in new packaging instead of being processed into plastic bollards, for example. In this section on the fourth lever, we want to address the current stock of materials (the 'urban mine') and current trends in waste processing. When recycling is not possible (anymore), material is incinerated with energy recovery, or landfilled; this is why we also discuss these trends in this section.

Using materials from the Dutch urban mine is essential for a circular economy, but is not always feasible
When material resources are processed into useful (consumer) products, they become part of the stock of material resources in the Dutch economy. This way, materials are stored in e.g. houses and roads, or in various daily goods, like cars, phones, or clothing. This stock is referred to as the 'urban mine'. It is essential to be aware of what is stored in the mine, within what timeframe materials can

become available, and how easy it is to recover such materials for reuse or recycling. This is important to ensure that the reuse of parts and recycling of materials can replace the use of primary material resources.

In 2022, the total stock of material resources in the Dutch urban mine was estimated at 9,000 megatonnes (a billion kilogrammes) (CBS 2024f). This can be divided into five main categories: mineral construction materials, metals, bio-based materials, critical raw materials, and other materials (plastic, textile, glass). By far the largest share (8,900 megatonnes or 96% of the total) is mineral construction materials like concrete, brick, asphalt, gravel, sand, soil, clay, gypsum, and limestone. These are primarily found in the ground- and road infrastructure as well as in buildings. Generally speaking, these minerals are easy to reuse and recycle, but they come with a huge delay. After all, the average lifespan of a building or construction infrastructure is multiple decades. The inflow of materials in e.g. homes is, however, still much greater than the outflow caused by demolition (see Chapter 4, where we discuss housing construction as a separate product group).

Following minerals, 247 megatonnes, or 3% of the total, consists of metal stores. Just as minerals, most metals are primarily stored in ground and road infrastructure, and buildings: approximately 21 megatonnes in the former and 172 megatonnes in the latter. Additionally, many metals are stored in the transportation sector (49 megatonnes) and in the energy system (3.5 megatonnes). Just like construction materials, theoretically speaking it is relatively easy to recover, reuse, or recycle metals.

Finally, it is important to mention that critical raw materials (approximately 10 megatonnes, 0.1% of the total) are primarily stored in buildings (4.8 megatonnes), the transportation sector (3 megatonnes), and in the energy system (1.1 megatonnes). Despite the majority of these being aluminium and copper, the other materials are often even rarer and come with significant supply risks (see more in section 3.2.2). Such critical raw materials are also important for the energy transition or the Dutch manufacturing industry. From this standpoint, it is therefore essential to have a good overview of these materials and find possible ways of recovering and recycling them in the near future.

A decrease in waste supply, landfill, and waste incineration

Total domestic waste generation has further reduced over the past few years from approximately 60 megatonnes in 2020 and 2016, to approximately 58 megatonnes in 2022 (CBS 2024a). This decrease is mostly attributed to a lower number of mineral materials in the waste supply. The domestic waste supply consists for 90% of mineral waste (especially rock-like material from buildings, roads, and industry) and bio-based waste (wood and vegetable, fruit, and garden waste).

The total amount of waste processed in the Netherlands in 2022, including total imported waste, has slightly increased: from approximately 64 megatonnes in 2020, to over 66 megatonnes in 2022. Of this total, around 53 megatonnes were recycled (see also Figure 3.1). This means that around 80% of all waste processed in the Netherlands is either recycled or incinerated with energy recovery, making the country a forerunner in this field within Europe. Processed waste mostly refers to minerals (construction and demolition waste) which are used as a foundation, for example under asphalted roads (CBS 2024a; CLO 2020a). Additionally, a large part of waste processing concerns single-use waste, such as plant and animal waste that is used as energy through fermentation or incineration, or for processing into animal feed. This therefore involves, to a lesser extent, recycling of e.g. plastics, beverage cartons, or electronics. Very few recycled materials are

being used in the original products from which they come, or in another high-quality manner. In other words, there is plenty of recycling, but still too little recycling specifically for high-quality reuse; much advancement can still be made here.

The total amount of household waste in 2022 was 8 megatonnes; this was lower than previous years, as it was 9 megatonnes in 2020 and 8.3 megatonnes in 2016 (Rijkswaterstaat 2024b). Comparatively, this was 489 kilos of waste per person in 2016, 519 kilos in 2020, and 457 kilos in 2022. In 2016, 51% of household waste was recycled, compared to 54% in 2020 and 53% in 2022. As some waste streams are lost after sorting, this only includes waste streams that are actually recycled and not just what is collected and sorted. In the production of plastic recyclate, for example, there are often fractions left over that are unusable, and much of the sorted plastic waste turns out to be too contaminated for recycling, resulting in incineration regardless.

For decades now, there has been strict waste policy in the Netherlands to promote recycling and discourage incineration and landfilling. As such, the amount of landfilled waste has steadily declined over this time frame (CLO 2020b). In 2022, the net landfilled waste was 12% lower than in 2020 (Rijkswaterstaat 2024c); this concerns all types of waste, including construction and demolition waste, business waste, industrial waste, and residuals from waste incineration plants.

In 2022, nearly 7.4 megatonnes of waste was incinerated in Dutch waste incineration plants; around 6.2 megatonnes of this total came from the Netherlands itself (Rijkswaterstaat 2024c). This mostly consisted of organic material, plastic waste, construction and demolition waste, paper and cardboard, and sorting residuals (Rijkswaterstaat 2023). The amount of incinerated waste had been relatively stable for some time, declining slightly in 2022 relative to 2020 (-2%) and relative to 2016 (-3%). The latter was primarily related to a reduction between 2017 and 2022 of the total import of waste that is then incinerated. In 2022, approximately 16% of such waste came from abroad, while in 2016, this was around the 25%. This decrease is partly offset by an increase in the amount of domestic waste that was incinerated in this same period.

Numerous national waste targets are not being met on time

The current Dutch National Waste Management Plan contains multiple, concrete waste targets: for total waste generation, the methods of processing it, total household waste and comparable waste by businesses, organisations, and governments (Rijkswaterstaat 2024d). The previous target to incinerate and landfill half the amount of waste in 2023 compared to 2013 has, however, not been met. As a result, materials that are recyclable (at a high quality) are still being incinerated on a large scale, such as plastic waste, construction and demolition waste, or paper. Furthermore, after waste incineration, a quantity of bottom ash remains for which a use must still be found. The NPCE endorses the ambition to burn less waste and that the incineration of recyclable waste should completely be a thing of past by 2050 (IenW et al. 2023).

There is the target to limit the total amount of waste generation in the Netherlands to a maximum of 61 megatonnes by 2023; as this amount was around 58 megatonnes in 2022, this target has likely been met. Other national waste targets, however, are not being realised with current trends and existing adopted policy. For household waste, for example, there was a long-standing target to limit residual waste per resident to a maximum of 100 kilogrammes by 2020. With the introduction of a new household waste programme (VANG-Huishoudelijk Afval Programma), this target was adjusted and it was determined that residual waste should be viewed from a broader perspective (European Union 2024; Rijkswaterstaat 2024e). For that reason, the programme was connected to

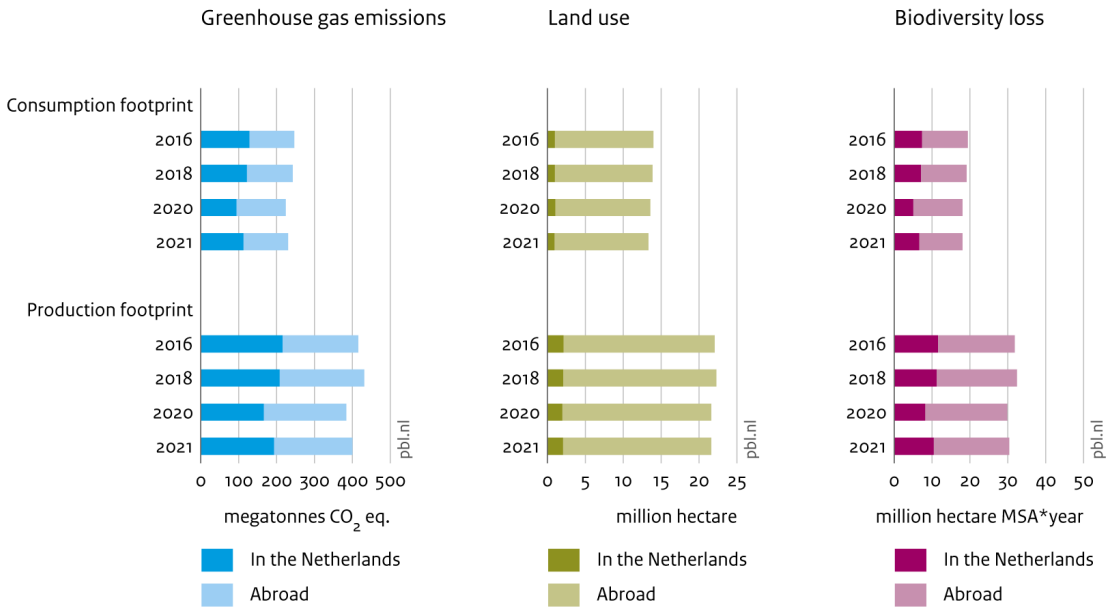
the targets of the EU framework on waste: 55% recycling in 2025, 60% in 2030, and 65% in 2035 (European Union 2024; Rijkswaterstaat 2024e). Here, 65% of recycling in 2035 is assumed to result in approximately 100 kilogrammes of residual waste. The same targets apply not only to household waste but also to the office, retail, and service sectors.

3.2 Effects of Dutch material resource use

The Dutch use of material resources has effects both within and outside of the Netherlands. In this section, we discuss the various environmental effects associated with this, such as greenhouse gas emissions, changes in land use, and damage to biodiversity. We consider effects that occur throughout the whole chain, across the world; in other words, from source to production to consumption. These total effects are also called the footprints of Dutch production and consumption.

The NPCE formulates the ambition to reduce the environmental effects of Dutch material resource use by 2050 to within planetary boundaries and the resulting 'safe operating space' for the Netherlands. Because this so-called operating space is not yet established for the Netherlands, we can, as of yet, not comment to what extent the Netherlands will stay within this safe space with current trends in environmental effects. Additionally, alongside environmental effects, we also discuss the supply risks of critical raw materials in this section.

Figure 3.4
Environmental effects of Dutch material resource use



Source: CBS et al. 2025

Dutch production and consumption cause environmental effects throughout the global chain. In 2021, compared to 2016, these effects have slightly decreased. In this section, we make comparisons with 2016 with a baseline year of 2021 rather than 2022, since, at the time of writing, no more recent data was available. The slight decrease applies to the following footprints: greenhouse gases, land use, and biodiversity (see Figure 3.4), with consumption footprints decreases somewhat more strongly than the production footprints. As demonstrated in Figure 3.4,

roughly 50% of greenhouse gas emissions occur inside the Netherlands, and roughly 50% occurs outside of the country. This is not the case for the land use and biodiversity footprints, where the largest part of these environmental effects take place outside of the Netherlands, primarily because the Netherlands imports relatively large amounts of material resources for food production and animal feed.

This overall declining trend in environmental effects is due, on the one hand, to reduced global trade during the COVID-19 lockdowns and, on the other hand, to efficiency improvements in supply chains both domestically and internationally. This leads to lower environmental pressure per Euro of production. Additionally, the consumption footprints have declined more strongly than the production footprints because domestic final demand, on which the consumption footprints are based, increased slower in 2016-2021 than the Dutch export of goods and services (export is part of production footprints but not consumption footprints).

Since 2016, greenhouse gas emissions due to consumption and production have slightly decreased

The greenhouse gas footprint of Dutch consumption of goods and services has decreased: from 247 megatonnes CO_2-equivalents in 2016, to 230 megatonnes CO_2-equivalents in 2021 (a decrease of 7%; *see indicator greenhouse gas footprint*). Equally, there was a decrease due to Dutch production, namely a reduction from 415 to 400 megatonnes CO_2-equivalents (a decrease of 4%). The fact that the greenhouse gas footprint for both Dutch production and consumption decreased is mostly due to the COVID-19 pandemic and the associated lower fossil fuel consumption in 2020 and 2021. The production footprint did not decline as much as the consumption footprint, mostly because there was an observable increase in greenhouse gas emissions in chains related to export products (particularly food products and services).

Additionally, the reduction in greenhouse gas footprints is partly due to the increasing global use of renewable energy. In the period of 2016-2020, there was also increased investments in the construction and transportation sectors, leading to lower greenhouse gas footprints, as these sectors have a relatively low greenhouse gas intensity compared to other sectors.

In 2021, the consumption and production footprints were somewhat larger than in 2020, despite similar levels and durations of COVID-19 restrictions in both years (Rijksoverheid 2024); a growth of 3% (+6 megatonnes CO_2-equivalents) and 4% (+16 megatonnes CO_2-equivalents), respectively. During this period, production for export (especially in the basic industry) contributed significantly to the larger growth of the production footprint of greenhouse gas emissions.

In comparison to other EU countries, the Netherlands does have a larger than average greenhouse gas footprint. In 2022, the consumption footprint was around 12 tonnes CO_2-equivalents per resident and therefore 11% greater than the weighted average for the entire European Union. The production footprint (measured per Euro gross domestic product) was 24% greater than the weighted EU average.

Land use and biodiversity footprints are also smaller than in 2016

Land use footprints were, as the greenhouse gas footprints, also smaller in 2021 than in 2016 (*see indicator land use footprint*). For its production footprint, there was a decrease of 2% in 2021 versus 2016. For consumption, it was slightly bigger, namely 5%. The footprints for land use primarily consist of food and recreational goods (more than 50%).

In contrast to the greenhouse gas emission footprints, there was no growth in the land use footprints between 2020 and 2021, for production nor consumption. For consumption, the amount of agricultural area used for the Dutch consumption of food has become smaller. This is partly offset, however, by the increase in forest area for wood use in construction and furniture during this same period. For production, total land use in the chain is mainly due to the export of agricultural products and foodstuffs (accounting for 65% of the total production footprint).

Finally, the biodiversity footprints for both consumption and production have also decreased between 2016 and 2021; by approximately 7% and 5%, respectively (*see indicator biodiversity footprint*). We observe a stronger decrease in the consumption footprint regarding biodiversity loss, since greenhouse gas emissions and land use are the main pressure factors for biodiversity loss, causing biodiversity footprints to exhibit similar trends to greenhouse gas emission and land use footprints.

A stable water footprint: effects mostly due to food and mostly outside of the Netherlands

New in this ICER is the quantification of the Dutch water footprint. Here, we look at both the amount of so-called 'blue' water needed for Dutch production and consumption, as well as the 'water stress' they generate. 'Blue water' refers to water that is extracted from (fresh) surface water and groundwater. That is to say, water processed into products or evaporated during the production process; not cooling water that flows back to the water source. 'Water stress' is equal to blue water usage multiplied by a region-specific factor that decreases with the remaining water availability in an area after humans and nature have extracted water. Water stress is therefore based on the assumption that the less water is available per area, the more likely it is that shortages occur.

Both the blue water footprint as well as the water stress footprint have been mostly stable since 2016 (*see indicator water footprint*). The water stress footprints are a factor of 27-28 higher than the blue water footprints, which means that much of the Dutch blue water usage comes from areas with water scarcity. The Dutch consumption of food makes the biggest contribution to the blue water footprint at 62%; in the case of the water stress footprint, the contribution stands even higher, at 72%. The consumption footprints concern only indirect water use related to the final domestic expenditures and therefore exclude direct water usage by households. The production in the Dutch food industry contributes for 58% to the blue water footprint, and 75% to the water stress production footprint.

For both the consumption and production footprint for blue water usage, a portion occurs in the Netherlands: 13% and 22%, respectively. For the water stress footprints, this is 1%. Water stress mainly occurs in countries outside of the EU, and water stress due to Dutch production and consumption largely takes place in low- and middle-income countries.

3.2.1 Supply risks of critical raw materials

Supply risks of critical raw materials have increased for the Dutch manufacturing industry

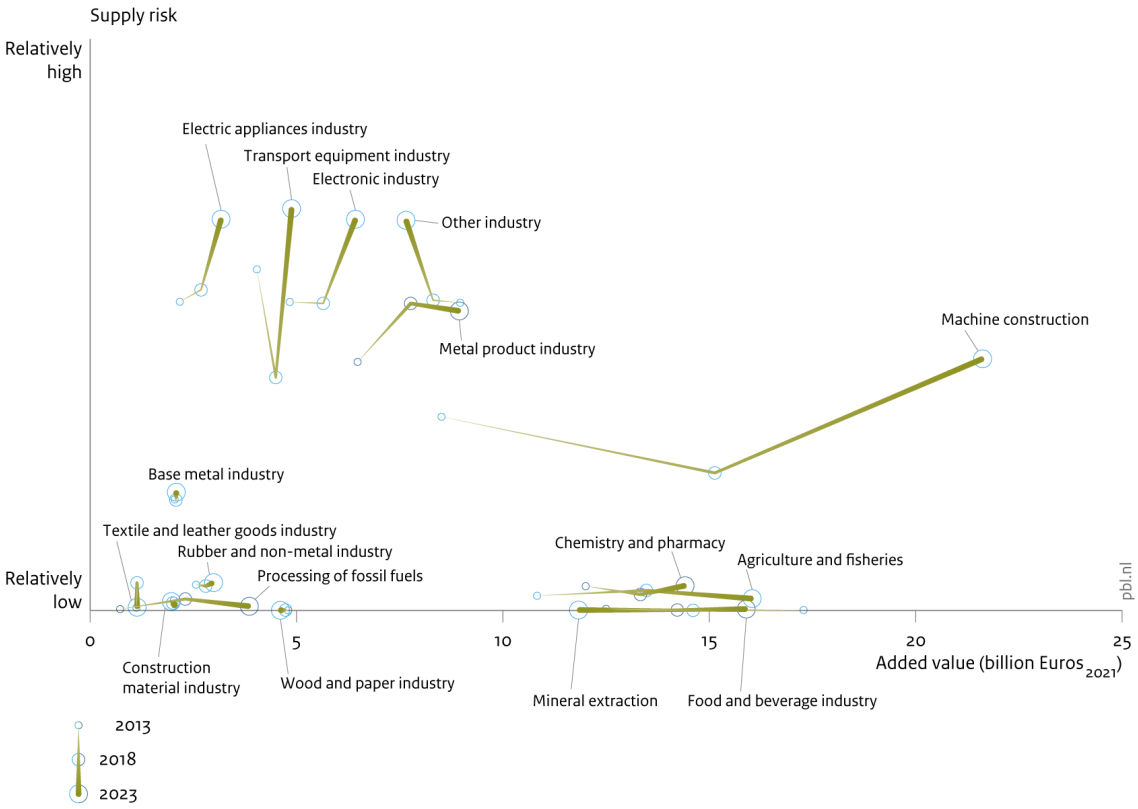
The Dutch economy is extremely dependent on material resources from abroad. For new metals and critical raw materials, the Netherlands is even fully dependent on other countries (CBS 2024a; EZK 2022). This places the Netherlands in a vulnerable position, since it now runs the risk that material resources are not delivered, for example because of scarcity or geopolitical conflicts.

For many Dutch industrial sectors, the supply risks have increased between 2014 and 2023 (see

Figure 3.5; NMO 2025). Especially since 2020, delivery times and prices of material resources and product parts have temporarily increased due to disrupted international chains, mainly due to international COVID-19 lockdowns, or because of the blockage of the Suez Canal in 2021 (Ubbens 2024; S&P Global 2024). Particularly those material resources used in sectors of the manufacturing industry experience increased supply risks; these sectors include the machinery industry, the transport equipment industry, and the electrical and electronics industry (production of e.g. laptops, phones, and tablets). These sectors have become of great economic value to the Netherlands.

Over the past decade, the total added value of the sector machinery has particularly increased, from almost 8.5 billion in 2013 to nearly 22 billion in 2023 (both at 2021 price levels). As such, this sector represents nearly 22% of the total added value of the Dutch manufacturing industry.

Figure 3.5
Relationship between supply risks and added value per Dutch sector



Source: Bastein and Rietveld 2015 and 2024; NMO 2025

The aforementioned sectors mainly face increased supply risks of critical raw materials from the platinum group (platinum, iridium, ruthenium, and rhodium), which are primarily used in catalytic converters, coatings, and electrical components (SCRREEN 2023a). Additionally, the supply risks for germanium have significantly increased, which is mainly used in electronics such as fibre optic cables. A large part of germanium (around 80%) is produced in China (SCRREEN 2023b). The supply risks of the light and heavy rare earth metals have also increased. These earth metals are primarily used in electric vehicles, wind turbines, and batteries, and are unmissable for defence purposes (SCRREEN 2023c). Finally, the supply risks of nickel and chromium have increased; these materials are primarily used for the production of stainless steel and batteries. For most material resources

that are important for the energy transition, the supply risks have not significantly increased over the past ten years (such as lithium, cobalt, and antimony, with the exception of nickel), despite the exponentially growing demand for these material resources for solar panels, wind turbines, and large batteries.

Circular strategies can play a big role in reducing supply risks

The increasing supply risks, and any associated concerns, are usually not caused by growing demand or lagging supply (and thus structural price increases), but by geopolitical developments. First of all, many critical raw materials come from countries where the administrative quality (as determined by the World Bank) has deteriorated (Bastein & Rietveld 2024). This quality is determined using indicators on e.g. political stability, quality of legislation, presence or absence of violence and terrorism, and approach towards corruption. Russia, for example, has held a significantly lower score for administrative quality since 2022 because of its invasion of Ukraine, while it does retain a significant position in terms of the extraction and production of material resources (e.g. in the platinum group metals and nickel). Secondly, there is an observable negative trend in global mining diversification, which is leading to a greater concentration of material resources in certain countries, especially China. Indeed, China has a large share in both the extraction and refinery of many critical raw materials, including indium, germanium, magnesium, tungsten, fluorspar, and rare earth metals. Finally, export restrictions to Europe are increasingly being imposed by several countries on specific material resources, with the aim of maintaining market position and influencing prices.

Both within the EU as in the Netherlands, several steps have been taken over the last few years in terms of policy to increase the security of supply of critical raw materials and strategic material resources. The European Critical Raw Materials Act (CRMA) and the Dutch National Resource Strategy are both aimed directly at critical raw materials which are important for strategic sectors like renewable energy, digital technologies, and defence (see Chapter 5).

Circular strategies can play a large role in reducing such supply risks; through lifespan extension and recycling, for example, the import of critical raw materials can be limited. On a European level, it is estimated that, through recycling, potentially 45-65% of the basic metal needs (aluminium, copper, and zinc) and 45-77% of the demand for battery metals (lithium, nickel, and cobalt), can be met by 2050 (KU Leuven 2022). Several of these critical raw materials (e.g. aluminium, copper, lithium, and silicon) are already present in the Dutch economy in the reserves (CBS 2024f). To be able to apply these available materials in the Dutch economy, it is essential to know when and with what quality these materials will be released and available for reapplication. This also calls for setting up a recycling infrastructure in the Netherlands or in Europe, since, up until now, hardly any critical raw materials are recycled here.

4 Progress of the transition process

Key takeaways

- Overall, there is no acceleration of the transition process, despite various positive developments in the transition to a circular economy. The financial support from the national government for circular projects has significantly increased over the past few years, however. This support mostly goes to R&D and recycling, and less so to market formation and other circular strategies that could accelerate the CE-transition. Additionally, there are several stubborn obstacles in the way. For one, there is no level playing field for circular businesses, making it harder for them to compete with linear businesses. Dutch recyclers of plastic are also having a hard time because of the low prices of virgin fossil fuels in, primarily, China and the United States.
- Recycling is the most dominant circular strategy adopted by Dutch governments and businesses; it will always play an important role in a circular economy, but is not sufficient on its own to realise full circularity. For example, only 7% of plastic packaging is made of recycled material. A commitment to more (high-quality) recycling can increase this percentage, but will not deliver sufficient recycled material to fulfil the growing demand for plastic packaging. This is why other circular strategies are also needed, such as less packaging in general, more reuse of packaging, and substitution by bio-based materials.
- The CE-transition faces various chicken-and-egg problems that hinder acceleration. For example, small and medium-sized enterprises (SMEs) are having difficulties obtaining bank financing for circular business cases, partly because there is still too little circular activity, making it hard for banks to properly assess risks. Another chicken-and-egg problem is the insufficient supply of circular products, making it relatively expensive and complicated for consumers and procurement officers to purchase circular products. As a result, the demand for circular products remains small, making it less attractive for companies to scale up their circular capacity. The national government can expand the market for circular products by levelling the playing field for circular and linear companies and implementing more circular procurement policies.
- The majority of consumers are open to circular behaviour and prepared to purchase fewer products such as furniture, clothes, and household goods, and to purchase refurbished instead of new products. High costs and practical objections, however, withhold consumers from actually consuming in a circular fashion. Governments and businesses can promote circular behaviour by making sustainable choices cheaper and easier. This calls for more than just providing information; it also calls for adjustments in the physical consumption environment, such as increasing the number of collection points for deposit bottles and cans and providing more space for second-hand shops at strategic locations like shopping centres.
- Over the next few years, numerous large, multiple-year investments are being made in housing and renewable energy. Here lie opportunities to connect circularity to other societal challenges, such as reaching the climate targets and fixing the housing crisis. These include product design that facilitates the recycling of wind turbines, for example, or the splitting or adding new stories to existing homes instead of starting new construction. If circular strategies are incorporated *now* into these huge investments which carry long-term consequences, then the waste of material resources can be prevented, both now and in the future.

4.1 Introduction

The National Circular Economy Programme (NPCE) carries the ambition to realise a fully circular economy by the year 2050. In this chapter, we discuss the progress of the transition process in the Netherlands. The transition to a circular economy is a complex societal transformation which will involve multiple generations. It calls for drastic changes and the development of circular products, services, and knowledge. It is therefore necessary to create the right preconditions for the transition, such as making adjustments in laws and legislation, or making risk models for financing to realise a market for circular products and services. Parallel to this, the transition also calls for phasing out and moving away from the current linear use of products and material resources. Different actors such as governments, businesses, citizens, societal organisations, and knowledge institutes all play a role in the transition, without any one party determining it.

The control and planning of transition processes is limited, but the direction and speed of these processes can be influenced. Building on the previous ICER, we distinguish four transition phases: pre-development; take off; acceleration; and stabilisation. The acceleration phase can be distinguished by a substantial market demand for circular products and services, the establishment of new rules (institutionalisation), a clear direction of change for all parties, and potentially also increased resistance to change (Hanemaaijer et al. 2023, on the basis of Bode et al. 2019; Hekkert et al. 2007; Hekkert et al. 2020). By making experimenting and learning self-evident, and by sharing information, policymakers and other stakeholders can learn from the innovative power of society and use this to accelerate the CE-transition (Het Groene Brein 2021; ROB 2023; PBL & VU 2024).

In Europe, the Netherlands is a frontrunner in the circular economy transition

The Netherlands is a frontrunner within Europe in the transition to a circular economy. This was noted in earlier ICERs (Hanemaaijer et al. 2021; Hanemaaijer et al. 2023) and is reaffirmed in two recently published studies on the progress of various European countries to a circular economy (D'Adamo et al. 2024; Claudio-Quiroga & Poza 2024). These two studies are based on 15 circular economy indicators by Eurostat, which relate to aspects like waste management, use of secondary resources, and competitiveness and innovation.

Being a frontrunner does not automatically mean that the Netherlands is making rapid progress. A ranking is, after all, relative and depends on the performance of other European countries (see also Van Opstal 2024). Additionally, the Netherlands is itself still at the beginning of the transition. Its leading position relative to other countries is due to high recycling percentages of various waste streams (see Chapter 3), the relatively highly developed use of and trade in secondary resources, and the competitive power and innovation within the circular economy.

Figure 4.1

Aspects of a circular economy transition

Source: PBL; based on Hekkert 2020

4.2 Progress of the transition on a national level

In this section, we discuss which activities governments, businesses, and societal organisations undertake to develop and spread innovations for a circular economy. As shown in Figure 4.1, the MIS framework (Mission-driven Innovation System) distinguishes eight key processes that together must act as a large 'gear mechanism' to initiate and sustain the circular economy transition (see Elzinga et al. 2020; Hekkert et al. 2020). The focus in this ICER lies on those key processes we observe changes in in relation to previous ICERs (Hanemaaijer et al. 2021; Hanemaaijer et al. 2023). This way, we identify obstacles for the transition and potential leverage points for fostering the transition.

The amount of Dutch scientific publications remains vast, but growth is slowing down

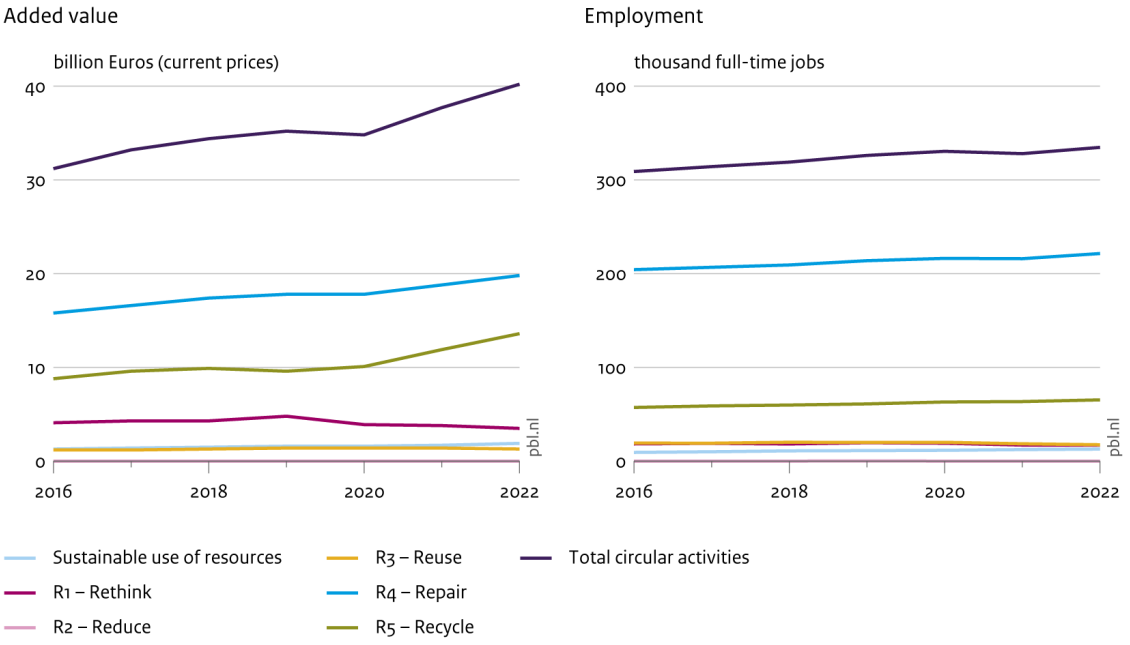
With a total output of 1,020 publications on the circular economy, Dutch knowledge institutes account for nearly 4.5% of the worldwide number of publications on this topic. Nearly 39% of these Dutch publications appeared in 2022 and 2023, demonstrating the effort by Dutch institutes to

remain up to date on the circular economy. Yet, globally as well as in the Netherlands, the earlier exponential growth in the number of publications on the circular economy has been slowing down over the last two years.

On average, Dutch publications are among the most cited in the world and, as such, the Netherlands holds a top position in the international knowledge landscape regarding circularity (Türkeli 2024; see also *indicator publications*). Most Dutch publications concern recycling, more efficient manufacture of products, and recovery of energy from materials. Relatively little scientific attention is spent on possibilities of using fewer material resources by sharing and refusing products (Türkeli 2024). Scientific publications gain value when they better align with practice, and if the content of the research reaches businesses, citizens, and policy. The Dutch Academic Network on Circular Economy (DAN-CE) was founded to support this type of knowledge sharing.

Figure 4.2

Added value and employment because of circular activities



Source: CBS 2024

The circular economy is growing less rapidly than the total Dutch economy

Between 2020 and 2022, employment in sectors engaging in circular activities increased from 330,500 to 334,700 full-time jobs (see *employment indicator*). In 2020, because of COVID-19, the added value of these sectors declined for the first time since 2013, but then grew from 34.8 billion Euros in 2020 to 40.2 billion Euros in 2022 (see *added value indicator*). In absolute terms, hence, there is a clear recovery from the 'COVID dip' of 2020 (see Figure 4.2). However, the total economy grew faster than circular activities did in 2020-2022. As a result, both the share of circular economy-related employment and the added value of circular businesses decreased relative to the total Dutch economy. Despite the growth in circular employment and added value in absolute terms, the relative macro-economic figures show no signs of acceleration in the circular economy transition (CBS 2022; see also the *employment* and *added value indicators*).

Fiscal support and subsidies are increasing, especially for research and innovation

In 2022, through the Netherlands Enterprise Agency (RVO), the Dutch national government, the provinces, and the EU allocated 440 million Euros to support circular projects by companies and institutions through subsidies and tax schemes. This is a substantial increase from 236 million in 2018, and 295 million in 2020. Relatively speaking, the amount of governmental support increased also for circular projects (as part of the total support for sustainable projects via RVO). This an increase was of 7% in 2018 to 9% in 2020, and to 14% in 2022 (RVO 2024a; see also *indicator financial resources*).

The majority of this financial support consisted of subsidies (301 million Euros). An additional 138 million Euros in tax exemptions were granted for circular innovation and circular investments through the Research and Development Promotion Act (WBSO): the Environmental Investment Deduction and the Random Depreciation of Environmental Investments (MIA\Vamil) financial instruments, respectively. This amounts to 31% of the total MIA\Vamil budget and 5% of the WBSO budget. Since the WBSO broadly stimulates innovation and can be considered an indicator of the themes the Netherlands is engaged in with regard to innovation, these percentages do indicate that innovation with a focus on the circular economy is not yet at the top of companies' agendas.

Most circular projects that received financial support from the government are aimed at recycling and research and innovation (see *indicator stimulating knowledge development*). Less financial support went to projects aimed at other circular strategies and market formation (see *indicator stimulating market introduction*). The latter is essential to scale up circular activities. Most financial schemes are broader in scope than just support for circular projects. On average, 14% of all support (subsidies and tax benefits) went to circular economy-related projects in 2022. Only the financial support for Circular Chain Projects and the Knowledge and Innovation Agenda – Circular Economy are 100% focused on the circular economy. This concerns a relatively small budget of 4.8 million and 3.5 million Euros, respectively (RVO 2024a).

Table 4.1
Core figures circular innovation projects, fiscal schemes, and investments via RVO, in million Euros

	2018	2020	2022
Subsidies R&D	167	217	301
WSBO (fiscal contribution)	36	55	68
MIA\Vamil (fiscal contribution)	34	22	71
Total in subsidies and fiscal contributions	**236**	**295**	**440**
Share circular	7%	9%	14%

Source: RVO 2022; RVO 2024a (adjustments by PBL)

Limited exchange of knowledge hinders scaling up circular initiatives in small- and medium-sized enterprises (SMEs)

When businesses begin developing a circular strategy, it is often the case that only one employee or a small group of dedicated colleagues are involved. To then scale up a circular strategy, growth in knowledge and skills is necessary in all parts of a company; both 'vertically' (from CEO to the work floor) as 'horizontally' (from catering to the sales department). In practice, this is difficult for SMEs to organise as knowledge about shaping circular business models is limitedly available. This is partly due to the fact that businesses consider such knowledge to be competition-sensitive;

businesses who do possess that knowledge are therefore hesitant to share it (Versnellingshuis 2024). As such, some circular initiatives remain under the radar, while it is important for the circular economy-transition that businesses are visible when they explore (innovative) circular activities so they can act as an example for other businesses. To scale up circular initiatives, a change in company culture will be necessary: from a focus on competition to a focus on collaboration throughout the chain. Additionally, businesses need employees with circular knowledge and skills. In the current tight labour market, however, it is a challenge for many businesses to find employees with the right set of skills. Another complicating factor is that the current education system does not always align well with the wishes and needs of circular entrepreneurs. For instance, current entrepreneurs offering to repair furniture are finding it difficult to find properly trained workers, because reparation has not been part of most educational programmes for a long time (Versnellingshuis 2023, 2024).

Levelling the playing field for circular entrepreneurs stimulates the progress of the transition process
In previous ICERs, we named various obstacles for circular entrepreneurship that still linger to this day. For example, circular products and services are often more expensive than their non-circular counterpart, because polluting and wasteful production practices are not (sufficiently) prized.

As the market for material resources is an international market, international collaboration, e.g. within the EU, is crucial to level the playing field for Dutch, and European, entrepreneurs. Among entrepreneurs, there is also a call for more standardising policy instruments to level the playing field for circular and linear products and services (Versnellingshuis 2024; see also RLI 2023). Such policy could be aimed at supporting circular entrepreneurship, for example by requiring products to contain a specific share of secondary material. It could also be aimed at phasing out non-circular practices, such as by setting requirements for the lifespan and repairability of products (Versnellingshuis 2024; see also RLI 2023). Over the past few years, various legislative initiatives were taken to promote more sustainable and more circular products, among which are the European Single Use Plastic (SUP) directive, the Corporate Sustainability Reporting Directive (CSRD), and Ecodesign for Sustainable Products Regulation (ESPR), as well as the Dutch extended producer responsibility (EPR) on textiles (see also Chapter 5).

Risk-averse financing hinders the scaling up of circular business models
When entrepreneurs want to scale up their circular activities, they are primarily dependent on banks in terms of financing. Banks are, however, hesitant in financing circular business cases, mainly because they judge these to be a greater risk than the more familiar linear business cases, especially in the case of SMEs. Many promising circular initiatives consequently receive no financing (Versnellingshuis 2024). This creates a mismatch between demand for financing and supply; currently, the financing need of circular SME entrepreneurs is estimated to be at least 21 times greater than the financing offered by banks (Copper8 & Circular Finance Lab 2024).

For a more balanced assessment of circular activities, banks need to restructure their risk assessment process. Additionally, to facilitate stronger circular business cases, the government must create a more level playing field for circular and linear companies (SER 2018; Copper8 & Circular Finance Lab 2024). Since these actions influence and reinforce each other, it is necessary and urgent for the government and banks to coordinate these actions together.

To develop new risk models, banks need data on circular business activities in the coming years. At the moment, this data is limitedly available, partly due to the lack of bank financing for circular

business activities. In an attempt to break this situation, the government and banks are collaborating through the so-called Kopgroep (Leading Group) Circular Funding. The goal of this group is to make circularity a standard consideration in the assessment of financing applications by 2030 and to close multiple deals that allow for innovative public-private partnership models and financing. In 2024, the Ministry of Infrastructure and Water Management (IenW) and the Dutch Banking Association (NVB) agreed to further collaborate on accelerating the circular economy (NVB & IenW 2023). Given the Dutch ambitions for 2030 and 2050, it is necessary to turn these agreements into actions and thereby align with the developments initiated by the National Circular Economy Programme 2023-2030 (NPCE), where there is a shift towards more standardisation and pricing measures, as well as towards more adopted policies (see *indicator policy instruments*).

Limited market demand and limited supply form a chicken-and-egg problem

Businesses are experiencing a limited demand for circular products and services. This is partly due to the fact that governments and businesses often choose the lowest price in practice and apply few ambitious purchasing criteria in terms of circularity, despite the existence of policy for circular procurement and tendering (WRR 2023; Versnellingshuis 2024; see also *indicator circular procurement*). Governments can expand the market for circular products if they better utilise the possibilities of circular procurement policy by making use of available expertise and tools.

Currently, it is often difficult for circular businesses to compete in tenders that typically involve large volumes. Companies also experience limited interest in their circular supply from consumers. Consumers are mainly inclined to exhibit circular behaviour when it can easily be integrated into their busy daily lives and when circular products and services are not disadvantageous in terms of price and convenience compared to conventional alternatives (EC 2018; Wolf et al. 2022; Versnellingshuis 2024). At present, a significant portion of the circular supply does not yet meet these criteria, because it is available in a limited number of places, making it cost more money, time, and effort for consumers to purchase than non-circular supply (Rood & Evenhuis 2023; Versnellingshuis 2024).

This creates a chicken-and-egg problem: the demand for circular products and services lags behind because the supply is limited, and supply is limited because there is little demand (see also In 't Veld et al. 2023). To solve this problem, governments can level the playing field and create a market by leveraging their substantial purchasing power and acting as a launching customer. By creating demand for innovative circular products through their own procurement policy, governments can take away part of the uncertainties that businesses feel who want to scale up (RIVM 2021; WRR 2023).

Willingness to consume circularly is hardly translating into different behaviour

Whether consumers are willing to change their consumption behaviour is very dependent on the behaviour in question. Few people are prepared, for example, to stop eating meat and dairy, or not own a car, while these types of behaviour can deliver great environmental effects (Koch & Vringer 2023; Milieu Centraal 2023; see also *indicator consumers*). The majority of Dutch consumers are, however, willing to purchase less furniture, clothing, ICT, and household appliances (or at least less often); purchase refurbished instead of new products; and buy furniture made with environmentally friendly materials (Milieu Centraal 2023). Willingness to display more circular behaviour, as of yet, hardly translates to more actual circular behaviour.

Governments and businesses can facilitate circular consumption behaviour by making it easier and

(relatively) cheaper for consumers to make a circular, sustainable choice. Existing policy surrounding circular consumption behaviour is primarily aimed at providing information to the consumer (IenW 2023). To let consumers make the circular choice, however, more is needed and more is also possible; this calls for adjustments in the physical consumption environment and for standardisation and pricing. Consider deposit schemes on more types of products combined with the expansion of collection points at strategic locations, such as places where these products are sold; or the mandatory reservation of space in shopping centres for the sale of second-hand and refurbished products (Rood & Evenhuis 2023). Here, it is essential to note that consumption behaviour is not a fully individual choice on the part of the consumer. Behaviour, after all, takes place in a physical, economic, and socio-cultural context which is also shaped and influenced by other parties, such as governments, businesses, and societal organisations. Making consumption patterns more sustainable therefore requires involvement of – and policy attention directed at – all of these parties; consumers cannot do this on their own (De Krom et al. 2020).

4.3 Progress of the transition process in three product groups

In this section, we look at the progress of the circular transition process by looking at three products groups from the National Circular Economy Programme (NPCE). This way, we want to provide a more detailed picture of the dynamics of the circular economy transition than an analysis on national level allows. This more detailed picture is important because the transition dynamic can vary significantly per product group. For example, there are differences in material resources used, the nature of products, the structure and organisation of supply chains, and relevant policies. By focusing explicitly on the transition dynamic within specific product groups (see also the ICER webpage on product group analyses), it is possible to gain insight into product group-specific challenges and opportunities to encourage the circular economy transition. The insights and management opportunities that such a focus delivers are also often applicable on a broader scale.

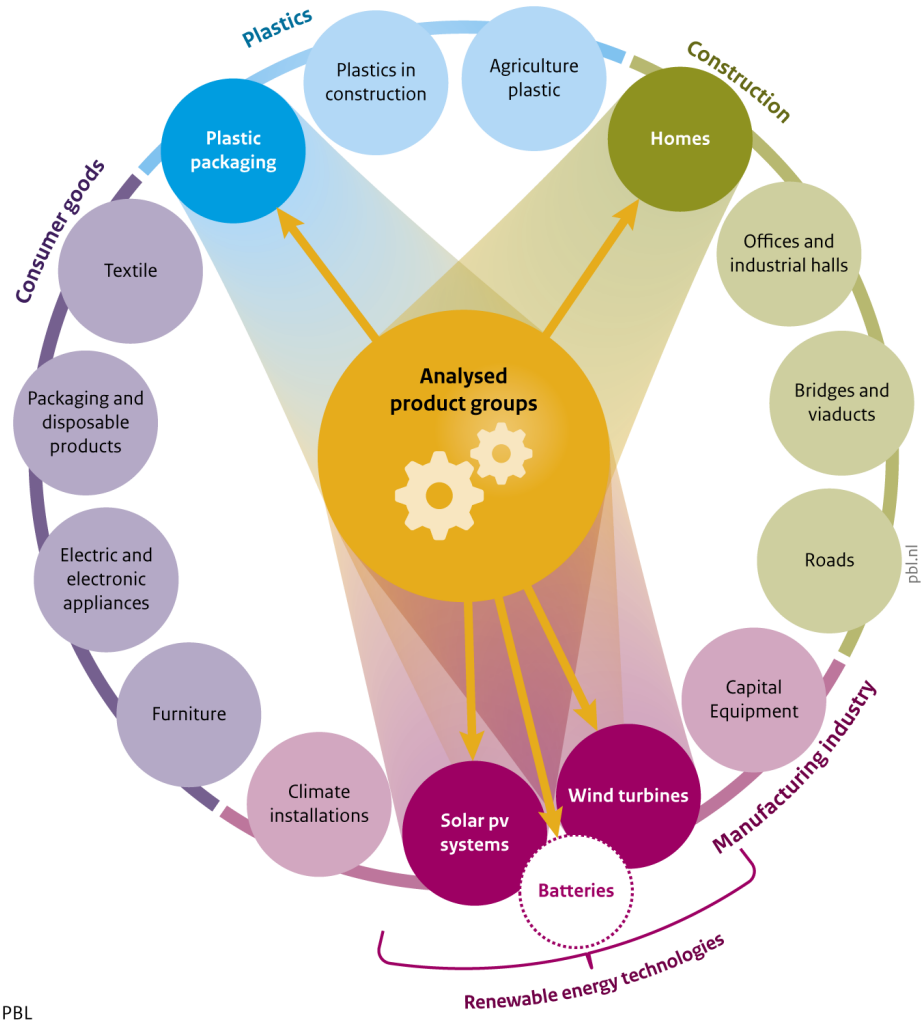
We look at the following three product groups in this ICER: houses, plastic packaging, and renewable energy technologies. These have been identified in the NPCE as priority product groups (see also Figure 4.3). They are characterised by a significant use of material resources and a large impact on climate, biodiversity, the environment, and security of supply (Prins 2023).

For each of the three product groups, we first specify why this group is relevant in light of the CE-transition. In doing so, we use the MIS-framework (Mission-driven Innovation System) and the various circular strategies.

Then, we discuss the progress of the transition within each product group. We have also executed an overarching analysis (Rood & Van Hoorn 2024), where we identify obstacles that hinder the progress and in which we provide policy opportunities to take away these obstacles and accelerate the transition.

Figure 4.3

Analysed product groups in the ICER 2025 within priority product groups in the National Circular Economy Programme (NPCE)



Source: PBL

4.3.1 Product group: housing

When consuming, renovating, and demolishing houses, vast quantities of material resources are used and disposed of as waste. As such, these activities are important causes of greenhouse gas emissions, biodiversity loss, waste production, and environmental pollution. For this product group on housing, there are several relevant policy ambitions. Alongside the circular ambitions for 2030 and 2050, there is the housing construction ambition (900,000 additional homes by 2030) and the goal to make the housing stock more sustainable (all homes to be heated emission-free by 2050).

The significant demand for material resources to build homes and make them more sustainable is partly covered by materials released by demolition, and partly by bio-based materials (Bletsis et al. 2024). In 2019, the total incoming material streams were at least 4.5 times larger than the outgoing streams (EIB 2022). The material reserves in houses will, it is expected, significantly increase the coming decades (without additional policy). By implementing circular strategies, the increase in

material use can be substantially decreased relative to current trends and, therefore, avoid further significant negative impact on the environment.

There is increasing attention for circular construction, but it threatens to be limited to CO_2 reduction
Parties in the housing sector have developed various circular initiatives in recent years. Since 2019, the Transition team Circular Construction Economy (CBE) in the Netherlands has been working to achieve the ambitions for circular construction by 2050. For example, there is a collaboration of twelve major clients and contractors to establish a new standard for circular construction (Het Nieuwe Normaal 2023). Additionally, industry associations from the construction sector have developed a multi-year programme with the 'Dutch Spring Agreement 2.0' to embed circular industrial construction in building practices. The concrete and steel agreement was established several years ago, and the Ministry of the Interior and Kingdom Relations is working with market parties to conclude a building materials agreement to accelerate sustainability in supply chains (Bouwend Nederland 2024). Finally, since 2023, the National Approach to Biobased Building (NABB) 2023-2030 focuses on the entire chain in bio-based construction, including efforts on joint certification for fibre crops (Volkshuisvesting Nederland 2023).

In other words, there is already the necessary attention for circularity in the construction sector. Simultaneously, various parties do indicate that they still consider circularity a vague and new concept (Bours et al. 2024). In an attempt to get a better understanding of circularity, these parties use the reduction of CO_2 emissions as a benchmark for circularity, because CO_2 emissions are easier to measure than the concept of circularity itself (Bours et al. 2024). Circular construction can definitely deliver a contribution to the reduction of CO_2 emissions. When the focus is exclusively on CO_2 reductions, however, there is no attention for fixing other problems, such as biodiversity loss and environmental pollution. Another benchmark in the construction sector is the so-called 'Environmental Performance of Buildings' (MPG) in Dutch. This benchmark has been in effect since January 1st, 2023, and is mandatory for each application for an environmental permit for new residential buildings (RVO 2024b). The so-called MPG score indicates the total environmental burden of all materials applied in a building. Incorporated in this score are numerous environmental costs, but not circular strategies like reduce. The calculation is done at the hand of a Life Cycle Analysis (LCA) per product. The maximum threshold value of the MPG is periodically adjusted downward with the goal of halving it by 2030 at the latest. Although the MPG has its own shortcomings, it does map more environmental effects than just CO_2.

More housing without building new houses; intervening in existing buildings deserves priority
To solve the housing shortage, the primary focus lies on new construction. Interventions in existing buildings can also create additional housing, however, such as by adding floors and splitting homes, and transforming offices into residences. Such interventions require fewer (new) materials than new construction and would therefore be preferable in a circular economy (Bletsis et al. 2024).

Interventions in existing buildings, however, do encounter policy and legal barriers in practice. For instance, for splitting and adding floors to private homes, a time-consuming legal division is often needed in addition to a structural division. Municipal regulations and procedures (e.g. parking standards and objection procedures) can also lead to delays in or rejection of permit applications. Partly due to these reasons, the Dutch national government and construction sector primarily focus on new construction as a means to solve the housing shortage.

There are already several initiatives to encourage adding floors, splitting, or transforming existing houses. For example, there is a so-called 'Guide splitting 1.0' by the housing association Aedes and the provinces North Holland, South Holland, Utrecht, North Brabant, and Gelderland (Geuting et al. 2024). Provinces can position municipalities and associations through process guidance and subsidy schemes. Municipalities can also facilitate interventions like adding floors and splitting by adjusting permit procedures. They can look at possibilities to expedite permit procedures in the case of splitting and increase the standard for the number of households per residential address (Copper8 2024). To prevent each municipality from starting from scratch, good examples can be collected and shared.

The heat and circular economy transition are currently at odds

In addition to the housing challenge, the heat transition (the emission-free heating of Dutch homes by 2050) is significant for the housing sector. To improve the energy performance of a home, extra (insulation) materials are often required. As it stands, housing corporations are required to improve the energy label of over 200,000 homes (homes with an E, F, G, or H energy label, A++++ being the best). To reduce the costs involved and prevent large rent increases, there is a chance they will primarily choose the cheapest possible insulation options, which are not or hardly circular. For the large and diverse group of private homeowners (who own over half of the current housing stock), the question is how they can be involved in the heat transition and what role circular strategies will play in this.

The Dutch national government is currently offering subsidies for the purchase of insulation materials. There is a subsidy for both biobased as well as less sustainable insulation materials. This is understandable in the context of accelerating the heat transition. It is, however, undesirable for the transition to a circular economy (Bletsis et al. 2024). Circular materials are mostly more expensive than conventional materials because environmental costs are insufficiently accounted for in the price of materials. The EU Emissions Trading System (EU ETS) can help here, but more is necessary to make circular materials economically competitive. One option is an additional environmental tax based on environmental costs or an additional national CO_2 tax (Copper8 2024).

Construction and demolition waste from the housing sector is mostly recycled outside of this sector

Most construction and demolition waste are recycled. The majority of the resulting recycled material (approximately 90%) is, however, reused outside of the housing sector (e.g. as fill material in road construction) and therefore not reused as building material. High prices and uncertainties about the quality and safety of secondary materials hampers the large-scale application of recycled materials in the construction sector itself (Bours et al. 2024).

Infrastructure for the reuse of components and the use of secondary materials within the housing sector is still absent, as well as clear and systematic documentation of these materials. This complicates matching supply and demand (Bletsis et al. 2024). A materials passport could help overcome this, but its effect will only be noticeable in the long run when buildings, whose materials are documented in such a passport, are renovated or demolished. When developing such a system, consensus is needed regarding its setup to ensure that the data in the passport can be exchanged effectively, efficiently, and safely. The focus on digitalisation (with Dutch systems like DigiGO, Digideals, and Duspot) and the Dutch *Approach to circular demolition and high-quality reuse*, will contribute to this. In the short term, other actions will be necessary to better manage the use of secondary materials. This could include mandatory circular demolition, overseeing sorting during

demolition and renovation, or imposing more requirements on the post-sorting of mixed construction and demolition waste.

Circular construction faces pressure from pricing and risk avoidance

The construction sector is traditionally highly risk-averse because it is essential to ensure the safety of buildings and thus prevent liability claims. This risk aversion may be further reinforced by the introduction of the Quality Assurance Act in the Netherlands of January 2024, which makes contractors responsible for the consequences of any defects in construction. As a result, contractors are likely to be less inclined to choose circular materials and construction methods that have not yet been proven in practice. Additionally, the lowest price still predominates in tenders and project assignments, and there are insufficient mechanisms to give circular measures a financial advantage. Permit issuers are also highly risk-averse and sometimes refuse to grant permits when circular materials are used, even when these meet all legal performance requirements (Copper8 2024). Establishing a warranty fund through which the government takes over some of the risks from construction companies, and training permit issuers in the field of circular construction, could help remove these obstacles and promote circular building (Copper8 2024).

More coordination is needed to capitalise on opportunities for the circular housing sector

Despite the aforementioned tensions between construction ambition for housing, the heat transition, and the transition to a 'circular housing sector', there are many potential synergies. To realise these, however, a coordinated approach is required. Currently, policy focused on the housing product group is fragmented. The primary responsibility for the circular economy transition lies with the Ministry of Infrastructure and Water Management in the Netherlands, while other ministries are primarily responsible for other relevant policy areas. As such, the housing challenge mainly falls under the Ministry of Housing and Spatial Planning, while the sustainability of existing homes is the responsibility of the Ministry of Climate and Green Growth and the Ministry of the Interior and Kingdom Relations.

Coordination between these ministries is needed to create synergy between the various challenges the housing sector is facing. Ideally, this coordination is organised in the short term, as significant investments in housing will be made in the coming years, by building more houses and by making homes more sustainable. By incorporating circularity in these investments *now*, large quantities of raw materials can be saved both in the short and long term (Bletsis et al. 2024).

Clear, accountable circular targets are needed to guide companies

Parties in the construction sector are experiencing a lack of clear and accountable circular targets (Copper8 2024). The ambition to halve the primary abiotic material resource use by 2030, and the ambition to be fully circular by 2050, offer businesses too little directionality to incorporate circularity into their investment decisions. Businesses are looking at the Dutch national government to take the lead and formulate clear, concrete targets for a sustainable and circular housing construction (Copper8 2024).

Circularity can be explicitly linked to other societal challenges, such as the heat transition and the housing challenge. This linkage is necessary to facilitate synergies between these challenges and to prevent any undesirable trade-offs (Copper8 2024; Gideons 2022; Transitieteam circulaire bouw 2023). Applying the aforementioned 'Environmental Performance of Buildings' (MPG) in new construction is a step in the right direction, especially because the maximum allowable environmental pressure is periodically adjusted downwards. Moreover, MPG ensures that the necessary extra materials needed for better energy performance are limited as much as possible, or

are environmentally friendly, in accordance with the legal requirements for nearly zero-energy buildings in the Netherlands (Bletsis et al. 2024; Copper8 2024). MPG is, however, not perfect and still requires adjustments so that, in the long run, all circular strategies are taken into account. MPG also does not provide sufficient guidance when renovating houses, transforming, or splitting them (Copper8 2024).

4.3.2 Product group: plastic packaging

Plastic packaging forms the largest category of plastic products, both globally as well as in the Netherlands. In Europe, plastic packaging constitutes around 40% of the total amount of plastics (Plastics Europe 2023). The current format of production and consumption of plastic packaging is contributing to climate change, has a negative impact on biodiversity, and leads to pollution of air, soil, and water; as a source of litter, microplastics, and substances of high concern such as PFAS.

The Dutch packaging industry has formulated the ambition to no longer use primary fossil resources by 2050 (Verpact 2023). Based on current consumption patterns and trends, however, the demand for plastic packaging in the Netherlands is expected to increase: approximately 17% over the coming decades, from 386 kilotonnes in 2022 to 451 kilotonnes in 2050 (Spanbroek et al. 2024). This makes the ambition to reduce the amount of fossil resources to zero extremely challenging. To achieve this target, the share of plastics based on recycled materials or bio-based resources must increase significantly. Currently, 7% of plastic packaging worldwide is made from recycled material (Spanbroek et al. 2024). The share of bioplastics accounts for less than 1% of the global plastic market. Much plastic packaging still ends up in incinerators. In the Netherlands, this comprises about half of the total amount of plastic packaging (Spanbroek et al. 2024).

A lack of transparency and data makes gaining insight into the supply chain challenging

There are many different types of packaging. They vary from rigid to flexible (film) forms. Materials used are primarily polyethylene terephthalate (PET), polyethylene (PE), and polypropylene (PP), and combinations thereof, but the number of variants with different product specifications is quite extensive. Packaging also differs in terms of the quality requirements that have to be met; stricter requirements apply to food packaging while for other packaging, e.g. paint buckets or detergent bottles, the standards are less strict. Plastic packaging is produced and traded in complex, often international, trade flows involving many different actors, including manufacturers, retailers, sorters, processers, and consumers.

This complexity makes it difficult to get a good overview of material flows in the supply chain. There is a lot of information available about the amount of plastic in waste. There is also a lot of information on the system of extended producer responsibility (EPR) that is in effect for plastic packaging (EPR is aimed at organising and financing efficient waste management by the responsible producer who markets the product in the Netherlands). There is, however, limited visibility of the supply chain that falls outside the legal reporting obligation of EPR. For example, it is often unclear what happens to exported materials (Thapa et al. 2024). Better insight into material use at all steps of the supply chain is needed to develop interventions that facilitate circularity.

International market dynamics complicate the business sector's efforts towards circularity

Plastic packaging is produced and traded in international supply chains. Additionally, the Netherlands imports and exports plastic-packaged products as well as recyclable materials (recyclate). Price developments for fossil resources and recyclate all occur on the global market.

In 2024, the prices for primary fossil resources were relatively low in China and the United States. As a result, the current price for recyclate is higher than that for plastics derived from primary fossil sources. Recycling businesses in the Netherlands are therefore under immense pressure, and several recyclers have already gone bankrupt (Spanbroek et al. 2024). As a result, the supply of recyclate is at risk of shrinking, while more use of recyclate is necessary to achieve the desired reduction in the amount of primary fossil resources in the first place. The current low prices for primary resources also make it difficult for initiatives aimed at circularity in the supply chain to gain traction. Adjustments in the production, collection, and recycling of packaging requires investments that are difficult to recoup under these circumstances.

The target to have fossil-free packaging in 2050 calls for efforts by both businesses and the government
As mentioned above, the packaging industry has the ambition to no longer use primary fossil resources by 2050 (Verpact 2023). This ambition is in line with European and national developments as indicated in the National Circular Economy Programme (NPCE). It is an important objective, because it provides explicit direction towards a desired future. Plastic products and packaging will then have to be made from recyclate or sustainable bio-resources – or, in the long run, potentially of CO_2-based resources (IenW et al. 2023).

With the current design of the chain and current policy focus, the above-mentioned target is not feasible (assuming a progression of historical consumption patterns for packaging). Even when we use an optimistic scenario, in which all technical measures are being implemented that experts consider achievable within the current packaging chain, there will remain a substantial demand for primary plastic for packaging (Spanbroek et al. 2024).

To achieve the target for 2050, then, additional efforts will be required of both businesses and the national government that go beyond the technological optimalisation of the current packaging chain. To reduce the demand for primary plastic, the government can focus on phasing out packaging types based on primary resources by pricing and regulating them. Several instruments are available to do this (see below, section on 'Each circular strategy for plastic packaging has obstacles and opportunities'). The government and businesses alike can also take measures outside of the current packaging chain, such as promoting local and fresh food that needs less packaging than processed products. If the demand for primary plastic cannot be reduced with such measures as named above, then a switch can be made towards the use of alternative resources, such as plastic waste from other sectors, or biomass (Spanbroek et al. 2024).

Food safety requirements limit the use of recyclate in food packaging
The use of recyclate in food packaging is regulated by EU Directive 2022/1616. In food packaging, only the use of recycled PET is allowed, provided it has been cleaned using a prescribed technology. However, approximately three-quarters of plastic food packaging is made of other plastics (particularly polyethylene (PE) and polypropylene (PP)). Recycling techniques for these materials have not yet been assessed as 'suitable', and they are therefore not yet permitted to serve as food-safe recyclate. Consequently, the current recycling infrastructure is primarily focused on the (high-quality) recycling of PET. There is no infrastructure in place yet for producing food-safe recyclate from either PE or PP. The circular ambition to increase the use of recyclate in food packaging is therefore at odds with food safety policy.

The amount of recyclate available is also related to the manner of collection. There are many types of plastic, which are gathered together with product rests. In the case of food contact materials,

attention and targeted measures are needed to prevent unwanted substances from various packaging components (such as adhesives, inks, labels) from negatively affecting the quality of the recyclate. This includes setting specific requirements for the design and composition of packaging, increased standardisation, and improving the traceability and sorting processes so larger amounts of food-safe recyclate becomes available.

Alongside recycling, other circular strategies are also needed

In practice, most businesses in the Netherlands focus on (mechanical) recycling. Existing governmental policy is also primarily aimed at this circular strategy. As such, there are quantitative targets for recycling, there is an established infrastructure, and there is a legally established EPR system. Businesses and the government are paying less attention to other circular strategies, however (such as reducing packaging, substitution by bio-resources, and lifespan extension and reuse of packaging). Moreover, hardly any targets have been formulated in law and legislation for these other strategies.

To realise the ambition to package fully fossil-free by 2050, it is necessary to start utilising all circular strategies. This calls for a clear vision for the route towards a circular plastic packaging chain; the government can play an important role in realising this vision. With this vision, a coherent set of targets can be formulated which collectively lead to a fossil-free packaging chain by 2050. Here, it is important to get an understanding of the amounts of sustainable bio-based and recyclate which will be needed on the route towards 2050. This will help businesses to take decisions about technological developments and long-term investments.

Each circular strategy for plastic packaging has its obstacles and opportunities

The circular strategy to reduce material resource use (narrow the loop) is at odds with the growing demand for plastic packaging. Producers and retailers of products packaged in plastic are currently not interested in reducing the amount of packaging, because there are no measurable targets that guide such a reduction. To encourage the use of fewer resources, one could consider introducing a European feedstock tax on the chemical industry or passing on the existing European 'Packaging Tax' to producers, as is currently the practice in Spain, instead of deriving this from public funds as is currently the practice in the Netherlands. Another option is pricing the single use of plastic packaging, which would encourage consumers to use their own refillable packaging (see, for example, the Norwegian Tax Administration, n.d.). Finally, another option would be to look at stricter enforcement of the existing rules in the Dutch 'Decision Management Packaging' ('Besluit Beheer Verpakkingen'), which prescribe that the volume and weight of packaging must be minimised (CE Delft 2024).

Lifespan extension through the reuse of plastic packaging (slow the loop) is still in full development. This particular circular strategy calls for changes to the current system, which will require large-scale investments by businesses for e.g. reverse logistics and cleaning. Moreover, reuse also calls for changes to consumer behaviour, although it is still unclear if and under which circumstances consumers would be willing to do so. After all, reuse is hindered by the lack of a clear definition, which makes consistent monitoring difficult. Reuse of consumer packaging is, however, not uncharted territory: beer bottles made of glass are already being reused on a large scale. To promote a similar reuse of plastic packaging, the government can mandate reusable packaging for certain products. The government could also formulate a legally enforceable objective aimed at the amount of reusable packaging on the market; in Austria, for example, this objective is 25% (CE Delft

2024; RIS 2024).

Major obstacles to high-quality mechanical recycling (close the loop) are the limited quantity of high-quality recyclate, while this recyclate is also relatively expensive compared to primary fossil raw materials. These obstacles can be overcome by implementing temporary subsidies for the usage of bio-based raw materials and recyclate in packaging to finance the unprofitable margin, or by promoting products designs that encourage recyclability, for instance through a bonus-malus system (Citeo France 2013). Additionally, the waste levy for PMD waste (Plastic, Metals, and Drink cartons) can be increased, allowing the sorting of plastic packaging to better compete with incineration. Consideration can also be given to a packaging tax with different rates for packaging made from virgin plastics, recyclate, and bio-based materials (CE Delft 2024).

Chemical recycling technologies are still in a relatively early stage of development. There is still much debate about the (potential) advantages and disadvantages of chemical recycling. Various chemical technologies exist with different efficiencies, environmental impacts, and inputs streams, some of which compete with mechanical recycling streams, such as PET. As of yet, there is no clear, collective framework for determining which mechanical and chemical recycling technologies are (potentially) most suitable for which kinds of packaging. Such a framework is necessary to provide clarity for supply chain parties and to create opportunity for innovations that go beyond optimising the current infrastructure, which is mainly geared towards mechanical recycling (Spanbroek et al. 2024).

The substitution of fossil raw materials by bio-based materials is already on the radar for both companies and policymakers. Various actors, however, such as governments, businesses, and societal organisations, are hesitant to invest in bioplastics due to doubts about the recyclability and the environmental benefits of biodegradable packaging (Spanbroek et al. 2024). To alleviate concerns about the sustainability of bio-based plastics, the government can formulate and promote clear sustainability criteria for bio-based plastics, for example by making government support available only for bio-based applications that achieve a defined reduction in climate impact compared to fossil plastics (SER 2020; CE Delft 2024).

The challenge to expand producer responsibility to chain responsibility
Currently, agreements with producers regarding their responsibility after a product is discarded (extended producer responsibility, or EPR) play a significant role in circular strategies within the packaging product group. The challenge is to assign responsibilities across the entire supply chain, not just to the producer. This could be achieved by making chain agreements incorporating more general circular principles, through EPR or in product regulations. Attention is needed for the rule of thumb in applying circular strategies from 'top to bottom': first focus on 'no or less packaging' or less packaging material per unit of product, then on reusable packaging, followed by retaining material within the chain, and only then on (lower-quality) recycling outside the chain. Targeted enforcement is also necessary for the obligation to actively share information and data (transparency) within the chain, designing with safe substances aimed at a long lifespan and complete recyclability, and implementing quantitative standards for the maximum weight of packaging per product-packaging combination.

4.3.3 Product group: renewable energy technologies

The Netherlands has a legally established target of becoming climate-neutral by 2050. Reaching this target requires a transition towards using renewable energy technologies such as wind

turbines, solar panels, and large batteries for mobility. For the production of these technologies, large quantities of materials, metals, and critical raw materials will be needed over the coming decades. Without policy interventions, the use of primary materials in wind turbines, solar panels, and large batteries could increase in the coming decades by a factor of 3 (De Koning et al. 2024). This growing material demand is at odds with the circular ambitions for 2030 and 2050. Moreover, harmful substances are used in the production of renewable energy technologies, harmful both to people and the environment, including lead and PFAS in solar panels and, depending on the type of battery, heavy metals like cobalt. Circular measures can help reduce material use and material loss with the expansion of the renewable energy system by 19-38% relative to current trends. The annual needed amount of critical and strategic raw materials can, then, decrease by at least 54% relative to the current trend (De Koning et al. 2024).

Attention for circular strategies differs per technology

The role that circular strategies play in the design, production, and use of wind turbines, solar panels, and batteries differs per technology.

Wind turbines have so far been assembled and constructed in such a way that makes them only moderately suitable for recycling. For example, turbine blades are made of composite materials. Recycling composites is so complex and expensive that it is currently not profitable. Removing the foundations of wind turbines causes so much underground damage that they are often left in place. Other parts, such as the towers and components from the generator, are processed by recyclers in the current market. However, wind turbines are not a primary focus for these recyclers, resulting in relatively little investment in capacity to properly process wind turbines. Without government guidance, there is a chance that there will be no infrastructure available to recycle the growing amount of wind turbines that will be decommissioned in the coming decades.

Circular strategies, such as extending lifespan through reuse, are still receiving relatively little attention, but could help to spread the peak of decommissioned wind turbines that is expected around the year 2050. The wind power sector is currently heavily driven by procurement policies that mostly focus on achieving the highest possible energy production at the lowest cost. This encourages the replacement of wind turbines before their technical lifespan is even over, with more energy-efficient, often larger, models. If procurement policies take material efficiency into account alongside energy efficiency, wind turbines could last much longer. The first tender incorporating circular criteria (to some extent) was issued recently, but in other tenders, stakeholders do not see circularity as a guiding factor (Elzinga 2024). Additionally, the current 20-25 years permits for onshore wind farms make it unattractive to invest in extending the lifespan of the turbines (through maintenance and repair) beyond the permitted years. Extending the number of permitted years, then, could increase interest in lifespan extension (Ecorys 2024).

In the case of **solar panels**, product innovations are primarily aimed at improving energy efficiency, with circularity currently hardly taken into consideration. The majority of solar panels produced abroad are difficult to recycle because of the way they are constructed. There are various innovative developments ongoing in the Netherlands, such as trying to design the panel differently, or using PFAS-free and recyclable materials. For these businesses it is difficult to compete with cheaper solar panels coming from China, however. Other Dutch actors consider recycling an important strategy to make solar panels more circular, but they indicate to have little influence on their design and production. Moreover, the volume of decommissioned solar panels is not (yet) big enough to enable profitable recycling. To improve the circularity of newly produced solar panels, the existing

public buyer group (the Dutch national government, provinces, and municipalities) could set up a more guiding collective procurement strategy with strict circularity criteria (RIVM 2022; Ecorys 2024). Repair and therefore lifespan extension of solar panels is almost never economically profitable, as their design is not aimed at repairability. Replacement by a new model with a better energy performance is therefore often more attractive, from an economic point of view.

For **large batteries**, the most important driving force for recycling and reuse is the European Battery Directive (launched in 2006, updated in 2023), which stipulates that producers have to collect and process all batteries brought on the market.

The Netherlands has a very good recycling and collection system, yet large batteries are hardly being recycled domestically at the moment. Recycling is, in practice, not profitable, because of the great variation in design, chemistry, and construction of batteries by different manufacturers, and because detailed information about used materials and components in most batteries is currently missing. Standardisation of battery components, encouraging modular design, and the introduction of material passports could be potentially very effective ways of simplifying the recycling process (Ecorys 2024).

Even reuse of batteries hardly takes place as of yet, because the differences between batteries complicate renovation and repurposing, and because producers of batteries are worried about their potential liability when a battery causes damage upon reuse. A (European-wide and harmonised) regulatory framework that clearly defines ownership, warranty obligations, and liability can encourage manufacturers to reuse batteries more often, as it would remove uncertainty and could provide legal protection (Ecorys 2024). The EU has the objective to become self-sufficient in battery production. The Netherlands and Europe are, however, fiercely dependent on the import of batteries and material resources, particularly from China (De Koning et al. 2024).

A future-proof energy system calls for the use of circular strategies

Parties working on the creation of the renewable energy system in the Netherlands and Europe are worried about the future-proofing of this system (De Koning et al. 2024). For the growth and maintenance of this system, the Netherlands and Europe as a whole are currently extremely dependent on a limited number of foreign countries, including China. Geopolitical shifts can complicate and even endanger the supply of strategic and critical raw materials, as recent developments in Ukraine and the Middle East have demonstrated.

To reduce supply risks, various strategies can be implemented, as is also suggested in the European Critical Raw Materials Act (EC 2023). As such, we can focus on mining (critical) raw materials in the Netherlands and Europe itself. Additionally, supply chains can be diversified by new strategic partnership with different resource-rich countries, as was recently done with Australia (EC 2024). Moreover, circular strategies, such as high-grade (closed loop) recycling of critical raw materials, can play an important role in minimising supply risks. Here, we need to think strategically about the integration between recycling and production locations. Recycling metals from energy technologies will only lead to a reduced dependency on other countries; meanwhile, not only is there sufficient recycling capacity being established in Europe, but enough capacity exists to reapply these materials in the production of renewable energy technologies.

A strategic vision is needed on circularity for the realisation of the energy transition

Up until now, governments and businesses have more attention for reaching the climate targets and the energy transition than for the transition to a circular economy. As a result, product innovations are primarily aimed at improving the energy efficiency of renewable technologies and not at more efficient material use. The replacement of older by newer, more energy-efficient renewable technologies results in a rapid build-up of installed capacity, with little focus on lifespan extension.

To prevent undesirable trade-offs and create synergies between the energy and circular economy transitions, a clear strategic vision is necessary so that circularity can play an important role in realising the energy transition. Circularity can, after all, play a role in reducing supply risks and guaranteeing the future-proofing of the Dutch and European energy system. Here, the Dutch national government plays a guiding and, equally crucial, coordinating role to enable and encourage collaboration between businesses (Ecorys 2024).

Long-term circularity calls for action now
Wind turbines, solar panels, and batteries have relatively long lifespans. As such, the effects of focusing on circular strategies will only be visible in the long term, often only after several decades. This means that the urgency to implement circular measures in the short term is not always felt. For example, only a limited number of wind turbines, solar panels, and batteries are being decommissioned at the moment, resulting in rather limited investments are made to create a recycling infrastructure for these renewable technologies.

By 2050, it is the expectation that material outflows will be 2,000-3,000 times greater than they are now (De Koning et al. 2024). To process this outflow, it is necessary to begin building recycling capacity in the short term, especially for critical raw materials. Additionally, the design of wind turbines, solar panels, and batteries should take recyclability at the end of their lifespan into account (De Koning et al. 2024), and measures to extend their lifespan should be taken. Although many of these actions will only have noticeable effects in decades to come, they are needed *now* to avoid missing out on opportunities to accelerate the circular economy transition and to create synergy between this transition and the energy transition. Given the anticipated growth in demand for wind turbines, solar panels, and batteries in the coming years, attention to circularity is urgent now.

4.3.4 Overarching insights from the product group analyses

Finally, we want to draw several conclusions and lessons from the three product analyses provided here for plastic packaging, housing construction, and renewable energy technologies.

Without additional policy, material resource use will increase in all three product groups
Assuming a continuation of current production and consumption trends, as well as current policies, material resource use in all three product groups will sharply increase over the coming decades. For example, the demand for plastic packaging will increase by 17% up to 2050 (Spanbroek et al. 2024). Additionally, the Netherlands is expected to have 4 times as many wind turbines, 11 times as many solar panels, and 38 times as many batteries by 2050 relative to 2024; in this case, a factor of 1.5-3 times more primary raw materials will be needed by 2050 than we currently need (De Koning et al. 2024). Moreover, realising extra houses and improving the sustainability of existing houses will require extra material resources as well. Particularly in the case of new construction, the necessary inflow of material resources will be much greater than the outflow of resources via demolition (Bletsis et al. 2024).

The extraction of the needed primary raw materials and their processing into materials, half-finished products, and fully finished products, leads to negative effects on health, the environment, nature, and landscapes. The necessity to procure material resources from other countries will also rise, which further increases the Netherlands' dependence on import (including the associated supply risks).

Opportunities to link circularity to other challenges remain underutilised

In practice, the circular economy transition receives little attention from politicians, governments, and businesses compared to other societal challenges, such as the housing crisis and the mitigation of climate change. As a result, opportunities are missed to connect circularity with other societal challenges. For instance, the emphasis on developing a more sustainable energy network is primarily focused on quickly building capacity at the lowest possible cost. There is little focus on efficient material use and on designing renewable energy technologies in such a way that they are suitable for reuse and recycling. Furthermore, additional housing is mostly achieved through the construction of new homes rather than by renovating existing buildings, such as adding stories or splitting homes, which require a far smaller use of materials.

This lack of attention for circularity is undesirable, not only considering the circular ambitions, but also with regard to other societal challenges. The implementation of circular strategies can potentially lead to reduced greenhouse gas emissions, lower impact on biodiversity, less environmental pollution, and lower supply risks. Given the large, long-term investments in housing and renewable energy technologies planned for the coming years, it is crucial to connect circularity to other societal challenges now to prevent the waste of valuable material resources both now and in the future (Rood & Van Hoorn 2024).

To scale up the transition, attention is needed for all circular strategies

For all three product groups discussed in this ICER, recycling remains the dominant circular strategy applied by governments and businesses alike. A large part of recycling results in secondary material of lesser quality and monetary value than primary material (low-quality recycling). More high-quality recycling, where the secondary material has the same quality as the original (new or primary) material, can significantly contribute to accelerating the circular economy transition.

A focus exclusively on recycling is not sufficient to realise a circular economy, however. Without substantial changes in the demand for materials, the potential for recycling will remain insufficient to reach full circularity. At the moment, approximately 7% of the amount of used plastic packaging is actually comprised of recyclate. More high-quality recycling would drastically reduce the demand for virgin materials, but with a continuation of current consumption trends, there will be insufficient suitable recyclate to meet the growing demand for plastic packaging. Using other circular strategies, such as the substitution of fossil resources by bio-based resources, or a lower material resource use, are also needed to realise a true circular economy.

Societal parties are missing a guiding long-term vision

In all three product groups, what is missing is a clear, long-term vision on what a circular future could look like, shared by both governments and businesses. Lacking such a vision, businesses are mostly applying circular strategies they are already familiar with. Moreover, it is not very attractive for businesses to invest in innovative circular solutions that go beyond optimising existing processes and products (Hanemaaijer et al. 2023). As such, entrepreneurs tend to take CO_2

reduction as a proxy for circularity in their management practices. Additionally, there is no clear vision for the optimum housing stock. As such, nearly half of planned houses until 2030 are new, single-family homes, for which there is high demand in the current market. Facilitating the transition of small households (senior, single individuals) from single-family homes to smaller dwellings can potentially save a lot of materials and thus reduce impact (Copper8 2024). Additionally, there is no shared vision (yet) on what a circular plastic packaging chain could look like in 2050. As such, chain parties are mostly focused on mechanical recycling (as it is existing policy) and hardly on other circular strategies like the use of bioplastics or the reuse of packaging. Finally, the lack of a strategic vision on the role of circularity in the energy transition means that entrepreneurs are not taking circular strategies into account when designing and exploiting wind turbines and solar panels; nor are they being encouraged to do so by existing permitting and procurement policies. Attention for circularity is therefore mostly limited to mechanical recycling, while other circular strategies such as lifespan extension and reuse can also deliver an important contribution to a reduced and more efficient material resource use.

There is a lack of trustworthy information in the chain, which hinders the CE-transition

In the current production and consumption chain, transparent, accurate, and trustworthy data about material flows are still missing. To reuse, repair, and recycle products and materials, accurate and trustworthy information is needed about these products and materials; such information is crucial to determine quality and safety when reusing batteries, for example. For producers of plastic packaging, accurate data about recyclate are also a requirement to get and give guarantees about the quality of recyclate. That way, businesses can better inform their customers about the properties of the material and the products, and therefore avoid liability or accusations of 'greenwashing', and thus preventing reputational damage (see also De Krom & Prins 2019).

Because there are still few (legal) standards available, nor is there uniform certification, it is difficult for circular companies to obtain and provide warranties. The European 'Right to Repair' directive and the development of digital product passports, which record relevant information about products, can both play an important role in ensuring transparent and reliable data in the supply chain in the long run. Until then, quality specifications for e.g. recyclate and the reuse of parts can be implemented by or in cooperation with the actors involved in the supply chain.

5 Policy, instruments, and governance to accelerate the CE-transition

Key takeaways:

- The National Circular Economy Programme (NPCE) 2023-2030 forms an important basis for Dutch circular economy policy. It contains, among other things, a framework for targets, a selection of priority product groups, and proposals for policy instruments. Up until now, the implementation of this policy programme has been limited, however. Indeed, there are no new established quantitative targets for the circular economy. There have been explorations for more binding policy over the past two years, but additional standardisation and pricing instruments are yet to be formulated.
- At the EU level, there are several binding agreements which are very important for a circular Netherlands and which the Netherlands itself has advocated for. These EU-wide agreements are levelling the playing field for businesses. Innovative Dutch circular businesses can profit from this. This way, the Ecodesign Regulation can set requirements for recyclability, reusability, and lifespan extension of products, for example. This regulation also makes it possible to prescribe a minimum share of recyclate in products and to prohibit the use of hazardous substances. Another example is the Right to Repair directive, which mandates sellers to repair defective devices within a reasonable timeframe and at a reasonable price if the customer requests it.
- In the NPCE, policymakers have high hopes for extended producer responsibility (EPR) and circular procurement by governments. Here, it is useful if they also set requirements that go further than the existing ones for collection and recycling. The requirements for EPR and circular procurement should also be aimed at reuse, use of recyclate, and reduced material resource use. By periodically tightening these requirements, innovation can be promoted, and environmental profit can be encouraged.
- Significant environmental gain can be made with the proposed and scheduled policy instruments in the NPCE. The total annual global environmental profit from the 55 measures in the NPCE is estimated at 4-7 megatonnes CO_2-equivalents in 2030. This depends on the further elaboration and implementation of these policy instruments, however. The biggest potential climate effects are expected of lifespan extension of products, and of circular procurement and tendering in ground, road, and hydraulic engineering.
- There are additional policy options with great potential environmental effects, such as an operational subsidy for circular measures, a European standard for sustainable carbon in the chemical industry, and a plant-based protein standard for supermarkets.
- Innovative circular businesses can play an important role in accelerating the CE-transition. This will require laws and legislation which would level the playing field, create the availability of financing for circular business models, ensure a bigger demand for circular products, and generate more circular consumption behaviour. Moreover, with an eye to

access new technologies and chain partners, it is necessary that the knowledge infrastructure for innovative circular activity is improved.
- To accelerate the CE-transition, collaboration is needed between different ministries, decentralised governments, businesses, and societal organisations. The consultation structure built up between these parties in recent years is valuable for establishing broadly supported agreements. However, accelerating the transition now requires stronger direction. The Dutch national government can achieve this by assigning roles and responsibilities and overseeing them.

5.1 Introduction

The Dutch government has the ambition to realise a circular economy by 2050. Since 2023, the publication of the previous ICER, various steps have been made towards circularity. For example, several noticeable measures have been taken against litter by introducing deposits on small bottles and cans. There have also been less noticeable measures, such as the further expansion of extended producer responsibility (EPR) for the lifespan extension of products.

In May 2024, a so-called Special Government Representative was appointed the task to further promote the circular economy. Simultaneously, there are trends that negatively impact circular material resource use, such as fast fashion and non-recyclable electronics within which are stored critical raw materials. New plastic is so cheap that recycled materials are disappearing from the market. The reality is that there is very little noticeable change in material resource streams (see also Chapter 3). As mentioned in the NPCE, an acceleration of the CE-transition is now becoming essential.

In this chapter, we therefore pay extra attention to the governance of the circular economy. Are there points of leverage for policy to accelerate the transition to a circular Netherlands using policy instruments and associated governance? The key processes from the MIS framework (Mission-driven Innovation System; see Chapter 4) provide an overarching view of the direction of the transition. In line with the previous ICER (2023), we also use four transition phases to indicate the pace: pre-development; start-up; acceleration; and stabilisation (Hanemaaijer et al. 2023, based on Bode et al. 2019; Hekkert et al. 2007; and Hekkert et al. 2020).

Some sectors and product groups are further along in the transition than others. While the circular transition for packaging materials like paper, glass, and metal is already well underway, for example, the transition is in its infancy in the case of electronic devices. The next phase of the transition requires governance and policy instruments that provide a clear direction for change. It is also important that they contribute to market formation and overcome resistance from the linear economy. Identifying and encouraging positive developments in society, and building on that creativity and associated momentum, is crucial (Allen & Malekpour 2023).

In this chapter, in section 5.2, we first outline the current situation. We examine the development of the vision for a circular Netherlands and the formulation of clear policy targets. We also map out how the transition to a circular economy is being governed and we consider how the ambition to achieve such an economy relates to other policy areas, such as climate policy. Then, in section 5.3, we discuss the policy instruments that have already been used in the Netherlands, Europe, and the region to promote a circular economy. In section 5.4, we explore what can be learned from

innovative circular businesses to accelerate the transition. Then, in section 5.5, we analyse which policy instruments can accelerate the transition and what effects can be expected from them. We conclude this chapter with a brief reflection on whether there is already acceleration in certain parts of the transition and what possible tools could be used to further realise this acceleration.

5.2 General overview of current policy

In the National Circular Economy Programme (NPCE) 2023-2030, the Dutch national government indicates its intention to accelerate and scale up the transition to a circular economy 'through more intensive policy, concrete targets for specific product groups such as furniture and textiles, and guiding measures' (IenW et al. 2023). The NPCE includes a framework for national circular targets and their intended effects. There are also targets for specific product groups, such as electrical appliances and plastic packaging. Additionally, it contains proposals for more binding policies, such as a required percentage of recycled material in products. The NPCE is thus an important step in the CE-transition, as it helps to develop concrete action options.

Now, it is important that the NPCE is further developed and implemented by, for example, establishing an approach towards circularity per product group. Such an approach should, in any case, contain concrete targets, as well as an overview of the intended efforts of involved parties and a distribution of roles and responsibilities.

The transition to a circular economy is underway

When considering the four transition phases named above, the Dutch transition to a circular economy has already passed the pre-development phase. In the overarching view that we mapped out using the MIS framework in Chapter 4 of this ICER, it is evident that a knowledge base has already been established and that there is growing societal attention for material resources. To really speak of an acceleration phase, development should be visible in each of the four acceleration characteristics: a clear direction for change, market formation, institutionalisation, and some resistance from established parties and consumers against phasing out linear practices.

The goal to become fully circular by 2050 as upheld by the Dutch national government, alongside the EU Circular Economy Action Plan, provide a framework to guide change (EC 2015). It remains the question, however, whether this circular 'mission' is supported by all parties involved, from policymakers to consumers and producers, and whether they can agree about the next steps towards 2050 (see paragraph 5.2.1).

There is a certain degree of circular activity in the Netherlands, as is evident by market formation. It remains limited, however, as it has only constituted 4-5% of total GDP for more than 20 years (see Chapter 4; Versnellingshuis 2024). The higher cost of circular products and convenience are contributing to consumer hesitation towards behaving more circularly. Hence, the market growth of circular businesses stagnates (MVO 2024).

Once policy instruments proposed in the NPCE are established, institutionalisation – formulating the rules for a circular economy and allocating mandates and resources – will become more defined. For example, when the deposit scheme on cans and small bottles was first introduced in the Netherlands, there was notable resistance from, first, producers and supermarkets, and then from consumers as well (Theelen & Maathuis 2023). This measure has, however, led to visibly less

litter, as 91% of consumers say they sometimes return their purchased cans (Conradie, Driessen & Van Huizen 2024; Rijkswaterstaat 2024).

5.2.1 Vision and targets

To engage citizens and businesses with the transition to a circular economy, a clear and widely supported vision on what this means is essential. It has to be clear which targets are being pursued and a clear, shared vision among all involved parties helps to give direction to the transition. As such, concrete, quantitative targets help to indicate the intended pace of the transition.

As of yet, there is no shared vision on what a circular economy means

The NPCE has the ambition to make the Netherlands fully circular by 2050. By that time, material resources will no longer be wasted, and the economy will generate as little waste as possible. Fully circular, in this case, means that the environmental effects of material resource use generated by Dutch consumption and production fall within the 'planetary boundaries' (IenW et al. 2023). This image of a future Dutch economy that fully fits within planetary boundaries is a concrete implementation of the NPCE vision. It is therefore the challenge to meaningfully translate the planetary boundaries to Dutch material resource use.

This is complex, since these boundaries have to be translated into the Dutch national borders. Additionally, environmental effects stem from a wide range of products and activities, and these effects can vary significantly between different resources. Translating this into kilotonnes of material resources provides insight into the scale of usage but not necessarily into the environmental effects (Hanemaaijer & Kishna 2023; IenW et al. 2023). This means that, while the sum of the weight of used resources can be used to convey the urgency of the problem, is it less suitable for guiding policy.

The NPCE states that, by 2050, 'companies will produce products that last longer, and consumers will find it a challenge to use their belongings for as long as possible. This has been achieved because governments have changed the rules, for example by setting requirements for product design and by legally mandating the pricing of environmental damage'. Formulating this perspective does not yet mean, however, that there is a widely shared vision in society. Are the guiding principles and the direction of the intended change clear enough, and are they shared? What do companies, citizens, and governments agree on, and where do they still disagree? Additionally, it is necessary to further develop the vision into concrete targets and policy instruments to achieve them.

Experiences by pioneers in the field can help set quantitative circular targets

In the NPCE 2023-2030, the Ministry of Infrastructure and Water Management (IenW) has formulated a framework with national circular targets for 2030. The framework follows the different circular strategies:

- Reducing material resource use in the chain for production and consumption;
- Striving for a maximum extension of the lifespan of products;
- Raising the share of secondary and sustainable bio-based material resources and alternatives with lower environmental impacts;
- High-quality recycling on an equal level as the original material.

Waste targets can help prevent the waste of material resources

There are several quantitative waste targets included in the Dutch National Waste Management Plan 3. These include the target to reduce the amount of residual waste by households to 100 kilos per resident in 2020, followed by 30 kilos per resident in 2025, and the target to halve the amount of incinerated and landfilled Dutch waste. In practice, the current targets for residual waste seem to motivate governmental waste policy. Many municipalities took the target of 100 kilos per resident as a starting point. The halving target for landfilling and incinerating between 2013 and 2023, on the other hand, has hardly generated any effect. Now, most of these targets are expired or have not been achieved (Hanemaaijer et al. 2023).

It is useful to determine whether and which waste targets can contribute to the ambition that material resources should not be needlessly wasted and that as little waste as possible is generated in the first place. The Dutch government has introduced the so-called Implementation Programme for VANG-Household Waste (VANG is an acronym for 'Van Afval Naar Grondstof', meaning 'From Waste to Resource'), an initiative to reduce waste, and increase the recycling and recovery of resources. With this programme, the Dutch government has chosen, alongside prevention, for increased and better recycling of valuable material resources, leading up to 65% by 2035. One obstacle here is that separated waste streams need to achieve better quality for the stream to be recycled at a high quality. This will then automatically lead to less residual waste to incinerate. This remains a high-risk approach, however, since it gives no guarantee that less waste will actually be incinerated.

This could be achieved by, for example, including a goal for less landfilling and incineration of waste in the Dutch Circular Materials Plan, which is the successor to the National Waste Management Plan 3 mentioned above. Continuous governance on preventing the outflow of resources via landfilling and incineration of waste forms a logical part of a set of circular targets (Hanemaaijer et al. 2023; Hanemaaijer & Kishna 2023). Here, we do need to take into account the fact that, even after high-quality recycling, a portion of the material will remain as residue, which will then still have to be landfilled or incinerated.

This framework of targets will, in the long run, replace the existing national target of halving the amount of primary abiotic material resources by 2030. This target was formulated in 2016, as part of the government-wide Programme Circular Economy (Rijksoverheid 2016). Many of the targets included in the NPCE for 2030 are still qualitative, with the intention to be further developed in 2023 and established in 2024 (IenW et al. 2023). This qualitative implementation is necessary to accelerate the transition.

The Ministry of Infrastructure and Water Management has begun developing the target trajectory. This will involve speaking to numerous parties in order to arrive at a fully developed and elaborated set of national circular targets. This process has been delayed, however, which means the full formulation of the new quantitative targets has shifted to 2025. Considering that the current qualitative targets in the NPCE have little transformative power, it is urgent that targets be quantified, especially given the short time left between 2025 and 2030.

Alongside establishing national targets, it is also necessary to make quantitative targets for the various product groups. Here, it will sometimes be necessary to set specific targets per product group and make different agreements, as there are differences between parties involved per product chain. There are also differences between the possibilities for reduced material use, reuse, and recycling between the various product groups.

An agreement should also be made concerning whose responsibility it is to collect information about the progress of the different product groups. One approach is that this responsibility should lie with the primary responsible ministries for the groups, with coordination by IenW to harmonise this process and make the information comparable. But an alternative approach is possible.

One way to establish achievable and ambitious targets for product groups is by learning from the experiences of existing innovative circular companies. These leading companies and their current performance can serve as an example to establish achievable and ambitious targets that will apply to the entire sector in a few years. By indicating upfront that periodic tightening of targets will take place – in other words, by setting dynamic targets – the direction and procedure are clear to all parties from the start. These types of dynamic targets can play an ongoing role in stimulating innovation. They can also provide an incentive to increasingly reduce the use of primary material resources, enhance recycling, improve product design, and extend product lifespan. To realise these targets, additional policy instruments are needed (see section 5.5).

A product-specific approach is useful and calls for expansion

Dutch national policy for a circular economy specifically focuses on five domains, also known as the transition themes. These include construction; consumer goods; the manufacturing industry; plastics; biomass and food. The NPCE provides an overview of priority product groups for each transition theme, such as electrical appliances, housing, and plastic packaging (IenW et al. 2023; see also Chapter 4). The selected product groups within the transition themes are generally relevant because of their material resource usage, waste volume, land use, and impact on biodiversity and climate change (Hanemaaijer & Kishna 2023).

Noticeable in the NPCE is that, for the selected product groups within the theme of the manufacturing industry, there is a strong focus on renewable energy technologies. These product groups are particularly relevant because of the supply risks of critical raw materials, but they only partially cover the environmental impact of the entire manufacturing industry. Therefore, in the progress letter of the Dutch National Raw Materials Strategy, the product groups base metals, electrolysers, and batteries have been added as priority product groups (EZK 2023). Some other groups, which are relevant to the environmental impact generated by the manufacturing industry, have yet to be included, such as chemical products and means of transport.

The NPCE indicates that further research will be done into the possibility of establishing additional transition themes for healthcare and mobility, which will lead to the identification of additional priority product groups. This is relevant because of the material resource usage of these product groups and the associated effects in production chains. For instance, the production of transport means like cars requires a lot of steel, aluminium, and plastics. Without additional policy, the number of cars and their weight are only expected to continue to grow (SNM 2024).

Furthermore, it is noticeable that the NPCE does not include any proposals for priority product groups within the transition theme of biomass and food. Indeed, there are no targets for bio-based resources and routes to reach these targets in the NPCE. This is a shortcoming since biotic resource use significantly contributes to global biodiversity loss. The substitution of abiotic resources by bio-based resources is one of the possibilities the NPCE suggests reducing the amount of new material resources (Hanemaajier et al. 2023).

The priority product groups identified in the NPCE so far are relevant, but there are desirable additions, especially to tackle a larger share of the environmental effects and supply risks that go paired with material resource use. It is the challenge to identify a set of product groups that reasonably encompasses the intended effects, and which are simultaneously manageable in number for policymakers and politicians.

5.2.2 Governance of the transition

The Dutch national government is responsible for the transition to a circular economy when it comes to policy. The State Secretary of the Ministry for Infrastructure and Water Management (IenW) is the coordinating minister in this regard. The government provides direction for the transition in coordination with a large number of other societal parties. For example, the business sector is a natural and important conversation partner concerning the economy. On the road towards a circular Netherlands, the government has high hopes for companies that produce innovative products and services that are seen as 'frontrunners' or 'pioneers' in the transition. The NPCE states that the transition has now entered the phase where policy will also focus on the large majority of (still) linear businesses, nicknamed the 'peloton'.

Innovative circular businesses play a leading role in accelerating the Dutch CE-transition
As the transition moves towards its acceleration phase, the NPCE envisions a significant role for innovative circular businesses. They have to provide direction and demonstrate the possibilities (IenW et al. 2023, p. 156). The NPCE also states that it is now crucial to accelerate the 'peloton' and prevent them from slowing down the transition. Also referred to as the 'change theory', how this will be implemented is less well-developed in the NPCE than the roles they describe for the pioneers.

The theory of transitions suggests that transitions start small with a few good examples, thereby initiating larger change in the established order. This involves a new relationship between the government, citizens, and businesses (ROB 2012; NSOB 2014). Instead of a government directing processes top-down, the emphasis has shifted over the past decade towards harnessing the energy of innovative companies and citizens to address societal challenges. According to transition thinking, scaling up means companies grow from small startups to a point where circular activity becomes the norm – even for competitors, consumers, and the government.

There are different levels at which an innovative business and its activities can be developed:

- **Scaling up:** Companies or business activities in the scaling-up phase grow in size.
- **Scaling out:** Scaling occurs for an entire sector. Innovation is adopted by other players in the sector, resulting in multiplication or quantitative growth.
- **Scaling deep:** When the activities of a circular company become the norm. Innovation replaces the traditional, linear alternative, creating a new normal.

These scales indicate the varying degrees of a transition. In a successful transition to a circular society, circular products and services are fully integrated into society itself, its practices, and its norms. Ultimately, the goal is to scale deep (whether through scaling up and out, but this is not the only way) (Moore, Riddell & Vocisano 2015; RHDHV 2024). This does not happen automatically, however. The NPCE governance model places high expectations on a relatively small group of companies that themselves only represent a small part of the current Dutch economy. Scaling deep

can only be achieved if consumers, financiers, knowledge institutes, and especially the government actively participate in governance and collectively create the right conditions (see also section 5.4).

The role of covenants changes after the start-up phase

One type of governance that comes up often in a circular transition is the use of covenants. A covenant is a voluntary agreement through which the signing companies in a sector aim, in this case, for increased circularity. These covenants can be initiated either by the government or by the companies themselves. Examples of Dutch covenants include the so-called Plastic Pact and the Concrete Agreement, which have demonstrated that covenants can be useful for initiating change, as it brings companies together and helps them formulate and pursue a common goal. They also allow for the exchange of experiences and provide an incentive for making progress.

There is the risk, however, that smaller businesses remain out of view, even if they are particularly innovative. Progress can also be hindered by conflicting interests among participants. Although most covenants involve monitoring progress, it is difficult to keep track of data that is anonymised for competition reasons. Without positive incentives, participating companies may adopt a wait-and-see attitude instead of innovating and sharing knowledge and data (Bours et al. 2023).

In 2023 and 2024, many Dutch covenants expired. Several of them have resulted in the formulation of objectives or targets in law and legislation. For example, the so-called Mattress Agreement has led to a generally binding declaration (GBD) which made voluntary agreements binding for the entire product chain. Not all covenants have an immediate and concrete impact on policy, however; another outcome can be increased awareness or a follow-up covenant. A recent covenant, Clean and Emission-Free Construction, was established with continued support from the Concrete Agreement. For new covenants, it is important that the signatories learn from previous experiences if they want to achieve acceleration and not delay in the respective product chain. It is crucial, moreover, to form a diverse and inclusive group of participating parties (Bours et al. 2023).

Beyond the start-up phase of the CE-transition, however, a different form of governance seems more suitable than covenants. A transition broker (see also section 5.3.3), a figure that made a significant difference in earlier covenants, can play a role in the acceleration phase with the right authority and appropriate resources. They can act as a central figure, bringing and keeping the right parties together. This broker is responsible for jointly determining the direction of change among a large number of parties and investigating where resistance from various actors comes from. A successful transition broker also ensures that what is necessary to accelerate actually happens, and they hold parties accountable for their responsibilities.

Transition teams are a bridge between the pioneers and the peloton

In the Dutch circular transition, a special role has been set aside for transition teams. The government-wide Programme Circular Economy of 2016 established five priority sectors: construction; consumption goods; plastics; biomass and food; and the manufacturing industry. Overall, these sectors are important for the Dutch economy, link with the priorities of the European Commission, and have production chains with a high environmental impact (Rijksoverheid 2016).

Five transition teams have made so-called transition agendas for these five sectors. Actors from these sectors are involved in a personal capacity. In this role, they provide both solicited and unsolicited advice to the government. In addition to supply chain actors, members of implementing agencies, ministries, and societal organisations also participate. One of the five teams has now

been disbanded, however: the Ministry of Agriculture, Nature and Food Quality (LNV, now LVVN in Dutch) has taken over the transition of biomass and food.

As stated in the ICER 2023, this Ministry focused on circular agriculture. Other relevant aspects are therefore not automatically included but are still relevant to the transition agenda on biomass and food, such as the protein transition and the role of farmers as suppliers of bio-based materials. It is still unknown what the new Ministry of LVVN will focus on.

The other transition teams are all still active and work in their sector by providing solicited and unsolicited advice to politicians and policymakers. Over the next few years, potentially more product groups will be included and then more transition teams will be founded, such as for healthcare and mobility (IenW et al. 2023).

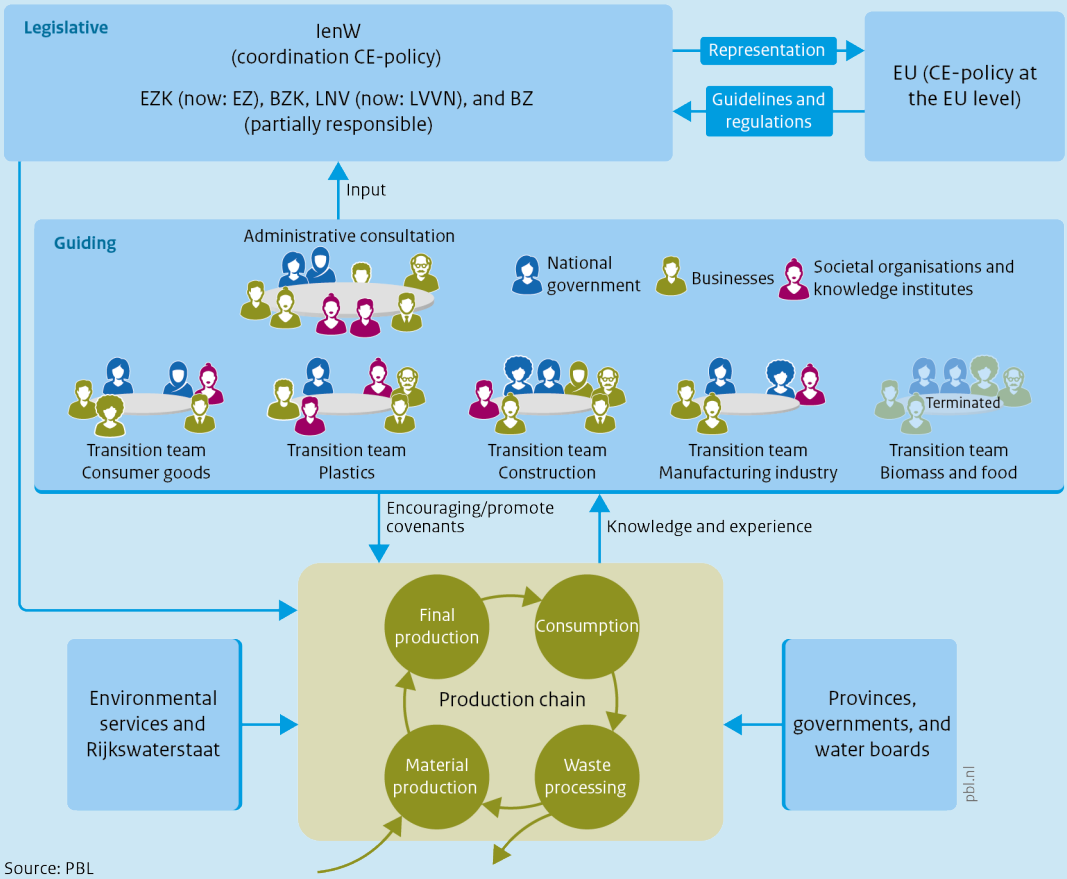
Up until 2023, transition teams had the task of finding new pioneers and involving them with circular economy policy. From 2023 onwards, the NPCE attributes a new important task to these teams: to consider, per product group, whether the focus can shift from pioneer to peloton. In other words, from leading companies to the rest of the sector. Even though the chairpersons of the transition teams requested more resources and advisory rights for new legislation and regulations, as recorded in a letter to the coordinating officials of 2022, this was not included in the NPCE 2023-2030 (Rakhorst et al. 2022; IenW et al. 2023).

In 2024, the four transition teams reiterated what they need to further advance the CE-transition. First, they are asking for more resources to capitalise on the opportunities that circularity offers for broad prosperity and improved competitiveness. Secondly, the teams request explicit attention in the formation of the new coalition agreement for linking the circular and climate transitions (Gruis et al. 2024).

Currently, the governance of the CE-transition encourages non-commitment, safeguarding consensus, and fostering anticipation (NSOB 2022). The actors involved in the transition teams are motivated to contribute to the circular transition and, indeed, a continued role for them is envisioned in the policy. If the goal is to accelerate, however, adjustments to governance will be necessary. Additionally, acceleration also requires legislation and regulations that involve entire sectors in the transition, including companies that are not part of any transition team.

Figure 5.1

Governance model according to the National Circular Economy Programme 2023-2030



Source: PBL

To accelerate, clear, binding agreements are needed in the governance model

Figure 5.1 above shows an overview of the current governance of the circular transition in the Netherlands. It demonstrates which actors influence the production chains and how they are connected. Central to the NPCE vision are the transition teams, in which governments, businesses, and societal organisations come together to establish the direction and acceleration of the transition for the various product groups. The visual block illustrating the consultation network between the government and other parties is indicated in the Figure with the term 'guiding'.

On the basis of performance by pioneers, covenants, and other activities in the 'guiding' block, we conclude that it is valuable to also allow a broad group of involved parties to help with governing the CE-transition. The transition teams can channel and mobilise the energy of enthusiastic pioneers. Nevertheless, acceleration with the governance model as proposed in the NPCE has not yet materialised; the energy of the pioneers does not automatically flow to other businesses, and there is no clear plan for this in policy documents.

The NPCE states that governing agreements are being developed with governments, provinces, and water boards that are all strongly committed to circular policy. This plan should have been released in 2023, however. Despite the delay, these governing agreements are a valuable and opportunity-rich resource for the acceleration of the CE-transition; indeed, there are municipalities where this is already happening. This offers opportunities for experimenting, scaling-up, and generating support.

Alongside pioneers, it is necessary to involve other parties which would lead to a broader and fuller representation of the constituency. In the transition teams, members currently only participate in a personal capacity. The Transition Team for Consumer Goods, for example, initiated a coalition in 2024 focused on electrical and electronic devices, with participating organisations from this sector. Such coalitions around product groups can serve as a steppingstone towards agreed-upon arrangements among a broader group of stakeholders and are a relevant scale for formulating quantitative targets (New Foresight 2024). The idea of determining strategies for more efficient material resource use with relevant stakeholders for various product groups is comparable to the Dutch Climate Tables. To achieve a similar setup, sufficient mandate and proportional representation are needed to reach effective agreements.

A first requirement to achieve the same setup as the Dutch Climate Tables with the transition teams, is clarity about the targets as well as the routes and instruments to reach them. CE-policy is maturing constantly. This calls for clear, binding agreements between those actors involved and about the roles, responsibilities, and resources needed to achieve the set targets and thereby accelerate the CE-transition.

5.2.3 Relationship of CE-policy with other policy pathways

Policy to promote a circular economy connects with various other policy pathways. In this section, we discuss the relationship between CE-policy and three other relevant policy pathways: climate policy, the national resource strategy, and development aid and trade policy.

More climate gains are possible by making the effects of circular options in the production chains visible and valuing them

Climate policy pays attention to emission reduction via recycling. However, we see little attention to the effects of other circular strategies, such as reduced resource use, extended lifespan, and product design. The focus of climate policy lies on reducing greenhouse gas emissions and realising more renewable energy in the Netherlands. This aligns well with international agreements to reduce emissions within national borders. Conversely, CE-policy pays a lot of attention to the potential contribution to reducing greenhouse gas emissions. Recent research shows that this could be a significant contribution (Warringa et al. 2024a & 2024b). For 55 policy measures proposed in the NPCE alone, this involves a reduction of 4-7 megatonnes (Mton) of CO_2 in the global production hain (see also section 5.5).

An important difference between climate policy and CE-policy measures is that the former is primarily aimed at the emissions on Dutch territory, while circular policy measures are aimed at emission reductions throughout the whole production chain, which is often international in character. It is often unclear to what extent the measures that reduce emissions are also influenced by other policy, domestic or foreign. As such, an outlook study into points of impact for promoting emission reductions in the chain – the so-called scope-3-emission reductions – indicates that there are significant sector-specific differences. It is wise to keep this in mind when developing policy (Broecks et al. 2024).

Scope-3-emissions are indirect emissions which are emitted within the production chain of a business. They are the result of business activities and are outside the direct sphere of influence of the company in question; indeed, part of these emissions take place abroad. To reinforce the synergy between climate and circular policy, more attention is needed for the effects of indirect emissions. This way, policymakers can determine whether additional policy instruments are

necessary and, if so, which ones. Hence, greenhouse gas reductions can be encouraged across the entire lifespan of products in the international production chain (SER 2023). This remains difficult in practice, especially because there are different methods of measuring scope-3-emissions for businesses. The use of existing methods leads to significant differences in reported data (Nguyen et al. 2023). These methods are also being developed for countries where, alongside upstream emissions (Wilting 2021), downstream emissions are also integrated (Schoenaker & Steenmeijer 2024).

Measuring and reporting on scope-3-emissions remains a big challenge for businesses, mainly because the information sources and locations where greenhouse gas emissions take place lie outside of the business itself, particularly in the case of smaller businesses where no good quality data is available. Additionally, a lot of specialist knowledge is needed to understand the standards. Acquiring such data calls for collaboration with other parties, which can stand at odds with confidentiality. It is also a question of how to report on these scope-3-emissions with limited financial and human resources (Deloitte 2023). As it stands, the NPCE does not yet include a clear policy plan which shows how scope-3-emissions can be better understood and appreciated in the future (SER 2023). Despite their complexity, it is crucial for circular measures by companies that this understanding and appreciation of scope-3-emissions abroad are better incorporated into policy.

Further development is needed for circular strategies about supply risks

Critical raw materials (CRMs) are metals and minerals that are extremely desirable, difficult to replace, and of which the supply is vulnerable. Both within the EU as well as in the Netherlands, especially over the past three years, steps have been made by policy to increase the security of the supply of critical and strategic raw materials. The European Critical Raw Materials Act (CRMA) and the Dutch National Raw Materials Strategy (NGS) (European Parliament and Council 2024a; EZK 2022) are both aimed at those CRMs that are important for strategic sectors like renewable energy, digital technologies, and defence. The CRMA also includes targets to limit the supply risks of raw materials. For example, the EU aims to annually extract at least 10% of its total consumption of critical raw materials on its own soil by 2030, process 40% of this, and recycle 15% (European Parliament and Council 2024a). Additionally, the EU should not be overly dependent on any individual country for any of the processing steps (a maximum of 65% dependence). In the National Raw Materials Strategy, the Dutch government proposes five action options that align with the European CRMA. These include:

- Promoting a circular economy and stimulating innovation to more efficiently use and recycle material resources;
- Realising more mining and refinery practices within Europe;
- Diversifying the sources of material resources;
- Making international supply chains for critical raw materials more sustainable;
- And improving knowledge and monitoring in relation to material resources (EZK 2022).

Generally speaking, critical raw materials are included in small amounts in products like wind turbines, solar panels, and batteries. This is part of the reason why they are so difficult to recover. Many raw materials are not on the CRM list by the EU, but are still considered crucial for the energy transition, including chromium, molybdenum, zinc, and steel. These do also have polluting production chains, just like the raw materials that are listed as CRMs by the EU. When developing policy to make production chains more sustainable, it is therefore important to keep a broader scope than the existing CRM list by the EU.

Currently, hardly any or no recycling of critical raw materials takes place in the Netherlands and in Europe. To recycle these materials, an international scale is often necessary to make their recovery economically profitable. Additionally, those materials stored in products are only available once the lifespan of the product in question expires. To increase the availability of critical raw materials, then, more attention is needed for circular design, reuse of parts, and realising high-quality recycling infrastructure. Up until now, attention for the trading perspectives of CRMs is not explicit enough and needs more attention.

Positive developments, on the other hand, include the covenants on metal and renewable energy technologies. Within the Netherlands, information on these covenants is shared throughout the whole production chain, with particular attention to so-called IMVO policy. IMVO stands for 'Internationaal Maatschappelijk Verantwoord Ondernemen', which translates to 'International Corporate Social Responsibility'. A Dutch Materials Observatory is also under development, where the chains of critical raw materials and their reserves in products can be better monitored. This will also result in a CRM list for the Netherlands itself. Because there are close relationships between policies to stimulate a circular economy and those that limit supply risks, coordination and monitoring is needed between the coordinating ministries of the National Raw Materials Strategy (which is the Ministry of Economic Affairs) and the NPCE (which is the Ministry of Infrastructure and Water Management). Both policy areas require information on raw materials to guide action, at the national level as well as for the materials present in product groups. Harmonising these approaches would ensure that consistent data and information are available and would prevent the potential duplication of such information.

Policy cohesion is important for a circular Netherlands and a good life elsewhere

Many materials and products come from low- and middle-income countries (LMICs) and many discarded goods once more end up in these countries after use. Striving for a circular economy in the Netherlands and in Europe therefore has consequences for these countries (Lucas et al. 2022; Ashraf et al. 2024). These consequences include an increased pressure on food systems and nature by increased use of biomass, but also potential loss of employment when extracting material resources as well as loss of employment in the manufacturing industry as a result of stricter product standards. These consequences disproportionately affect vulnerable groups, such as people with low income, women, immigrants, and indigenous people. Promoting a circular economy can therefore lead to the repetition of the global unjust distribution of benefits and burdens perpetuated by the current linear economy (Pansera et al. 2024).

In a just circular economy transition, these negative effects will be taken into account. In the case of such a just transition, this includes two questions (Oates & Verveld 2024). First, a question on distribution: who carries the burdens of the transition and who enjoys its benefits? Secondly, on inclusivity: are different voices equally represented in decision-making processes, especially those of vulnerable groups? These questions play a role both nationally as well as internationally. The distribution question is partly acknowledged in the NPCE: 'where possible, limit any negative consequences of our circular transition on production and developing countries and stimulate fair local transition processes'. However, this has only been minimally developed further in the NPCE. A just transition can also contribute to socio-economic development and environmental restoration in LMICs (Council of the European Union 2022). This is not yet part of CE-policy in the Netherlands.

To limit negative effects that the Dutch transition can have on other countries, policy guarantees are necessary, such as measures and standards to limit local environmental impacts of mining, and ensuring good labour conditions upon the extraction, production, and waste processing in these countries (see Lucas et al. 2022). To prevent environmental effects in the mining industry (e.g. acid mine drainage and pollution of water and soil), more binding and expansive regulations are important. Examples of such regulations include the mandated restoration of mining sites after closure and incorporating indirect effects and long-term consequences in environmental evaluations (which are needed for the approval of mining projects) (De Haes & Lucas 2024).

Good coordination is needed between CE-policy and development cooperation and trade policy to also contribute to socio-economic development and the restoration of the environment in LMICs (Lucas et al. 2022); in other words, policy cohesion for development (BHOS 2022). This calls for traceability and transparency of international production chains, the integration of circular strategies in existing policy like trade agreements and covenants to promote corporate social responsibility, and to involve various stakeholders from LMICs when designing and implementing CE-policy (Lucas et al. 2022). Additionally, LMICs can be better supported to help anticipate changing trade flows and product requirements, as well as in their efforts at greater circularity and sustainability. This can be done through, for example, financial support from Western countries as promised in the Climate Agreement (Van Vuuren et al. 2024). This can be considered 'just' from the perspective that environmental crises are largely the result of Western consumption patterns. International cooperation can ensure that the circular economy is effective at reaching environmental targets while simultaneously contributing to a good life elsewhere in the world.

5.3 Existing instruments

Strong governance and the use of more binding policy instruments are necessary measures to reach the acceleration phase (Hanemaaijer et al. 2023). By instruments, we mean active governmental interventions aimed at reaching the formulated circular targets (Vollebergh & Renes 2019; Bauhaus et al. 2024). Instruments encourage or mandate businesses and citizens to more circular behaviour. The NPCE emphasises that more standardisation and pricing policies are needed to accelerate the CE-transition. The Dutch government presented several action points in the NPCE to realise this.

The policy necessary to realise a circular economy calls for using instruments on multiple scale levels; in other words, on a European level, a national level, and a regional level, with considerable interactions between these levels. As such, European guidelines should be translated into national policy, whereas good examples of successful national legislation can form the basis for EU policy. Additionally, lessons about local implementation and enforceability by regional governments can prompt adjustments in national policy. In this section, we will therefore consecutively address Dutch national policy instruments, EU policy, and regional policy that is all aimed at a circular economy.

5.3.1 National policy instruments

Current national circular policy is mostly stimulating in nature

The previous ICER stated that existing policy was insufficient to realise the ambitions set by the Dutch government and that more binding policy would be necessary (Hanemaaijer et al. 2023). The NPCE, which was released shortly after the ICER 2023, acknowledged that a next step is necessary to arrive at a fully circular economy. This calls for 'more intensive policy and more guiding and binding measures', per the NPCE (IenW et al. 2023).

To determine which instruments have been used up to today, and what policy has been added since the publication of the previous ICER, we distinguish between adopted, proposed, and scheduled policy. Adopted policy refers to an instrument that has been concretely implemented – including the financial resources – and which has been adopted by both the Dutch Senate and the House of Representatives. In the case of proposed policy, a policy instrument has already been named, but there is no concrete policy plan with the necessary financial resources and exact design of the instrument. Scheduled policy is still in the idea phase and even the choice for a specific instrument has not yet been made. A first step in further developing scheduled policy is often an exploration or outlook.

An inventory of policy instruments to promote a circular economy in the Netherlands (Bauhaus et al. 2024) reveals that, of all adopted CE policy instruments, nearly 60% is of a promotional, or stimulating, and facilitating nature. This includes supporting circular design via CIRCONNECT and CIRCO-hubs; reinforcing circular craft centres through subsidies; developing a repair registry with certified repairers; and continuing the Dutch Knowledge and Innovation Agenda for a Circular Economy. Standardisation and pricing instruments remain mostly scheduled and have only been adopted to a limited extent.

The NPCE contains numerous proposals for the intensification of policy

The NPCE focuses on a mix of standardisation, pricing, and promotional measures to realise circular ambitions. It also contains a structured overview of proposals and outlooks of instruments (IenW et al. 2023). The proposed binding instruments in the NPCE could have a significant impact, but this does depend on their further development. Such binding instruments include, for example, taxing fossil raw materials for plastics; mandating percentages of recyclate or sustainable bio-based raw materials; requiring an Environmental Cost Indicator (ECI) that must not exceed a certain value in tenders within ground, road, and hydraulic engineering; and setting stricter requirements for extended producer responsibility (EPR) for various products.

A general comparison of the NPCE 2023-2030 to the Dutch Implementation Programme Circular Economy 2021-2023 indicates that both the number and proportion of proposed binding policy measures have increased (RWS 2024).

The phase of these proposals differs. As such, the NPCE specifies the further exploration of improved pricing of environmental damage, on a national and European level. This concerns improved pricing of environmental pollution, further pricing of primary material resource use, and pricing activities that hinder the high-quality use of material resources. For this scheduled policy, it is not yet clear what rates are being considered and what the design of the policy instruments themselves will look like.

There are several proposed policy instruments under development specifically for plastics. To make plastics circular, the Schoof administration wants to use a combination of standardisation, stimulating, and pricing policy instruments (Rijksoverheid 2024). It plans to introduce a levy on plastic, starting in 2028. Additionally, the previous administration, Rutte-IV, had a proposal for a blending obligation of 30% secondary or bio-based resources in plastics by 2030, starting with 15% in 2027. If these percentages are maintained, it is expected to strongly incentivise companies to apply more recyclate and bio-based material resources on a larger scale in plastic products. The possibility of leakage effects have to be taken into account; if the Netherlands implements these policy instruments for plastic, part of the plastic production could potentially be relocated to other countries within the European Union. Alongside this obligation, the Rutte-IV administration has also allocated financial resources from the Climate Fund, amounting to 267 million Euros until 2030, to support companies in transitioning to the blending obligation (IenW 2023b).

The development of the NPCE has hardly led to more binding policy

Up until now, the preparations and outlooks in the NPCE have hardly led to more binding policy which is also adopted at the national level (Bachaus et al. 2024). This still calls for further development of policy instruments, which then have to be adopted by the House of Representatives. The NPCE has, however, led to new regulation for EPR on textiles, which stipulates that 50% of textile sales on the Dutch market must be recycled or reused by 2025, increasing to 75% in 2030.

Other binding instruments that have recently been implemented mostly come from European waste legislation, such as the national interpretation of the Single Use Plastics directive (SUP). Since 2021, the SUP has led to a trade ban on single use plastic products (e.g. single use cutlery, plates, stirrers, straws, and food and drink packaging made of expanded polystyrene, or styrofoam). Additionally, since mid-2024, all caps and lids of plastic bottles and drinking packages up to 3 litres must be attached to the product. From 2025 onwards, PET-bottles must consist of at least 25% recycled material; in 2030, this increases to 30% (In 't Veld et al. 2023).

On a national scale, then, there are primarily opportunities to establish policy proposals introduced in the NPCE into legislation as binding instruments. We will further elaborate on this in section 5.5. There is also room at the decentralised level to implement policy instruments with a stronger incentive, such as setting higher requirements for circular procurement by the government. Table 5.1 below provides an overview of adopted, proposed, and scheduled national policies in the Netherlands, including the number of policy instruments and several important examples.

In line with the earlier conclusion that current, national CE-policy is primarily promotional and facilitating, Table 5.1 highlights the small number of instruments with a particularly strong incentive. Incentives can involve the level of an environmental standard or an imposed collection percentage and, in the case of a subsidy, the amount of money, and in the case of a tax, the rate. Of the 63 adopted instruments at the national level, 47 can be assessed as having a ‘low’ or ‘weak’ incentive (Bachaus et al. 2024). Among the proposed and scheduled policies, there are more instruments with a (potentially) strong incentive, such as the proposed standard for a share of recyclate or bio-based materials in plastics. The intention is then to deploy more instruments with such a strong incentive.

Table 5.1
National adopted, proposed, and scheduled policy for a circular economy

Category instruments	Total	Which have a strong incentive
Instruments aimed at waste and recycling (generic)	14	2
e.g. waste taxation, landfill ban, most EPRs		
Instruments aimed at circular strategies higher than recycling	16	3
e.g. ban on specific disposable plastic products (SUP directive) *and a minimum share recycled or reused material in EPR Textile*		
Instruments aimed at multiple circular strategies	33	0
e.g. subsidies for circular and supply chain projects and circular craft centres, and Versnellingshuis Nederland Circulair		
Total adopted instruments	**63**	**5**
Proposed instruments	30	5
e.g. norm for share recyclate or bio-based resources in plastics		
Scheduled policy (including outlooks)	**33**	**7**
Total national CE instruments	**126**	**17**
Source: Bachaus et al. (2024), adjustments by PBL		

Limited resources for the circular economy in the Dutch national budget

The available government resources for the CE-transition have been limited so far. Financial resources for various schemes have increased over the past two years, but this mainly concerns subsidies for research and innovation focused on recycling (see Chapter 4). This also applies to the climate funds available for the circular economy. Supply chain projects and projects aimed at extending lifespan, or those with effects outside of the Netherlands, can hardly be financed from the current climate funds. To date, there are few financial schemes specifically focused on the circular economy.

Additionally, the NPCE has provided financial coverage for exploring more binding policies, but no budget is included for the follow-up. As a result, implementation is not guaranteed and remains dependent on whether it can be accommodated within the regular budget. Furthermore, it is notable that the amounts in the budget for the circular economy, as monitored by the Ministry of Infrastructure and Water Management, will significantly decrease after 2026 and 2027 (IenW 2023b). PBL and the Social and Economic Council (SER) have previously indicated that more independent resources are needed for the CE-transition (Hanemaaijer & Kishna 2023; SER 2023). These specific resources for the circular economy are necessary for the implementation of the NPCE and all subsequent steps needed to accelerate its transition. How many resources are needed exactly, partly depends on the standardisation and pricing instruments that are employed.

Waste policy provides a basis for circular policy

The inventory of instruments named above indicates that, in adopted policy, recycling and close the loop are the two dominant strategies (Bachaus et al. 2024). In the Netherlands, waste policy is the foundation for circular policy. Instruments such as the landfill ban, waste tax, and waste levy have all been established as binding instruments. As a result, relatively little waste is landfilled in the

Netherlands compared to other countries.

Since a large part of waste policy is generic and thus applies to all production and consumption, it provides a basis for circular economy policy. Additionally, various waste streams now have an end-of-waste status, making it easier to use waste materials once more as resources. On the other hand, obtaining an end-of-waste status is a time- and capacity-intensive process that can take years. A newer definition of waste in policy and legislation could promote more reuse and recycling. Furthermore, various initiatives are underway to better align existing waste policy with circular ambitions, such as the Circular Materials Plan (see the text box below).

Up until now, waste policy has primarily been aimed at producing recyclate, regardless of how it would then be applied. The quality of said application is therefore an important point of contention. To further develop the closing the loop-strategy, more is needed than just waste policy. While the policy instruments mentioned above result in fewer raw materials and fewer materials being discarded overall, recycling capacity does lag behind, as does the demand for high-quality application of secondary materials. Due to the low prices of fossil plastics, several recycling companies have recently gone bankrupt, such as Umincorp, Ecocircle, and THR Recycling (Afval Online 2024). To prevent this in the future, an operational subsidy is one option to temporarily bridge the unprofitable margin of recyclate. Additionally, developing this market requires that companies using plastic, receive incentives to purchase recycled plastic instead of fossil plastic, such as through the aforementioned standard for plastics starting in 2027 (see also section 5.5).

The Dutch Circular Materials Plan contains circular guidelines for implementation and enforcement

From 2025 onwards, the Circular Materials Plan (CMP) will act as successor the National Waste Management Plan LAP3. The goal of the CMP is to provide a uniform framework for the use of material resources, dealing with waste, and issuing of licenses. The CMP will also provide an overview of binding Dutch waste policy.

The Plan brings more attention to material streams instead of waste products. Existing sector plans from the Waste Management Plan will be converted to chain and waste plans in the CMP. These chain plans contain information about processing and other phases in the material chain, such as design and use. These plans should provide an overview of circular practices for a specific material stream and the legislation applicable to it. Additionally, competent authorities are obliged to inform the Ministry of Infrastructure and Water Management if they deviate from the CMP. This can help with identifying bottleneck and evaluating CE-policy. A third element is that the CMP includes an instrument that establishes a 'Minimum Standard'. This gives the licensing authority the ability to determine when something is more or less high-quality, which techniques are desired for which waste stream, and whether they can obtain a permit.

The CMP can assist companies in making more circular choices in their operations, such as repair, reuse, and high-quality recycling. Additionally, it can help competent authorities in making decisions and enforcing them, such as decisions around environmental permits and environmental planning. Thus, the CMP forms an important bridge between policy and implementation. It also offers more possibilities for governing a circular economy than the existing Waste Management Plan.

However, it is important to ensure that there is sufficient knowledge, expertise, and resources available for regional governments and enforcement agencies in order to utilise these circular tools and carry out implementation and enforcement. This also requires organising cooperation between decentralised governments, and among environmental services. One example is the

Dutch knowledge platform 'Afval of niet' ('Waste or not') which was founded under the direction of Omgevingsdienst NL.

EPR contributes to closing material loops through collection and recycling

The Dutch government has high hopes for the policy instruments concerning extended producer responsibility (EPR) in the NPCE. In an EPR system, producers remain financially and often organisationally responsible for a product after it has been discarded by end users. In the Netherlands, EPR systems have been implemented for cars, batteries, electrical and electronic equipment, packaging, and textiles, to name a few examples. In the NPCE, there is an important role attributed to further expanding the existing EPR instruments and number of EPR systems, such as the one established for textiles in 2023.

One positive result of EPR is that it has led to an increase in the number of products being separately collected and processed, indicating that the incentives of collection and recycling requirements are effective. Collection requirements can, however, frustrate other circular strategies, for example in the field of reuse and repair (Dimitropoulos et al. 2024). Even though EPR promotes the use of recycled materials through a larger supply and lower production costs, it is not yet clear whether this actually improves the quality of secondary material (Dimitropoulos et al. 2021). In the case that material collected for recycling is of a low quality, this can lead to downcycling; in other words, processing into lower-value products. In section 5.3.3, we provide several recommendations for potential improvements to EPR systems.

There is too little policy to stimulate circular consumption aimed at reuse and reduce

Alongside policy aimed at circular production, there should be policy to promote circular consumption. Control instruments aimed at consumers mostly consist of information (e.g. labels on products) and pricing policy (deposits, recycling contributions). Policy instruments aimed at behavioural changes, which face more resistance from consumers, are still out of focus. These include reduced consumption of meat or dairy and opting for other forms of mobility (Koch & Vringer 2023). There are also no measures to make circular behaviour easier, more attractive, and more convenient. The latter calls for more fundamental structural and cultural changes, driven by standards and price incentives, and facilitated by interventions in the physical consumption environment, such as making space for the sharing economy at strategic locations (De Krom et al. 2020; Zibell et al. 2021; Koch & Vringer 2023; Rood & Evenhuis 2023).

5.3.2 EU policy

European CE-policy is essential to realise a fully circular Netherlands

Over the past two years, a significant amount of legislation aimed at the circular economy has been introduced at the European level. The Netherlands is one of the Member States that has pushed for ambitious legislation in this field, in line with the NPCE. European circular economy policy is essential to realise a circular economy in the Netherlands, especially since the Netherlands has a good starting position with the presence of innovative companies. Products and trade policy primarily take place at the EU level when establishing the rules for the internal EU market. Additionally, waste policy is also being formulated at the EU level, the REACH policy focuses on preventing harmful substances, and there are reporting obligations for companies regarding the effects on people and the environment in the production chain, such as the Corporate Sustainability Reporting Directive (CSRD).

The EU has established several standards that have become mandatory, and which have a strong impact on Dutch national policy (Bachaus et al. 2024). Multiple instruments have been implemented with stringent effects that influence the entire European market, such as the Single Use Plastics Directive (European Parliament and Council 2019). Since 2022, sellers are required by European guidelines to keep digital devices and services operational and safe by providing updates. Additionally, there are several instruments being prepared (already adopted by the European Parliament and the Commission) concerning the Right to Repair and the Ecodesign Regulation (European Parliament and Council 2024b). With these instruments, the European Commission is visibly focusing on measures that intervene earlier on in the chain, such as requirements for product design, reuse, reduction in the use of raw materials, repairability, and recyclability.

European policy, as does Dutch national policy, primarily focuses on the waste phase of products and the high-quality processing and recycling of waste. Of the 42 instruments identified, 14 are categorised as 'close the loop' and 4 are 'narrow the loop' (Bachaus et al. 2024). Yet there is a visible shift in the Ecodesign Regulation and the Corporate Sustainability Reporting Directive, which are more focused on the production phase.

Repair will become a right and will be easier for the consumer because of EU policy
The European Right to Repair will make it easier and cheaper for the consumer to have a product repaired if technically possible, such as washing machines, vacuum cleaners, or mobile phones – even outside of the warranty period. Sellers will be required to repair defective devices within a reasonable period of time and at a reasonable price, if the customer requests it. The recently established Ecodesign Regulation should ensure that devices also have a longer lifespan. Devices have to be designed in such a way that they are easy to repair, and manufacturers must be able to supply spare parts to professional repairers for a longer period of time. For cooling appliances, this is seven years after purchase, and for washing machines and dryers, this is ten years. This policy instrument helps to increase repairability and extend the lifespan of devices. It is expected that such instruments like the Ecodesign Regulation will lead to more circularly designed products. The challenge here lies in implementing the Regulation over a short period of time for different product groups, as the focus now lies mostly on electronic devices.

Additionally, starting from 2030, a mandatory digital product passport will be required at the EU level for all products placed on the European market. This obligation will lead to the sharing of information and standardisation of data. The passport can then be used for imposing standards. The digital product passport will first be implemented for batteries in 2027, a product group that uses many resources and has significant potential for circularity (repair, reuse, recycling). Textiles and electrical appliances are expected to follow soon after.

5.3.3 Regional policy

Up until now, regional policy instruments are mostly stimulating in nature
Nearly all Dutch provinces have a policy programme in place for the circular economy. These programmes are mostly promotional in nature. They are aimed at connecting businesses in production chains or take the shape of subsidy schemes for the circular economy. For example, in West-Friesland, North Holland, a transition broker has been deployed to connect the various involved parties around demolition and construction. Additionally, provinces are committed to spreading knowledge about the circular economy, supporting companies with circular design, and addressing regulatory barriers experienced by businesses. Provinces have limited ability, however, to really establish legislation to promote a circular economy (Bachaus et al. 2024). They can give a

boost to the circular economy and help phase out undesirable activities through Environmental Plans and by their role in permitting, implementation, and enforcement via environmental services.

Local governments are focused on the waste chain, primarily household waste. This is logical, since governments have a legal responsibility for the collection and processing of this waste. Additionally, there are significant differences among municipalities regarding the quantities of separately collected waste, as well as differences in ambitions and knowledge. Leading governments can therefore demonstrate what is possible to others, thereby serving as examples and inspiration. Several larger governments, such as Amsterdam or Rotterdam, have policy plans outlining how they aim to achieve a circular economy. These governments often seek space to experiment and actively collaborate with the national government. Moreover, there is a large group of municipalities who would like to focus more on circularity but have limited people, resources, and knowledge to do so. These municipalities have a strong need for knowledge exchange, inspiring examples, support, and collaboration, particularly in the areas of circular construction and circular procurement.

Dutch water boards play an important role in the recovery of resources from wastewater. With an innovative approach, they recover material resources from waste streams, such as phosphate (struvite) and plastic (Bachaus et al. 2024). However, current legislation makes it challenging to bring these resources once more to market. For example, recovered phosphate and struvite cannot simply be used in agriculture due to existing waste policies. Water boards are also actively involved in circular commissioning and material passports.

The NPCE also touches on the importance of sharing regional knowledge. Facilitating learning and knowledge exchange is already happening in regional networks and via platforms, such as the so-called 'De Verschilmakers' (which translates to 'Those who make a difference') and Circulaw. The former is a platform where experiences are bundled, circular case studies are documented, and where policymakers are offered practical guidelines. Circulaw is a knowledge platform developed to help policymakers, project leaders, and procurers to make better use of legislation to promote a circular economy. The knowledge exchange between regional governments and the Dutch national government could, however, be stronger; a structural knowledge infrastructure would be helpful in this regard (Rood et al. 2021), not only for sharing knowledge, but also as a consultation point for regional authorities and to share experiences.

Location policy is an important instrument to promote the circular economy at the regional level. Various municipalities and harbour businesses are already acquainted with location policy where companies can receive priority to utilise residual streams from nearby businesses. Spatial policy choices are also of broader importance to enable a circular economy by 2050. It is relevant to already consider the spatial requirements of circular activities in the planning process. This includes, for example, business parks with a high environmental category, locations for circular businesses in harbours and industrial areas, business parks on the outskirts of cities, and business locations in city centres and neighbourhoods for repairing, sharing, reusing, and recycling (Rood & Evenhuis 2023).

Finally, nearly all regional municipalities are committed to buy more circular. A collective approach via so-called buyer groups offers the opportunity to exchange regional knowledge and experiences. Additionally, a collective approach ensures a larger scale, which creates more purchasing power for the buying parties. This applies not only to road construction but also to procurement and tenders

for office furnishings. As both regional and national governments increasingly procure circularly and progressively impose requirements on aspects such as material types, lifespan, reuse, and high-quality recycling, innovation can be promoted. This can provide a significant boost to the adoption of circular products and services.

5.4 Driving acceleration by and for circular businesses

In a recently published report, former President of the European Central Bank (ECB) Mario Draghi states that one of the most important ways for Europe to become a strong, future-proof, and competitive economy, is to create a low-carbon and circular economy (EC 2024a). The Dutch economy is one of the most innovative of those in Europe (EC 2024b) and that drive to innovate translates into several innovative circular businesses.

Several companies with proven successful circular business models have moved beyond the start-up phase. They sell more sustainable versions of items like mobile phones, clothing, and coffee, which have significant positive environmental impacts compared to their linear counterparts. Some of these circular companies also influence how goods are purchased or used by offering options like second-hand building materials or packaging-free groceries.

Companies engaged in circularity are increasingly seeking each other out, in a so-called Club of Circular Entrepreneurs, or in established business associations like Corporate Social Responsibility Netherlands (MVO Nederland), Confederation of Netherlands Industry and Employers (VNO-NCW), and the Dutch Federation of Small- and Medium-Sized Enterprises (MBK-Nederland). Recently, these groups have made various calls to the political sphere, including with the Agenda Circular Netherlands (Circularities 2030) and the pamphlet 'Circular Economy for a Strong and Independent Netherlands' (VNO-NCW et al. 2024). The signatories of these publications emphasise the importance of a swift transition to a circular economy and outline what they need to drive this change.

In this section, we explore the limits and possibilities for companies wanting to take steps towards circularity, and where and when system-level guidance is needed to achieve the necessary acceleration.

Businesses need an environment that facilitates circularity

Inventiveness and the ability to quickly seize new opportunities are inextricably linked to entrepreneurship. This potential remains underutilised in addressing societal challenges, such as the circular economy (WRR 2023). Businesses that are currently characterised as innovative and circular, began because of various reasons: there is potential to earn money with this new approach, the entrepreneur is socially engaged, or the entrepreneur has a significant interest in innovation. It usually concerns a combination of these factors. At the moment, however, 'linear' businesses remain the norm and there is no noticeable acceleration in the growth of the number of circular businesses.

Business characteristics and external factors determine the opportunities for growth and the acceleration of businesses who want to contribute to circularity. There are both 'born' as well as 'grown circular' businesses: businesses that started circular, or that became circular over time. To

grow and multiply circular business activities (scale out) and ultimately make them the norm (scale deep), the environment in which these businesses operate is important. We explain four conditions of such an environment, which relate to the components of the MIS framework (Mission-driven Innovation System, building on RHDHV 2024). We also describe how the various actors can make sure that these conditions are met, so circular business activities can become the norm.

Condition 1: legislation that fits with the circular management of material resources

One of the key conditions for a circular economy is that 'doing good business' must be rewarding (WRR 2023). As the responsible entity, the Dutch national government can use policy to drive more system transformation in the long term, thereby providing stakeholders with support and direction (RHDHV 2024). Through pricing and regulatory policies that businesses can navigate, circular practices can become the norm, and undesirable practices can be phased out. The circular economy cannot accelerate without reducing or at least transforming linear practices.

The government has a key role to play in this. It must consider all stakeholders yet not shy away from making difficult decisions to phase out certain activities, such as reducing the capacity of waste incineration plants. Oversight of implementation is crucial. New innovations sometimes need a push in the form of subsidies, but it is important that businesses can sustain themselves in a circular economy afterwards (WRR 2023).

Businesses can also influence standards and legislation themselves within their production chains. One example is Schijvens, a producer of circular workwear. The company has existed since 1863 and has grown towards circularity over the past few decades. It is part of the standards committee for textiles at NEN (Netherlands Standardisation Institute), a member of the steering group of Corporate Social Responsibility Netherlands (MVO), and was a signatory of the covenant on sustainable clothing and textiles established on the advice of the Social and Economic Council of the Netherlands (SER) (RHDHV 2024; Schijvens 2024). This is an example of how an innovative circular company drives circularity within its own operations and supply chain, while also actively contributing to the discussion on sector-wide regulatory and pricing policies.

Condition 2: new and sufficient financing structures

Currently, it is difficult for circular companies to finance their activities. More than 95% of financing still goes to linear business activities. For circular businesses, there is a gap between what they need and what they receive in terms of financing (Copper8 & Circular Finance Lab 2024). The financial sector has a primary role in reevaluating circular business models. Banks, private equity, and institutional investors play an essential role here (see also Chapter 4). The Dutch national government has an important role in shaping the conditions that enable this shift in perspective toward circular businesses. For example, it requires reconsidering barriers such as the seven years of empirical data required for calibrating the risk models that banks use to decide whether to provide financing to companies (Copper8 & Circular Finance Lab 2024).

Financing circular enterprises is essential to accelerate the transition. This can happen through new forms of banking, for example, such as a public-private investment bank. Because private parties co-invest, the available capital grows, while the government commits to a clear mission and stability in the long term (WRR 2023; Versnellingshuis Nederland Circulair! 2024). The government can further contribute by being a strong commissioner, with financing instruments on both a national and regional level. Additionally, the collaboration and cohesion between the financial sectors and government institutions is important for a shared long-term perspective; examples

include regional development agencies, Invest-NL, and the European Investment Bank (RHDHV 2024).

Another way in which circular business activities and innovations can currently be financed, is as a circular division within an originally linearly operating business. An example of a product developed this way is the circular lead substitute Leadax by the construction materials company VisscherHolland. Mattress manufacturer Auping is an example of a business that was linear with a circular division; they ultimately realised a fully circular product (RHDHV 2024).

The financing route via a larger, existing company is not an option for many circular startups. These examples do demonstrate that established businesses can recognise the economic potential of circularity by themselves and know how to capitalise on this. For example, Philips does not express circularity in individual products, but in targeted percentages of revenue. The company aims for 30% of its revenue to come from circular products by 2032. From the various success stories, both the financial sectors as well as the Dutch national government can learn what are the opportunities and risks of specific business models and financing structures, and when circular financing is needed the most.

Condition 3: increasing market demand and circular consumer behaviour

Market formation is a third condition for accelerating and embedding the circular economy transition. This is possible through circular procurement by the government (see also section 5.5) and by increasing circular consumer behaviour (see also Chapter 4). The willingness towards certain forms of circular behaviour, such as sharing instead of purchasing products, is currently quite low. This can be increased by focusing on factors important to consumers – where possible within the business case – such as low price and convenience (Koch & Vringer 2023).

Additionally, more knowledge is needed about the conditions under which the consumer actually switches to circular behaviour, particularly when it concerns using fewer products or using them for longer (higher circular strategies). As such, guarantees appear to play an important role when purchasing a second-hand or revised product. The national government can guide this knowledge and, where necessary, use regulation, pricing, and incentives to steer consumers towards more circular behaviour. Examples include the levy on disposable packaging and, abroad, the repair vouchers subsidised by the French and Austrian governments.

An initial step to incorporate knowledge about circular consumer behaviour into policy is being made in the so-called Behavioural Strategy for Citizens and the Circular Economy. Furthermore, behaviour changes can be guided by national services, knowledge institutions, and platforms such as the Netherlands Enterprise Agency (RVO) and Milieu Centraal. Here, it is important not to lose sight of the preconditions for circular behaviour: consumers are currently being led towards non-circular behaviour because of costs and convenience. The national government can make a big difference here with legislation which makes non-sustainable goods and services more expensive or even prohibited.

Circular pioneers that have been around for longer have succeeded in creating a market for their innovative products and services. These businesses can also influence the creative integration of the production chain, other companies, governments, and the consumer. Ambitious circular procurement policy by the government is an important instrument for shaping or expanding new markets. Procurement criteria have significant effects in the construction sector, for example. Dura

Vermeer (a Dutch construction company) reports that, through numerous pilot projects, they are able to use recycled concrete in ground, road, and water construction as well as large infrastructure projects. If using recyclate becomes a criterion in tenders for new large projects, then then market for recycled concrete will grow rapidly.

Another example of market formation by a business-to-consumer, born-circular company is Paper on the Rocks. This company makes circular, sustainable paper from rocks instead of trees. They are active in the luxury sector, where they address a market that is not being driven by sustainability but by other aspects of the product (RHDHV 2024).

Condition 4: strong knowledge and chain partners

Circular businesses mature because of good entrepreneurship, but this also includes that they are not isolated. The right knowledge and a strong network are essential here, for instance when a company wants to redesign the production process (RHDHV 2024). Alongside the influence entrepreneurs have themselves in the production chain, the national government can also guide/steer on knowledge development and exchange. Organisations like the RVO (Netherlands Enterprise Agency), Versnellingshuis Nederland Circulair! and other knowledge platforms can contribute to this knowledge infrastructure. These platforms and knowledge institutes can help the government and businesses to accelerate the transition to a circular economy by sharing lessons learnt, connect chain partners, and signalling hindrances/obstacles which policymakers can focus on.

A great number of innovative Dutch circular companies have already looked for solutions in the product chain themselves. For example, Falk Bouwsystemen, a producer of circular building panels, constructed their own recycling facility and adjusted their product design when no recycler could be found for their product. Furniture manufacturer Gispen periodically organises a conference where parties from the sector discuss together how they can take steps towards sustainability; at this conference, innovative startups are particularly encouraged to take the stage (RHDHV 2024). A final example is the Green Deal Circular Festivals, a collaborative partnership in which a large number of European festivals are working towards circularity. Concrete steps have been taken in areas such as catering, energy, and waste management for these ‘mini societies’. The festivals learn from each other and have developed their own monitoring system to measure their impact (Green Deal Circular Festivals 2024).

Accelerators of the Dutch circular economy need vision, a mandate, and tools

Innovative circular businesses have been granted a leading role in accelerating the transition. In the Netherlands, there are plenty of good examples of businesses that offer a circular product or service. Additionally, they know how to find innovative solutions for financing and forming a market in a still linear system.

Other actors involved with the circular economy, from governments to banks to knowledge platforms, are, however, also unmissable to accelerate the transition. To have all those involved actors collaborate on accelerating the transition, we, first, need a vision: a perspective for the long term with concrete targets. Additionally, those actors involved also need a mandate: the authority to handle material resources and materials differently, to contribute to legislative discussions, and to experiment with new forms of financing. Finally, associated financial tools are needed for acceleration to encourage/promote innovation and form new markets, and therefore expand/broaden the transition from just a group of driven pioneers to the rest of the Netherlands.

5.5 Policy options and expected effects

In this section, we discuss the expected effects of circular economy policy. Here, we first look at the potential effects of policy in the National Circular Economy Programme (NPCE; section 5.5.1). Then, we look at potential policy instruments that can be applied on top of the NPCE to accelerate the transition (section 5.5.2). These can be both new as well as existing instruments of which the requirements have been tightened. Finally, we take a closer look at several existing policy instruments that can be applied broadly, such as EPR and circular procurement (section 5.5.3).

5.5.1 Expected effects of NPCE policy options

With the instruments in the NPCE, significant environmental gains can be achieved

To provide an indicative picture of potential effects achievable with the NPCE, Warringa et al. (2024a) have assessed the impacts of measures from the programme. They selected 55 measures, which are sufficiently concrete to be calculated and potentially have a significant impact. Where the NPCE had not yet been concretely developed, some assumptions were made about the potential implementation of the policy instruments. It is evident that both the Rutte-IV administration in 2023-2024, as well as the Schoof administration in the Coalition Agreement of September 2024, have left many decisions regarding policy instruments in the NPCE open-ended (see also section 5.3). In other words, there is still plenty of uncertainty regarding policy. Ultimately, the exact implementation of the NPCE will determine the effectiveness of the policy instruments named in the programme.

Table 5.2 below contains several important policy options and an indicative estimation of the associated climate benefits. The uncertainty about this estimation is partly reflected in the range of the individual climate effects. Part I of the Table concerns a selection of the 55 policy measures in the NPCE for which an estimation of climate benefits could be made (Warringa et al. 2024a). Part II of the Table provides an estimation of the climate gains for several potentially additional policy options. These have been provided as suggestions by the Ministry of Infrastructure and Water Management (IenW) for the formation of the Schoof administration (Warringa et al. 2024b). The total effect of implementing multiple policy measures is smaller than the sum of the individual measures because their effects can overlap. In the rest of this section, we will also discuss other effects of circular policy measures alongside climate benefits. The starting point here is a broad welfare perspective (see, for example, CBP, PBL & SCP 2022).

Warringa et al. (2024a) estimate the total annual global climate benefits of the 55 measures in the NPCE at 3.6 – 6.9 megatonnes CO_2-equivalents (see Table 5.2). Of this, 1.6 – 2.8 megatonnes CO_2-equivalents can be realised with adopted and proposed policy, and 2.3 – 4.5 megatonnes CO_2-equivalents with scheduled policy. This provides an indicative picture of the expected effects of these measures. Because not all measures in the NPCE could be included in these calculations, the total CO_2 benefits from the NPCE may be even larger. As such, the policy measures in the NPCE that have to be implemented on EU level have not been included. This is also the case for policy measures to encourage the protein transition (see section 5.5.2).

The 55 measures analysed result in a material savings of more than 2 megatonnes by 2030, of which 1.5 megatonnes in buildings. This contributes to the security of supply of these materials. In 2022, the Netherlands had an abiotic material use of 121 megatonnes (domestic use, see Chapter 3).

There are also potential positive effects of these measures for biodiversity and for air and soil quality.

Table 5.2
Global estimation of the CO_2 reduction for several relevant circular instruments

I. Policy in the NPCE (Warringa et al. 2024a)		**Global estimated CO_2 reduction (Mton CO_2-eq)**
Phase of NPCE policy	***Instruments for***	
Scheduled	Lifespan extension of products	1.3 to 2.7
Scheduled	Sustainable procurement of GWW*	0.8 to 1.2
Adopted and proposed	Textile	0.76 to 0.8
Scheduled	Waste incineration installations	0 to 0.8
Proposed	Plastics	0.12 to 0.75
	Other instruments	Approximately 0.8
**** potential global climate benefits in the year 2030**		**3.9 to 6.9**
of which emission reductions on Dutch territory		*0.5 to 3.0*

II. Additional policy options (Warringa et al. 2024b)	
Financing of the unprofitable peak of circular business models for plastics (comparable to the SDE++ scheme)	3.3 to 4.6
European norm of 20% sustainable carbon in chemical industry (bio-based resources, recyclate, CO_2)	1.1 to 3.3
Feedstock tax on fossil resources for non-energy use; in combination with compensation for the use of secondary resources; national and European agenda	Unknown globally (*in the Netherlands: 2.8*)
Normalising the maximum Environmental Cost Indicator in the construction sector, expand to other sectors	0.6 to 0.8
Other instruments	0.5 to 1.0
**** global climate benefits of additional policy options**	**5.3 to 7.9**
of which emission reductions on Dutch territory	*unknown*

** GWW is the Dutch acronym for 'ground, road, and hydraulic engineering'*

*** Individual effects do not sum up to the total benefits; because of overlap between instruments*

Particularly environmental benefits through the extension of product lifespans and sustainable procurement
The biggest potential climate effects of the NPCE are expected by the effect of policy instruments on the lifespan extension of products, and by the circular procurement and tendering of ground, road, and water construction. Scheduled policy aimed at lifespan extension of products offers the greatest potential environmental benefits with a reduction in global greenhouse gases of 1.3 – 2.7 megatonnes CO_2-equivalents (Warringa et al. 2024a). Here, the estimated upper limit of 2.7 megatonnes CO_2-equivalents is based on a 25% increase in the trade of second-hand products. No consideration has been given here to a possible increase in consumption due to the so-called rebound effect. How much of the emission reduction through product lifespan extension will occur specifically within Dutch territory, is unknown.

The effect of the sustainable procurement of ground, road, and water construction is estimated at approximately 1 megatonnes CO_2-equivalents. Just as with lifespan extension, this currently only concerns scheduled policy. Additionally, there are lucrative measures aimed at textile (0.76 – 0.80

megatonnes CO_2-equivalents in proposed and adopted policy) and waste incineration installations (up to 0.80 megatonnes CO_2-equivalents in scheduled policy). Finally, the proposed policy for plastics is expected to achieve a climate benefit of 0.12 – 0.75 megatonnes CO_2-equivalents.

In the NPCE, the detailed policy measures primarily focus on achieving positive effects through the recycling of materials (close the loop), for example in the plastics industry. There are, however, certain exceptions. As such, the effects in the construction sector are mostly realised by the substitution with bio-based materials. The scheduled policy instruments for product lifespan extension also lead to the reuse of products (Warringa et al. 2024a).

5.5.2 Additional circular policy instruments

There is still a lot of environmental benefits achievable with additional circular instruments

Apart from the policy instruments in the NPCE, plenty is possible. Bachaus et al. (2024) have constructed a list of policy instruments in areas where, currently, there is little policy. They also selected instruments with a potentially strong incentive, from which a significant effect is expected in advance. The policy instruments were judged on their material resource effect (primary material use); environmental effects (climate, pollution, and biodiversity); and economic (competitiveness economic sectors), social (acceptability), and distribution effects (justice).

For several additional policy instruments, earlier research (Warringa et al. 2024b) also quantitatively estimated the climate effect. Bachaus et al. (2024) have made a qualitative assessment and tested this in an expert workshop. Some of the policy instruments named by Bachaus are completely new for the Netherlands but have already been introduced in other countries. This section also covers scheduled policy from the NPCE that has not yet been sufficiently detailed to be quantified, but for which an estimation of the expected effects could be made. The goal of this section is not to provide a complete overview, but to explore several additional policy instruments with potentially large effects. We therefore elaborate on eight options in this section that particularly have great potential effects on material resources and the environment (see Table 5.3).

Below, we first provide a short description of seven of the eight instruments in Table 5.3, with pros and cons for as far as these are known. EPR is further elaborated on in section 5.5.2. For many of the researched additional circular instruments, it is estimated that there are limited negative effects on the competitiveness of Dutch sectors (Bachaus et al. 2024). This is mainly because the policy instruments apply to both Dutch and European products as well as to imports from outside the EU. When products display a slight increase in price, it is estimated that these policy instruments are largely acceptable to consumers, especially if the products have a longer lifespan.

Several options with potentially large effects include the operational subsidy, the carbon standards, and the feedstock tax

1. *An operational subsidy for circular measures similar to the Dutch SDE+(+) scheme (Stimulation Sustainable Energy Production and Climate Transition)*

The operational subsidy is aimed at temporarily bridging the unprofitable peak of circular projects. Consider, for example, the current price difference between recycled plastics and the low prices for virgin plastics in China and the US. The estimated climate benefits of the operational subsidy for Dutch plastics are, globally, 3.3 – 4.6 megatonnes CO_2-equivalents. Climate benefits within Dutch territory occur when primary production in the Netherlands is reduced and/or when emissions from incineration are avoided. Conversely, there can also be additional emissions from recycling processes within the Netherlands. Therefore, the estimation of the effect of the operational subsidy

within Dutch territory varies from -1.0 to 3.1 megatonnes (Warringa et al. 2024b). This policy instruments also helps reduce environmental pollution because of primary material use. Of course, a proper assessment requires weighing these benefits against the cost of the subsidy.

2. *A European standard for sustainable carbon in the chemical industry*
The concept of this policy option is that a new European regulation mandates a minimum share of sustainable carbon (sustainable bioresources, secondary material resources, and captured CO_2). This means that, for example, plastics can no longer be made entirely out of oil, but that part of the oil must be substituted by bioresources or recycled plastic. At a standard of 20% sustainable carbon, a global climate benefit of 1.1 – 3.3 megatonnes CO_2-equivalents is expected to be achieved; at a standard of 30%, this would be 3.8 – 6.1 megatonnes CO_2-equivalents. Incidentally, this additional policy option partially overlaps with the announced national standard for recyclate and bio-based plastics in the Netherlands. The scope is, however, broader because the proposed European carbon standard applies to the entire chemical industry.

3. *A feedstock tax: pricing fossil resources for non-energy use*
Currently, fossil resources for non-energy use (e.g. the use of petroleum for plastic) is exempted from taxation in most cases (Vollebergh et al. 2021). This does not have to be a problem, as long as the emissions generated in the waste phase are still taxed. In practice, much of this usage remains outside any pricing mechanisms.

Table 5.3
Selection of eight policy instruments that can potentially be relevant for the intended targets

	Resource effect	Environmental effects			Economic, social, and distribution effects		
	Primary material use	Climate	Pollution	Biodiversity	Competitiveness economic sectors	Acceptability	Fairness
Operational subsidy circular measures	+	++	+	++	=	++	=
European standard for sustainable carbon in the chemical industry	+	++	+	++	=	+	=
Feedstock tax	+	+	+	+	-	- -	=
Mandated share green financing by banks	+	++	++	++	-	+	+
Plant-based protein standard for supermarkets	+	++	++	++	=	-	+
Consumption tax on dairy and meat	+	++	++	++	=	- -	-
Increased general VAT rate, excluding products with a low environmental pressure	+	++	++	++	=	- -	-
Standard for mandated share recyclate (in EPR)	+	+	+	+	=	+	=

Source: Bachaus et al. (2024)
NB: ++ Significant positive effect; + Positive effect; = Neutral; - Negative effect; -- Significant negative effect

A feedstock tax can ensure that fossil resources for plastics are taxed in the same way as fossil fuels. Copper8 (2023) estimates the emission reduction on Dutch territory of such a tax at 2.8 megatonnes. This is based on abolishing the exemption for the non-energy use of natural gas and coal. Further research is needed to determine whether such an instrument on a national scale would also lead to global climate benefits, or whether production is taken over by foreign countries (Warringa et al. 2024b).

More controversial policy options carry both risks and rewards

4. A mandatory share of green financing by banks

A mandatory share of green financing by banks aligns with the need for financing as a condition for circular market formation (see section 5.4 and Chapter 4). Recently, in the discussion around climate mitigation, the possibility of credit guidance was raised (Hickel & Stevenson 2024). In credit guidance, banks are prescribed what their credits must comply with. To achieve this, it is necessary to expand the mandate of central banks from solely price stability to include environmental targets. If this is possible, the environmental benefits could be substantial.

5. *A plant-based protein standard for supermarkets*
The protein transition is one of the programmes through which the Ministry of Agriculture, Nature and Food Quality is implementing the NPCE (IenW et al. 2023). One potential policy instrument to promote the protein transition is a reporting and sales standard for supermarkets. The standard would then prescribe that 50% of the supply of proteins must consist of plant-based sources and 50% from animal sources. Currently, approximately 57% of protein consumption comes from animal-based foods (Gezondheidsraad 2023). Many supermarkets have set themselves the goal of 60% plant-based proteins and 40% animal-based proteins by 2030 (LNV 2024). A protein norm for supermarkets established by the national government can help adjusting to the consumption pattern. This can lead to a decrease in greenhouse gases, pollution, and slow down biodiversity loss. The positive environmental effects in Table 5.3 will, however, only occur if the consumption pattern actually changes.

6. *A consumption tax on dairy and meat*
With a consumption tax on dairy and meat, comparable environmental benefits are achievable as with the plant-based protein standard for supermarkets. This instrument, and the previous one, will, it is expected, meet much resistance, because the protein transition is a political subject and the instruments intervene with the daily freedom of choice for consumers. The acceptability of a tax on dairy and meat is therefore estimated to be low.

7. *Increase in the general VAT rate, with exemptions for products that have a low environmental footprint*
The increase of the general VAT rate is also an instrument that can potentially be effective, but where problems with acceptability are also expected. Bachaus et al. (2024) estimate that this policy instrument may face resistance from companies that are directly affected in their production.

Experiences with circular instruments abroad

Research done by Bachaus et al. (2024) shows several other options from abroad that could help promote a circular economy. These examples are intended to inspire and provide learning opportunities. They are mostly aimed at promoting longer use of products and reducing the use of products.

Countries appear to use different instruments to encourage slowing the loop. For example, France has implemented a ban on and a fine for planned obsolescence to extend the lifespan of products. France has also extended the minimum legal warranty of products by six months, on top of the existing two years. Canada has introduced a deposit system for beverage cartons; Spain requires manufacturers to keep parts available for repairs for 10 years; Austria has introduced vouchers to finance repairs; and in Poland, so-called repair cafés are financed by the waste disposal tax.

Multiple countries have introduced a tax on packaging, including the United Kingdom, Italy, Spain, and Latvia.

When further developing policy instruments, it is useful for policymakers to focus on instruments with significant potential environmental effects, such as those named above. Additionally, they can learn from other countries by seeing which instruments are employed there to promote a circular economy. In the text box below, we provide several inspiring examples of circular instruments from abroad.

An expansion of requirements is needed to utilise EPR for recyclate

EPR systems are significant for the transition to a circular economy, as discussed in section 5.3.1. An important consideration here is not only to think outwards from the waste phase of a product, but also from the perspective of high-value utilisation of material resources. The Dutch Ministry of Infrastructure and Water Management (IenW) wants to expand EPR to new products groups and develop it further. Alongside improving the existing requirements for collection and recycling, this further development also concerns the issue whether it is possible to use EPR for 'higher' circular strategies. This includes reuse, repair, prevention, and the use of recycled material (recyclate) in products (IenW 2023a). Where it is not possible to incorporate such requirements in EPR systems, it is advisable to apply additional policy instruments.

The current requirements for EPR systems are primarily aimed at the collection of products for recycling and at limiting the amount of incinerated waste. These collection and recycling requirements do not, however, provide businesses with incentives for high-quality recycling, or for product designs with attention to reduced material resource use or a longer lifespan (Dimitropoulos et al. 2021).

The recently established Textile EPR in the Netherlands is an example of further developed EPR policy with expanded requirements. The textile industry is a complex global production chain, where one of the major challenges is to recycle materials of sometimes poor quality in a high-value manner (Van der Wal & Verrips 2019). Under EPR, producers (including importers) must comply with EPR requirements ('targets') for recycling, similar to those that already apply to car wrecks, as well as EPR requirements for preparing for reuse. As such, starting from 2030, 25% of the textiles placed on the market in the Netherlands per calendar year must be prepared for reuse. The EPR also includes requirements for fibre-to-fibre recycling, thereby promoting more 'high-quality' recycling. According to Warringa et al. (2024a), these requirements result in material savings of 140 kilotonnes of textiles, which, among other benefits, lead to water conservation and reduced land use. In addition to the EPR for textiles, a Textile Policy Programme for 2025-2030 is being prepared. The draft policy programme explicitly focuses on other circular strategies besides recycling, such as longer product lifespan, repair, reduced consumption, and substitution.

Policymakers can consider dynamic product requirements to promote innovation

The NPCE emphasises the need to reorganise the economic system based on different rules, making the supply of circular products increasingly attractive. One way to achieve this is by setting requirements that become stricter over time in the design and concrete development of policy instruments. To encourage high-quality recycling, better product design, and a longer lifespan, policymakers can consider dynamic requirements, such as a pioneer approach. The current performance of pioneers, or frontrunners, such as the use of a percentage of recycled material in a product, would then become the mandatory baseline in a few years for the entire sector. This requirement is then periodically tightened based on new insights about what is possible and for what costs.

An example of working with dynamic requirements are the minimum standards for high-quality processing in the so-called Dutch National Waste Management Plan LAP3. This approach is further developed in the Circular Materials Plan so these requirements can also be raised for new technologies. The principle of dynamic requirements can also potentially be applied in existing policy. This way, permanent innovation and environmental benefits can be promoted. Successful

examples of minimum standards in the past are reducing NO_x emissions and energy requirements for electrical and electronic devices.

Ambitious circular procurement can give a significant boost to the circular economy

By procuring goods and services in a circular manner, governments can influence market demand. In 2019, governments collectively procured goods and services worth 85 billion Euros (Steenmeijer et al. 2021). Therefore, public procurement is potentially an important instrument for accelerating the transition to a circular economy. By imposing requirements on resource use and the effects within the production chain, the government stimulates the supply of circular products. Companies that offer these products gain an advantage over those that offer products in a linear manner.

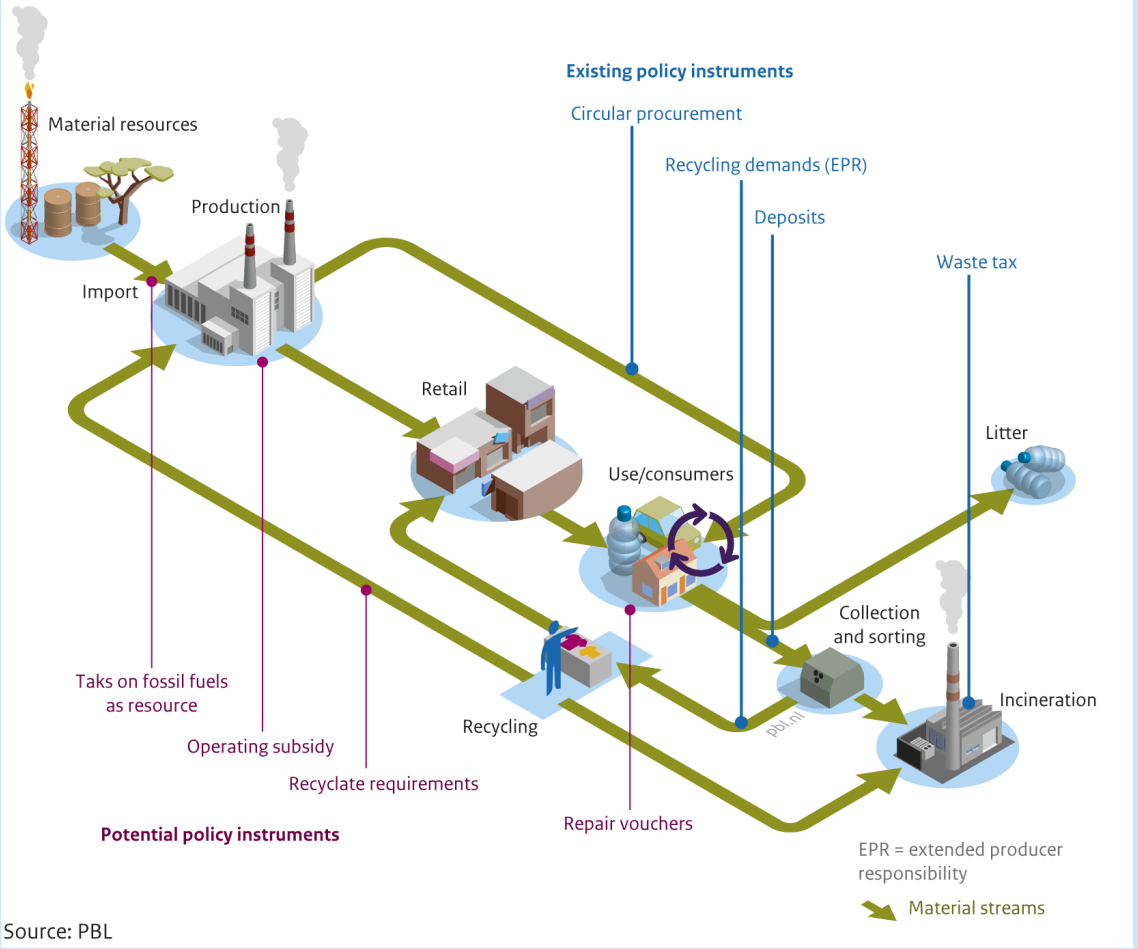
Policy aimed at more circular procurement and tendering has been in place for some time. For years, the conclusion has been that greater environmental benefits can be achieved, and circular innovation can be promoted by better utilising this instrument (see e.g. Zijp et al. 2020; Hanemaaijer et al. 2021). Through initiatives such as PIANOo and Buyer Groups (both collaborations of public procurers) in the Netherlands, circular procurement criteria and tools have been developed and offered. However, companies often note that the Dutch government has been somewhat conservative in practice in circular tendering and procurement, resulting in a lack of major innovations or circular impact (RHDHV 2024). If various governments can sharpen their circular procurement policies and make them more ambitious, they can support existing pioneers and can foster innovation in businesses.

The challenge in circular procurement is to work with all involved chain parties to establish requirements that go beyond recycling. This includes considering repair possibilities and the reuse of products and parts. Governments can also work with life cycle costing during tendering, taking into account maintenance costs and product lifespan during acquisition. A successful example is the renovation of an old defence building in Katwijk. By tendering with clear framework for the client, builder, and designer, it was possible to renovate using reused materials from donor buildings. This office renovation can be characterised as 'Paris proof', as it falls within the CO_2 budget per square metre of building to comply with the Paris Climate Agreement (Rijksvastgoedbedrijf 2024).

The reduction of environmental effects from socially responsible procurement (SRP) by the government can be significant. In 2021 and 2022, emissions resulting from SRP by the Dutch government were estimated to be at least 0.9 megatonnes CO_2-equivalents lower than they would have been without strategic procurement policies. This estimation was based on a sample of purchases in areas such as automation, energy, civil engineering and infrastructure, office facilities (such as clothing, catering, and furniture), office buildings, and transportation. When considering all procurements, the impact could be significantly larger. The potential for greater environmental benefits in the future through circular procurement and tendering is evidenced, among other things, by the estimated effects of measures from the NPCE. As such, scheduled policy to procure more circularly in civil engineering and infrastructure can lead to a reduction of approximately 1.2 megatonnes greenhouse gas emissions in 2030 (Warringa et al. 2024b).

Figure 5.2

Relevant mix of policy instruments for a circular production chain



Source: PBL

To accelerate the transition to a circular economy, it is necessary to use a mix of policy instruments which can vary between product groups

Using policy instruments is possible at various places in the production chain. Figure 5.2 above shows several relevant policy instruments of a general circular production chain: circular procurement, recycling requirements, deposit systems, the waste disposal tax, a tax on fossil resources for uses other than energy production (also known as the feedstock tax), operational subsidies for circular production processes, recyclate requirements, and repair vouchers. In the Figure, we indicate where these policy instruments intervene in the production chain and which instruments already apply. Noticeable here is that existing policy instruments are primarily aimed at waste and recycling.

Generally speaking, for each product group, a mix of policy instruments will be needed to mobilise all actors in the production chain. As such, a tax on the use of fossil fuels as material resource will predominantly affect primary industry, less so consumers. Deposit systems and repair vouchers are, on the other hand, very much aimed at the consumer.

It is important to realise that the optimal mix of policy instruments differs per product group. As such, deposit systems are only relevant for products with a relatively short lifespan and the Environmental Cost Indicator is a tool that has so far primarily been used in the construction sector to make projects comparable in terms of their environmental impact. Additionally, some policy

instruments have already been more extensively experimented with in the past than others. This makes it easier to estimate the potential effects compared to new instruments.

5.6 In conclusion

In current circular economy policy in the Netherlands, steps are being taken in the right direction, but the transition is not yet fast enough to achieve the ambition of full circularity by 2050. Does current policy lead to market formation, do policy instruments provide direction, is the transition institutionalised, is resistance expected because linear structures are being broken down? In this section, we reflect on these four acceleration conditions and, based on them, we provide several action options.

Key steps for acceleration are the goal trajectory and the instruments from the NPCE, which – if established – can have a significant impact. The transition can also be accelerated by calls from circular entrepreneurs, lessons on market formation from Corporate Social Responsibility Netherlands (MVO) and the Versnellingshuis, and breaking resistance against instruments like deposit systems.

Currently, it is uncertain if the direction of change is clear for a broad group of stakeholders. The various policy instruments, such as EPR instruments and landfill bans, are largely focused on the waste side of production and consumption chains. Instruments aimed at reducing consumption or extending product lifespan are in the minority. Resistance remains absent against the dismantling of linear modes of production and consumption. This is due to the still limited scope and strength of the current policy toolkit.

Dutch policy instruments in the field of the circular economy are characterised by a strong emphasis on recycling (close the loop), but less so on reducing material resource use (narrow the loop) and reusing products and parts (slow the loop). Key national, generic circular economy instruments include and remain landfill bans, waste disposal taxes, and waste taxes. Current regulatory instruments are primarily focused on producers. For consumers, guidance is provided through price policies for selected products (as such deposit systems and recycling contributions) alongside information (such as labels) to ensure that discarded products are offered for recycling.

The NPCE emphasises the urgency of more ‘push and pull’. This intention is particularly reflected in current proposed policies. However, we also see that the current established mix of policy instruments is not yet robust enough to accelerate the transition. This contributes to the current lack of substantial market demand for secondary raw materials, circular goods, and product-as-a-service. More established mandatory policies will therefore be needed in the coming years to realise the ambition of being fully circular by 2050. This applies to both European and national policies. New policies can emerge from the EU Circular Economy Action Plan or, for instance, from the elaboration of product legislation within the Ecodesign Regulation.

Movement is evident in each of the four acceleration features, but not enough to speak of a transition to the actual acceleration phase. Based on this ICER, we identify several important opportunities for policymakers to accelerate the transition to a circular economy for each acceleration criterion:

1. *Establish a clear direction of change*
    a. Make decisive decisions in the goal trajectory.
    b. Increase the powers and resources for transition teams.
    c. Develop a clear plan to involve a broader group of companies in the circular economy transition.
2. *Market formation*
    a. Involve a broader group of companies in circular practices through legislation.
    b. Further develop circular financing options.
    c. Increase demand for circular products through circular procurement, guiding consumer behaviour, and strong knowledge and chain partners.
3. *Resistance*
    a. Consensus is not an end in itself; account for resistance. Even if the circular transition offers perspective, dismantling the linear economy will inevitably lead to resistance.
    b. Instruments with low acceptability, such as a feedstock tax or a consumption tax on dairy and meat, can still yield significant environmental benefits.
    c. Resistance can also be overcome by offering attractive alternatives.
4. *Institutionalisation*
    a. Strong European circular economy policy is needed to create a level playing field for Dutch companies.
    b. Better utilise national instruments, such as extended producer responsibility and circular procurement by governments.
    c. Develop instruments with large potential environmental effects, such as a European tax on primary fossil raw materials for plastics, and an operational subsidy for circular measures to reduce the price difference between Dutch recyclate and primary raw materials.
    d. Clear, binding agreements between ministries, decentralised governments, businesses, and societal organisations about roles, responsibilities, and achieving of targets (governance).

A government-wide approach is necessary in the Netherlands to make circular solutions the new norm

The circular economy engages a broad group of stakeholders, bringing together economic, ecological, and social issues. The current steps towards a more circular economy are being taken by a driven yet select group of actors. To accelerate the transition, then, involvement from a broader group of consumers and producers is necessary. Additionally, an appropriate governance model is needed, in which the roles, powers, and responsibilities of the various public and private parties are clear.

To make progress towards 2030 and 2050, authorities, sufficient resources, and good legislation are all necessary. Alongside an overarching national approach, a specific approach focused on product groups is crucial to achieve workable agreements between the involved parties. The challenge remains to move beyond merely recycling materials by closing loops. This can be done by using recyclate in a high-quality manner, buying fewer items, and using them for longer. If the scope of the task and the direction of change are sufficiently clear and supported by a wide group of stakeholders, a route and pace can be outlined. The results and experiences of current pioneers can help in reaching realistic and ambitious agreements. Finally, for the acceleration of the circular economy transition, the rules need to be adapted, including changes to existing laws and

regulations across multiple ministries, as well as new forms of financing. Therefore, a government-wide approach is needed in the Netherlands to make circular solutions the new norm.

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