Impactanalyse circulaire plasticheffing

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List of abbreviations

ABS	Acrylonitrile Butadiene Styrene
CBAM	Carbon Border Adjustment Mechanism
CBS	Centraal Bureau voor de Statistiek
CE	Circular economy
CPB	Netherlands Bureau for Economic Policy Analysis
CR	Chemical recycling
EEA	European Environmental Agency
ELV	End-of-life Vehicles
EPR	Extended Producer Responsibility
EPS	Expanded Polystyrene
ESPR	Ecodesign for Sustainable Products Regulation
EU	European Union
GHG	Greenhouse gas
HDPE	High-density polyethylene
ITC	Information and telecommunication equipment
LCA	Life-cycle assessment
LDPE	Low-density polyethylene
LLDE	Linear low-density
MEG	Monoethylene glycol
M EUR	Million Euro
MMA	Methyl methacrylate
MR	Mechanical recycling
NL	the Netherlands
NRK	The Dutch Federation of the Rubber and Plastics Industry
PA	Polyamides
PBAT	Polybutylene adipate terephthalate
PC	Polycarbonate
PE	Polyethylene
PE-HD/MD	High/Medium Density Polyethylene
PE-LD	Low Density Polyethylene
PE-LD/LLDE	(Linear) Low Density Polyethylene
PET	Polyethylene terephthalate
PLA	Polylactic acid
PMMA	Polymethylmethacrylate
PP	Polypropylene
PPWR	Packaging and Packaging Waste Regulation
PS	Polystyrene
PUR	Polyurethane
PVC	Polyvinyl chloride
SAN	Styrene acrylonitrile
SUP	Single-Use Plastics

TFEU	Treaty on the Functioning of the European Union
US	United States
WEEE	Electrical and electronic equipment waste

Managementsamenvatting

Doel en doelstelling van de studie

De Nederlandse overheid is van plan om per 2028 een circulaire plastic heffing in te voeren. Deze studie onderzoekt de effecten van verschillende varianten voor de vormgeving van een dergelijke heffing op fossiele polymeren. Deze effectenstudie heeft betrekking op verschillende varianten voor de vormgeving van een heffing op primaire fossiele polymeren. Specifiek zijn de beleidseffecten beoordeelt van een heffing binnen de plasticwaardeketen met als aangrijpingspunt de productie- en verwerking van primaire fossiele polymeren in Nederland.[1] Daarnaast beoordeelt de studie de economische en milieu impact van een heffing op polymerenverwerkers of -producenten in Nederland, waarbij marktkenmerken en de potentiële rol van gerecyclede en bio-gebaseerde polymeren worden onderzocht.

Achtergrond

De Nederlandse plasticindustrie is een heterogene sector die sterk afhankelijk is van primaire fossiele grondstoffen/polymeren en wordt gekenmerkt door intensieve handel. De Nederlandse polymeerproductie-industrie bestaat uit enkele grote bedrijven die exportgericht zijn en voornamelijk afhankelijk zijn van fossiele grondstoffen. Deze industrie heeft de afgelopen jaren te maken gehad met hoge productiekosten en internationale concurrentie. Ondertussen bestaat de Nederlandse polymeerverwerkingsindustrie uit meer dan duizend bedrijven[2] die verschillende plastic producten maken. Net als bij de polymeerproductie heeft de polymeerverwerking de afgelopen jaren te maken gehad met hogere kosten. De polymeerverwerkingssector is echter minder exportgericht dan de polymeerproductiesector.

De Nederlandse plasticindustrie doet inspanningen om de overstap te maken naar circulaire alternatieven en methoden, voornamelijk door middel van recycling, hoewel ook bio-gebaseerde plastics steeds meer aandacht krijgen. Nederland heeft van oudsher een toonaangevende recyclingindustrie met aanzienlijke groeimogelijkheden.[3] Toch verkeert de sector in een kwetsbare positie door concurrentie van goedkope plastics van buiten de EU, wat de uitbreiding van recyclingactiviteiten bemoeilijkt. Als gevolg hiervan hebben verschillende toonaangevende recyclingbedrijven in Nederland de afgelopen jaren faillissement aangevraagd. Bio-gebaseerde plastics zijn over het algemeen duurder dan primaire fossiele polymeren, met prijsvariaties die worden beïnvloed door factoren zoals technologische vooruitgang en grondstof- en energiekosten.

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[1] *De invoering van een heffing op plastic producten valt buiten de scope van deze studie.*

[2] *CE Delft (2022). Een nationale belasting op primair fossiel plastic? Effecten op milieu en economie.*

[3] *In Nederland wordt meer dan de helft van het plasticafval nog altijd niet gerecycled. Energieterugwinning is nog steeds de meest gebruikte verwerkingsmethode.*

Opties voor een heffing op de productie of verwerking van primaire fossiele polymeren

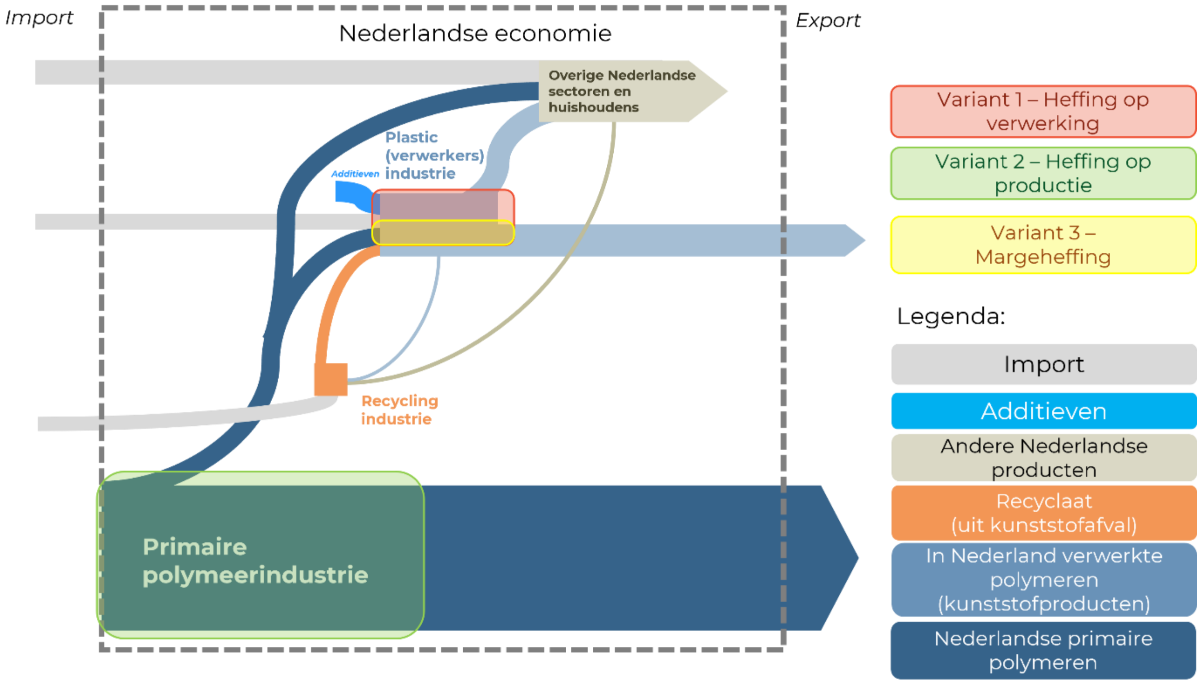
Drie varianten van een heffing op primaire fossiele polymeren zijn geanalyseerd:

1. **Variant 1 – Heffing op de verwerking van polymeren:** een vlakke heffing op de verwerking van primaire fossiele polymeren, met een beoogde gemiddelde jaarlijkse belastingopbrengst van 547 miljoen EUR.
2. **Variant 2 – Heffing op de productie van polymeren:** een vlakke heffing op de productie van primaire fossiele polymeren naast de voorgestelde Nederlandse Circulaire Plastic Norm, met een beoogde gemiddelde jaarlijkse belastingopbrengst van 547 miljoen EUR; en

een derde variant, die een heel andere structuur heeft dan de eerste twee:

3. **Variant 3 – Margeheffing:** een alternatieve vormgeving van de beoogde Nederlandse Circulaire Plastic Norm, waarbij in plaats van een handelssysteem in circulaire polymeereenheden, verwerkers alleen een heffing moeten betalen over het tekort in de hoeveelheid verwerkte circulaire polymeren in een specifiek jaar ten opzichte van de norm.

Figuur 1: Weergave van verschillende heffingsvarianten binnen de Nederlandse polymeerproductie- en verwerkingsketen



De pijlen geven de stromen van plastic polymeren, plastic producten en plastic afval binnen de Nederlandse economie aan en materialen die worden geïmporteerd/geëxporteerd buiten Nederland. Importen omvatten niet-Nederlandse grondstoffen en producten die door de Nederlandse economie worden gebruikt, zoals niet-Nederlands plasticafval voor de Nederlandse recyclingsector of niet-Nederlandse primaire polymeren voor de Nederlandse plasticindustrie.

De illustratie is gebaseerd op een figuur van het CBS (2016). Circulaire economie in Nederland.

Belangrijkste bevindingen

Het invoeren van een polymerenheffing, of deze nu gericht is op Nederlandse verwerkers of producenten, zou een aanzienlijke negatieve impact hebben op de industrie. Dit komt met name door verwachte productieverliezen (zogenaamde weglekeffecten) voor met name basispolymeren en plastic producten. De analyse van de verschillende heffingsvarianten laat zien dat de combinatie van de huidige blootstelling van de Nederlandse plasticmarkt aan wereldwijde concurrentie en de mogelijke prijsstijging als gevolg van de heffing, een risico vormt voor de Nederlandse plasticindustrie. Een heffing zou kunnen leiden tot een aanzienlijke afname van de Nederlandse activiteiten voor de verwerking en productie van basispolymeren, die doorgaans in grote hoeveelheden tegen lage kosten worden geproduceerd en in tal van toepassingen worden gebruikt. Deze producten vormen meer dan de helft van de Nederlandse productie en verwerking.

Een heffing op de verwerking of productie van polymeren zal naar verwachting nauwelijks leiden tot extra substitutie van primaire fossiele polymeren, afgezien van de substitutie die al voortvloeit uit de voorgenomen Circulaire Plastic Norm en de Europese Verordening inzake Verpakkingen en Verpakkingsafval (PPWR). Bij een heffing op de verwerking van polymeren (Variant 1) zouden de voorgenomen plastic norm en de heffing een overlappend effect hebben, aangezien de norm verwerkers al aanmoedigt om de meest economisch en technologisch haalbare circulaire alternatieven te gebruiken. Daarnaast zal een heffing op de productie van polymeren (Variant 2) naar verwachting geen effect hebben op de substitutie van primaire fossiele polymeren door circulaire alternatieven binnen de Nederlandse verwerkingssector. Aangezien het merendeel van de Nederlandse polymeerproductie bestemd is voor export, zullen Nederlandse verwerkers waarschijnlijk uitwijken naar goedkopere buitenlandse aanbieders van primaire fossiele polymeren in plaats van over te stappen op circulaire varianten.

Methodologie

In deze studie is gekozen voor een combinatie van kwalitatieve en kwantitatieve onderzoeksmethoden om inzicht te geven in de impact van een heffing op zowel macro- als microniveau. De studie bevat een uitgebreid literatuuronderzoek, aangevuld met vijf interviews en een schriftelijke reactie van verschillende belanghebbenden uit de sector. Daarnaast wordt via een kwantitatieve impactanalyse onderzocht in hoeverre de heffing kan leiden tot een weglekeffect en tot substitutie van primaire fossiele polymeren door circulaire alternatieven. Ten slotte worden verschillende profielen gebruikt om segmenten van de waardeketen te identificeren die meer of minder sterk worden beïnvloed in vergelijking met de algehele sector. De profielen zijn gebaseerd op twee belangrijke indicatoren: 1) de gevoeligheid voor een weglekeffect en 2) de techno-economische haalbaarheid van substitutie door circulaire polymeren.

De kwantitatieve analyse is gebaseerd op historische en actuele data, hoewel verschillende andere factoren van invloed kunnen zijn op hoe een heffing de Nederlandse industrie zou kunnen beïnvloeden. De analyse van de verwachte prijsgevoeligheid van polymeren en plasticproducten maakt gebruik van deze historische gegevens. Een heffing kan namelijk een prijsschok veroorzaken die aanzienlijk groter is dan eerdere prijsveranderingen. Als een dergelijke prijsschok zich voordoet, kan dit leiden tot een sterkere prijsgevoeligheid dan tot nu toe werd waargenomen, wat het risico op een groter weglekeffect vergroot. Daarnaast is de huidige plasticmarkt instabiel. De wereldwijde prijzen van primaire fossiele polymeren zijn de afgelopen twee jaar sterk gedaald. Dit heeft geleid tot een forse afname van productie en verwerking in Europa, waaronder Nederland, waar de productiekosten relatief hoog liggen. Of deze trend zich zal voortzetten, is onzeker en afhankelijk van mondiale marktomstandigheden en beleidsontwikkelingen.

Impact van een heffing op primaire fossiele polymeren op de Nederlandse sector

Voor elke heffingsvariant wordt de impact op de Nederlandse sector ingeschat, met bijzondere aandacht voor het verwachte weglekeffect en de mate van substitutie van primaire fossiele polymeren door circulaire polymeren.

Een belangrijke bevinding met betrekking tot de varianten is dat de heffing een prijsschok zou kunnen veroorzaken, wat mogelijk leidt tot een sterkere marktreactie dan in de recente geschiedenis is waargenomen. Afhankelijk van de mate waarin producenten of verwerkers de kosten van de heffing doorberekenen in de prijs, bestaat er het potentieel voor een relatief grote prijsstijging, wat mogelijk leidt tot een groter weglekeffect dan wat recentelijk is waargenomen. Bij een heffing op verwerkers (Variant 1 en 3) kan de prijsstijging lager uitvallen dan oorspronkelijk geschat, indien verwerkers een deel van de kosten absorberen om vraagverlies te beperken. Voor een heffing op de productie van polymeren (Variant 2), rekening houdend met de huidige financiële situatie in de sector, wordt echter niet verwacht dat producenten de ruimte hebben om de kosten van de heffing te absorberen om vraagverlies te beperken.

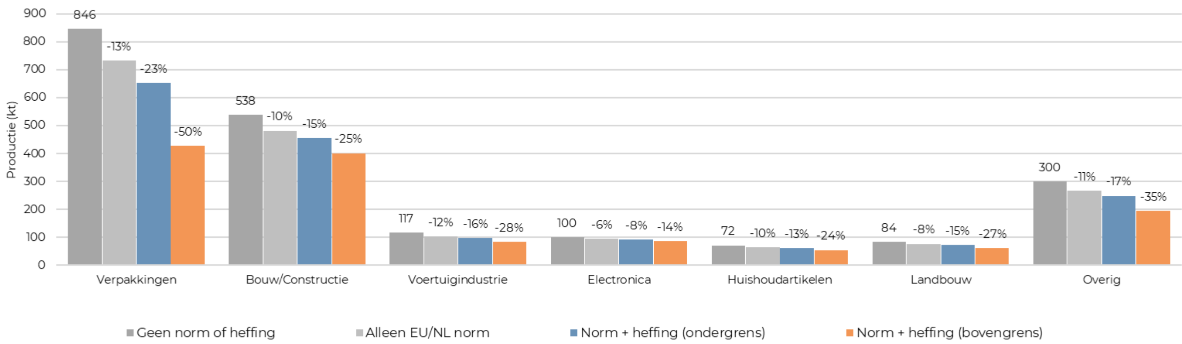
Heffing op de verwerking van polymeren (Variant 1)

Een heffing op de verwerking van polymeren zou een vlakke heffing zijn op alle primaire fossiele polymeren die in Nederland worden verwerkt. De initiële belastinggrondslag voor deze heffing, zonder rekening te houden met een mogelijk weglekeffect en substitutie, wordt geschat op ongeveer 1.070 kt primaire fossiele polymeren, los van het feit of het wordt geïmporteerd of binnenlands wordt geleverd.

Het heffingstarief dat nodig is om aan de jaarlijkse begrotingsvereiste van 547 miljoen EUR te voldoen, hangt af van de impact van de heffing op de productie. Het heffingstarief is afhankelijk van de omvang van de belastinggrondslag, die kan worden beïnvloed door het weglekeffect en de substitutie veroorzaakt door de heffing. In dit geval worden twee heffingstarieven overwogen: 640 EUR/t (zonder substitutie) en 920 EUR/t (met substitutie als een best-case marktscenario voor circulaire polymeren). De effectieve kosten van de heffing per ton plasticproduct zijn lager dan het heffingstarief, aangezien plastic producten ook circulaire en vrijgestelde polymeren bevatten.

Het implementeren van een heffing op de verwerking van polymeren zou kunnen leiden tot een significante negatieve impact op de concurrentiekracht van de Nederlandse plasticverwerkingsindustrie, met name voor verpakkingen. Met een heffingstarief van 640 EUR/t en de EU/Nederlandse normen wordt geschat dat het weglekeffect 18% tot 36% zou zijn. Met een heffingstarief van 920 EUR/t en de EU/Nederlandse normen zou dit 21% tot 47% zijn. Het grootste risico op een weglekeffect betreft plastic producten gemaakt van basispolymeren (vooral verpakkingen), zoals weergegeven in de onderstaande figuur.

Figuur 2: Weglekeffect van een heffing op de verwerking van polymeren (640 EUR/t) in 2030, per toepassingstype[4]



Het weglekeffect kan groter zijn dan geschat vanwege het risico van een extreme prijsschok, waardoor het mogelijk is dat de budgettaire taakstelling niet kan worden gehaald. Het is belangrijk op te merken dat de schattingen van het weglekeffect zijn gebaseerd op historische data, waarbij de heffing zou kunnen leiden tot een prijsschok die niet is waargenomen in het recente verleden. Met een heffing van 640 EUR/t zou deze prijsschok tot tien keer groter kunnen zijn dan de prijsveranderingen van plastic producten die in het verleden zijn waargenomen. Als de heffing een significante prijsschok veroorzaakt, kan het weglekeffect hoger zijn dan geschat. Met een nog groter weglekeffect bestaat het risico van een grote verschuiving van Nederlandse verwerking naar andere landen, en dus een afnemende belastinggrondslag.

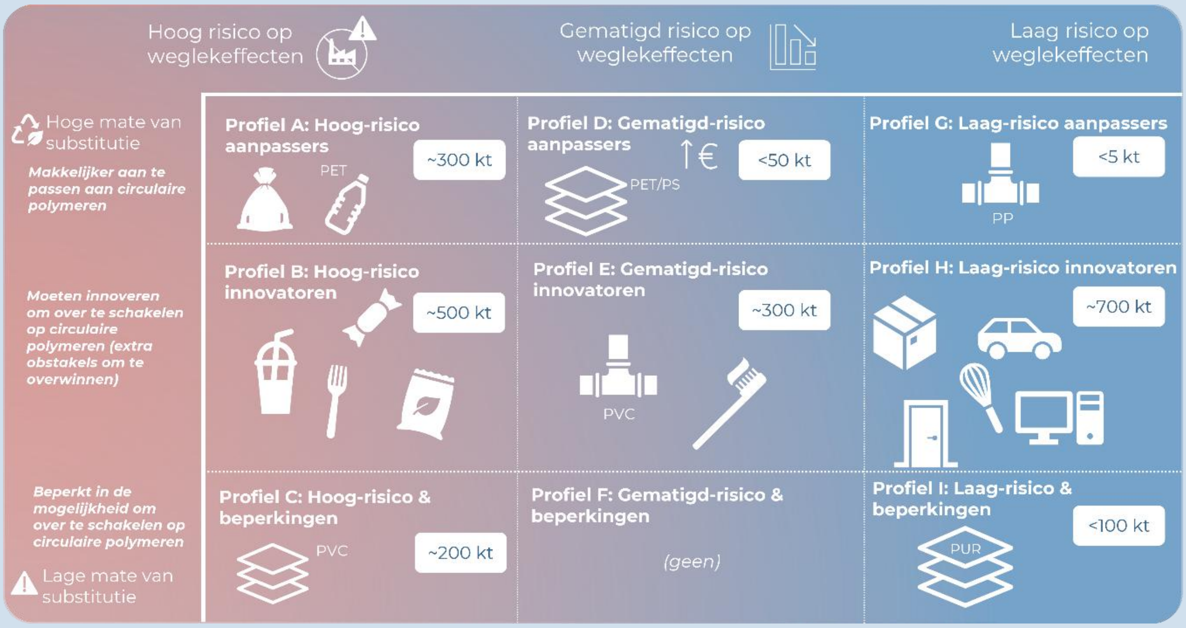
Van de heffing wordt verwacht dat deze slechts in beperkte mate bijdraagt aan de substitutie van primaire fossiele polymeren door circulaire polymeren, bovenop de bestaande EU- en Nederlandse normen. De heffing bovenop de norm zal waarschijnlijk niet leiden tot significante extra substitutie, bovenop wat de Nederlandse en EU-normen al aanmoedigen op basis van de huidige marktomstandigheden. In het beste geval zou een norm de bestaande circulaire polymeermarkt kunnen hervormen, wat zou kunnen leiden tot een grote toepassing van circulaire polymeren, vooral bio-PE. De combinatie van beide maatregelen zou echter minder substitutie kunnen opleveren dan de norm alleen, vanwege het weglekeffect.

[4] *Het weglekeffect van de EU/NL-normen is gebaseerd op de resultaten van de CE Delft studie (2024), waar de verwachte impact 5-18% (gemiddeld 11,5%) zou zijn. In deze studie is de verwachte impact verdeeld over de plastic toepassingstypes op basis van de hoeveelheid niet-vrijgestelde primaire fossiele polymeren die per toepassing worden verwerkt.*

De impact van een heffing op de verwerking van polymeren op fabrikanten van verschillende plastic producten.

Om de verschillende reacties van de Nederlandse plasticindustrie op een heffing te onderzoeken, is een profielanalyse uitgevoerd. Dit resulteerde in de uiteenzetting van acht profielen voor plastic producten. Deze profielen zijn gebaseerd op het categoriseren van producten met een hoog/gematigd/laag risico op een weglekeffect en de mate van substitutie door circulaire polymeren. De onderstaande figuur geeft een overzicht van deze profielen met illustratieve producten.

Figuur 3: Overzicht van profielen met illustratieve producten



De profielen tonen verschillende mogelijke gevolgen van een heffing. Voor een aanzienlijk deel van de Nederlandse productie van plastic producten lijkt er een hoog risico op weglekeffecten te bestaan (profielen A, B en C). Dit zijn meestal veelvoorkomende producten die zeer prijsconcurrerend zijn (zoals wegwerpplastic). Voor bedrijven die deze producten produceren, zou een heffing een hoog risico op faillissement creëren (vooral voor kleine/middelgrote bedrijven) of een verplaatsing van activiteiten naar andere landen. Dit is vooral een risico wanneer een heffing niet geleidelijk wordt geïmplementeerd. Hierdoor hebben bedrijven weinig tijd om over te schakelen naar circulaire methoden voordat de heffing financiële druk op het bedrijf zou leggen. Vooral voor bedrijven met weinig mogelijkheden voor circulaire alternatieven is de kans groot dat een heffing zal leiden tot sluitingen. Aan de andere kant zijn er ook Nederlandse producten die minder risico lopen op weglekeffecten (Profielen G, H en I). Deze plastic producten zijn meestal concurrerend op basis van kwaliteit in plaats van prijs (bijv. hoogwaardige goederen zoals keukenwaren, deuren/luiken, plastic voor auto's/elektronica), maar ook producten die hoge transportkosten hebben, waardoor een concurrentievoordeel voor lokale producenten ontstaat. Voor bedrijven in deze profielen, ongeacht of bedrijven besluiten primaire fossiele polymeren te vervangen door circulaire polymeren, zal een heffing waarschijnlijk de prijs voor tussenliggende/eindgebruikers verhogen en de winstmarges voor deze bedrijven tot op zekere hoogte verminderen. De onderstaande tabel toont de verschillende effecten van een heffing voor een specifiek product dat binnen dat profiel valt.

Tabel 1: De impact van een heffing op de verwerking van polymeren op illustratieve producten per profiel

Profiel	Illustratief product	% Weglekeffect (Variant 1a: 640 EUR/t)	Maximum potentiële substitutie met circulaire alternatieven
Profiel A: Hoog-risico aanpasser	PET fles	-29% tot -45%	Tot 90% met rPET
Profiel B: Hoog-risico innovator	Zakken en tasjes van PE	-28% tot -64%	Gerecycled PE kan niet worden gebruikt voor voedsel-verpakkingen; het kan worden vervangen door bio-PE.
Profiel C: Hoog-risico & Beperkingen	Vloeren van PVC	-34% tot -81%	Verontreinigingen in gerecycled PVC kunnen de kwaliteit verminderen.
Profiel D: Gematigd-risico aanpasser	Platen/folies van PET (hoge kosten)	-23% tot -49%	Hangt af van de toepassing; het kan oplopen tot 100% voor niet-voedseltoepassingen.
Profiel E: Gematigd-risico innovator	Pijpen/slangen van PVC	-20% tot -47%	25-60% substitutie met mechanisch recyclaat; tot 100% met chemisch recyclaat of bio-gebaseerd materiaal.
Profiel F: Gematigd-risico & Beperkingen	*(geen)*		
Profiel G: Laag-risico aanpasser	Pijpen/slangen van PP	-14% tot -21%	Tot 100% substitutie met rPP in bouwtoepassingen.
Profiel H: Laag-risico innovator	Keuken- en tafelgerei	-11% tot -20%	Beperkt gebruik van gerecyclede polymeren voor voedseltoepassingen (alleen rPET). Bio-gebaseerde alternatieven beschikbaar voor keuken- en tafelgerei gemaakt van polymeren zoals PP/PE.
Profiel I: Laag-risico & Beperkingen	Platen/folies van PUR	-17% tot -26%	Circulaire alternatieven kunnen ongeveer 25% van primaire fossiele PUR vervangen.

Heffing op de productie van polymeren (Variant 2)

Een heffing op de productie van polymeren is een vlakke heffing op alle primaire fossiele polymeren die in Nederland worden geproduceerd. De initiële belastinggrondslag voor de deze heffing, voordat rekening wordt gehouden met weglekeffecten en substitutie, wordt geschat op ongeveer 3.770 kt primaire fossiele polymeren die binnenlands worden geproduceerd.

Net als bij de heffing op de verwerking van polymeren (Variant 1) hangt het heffingstarief dat nodig is om aan de jaarlijkse budgettaire taakstelling van 547 miljoen EUR te voldoen af van de impact van de heffing op de productie. Dit kan variëren afhankelijk van het verwachte resultaat van de heffing. Om aan de taakstelling te voldoen, is het heffingstarief afhankelijk van de omvang van de belastinggrondslag. Dit kan worden beïnvloed door de eventuele weglekeffecten en substitutie veroorzaakt door de heffing. In dit geval wordt slechts één heffingstarief overwogen om aan de taakstelling te voldoen: 320 EUR/t. In tegenstelling tot de heffing op de verwerking van polymeren (Variant 1) zijn de effectieve kosten van de heffing *per ton polymeer* gelijk aan het heffingstarief voor alle niet-vrijgestelde primaire fossiele polymeren.

De implementatie van een heffing op de productie van polymeren kan leiden tot een aanzienlijke negatieve impact op de concurrentiekracht van de Nederlandse primaire

polymeerindustrie, met name basispolymeren. Met een heffingstarief van 320 EUR/t en de EU en Nederlandse normen wordt geschat dat het weglekeffect tussen de 26% en 70% zou liggen. Voor sommige basispolymeren kan een heffing tegen dat tarief zelfs leiden tot het volledig stopzetten van productie. Bovendien, aangezien het heffingstarief als relatief hoog wordt beschouwd in vergelijking met historische prijsveranderingen, wordt verwacht dat het weglekeffect aan de hoge kant zal zijn. Bij een groter weglekeffect dan geschat, bestaat het risico op een aanzienlijke verschuiving van polymeerproductie naar andere landen. Dit zou resulteren in een lagere belastinggrondslag. Gelet op de aanzienlijke prijsgevoeligheid van polymeren zullen Nederlandse verwerkers waarschijnlijk overstappen op buitenlandse leveranciers van primaire fossiele polymeren in plaats van circulaire polymeren.

De impact van een heffing op de productie van polymeren op producenten van verschillende polymeren.

Om de verschillende reacties van de Nederlandse plasticindustrie op een heffing op de productie van polymeren te onderzoeken, is een profielanalyse uitgevoerd. Dit resulteerde in de uiteenzetting van zes profielen voor plastic polymeren. Deze profielen zijn gebaseerd op het categoriseren van producten met een hoog/gematigd/laag risico op weglekeffecten en de mate van substitutie door circulaire polymeren.

Uit de profielanalyse blijkt een duidelijk onderscheid tussen basispolymeren en specialiteitspolymeren. Een groot deel van de Nederlandse polymeerproductie wordt gekarakteriseerd door een hoog risico op weglekeffecten (profielen A, B en C). Dit betreft meestal basispolymeren. Voor producenten van deze polymeren bestaat er een hoog risico op sluiting van fabrieken en mogelijk verplaatsing van activiteiten naar buiten Nederland, ongeacht de technische mogelijkheid om de productie van primaire fossiele polymeren te vervangen door circulaire polymeren. Aan de andere kant zijn er ook polymeren die minder risico lopen op weglekeffecten (Profielen G, H en I). Deze primaire polymeren zijn meestal concurrerend op basis van kwaliteit in plaats van prijs (bijv. specialiteitspolymeren zoals PA, PMMA en PUR). Voor bedrijven in deze profielen, ongeacht of bedrijven besluiten de productie van primaire fossiele polymeren te vervangen door circulaire polymeren, zal een heffing waarschijnlijk de prijs van deze polymeren verhogen. De onderstaande tabel illustreert de verschillende effecten van een heffing voor een specifiek product dat binnen dat profiel valt.

Tabel 2: De impact van een heffing op de productie van polymeren op illustratieve producten per profiel

Profiel	Illustratief product	% Weglekeffect (Variant 2a: 320 EUR/t)	Maximum potentiële substitutie met circulaire alternatieven
Profiel A: Hoog-risico aanpasser	PET	-28% tot -98%	Tot 90-100% te vervangen met rPET.
Profiel B: Hoog-risico innovator	PE-HD/MD	-24% tot -100%	Beperkt gebruik van recyclaat in contactgevoelige toepassingen. Tot 95% vervangbaar met bio-PE, maar voor specifieke toepassingen. Potentiële leveringsbeperkingen.
Profiel C: Hoog-risico & Beperkingen	PVC	-32% tot -100%	Tot 100% voor specifieke toepassingen, maar verontreinigingen in rPVC

			maken het moeilijk om het in de meeste toepassingen toe te passen.
Profiel D: Gematigd-risico aanpasser	PA	-7% tot -22%	rPA kan worden verwerkt in niet-kritische toepassingen; de huidige praktijken combineren mechanisch en chemisch recyclen.
Profiel E: Gematigd-risico innovator	*(geen)*		
Profiel F: Gematigd-risico & Beperkingen	PMMA	-11% tot -30%	Tot 30-50% vervangbaar met chemisch gerecycled PMMA.
Profiel G: Laag-risico aanpasser	*(geen)*		
Profiel H: Laag-risico innovator	*(geen)*		
Profiel I: Laag-risico & Beperkingen	PUR	-5% tot -16%	Circulaire alternatieven kunnen ongeveer 25% van primaire fossiele PUR vervangen. Versnipperd PUR kan opnieuw worden gebruikt, maar de gewijzigde eigenschappen beperken het gebruik. Beperkte vervangbaarheid met chemisch recyclaat of bio-gebaseerde polymeren.

Margeheffing (Variant 3)

Een margeheffing zou een alternatieve uitvoering kunnen zijn van een norm voor circulaire polymeren (25-30%), waarbij het gaat om een vlakke heffing over het tekort in de hoeveelheid verwerkte circulaire polymeren in een specifiek jaar ten opzichte van de norm. De margeheffing zou worden geïmplementeerd naast de Europese norm PPWR. Omdat de heffing alleen van toepassing zou zijn op het tekort in de hoeveelheid verwerkte circulaire polymeren ten opzichte van de norm, zou de belastinggrondslag relatief klein zijn. Naar schatting zouden ongeveer 325 kt primaire fossiele polymeren voor verwerking onderhevig zijn aan deze heffing.

In tegenstelling tot de andere twee heffingsvarianten, wordt het tarief van de margeheffing niet bepaald op basis van een budgettaire taakstelling, maar zou bij de tariefstelling uitgangspunt zijn dat dit verwerkers voldoende aan moet moedigen om aan de norm te voldoen. Deze variant van de heffing wordt geanalyseerd met een heffingstarief van 1.000 EUR/t. Dit heffingstarief is gekozen omdat het hoog genoeg is om de circulaire alternatieven van polymeren met een hoog volume aantrekkelijker te maken dan primaire fossiele polymeren, gebaseerd op huidige prijsramingen. Het heffingstarief dat nodig is om aan de norm te voldoen, kan echter veranderen afhankelijk van hoe de prijzen en beschikbaarheid van primaire fossiele en circulaire plastics zich ontwikkelen. De 1.000 EUR/t zou niet van toepassing zijn op alle primaire fossiele polymeerverwerking, maar op een kleiner aandeel dat niet voldoet aan de norm (geschat op 18,5%). Daarom zouden de effectieve extra kosten van de heffing per ton plastic product veel lager zijn, namelijk geschat op ongeveer 185 EUR per ton plastic product.

De implementatie van een margeheffing voor verwerkers zou leiden tot enige weglekeffecten voor de Nederlandse plasticverwerkende industrie. Met een heffingstarief van 1.000 EUR/t en de EU PPWR-norm voor verpakkingen, wordt geschat dat het weglekeffect tussen de 4% en 15% zou liggen. Het grootste risico op weglekeffecten is voor plastic producten gemaakt van basispolymeren, met name verpakkingen. Zoals eerder vermeld, kan het weglekeffect echter hoger zijn gezien de prijsstijging nog steeds relatief hoog is in vergelijking met historische veranderingen in de binnenlandse prijzen.

Een margeheffing kan leiden tot een onzekerder niveau van substitutie in vergelijking met een norm die uitgaat van een handelssysteem. Een norm met een handelssysteem creëert marktgedreven prikkels, waarbij de nalevingskosten worden aangepast op basis van vraag en aanbod van circulaire plastic eenheden. Dit zorgt ervoor dat de norm wordt gehaald, aangezien bedrijven met een tekort worden gecompenseerd door bedrijven met een overschot. Daarentegen brengt een margeheffing vaste administratieve lasten per ton primaire fossiele polymeren met zich mee die worden verwerkt, zonder de mogelijkheid van compensatie voor bedrijven die boven de norm presteren. Hoewel het gebruik van circulaire polymeren kan worden aangemoedigd bij bedrijven die onder de norm presteren, kunnen zij ervoor kiezen alsnog de margeheffing te betalen, waardoor substitutie minder zeker is dan bij een handelssysteem.

A standard gap levy would lead to a more uncertain level of substitution compared to a standard with a trading system. A standard with a trading system creates market-driven incentives, adjusting compliance costs based on supply and demand for circular plastic units. This ensures the standard is met, as companies with a deficit are compensated by those with a surplus. In contrast, a standard gap levy has a fixed compliance cost per ton of virgin fossil polymer processed, with no compensation from *surplus* companies. While it may encourage more circular plastic use from those which have a low share of circular polymer use, companies can still offset this by paying the gap levy, making substitution less certain than with a trading system.

Administratieve en juridische gevolgen

De administratieve lasten van de heffing voor bedrijven bestaan vooral uit het aantonen van hun recht op vrijstelling. Om in aanmerking te komen, moeten bedrijven bewijs leveren dat ze voldoen aan de vrijstellingscriteria, zoals het gebruik van circulaire polymeren. Bij een heffing op de verwerking van polymeren (Variant 1) met de Nederlandse norm, zal de aantoonbaarheid van circulaire polymeren al vereist zijn door de norm, waardoor de aanvullende administratieve last van de heffing beperkt zou zijn. Daarnaast zou uitbreiding van de heffing naar alle EU-lidstaten de weglekeffecten kunnen verminderen, maar dit is zeer onwaarschijnlijk vanwege de unanimiteitsvereiste van de EU inzake belastingzaken. De margeheffing (Variant 3), die kan worden gezien als een boete voor het niet-naleven van de Europese Richtlijn Ecodesign, zou in potentie makkelijker (hoewel nog steeds onwaarschijnlijk) kunnen worden aangenomen door andere EU-landen, wat zou helpen om het weglekeffect te verminderen.

Aanbevelingen

1. **Een heffing op de productie van polymeren (Variant 2) moet niet worden ingevoerd.** Aangezien producenten van primaire fossiele polymeren in Nederland zeer vatbaar zijn voor weglekeffecten en er zeer beperkte/geen verwachting is dat een dergelijke heffing zal leiden tot extra substitutie van primaire fossiele polymeren door circulaire polymeren, is een heffing op de productie van primaire fossiele polymeren geen geschikte beleidsoptie om de circulaire transitie in Nederland te bevorderen noch om de beoogde budgettaire opbrengst te halen.

2. **Indien wordt gekozen voor een heffing op de verwerking van polymeren (Variant 1), wordt het aanbevolen om een gefaseerde implementatie toe te passen.** Een gefaseerde implementatie zou een grote prijsschok voor Nederlandse verwerkers kunnen voorkomen door het heffingstarief geleidelijk te verhogen. Deze aanpak zou het risico op weglekeffecten echter niet volledig elimineren, maar biedt bedrijven wel de tijd om zich aan te passen. Dit zou de overheid ook in staat stellen om de marktreactie te monitoren en waar nodig aanpassingen door te voeren om onbedoelde negatieve gevolgen te minimaliseren. Gelet op het risico op weglekeffecten, kan het echter zijn dat de beoogde budgettaire opbrengst niet wordt gehaald met een heffing op de verwerking van polymeren.
3. **Als een margeheffing (Variant 3) wordt ingevoerd, moet worden overwogen hoe deze heffing op EU-niveau kan worden geïmplementeerd.** De Nederlandse norm zou als voorbeeld kunnen dienen om op EU-niveau te worden overgenomen, aangezien dit zou bijdragen aan een gelijk speelveld binnen de Europese industrie. De margeheffing is, vergeleken met de heffing op polymeerproducenten en verwerkers (varianten 1 en 2), eenvoudiger te implementeren op Europees niveau. Dit komt doordat de margeheffing kan worden gepresenteerd als een sanctie voor niet-naleving van een EU-brede norm. Hoewel belastingharmonisatie binnen de EU complex is, verloopt de afstemming van sancties bij overtreding van EU-wetgeving doorgaans eenvoudiger. Bij de beslissing om een margeheffing in te voeren, is het belangrijk ook de grotere onzekerheid over de effectiviteit ervan mee te nemen in vergelijking met een norm op basis van een handelssysteem.
4. **Creëer een businesscase voor circulaire plastics en faciliteer langetermijninvesteringen via aanvullende/alternatieve Nederlandse/EU-beleidsinstrumenten.** Een heffing op Nederlandse producenten of verwerkers van primaire fossiele polymeren is mogelijk ineffectief beleid om de circulaire transitie in Nederland te bevorderen, gegeven de huidige beleids- en marktomgeving. Vooral in combinatie met een norm is het onwaarschijnlijk dat de heffing een aanvullende prikkel zal bieden om over te schakelen naar circulaire polymeren. Andere Nederlandse/EU-beleidsmaatregelen zouden kunnen helpen bij het stimuleren van circulaire plastics door langetermijninvesteringen in circulaire oplossingen. Hierbij zou gedacht kunnen worden aan beleidsinterventie verderop in de plasticwaardeketen (bijv. belasting op plastic producten). Verder onderzoek is nodig naar de impact van een dergelijke beleidsmaatregel. Andere beleidsmaatregelen die de vraag naar circulaire plastics kunnen stimuleren, zijn EU- en/of Nederlandse regelgeving, zoals een Europese Circulaire Plastic Norm en duurzame/circulaire overheidsaanbestedingsstrategieën.

Executive summary

Purpose and objective of the study

The Dutch government plans to introduce a levy on virgin fossil polymers by 2028, where this study examines the impact of various options for implementing such a levy. This study has examined several options for implementing a levy on virgin fossil polymers, with a particular focus on assessing the impact of applying the levy at the polymer producer and processor levels of the plastic value chain.[5] In addition, the study assesses the heterogenous impacts of a levy on processors or producers within the Netherlands, examining market characteristics, and evaluating the potential role of recycled and bio-based polymers.

Background

The Dutch plastics industry is a heterogenous sector which is heavily reliant on virgin fossil-based feedstock/polymers and trade intensive. The Dutch polymer production industry is made up of a few large companies which are export-intensive and primarily based on fossil feedstock. This industry has faced high production costs and international competition over the past couple of years. Meanwhile, the Dutch polymer processing industry consists of more than a thousand companies[6] making a variety of different plastic products. Similar to polymer production, polymer processing has faced higher costs in recent years. The polymer processing sector is less export-focused than the polymer production sector.

The Dutch plastics industry is making efforts to transition towards more circular practices, primarily through recycling, though bio-based plastics are gaining attention. The Netherlands has historically had a leading recycling industry and there is further potential to increase recycling, however the Dutch recycling industry is currently in a vulnerable position. While there remains significant potential to increase operations[7], competition with low-cost plastics from outside the EU is fierce. Consequently, several leading recycling companies in the Netherlands have filed for bankruptcy in recent years. Bio-based plastics are generally more expensive than virgin fossil polymers, with price variations influenced by factors like technological progress and raw material and energy costs.

[5] *Implementation of a levy on plastic products is out of scope for this study*

[6] *CE Delft (2022). Een nationale belasting op primair fossiel plastic? Effecten op milieu en economie.*

[7] *More than half of plastic waste in the Netherlands is still not recycled and energy recovery continues to be the dominant method.*

Options for a levy on virgin fossil polymer production or processing

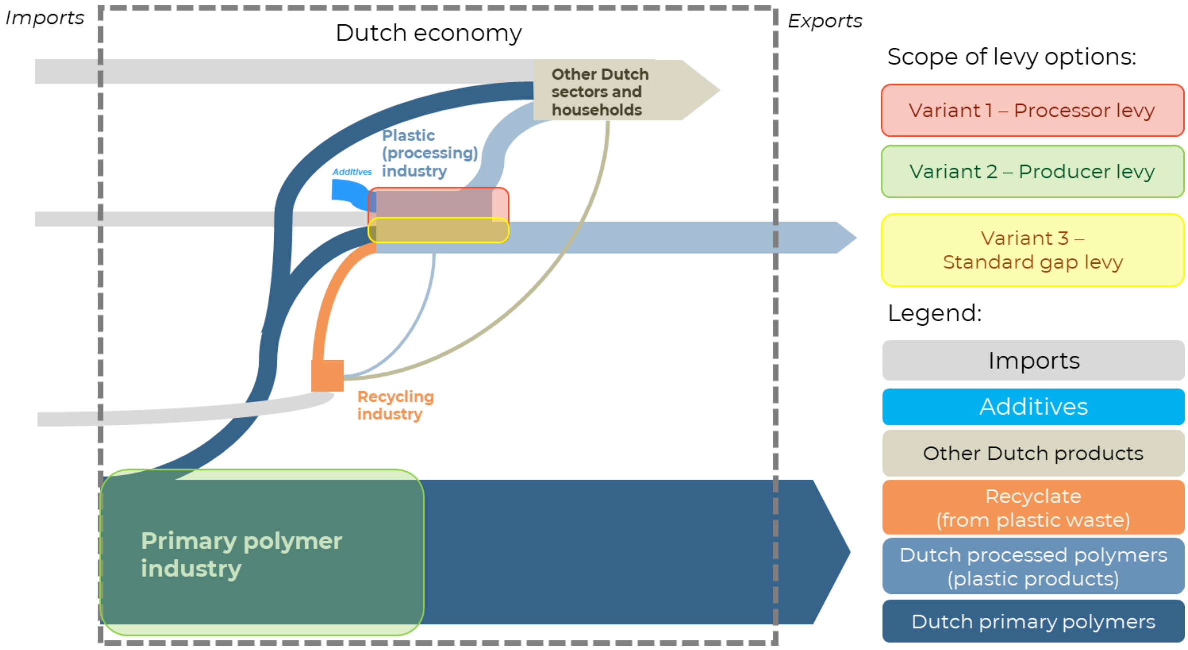
Three different variants of a virgin fossil polymer levy are assessed, which are illustrated in the figure below:

1. **Variant 1 – Processor Levy:** a flat tax on the *processing* of virgin fossil-based polymers in addition to a Dutch Circular Plastic Standard[8], which is designed to meet an average annual tax revenue of 547 M EUR.
2. **Variant 2 – Producer Levy:** a flat tax on the *production* of virgin fossil-based polymers in addition to a Dutch Circular Plastic Standard, which is designed to meet an average annual tax revenue of 547 M EUR; and

A third variant, which has a very different structure than the first two:

3. **Variant 3 – Standard gap levy:** an alternative implementation of the Dutch Circular Plastic Standard, where instead of a trading system, all processors must reach the standard or otherwise must pay a 'gap' levy to cover the extent to which they do not adhere to the standard.

Figure 1 Illustration of levy variant options within the Dutch polymer production and processing chain



Arrows indicate the flows of plastic polymers, plastic products and plastic waste within the Dutch economy and materials which are imported/exported outside of the Netherlands. Imports include non-Dutch products used by the Dutch economy, for instance non-Dutch plastic waste used by the Dutch recycling sector or non-Dutch primary polymers used by the Dutch plastic processing industry.

Illustration is based on figure from CBS (2016). Circulaire economie in Nederland.

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[8] The analysis also considers the impact of a levy *in addition to* the EU Packaging and Packaging Waste Regulation (PPWR).

Key takeaways

Implementing a levy, whether on Dutch polymer processors or producers, has a significant negative impact on the industry in terms of production leakage, particularly for commodity polymers and plastic products. The analysis of the variants of a virgin fossil polymer levy in this study showcases that the combination of the exposure of the Dutch plastic market to global competition and potential price increases resulting from the levy could put the Dutch plastic industry at risk. A levy could lead to significant reduction in Dutch operations for the processing/production, especially of commodity polymers, which tend to be produced at high volumes at a low price and used in many applications. These products make up more than half of Dutch production/processing.

A levy on polymer processing or production would be expected to provide no/limited additional substitution of virgin fossil polymers beyond what is already substituted via the Circular Plastic Standard and EU Packaging and Packaging Waste Regulation (PPWR). With a processor levy (Variant 1), the standard and the levy would have an overlapping effect, as the standard already encourages processors to take up the most economically and technologically feasible circular alternatives. A levy on polymer producers (Variant 2) would have no impact on the substitution of virgin fossil polymers with circular polymers within the Dutch polymer processing sector. Most of the Dutch polymer production is made for export and Dutch processors will likely switch to cheaper foreign suppliers of virgin fossil polymers rather than circular alternatives.

Methodology

This study uses a mixed method approach, including qualitative and quantitative analysis to provide an understanding of the impact of a levy on a macro and micro level. The study included a comprehensive literature review, along with five interviews and one written response from different types of stakeholders in the sector. Further, a quantitative impact analysis is used to establish how the levy could lead to production leakage as well as to substitution of virgin fossil polymers with circular polymers. Lastly, different profiles are used to identify segments of the value chain based on their susceptibility to impact by a levy. They are based on two key indicators: 1) susceptibility to production leakage and 2) techno-economic capacity to be substituted by circular polymers.

The quantitative analysis is based on historical and current data, though several other factors can influence how a levy could impact the Dutch industry. The quantitative analysis is based on estimates of price sensitivity of polymers and plastic products based on historical data. However, a levy could introduce an extreme price shock compared to historical price fluctuations. If a levy would lead to such a price shock, this may trigger stronger price sensitivity that historically observed, and thus greater production leakage. This is even more relevant since the current plastic market is unstable - global virgin fossil polymers prices have dropped significantly in the past two years. This has led to a steep reduction in production and processing in Europe, including the Netherlands, where production costs remain relatively high. Whether this trend will continue is uncertain, as it depends on global market conditions and regulatory developments.

Impact of a virgin fossil polymer levy on the Dutch sector

For each variant of the levy, the impact on the Dutch sector in terms of expected production leakage and substitution of virgin fossil polymers with circular polymers is estimated.

An important common finding across the variants is that the levy could create a price shock, which could lead to a stronger market reaction than observed in recent history. Depending on the extent to which producers or processors pass on the cost of the levy to the price, there is potential for a relatively high price increase which may trigger more production leakage compared to recent historical observations. For a levy on processors (Variant 1 and 3), the price increase may be lower than estimated if processors absorb some of the cost to mitigate demand loss. For a producer levy (Variant 2), if the current financial situation continues in the industry, it would not be expected that producers would have any room to absorb the cost of the levy to mitigate demand loss.

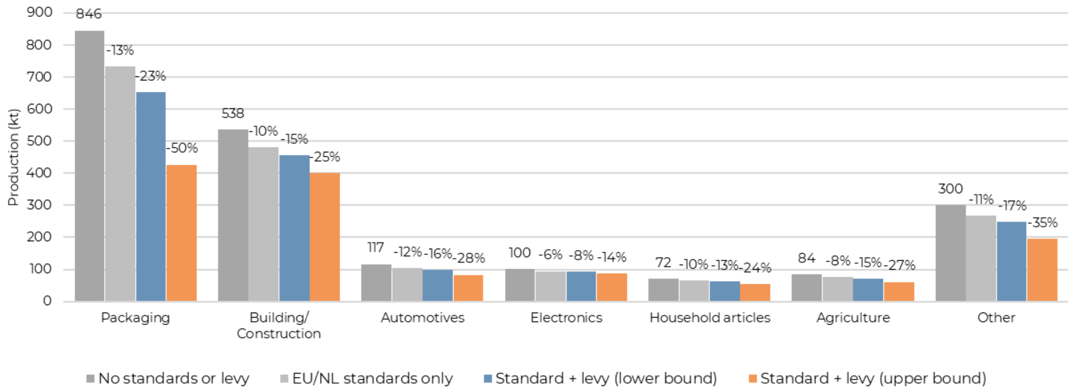
Polymer processor levy (Variant 1)

A *processor* levy would be a flat tax on all virgin fossil polymers processed in the Netherlands. The initial tax base for the processor levy, before considering production leakage and substitution, is estimated to be about 1,070 kt of virgin fossil polymers, whether imported or supplied domestically.

The levy rate necessary to meet the 547 M EUR annual budget requirement depends on the size of the tax base and the impact of the levy on production, Consequently, the tax base can be impacted by the production leakage and substitution caused by the levy. In this case, two levy rates are considered: 640 EUR/t (without substitution) and 920 EUR/t (with substitution in a best-case market scenario for circular polymers). The effective cost of the levy *per ton of plastic product* is lower than the levy rate, as plastic products also include circular and exempted polymers.

Implementing a processor levy could lead to significant negative impact on competitiveness for the Dutch plastic processor industry, particularly for packaging. With a levy rate of 640 EUR/t *and* the EU/Dutch standards, it is estimated that production leakage would be 18% to 36%. With a levy rate of 920 EUR/t *and* the EU/Dutch standards, would be 21% to 47%. The greatest risk of production leakage is for plastic products made of commodity polymers, particularly packaging, as shown in the figure below.

Figure 2 Production leakage from a processor levy (640 EUR/t) in 2030, per application type[9]



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Production leakage may be greater than is estimated due to the risk of an extreme price shock, leading to the possibility that the budget requirement could not be met. It is important to note that production leakage estimates are based on historical data, where the levy could lead to a price shock which has not been observed in the recent past. Namely, with a 640 EUR/t processor levy, this price shock could be up to ten times that of historical relative price changes of plastic products. If the levy creates a significant price shock, production leakage could be higher than estimated. With even greater production leakage, there is risk of a large shift of Dutch processing to other countries, and thus a shrinking tax base.

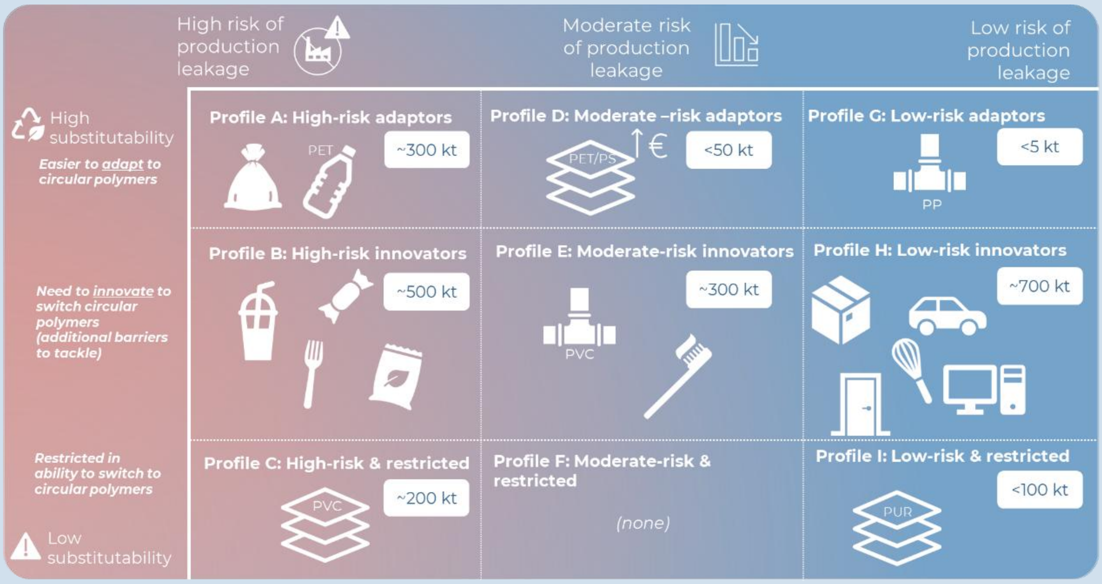
Limited additional substitution of virgin fossil polymers with circular polymers from the levy would be expected beyond the implementation of EU/Dutch standards. The levy on top of the standard is unlikely to significantly enhance substitution beyond what the Dutch/EU standards already encourages based on the current market conditions. In this best-case scenario, standards could reshape the existing circular polymer market, driving a broader scale-up of circular polymer operations, particularly bio-PE. However, the combination of the two policies could lead to less substitution than the standard alone due to production leakage.

The impact of a processor levy on manufacturers of different plastic products

To investigate the various responses of the Dutch plastic industry to a levy, a profile analysis was conducted, which led to the distinction of eight profiles for plastic products. These profiles are based on categorising products with high/moderate/low risk of production leakage and substitutability with circular polymers. The figure below provides an overview of this analysis with illustrative products.

[9] *Production leakage from the EU and Dutch standards is based on the results of the CE Delft study (2024), where the expected impact would be 5-18% (11.5% on average). In this study, the expected impact has been split between the plastic application types based on quantity of non-exempt virgin fossil polymers processed per application.*

Figure 3 Overview of plastic product profiles with illustrative products



The profiles show different consequences of a levy. A significant share of Dutch manufacturing plastic products are identified at high-risk of production leakage (Profiles A, B and C). These tend to be commodity products which are very price competitive (such as single-use plastics). For companies producing these products, a levy would create a high risk of bankruptcy (particularly for small/medium-sized companies) or relocation of operations to other countries. This is particularly a risk when a levy is not implemented gradually, where companies have little time to phase into circular operations before the levy would put financial strain on the company. Particularly for companies with little opportunities for circular alternatives, there is a high likelihood that a levy will lead to closures. On the other hand, there are also Dutch products which are at less risk of leakage (Profiles G, H and I). These plastic products tend to be more competitive based on quality than on price (e.g. high-cost goods such as kitchenware, doors/shutters, plastics for automotives/electronics), but also products which tend of have high transport costs, thus creating a competitive advantage for local producers. For companies in these profiles, regardless of whether companies decide to substitute virgin fossil with circular polymers, a levy will likely increase the price for intermediate/end users and reduce profit margins for these companies to some extent. The table below illustrates the various impacts of a levy for a specific product which would be categorised in that profile.

Table 1 Impact of a processor levy on illustrative products per profile

Profile	Illustrative product	% Production leakage (Variant 1a: 640 EUR/t)	Maximum potential substitution with circular substitutes
Profile A: High-risk adaptor	PET bottles	-29% to -45%	Up to 90% with rPET
Profile B: High-risk innovator	Sacks and bags of PE	-28% to -64%	Recycled PE cannot be used for food packaging; can be replaced with bio-PE.
Profile C: High-risk & restricted	Flooring of PVC	-34% to -81%	Contaminants in recycled PVC can reduce quality.

Profile D: Moderate-risk adaptor	Sheets/films of PET (high cost)	-23% to -49%	Depends on the application, can be up to 100% for non-food applications.
Profile E: Moderate-risk innovator	Pipes/hoses of PVC	-20% to -47%	25-60% substitutability with mechanical recyclate; up to 100% with chemical recyclate or bio-based.
Profile F: Moderate risk & restricted	*(none)*		
Profile G: Low-risk adaptor	Pipes/hoses of PP	-14% to -21%	Up to 100% replacement with rPP in construction applications
Profile H: Low-risk innovator	Kitchen and tableware	-11% to -20%	Restricted use of recycled polymers for food applications (rPET only). Bio-based alternatives available for kitchen/tableware made of polymers such as PP/PE.
Profile I: Low-risk & restricted	Sheets/films of PUR	-17% to -26%	Circular alternatives can replace ~25% of virgin fossil PUR

Polymer producer levy (Variant 2)

A *producer* levy would be a flat tax on all virgin fossil polymers produced in the Netherlands. The initial tax base for the producer levy, before considering production leakage and substitution, is estimated to be about 3,770 kt of virgin fossil polymers produced domestically.

Similar to the processor levy (Variant 1), the levy rate necessary to meet the 547 M EUR annual budget requirement depends on the impact of the levy on production, which can vary depending on the expected outcome of the levy. In order to meet the budget requirement, the levy rate is dependent on the size of the tax base, where consequently the tax base can be impacted by the production leakage and substitution caused by the levy. In this case, there is very limited expected circular substitution from the producer levy. Therefore, only one levy rate is considered to meet the budget requirement: 320 EUR/t. Unlike the processor levy (Variant 1), the effective cost of the levy *per ton of polymer* is the same than the levy rate for all non-exempted virgin fossil polymers.

Implementing a producer levy, could lead to significant negative impact on competitiveness for the Dutch primary polymer industry, particularly commodity polymers. With a levy rate of 320 EUR/t and the EU/Dutch standards, it is estimated that production leakage would be 26% to 70%. For some commodity polymers a producer levy at that rate may even cause a complete stop of production operations. Further, given that the levy rate is considered relatively high compared to historical price changes, production leakage is expected to be more on the higher end. With greater production leakage than estimated, there is risk of a large shift of polymer production to other countries, and thus a shrinking tax base. Given the significant price sensitivity of polymers, Dutch processors are likely to switch to foreign suppliers of virgin fossil polymers rather than to circular alternatives.

The impact of a producer levy on manufacturers of different polymers

To investigate the various responses of the Dutch plastic industry to a producer levy, a profile analysis was conducted, which led to the distinction of six profiles for plastic polymers. These profiles are based on categorising products with high/moderate/low risk of production leakage and substitutability with circular polymers.

From the profile analysis of polymers, there is a clear distinction between commodity and specialty polymers. A significant share of Dutch polymer production is identified at high-risk of production leakage (Profiles A, B and C), which tend to be commodity polymers. For producers of these polymers, there is high risk of closure of plants and potentially relocation of operations to outside the Netherlands, regardless of the technical ability to substitute virgin fossil polymer production with circular polymers. On the other hand, there are also polymers which are at less risk of leakage (Profiles G, H and I). These primary polymers tend to be more competitive based on quality than on price (e.g. specialty polymers such as PA, PMMA and PUR). For companies in these profile, regardless of whether companies decide to substitute virgin fossil polymer production with circular polymers, a levy will likely increase the price of these polymers. The table below illustrates the various impacts of a levy for a specific product which would be categorised in that profile.

Table 2 Impact of producer levy on illustrative products per profile

Profile	Illustrative product	% Production leakage (Variant 2a: 320 EUR/t)	Maximum potential substitution with circular substitutes
Profile A: High-risk adaptor	PET	-28% to -98%	Up to 90-100% replaceable with rPET
Profile B: High-risk innovator	PE-HD/MD	-24% to -100%	Restricted use of recyclate in contact-sensitive applications. Up to 95% replaceable with bio-PE, but for specific applications. Potential supply constraints
Profile C: High-risk & restricted	PVC	-32% to -100%	Up to 100% for specific applications, but contaminants in rPVC make it difficult to apply in most applications
Profile D: Moderate-risk adaptor	PA	-7% to -22%	rPA can be processed in non-critical applications; current practices combine mechanical and chemical recycling.
Profile E: Moderate-risk innovator	*(none)*		
Profile F: Moderate-risk & restricted	PMMA	-11% to -30%	Up to 30-50% with chemically recycled PMMA
Profile G: Low-risk adaptor	*(none)*		
Profile H: Low-risk innovator	*(none)*		
Profile I: Low-risk & restricted	PUR	-5% to -16%	Circular alternatives can replace ~25% of virgin fossil PUR. Shredded PUR can be reused but altered properties limit use. Limited substitution with chemical recycling or bio-based polymers.

Standard gap levy (Variant 3)

A *standard gap* levy would be an alternative implementation of a standard for circular plastics (25-30%), which would be a flat tax on non-compliant virgin fossil polymers processed. The standard gap levy would be implemented in addition to the EU PPWR. As the levy would only apply to non-compliant processing, the initial tax base would be relatively small. About 325 kt of virgin fossil polymers for processing are estimated to be subject to the levy.

Unlike the other two levy variants, the standard gap levy rate is not determined based on a budgetary requirement, but would have to be set to sufficiently encourage processors to meet the standard. This variant of the levy is analysed with a levy rate of 1,000 EUR/t. This levy rate is chosen as it is high enough to make the circular alternatives of high volume polymers more attractive than virgin fossil polymers, based on current price estimates. However, the levy rate required to meet the standard may change depending on how the prices and availability of virgin fossil-based and circular plastics develop. The 1,000 EUR/t would not apply to all virgin fossil polymer processing, but a smaller share which is non-compliant with the standard (estimated to be 18.5%). Therefore, the effective additional cost of the levy per ton of plastic product would be much lower, namely estimated to be around 185 EUR per ton of plastic product.

Implementing a standard gap processor levy would lead to some production leakage for the Dutch plastic processor industry. With a gap levy rate of 1,000 EUR/t and the EU PPWR standard on packaging, it is estimated that production leakage would be 4% to 15%. The greatest risk of production leakage is for plastic products made of commodity polymers, particularly packaging. However, as mentioned, the production leakage could be higher given that the price increase is still relatively high compared to historical changes in relative domestic prices.

A standard gap levy would lead to a more uncertain level of substitution compared to a standard with a trading system. A standard with a trading system creates market-driven incentives, adjusting compliance costs based on supply and demand for circular plastic units. This ensures the standard is met, as companies with a deficit are compensated by those with a surplus. In contrast, a standard gap levy has a fixed compliance cost per ton of virgin fossil polymer processed, with no compensation from *surplus* companies. While it may encourage more circular plastic use from those which have a low share of circular polymer use, companies can still offset this by paying the gap levy, making substitution less certain than with a trading system.

Administrative and legal impacts

The primary administrative burden of the levy for companies is demonstrating their right to be exempted. To qualify, companies must provide evidence that they meet the exemption criteria, such as the use of circular polymers. In the case of implementing a processor levy (Variant 1) with the Dutch standard, this demonstration of circular polymers will already be required by the standard, therefore the additional burden from the levy would be limited. Next to that, expanding the levy across all EU Member States could reduce production leakage but is very unlikely due to the EU's unanimity requirement on tax matters. The standard gap levy (Variant 3), which could be seen as a penalty for non-compliance with ecodesign rules, holds the potential to be (albeit unlikely) adopted by other EU countries, helping to mitigate production leakage.

Recommendations

1. **A producer levy (Variant 2) should not be implemented.** Since producers of virgin fossil polymers in the Netherlands are highly susceptible to production leakage and there is very limited/no expectation of such a levy to lead to additional substitution of virgin fossil polymers with circular polymer, a levy on virgin fossil polymer producers is not an appropriate policy option to further the circular transition in the Netherlands.
2. **If a processor levy (Variant 1) is chosen, it would be recommended to have a phased implementation.** A phased implementation would avoid a huge price shock for Dutch processors by incrementally increasing the levy rate over time. However, this approach would not completely remove the risk of production leakage, but rather allowing companies time to adjust. This would also allow the government to monitor the market's response and make necessary adjustments to minimise unintended consequences. Given the risk of production leakage, the annual budget requirement for tax revenue may not be reached with a processor levy.
3. **If a standard gap levy is (Variant 3) implemented, it should be considered how this levy could be implemented at EU level.** The Dutch standard could be encouraged to be generalised to EU level, as this would create a level playing field across the European industry. The standard gap levy, compared to the levy on polymer producers/processors (Variants 1 and 2), is easier to implement at EU level. This is because the standard gap levy could be framed as a penalty to non-compliance to an EU-wide standard. While EU harmonisation of taxes is quite difficult, EU harmonisation of penalties for infringement of EU law are relatively easier. When deciding on whether to implement a standard gap levy, it is also important to consider the higher level of uncertainty in relation to its effectiveness compared to a standard with a trading system.
4. **Create a business case for circular plastics and facilitate long-term investments via additional/alternative Dutch/EU policy instruments.** A levy on Dutch producers or processors of virgin fossil polymers may be an ineffective policy to support the circular transition in the Netherlands in the current policy and market environment. Particularly, in combination with a standard, it would be unlikely that the levy would provide additional incentives to switch to circular polymers. Other Dutch/EU policies could support stimulating circular plastics by encouraging long-term investments into circular solutions. This could potentially be policy intervention further down the plastic value chain (e.g. plastic product tax), though further research is required to understand the impact of such policies. Other policies which could be considered to drive circular demand could be EU and/or Dutch regulations such as an EU Circular Plastic Standard and green public procurement strategies.

1. Introduction

1.1. Context

Plastics are a key component of the transition towards a circular economy in the Netherlands. Plastics is considered one of the five key transition agendas in the National Circular Economy Programme 2023-2030 (Nationaal Programma Circulaire Economie 2023-2030)[10] to achieving the circular economy by 2050. It thereby focuses especially on plastic in packaging, the construction industry and in agriculture, which together account for nearly two-thirds of the total volume of plastic in the Dutch market.[11]

While plastic waste recycling is already far developed, policy instruments to enhance more sustainable domestic consumption and production of plastics are missing. The Netherlands has played a strong role in the recycling of plastic waste within the EU, with its current plastic packaging recycling targets going beyond EU requirements. Updates to the national legislation, via the Circular Materials Plan (Circulair Materialenplan)[12], applicable from 2026, aim to further promote the recycling of waste streams.[13] Additionally, stricter restrictions of the incineration of plastics and higher targets on the collection and sorting of plastics from construction and demolition waste will be introduced.[14] However, a comprehensive policy approach to change plastic consumption patterns, reduce plastic waste production, and enforce more sustainable plastic production remains rather underdeveloped. [15]

The Dutch government is currently exploring opportunities to support the transition from fossil-based plastics to circular plastics. To enable greater sustainability across the whole value chain, and to prepare the market for potential new EU regulation on this topic, several national policy initiatives are currently ongoing that align with the National Circular Economy Programme.[16] Thereby, a focus in national policy making is set on the promotion of recycled plastics, while the use of bio-based plastics is less supported. Voluntary goals are communicated together with the industry[17], and financial support on the development of circular plastics is provided.[18] Among others, the government proposed amending the *Wet milieubeheer*[19] to introduce a Circular Plastics Standard (i.e., 'nationale circulairplasticnorm') which requires processors of polymers to process a minimum proportion of recyclate or bio-based polymers in their partial or finished products by 2027. The thresholds are expected to be 25-30% by 2030.[20] Not all polymer processors are capable to replace fossil based polymers by circular ones. Therefore, the current proposed framework of the standard would include a trading system,[21] where companies would be

[10] *Rijksoverhheid (2023). Nationaal Programma Circulaire Economie 2023 - 2030.*
[11] *Ibid.*
[12] *Circulair Materialenplan*
[13] *Rijkswaterstaat (n.d.). 11 Kunststof en rubber.*
[14] *Nederland circulair in 2050 (n.d.). Regelgeving voor circulaire plastics.*
[15] *CE Delft (2024). Balanced policy support for bio-based and recycled plastic.*
[16] *A incomprehensive overview of the main EU legislation relevant to circular plastics is provided in Annex 5 – Overview of EU legislation on CE and plastics*
[17] *CE Delft (2022). Mandatory percentage of recycled or bio-based plastic In the European Union.*
[18] *E.g., Rijksdienst voor ondernemen Nederland (2025). Subsidie Circular Plastics NL (CPNL).*
[19] *NEa (2024). Consultatie geopend voor een nationale circulaire plastic norm.*
[20] *Rijksoverheid (n.d.). Regelgeving voor circulaire plastics.*
[21] *Ibid.*

allowed to trade circular plastic 'credits', allowing companies that are capable of processing more than the required amount of circular plastics to gain credits that they can trade with companies that do not meet the standard.

As one of the potential policy interventions, the government is exploring the implementation of a levy on virgin fossil-based plastic polymers by 2028. In light of this, the Ministry of Finance is seeking an in-depth impact analysis of potential design variants for the planned plastic levy, which, besides encouraging the shift towards circular plastics, aims to generate a budget net revenue of 547 million euros.[22] This study provides such analysis, carefully considering aspects such as feasibility, risks of production shifting abroad, economic burden, and environmental impacts.

1.2. Objective and scope

This report aims to assess the potential impacts of implementing a levy on the Dutch polymer producers and processors. To do so, it provides a detailed overview of the polymer value chain in the Netherlands. It focuses on the domestic production and processing of polymers relevant to the country, examines market characteristics, and evaluates the role of recycled and bio-based materials.

The study focuses on Dutch plastic polymers producers and processors by analysing the impacts of a potential levy on Dutch producers and processors of fossil-based polymers in the plastic sector. Plastic polymer producers are companies that are part of the chemical industry and produce plastic polymers. Thereby, they can rely on a diverse feedstocks, such as fossil feedstock, feedstock generated due to chemical recycling or renewable plant-derived bio-based feedstocks to produce polymers.[23] Polymer processors are those manufacturing companies that convert raw polymers into plastic products of desirable shape, microstructure and properties.[24] They can rely on input from different feedstocks, including fossil feedstock, mechanical and chemical recyclate or bio-based polymers. Producers and processors are to be distinguished from recyclers, which rely on plastic waste feedstock and produce recyclate (i.e., mechanical recycling) or feedstock for polymer productions (in case of chemical recycling). A full list of definitions is provided in Annex 1 – Definitions.

1.3. Methodology

This study followed a mainly quantitative approach, complemented by qualitative research, to meet its objectives. The study's approach consisted of qualitative research, in particular desk research and interviews, and a quantitative data assessment.

1.3.1. Qualitative approach

Desk research

A comprehensive literature review has been conducted, starting from an initial list of more than 45 literature documents. The documents covered market analyses of the current application of fossil-based and circular plastics in the Netherlands, impact

[22] *Tweede Kamer der Staten-Generaal (2024). 32 140 Herziening Belastingstelsel.*
[23] *Science Direct: Polymer production.*
[24] *Xanthos, M. (2000). Polymer processing.*

assessments of different policy interventions, and predictions on future developments, among others. The main sources of literature can be found in Annex 2.

Interviews

To fill remaining gaps in the desk research and to validate the findings, five expert interviews were conducted, and one additional written response was received. The interviewees were representatives of the plastics and chemical industry focusing on converters, producers and the packaging sector, the waste industry, and an environmental organisation. An overview of the interviewees is shown in the table below. Questions revolved around the impact of a levy on the Dutch polymer industry, the impact of the levy on the transition to a more circular industry, the potential and challenges of circular plastics, and waste management in the Netherlands. Note that the interviewees provided their inputs without any knowledge of the conclusions and recommendations of this report.

Table 1-1: List of interviewees

Name	Type of organisation	Type of response
NRK (Nederlandse Rubber- en Kunststofindustrie)	Business Association	Interview
NRK – Verpakkingen	Business Association	Interview
VNCI (Koninklijke Vereniging van de Nederlandse Chemische Industrie)	Business Association	Interview
Plastics Europe NL	Business Association	Interview
Natuur en Milieu	Non-governmental organisation	Interview
Vereniging Afvalbedrijven	Business Association	Written response

Methodology to define profiles

To enable a more granular view of the potential levy impacts, and to identify those segments of the value chains susceptible to be impacted more or less strongly than the overall sector, profiles have been developed. Profiles are sub-sets of the polymer value chains that are expected to experience a similar effect due to a levy, and the experienced impacts might be different to those experienced by the whole sector on average. The profiles are compiled from a clustering of polymers and related plastic products, based on the expected categories (Low / Moderate / High) for the following two indicators:

- Susceptibility to production leakage; and
- Techno-economic capacity to be substituted by circular polymers.

A more detailed definition of the indicators is given in Annex 3 – Details on methodology.

1.3.2. Quantitative assessment

The study analyses the impact of the levy in terms of production leakage and circular polymer substitution quantitatively. Details of the methodology for the quantitative analysis can be found in Annex 3.

Estimation of the production leakage impact of the levy variants

For each variant, the production leakage and potential substitution with circular polymers (and subsequent carbon emissions reduction) are estimated. In this sub-section, the method of estimating these impacts is briefly described, where a more in-depth description of the approach can be found in Annex 3.A.

The extent to which a product is susceptible to production leakage is based on two main parameters: 1) the expected percentage increase in price from the levy and 2) the price sensitivity of the product. The expected increase in a product price from the levy is based on a few factors namely:

- Levy rate per ton of virgin fossil polymers produced/processed (EUR/t): a higher levy rate leads to higher production leakage;
- Domestic sales price of the product before the levy EUR/t): a higher product price leads to a relatively lower percentage increase in price from the levy, therefore lower production leakage;
- Virgin fossil polymer content of the product (%): a higher virgin fossil polymer content leads to higher production leakage; and
- Exempted content of the product (%) (e.g. other thermoplastics/thermosets): the more of the product content which is exempt, the lower the production leakage.

Table 0-1 in Annex 3.A provides an overview of the average values of these parameters per product group.

Based on these parameters, the *effective levy rate* per product can be estimated. For instance, if the levy rate is 400 EUR/t of processed virgin polymers and a plastic product contains 50% non-exempt virgin fossil polymers, then the effective levy rate would be 200 EUR per ton of plastic product. If the product sells on the market for 2000 EUR/t, then the price increase from the levy would be 10%. We assume that 100% of the cost of the levy is passed down to the consumer price, such that the producer/processors does not absorb the cost to avoid loss in product demand. However, in reality, producers/processors may only partially raise the price and absorb the remainder of the levy as profit loss.

Price sensitivity is determined at product level, which allows for a more nuanced overview of the impact, though can also lead to uncertainty of the resulting production leakage. For this analysis, price sensitivity is based on the estimation of trade elasticities at product level. As mentioned before, this allows for a more heterogenous illustration of the impact of the levy across the industry. From this price sensitivity, it is determined to what extent an increase in price will lead to production leakage (from imports and exports). For instance, if the trade elasticity of a product is 2 and the expected price increase is 10%, then the expected production leakage would be 20%.

The representativeness of the estimated price sensitivities depends on whether the price increase from the levy is similar to historically observed price changes. As these elasticity estimates are based on historical data, there may be limits on how this estimated relationship between price and demand would translate to a price increase from a levy if the levy leads to a large price shock. Therefore, in cases where the price increase is significantly higher compared to historical price changes, we could expect that price sensitivity could be higher than historical observed. This is particularly the case for processed polymers where historically price movements of plastic products can be relatively smaller compared to the potential price increase from a levy (see Section 4.1.1). Additional caveats to this method are explained in more detail in Annex 3.A.

Estimation of potential substitution and environmental benefits from the levy variants

The potential for virgin fossil polymers to be replaced with circular polymers is based on the economic feasibility, technical capacity and supply constraints. Economic feasibility is based on the price differentials between virgin fossil polymers (including the levy) and circular polymers, which are considered equivalent in terms of quality. Technical capacity is based on a literature review of commercially-available technologies for processing circular polymer alternatives (See Annex 3.G). Supply constraints for bio-based polymers is considering that bio-based polymer production remains limited. More details on the methodology of estimating potential substitution is explained further in Annex 3.B. The potential substitution is split between recyclate and bio-based as well as whether the substitution is of domestically or foreign produced polymers.

The potential carbon emissions reduction from the substitution of virgin fossil polymers with circular polymers is based on the comparison of climate impacts. The use of circular polymers can lead to emissions reduction through reduced production of virgin fossil polymers as well as avoided incineration of plastic waste (in the case of recyclate). In this study, CO_2 emissions reduction factors were used for replacing virgin fossil-based polymers with circular plastics from literature,[25] which are:

- -3.2 kgCO_2/kg of mechanical recyclate;
- -3.1 kgCO_2/kg of chemical recyclate from pyrolysis[26]; and
- -2 kgCO_2/kg of bio-based plastic.

It is important to note that not all emissions reduction from substitution would occur in the Netherlands, as these emissions factors consider the entire value chain.

1.4. Reading Guide

The following proposal is structured as follows:

- ✓ **Chapter 1** consists of an introductory chapter containing the context / policy background of the study, its objectives and the methodology used;
- ✓ **Chapter 2** provides a description of the Dutch plastic market, encompassing findings on the polymer industry, the polymer processing industry and the environmental impact of fossil-based plastics;
- ✓ **Chapter 3** elaborates on the *circular* plastics market in the Netherlands, specifically touching upon circular plastics production, economic performance of circular plastics and trade of circular plastics;
- ✓ **Chapter 4** presents the analysis results for the three options (variants) for a levy on the Dutch plastics polymers;
- ✓ **Chapter 5** presents the analysis of profiles;
- ✓ **Chapter 6** describes the administrative and legal impacts expected from the levy;

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[25] CE Delft (2022). Een nationale belasting op primair fossiel plastic?.
[26] Pyrolysis needs 2 kg of plastic waste to produce 1kg of recyclate, therefore leading to a double factor of the avoided incineration of plastic waste.

- ✓ **Chapter 7** provides the conclusions and recommendations for this study.

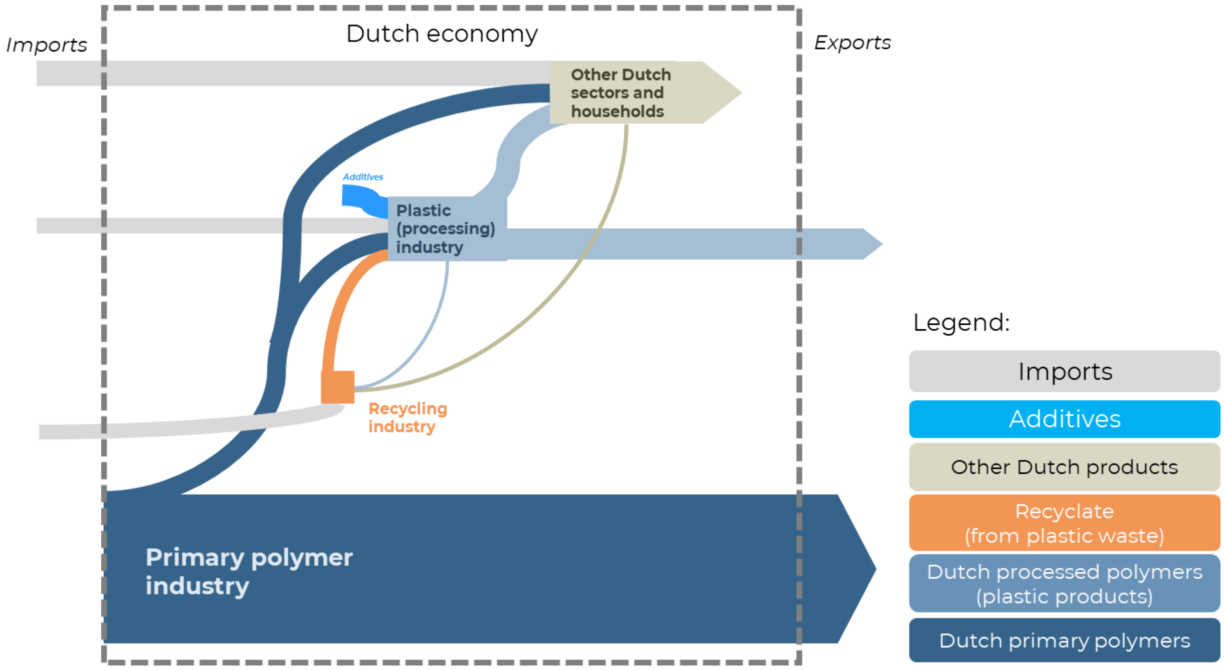
The annexes include:

- ✓ **Annex 1** – Definitions
- ✓ **Annex 2** – List of literature sources
- ✓ **Annex 3** – Details on methodology to quantitative analysis
- ✓ **Annex 4** – Data sources
- ✓ **Annex 5** – Overview of EU legislation on CE and plastics

2. The plastic polymer market in the Netherlands

The Dutch plastic polymer market is based on a complex system that unites material flows of different sectors. Figure 2-1 shows the flows of virgin polymers, processed polymers and plastic waste in the Netherlands. The following sections dive to the key sectors within the Dutch plastics market, and elaborate on the polymer industry (Sub-chapter 2.1) and the polymer processing industry (Sub-chapter 2.2). The use phase of plastic products[27] are out of scope of this study. Chapter 3 of this report dives specifically into the circular plastics market in the Netherlands.

Figure 2-1 Simplified flow of virgin polymers, processed polymers and waste in the Netherlands



Arrows indicate the flows of plastic polymers, plastic products and plastic waste within the Dutch economy and materials which are imported/exported outside of the Netherlands

Based on figure from CBS (2016). Circulaire economie in Nederland. (translated)

2.1. Polymer industry

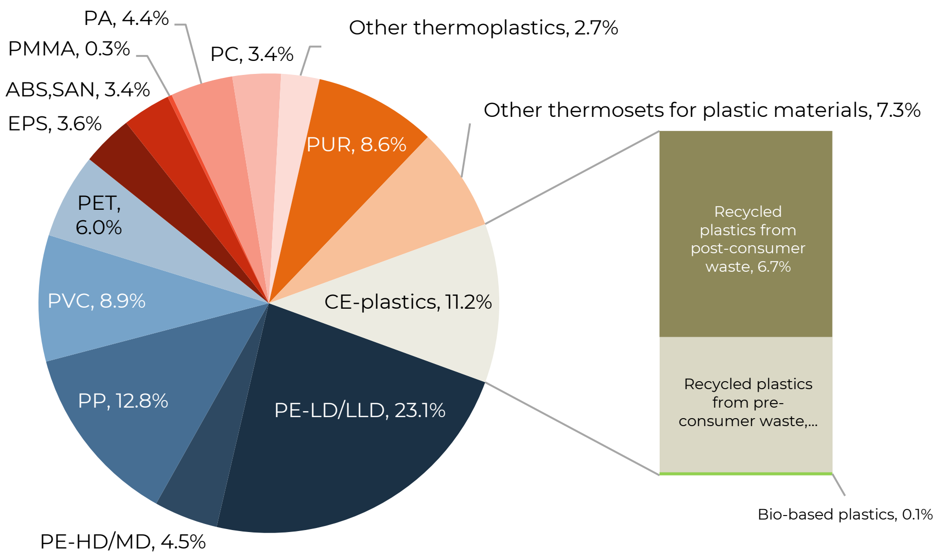
2.1.1. Production

The Dutch polymer market is predominately based on fossil feedstock. In 2022, the Netherlands produced 6.2 Mt of plastic polymers,[28] of which 89% were fossil-based.[29] The remaining 11% of polymers *produced* in the Netherlands can be classified as circular, which mostly comprises of recyclate (11.1%), but also a limited amount of bio-based plastic polymers (0.1%).[30] In comparison to EU27, Switzerland, Norway and the United Kingdom

[27] *'Other economy' and 'Households' in the figure*
[28] *excluding elastomers, adhesives, coatings, and sealants*
[29] *40.4% fossil-based polyolefins; 32.6% other fossil-based thermoplastics; 15.8% fossil-based thermosets for plastic product applications, including polyurethane (PUR). Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.*
[30] *Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.*

(EU27+3 comparison), only Germany (13 Mt) and Belgium (7.3 Mt) produced more polymers in 2022.[31] Also amongst European countries, the Netherlands stands out for its high reliance on virgin fossil-feedstock. The detailed split by polymers for the Netherlands is presented in Figure 2-2, where the polymers can be categorised as shown in Table 2-1.

Figure 2-2 Plastics production in the Netherlands 2022 by polymers (Total of 6 194 kt)



Source: Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.

Table 2-1 Overview of polymer categories, the respective polymers and their abbreviations

Polymer category	Polymer acronym	Polymer full name
Polyolefins	PE-LD/LLDE	(Linear) Low Density Polyethylene
	PE-HD/MD	High Density Polyethylene
	PP	Polypropylene
Other thermoplastics	EPS	Expandable Polystyrene
	PS	Polystyrene
	ABS,SAN	Acrylonitrile Butadiene Styrene
	PVC	Polyvinyl Chloride
	PET	Polyethylene Terephthalate
	PMMA	Polymethylmethacrylate
	PA	Polyamide
Thermosets	PUR	Polyurethane

2.1.2. Economic performance and trade of virgin fossil polymers

Steady growth of the Dutch polymer industry over the past decade has been followed by unstable conditions in recent years due to the various recent crises. From 2012 to 2022, polymer production and sales has overall increased by over 50%.[32] As an export-intensive industry, the Covid-19 pandemic transport restrictions had a sizeable impact on operations in 2020, followed by a rebound in production and sales in 2021. However, with the start of the energy crisis in 2022, sales remained fairly stable whereas production costs

[31] *Plastics Europe (2024).* The circular economy for plastics - A European analysis.
[32] *CBS (2024).* Bedrijfsleven; arbeids- en financiële gegevens, per branche, SBI 2008.

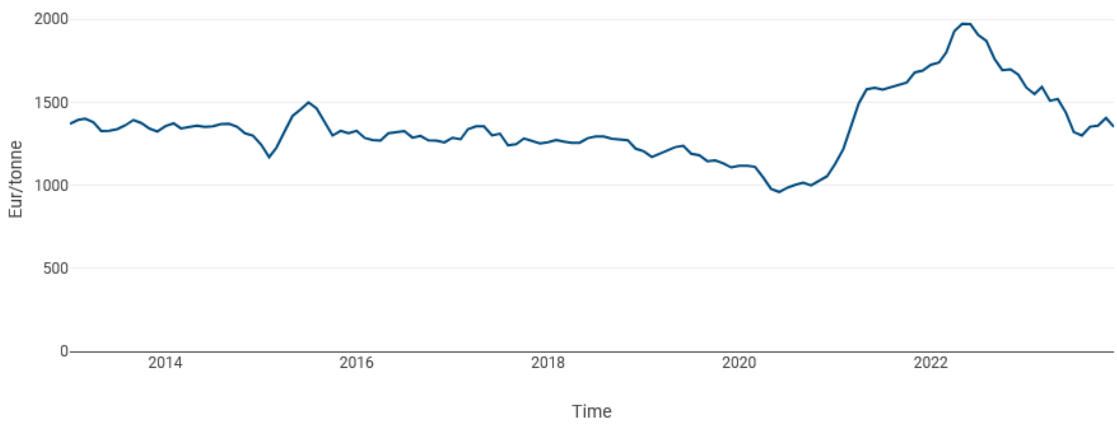
increased by 10%. Namely, in 2022, energy costs made up 10% of total operation costs, whereas energy has previously accounted for 4% on average in the ten years prior.[33]

High production costs and inflation in recent years have led to a decline in plastic polymers production in Europe, including the Netherlands, while global plastic production continues to increase. In 2023, global polymer production increased to 413.8 Mt (+3.3% from the previous year).[34] Meanwhile, European polymer production decreased by 8.3% in 2023 (54 Mt), and slightly more so for fossil-based plastics, with a 9.1% decrease.[35] The Netherlands followed a similar trend: polymer production dropped by 11% from 2022 to 2023, and declined further by 4% in 2024 (up to Q3).[36] The Dutch Federation of the Rubber and Plastics Industry (NRK) reports that the decline in polymer production is due to the high production costs in Europe due to high energy and raw material costs as well as inflation.[37]

The competitive advantage of the Dutch (and European) polymer industry is diminishing, putting Dutch and European upstream chemical and polymer sector at risk. High production costs within Europe have put strain on European polymer producers competing in the global market. This has led to the closure of several plants in the Netherlands.[38] Once a site is shut down, reopening is unlikely due to the high capital costs involved and, in some cases, opposition from local communities.[39]

The price of virgin fossil polymers has been volatile in recent years. Figure shows the fluctuations of the price development of virgin PE over the past decade as example. These price surges in the industry have also been prompted by the Covid-19 pandemic and the energy crisis (especially the price increases in 2020 and 2021).[40] In 2023 and 2024, prices of polymers have decreased due to oversupply mainly from China and the United States.[41]

Figure 2-3 Development of the average price of virgin polyethylene plastics in the EU, 2013-2023



Source: EEA (2025). Competitiveness of secondary materials.

[33] *Ibid.*
[34] *Plastics Europe (2024). Plastics - the fast facts 2024.*
[35] *Ibid.*
[36] *Based on Eurostat statistics on indexed production in NACE code 2016 (Manufacture of plastics in primary forms) (Eurostat (2025). Production in industry - quarterly data.))*
[37] *NRK (2024). Plasticproductie in Europa zakt harder dan verwacht.*
[38] *Circular Plastics NL (2024). CPNL Bestuurder Ton van der Giessen aan het woord.*
[39] *Cefic (2025). The Competitiveness of the European Chemical Industry.*
[40] *EEA (2025). Competitiveness of secondary materials.*
[41] *Ibid.*

The overall polymer industry in the Netherlands operates with relatively narrow and unstable profit margins. The profit margins in the Dutch polymer industry range from -0.1% to 13.5% over the last decade.[42] In 2022, primary plastics (NACE 20.16) had a profit margin[43] of 2.5% (compared to the manufacturing industry average of 8%). This is likely due to several factors, such as the high cost of raw materials (e.g., crude oil) and homogenous nature of polymers, which make it difficult to differentiate from foreign competitors.[44]

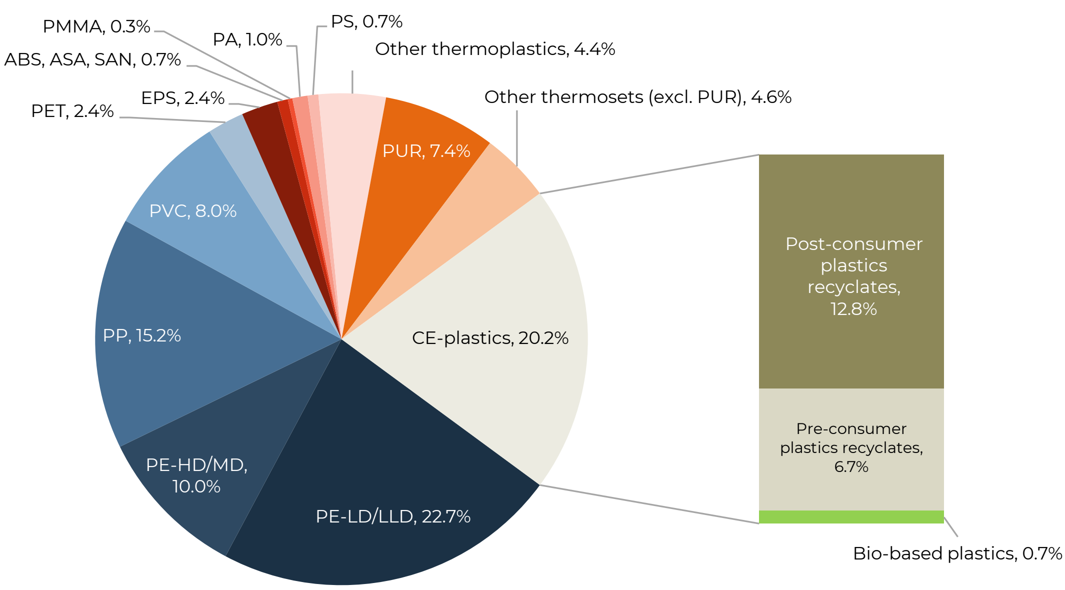
The Dutch polymer industry is export-intensive, mainly supplying polymers to the European market. About 90% of polymers produced in the Netherlands are exported.[45] Most of the exported value goes to European countries (71%), with the remaining 30% going to outside of Europe.[46] This underlines the importance of aligning domestic policies with international trade dynamics. The remaining share of polymers produced in the Netherlands remains in the country for the production of plastic products.

2.2. Plastic processing industry

2.2.1. Processing

The Netherlands also plays a strong role in the processing of plastics within Europe, and relies mainly on virgin fossil polymers. Regarding the conversion of polymers to plastic products, the Netherlands is a strong player, ranking 8th within the EU27+3, having processed about 2.3 Mt in 2022. 80% of the processed plastics were virgin fossil-based,[47] of which nearly half were fossil-based polyolefins, 20% other fossil-based thermoplastics, and 11.9% fossil-based thermosets for plastic product applications, including PUR. The remaining 20% consisted of recycled plastics from post-consumer waste (12.8%) and post-industrial waste (6.7%) as well as bio-based plastics (0.8%).

Figure 2-4 Plastics processing in the Netherlands 2022 by polymers (total: 2,295 kt)



[42] CBS (2024). Bedrijfsleven; arbeids- en financiële gegevens, per branche, SBI 2008.
[43] Ratio of operating results and revenue
[44] Trinomics (2022). Risk of carbon leakage in Dutch non-ETS sectors.
[45] Based on figures from CBS (2016). Circulaire economie in Nederland.
[46] CBS (2021). Invoer en uitvoer CBAM-producten 2017-2019.
[47] Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.

Source: Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.

The Dutch processing industry is composed of numerous companies, which sell a variety of plastic products to other companies or directly to end-consumers. About 1,400 companies (mostly small and medium-sized) in the Netherlands process polymers and make plastic products (NACE 22.2).[48][49] Processed plastics are mainly sold to other companies (e.g., packaging for food, etc.) and partly sold directly to consumers.

Packaging is the dominant application for processed plastics, which makes up 40% of all processed plastics in the Netherlands. There are seven main types of applications for processed plastics: packaging; building and construction; electronics; agriculture; automotive; houseware, leisure and sports and other (e.g., furniture, medical purposes, office supplies, etc.). Packaging dominates the demand for processed polymers, accounting for 40% of the overall weight of processed polymers, and relies heavily on polyolefins and PET. About 60% of plastic packaging in the Netherlands is contact-sensitive (e.g. for food).[50] The second most common plastic application is for building/construction, which accounts for 20% of processed plastics in terms of weight (mainly PVC for products such as windows, pipes and cables).[51] Other notable applications include for the automotive industry, agriculture, and household goods.[52] The use of polymers per application area is illustrated in Figure 2-5.

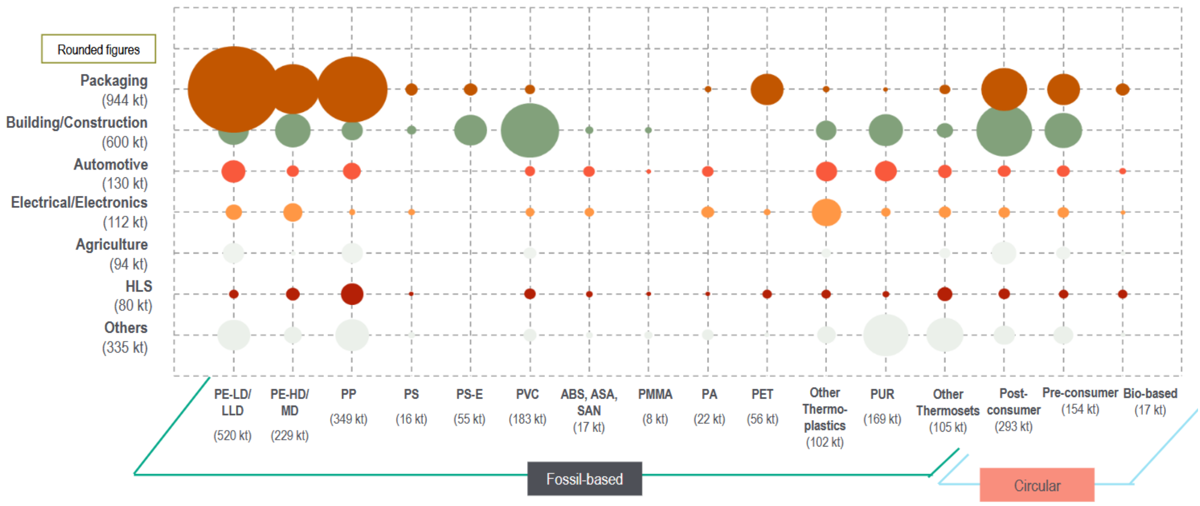


Figure 2-5 Overview polymer application area in the Netherlands, 2022

Source: Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.

2.2.2. Economic performance and trade of plastic products

Over the past decade, the Dutch plastic processing industry has grown, however, it has declined in the most recent years. From 2012 to 2022, polymer processing and sales have overall increased by about 30%.[53] The processing industry was also impacted by the

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[48] *Dutch enterprises included in the plastics value chain are divers and can be categorised based on their annual purchase values of polymers. Small enterprises are companies, buying less than 500 t; medium enterprises purchase 500-5000 t, and large enterprises purchase more than 5 000 t. (Partners for Innovation (2023). Gevolgen nationale norm circulaire plastics.)*
[49] CE Delft (2022). *Een nationale belasting op primair fossiel plastic? Effecten op milieu en economie*.
[50] TNO (2024). *Circularity and greenhouse gas assessment of the plastic packaging and beverage carton system in the Netherlands until 2050*.
[51] CPB (2019). The Circular Economy of Plastics in the Netherlands.
[52] Conversio (2024). *Substantiation of data for polymer production and processing in the Netherlands*.
[53] CBS (2024). *Bedrijfsleven; arbeids- en financiële gegevens, per branche, SBI 2008*.

recent crises, but to a lesser extent than the polymer industry. The muted impact of the Covid-19 pandemic in 2020 may relate to the particular increase in demand for plastic medical equipment and single-use packaging (e.g., increased food delivery, online shopping). However, over the course of 2023, the Dutch production of plastic products and rubber (NACE 22) decreased by 10.2%.[54] In 2024, the production decline continued by 1.3%. Similar to the polymer production industry, this declining trend goes hand in hand with increased production costs in the industry and strong competition from foreign competitors.

Processed plastic products tend to have relatively higher profit margins than polymers, though it remains a highly competitive market. Profit margins have been historically stable for polymer processors to plastic products (NACE 22.2), averaging about 8% over the past decade, which is comparable to the manufacturing industry average.[55] Nonetheless, according to processors the plastic product market is extremely competitive where a small price difference can lead to a shift in sales to foreign processors.[56] Interviewees agreed with this but mentioned an exception would be products which have high transportation costs (e.g., large tubes), where these costs for foreign competitors can offset competitive disadvantage of an increase in production costs for domestic companies. This is also further elaborated in Chapter 4.1.3.

The Dutch polymer processing industry is relatively less export-intensive than the polymer production industry. Still, about 50% of processed polymers (i.e. plastic products) in the Netherlands are exported.[57] The rest is for domestic use.

[54] *Based on CBS statistics on indexed production in NACE code 22 (Manufacture of rubber and plastic products). Data on plastic products only is not available. (CBS (2025). Industry; production and turnover, development and index, 2021=100.)*
[55] *CBS (2024). Bedrijfsleven; arbeids- en financiële gegevens, per branche, SBI 2008.*
[56] *Partners for innovation (2023). Gevolgen Nationale Circulaire Plastics Norm.*
[57] *CBS (2020). Circulaire economie in Nederland.*

3. The circular plastic market in the Netherlands

In the Netherlands, the circular economy transition for the plastics market is mainly approached via recycling but bio-based plastics are receiving increasing attention. Currently, recycled polymers feed in 19% of the overall processed polymers in the Netherlands. Of this, 12.8% stem from post-consumer waste and 6.7% from pre-consumer waste. 0.8% are bio-based, accounting for 17 kt.[58]

3.1. Recycled plastics

3.1.1. Production

The Netherlands has historically had one of the most advanced recycling industries in Europe,[59] with substantial growth over the past few decades, particularly for post-consumer waste. Between 2006 and 2022, domestic recycling of plastic waste grew by nearly 200%,[60] and Dutch plastic waste recycling generates currently 5.4% of all post-consumer recyclate in Europe.[61] Between 2018 and 2020, the Netherlands saw an 8.5% increase in post-consumer plastics sent for recycling and a 4.3% reduction in plastics sent to landfill. As a result, the supply of post-consumer recycled plastics grew by 11%, and their integration into new products increased by 15%. Further, the share of recycled plastics in manufacturing rose from 7.2% in 2018 to 8.5% in 2020.[62] In 2022, the recycling rate for overall post-consumer plastics in the Netherlands was with 38% the third-highest in Europe, well above the EU average of 25%.

However, the Dutch recycling industry faces strong competition which currently puts the industry at risk of decreasing production. the Dutch recycling industry is currently in a vulnerable position due to competition with low-cost plastics from outside the EU. Consequently, several leading recycling companies in the Netherlands have filed for bankruptcy in recent years.

There still remains key opportunities for the Dutch recycling industry, as more than half of the plastic waste generated in the Netherlands is still not recycled. In 2022, a total of 1,100 kt of post-consumer plastic waste was collected and sorted, of which over 60% was used for energy recovery while the remaining 40% was recycled. Only a small fraction of the waste was sent to landfill.[63][64] Considering both the recyclate from post-consumer waste (413 kt) and recyclate from post-industrial waste (272 kt), the total production of recyclate in the Netherlands amounted to 685 kt.[65]

[58] *Conversio* (2024). *Substantiation of data for polymer production and processing in the Netherlands*.
[59] *KPMG (2023). Plastic feedstock for recycling in the Netherlands.*
[60] *Plastics Europe (n.d.). Circular economy for plastics - Data for 2022; p. 24.*
[61] *Plastics Europe (2023). Plastics - the fast fact 2023.*
[62] *Plastics Europe (2022). The circular economy for plastics. A European overview.*
[63] *The Netherlands has a ban on landfilling for plastics, as well as for several other products, since 1995 which implemented via the Directive for Landfill and Waste Disposal Bans (Besluit stortplaatsen en stortverboden afvalstoffen). Overheid.nl (2024). Besluit stortplaatsen en stortverboden afvalstoffen.*
[64] *Plastics Europe (2024). Circular Economy for plastics - Data for 2022.*
[65] *Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.*

Most recyclate is produced via mechanical recycling but its application is restricted by the difficulties to separate plastic waste into homogenous flows of plastic types. While mechanical recycling is generally more accessible, energy-efficient and cost-effective than chemical recycling[66], it still faces economic challenges, particularly in sorting and cleaning the plastics to maintain quality. [67][68] It is limited in the types of plastics it can process and typically allows plastics to be recycled only 2-3 times before their quality degrades.[69]

Chemical recycling currently accounts only for a fraction of recyclate produced in the Netherlands, but will need to play a large role in increasing the use of circular plastics. Chemical recycling offers the potential to overcome some of the limitations of mechanical recycling by converting plastics into their original monomers. Techniques such as depolymerization, pyrolysis and hydrothermal treatments allow for the processing of mixed or contaminated waste streams, producing high-quality monomers suitable for a broader range of applications. However, the costs associated with chemical recycling remain significantly higher than those of fossil-based plastic production, for example due to high energy demands.[70] It offers the ability to process a wider range of plastics than mechanical recycling and to produce high-quality materials that can be reused without significant degradation.[71] Currently, only 19 kt of recyclate came from chemical recycling in the Netherlands, which is only 5% of the Dutch recycling output.[72] Today, the technology for chemical recycling is still in the early stages, meaning the future availability of chemical recyclate remains uncertain.[73]

3.1.2. Economic performance of recycled plastic polymers

Recycling companies in the Netherlands face a challenging market, which makes it difficult for them to compete with the international market. About 55 recycling companies exist in the Netherlands.[74] In 2024, five of the recycling companies in the Netherlands went bankrupt. The main challenges, mentioned by recycling company owners, are the competition with cheap plastics from outside the EU. Plastic recycling so far does not generate revenue and companies rely on additional business activities to cover their costs.[75]

The cost price of recyclate of most polymers is higher than that of primary fossil-based plastics, often due to costs of R&D and collection and sorting. The cost of recyclate often remains higher than virgin fossil-based plastics, partly due to development and testing costs when introducing new materials.[76] Another cost aspect is the collection and sorting costs. Dutch policy is based on EPR[77], whereby producers or importers of packaging material pay a packaging waste management fee to reimburse municipalities responsible for the waste collection and to reimburse sorting and recycling activities.[78] However, the

[66] *Partners for Innovation (2023). Gevolgen nationale norm circulaire plastics.*
[67] *CPB (2019). The Circular Economy of Plastics in the Netherlands*
[68] *Moad, G., & Solomon, D. H. (2021). The critical importance of adopting whole-of-life strategies for polymers and plastics.*
[69] *Cefic (2025). The Competitiveness of the European Chemical Industry.*
[70] *Moad, G., & Solomon, D. H. (2021). The critical importance of adopting whole-of-life strategies for polymers and plastics.*
[71] *Cefic (2025). The Competitiveness of the European Chemical Industry.*
[72] *Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.*
[73] *KPMG (2023). Plastic feedstock for recycling in the Netherlands.*
[74] *ENF (n.d.). Plastic recycling plants in the Netherlands.*
[75] *Hoenders, J. & d. Jong, G. (2024). Dit jaar al vijf plastic recyclingbedrijven failliet, afvalsector wil daarom dat kabinet te hulp schietv.*
[76] *Partners for Innovation (2023). Gevolgen nationale norm circulaire plastics.*
[77] *KVK (n.d.). EPR: producers responsible for waste from used products.*
[78] *Business.gov.nl (2022). Packaging waste management contribution.*

costs for the plastics' collection and sorting still outweigh the revenues generated from selling recyclate.[79] Dutch municipalities have raised concerns that the compensation via Verpact[80] (previously *Stichting Afvalfonds Verpakkingen*) is not sufficient to cover their costs.[81]

The price of recyclate interlinks with the developments of the virgin fossil-based plastics and is also determined by the quality of recyclate. The prices of virgin fossil and recycled polymers are closely related, as recyclate is in principle made from virgin fossil polymers. However, this is not a direct one-to-one correlation. Prices of virgin fossil-based plastics are subject to considerable fluctuations (as explained in Chapter 2), where prices for mechanical recyclate in particular can sometimes be lower and sometimes higher than those of virgin fossil-based plastics.[82] Furthermore, the costs of recyclate also depend on costs for collection, sorting, washing, and the actual recycling.[83] Therefore, there is a fixed minimum cost that is independent from virgin fossil polymers. Despite mechanical recyclate often having higher production costs, their price can be lower than that for virgin fossil-based plastics due to limited customer willingness to pay a premium for (perceived) lower-quality materials.[84] The current lack of a business case for mechanical recycling was also confirmed by interviewees. For chemical recyclate the market is not developed enough yet to identify price dependencies. So far, the prices tend to follow virgin fossil-based plastic prices as it offers comparable quality[85].

Chemical recycling is still in the early stages and is more expensive than mechanical recycling. Chemical recycling has higher production costs than fossil-based production and mechanical recycling. Chemical recycling processes are more energy-intensive, more complex as well as performed at a small scale compared to traditional processes. The current operation costs of producing chemical recyclate is almost two times the cost of virgin fossil production.[86] As the technology advances and production costs decrease, chemical recycling can become competitive with virgin fossil polymers by 2045.[87]

Accordingly, the profitability of recycling varies considerably. Higher quality recycled polymers can have an approximately 50% mark-up compared to the prices of fossil-based polymers. For example, the high-quality recycled plastics high-density polyethylene (HDPE) and polypropylene (PP) currently have a mark-up of 800-900 EUR/t, while food-grade rPET has a mark-up of 400-500 EUR/t.[88] However, the margin depends on the availability of plastic waste, the type of grade and the demand for it, which mostly tends to be higher in case of higher oil prices. Lower-quality recyclate on the contrary can be cheaper than virgin plastics. A generalisation should be avoided though, as price aspects depend highly on the polymer under discussion and its grade.[89]

The demand for recycling has increased. Despite the fluctuating prices due to inconsistent availability of materials, quality differences, and changing virgin fossil polymer prices, the demand for plastic waste for recycling has increased over the past years. This is,

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[79] *Gradus, R., et al. (2017). A cost-effectiveness analysis for incineration or recycling of Dutch household plastic waste.*
[80] *Verpact*
[81] *Brouwers, J. (2024). Gemeenten willen af van het afvalfonds.*
[82] *Partners for Innovation (2023). Gevolgen nationale norm circulaire plastics.*
[83] *Van Kamp, N., et al. (2024). Exposing the pitfalls of plastics mechanical recycling through cost calculation.*
[84] *CE Delft (2022). Een nationale belasting op primair fossiel plastic? Effecten op milieu en economie.*
[85] *Ibid.*
[86] *Plastics Europe (n.d.). The plastics transition.*
[87] *Ibid.*
[88] *ICIS (2024). Europe petrochemicals transform to thrive.*
[89] *Emphasised by various interviewees of this study*

among others, because of price increases of virgin plastics production. The higher demand also reflects in the prices for plastic waste. In 2020, a sorted plastic bale has been given away for free, whereas it costed about EUR 700-800 in 2022.[90] This trend is also recognisable at EU level, where plastic waste reached the record price of 467 EUR/t in 2022. Multiple aspects are mentioned as possible drivers, including: the Chinese waste import ban, amendments in the Basel Convention in 2020, and the recent focus of EU policy making on recycled content requirements.[91]

3.1.3. Challenges and barriers linked to the uptake of recycled polymers

Besides price, additional factors deter the uptake of recycled polymers. Barriers to the circular transition, as anticipated by Dutch processors, include limited availability of alternative materials, high costs, legal challenges, technical difficulties, and mismatched demand and supply.[92] Besides the price of recyclate, their quality and availability are also factors that impact the choice for virgin polymers versus recyclate. Furthermore, policy and safety regulations might limit flexibility, such as strict safety requirements for food packaging restrict the use of recyclate.

A lack of finance for R&D and other costs hamper the uptake of plastic recycling. Costs for, for example, development, testing, and process adaptation are decisive for the adopting of more recycling. The high required investment and transition costs hinder the commercialisation of emerging technologies capable of improving the plastics recycling into high-purity polymers.[93] There are also one-off costs to switching to recyclate (changing labels, converting machines, testing, etc.).

Difficulties in long-term planning cause uncertainties for producers and processors. Many recyclers would be interested in increasing their recycling capacity, but lack of clarity on (local) availability of feedstock and policies are delaying their investment decisions. A shortage of plastics waste feedstock might become challenging. The input capacity is expected to grow from 1 Mt in 2022 to 2.2 Mt by 2030. This increase is primarily driven by the ramp-up of existing mechanical recycling projects and the development of pyrolysis recycling projects.[94] However, there will probably only be an available feedstock of 1.2 Mt. While the total plastic waste feedstock in the Netherlands is expected to increase, the quantity of local supply might remain insufficient to meet the future feedstock demand for plastic recycling, especially regarding monostreams and mixed films. This would be the case even when improving the sorting of residual waste.[95] Another aspect hampering long-term planning is uncertainty about the availability of input materials. Additional to the lack of a reliable stream of recyclable plastics, the composition of waste streams is currently unsteady, making it difficult to predict the quality of waste batches.[96]

Technological advancements in both mechanical and chemical recycling continue to play a crucial role in addressing plastic waste.[97] Emerging methods for chemical recycling, such as enzymatic hydrolysis, are promising but are still constrained by slow

[90] *CE Delft (2022). Een nationale belasting op primair fossiel plastic? Effecten op milieu en economie.*
[91] *EEA (2025). Average yearly price of plastic scrap (EUR/tonne).*
[92] *Partners for Innovation (2023). Gevolgen nationale norm circulaire plastics.*
[93] *Dijkstra, H., van Beukering, P. and Brouwer, R. (2020). Business models and sustainable plastic management: A systematic review of the literature.*
[94] *KPMG (2023). Plastic feedstock for recycling in the Netherlands.*
[95] *Ibid.*
[96] *Van der Vegt, M., et al. (2021). Inventory of barriers and enablers for the uptake of recycled plastic.*
[97] *Moad, G., & Solomon, D. H. (2021). The critical importance of adopting whole-of-life strategies for polymers and plastics.*

reaction rates and large facility requirements, which hinder their widespread adoption. Of the chemical recycling technologies available, a study found that pyrolysis (e.g., thermal cracking) seems to have the greatest development in the coming years in the Netherlands, with 13 plants expected to be developed after 2022.[98] However, the plastic-to-plastic yield seems to be relatively low (49%). Other options with a higher yield would be solvent-based extraction (100%) and depolymerisation (97%).[99]

More recycling does not always result in improvements in the national GHG inventories. Externalities are important to consider when planning to enforce a greater share of circular materials in production. For example, as interviewees to this study stated, if recyclate were imported from China, the higher share of recycled content in a product would not have to lead to an improvement in the product's CO_2 balance. For a truly sustainable transition to high-value circular plastics, higher R-strategies (i.e., reduce and reuse) would require receiving more attention.

3.2. Bio-based plastic

3.2.1. Production

Bio-based plastic polymers production in the Netherlands remains limited. 9 kt of bio-based plastic polymers were produced in the Netherlands in 2022. This is about 4% of the global production[100] and 2.5% of total bio-based plastic polymers produced within Europe[101].[102] Bio-based PE and PP make up more than 40% of domestic bio-based polymer production.[103] 15-20% of the production is of starch-containing polymer compounds and roughly 10-15% is of PBAT.[104] Most bio-based plastic polymers are used for the production of packaging.[105]

3.2.2. Economic performance of bio-based plastics

Bio-based plastic polymers tend to be more expensive than virgin fossil polymers, though the difference in price ranges significantly. As for recyclate, high price fossil-based polymers would increase the demand for bio-based polymers. The difference in price between bio-based and virgin fossil-based polymer ranges from 400 to 3,900 EUR/t.[106] For example, bio-based alternatives for PVC can be four times as high as virgin fossil PVC.[107]

Factors such as technological progress and costs for raw materials and energy determine the price development of bio-based plastics. Besides developments in the prices of virgin fossil-based plastics, technological developments are key to ensure a substitutability of a polymer which eventually would increase demand. The price of bio-based polymers would in addition benefit from low cost raw material, energy and end-of-life disposal costs[108] in particular since the main incentive for consumers to purchase more

[98] KPMG (2023). *Plastic feedstock for recycling in the Netherlands.*
[99] CE Delft (2022). *Monitoring chemical recycling.*
[100] Conversio (2024). *Substantiation of data for polymer production and processing in the Netherlands.*
[101] *EU27+3 countries*
[102] Plastics Europe (2023). *Plastics - the fast facts 2023.*
[103] Conversio (2024). *Substantiation of data for polymer production and processing in the Netherlands.*
[104] *Ibid.*
[105] KIDV (2023). *Fact sheet - Bio-based plastic packaging.*
[106] CE Delft (2022). *Een nationale belasting op primair fossiel plastic?.*
[107] Partners for Innovation (2023). *Gevolgen nationale norm circulaire plastics.*
[108] Döhler, N., Wellenreuther, C. and Wolf, A. (2022). *Market dynamics of biodegradable bio-based plastics: Projections and linkages to European policies.*

bio-based products currently is a lower price.[109] However, the cost of raw materials required for bio-based polymers is dependent on the available supply and competing demands for bio-feedstocks (e.g. biofuels).

3.2.3. Challenges and barriers linked to the uptake of bio-based plastics

Bio-based plastics can come with environmental benefits but their broader sustainability impact is context dependent. Life cycle assessment (LCA) studies comparing bio-based and virgin fossil-based plastics have demonstrated the environmental advantages of bio-based plastics. These include substantial energy savings and reductions in GHG emissions.[110] Nonetheless, the production of bio-based plastics raises environmental and broader sustainability concerns since their generation can require substantial land, water, agricultural and energy inputs.[111] To prohibit these negative impacts, the Dutch bio-based industry must meet strict sustainability criteria as stated within the Framework for Sustainable Biomass (*Duurzaamheidskader Biogrondstoffen*).

Bio-based plastics remain a potential solution for more sustainable plastics, but their upscaling remains challenging due to a lack of investments. The growing emphasis on sustainability keeps driving research into bio-based plastics as alternatives to fossil-based materials.[112] Bio-based feedstocks, such as carbohydrate-rich food plants, lignocellulose-rich materials (e.g., wood and non-edible by-products of food crops and agricultural wastes), and algae and industrial waste, are emerging as alternatives.[113]

A suitable system for the end-of-life treatment of bio-based plastics is crucial for their potential contribution of environmental benefits. For example, for the bio-based polylactic acid (PLA), which has similar characteristics as PP, PE or polystyrene (PS), studies found that its contamination in the feed to mechanical recycling should be lower than 0.1% to protect rPET quality, or in other words, to avoid contaminating other recycling streams.[114] However, since the share of bio-based is still relatively small, it may not be economically viable to separate the collection. This may change if there is a shift in the market towards bio-based plastics.

Bio-based plastics further face the critical barriers of limited availability and costs of bio-based feedstocks. Suppliers of bio-based materials often prioritise contracts with large companies, which restrict access for smaller businesses. Additionally, the demand for bio-based materials often outpaces supply, a challenge that will intensify as the adoption of bio-based fuels and chemicals accelerates.[115] Also, in light of the Annual Obligation Energy Transport (Jaarverplichting Energie Vervoer) and green gas blending obligation (Bijmengverplichting groen gas), the growing demand for biomass is likely to inflate the price for biomass while simultaneously decrease biomass availability for the chemical industry.[116] However, the Dutch government is focused on enhancing incentives for the chemical industry to shift to bio-based materials by giving priority within the Framework for Sustainable Biomass (Duurzaamheidskader Biogrondstoffen).

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[109] *Gaffey, J., et al. (2021). Understanding consumer perspectives of bio-based products - A comparative case study from Ireland and the Netherlands.*
[110] *Singh, N., et al. (2022). Sustainable materials alternative to petrochemical plastics pollution: A review analysis.*
[111] *Ibid.*
[112] *Ibid.*
[113] *Ibid.*
[114] *Alaerts, L., Augustinus, M. and Van Acker, K. (2018). Impact of bio-based plastics on current recycling of plastics.*
[115] *Partners for Innovation (2023). Gevolgen nationale norm circulaire plastics.*
[116] *CE Delft (2024). Balanced policy support for bio-based and recycled plastic.*

4. Options for a levy on the Dutch virgin fossil polymers

This study considers how a levy could be applied either to polymer processors or producers with varying levy rates. There are several ways in which a plastics levy could be implemented, namely in terms of which part of the plastic value chain is taxed. In this study, three options were considered of how a levy on plastics could be administered, the first two being:

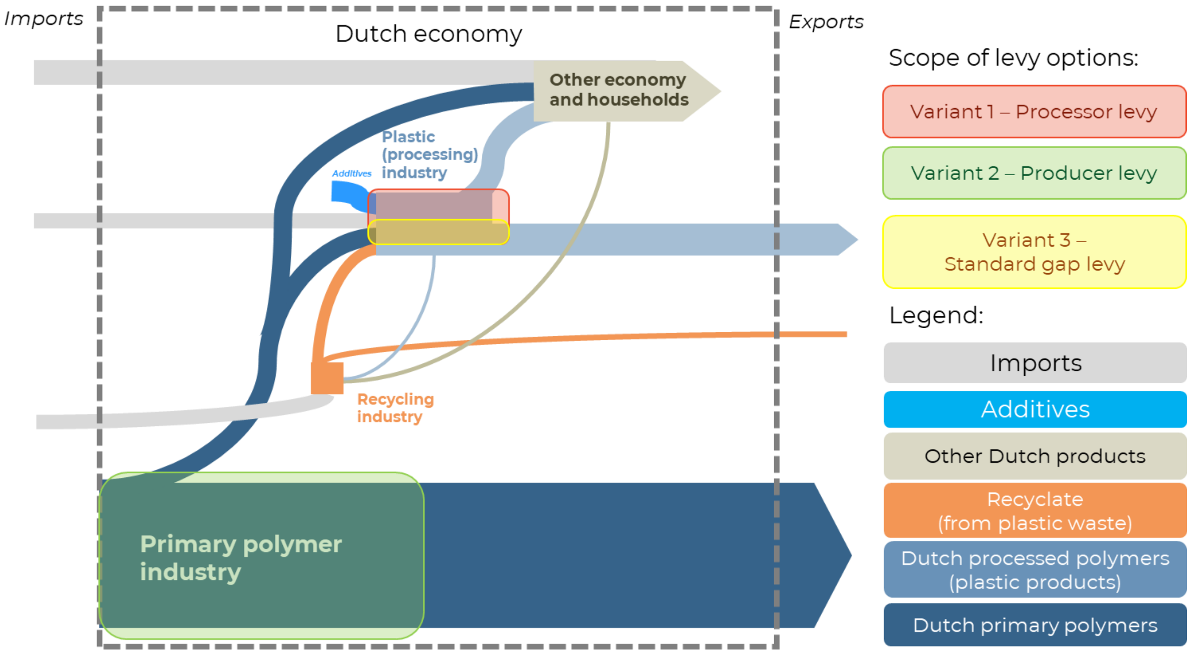
1. **Variant 1:** a flat tax on the *processing* of virgin fossil-based polymers in addition to the Dutch Circular Plastic Standard and EU PPWR standard on packaging.
2. **Variant 2:** a flat tax on the *production* of virgin fossil-based polymers in addition to the Circular Plastic Standard and EU PPWR standard on packaging;

The last variant of the levy analysed has a very different structure than the first two:

3. **Variant 3** is a gap levy for a circular standard on polymer processing. This would be an alternative implementation to a Dutch Circular Plastic standard, where there would be no trading system, but rather all processors must reach the standard, otherwise they must pay a levy to cover to the extent which they do not adhere to the standard.

The figure below showcases the three variants of the virgin fossil polymer levy examined in this study.

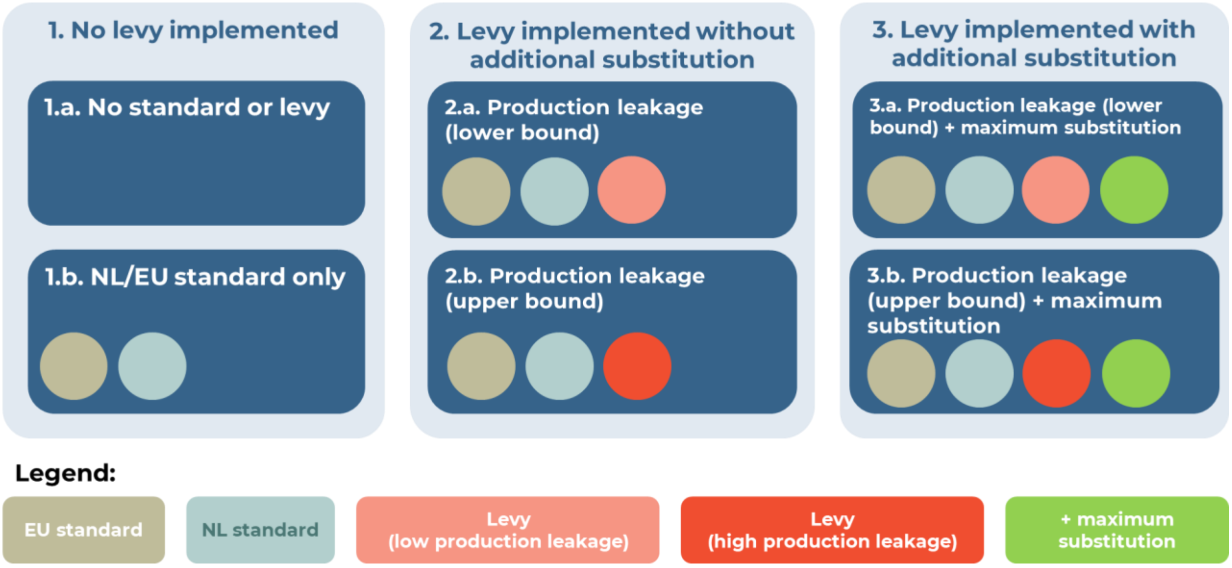
Figure 4-1 Illustration of levy variant options



Material flow diagram based on figure from CBS (2016). Circulaire economie in Nederland. *(translated)*

For each variant, three main situations are analysed, illustrated in the figure below.

Figure 4-2 Situations examined in the impact analysis



1. ***No levy implemented***
    a. No standard or levy: there are no Dutch/EU circular standards or levy in place and companies continue to produce at the existing rates without shifting to circular alternatives[117];
    b. NL/EU circular plastic standards only: The Circular Plastic Standard is implemented in 2027, which is assumed to reach 27.5% by 2030,[118] and the EU PPWR is implemented (25% standard on packaging). This leads to an increase in circular polymer processing up to 27.5% in 2030, but also the Dutch standard leads to production leakage due to the higher cost of circular polymers or cost of buying circular plastic units. Production leakage from the standard is based on previous literature, whereby a standard would lead to 8-15% production leakage (11.5% on average).[119]
2. ***Levy implemented but does not lead to additional substitution of fossil polymers with circular plastics:*** The levy is implemented in addition to the implementation of the EU/NL circular standards (1.b). The cost of the levy will lead to an increased price of Dutch polymers and/or plastic products, which will lead to some degree of production leakage. A range of production leakage from the levy is used given the methodology for estimating trade elasticities at product level, leading to a lower and upper bound of the expected production leakage (how these boundaries are defined can be found in Annex 3.A). These

[117] Production growth in this situation is based on the PBL study (2024), where there is no additional circular plastic uptake. This leads to annual production growth of +0.2% for the chemical sector (including primary polymers) and +0.1% for the plastic product sector. The base value for production is from 2022, where production is adjusted for developments in the last two years based on Eurostat data on production in the primary plastic (NACE 20.16) and plastic product (NACE22.2) industries.
[118] The Circular Plastic Standard will reach 25-30% by 2030, therefore, a standard of 27.5% is assumed.
[119] CE Delft & TNO (2024). Plasticnorm – Quickscan economische effecten.

two situations assume there is not additional circular substitution beyond the EU/NL standards.

   a. Production leakage (lower bound): This situation uses the lower bound estimate of production leakage from the levy, where the levy would lead to a lower degree of production leakage.
   b. Production leakage (upper bound): This situation uses the upper bound estimate of production leakage from the levy, where the levy would lead to a higher degree of production leakage;

3. ***Levy is implemented in a best-case market scenario for circular polymers:*** the last two situations add on to Situations 2.a and 2.b, where there is a best-case market scenario for circular polymers. In this case, we assume that processors are faced with limited supply constraints and current price differentials between virgin fossil and circular-based polymers remain the same. In reality, supply constraints of recyclate and bio-based polymers as well as consequential changes in circular polymer prices will hinder the uptake of circular polymers. Therefore, these scenarios are considered the *maximum substitution* possible by the levy.
   a. Production leakage (lower bound) with maximum substitution with circular polymers: based on the *'production leakage (lower bound)'* situation (2.a.) with the addition of a maximum potential substitution of virgin fossil polymers with circular polymers.; and
   b. Production leakage (upper bound) with maximum substitution with circular polymers: based on the *'production leakage (upper bound)'* situation (2.b) with the addition of a maximum potential substitution of virgin fossil polymers with circular polymers.

The text box below provides some considerations for the interpretation of the analysis results in light of the uncertainties and market instability currently being observed in the chemical and plastics industry.

Box 4-1 Uncertainty and market instability: limitations in analysing the potential impact of a virgin fossil polymer levy

This analysis provides a snapshot of the potential impact of a levy on virgin polymer production and processing, based on the current industry landscape. However, the plastic market is currently unstable; global prices for virgin fossil polymers having dropped significantly the past two years, leading to a steep reduction in production and processing in Europe, including the Netherlands, where production costs remain relatively high. Whether this trend will continue is uncertain, as it depends on global market conditions and regulatory developments.

If, for example, other countries continue to increase their fossil feedstock production, which in turn drives up virgin fossil polymer production, the global price for virgin fossil polymers could decline further. This has several implications regarding the impact of a levy:

- The decline in the global price of virgin fossil polymers will reduce the competitiveness of the Dutch sector, leading to further production losses. To meet budgetary requirements with this smaller tax base, the levy rate will need to be increased. However, if producers or processors cannot absorb the additional cost of the levy, this will further reduce their competitiveness of Dutch companies and increase the risk of production leakage.

- If producers or processors have reduced their prices to maintain competitiveness in the global market, thus minimising production leakage, the additional levy would become a larger share of the product price. For instance, if a Dutch plastic product is originally priced at EUR4/kg and the Dutch producer reduces the price to EUR3.50/kg (the current global price), and the levy rate is EUR1/kg, the original price increase due to the levy would have been 25%, but with the new price, it would be 29%. Therefore, with the same levy rate, the change in the price of the product increases the estimated production leakage.
- Additionally, if the price of virgin fossil polymers continues to decline, the price difference between virgin fossil polymers and circular polymers of equivalent quality can increase (depending on to what extent circular polymer prices also change). This could make it less attractive for processors to switch to circular alternatives.

On the other hand, if other Dutch and/or EU regulation is introduced which supports a circular transition in the plastics industry, this could change the market conditions within Europe, for example:

- Subsidies for the plastic polymer production and/or processors investing in circular polymer technologies can further advance the circular plastic industry, which can lead to greater uptake and lower prices for circular polymers.
- An EU Circular Plastic Standard could lead to lower production leakage (PPWR and end of life vehicles regulation ELV), as it could create a level playing field within the EU. If production leakage from a standard is lower, this would lead to a higher tax base, thus a lower levy would be required to meet the budget requirement.

In conclusion, the impact of the levy on the plastic industry also depends on several factors which remain uncertain in the current global market and EU/NL regulatory conditions.

Scope of the levy

The current scope of the levy for this analysis follows the list of polymers intended to be included in the Circular Plastics Standard.[120] Polymers covered by the levy are listed in the table below. Following previous communications concerning the Circular Plastic Standard, elastomers, coatings, adhesives, natural polymers, fibres, other thermoplastics and other thermosets are out of scope. These products are considered not suitable to be under a standard/levy (e.g. difficult to apply circular alternatives), and thus also not assessed in this study. All circular polymers, including bio-based, post-industrial recyclate and post-consumer recyclate are considered exempt from the levy. The table below provides an overview of the potential scope of the levy based on previous scoping of the Circular Plastic Standard. However, the standard's scope is still subject to change.

Table 4-1 Scope of levy

Polymer	Production (kt) 2022	Processing (kt) 2022	Included?
(Linear) Low Density Polyethylene (PE-LD/LLDE)	1,431	520	Yes
High/Medium Density Polyethylene (PE-HD/MD)	280	229	Yes
Polypropylene (PP)	792	349	Yes
Polyethylene terephthalate (PET)	370	56	Yes
Expanded Polystyrene (EPS) / Polystyrene (PS)	220	71	Yes
Polyvinyl chloride (PVC)	550	183	Yes
Acrylonitrile Butadiene Styrene (ABS) / Styrene acrylonitrile (SAN)	210	17	Yes
Polymethyl methacrylate (PMMA)	20	8	Yes

[120] *Circular Plastic Norm (CPN) explanatory memorandum (2024)*

Polyamides (PA)	270	22	Yes
Polyurethane (PUR)	530	169	Yes
Polycarbonate (PC)	210	0	No
Other thermoplastics	167	102	No
Other thermosets	450	105	No
Bio-based plastics	9	17	No
Post-consumer recyclate (PCR)	413	293	No
Post-industrial recyclate (PIR)	272	154	No
Total polymers	***6,194***	***2,295***	
Total tax base	***4,673***	***1,624***	

Based on data from Conversio (2024)

The initial tax base of the levy is determined based on previous literature and adjusted based on expected market and regulatory changes. The 2024 Conversio study[121], which maps out Dutch production and processing of polymers per polymer and application type in 2022 is used as a basis for defining the tax base of the levy (see table below). By 2030, Dutch production and processing of polymers is expected to change. First, we consider changes which have already occurred in the past two years, where production has declined.[122] Further, we assume limited autonomous growth of polymer processing and production where there is no additional circular plastic uptake, following the 2024 PBL study, assuming a +0.2% annual growth for polymer production and 0.1% annual growth for the plastic product sector. These two factors lead to an overall decline in production and processing of all polymers from 2022 to 2030. With the introduction of a Dutch circular standard and EU PPWR, there will be an expected rise in circular plastic processing and decline of the use of virgin fossil polymers. With these policies, there are two dynamic considered: 1) the substitution of virgin fossil polymers and 2) the production leakage due to the increase cost for Dutch companies adhering the new regulation. For the first dynamic, this will directly increase PCR and bio-based processing and decrease non-exempted virgin fossil polymer use. In terms of production leakage, this will impact all processing except for processing of exempted virgin fossil polymers. This is because the cost for Dutch companies to adhere to the standards also includes the cost of switching to circular polymers.

Table 4-2 Expected intial tax base before production leakage or substitution from the levy

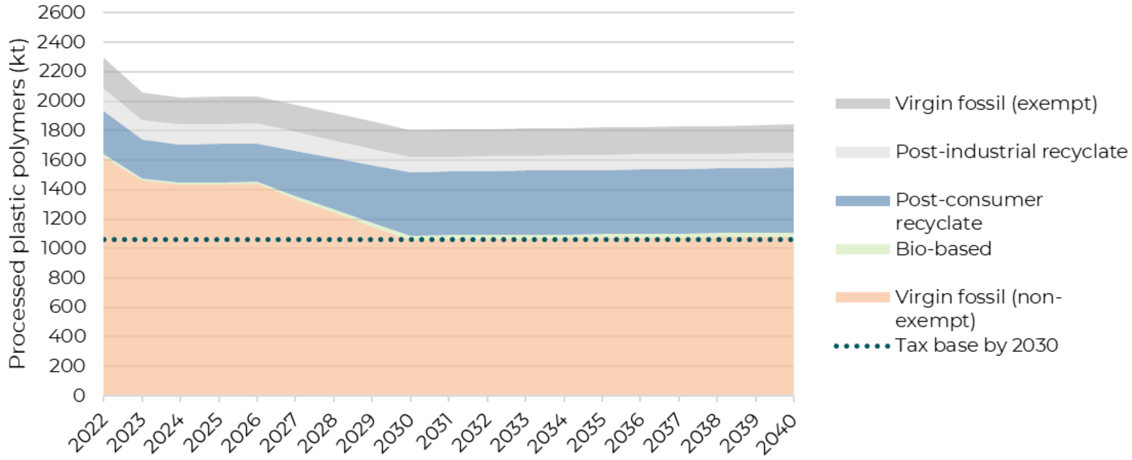
	Production				Processing			
	2022		2030		2022		2030	
	kt	%	kt	%	kt	%	kt	%
Total polymers	**6,194**	**100%**	**5,131**	**100%**	**2,295**	**100%**	**1,821**	**100%**
Virgin fossil polymers	5,500	89%	4,468	87%	1,831	80%	1,245	68%
of which not exempted	4,673	75%	3,772	74%	1,624	71%	1,070	59%
of which exempted	827	13%	696	14%	207	9%	186	10%
Total circular polymers	694	11%	623	12%	464	20%	565	31%
PCR and bio-based only	422	7%	388	8%	310	14%	463	25%
PIR	272	4%	235	5%	154	7%	102	6%
Initial tax base	**4,673**	**75%**	**3,772**	**76%**	**1,624**	**71%**	**1,070**	**59%**

[121] *Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.*
[122] *In 2023, polymer production (NACE 20.16) reduced by 10.9% and polymer processing (NACE 22.2) by 10.2%. By 2024 Q3, polymer production further declined by 6.2% and polymer processing by 1.4%. (Eurostat 2025).*

4.1. Variant 1 – levy on plastic polymer processors

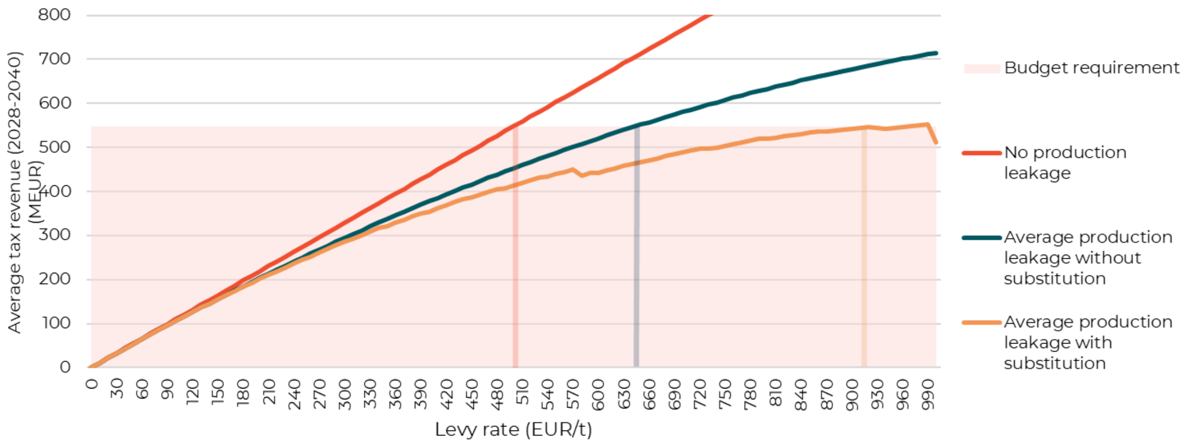
The first variant would be a levy on virgin fossil-based polymers *processed* in the Netherlands. This is regardless of whether the polymers are produced in the Netherlands or are imported. The expected initial tax base for Variant 1 after taking into account autonomous production changes, exemptions, as well as the impact of the EU and Dutch circular standards on the share of circular polymers processed and production leakage, would be about 1,070 kt.

Figure 4-3 Forecasted processing of plastic polymers (kt), 2022-2040



The levy rate necessary to meet the 547 M EUR budget requirement depends on the impact of the levy on production, which can vary depending on the expected outcome of the levy. The figure below illustrates how the levy required varies depending on the expected outcome (e.g. with or without production leakage; with our without substitution). If virgin fossil polymer processing were to remain at 1070 kt (i.e. there is no production leakage), then the levy rate to meet the budget requirement would be 500 EUR/t. With average production leakage (of the lower and upper bound), the levy rate required would be 640 EUR/t to compensate for the loss of production. Further, if we were to assume that the maximum potential substitution is possible, then the levy rate would need to be further raised to 920 EUR/t to compensate for the decrease in virgin fossil processing but also the production leakage from increasing the rate from 640 to 920 EUR/t Notably, after the levy rate reaches 1,000 EUR/t, there is a drop in tax revenue. This is indicates that as the levy reaches this level, there is a more significant chance that the budget will not be met as the rate of the levy could provide a strong enough signal for a market shift to circular polymers. To consider in both cases with and without substitution, for analysing this variant, we consider these two levy rates: 640 EUR/t and 920 EUR/t.

Figure 4-4 Average annual tax revenue (M EUR) from 2028-2040 per processor levy rate with or without production leakage and/or circular substitution



Note: the calculation for production leakage is linear, however, the maximum production leakage is 100%, which can make the relationship between the levy rate and tax revenue non-linear. For instance, there may be a product where the production leakage is 100% in all instances where the levy rate is 500EUR/t. In this case, the production leakage would plateau at 500EUR/t. For substitution, the estimation is step-wise, where if the levy rate makes virgin fossil polymers more expensive than circular polymers, then the maximum potential substitution is used. This can create jumps in the figure.

4.1.1. Increase in plastic product prices due to the levy

A processor levy of 640 EUR/t would lead to an average price increase of Dutch plastic products of 11%, where the impact on prices would range from 2%-37% at product level. For plastic products, we assume that ~70% will be made of made of virgin fossil polymers (via standards), where 15% of virgin fossil polymers are exempt. In the case of a processor levy of 640 EUR/t, the effective levy rate would therefore be about 380 EUR/t of plastic product.[123] Assuming on average the price of plastic products is 3360 EUR/t, the average increase in price would be 11%. However, the price increase varies across from product to product, where the impact on price would range from 2% to 37%, depending on the price and non-exempt virgin fossil polymer content of the product. For instance, flooring and sheets/films of PE would be faced with a relatively higher price increase (>20%), whereas electronics, clothing/shoes and other plastics made from mainly exempted polymers would face relatively lower price increase (<5%).

A processor levy of 920 EUR/t would lead to an average price increase of Dutch plastic products of 16%, where the impact on prices would range from 3%-53% at product level. In the case of a processor levy of 920 EUR/t, the effective levy rate would therefore be about 550 EUR/t of plastic product.[124] Assuming on average the price of plastic products is 3360 EUR/t, the average increase in price would be 16%. However, the price increase varies across from product to product, where the impact on price would range from 3% to 53%, depending on the price and non-exempt virgin fossil polymer content of the product.

These processor levy rates could trigger a price shock significantly greater than historical price fluctuations in plastic products, raising uncertainty about the reliability of using past price changes for production leakage estimation. This analysis estimates price sensitivity based on historical data and assumes that is linear. However, the levy could

*[123] 640 EUR/t of virgin fossil polymers * 70% virgin fossil polymer content * 85% of virgin polymers are not exempt = ~380 EUR/t*
*[124] 920 EUR/t of virgin fossil polymers * 70% virgin fossil polymer content * 85% of virgin polymers are not exempt = ~550 EUR/t*

lead to an extreme price shock which has not been observed in the recent past[125], making the levy's potential impact on production leakage more uncertain. Further, the assumption that 100% of the levy cost is passed on to buyers may not hold in practice. Processors might absorb part of the cost, sacrificing profits to mute price increases and mitigate demand loss. If this occurs, the actual price rise would be lower than currently assumed. Given these uncertainties, as the price increase rises, the accuracy of production leakage estimates may worsen

4.1.2. Tax revenue and cost of the levy for processors

By design, the tax revenue from Variant 1 reaches the budget requirement of 547 M EUR, however, given the potential price shock from such a levy, there is uncertainty of whether the budget could be met due to potentially high risk of production leakage. Tax revenue from the levy primarily depends on the size of the tax base and the levy rate determined. However, when considering production leakage and the substitution of virgin fossil materials with circular polymers, it becomes clear that the tax base itself is influenced by the levy rate. As the levy rate increase, it can drive more production leakage and substitution, both of which reduce the tax base. Consequently, the levy rate and tax base size have an inverted relationship, where higher levies result in smaller tax bases. If the expected production leakage and/or substitution are too high from the expected levy, this can make meeting the budget requirement of 547 M EUR a challenge. Further, this analysis does not consider the loss of other tax revenue due to production leakage (e.g. corporate/income taxes).

The cost of the levy is very high compared to average profit margins for the processing industry. This average tax revenue would equate to about 7% of the processing industry total revenue. As comparison, the average profit margin in the plastic processing industry (NACE 22.2) has averaged around 8.5% from 2018-2022.[126] The cost of the levy for processors is very high compared to the average profit margins, indicating that the levy could put financial strain on the industry, especially companies with below average profit margins. Companies may decide to (partially) absorb the levy cost instead of passing it on into the price of plastic products, leading to reduced profit margins, to avoid production loss.

4.1.3. Impact of the processor levy on the Dutch plastics market

Production leakage

A levy on the processing of polymers (640 EUR/t) in combination with a EU/NL circular standards is estimated to lead to production leakage of 18-36% for polymer processors, however if the levy creates a significant price shock and/or additional circular substitution, production leakage could be higher.[127] This production leakage is relative to the situation without standards or a levy. A processor levy will directly impact the production of plastic products. Processing virgin fossil polymers for these products will

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[125] *Historically, relative annual price changes (based on domestic/import price ratios) ranged from -1% to 1% from 2001 to 2019, with product-specific variations ranging -5% to 7%. Based on price data from CBS.*
[126] *StatLine (2024). Bedrijfsleven; arbeids- en financiële gegevens, per branche, SBI 2008.*
[127] *The expected average price increase is 11% from the levy, where the range for the sector level weighted average of the import and export elasticities is 0.7-2.3. Therefore, on top of the 12% production leakage from the standard, the levy would lead to an additional 8-26% production leakage (19%-37% including leakage from the standard and levy). Some discrepancies may occur due to rounding estimates.*

become more expensive and thus increasing the price of these products. This can lead to consumers of Dutch plastic products, whether it be by Dutch buyers or buyers outside the Netherlands, to switch to a cheaper foreign supplier of the same product. Assuming that price sensitivity is linear, a levy rate of 640 EUR/t of virgin fossil polymers processed is set to meet the budget requirement if no additional circular substitution is assumed. However, if processors do indeed pass on all of the cost of the levy to the price and such a large price shock leads to a stronger reaction from buyers, than the production leakage could be higher. In such a case, a higher levy rate would be required to compensate for the smaller tax base. However, a higher levy rate in itself leads to higher production leakage. Consequently, the cascading effect of setting a higher levy rate, which lowers the size of the tax base, could make it infeasible to reach the budget requirement. Furthermore, if the levy were to lead to additional circular substitution, then a higher levy rate would need to be set (920 EUR/t), which would lead to greater production leakage (21-47%).[128] Even more, with this high of levy rate, there is risk that production leakage could be even higher.

The levy could also indirectly impact Dutch polymer producers, as a reduction in polymer processing will lead to a reduction in domestic demand for polymers. This indirect impact would be Dutch polymer production for the domestic market, which on average accounts for 10% of Dutch polymer supply, where the remainder is exported. The export-orientation of the Dutch primary polymer sector means that the impact would be limited (up to 7%).

Table 4-3 Production leakage from a levy on processors in 2030

Production leakage (%)	EU/NL standards only*	Standards + levy (640 EUR/t)	Standards + levy (920 EUR/t)
Processors	-12%	-18% to -36%	-21% to -47%
Producers**	-3%	-4% to -6%	-4% to -7%

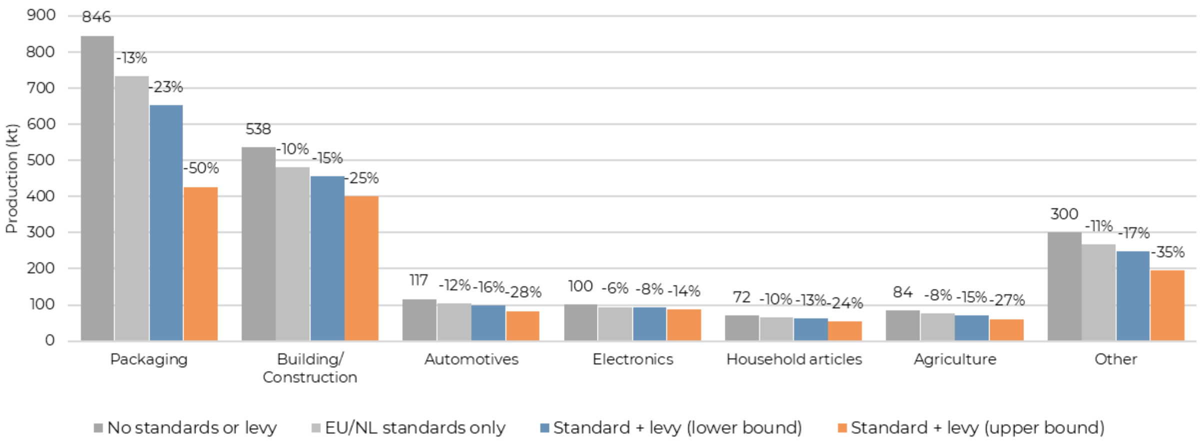
**Production leakage from the EU/NL standards is based on the results of the CE Delft study (2024), where the expected impact would be 5-18% (11.5% on average).*
***About 90% of Dutch polymer production is for export, where the remaining production is for the Dutch market (domestic supply = 5500*10% = 550kt). This domestic supply accounts for about 30% of domestic demand (550kt/1830kt=30%). Indirect production leakage would only occur to non-exempt polymers (85%). Therefore, indirect leakage would be 3% (11.5%*0.3*0.85).*

Production leakage would impact products made from commodity plastics most, particularly, packaging plastics. Commodity plastics products (e.g. PE, PP, PVC) are relatively low cost plastics, which are also more price sensitive. This can lead to relatively more production leakage, as these products are more vulnerable to losing their competitive advantage with cost increases (such as a levy). These at-most-risk products include items like plastic pipes/hoses made of PE/PVC, sheets/films/foils/strips made of PE/PP/PS, PE sacks/bags, PVC flooring, and (PET) bottles. Notably, the impact on plastics for electronics is relatively limited as these products also contain other thermoplastics which are exempted from the standard and levy. Interviewees stated that Dutch plastic products would still be purchased despite potentially higher prices if transportation costs of foreign plastic products would be significantly higher (e.g. light weight products with

[128] *The expected average price increase is 11% from the levy, where the range for the sector level weighted average of the import and export elasticities is 0.7-2.3. Therefore, on top of the 12% production leakage from the standard, the levy would lead to an additional 8-25% production leakage (18%-36% including leakage from the standard and levy). Some discrepancies may occur due to rounding estimates.*

high volume). However, if the levy would be so high that it balances out the price advantages of transportation, also these products would be purchased from abroad.

Figure 4-5 Production leakage from a processor levy (640 EUR/t) in 2030, per application type



**Production leakage from the EU/NL standards is based on the results of the CE Delft study (2024), where the expected impact would be 5-18% (11.5% on average). In this study, the expected impact has been split between the plastic application types based on quantity of non-exempt virgin fossil polymers processed per application.*

Interviewees raised concerns that a levy on processors increases the risk of more imports of plastic products, with the risk being different for different products. Moreover, the interviewees emphasised that the additional pressure on Dutch converters due to the leakage to foreign competitors, would also restrict the converters' abilities to adjust to more circular opportunities. This would be the case because the converters' focus would be on price aspects in order to stay competitive.

Transition to circular plastics and environmental impact

The impact of the levy on incentivising processors to switch to circular plastics will depend on the cost, quality and availability of circular polymers after the implementation of the standard. The levy will principally change the price incentive for Dutch processors since using virgin fossil polymers will become more expensive. However, this does not necessarily mean that the levy will lead to greater substitution with circular polymers. The introduction of the Dutch and EU standards will already incentivise processors to use the most cost-effective and available circular polymers.[129] Given the existing market dynamics, including limitations in circular plastic polymer supply, price volatility, technology/regulatory constraints, etc., the levy on top of the standard would have a limited ability to enhance substitution beyond what the Dutch/EU standards already encourages based on the current market conditions. Therefore, the levy may primarily reinforce existing incentives rather than create new opportunities for increased uptake of circular plastics.

However, at the same time, the standard could reshape the existing circular polymer market, driving a broader scale-up of circular polymer operations, though this could be dampened severely if there is significant production leakage. If the standard is able

[129] *It is assumed that all circular plastics have the same circular plastic units for the implementation of the Dutch Circular Plastic Standard trading system.*

to establish a clear market signal, this could create a stable demand for circular plastics, leading to more long-term investments in circular polymers. This could consequently lead to greater capacity and incentives for substituting virgin fossil polymers with circular ones. However, interviewees mentioned their scepticism of such a scenario, as the standard will likely lead to greater production leakage than market transformation. As mentioned previously, if the levy would create such a price shock, it could lead to more production leakage, which could significantly reduce the possibility of a market transformation. Further, such a transition of the market would likely be in the long-term and still be dependent on global market trends and technological advancements.

Although the processor levy, in combination with the standard, is not expected to lead to significant additional substitution, it was considered what levy rate would be required to meet the budget requirement if the maximum potential substitution occurs. In this case, the levy rate required is estimated to be 920 EUR/t, based on not only the additional substitution, but also the additional production leakage from a higher levy rate.

A levy of 920 EUR/t, in combination with the EU/NL standards would lead to less substitution than the EU/NL standards alone due to production leakage. With a levy rate of 920 EUR/t, in combination with EU/NL standards, the total maximum potential additional substitution with circular polymers would be about 180 kt by 2030. In comparison, without a levy, it would be expected that EU/NL standards would lead to about 184 kt of additional circular plastics.[130] It is important to note that the estimated substitution from the levy is less predictable than that of the standard, as the standard is a mandate which companies must find a way to comply, whereas the levy is a price signal, where the impact is less certain as it relies on the market response, therefore substitution behaviour is not guaranteed. Therefore, the estimate substitution *from the levy* is a maximum potential whereas the substitution from the standard is based on meeting the 27.5% requirement at industry level and 25% for packaging. Nevertheless, as the combination of the two policies does not lead to significantly more substitution than the two policies alone, the two policies have *overlapping* effects, meaning that when combined, they could have reinforcing effect, rather than a multiplicative effect.

Table 4-4 Potential substitution with circular plastics from a levy and standard on processors (920 EUR/t) in 2030

	EU/NL standards only	Levy and EU/NL standard
Total (kt)	184	60-180
Additional Circular plastics from standard (kt)	184	60*
Additional Circular plastics from levy (kt)	-	0-120
- Bio-based (kt)	-	0-114
- Recyclate (kt)	-	0-6

*Substitution from the standard is much lower when combined with the levy, compared to the scenario where there is no standard or levy, due to production leakage. The production leakage from the standard + levy will not only impact virgin fossil polymers, but also the uptake of circular polymers.

[130] *The standards would lead to an additional 249 kt of circular plastics, but production leakage would lead to a decrease of 65 kt of circular plastics (249kt-65kt = 184kt)*

The most cost-effective recyclate will be taken up to fulfil the EU and Dutch standards and most high quality recyclate have a higher mark-up than the levy rate, leading to limited additional uptake of recyclate. Mechanical recyclate varies in quality due to factors such as feedstock purity, contamination levels, polymer degradation, etc., all of which impact the price of recyclate. High quality recyclate comes from well-sorted waste streams, while lower-quality recyclate can often contain mixed plastics and contaminants, which require additional processing. To take into account this variation in additional costs required, we only consider the prices of high-quality recyclate. High quality recycled PP and PE currently have a mark-up of +800 EUR/t, which is higher than the levy rate. Whereas, food grade rPET is about 400-500 EUR/t. However, most of the potential recyclate uptake will already be taken up via the standard. Therefore, the levy (920 EUR/t) could lead an additional uptake of rPET, to a limited extent (up to 6 kt).

Chemical recycling is still in the early stages, though it could potentially have a greater role as the chemical recycling technologies advance after 2030. Chemical recycling is not yet widely scaled-up or cost-effective, as the current investment in infrastructure is limited and it is a highly energy intensive process (for pyrolysis). However, if there are enough market signals to invest in chemical recycling, these processes could become cheaper and more energy efficient, making them viable to be upscaled.

There is potential for additional substitution with more cost competitive bio-based polymers, however there are additional factors which could limit this replacement. Based on the price differences between bio-based and virgin fossil-based polymers (See Annex 2.B), the levy has the potential to make bio-PE a more attractive alternative for processors. Bio-PE is about 500 EUR/t more expensive than fossil-based low-density polyethylene (LDPE).[131] However, considering that bio-plastic production remains limited, it is not expected that the levy would lead to a total replacement of LDPE with bio-PE. The risk is of supply constraints due to competing demand for bio-feedstocks (e.g. biofuels) and volatility in available supply (e.g. low yields, fires). Further, total replacement would increase demand for bio-PE to such a level that the price of bio-PE could consequently exceed that of levied virgin polymers, thus a loss of the price incentive. Considering current global capacity for bio-PE production[132], it is estimated that the levy could lead to a replacement of up to 114 kt of PE with bio-PE, which would make the Netherlands almost 40% of global demand for Bio-PE.

The total potential CO_2 reduction from the levy and standard is 0.18 to 0.43 $MtCO_2$ in 2030, where emissions reduction within the Netherlands would be limited to up to 0.15 $MtCO_2$. If the levy and standard are able to reduce further demand for virgin fossil-based polymers due to the transition to circular plastics, this can lead to environmental benefits, particularly a reduction in greenhouse gas (GHG) emissions. However, not all of this emissions reduction will be from Dutch sources, where the location of the emissions reduction depends on the source of the virgin fossil polymers[133]. In this case only a share of the emissions reduction would come from within the Netherlands, where Dutch-sourced emissions could decrease by 0.15 $MtCO_2$.

[131] *CE Delft reports Bio PE being 400 EUR/t more expensive than fossil-based LDPE (JRC, 2019), the value is adjusted for inflation*
[132] *In 2024, 11% of 2.47 Mt of bioplastic production capacity was bio-PE (271.7 kt), of which 42% is unused capacity. Therefore, the unused capacity is 114 kt.*
[133] *It also depends on where the plastic would be incinerated, where we assume this would occur within the Netherlands*

Table 4-5 Potential GHG emissions reduction from transitioning to circular plastics in 2030 ($ktCO_2$)

	Standard only		Levy and standard	
	Total	From Dutch polymer production only	Total	From Dutch polymer production only
Total	590	204	182-428	63-148
Additional Circular plastics from standard	590	204	182	63
Additional recyclate from levy	-		0-18	0-6
Additional bio-based plastics from levy	-		0-228	0-79

Additionally, the levy could lead to further environmental benefits, though limited. The levy could lead to other environmental impacts, such air and water pollution. However, as illustrated in literature[134], these additional benefits from a plastic levy are expected to be limited in comparison to CO_2 reduction.

The box below provides insights on what the impact of a processor levy would be without a Dutch circular plastic standard implemented.

Box 4-2 Processor levy without a Dutch Circular Plastic Standard

A processor levy without a Dutch standard[135] would have a few different implications. Namely, without a Dutch standard, there would be less production leakage (from the standard). However, more virgin fossil polymer processing also means that a higher share of the total production of plastic products is taxed. This leads to a relatively higher effective levy rate. For example, with the standard and a levy rate of 640 EUR/t , the effective levy rate is 380 EUR/t of plastic product. Without the standard and the same levy rate, the effective levy rate is 420 EUR/t.[136] Therefore, production leakage is not necessarily lower, as a more processing virgin fossil polymers can increase the effective rate of the levy per ton of plastic product.

The table below illustrates how the production leakage from the levy alone would be lower than the with the standard. Following the discussion above, this reduced production leakage is not a simple reduction of production leakage from the standard (-11.5%), but also considers that more of processors' production will be taxed.

Table 4-6 Production leakage from a levy on processors in 2030 with and without a standard

Production leakage (%)	Standards + levy (640 EUR/t)	Levy only (640 EUR/t)
Processors	-18% to -36%	-8% to -31%
Producers	-4% to -6%	-1% to -3%

Administering a levy without a standard also would have implications on the levy rate required to meet the budget requirement. Without a Dutch standard, relatively more virgin fossil polymers would be processed. While the circular share would be ~30% with the standard, without the Dutch standard, the share would be ~20%. This would lead to a larger tax base compared to the situation where a Dutch standard is implemented, namely 1345kt vs 1070 kt.

[134] *CE Delft (2022). Een nationale belasting op primair fossiel plastic? Effecten op milieu en economie.*
[135] *EU standard on packaging still applies*
[136] *640 EUR/t x (80% virgin fossil polymer processing – 5% post-industrial recyclate) x 87% non-exempt = 420 EUR/t*

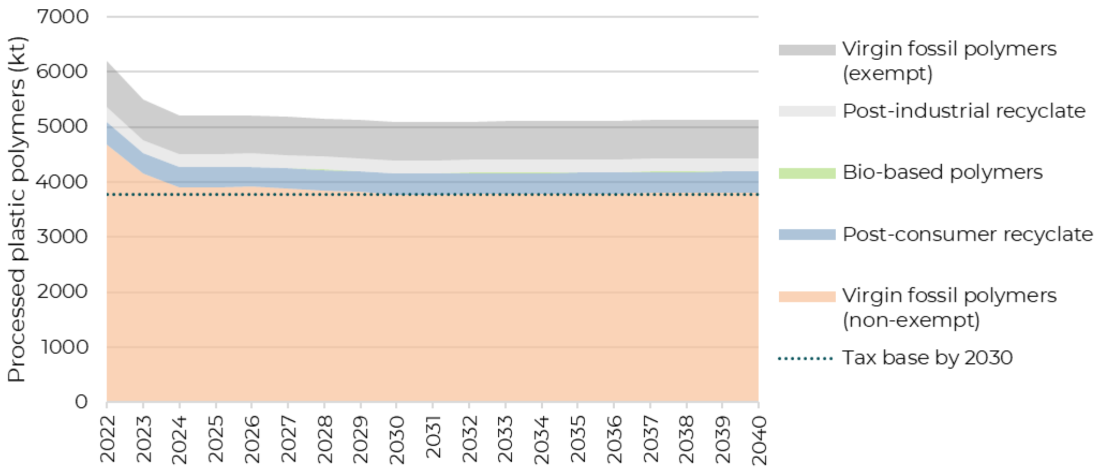
With a larger tax base, a relatively lower levy rate could be applied as production leakage can be lower.

Therefore, with average production leakage and substitution, the levy rate required for a levy without a Dutch standard would be 520 EUR/t, where expected production leakage would be 7-25%. However, with a lower levy rate, this will provide relatively less incentive for processors to switch to circular polymers which tend to be priced higher than virgin fossil polymers by more than 520 EUR/t. Although such a levy could lead to more substitution from 2030 to 2040 as circular alternatives become more relatively competitive with virgin fossil polymers. That being said, the potential price increase from a 520 EUR/t levy would still be relatively high compared to historical price changes, indicating that such a levy may trigger a price shock which will lead to a stronger response from the market. This would consequently lead to greater production leakage, potentially creating a cascading effect where a high levy would need to be set to offset the shrinking of the tax base.

4.2. Variant 2 – Levy on polymer production

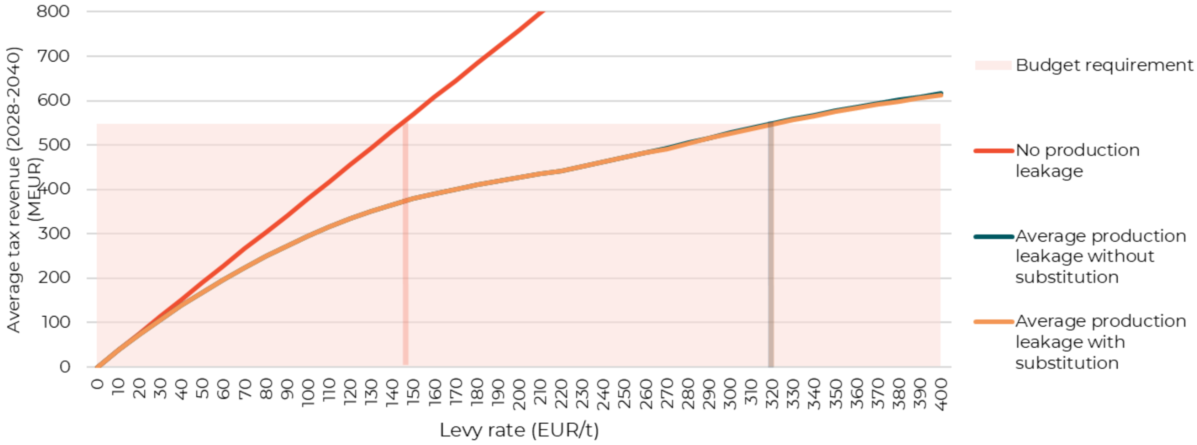
The second variant would be a levy on the *production* of virgin fossil-based polymers in the Netherlands, regardless of whether the polymers are intended for domestic use or export. The table below illustrates the expected tax base for Variant 2 after taking into account exogenous production changes and exemptions, which would lead to ~3,770 kt.

Figure 4-6 Forecasted production of plastic polymers (kt), 2022-2040



Similar to Variant 1, the levy rate necessary to meet the 547 M EUR budget requirement depends on the impact of the levy on polymer production, which can vary depending on the expected outcome of the levy. The figure below illustrates how the levy required varies depending on the expected outcome (e.g. with or without production leakage; with our without substitution). If virgin fossil polymer production were to remain at 3,770 kt (i.e. there is no production leakage), then the levy rate to meet the budget requirement would be 150 EUR/t. With average production leakage (of the lower and upper bound), the levy rate required would be 320 EUR/t. In other words, on average, the levy rate would need to be doubled to compensate for the loss of production due to leakage. There are no differences in the levy required whether there is possible substitution or not, as most of Dutch virgin fossil polymer production is exported. This is because of the high price sensitivity of Dutch buyers of primary polymers. This price sensitivity will lead to processors buying imported polymers rather than switch to circular alternatives. Consider the price sensitivity of primary polymers, we consider two levy rates, 320 EUR/t, meet the budget requirement with average production leakage, and a lower levy rate, 150 EUR/t, to test the levy at a lower rate.

Figure 4-7 Average annual tax revenue (M EUR) from 2028-2040 per producer levy rate with or without production leakage and/or circular substitution



Note: the calculation for production leakage is linear, however, the maximum production leakage is 100%, which can make the relationship between the levy rate and tax revenue non-linear. For instance, there may be a product where the production leakage is 100% in all instances where the levy rate is 500EUR/t. In this case, the production leakage would plateau at 500EUR/t. For substitution, the estimation is step-wise, where if the levy rate makes virgin fossil polymers more expensive than circular polymers, then the maximum potential substitution is used. This can create jumps in the figure.

4.2.1. Increase in primary polymer prices due to the levy

A producer levy of 320 EUR/t would lead to an average price increase of Dutch virgin fossil polymers of 18%, where the impact on prices would range from 0%-30% depending on the polymer. For a producer levy, the effective levy rate is the levy rate for all non-exempted virgin fossil polymers. Assuming that the average price of virgin fossil polymers is 1730 EUR/t, the average price increase would be ~18%. For non-exempted polymers, the price increase would range from 7% to 30%, depending on the price of polymers (pre-levy). For instance, commodity polymers (e.g. PE, EPS/PS, PVC, PET and PP) would be faced with a relatively higher price increase (>20%), whereas specialty polymers (e.g. PMMA, PUR, PA) would face a lower price increase (<10%). For exempted polymers (e.g. PC, other thermoplastics/thermosets), the price increase would inherently be 0%.

A producer levy of 150 EUR/t would lead to an average price increase of Dutch virgin fossil polymers of 9%, where the impact on prices would range from 0%-14% depending on the polymer. Assuming that the average price of virgin fossil polymers is 1730 EUR/t (including exempted polymers), the average price increase would be 9%. For non-exempted polymers, the price increase would range from 0% to 14%, depending on the price of polymers (pre-levy). The variation in price increases with a lower levy rate follows the same logic as with a higher levy rate.

A producer levy at these rates could lead to a price increase above historically observed increases in the relative polymer prices, where it could be expected that a higher levy rate could lead to more production leakage. This analysis estimates price sensitivity based on historical data and assumes that is linear. To understand whether this estimated price sensitivity would be representative of the price increase from the levy, it is important to compare historical changes versus the expected change from the levy. Historically, relative annual price changes[137] of primary polymer have ranged from -12% to 13% from 2001 to 2019, with product-specific variations ranging -20% to 33%.[138] Compared to plastic products, polymer prices are much more volatile, as the production costs for polymers (e.g. feedstock and energy costs) can fluctuate significantly. Additionally, profit margins tend to be lower in the primary polymer industry, allowing for little room for producers to absorb shocks in costs, such as a levy. In this sense, polymer producers would have to pass on the cost of the levy to the price of the polymer. Therefore, the difference between historical relative price increases and a price increase from a levy of 320EUR/t (ranging from 0%-30%) would not be as unprecedented compared to the price increase expected from a processor levy, however it still remains an outlier. The price increase from levy of 150 EUR/t (9%) would be more comparable to price increases observed in previous years. Keeping in mind the significance of the price increase and inability to absorb the cost of the levy, it can be presumed that production leakage would be closer to the higher bound when the levy rate is as high as 320 EUR/t.

4.2.2. Tax revenue and cost of the levy for polymer producers

By design, the tax revenue from Variant 2 reaches the budget requirement of 547 M EUR, however meeting this budget remains uncertain given the high risk of production leakage. As with Variant 1, tax revenue from the levy primarily depends on the size of the tax base and the levy rate determined. However, when considering production leakage, it becomes clear that the tax base itself is influenced by the levy rate. As the levy rate increases, it can drive more production leakage, both of which reduce the tax base. Consequently, the levy rate and tax base size have an inverted relationship, where higher levies result in smaller tax bases. If the expected production leakage is too high from the expected levy, this can make meeting the budget requirement of 547 M EUR a challenge. Further, this analysis does not consider the loss of other tax revenue due to production leakage (e.g. corporate/income taxes).

The cost of the levy is very high compared to the average profit margins for the polymer production industry. This average tax revenue with a 320 EUR/t producer levy would equate to 4% of the polymer industry total revenue. As comparison, the profit margins in the polymer industry (NACE 20.16) have been quite volatile in recent years, where the industry average ranges from 1.1% to 10.1% in the past five years.[139] In 2022, the profit margin was 2.5%. The average cost of the levy for polymer producers is higher than the average profit margin for the industry, indicating that the levy would put significant financial strain on the industry. If profit margins continue to remain low in the industry, there would be little room for companies to absorb the costs.

[137] based on domestic/import price ratios
[138] Based on price data from CBS.
[139] StatLine (2024). Bedrijfsleven; arbeids- en financiële gegevens, per branche, SBI 2008.

4.2.3. Impact of the levy on the Dutch plastics market

Production leakage

A levy on the production of polymers (320 EUR/t) is estimated to lead to production leakage of 26% to 70% for polymer production in the Netherlands.[140] Such a levy would directly impact the producers of primary plastics in the chemical industry. For these producers, selling virgin fossil polymers domestically and abroad will become more expensive and thus increasing the price of Dutch polymers. This can lead to processors, whether it be by Dutch processors or processors outside the Netherlands, to switch to a cheaper foreign supplier of the same polymer. Interviewees have complemented that a levy on the producers might accelerate the current trend of complete stop of production. With a lower levy rate of 150 EUR/t, the expected production leakage would range from 14% to 47%.[141]

The levy could also indirectly impact Dutch processors with domestic suppliers of polymers, though it is expected to be limited. The EU and Dutch standards alone will lead to 12% production leakage for processors. On top of this, Dutch processors will face higher prices for the polymers they buy from Dutch producers as the cost of the levy will be passed on in the price. However, this impact from the levy is expected to be fairly limited (1-6% on top of the 12% from the Dutch standard), as the majority of the Dutch plastic market is supplied by imports, and further, processors have the option to switch to cheaper foreign suppliers.

Table 4-7 Production leakage from a levy on producers in 2030

Production leakage (%)	EU/NL standards only*	Standards + levy (320 EUR/t)	Standards + levy (150 EUR/t)
Producers	-3%	-26% to -70%	-14% to 47%
Processors	-12%	-13% to -18%	-12% to -14%

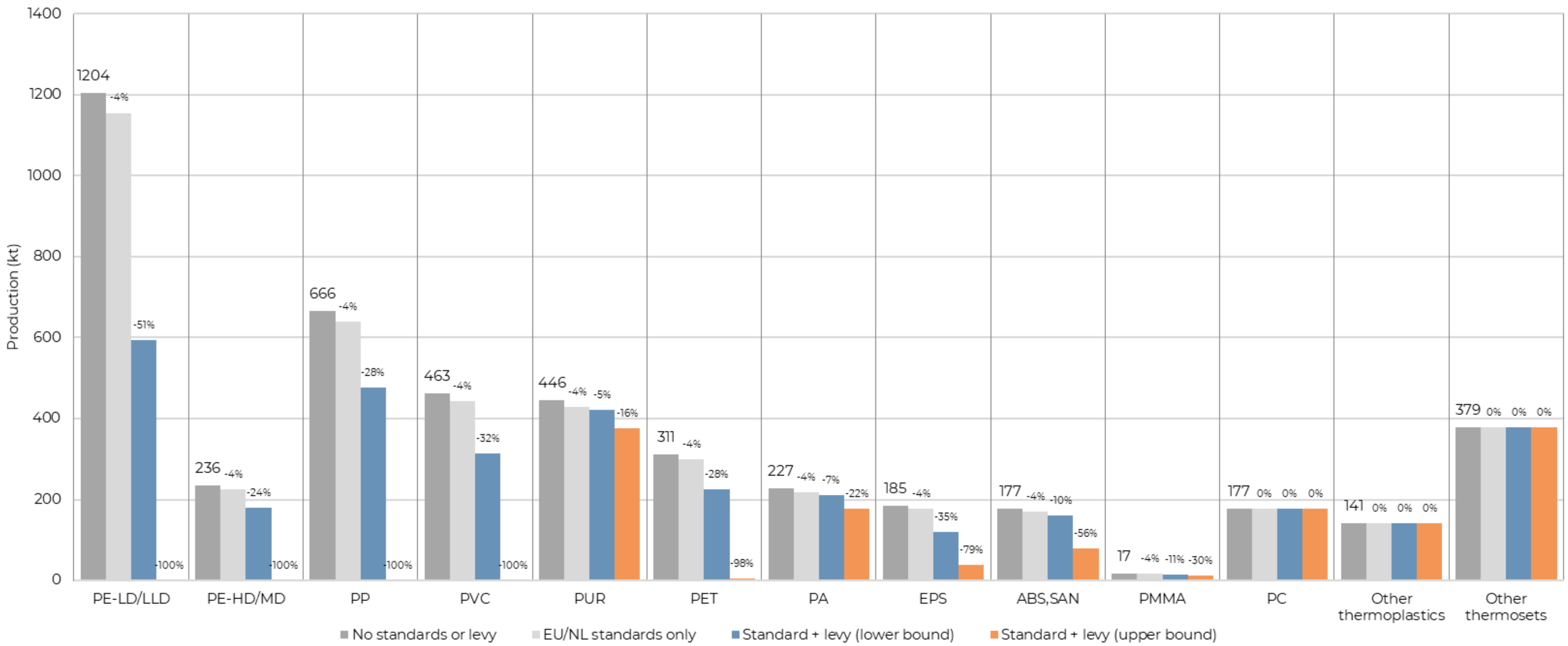
Production leakage, particularly for commodity plastics, is highly uncertain, with estimates ranging widely due to variations in price sensitivity, where there is risk of a potential complete cease of production of most commodity polymers in the Netherlands. Commodity plastics (e.g. PE, PP, PVC, PET) are relatively low cost plastics, which are also more price sensitive. This can lead to relatively more production leakage, as these products are more vulnerable to losing their competitive advantage with cost increases (such as a levy). Interviewees emphasised that Dutch plastic polymer producers have already been struggling with low profit margins over the past years. Hence, the producers would have little to no room to compensate for an additional levy. The potential range of production leakage estimated for these polymers is significant with potentially a complete stop of production of PE, PVC, PP and PET for instance. The broad range of

[140] *The expected average price increase is 18% from the levy, where the range for the sector level weighted average of the import and export elasticities is 1.0-4.5. By taking the simple multiple, it would be estimated that production leakage would range from 18-81%. However, when considering that for some polymers, the estimated production leakage would be greater than 100% (in these cases, capped at 100%), then the total production leakage is lower than the simple multiple, as there cannot be greater than 100% production leakage.*

[141] *The expected average price increase is 9% from the levy, where the range for the sector level weighted average of the import and export elasticities is 1.0-4.5. Therefore, on top of the 3% production leakage from the standard, the levy would lead to an additional 9-42% production leakage (9%-46% including leakage from the standard and levy). Some discrepancies may occur due to rounding estimates.*

impact for these polymers indicates that the exact impact is uncertain. A potential reason for this is that within each polymer type, pricing and price sensitivity can vary. Namely, each polymer can be produced in different grades/forms (e.g. LDPE for film, injection moulding, blown film, etc.), which leads to price differentials within each polymer type. Engineering plastics, such as PMMA, PA and PUR, which are more specialised, would be relatively less impacted than commodity plastics. These engineering plastics are less price sensitive, as well as sold at a higher price (the levy is a smaller percentage of the total price of these polymers).

Figure 4-8 Production leakage from a levy on producers (320 EUR/t) in 2030, per polymer



Transition to circular plastics and environmental impact

A levy on plastic polymer producers is expected to have no/limited impact on the circular transition in the Dutch plastics industry and consequentially limited environmental impact. Although in theory a levy implemented at the production level could reinforce incentives to substitute from the standard, given that Dutch polymers only make a share of the Dutch market, it is not likely to have an impact. The majority of the Dutch polymers are destined to export, where only Dutch polymers make up about 30% of supply to the Dutch market.[142] This means that a change in the price of Dutch polymers will have limited impact on the price of virgin fossil polymers for Dutch processors. Additionally, the levy rate required to meet the budgetary requirement is much lower than the price differentials between virgin fossil and circular polymers. This would mean if a Dutch processor would decide to continue buying polymers from a Dutch producer, the price of this virgin fossil polymer would still be lower than the circular plastic alternatives. Therefore, without a shift to circular plastics such a levy would also have an limited/no positive impact on the environment.

4.3. Variant 3 – Plastic standard gap levy

The third variant is an alternative scenario of the Dutch Circular Plastic Standard, where a gap levy would replace the currently considered trading system. The gap levy would act as the enforcement mechanism for the Dutch Circular Plastic Standard instead of a trading system, which is currently being considered for implementation. With a gap levy, all processors would be obliged to either meet the plastic standard (25-30% by 2030) or pay the levy which would act as a fine for not meeting the standard. It is still assumed that the EU packaging standard (25%) is implemented and adhered to.

The tax base for the gap levy depends on how many processors would meet the standard. With a gap levy, all processors will need to comply with the standard (27.5%), without the ability to be compensated by processors with additional circular processing. As the current circular polymer use is concentrated amongst a few processors, basing the tax base for the gap levy on the current circular share (~15%) would be an underestimate of the tax base. On the other hand, if we assume that no processors process any circular polymers, this would be an overestimate of the tax base, as there are some processors which do. To provide a better estimate of what extent processors would not meet the standard, previous literature[143] concerning the standard was considered. From this literature, it is approximated that at least 18.5% of production will not meet the standard by 2030 and therefore will be taxed.[144] **The scope of the Variant 3 will be much lower than the other two variants, with about 325 kt of processed virgin fossil polymers subject to the tax.** Without a Dutch Plastic Standard, it would be expected that total Dutch polymer processing would amount to 1933 kt, of which 185 kt is exempted virgin fossil polymers. Therefore, the tax base for the gap levy would be about 325 kt.[145]

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[142] About 90% of Dutch polymer production is for export, where the remaining production is for the Dutch market (domestic supply = 5500*10% = 550kt). This domestic supply accounts for about 30% of domestic demand (550kt/1830kt=30%). Indirect production leakage would only occur to non-exempt polymers (85%). Therefore, indirect leakage would be 3% (12%*0.3*0.85).

[143] *Partners for Innovation (2023). Gevolgen nationale norm circulaire plastics. It is important to note that this survey study is not necessarily representative of the Dutch processing sector, but in any case provides more insights than using the sector level data (which would lead to an underestimate of the tax base).*

[144] *See Annex 3.C for explanation of calculation.*

[145] *1933kt – 185kt = ~1750 kt. 1750kt * 18.5% = 325 kt.*

The levy on processors is analysed with one levy rate, 1,000 EUR/t. This levy rate is chosen as it is high enough to make the circular alternatives of high volume polymers (PE, PP, PVC and PET) more attractive than virgin fossil polymers, based on recent price estimates available (See Annex 2.B). However, the levy rate required to meet the standard may change depending on how the prices and availability of virgin fossil-based and circular plastics develop.

4.3.1. Increase in plastic product prices due to the standard gap levy

A standard gap levy of 1,000 EUR/t would lead to an average increase of in the total price of Dutch plastic products of 6%, where the impact on prices would range from 4-8% at product level. For plastic products, we assume that the levy would apply to about 18.5% of total production on average (excluding exempted virgin fossil polymers). In the case of a gap levy of 1,000 EUR/t, the effective levy rate would therefore be 185 EUR/t of plastic product. However, given that the gap levy would be expected to lead to substitution, the effective levy rate would decrease as virgin fossil polymer use decreases. On the other hand, substitution with circular polymers also adds a cost for processors. Taking both these factors into account, the effective additional cost from the levy is about 200 EUR/t of plastic product, considering the cost of the levy as well as additional cost of circular polymers. Assuming on average the price of plastic products is 3360 EUR/t, the average increase in price would be 6%. The price increase would vary across from product to product, where the impact on price would range from 1% to 9%. The price increase would be greatest for most packaging plastics, (PVC) flooring, pipes and agricultural plastics (>5%).

Although the additional cost from the levy is lower compared to that of the processor levy (Variant 1), the price increase is still relatively high compared to historical relative price[146] changes. As described in Section 4.1.1, buyers may have a stronger reaction to a price increase such as 6%, such price changes are not common within the plastic product sector historically. At the same time, processors might absorb part of the cost, sacrificing profits to mute price increases and mitigate demand loss. If this occurs, the actual price rise would be lower than currently assumed. Given these uncertainties, it is denoted that the production leakage may be higher than estimated.

4.3.2. Tax revenue and cost of the standard gap levy

Unlike Variants 1 and 2, the standard gap levy is not necessarily designed to meet a certain budget, where with a standard gap levy of 1,000 EUR/t, there would an average annual tax revenue of 240 M EUR. This is based on the average annual tax revenue with production leakage and with and without substitution.

The cost of the levy for processors is relatively high compared to industry profit margins. The average tax revenue would equate to 2.5% of the processing industry total revenue. As comparison, the average profit margin in the processing industry (NACE 22.2) has averaged around 8.5% from 2018-2022.[147] Therefore, the relative cost of the levy, although not as high as in Variant 1, is still relatively high compared to profit margins. Companies may decide to (partially) absorb the levy cost instead of passing it on into the price of plastic products, leading to reduced profit margins, to avoid production loss.

[146] *Relative price is based on the domestic/import price ratio*

[147] *StatLine (2024). Bedrijfsleven; arbeids- en financiële gegevens, per branche, SBI 2008.*

4.3.3. Impact of the levy on the Dutch plastics market

Production leakage

A standard gap levy on the processing of polymers (1,000 EUR/t) implemented in combination the EU PPWR, is estimated to lead to production leakage of 4-15% for polymer processors, though production leakage could be higher. As described above, the effective additional cost of the levy per ton of plastic product produced would be much lower than the gap levy rate. Namely, it estimated that the gap levy would lead to about 200 EUR of additional costs per ton of product. If processors were to pass on all of this cost to the price of the product, this would lead to about 4-15% shift in demand from Dutch to foreign products. However, as mentioned, the production leakage could be higher given that the price increase is relatively high compared to historical changes in relative domestic prices.

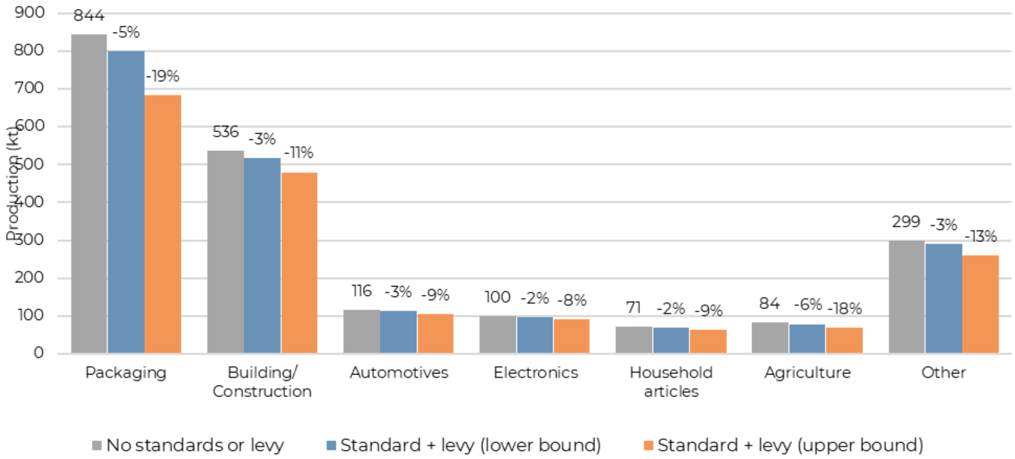
Similar to Variant 1, the standard gap levy would also indirectly impact Dutch polymer producers, as a reduction in polymer processing will lead to a reduction in demand for polymers. However, this impact would be minimal as Dutch production of polymers for the domestic market is limited.

Table 4-8 Production leakage from a levy on processors in 2030

Production leakage (%)	NL standard with trading system + EU PPWR	NL standard gap levy + EU PPWR
Producers	-3%	-2% to -3%
Processors	-12%	-4% to -15%

Production leakage from the gap levy would impact products made from commodity plastics most, particularly, plastics for packaging, building/construction and agriculture. Commodity plastics products (e.g. PE, PP, PVC) are relatively low cost plastics, which are also more price sensitive. This can lead to relatively more production leakage, as these products are more vulnerable to losing their competitive advantage with cost increases (such as a levy).

Figure 4-9 Production leakage from a standard gap levy on processors (1,000 EUR/t) in 2030, per application type



Transition to circular plastics and environmental impact

The standard gap levy would lead to a more uncertain outcome than a standard with a trading system. A standard with a trading system creates market-driven incentives, where the cost of compliance is adjusted based on the supply and demand for circular plastic units. In this sense, there is a guarantee the standard will be met, as companies with a deficit in circular processing are compensated by companies with a surplus. On the other hand, in the case of a standard gap levy, the cost of compliance is fixed (per ton of virgin fossil polymer processed) and there is not compensation by companies with a surplus. While this can potentially lead to more uptake of circular plastics as companies with a low circular share are no longer compensating for companies with a lower share, these companies can also offset their under-processing of circular polymers by paying the levy. Therefore, the standard gap levy leads to less certain substitution than a standard with a trading system.

5. Analysis of profiles

Profiles are sub-sets of the value chains of polymers and plastic products, which are expected to experience a similar effect of the levy on fossil-based polymers. Profiles have been developed for this study to enable a more detailed assessment of the expected impacts of this levy. The profiles were compiled out of a set of different polymers and related plastic products which are likely to have a similar impact due to a levy. They are grouped together because this impact can be expected to be different from the impact on the average sector. The profiles thus aim to identify those segments of the value chains susceptible to be impacted more or less strongly than the average sector. The profiles are not designed to provide a full coverage of all products being manufactured in the Netherlands, but rather exemplify the variation in effects across the industry.

The profiles provide a more nuanced, yet still simplified view of the complex market for polymers and plastic products. The qualitative discussion below will make some inroads into accounting for the key issues that were identified during the project regarding mainly the legislation applicable to recycled products and their quality.

5.1. Defining the profiles

The profiles-approach is based on the quantitative assessment performed in Chapter 4 of the impacts of the plastic levy. Hence, the results of Chapter 4 regarding the whole sector have been applied selectively to the products belonging to specific profiles, deriving quantitative results. The details of the method are provided in Annex 3.F (*definition of profiles*), 3.G (*susceptibility to production leakage*) and 3.H (*substitution with circular plastics and environmental impacts*).

The allocation of polymers and plastic products to specific profiles was based on two indicators, namely the '*susceptibility to production leakage*' and their '*techno-economic capacity to be substituted by circular polymers*'. The profiles have been defined as combinations of categories (Low / Moderate / High) for the following two indicators: 1) *Susceptibility to production leakage*; and 2) *Techno-economic capacity to be substituted by circular (bio-based / recycled) polymers*.

Each of these indicators is detailed in one of the paragraphs below. Annex 3Annex 3 – Details on methodology provides further details on the methodology taken per indicator and on the values taken per indicator for each polymer and plastic product.

The indicator of susceptibility to production leakage combines values of elasticity, price / kg and share of plastic in the final product. It is based on data from the modelling performed in Chapter 4 above to support the assessment of the impacts of the variants of the levy. It depends on the availability of data on elasticities, which is lacking for two categories of plastic products: for automotive and for electronic applications. These plastic products could hence not be included in this analysis. It is also based on average price for the products, obtained in the modelling phase described in chapter 4 above. An important limitation of the method is that it considers a single price for each broad category of polymers or of plastic products, whereas the reality in the market is that the price of polymers and plastic products can vary considerably with the grade of the polymer and its purity level (in particular in case of contact with food or drinking water). Unfortunately, the data available within the time and budget frame of the study did not enable this high level of granularity.

The indicator of techno-economic potential to be substituted by circular polymers mixes different methods. It combines:

- The interpretation of data on the share of circular polymers, i.e. mechanically or chemically recycled from post-consumer waste or bio-based, that are observed on commercially-available products (which implies that the underlying manufacturing process has reached an industrial grade of technical readiness);
- An estimation of the applicability of 'circular' alternatives to specific markets (food packaging, construction, household articles, agriculture, other), because of applicable legislation and of the presence of legacy products;
- Information on the price differences between a circular alternative and the market price reference of the fossil polymer. This was used to eliminate from the assessment those circular alternatives whose price is significantly higher than that of the reference virgin fossil polymer (i.e. higher than the levy rates investigated in this study).

For reasons analogous to those outlined above, this approach to the substitutability by circular polymers is considerable simplification of the complex reality of the plastics market. According to the presence or not of legacy additives in the recovered waste plastics, of the nature and legal status of these additives (some of which may have been banned by subsequent chemical safety legislation since their initial placement on the market) and to the nature of the application (in particular regarding the contact or not of the plastic product with food or drinking water), the substitution of virgin fossil polymers with circular alternatives, and in particular with mechanically recycled plastics, can be allowed or forbidden. In addition, the exact composition of circular alternatives (in particular: of recyclate) is more poorly controlled than that of virgin fossil polymers, so that their mechanical properties are also more poorly controlled. This reduces their suitability for structural elements in mechanically demanding (and higher value) applications such as automotive or aeronautics.

The profiles consist of polymers and plastic products with the same combination of indicators. In order to populate the combinations of indicators, the polymers and plastic products were allocated to the categories defined by the values taken by the two indicators defined above.

5.2. Allocation of polymers and plastic products to combinations of indicators

As shown in Table 5-1 below, the allocation of primary polymers to the combination of indicators show that they are concentrated in the region of 'high' susceptibility to production leakage. There are some exemptions particularly for specialty polymers, such as Table 5-1Polyamide (PA), Polymethacrylate (PMMA) and Polyurethane (PUR).

Table 5-1 Polymers per values of susceptibility to production leakage and substitutability by 'circular' alternatives.

Susceptibility to production leakage / Substitutability by circular alternatives	High	Moderate	Low
Almost completely substitutable	PE-LD/LLD, PET	PA	
Substitutable to a good extent	PE-HD/MD, EPS, ABS,SAN, PP		
Poorly substitutable	PVC	PMMA	PUR

As shown in Table 5-2 below, the allocation of plastic products to combination of indicators displays a more even distribution over the whole matrix of possibilities. Even if the bulk of the plastic products lie in the middle situation of medium susceptibility and substitutability, some also display more contrasted anticipated behaviours, such as bottles (high susceptibility to production leakage, almost complete substitutability), flooring of PVC (high leakage, poor substitutability), pipes and hoses of Polypropylene (low leakage, high substitutability).

Table 5-2 Plastic products per values of susceptibility to production leakage and substitutability by 'circular' alternatives.

Susceptibility to production leakage / Substitutability by circular alternatives	High	Moderate	Low
Almost completely substitutable	Bottles	Sheets/films of PET Sheets/films of PS	Pipes and hoses of PP
Substitutable to a good extent	Monofilaments Sacks and bags of PE	Pipes and hoses of PE Pipes and hoses of PVC Sheets/films of PE Sheets/films of PP Sacks and bags, other Packaging, other Hygiene and toiletries Sheets/films, self-adhesive	Pipes and hoses, other Sheets/films, other Boxes, trays and crates Building/Construction, other Kitchen and tableware Fittings for furniture Other processed plastics Automotive plastics Electronic plastics
Poorly substitutable	Flooring of PVC		Sheets/films of PUR

5.3. Definition of the profiles and impacts of the levy

The nine profiles are identified amongst Dutch production and processing of polymers, which are displayed in Table 5-1 and Table 5-2. From the analysis, seven profiles are recognised within the Dutch polymer/plastics industry:

- **A. High-risk adaptor** (*high risk of leakage / high potential for circular polymers*): can more easily adapt to using circular alternatives, putting them in a stronger position to transition. However, there is high risk of losing competitiveness with foreign companies if their prices increase (due to levy or higher costs of circular feedstocks/polymers).;

- **B. High-risk innovator** (*high/moderate risk of leakage / moderate potential for circular polymers*): has some ability to transition to circular alternatives but faces technical, regulatory and/or economic barriers, which may require additional investments in *innovative* solutions. However, there is high risk losing competitiveness with foreign companies if their prices increase (due to levy or higher costs of circular feedstocks/polymers).;
- **C. High-risk & restricted** (*high risk of leakage / low potential for circular polymers*): faces severe challenges in adopting circular polymers due to technical limitations or lack of viable alternatives. There is a high risk of losing competitiveness with foreign companies if the price increases from the levy.;
- **D. Moderate-risk adaptor** (*moderate risk of leakage / high potential for circular polymers*): can more easily adapt to using circular alternatives, putting them in a stronger position to transition. However, the cost pressure from the levy or additional cost of circular polymers could still put these companies at risk of losing competitiveness with foreign companies.;
- **E. Moderate-risk innovator** (*moderate risk of leakage / moderate potential for circular polymers*): has some ability to transition to circular alternatives but faces technical, regulatory and/or economic barriers, which may require additional investments in *innovative* solutions. However, the cost pressure from the levy or additional cost of circular polymers could still put these companies at risk of losing competitiveness with foreign companies.;
- **F. Moderate-risk & restricted** (*moderate risk of leakage / low potential for circular polymers*): has limited ability to transition to circular alternatives and the cost pressure from the levy could still put these companies at risk of losing competitiveness with foreign companies.;
- **G. Low-risk adaptor** (*low risk of leakage / high potential for circular polymers*): well-positioned to integrate circular polymers with minimal disruption. Likely able to pass on (some of) the cost of the levy or additional cost from substitution to the intermediate or end user without significant loss of demand.; and
- **H. Low-risk innovator** (*low risk of leakage / moderate potential for circular polymers*): has some ability to transition to circular alternatives but faces technical, regulatory and/or economic barriers, which may require additional investments in *innovative* solutions. Likely able to pass on (some of) the cost of the levy or additional cost from substitution to the intermediate or end user without significant loss of demand.
- **I. Low-risk & restricted** (*low risk of leakage / low potential for circular polymers*): has very limited ability to transition to circular alternatives. However, manufactures of these products are likely able to pass on some of the cost of the levy to intermediate or end users without significant loss of demand.

In some cases, a profile may not be evidently present within the primary polymer or plastic product industry, though they are present within the other sector (e.g. present within plastic product industry but not primary polymers). These profiles are included for both industries to maintain consistent categorisations.

While the profiles provide important insights on the potential variation in impact of the levy, they do not provide a full picture of all the intricacies within the plastic industry. The profiles are based on the categorisation of products. However, there are other company characteristics which would also influence the impact of a levy, such as company size, high/low tech, trade orientation etc.. Some insights relating to these characteristics are addressed in the tables below, however, not all aspects can be captured.

Table 5-3 below provides the main features of each of the primary polymer profiles, where there is a clear distinction of commodity polymers (Profiles A, B and C) and specialty polymers (Profiles D, F, and I). The impact of the levy on production leakage for the representative product in each profile is displayed for the two levy rates of a *producer* levy (Variant 2). The impact is computed only for the producer levy, as it is the variant targeting primary polymers. In terms of ability for substitution, from the perspective of primary polymers producers, it is considered whether production of circular alternatives is viable, such as a virgin fossil polymer producer to invest in circular polymer production.

For commodity polymers (Profiles A, B and C), a producer levy creates a high risk of closure of plants and potentially relocation of operations to outside the Netherlands. The primary polymer industry is comprised mainly of a few large companies producing commodity polymers, which are largely export-oriented. These types of polymer producers face high competition, and thus have high risk of production leakage, and fit within the A, B and C profiles. These profiles account for the majority of primary polymer production in the Netherlands (~3,850 kt). Namely, there is a significant risk that the consequence of the levy for these companies will be closure of plants and potentially relocation of operations to outside the Netherlands rather than reduction of production. There is also a risk of closure/relocation for specialty polymers with moderate risk of leakage (Profiles D and E).

While within the commodity polymer profiles (A, B and C), there is variation in the adaptability to circular polymers, limited substitution would be expected across all commodity polymers. While some commodity polymers are more technically adept to being substituted with circular polymers, the levy rate required to make production of these circular alternatives an attractive investment for producers is significantly high. The investment in the implementation of production operations of circular alternatives is slow, costly and risky. Even with a gradual implementation of a high rate levy, large companies producing these commodity polymers are likely to decide to close plants within the Netherlands and invest in production in other countries. This is because they will make long-term investment decisions keeping in mind the anticipated high levy rate and larger companies have greater means to shift operations to other countries.

For specialty polymers (Profiles D, F, and I), a producer levy still creates a possible risk of plant closures, though these companies are better able to sustain operations when faced with a levy compared to commodity polymers. Specialty polymers, such as PA, PMMA and PUR, are high-valued polymers which are typically used in specific applications such as automotives and electronics. Given the high quality requirements for these applications, the users of these polymers may be more willing to accept a higher price (whether it be passed-on costs form the levy or cost of switching to circular alternatives). That being said, these polymers are export-oriented and can face foreign competition, where increasing their prices will lead to some production leakage. Therefore, there is still possible risk of relocation of operations to other countries (similar to commodity polymers), particularly for Profiles D and F. However, these is also the possibility that these companies (Profiles D and F) will accept lower profit margins to mitigate production leakage, depending on the levy rate. For the case of Profile I, the low-risk and restricted, the levy will likely increase the price of polymers for intermediary users. This is because competitiveness of these polymers is more based on quality rather than price.

Table 5-3 Profiles for polymers

Position in the matrix: susceptibility to production leakage; substitutability	Products in the profile (illustrative product <u>underlined</u>)	Company characteristics	Potential consequences of a producer levy / possible response from producers	Estimation of total quantity manufactured in the Netherlands (kt / year) (based on 2022 production)	Production leakage of the <u>illustrative product</u> (as % of production) upon implementation of the levy on polymer production (Variant 2a: 320 EUR/t; 2b: 150 EUR/t)	Maximum potential substitution of the <u>illustrative product</u>
A: High - High **High-risk adaptor**	PE-LD/LLD, <u>PET</u>	Manufacturers of commodity polymers (low-cost, high volume production) with circular alternatives available	• If the levy is not phased-in, no time to invest in circular alternative and high risk of closure/bankruptcy. Most producers are large companies, so relocation of production outside of the Netherlands is likely. • If implemented gradually, there may be sufficient time to invest in circular alternatives, though levy rate would need to be very high given the higher production costs of circular alternatives.	1800	<u>PET</u> Variant 2a: -28% to -98% Variant 2b: -15% to -61%	<u>PET</u> Up to 90-100% replaceable with rPET
B: High – Mod **High-risk innovator**	<u>PE-HD/MD</u> , EPS, ABS/SAN, PP	Manufacturers of commodity polymers with some circular alternatives	*Similar consequences as Profile A, though potential investment in circular alternatives is more limited, thus higher risk of Dutch operations stopping*	1500	<u>PE-HD/MD</u> Variant 2a: -24% to -100% Variant 2b: -13% to -75%	<u>PE-HD/MD</u> Restricted use of recyclate in contact-sensitive applications. Up to 95% replaceable with bio-PE, but for specific applications. Potential supply constraints
C: High – Low **High-risk & restricted**	<u>PVC</u>	Manufacturers of commodity polymers with no circular alternatives available.	Loss of price competitiveness in the global market. High risk of bankruptcy or relocation of production outside of the Netherlands.	550	<u>PVC</u> Variant 2a: -32% to -100% Variant 2b: -17% to -84%	<u>PVC</u> Up to 100% for specific applications, but contaminants in rPVC make it difficult to apply in most applications

Position in the matrix: susceptibility to production leakage; substitutability	Products in the profile (illustrative product underlined)	Company characteristics	Potential consequences of a producer levy / possible response from producers	Estimation of total quantity manufactured in the Netherlands (kt / year) (based on 2022 production)	Production leakage of the illustrative product (as % of production) upon implementation of the levy on polymer production (Variant 2a: 320 EUR/t; 2b: 150 EUR/t)	Maximum potential substitution of the illustrative product
D: Medium – High Moderate-risk adaptor	PA	Manufacturers of higher-value polymers (used e.g. in the automotive, electronics, aeronautics sectors) with easily accessible circular alternatives.	• If the levy is not phased-in, the time to invest in circular alternative may be insufficient and the company is likely to lose margin or even go bankrupt/relocate production to another country. If operations remain within the Netherlands, they may accept a reduced profit margin, depending on the levy rate. • If implemented gradually, there may be sufficient time to invest in circular alternatives, though levy rate would need to be very high given the higher production costs of circular alternatives.	250	PA Variant 2a: -7% to -22% Variant 2b: -5% to -12%	PA rPA can be processed in non-critical applications; current practices combine mechanical and chemical recycling.
E: Mod – Mod Moderate-risk innovator	*(none)*					
F Mod – Low Moderate-risk & restricted	PMMA	Manufacturers of higher value polymers with very limited circular alternatives	• Relocation of production outside of the Netherlands is possible. If operations stay within the Netherlands, companies may accept a reduced profit margin, depending on the levy rate. • If implemented gradually, there may be sufficient time to invest in circular alternatives, though levy rate would need to be very high given the higher production costs of circular alternatives and complete substitution in operations is unlikely. A high levy rate would still have risk of leading to a stop of operations in the long-term.	<50	PMMA Variant 2a: -10% to -30% Variant 2b: -7% to -16%	PMMA Up to 30-50% with chemically recycled PMMA
G: Low – High Low-risk adaptor	*(none)*					
H: Low – Mod Low-risk innovator	*(none)*					

Position in the matrix: susceptibility to production leakage; substitutability	Products in the profile (illustrative product underlined)	Company characteristics	Potential consequences of a producer levy / possible response from producers	Estimation of total quantity manufactured in the Netherlands (kt / year) (based on 2022 production)	Production leakage of the illustrative product (as % of production) upon implementation of the levy on polymer production (Variant 2a: 320 EUR/t; 2b: 150 EUR/t)	Maximum potential substitution of the illustrative product
I: Low – Low **Low risk & restricted**	PUR	Manufacturers of high-value polymers (used mainly in the automotive sector) with very limited circular alternatives (for most applications).	• The levy will increase the price of the polymers for intermediary users. It may create an incentive to invest in circular alternatives, but likely to a limited extent. • Companies may accept a moderately reduced profit margin while remaining in the Netherlands.	550	PUR Variant 2a: -5% to -16% Variant 2b: -4% to -9%	PUR Circular alternatives can replace ~25% of virgin fossil PUR

The table demonstrates the diversity of impact the levy could have on various types of plastic products. The table provides distinct insights concerning the characteristics, potential consequences of the levy and expected volume of manufacturing impacted for each profile. Some of the key common insights and distinctions are described in the text below.

A significant share of plastic products produced in the Netherlands are considered at high risk of production leakage (Profiles A, B, and C), with a high risk of bankruptcy particularly for small/medium sized companies. Almost 1,000 kt of plastic products are within these profiles, with various ability to substitute virgin fossil with circular polymers. , These mainly consist of single-use, commodity, low-cost plastic products, mainly for packaging and agriculture. Regardless of their substitutability, there is a significant risk that these types of companies would have no time to adjust to the levy and invest in circular polymers, and thus risk bankruptcy. This is particularly a risk for small/medium size companies, where larger companies may decide to relocate operations to outside the Netherlands in anticipation of the levy. If the levy was implemented gradually, there may be sufficient time for companies, such as those in Profiles A and B, to switch to circular polymer suppliers and invest in necessary infrastructure. Though, the levy rate would need to be high enough to incentivise the switch. Particularly for the case of high-risk innovators (Profile B), the levy rate required to make such an investment attractive may be counterproductive if it leads to significant production leakage. Additionally, if these companies which make these types of products also make other products, which are less susceptible to production leakage, production may shift to these lower risk products. This could lead to a more homogenous market for domestic production within the Netherlands.

Some plastic products produced in the Netherlands are considered to have moderate risk of production leakage (Profiles D and E), where there is some risk of closure/relocation of Dutch operations. Almost 350 kt of plastic products are within these two profiles. These profiles mainly consist of products with more durable, low-cost products (e.g. toiletries, PVC pipes) or high-cost intermediary products (e.g. high cost films/sheets). These profiles would have similar consequences to the high risk profiles (A, B and C), although there is more potential for companies to remain in the Netherlands and accept lower profit margins (as not all of the cost of the levy can be passed on to consumers). That being said, particularly if the levy is set at a high rate and is not gradually implemented, there is risk of putting significant financial strain on these companies and risking bankruptcy. With gradual implementation, this may provide sufficient time for these companies to make the necessary investments to switch to circular alternatives. However, for Profile E, moderate-risk innovators, there may be difficulty to switch completely to circular alternatives (e.g. because of technical constraints or high investment costs).

On the other hand, there is also a large share of relatively high-value plastic products produced in the Netherlands which are less at risk (Profiles G, H and I). About 800 kt of plastic products are considered to have relatively lower production leakage risk. These products mainly consist of high-valued specialised products such as for automotives, electronics, high-cost consumer goods (e.g. kitchenware) and high-cost construction/building materials (e.g. doors, shutters). These categories can also include products which have high transport costs. High transport costs create a competitive advantage for domestically produced products. For these types of products, the levy would increase the price of the product for intermediate/end users and reduce profit margins for these companies (depending on to what extent companies can pass on the cost of the levy to users). For companies in these profiles, they may decide to invest in circular alternatives, though there will be less pressure from price competition to do so. That being said, products in Profiles H and I can also struggle to have equivalent circular alternatives, making substitution more difficult.

Table 5-4 **below provides the main features of each of the profiles in the case of plastic products.** The impact of the levy on production leakage for the representative product in each profile is displayed for the two levy rates of the *processor* levy (Variant 1). The impact is computed only for the processor levy, as it is one of the variants targeting the plastic product industry. In terms of ability for substitution, from the perspective of plastic product producers/polymer processors, it is considered whether processing of circular polymers is viable, such as a processor buying circular polymers and investing in the necessary infrastructure.

The table demonstrates the diversity of impact the levy could have on various types of plastic products. The table provides distinct insights concerning the characteristics, potential consequences of the levy and expected volume of manufacturing impacted for each profile. Some of the key common insights and distinctions are described in the text below.

A significant share of plastic products produced in the Netherlands are considered at high risk of production leakage (Profiles A, B, and C), with a high risk of bankruptcy particularly for small/medium sized companies. Almost 1,000 kt of plastic products are within these profiles, with various ability to substitute virgin fossil with circular polymers. , These mainly consist of single-use, commodity, low-cost plastic products, mainly for packaging and agriculture. Regardless of their substitutability, there is a significant risk that these types of companies would have no time to adjust to the levy and invest in circular polymers, and thus risk bankruptcy. This is particularly a risk for small/medium size companies, where larger companies may decide to relocate operations to outside the Netherlands in anticipation of the levy. If the levy was implemented gradually, there may be sufficient time for companies, such as those in Profiles A and B, to switch to circular polymer suppliers and invest in necessary infrastructure. Though, the levy rate would need to be high enough to incentivise the switch. Particularly for the case of high-risk innovators (Profile B), the levy rate required to make such an investment attractive may be counterproductive if it leads to significant production leakage. Additionally, if these companies which make these types of products also make other products, which are less susceptible to production leakage, production may shift to these lower risk products. This could lead to a more homogenous market for domestic production within the Netherlands.

Some plastic products produced in the Netherlands are considered to have moderate risk of production leakage (Profiles D and E), where there is some risk of closure/relocation of Dutch operations. Almost 350 kt of plastic products are within these two profiles. These profiles mainly consist of products with more durable, low-cost products (e.g. toiletries, PVC pipes) or high-cost intermediary products (e.g. high cost films/sheets). These profiles would have similar consequences to the high risk profiles (A, B and C), although there is more potential for companies to remain in the Netherlands and accept lower profit margins (as not all of the cost of the levy can be passed on to consumers). That being said, particularly if the levy is set at a high rate and is not gradually implemented, there is risk of putting significant financial strain on these companies and risking bankruptcy. With gradual implementation, this may provide sufficient time for these companies to make the necessary investments to switch to circular alternatives. However, for Profile E, moderate-risk innovators, there may be difficulty to switch completely to circular alternatives (e.g. because of technical constraints or high investment costs).

On the other hand, there is also a large share of relatively high-value plastic products produced in the Netherlands which are less at risk (Profiles G, H and I). About 800 kt of plastic products are considered to have relatively lower production leakage risk. These products mainly consist of high-valued specialised products such as for automotives, electronics, high-cost consumer goods (e.g. kitchenware) and high-cost construction/ building materials (e.g. doors, shutters). These categories can also include products which have high transport costs. High transport costs create a competitive advantage for domestically produced products. For these types of products, the levy would increase the price of the product for intermediate/end users and reduce profit margins for these companies (depending on to what extent companies can pass on the cost of the levy to users). For companies in these profiles, they may decide to invest in circular alternatives, though there will be less pressure from price competition to do so. That being said, products in Profiles H and I can also struggle to have equivalent circular alternatives, making substitution more difficult.

Table 5-4 Profiles for plastic products

Susceptibility to production leakage - Substitutability	Products in the profile (illustrative product underlined)	Company characteristics	Potential consequences of processor levy / potential response of processors	Estimated total quantity manufactured in the Netherlands (kt / year) (based on 2022 production	% production leakage of the illustrative product (Variant 1a: 640 EUR/t; Variant 1b: 920 EUR/t)	Maximum potential substitution of the illustrative product
A: High – High High-risk adaptor	• (PET) Bottles • Non-food, single-use packaging (shopping/garbage bags, low-cost industrial plastic wrap, etc.)	Manufacturers of low-cost, commodity products mainly for single-use with circular alternatives available when the feedstock is appropriately sorted. Limited regulatory restrictions impede on using circular polymers. However, large-scale production can make substitution more challenging.	• If the levy is not phased in, there is no time to invest in circular alternative and high risk of bankruptcy for companies only operating in the Netherlands. Larger companies may relocate production outside of the Netherlands. • If implemented gradually, time can be sufficient to invest in circular alternatives, if the levy rate is high enough to justify it. Thus reduction in operations in the Netherlands could be mitigated.	~300	(PET) Bottles Variant 1a: -29% to -45% Variant 1b: -37% to -60%	(PET) Bottles Up to 90% with rPET
B: High – Mod High-risk innovator	• Sacks and bags of PE • Other food, single-use packaging (films, non-PET packaging) • Agricultural films • Monofilaments (e.g. for netting)	Manufacturers of low-cost, commodity single-use products where some circular alternatives are available, but technical/ regulatory restrictions impede on substitutability	*Similar consequences as Profile A, though potential investment in circular alternatives is more limited, thus higher risk of Dutch operations shrinking/stopping*	~500	Sacks and bags of PE Variant 1a: -28% to -64% Variant 1b: -34% to -85%	Sacks and bags of PE Recycled PE cannot be used for food packaging; can be replaced with bio-PE.
C: High/Mod – Low High-risk & restricted	• Flooring of PVC • Sheets/films of PVC (low-cost)	Manufacturers of commodity products with very limited circular alternatives available, specifically if the feedstock for recycling contains legacy hazardous chemicals.	Loss of price competitiveness in a commodity market with very limited capacity to evade it. High risk of bankruptcy for companies only operating in the Netherlands. Larger companies may relocate production outside of the Netherlands.	~200	PVC flooring Variant 1a: -34% to -81% Variant 1b: -45% to -94%	PVC flooring Contaminants in recycled PVC can reduce quality.
D: Mod – High Moderate-risk adaptor	• Sheets/films of PET (high cost) • Sheets/films of PS (high cost)	Manufacturers of higher-value added intermediary products with easily accessible circular alternatives, when the feedstock is of appropriate level of compatibility with end-use application.	• If the levy is not phased in, the time to invest in circular alternative may be insufficient and the company is likely to lose profit margin or go bankrupt (particularly with a high levy rate). Larger companies may relocate production outside of the Netherlands • If implemented gradually, time can be sufficient to invest in circular alternatives, if the levy rate is high enough to justify it. Thus reduction in operations in the Netherlands could be mitigated.	<50	Sheets of PET (high cost) Variant 1a: -23% to -49% Variant 1b: -49% to -64%	Sheets of PET (high cost) Depends on the application, can be up to 100% for non-food applications.

Susceptibility to production leakage - Substitutability	Products in the profile (illustrative product underlined)	Company characteristics	Potential consequences of processor levy / potential response of processors	Estimated total quantity manufactured in the Netherlands (kt / year) (based on 2022 production	% production leakage of the illustrative product (Variant 1a: 640 EUR/t; Variant 1b: 920 EUR/t)	Maximum potential substitution of the illustrative product
E: Mod-Mod Moderate-risk innovator	• Low-cost consumer goods (Hygiene and toiletries) • PVC pipes	Manufacture of durable, relatively cheaper products which have some circular alternatives available, but large scale substitution can be a challenge	• Larger companies may relocate production outside of the Netherlands, whereas smaller businesses may reduce or stop operations. Though, there is some potential investment in increasing the share of circular alternatives to avoid the levy, though the levy rate would need to high enough to justify the additional investment. Gradual implementation would give more time to invest in circular alternatives. Whether or not the levy shifts companies to more circular polymer use, companies will face higher costs, which either will lead to increase in their product prices (potential production leakage) or loss in profit margins (due to (partial) absorption of costs)	~300	PVC pipes Variant 1a: -20% to -47% Variant 1b: -23% to -63%	PVC pipes 25-60% substitutability with mechanical recyclate; up to 100% with chemical recyclate or bio-based.
F: Mod-Low Moderate-risk & restricted	*(none)*					
G: Low – High Low-risk adaptor	• Pipes and hoses of PP	Manufacturers of products with a high value added and good prospects for low-cost substitution by circular alternatives. This category can also include low-cost products which have high transport costs.	The levy is likely to moderately reduce profit margins of the manufacturer, as it should be able to pass on an important part of the additional cost to its customer. If set at a high enough rate, the levy can create an incentive to invest in circular alternatives.	<5	PP pipes Variant 1a: -14% to -21% Variant 1b: -16% to -27%	PP pipes Up to 100% replacement with rPP in construction applications
H: Low - Mod Low-risk innovator	• *Durable packaging* (Boxes, trays, and crates) • *High-cost building/ Construction plastics* (plastic doors, shutters) • *High-cost consumer goods* (Kitchen and tableware, Fittings for furniture) • Other processed plastics • *Products made of mostly exempted polymers* • Automotive plastics • Electronic plastics	Manufacturers of high-value added end-use or intermediary products with moderately accessible circular alternatives and/or contain virgin fossil polymers which are exempted from the levy. This category can also include low-cost products which have high transport costs.	The levy will increase the price of the product for intermediary users/ consumers (except for products with high exempted content). It may create an incentive to invest in circular alternatives, but likely to a limited extent.	~700	Kitchen and tableware Variant 1a: -11% to -20% Variant 1b: -13% to -25%	Kitchen and tableware Restricted use of recycled polymers for food applications (rPET only). Bio-based alternatives available for kitchen/tableware made of polymers such as PP/PE.

Susceptibility to production leakage - Substitutability	Products in the profile (illustrative product underlined)	Company characteristics	Potential consequences of processor levy / potential response of processors	Estimated total quantity manufactured in the Netherlands (kt / year) (based on 2022 production	% production leakage of the illustrative product (Variant 1a: 640 EUR/t; Variant 1b: 920 EUR/t)	Maximum potential substitution of the illustrative product
I: Low-Low Low-risk & restricted	• Sheets/films of PUR	Manufacturers of high-value added end-use or intermediary products with limited circular alternatives. This category can also include low-cost products which have high transport costs.	The levy will increase the price of the product for intermediary users/ consumers. Limited switch to circular alternatives expected.	<100	Sheets/films of PUR Variant 1a: -17% to -26% Variant 1b: -20% to -32%	Sheets/films of PUR Circular alternatives can replace ~25% of virgin fossil PUR

6. Administrative and legal impacts

6.1. Administrative impacts

6.1.1. For obligated entities

The primary administrative burden of implementing the plastic levy stems from the requirement for polymer processors to prove that polymers used in their products are circular if they want to be exempted from the levy. Given the market dominance of fossil-based polymers, it is reasonable to assume that, by default, all polymers and polymer-containing products (dependent on the variant chosen) are made from fossil-based materials and are therefore fully subject to the levy. It is only if a polymer processor wishes to be exempt from the levy that it would need to demonstrate that (part of) the polymers that it incorporates in its products are circular.

The administering of the levy would benefit from the technical and administrative requirements derived from the Circular Plastic Standard. Under a Circular Plastic Standard, polymer processors wishing to be exempt from the levy would implement the technical and administrative measures to measure the share of circular polymers in their products. Because this study is performed under the assumption that the Circular Plastic Standard is implemented, this techno-institutional problem is considered as solved for this study. Calculating the plastic levy that the processors would have to pay is then a multiplication of the tax base deduced from that circular content (dependent on the Variant 1 or 3 chosen) by the tax rate.

Also for polymer producers, the additional certification efforts needed would be covered already by the Circular Plastic Standard. Polymer producers are in full control of their manufacturing processes, and hence are aware of whether the polymer that they produce is fossil-based (and hence subject to the levy under Variant 2) or circular (and then exempt). Under the assumption that the Circular Plastic Standard is implemented, the polymer manufacturers would already be obliged to set up a certification system[148] demonstrating, with a legal validity, that a given batch of polymer is indeed circular and hence exempt. Accordingly, a plastic levy would not generate any additional work to demonstrate that right to exemption.

Additional efforts from producers and processors would be caused by additional reporting requirements. The only administrative task producers and processors would need to implement in light of a plastic levy would be to report the relevant production volumes and to pay the corresponding tax, computed by a multiplication by the levy rate.

6.1.2. For the Dutch government

Assuming the Circular Plastic Standard is in place, the Dutch government would already have established mechanisms for market surveillance and for measuring the circular content of plastic products. Therefore, the additional effort required from the

[148] *E.g. based on a traceability system.*

government would remain limited. Once the share of circular polymers in a product is determined, these figures can be applied to calculating the levy to be paid by that product.

6.2. Legal impacts

6.2.1. Generalisation of a Dutch plastic levy at EU level

The generalisation of a plastic levy to all EU Member States would mitigate production leakage. As described in the previous chapters, the main negative consequence of the implementation of a plastic levy is the leakage of production and processing of polymers from the Netherlands to (1) other EU Member States within the Internal Market, where free movement of goods applies, and to (2) third countries. This negative impact would be strongly mitigated if the Dutch 'plastic levy' were generalised at the scale of the EU as a harmonisation of indirect taxation.

This generalisation is however unlikely because of EU unanimity requirement on tax matters stated in the Treaty on the Functioning of the EU. Art.113 of the Treaty on the Functioning of the European Union (TFEU) requires an unanimous decision by the Council for all "*provisions for the harmonisation of legislation concerning turnover taxes, excise duties and other forms of indirect taxation*". This unanimity requirement makes an harmonisation of the Dutch plastic levy very difficult to achieve. Historically, the harmonisation of indirect taxation rules at EU level has been limited to a handful of products (alcohol, tobacco, energy products), and has taken decades to be decided or amended.[149] It is hence unlikely that an harmonisation at EU level of indirect taxation of polymers or plastic products would be decided in a time frame short enough for the negative impacts on the volumes of these products to be avoided.

6.2.2. Reflections on the potential consideration of Variant 3 as a penalty for non-compliance with the Circular Plastic Standard in light of the ESPR

Variant 3 of the levy could be considered as a penalty for non-compliance with the Circular Plastic Standard. Different to a levy on producers and processors, Variant 3 of the plastic levy would apply only to the share of polymers in a plastic product that does not comply with the requirements of the Circular Plastic Standard. Hence, it could be legally considered as an penalty for non-compliance with the Circular Plastic Standard. Here, careful consideration would be needed since the presentation of the levy as a penalty could trigger resistance by potentially affected stakeholders.

The Circular Plastic Standard can be seen as a means to implement the ESPR. The Circular Plastic Standard itself is a form of Ecodesign requirement, bearing on the circular content of materials. It anticipates a potential EU-wide legislation that may be adopted in the future by the Commission in the wake of the Ecodesign for Sustainable Products Regulation (ESPR)[150]. This Regulation enables the Commission to regulate in particular: the "*use or content of recycled materials and recovery of materials, including critical raw*

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[149] *As illustrated in the historical overview of indirect taxation rules in the EU provided by the European Parliament (consulted 16 January 2025 with a latest update in April 2024): https://www.europarl.europa.eu/factsheets/en/sheet/81/indirect-taxation , § 2 Excise duties on alcohol, tobacco products and energy.*

[150] *Regulation (EU) 2024/1781 establishing a framework for the setting of ecodesign requirements for sustainable products, available at: http://data.europa.eu/eli/reg/2024/1781/oj*

materials"; and the "*use or content of sustainable renewable materials*" In light of the Circular Plastic Standard, this would address the circular content of products.

A plastic levy would be considered as the enforcement mechanism of the ecodesign requirements set up by the Dutch government that it places on polymers and plastics products. Under ESPR, Art.74(1), Member States retain full responsibility for "*the rules on penalties applicable to infringements of this Regulation*". However, they are not free to set them arbitrarily, nor to engage in a race to the bottom, as this Article further specifies that:

- "*[Member States] shall take all measures necessary to ensure that they are implemented*" and
- "*The penalties provided for shall be effective, proportionate and dissuasive*".

"*Shall*" in a legal context is synonymous of a legal obligation.

A domestic plastic levy as part of ESPR implementation could be more easily matched by equivalent measures in other EU Member States and, hence, mitigate the production leakage to these countries. In a context where the Dutch Circular Plastic Standard is generalised at EU level in the form of a Delegated Act implementing the ESPR for polymers and plastic products, the plastic levy in its Variant 3 could be considered as a penalty to enforce that requirement. It would have to be matched by measures with the same intention and equivalent effect to those set by all other EU Member States. This could provide a level playing field among the Dutch polymer processors and their competitors based in other EU Member States.

The introduction of the levy could be viewed as an effort to implement EU requirements early in the Dutch market, thereby reducing medium-term risks for market actors. If the plastic levy were considered an indirect tax, Member States would retain full sovereignty, making tax harmonisation unlikely. However, penalties imposed by other EU Member States would be subject to European Commission scrutiny. If a penalty in a Member State penalty were too lenient, disadvantaging Dutch manufacturers, the Commission could legally request an amendment to ensure fair competition in the Internal Market. Given the strong legal basis of the ESPR, such requests would likely be upheld by the EU Court of Justice. Thereby, Variant 3 of the 'plastic levy' could be implemented in such a manner to put the competitive position of Dutch manufacturers of polymers and plastic products, compared to their counterparts in other EU Member States, at a lesser risk in the medium term. The 'plastic levy' could be matched by penalties with the equivalent effect (even if not strictly identical) taken by these other EU Member States, with the European Commission in a legal position to ensure that the competition remains fair.

7. Conclusions and recommendations

The Dutch plastics industry is making efforts to transition towards more circular practices, though there still remain challenges in bringing the circular transition fully into force. This study confirms that the Netherlands is an important player in the European plastic market, but still relies heavily on fossil feedstock. While the country has a leading role regarding recycling, a comprehensive transition to a circular economy is hampered by diverse aspects, such as insufficient demand, technological availability, cost competitiveness, trade policies, and potential negative wider sustainability trade-offs.

To enable the circular transition in the Netherlands, a coherent policy framework and a business case for circular solutions is needed. The most important factors impacting the circular transition have shown to be the creation of demand for circular plastics and legislative interventions, preferably at EU level, that ensure a level playing field and long-term continuity. To ensure that Dutch market actors can follow this transition, the Netherlands would need a policy framework that is in line with EU regulation.

Dutch policy making aims to support the circular economy transition, but needs further refinements to address the vulnerability of the Dutch plastic market to global competition. The Netherlands is pioneering the circular transition in comparison to the rest of the EU. Namely, the recycling rate for post-consumer plastic waste is 38%, which is well above the EU average. In this realm, the Dutch government and industry actors have undertaken some supportive interventions. However, additional future interventions require careful considerations of their potential wider impacts. The analysis of the variants of a virgin fossil polymer levy in this study showcases that the combination of the exposure of the Dutch plastic market to global competition and potential price increase from the levy could put the Dutch plastic industry at risk.

7.1. Impact of the levy variants on the Dutch plastics market

Implementing a levy on processors or producers of virgin fossil polymers could lead to a significant negative impact on the competitiveness of the Dutch plastic industry. Namely, the cost of the levy would present a significant share, or could even be greater than, the current profit margins for both industries. This indicates that a levy on producers or processors could put financial strain on the Dutch plastic industry. However, the indirect impact of the levy in the value chain would be limited. For instance, a levy on processors would have a limited impact on producers and a levy on producers would also have a limited impact on processors. This is because producers are export-oriented and processors will likely switch to foreign suppliers if the price of Dutch polymers increases. That being said, the indirect impact of the levy beyond polymer production and processing industries is out of scope of this study.

The impact of a virgin fossil polymer levy varies from product to product, where the greatest impact would be expected for commodity polymers/plastic products. Commodity polymers (e.g. PE, PP, PVC, PET, etc.) and commodity plastic products tend to be produced at high volumes at a low price and used in many applications. These products are highly cost competitive, and therefore, buyers of these products are sensitive to price changes. These products make a large portion of Dutch production/processing.

A levy on polymer processing or production would be expected to provide no/limited additional substitution of virgin fossil polymers beyond what is foreseen to be substituted via the proposed Circular Plastic Standard. With a processor levy (Variant 1), the standard and the levy would have an overlapping effect, as the standard already encourages processors to take up the most economically and technologically feasible circular alternatives. Further, a combination of a processor levy and standard could lead to less substitution than the standard alone due to the risk of production leakage. A levy on polymer producers (Variant 2) would have limited to no impact on the substitution of virgin fossil polymers with circular polymers within the Dutch polymer processing sector, as most of the Dutch polymer production is made for export and Dutch processors will likely switch to cheaper foreign suppliers of virgin fossil polymers rather than circular alternatives.

A Circular Plastic Standard gap levy (Variant 3) would lead to a more uncertain outcome concerning substitution compared to a standard with a trading system. A standard with a trading system creates market-driven incentives, since the compliance costs (i.e. price of circular plastic units (CPE)) are adjusted based on supply and demand for CPEs. This ensures the standard is met, as companies with a deficit are compensated by those with a surplus. In contrast, a standard gap levy has a fixed compliance cost per ton of virgin fossil polymer processed, with no compensation from *surplus* companies. Thus, while Variant 3 may stimulate circular plastic use by companies with a low share of circular polymer use, these companies can still offset this by paying the gap levy, making substitution less certain than with a trading system.

The table below provides a comparative overview of the impact of the three variants of the levy.

Table 7-1 Comparative overview of the three variants

	Variant 1: Processor levy	Variant 2: Producer levy	Variant 3: Plastic standard gap levy
Scope of the levy	All processing of virgin fossil polymers in the Netherlands	All production of virgin fossil polymers in the Netherlands	Processing of virgin fossil polymers in the Netherlands which are not compliant with the Dutch Circular Plastic Standard
Standards on Circular Plastics	• Dutch Circular Plastic Standard (27.5%) with a trading system • EU PPWR (25% for packaging)	• Dutch Circular Plastic Standard (27.5%) with a trading system • EU PPWR (25% for packaging)	• *Alternative* Dutch Circular Plastic Standard (27.5%) with a levy for non-compliancy • EU PPWR (25% for packaging)
Initial tax base[151]	Medium (~1,070 kt)	Large (~3,770 kt)	Limited (~325 kt)
Levy rates analysed	• 640 EUR/t of virgin fossil polymer • 920 EUR/t of virgin fossil polymer	• 320 EUR/t of virgin fossil polymer • 150 EUR/t of virgin fossil polymer	1,000 EUR/t of virgin fossil polymer processed which is non-compliant with the standard
Cost of the levy per ton of product	The cost of the levy per ton of plastic product is lower than the levy rate, as plastic products also include circular and exempted polymers. Effective cost of the levy per ton of plastic product is: • 380 EUR/t (for a 640 EUR/t levy) • 550 EUR/t (for a 920 EUR/t levy)	The cost of the levy per ton of polymer sold is equal to the levy for all non-exempted polymers.	The cost of the levy per ton of plastic product would be much lower than 1,000 EUR/t as the levy only applies *non-compliant* virgin fossil polymer processing. Effective cost of the levy is 185 EUR per ton of plastic product.
Potential % price increase from the levy	Depending on to what extent processors pass on the cost of the levy to the price, the average price increase for plastic products could be up to 11% for a 640 EUR/t levy and 16% for a 920 EUR/t levy. Price increases would vary widely from product to product. Passing on the entirety of the levy to the product price would create an extreme price shock which may trigger a stronger reaction from buyers (e.g. more production leakage). The price increase may be lower if processors absorb some of the cost to mitigate demand loss.	Depending on to what extent producers pass on the cost of the levy to the price, the average price increase for plastic products could be up to 18% for a 320 EUR/t levy. Price increases would vary widely from polymer to polymer. Passing on the entirety of the levy to the polymer price would create relatively high price increase which may trigger a stronger reaction from buyers (e.g. more production leakage). If the current financial situation continues in the industry, it would not be expected that producers would have any room to absorb the cost of the levy to mitigate demand loss.	Depending on to what extent processors pass on the cost of the levy to the price, the average price increase for plastic products could be up to 6% for a 1,000 EUR/t levy. As mentioned, the levy is administered to a much smaller share of processing, so the cost of the levy per ton of product is lower than the levy rate. Price increases would vary widely from product to product. Passing on the entirety of the levy to the product price could create an price shock which may trigger a stronger reaction from buyers (e.g. more production leakage). The price increase may be lower if processors absorb some of the cost to mitigate demand loss.
Tax revenue[152]	By design, the levy would lead to 547 M EUR annually. However, there remains uncertainty of the extent of the production leakage from such a levy (due to risk of high price shock), where there is risk of the budget requirement not being met.	By design, the levy would lead to 547 M EUR annually. However, there remains uncertainty of the extent of the production leakage from such a levy (due to risk of high price shock), where there is risk of the budget requirement not being met.	The standard gap levy does not meet the budget requirement. It would be expected that the levy would lead to 240 M EUR annually.

[151] *Before production leakage or circular substitution*
[152] *Tax revenue only take into consideration the direct impact of tax revenue from the levy. Indirect impact of the levy on tax revenue (e.g. income/corporate taxes due to production leakage) is not taken into account in this study.*

	Variant 1: Processor levy	Variant 2: Producer levy	Variant 3: Plastic standard gap levy
Production leakage for polymer producers	Up to 10%, producers mainly supply to foreign countries	• Production leakage estimates are based on historical data, though if the levy creates a significant price shock, production leakage could be higher than estimated. • 26-70% production leakage with a 320 EUR/t levy • Potential to completely stop production operations for commodity polymers.	Limited (<3%), producers mainly supply to foreign countries

Production leakage for polymer processors	• Production leakage estimates are based on historical data, though if the levy creates a significant price shock, production leakage could be higher than estimated.
	  • 18-36% production leakage with a 640 EUR/t levy
	  • 21-47% production leakage with a 920 EUR/t levy
	• Greatest risk of production leakage is for plastic products made of commodity polymers (e.g. PE/PP/PVC/PET), such as pipes, bottles, films, etc.), particularly packaging
		Limited (<5% from levy), processors can switch to cheaper foreign suppliers of polymers	• Production leakage estimates are based on historical data, though if the levy creates a significant price shock, production leakage could be higher than estimated.
			• 4-15% production leakage with 1,000 EUR/t levy, as the levy would only apply to a portion of the total plastic product production
			• Greatest risk of production leakage is for plastic products made of commodity polymers (e.g. PE/PP/PVC/PET), such as pipes, bottles, films, etc.)

Transition to circular plastics and environmental benefits	• Limited additional substitution expected beyond the implementation of Dutch and EU standards alone • In a *best-case* market scenario, the levy rate would need to be set at 920 EUR/t to compensate for the substitution. Such a levy rate (and EU/NL standards) could lead to 180 kt additional circular plastics • In a best-case market scenario, up to 0.43 Mt of CO_2 reduction, of which up to 0.15 MtCO_2 comes from Dutch sources.	No impact beyond EU and Dutch circular plastic standards	A standard gap levy would lead to a more uncertain outcome than a standard with a trading system. A trading system guarantees that the standard will be met, where with a gap levy, the adherence to the standard is less certain.

To investigate the various responses of the Dutch plastic industry to a levy, a profile analysis was conducted, which led to the distinction of seven profiles for primary polymers and plastic products (See Section 5 for a description of each profile). The key insights from the analysis are:

- ***For polymer producers:***
  - There is a clear distinction of commodity polymers (Profiles A, B and C) and specialty polymers (Profiles D, F and I).
  - For commodity polymers (Profiles A, B and C), a producer levy creates a high risk of closure of plants and potentially relocation of operations to outside the Netherlands. While within the commodity polymer profiles (A, B and C) there is variation in the adaptability to circular polymers, limited substitution would be expected across all commodity polymers.
  - For specialty polymers (Profiles D, F and I), a producer levy still creates a possible risk of plant closures, though these companies are better able to sustain operations when faced with a levy compared to commodity polymers.
- ***For polymer processors:***
  - A significant portion of plastic products produced in the Netherlands are considered at high risk of production leakage (Profiles A, B, and C). Almost 1,000 kt of plastic products are within these profiles, with various ability to substitute virgin fossil with circular polymers. These mainly consist of single-use, commodity, low-cost plastic products, mainly for packaging and agriculture. While there is a high risk of bankruptcy for small/medium-sized companies, larger companies may decide to relocate to other countries. Alternatively, for companies which make multiple products, they may decide to focus operations on products which are less at-risk (e.g., use exempted polymers, higher ability to use circular polymers, lower risk of production leakage). Gradual implementation of the levy may give processors more time to adjust to circular alternatives and mitigate production loss.
  - Some plastic products produced in the Netherlands are considered to have moderate risk of production leakage (Profiles D and E), where there is some risk of closure/relocation of Dutch operations. Almost 350 kt of plastic products are within these two profiles. These profiles mainly consist of products with more durable, low-cost products (e.g. toiletries, PVC pipes) or high-cost intermediary products (e.g. high cost films/sheets).
  - There is also a large portion of relatively high-value plastic products produced in the Netherlands which are less at risk (Profiles G H and I). About 800 kt of plastic products are considered to have relatively lower production leakage risk. These products mainly consist of high-valued specialised products such as for automotives, electronics, high-cost consumer goods (e.g. kitchenware) and high-cost construction/ building materials (e.g. doors, shutters), but also products which tend of have high transport costs, thus creating a competitive advantage for local producers. For companies in these profile, regardless of whether companies decide to substitute virgin fossil with circular polymers, a levy will likely increase the price for

intermediate/end users and reduce profit margins for these companies to some extent.

7.2. Recommendations

Policy intervention will be key to improve the business case of circular plastic in the Netherlands. In the current market, circular polymers struggle to compete with virgin fossil polymers, and their adoption may remain limited without policy intervention to drive demand for recyclate and bio-based polymers. Policies, such as a virgin fossil polymer levy investigated in this study, have the capability to encourage circular polymer use, but at the same time create serious risks of decreasing the competitiveness of Dutch companies facing strong global competition. Based on the analysis of this study, the following recommendations point to policy options that may (or may not) stimulate the use of circular polymer and limit the economic risks for the Dutch plastics sector.

7.2.1. A producer levy (Variant 2) should not be implemented

A producer levy is not deemed as a viable policy option to support circular plastic in the Netherlands. Since producers of virgin fossil polymers in the Netherlands are highly susceptible to production leakage and there is very limited/no expectation of such a levy to lead to additional substitution of virgin fossil polymers with circular polymer, a levy on virgin fossil polymer producers is not an appropriate policy option to further the circular transition in the Netherlands.

7.2.2. If a processor levy (Variant 1) is introduced, implementation should be gradual

If a levy on processors is chosen, it would be recommended to have phased-in implementation. Implementing a processor levy to meet the budget requirement could lead to a significant price shock, leading to high risk of production leakage. To avoid such a price shock, the levy rate could be phased-in such that the levy rate increases every year over a certain period. However, a phased-in approach does not remove the risk of production leakage, but rather allowing companies time to adjust. This would also allow the government to monitor the market's response and make necessary adjustments to minimise unintended consequences. Particularly, careful monitoring would be needed in case the processor levy is implemented in combination with the standard. This is because of the overlapping effect of the policy, where the combined effect of the policies on production leakage may lead to less substitution than the standard alone. If a phased-in processor levy is chosen, further research would be required to determine the optimal approach. This may also consider different phasing for different polymer types depending on susceptibility to production leakage and substitutability (such as illustrated by the profile analysis in Section 5).

However, with a processor levy, the annual budget requirement may not be reached. Depending on how the levy would be phased in, the tax revenue during the roll out of the levy would be relatively low. Based on the budget requirement in terms of annual tax revenues of 547 M EUR, these low revenue years would need to be compensated or complemented It is important to note that even without a phased-in approach, the annual budget requirement may not be reached given the potential for significant production leakage.

7.2.3. If the standard gap levy (Variant 3) is introduced, it should be considered how this could lead to an EU-wide levy.

The Circular Plastic Standard, if adopted by the Netherlands, could potentially lead to a generalised EU circular plastic standard. If the Dutch standard is successfully implemented, the Netherlands could potentially act as a front-runner, where such a standard could then be encouraged as a preferred option for an EU-wide eco-design requirement. In terms of the competitiveness of the Dutch industry, an EU-wide regulation is more favourable, as it would create a level playing field amongst European industry.

While a levy on polymer producers or processors (Variants 1 and 2) would be more difficult to generalise at the EU level, the standard gap levy would have a stronger position to be implemented across the EU. Generalising Variants 1 or 2 to the EU level could be difficult, as harmonisation taxes at EU level requires unanimity in the EU council, which is notoriously difficult to achieve. Whereas, the standard gap levy could be implemented as a *penalty* for non-compliance to the standard. EU harmonisation of penalties for infringement to EU law is easier, as it is subject to the oversight of the European Commission.

However, it is important to keep in mind that the potential substitution from a gap levy would be more uncertain than implementing a standard with a trading system. While the cost of non-compliance to the standard within a trading system is market driven, the cost of non-compliance with a standard gap levy is fixed per ton of virgin fossil polymer. The trading system creates a flexible mechanism where the cost of non-compliance fluctuates based on market conditions. In contract, the gap levy imposes a fixed cost per ton of virgin fossil polymers used beyond the allowed limit. While a gap levy is straightforward, ensuring its effectiveness can be complex. The effectiveness of a gap levy is dependent on the levy rate, which is fixed, and the market conditions, which can be difficult to predict. In this sense, a trading system provides greater assurance that the standard is met.

7.2.4. Create a business case for circular plastics and facilitating long-term investment could be accelerated by additional and/or alternative Dutch/EU policy instruments

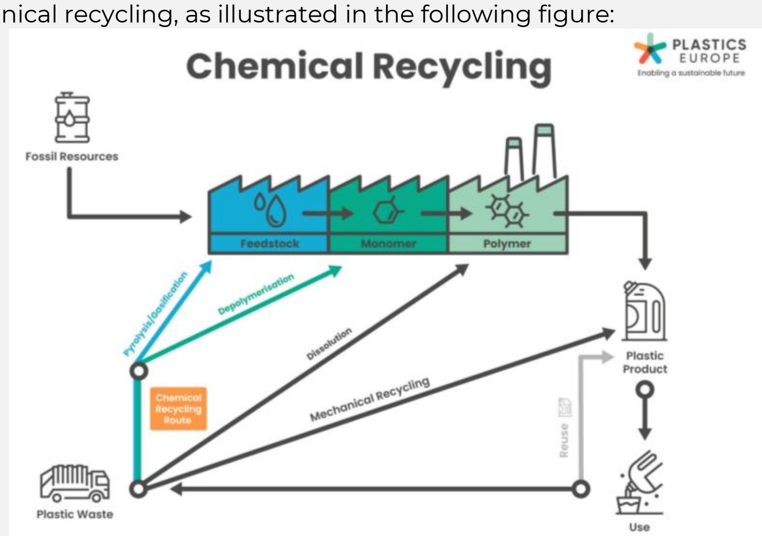
A levy on Dutch producers or processors of virgin fossil polymers may be ineffective policy to support circular plastic in the Netherlands in the current policy and market environment. As illustrated by the impact analysis, the Dutch plastic industry is very price sensitive, where a levy of virgin fossil polymers, whether placed on producers or processors, can lead to significant risk of production leakage. In this sense, a levy could lead to greater use of virgin fossil polymers in foreign countries (due to production leakage), rather than leading to greater use of circular polymers. Further, even with a lower levy rate, this would most likely not lead to significant additional substitution of virgin fossil polymers with circular alternatives given the current large price differential between virgin fossil polymer and circular equivalents.

In addition, other policy instruments should be explored to improve the business case for circular plastics, particularly further down the value chain. The production or processing of circular plastics is currently not sufficiently profitable or profitable at all and therefore policy intervention is required to facilitate the circular economy transition. One of the main aspects essential to stimulate circular plastics in the Netherlands is to increase the demand for circular plastics. Most stakeholders would support measures for the improvement of a business case for circular plastics. However, they consider it more effective to implement measures particularly further down the value chain (e.g. purchase of plastic products) as compared to a levy for producers and processors, They signal this could increase the demand for circular solutions. An option to increase demand for circular plastics could be revising green public procurement strategies, in terms of increasing prioritisation of CE factors in the public procurement approach. This could contribute to an increased demand for circular solutions.

Further, any policy instrument to support the circular economy transition in the plastics industry should encourage long-term investments in circular plastics. Current uncertainties in legislation, both at EU level and nationally, international competition as well as unstable quality and supply/availability of feedstocks for circular plastics hamper the long-term planning for Dutch producers and processors to invest in circular solutions. To address this, fiscal and regulatory barriers might have to be updated to enable the use of existing plastic-rich waste streams and, thus, the additional provision of recyclable feedstock. Timely clarification of relevant policies would be essential to create a reliable investment climate.[153]

[153] *KPMG (2023). Plastic feedstock for recycling in the Netherlands.*

Annex 1 – Definitions

Term	Definition
Bio-based feedstock	Raw materials of biological origin, that can either be produced from grown crops (so-called “first-generation” such as maize, rapeseed, …) or organic residuals and waste (“second-generation” such as agricultural waste, frying oils, manure, …). It includes materials that grow and naturally replenish at human time scale, and thus excludes materials embedded in geological formations and/or fossilised.[154]
Bio-based plastics	Plastics that are fully or partially produced from a bio-based feedstock.[155]
Chemical recycling	Chemical recycling converts e.g. polymeric waste by changing its chemical structure to produce substances that are used as products or as raw materials for the manufacturing of other products (excl. products used as fuels or means to generate energy). Chemical recycling covers various technologies, i.e. depolymerisation / solvolysis (hydrolysis, glycolysis, alcoholysis, etc.) and thermal processes (pyrolysis, gasification, hydrogenation, etc.). Those technologies change the chemical structure of the plastics waste, turning polymers back into their original molecules so they can be processed and used again several times. [156] Chemical recycling produces products closer to virgin materials than mechanical recycling, as illustrated in the following figure:  *Source: PlasticsEurope (n.d.).* Chemical recycling.
Circular feedstock	Different feedstocks that can be recycled, bio-based, or derived from carbon-capture and are used for the production of products/plastics.[157]
Circular plastics	Plastics which origin is fully or partially produced from circular feedstock. This thus excludes fossil-based plastics.[158]
Energy recovery	The use of combustible plastics waste (with or without other types of waste) to generate energy through direct incineration for electricity and/or heat. Energy recovery includes high-grade energy recovery in industrial facilities, if the main purpose of the operation is to replace fossil fuels (e.g., cement kilns, pulp mills, gasification plants).[159]

[154] *Plastics Europe (2024). The circular economy for plastics - A European analysis.*
[155] *Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands., Plastics Europe (2024). The circular economy for plastics - A European analysis.*
[156] *Ibid.*
[157] *Plastics Europe (2024). The circular economy for plastics – A European analysis.*
[158] *Ibid.*
[159] *Ibid.*

Feedstock	Materials that are used as the principal input for an industrial production process.[160] There are diverse feedstocks that can be used for plastic production, such as bio-based, carbon-captured, chemically or mechanically recycled, or fossil feedstock.
Fossil-based plastics	Plastics that are directly and fully produced from fossil feedstock, and sold to the plastics processing industry (e.g., powder, granules). It includes fossil-based thermoplastics, PUR and other fossil-based thermosets used for plastic product applications. Fossil-based plastics excludes raw materials obtained from the recycling of post-industrial or post-consumer waste as they are categorised as recycled plastics. Fossil-based plastics.[161]
Mechanical recycling of plastics	A processing method by which plastics are recovered from waste plastics without changing the basic polymeric structure of the material. After sorting, cleaning and grinding, the material is recovered due to melting and reshaping processes to be used in the manufacture of new plastic products and components.[162]
Plastics	Material from an organic polymer that can, at some stage in its processing into finished products, be shaped e.g., by flow, extrusion, or moulding.[163]
Plastics in primary form	According to NACE C20.16, plastics in primary form are derived from manufacturing resins, plastics materials and non-vulcanisable thermoplastic elastomers, the mixing and blending of resins on a custom basis, as well as the manufacture of non-customised synthetic resins. It can also be produced from mechanical recycling, for example.[164]
Polymers	Polymers are chemical building blocks (i.e. a sequence of one or more types of monomer units) used in the production of intermediate or final products, such as plastic, rubber, paint, textiles, and adhesives.[165]
Polymer processors	Manufacturing companies that convert raw polymers into products of desirable shape, microstructure and properties.[166]
Polymer producers	Companies that are part of the chemical industry and produce plastic polymers. Thereby, they can rely on various feedstock, such as fossil feedstock, renewable plant-derived bio-based feedstocks, or feedstock from chemical recycling.[167]
Post-consumer waste	Material and products which have reached their end of life, having fulfilled its intended purpose or not longer usable. Post-consumer waste can be generated by households or by commercial, industrial and institutional facilities. This waste category also includes returns of material from the distribution chain, and waste that is generated during installation and assembly processes (i.e., pipes, cables, flooring, films/tarpaulins). [168]
Pre-consumer/Post-industrial waste	Material and products that are arise during the manufacturing or converting process. It excludes by-products, which is re-utilised material, such as rework, regrind or scrap that can be reclaimed within the same process it has been produced in. (Same process means the same manufacturing operation for the same type of product in the same or different physical location.)As a synonym, the term "post-industrial material" is sometimes used. [169]
Recyclers	Recyclers are companies that reclaim plastics (as polymer, monomer, or constituent chemical building blocks) in such a manner that they can be used to displace the primary or raw materials that are used as chemical building blocks in the production of plastics and plastic products and packaging. In the case of bio-based plastics, recyclers process bio-based plastics into biological nutrients.[170]

[160] *Plastics Europe (n.d.). Glossary.*
[161] *Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.; Plastics Europe (2024). The circular economy for plastics – A European analysis.*
[162] *Ibid.*
[163] *Plastics Europe (2024). The circular economy for plastics – A European analysis.*
[164] *EC (n.d.). Manufacture of plastics in primary form.*
[165] *Rijksoverheid (2024). Wijziging van de Wet milieubeheer voor een nationale circulaire plastic norm; Plastics Europe (2024). The circular economy for plastics – A European analysis.*
[166] *Xanthos, M. (2000). Polymer processing.*
[167] *Science Direct: Polymer production.*
[168] *Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.*
[169] *Ibid.*
[170] *Valiante, U., Gies, G., Moreside, E. (2021). Defining Recycling in the Context of Plastics. A Principled and Practical Approach.*

Recyclate	Recycled plastics that are raw materials, produced due to the recycling of plastic waste.[171]
Virgin plastic polymers	This is newly manufactured resin produced from fossil-based or biomass feedstock used as the raw input material for the manufacture of plastic products and which has never been used or processed before.[172] Chemical recycling also allows the production of recycled plastic with virgin plastic properties.[173]
Sector-specific waste	
Agriculture	Waste collected from agricultural, farming and gardening applications, excluding the packaging. Farming includes e.g., handling & transport material and gardening/horticulture includes cans, flower & plant pots etc.[174]
Automotive	"Service material" from repair workshops or material generated from End-of-life Vehicles waste (ELV), such as car dismantlers and shredder facilities. It also includes applications like interiors, exteriors and under-the-hood.[175]
Building and construction	Waste collected from construction, renovation, demolition of buildings and installation. This includes resilient flooring, carpet, roofing, building membranes and sheets, windows, doors and related building products, pipes and fittings, building profiles cladding, insulation materials, cables.[176]
Electrical/electronics	Electrical and electronic equipment waste (WEEE) from households and all kinds of commercial and industrial activities. WEEE directive 2012/19/EU categorises WEEE by six categories (Temperature exchange equipment, Screens, Lamps, Large Appliances, Small Appliances, Information and telecommunication equipment (ITC))[177]
Housewares, leisure and sports	Waste from private houses, such as housewares, toys or sport and leisure equipment. [178]
Packaging	Waste from all products made of any materials to be used for the containment, protection, handling, delivery and presentation of goods (incl. raw materials). This includes sales (primary) packaging, grouped (secondary) packaging or transport (tertiary) packaging.[179]
Others	All other applications of plastics, not explicitly listed, such as furniture, medical sector, office supplies, machinery parts.[180]

[171] *GKV, BDE & BVSE (n.d.). Recycled plastics in products.*
[172] *EIA (2022). Convention on plastic pollution – Essential elements.*
[173] *PlasticsEurope (n.d.). Chemical recycling.*
[174] *Conversio (2024). Substantiation of data for polymer production and processing in the Netherlands.*
[175] *Ibid.*
[176] *Ibid.*
[177] *Ibid.*
[178] *Ibid.*
[179] *Ibid.*
[180] *Ibid.*

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Annex 3 – Details on methodology

A. Production Leakage calculation

The extent to which a product is susceptible to production leakage is based on two main parameters: 1) the expected percentage increase in price from the levy and 2) the price sensitivity of the product. The expected increase in a product price from the levy is based on a few factors namely:

- Levy rate per ton of virgin fossil polymers produced/processed (EUR/t);
- Domestic sales price of the product before the levy (for polymers, sales price of the polymer; for processed polymers, sales price of the plastic product) (EUR/t);
- Virgin fossil polymer content of the product (%); and
- Exempted content of the product (%) (e.g. other thermoplastics/thermosets).

The table below provides an overview of the values used for each product group. The prices are based on a weighted average of the PRODCOMs which are categorised in each product group. The virgin fossil polymer content and exempted percentages are based on data from the Conversio 2024 report.

Table 0-1 Production leakage parameters to determine the percentage increase in price from the levy per product group

	Weighted average* price of domestic production sold (EUR/t) (2023)**	Virgin fossil polymer content (%)**	Exempted virgin fossil polymers (%)
Primary fossil plastics			
PE-LD/LLD	1,225	100%	0%
PE-HD/MD	1,210	100%	0%
EPS	1,630	100%	0%
ABS,SAN	1,625	100%	0%
PVC	1,050	100%	0%
PET	1,130	100%	0%
PP	1,190	100%	0%
PMMA	3,675	100%	0%
PA	4,740	100%	0%
PUR	3,810	100%	0%
Other thermoplastics	4,140	100%	100%
Other thermosets	3,910	100%	100%
Processed plastic products**			
Packaging	2,860 (1,790-4,963)	70%	3%
Building/Construction	4,165 (910-7453)	60%	7%
Automotives	4,660	80%	23%
Electronics	5,520	85%	66%
Household articles	4,650 (4,560-9,090)	75%	30%
Agriculture	3,375 (2,480-4,295)	50%	19%
Other	3,120 (4,765-5,795)	80%	28%
Source	*Based on Dutch sold production quantity (kg) and value (EUR) from Eurostat and CBS; gap-filling is based on 2022 data corrected for price changes in 2023 (Eurostat), otherwise based on EU-level data*	*Based on data from Conversio (2024)*	*Based on data from Conversio (2024)*

Note: for prices, the minimum and maximum values per product type are provided per application. This is not available for plastics for electronics and automotives
**Weighted average is based on Dutch production in 2022*
***Rounded values*

Price sensitivity per product is based on trade elasticities, which were estimated at product level, with Eurostat and CBS PRODCOM data on trade and sold production. To estimate the two effects on imports and exports, two elasticities were estimated: *import demand (Armington) elasticity* and an *export supply elasticity*. The use of two elasticities is due to the fact that Armington elasticities only estimate the substitution of domestic production for domestic use with imports and does not take the substitution of exports into account. To proxy for the substitution of Dutch production with foreign products in the foreign market, a substitution elasticity based on comparing Dutch and EU prices/production was also estimated. Ideally, global level data should be used, however, this is not available at product level. It is expected that exported Dutch production is more sensitive to price changes.[181]

There are some limitations to this methodology to determine production leakage. Namely, estimating elasticities for the Netherlands in particular can be a challenge, given the constraints on data availability due to confidentiality issues, where there are several gaps in time-series data on domestic production, as well as re-exports which are included in trade data. For products where Netherlands data is insufficient/unreliable, an Armington elasticity using EU data is estimated. Additionally, data from 2020 to 2023 is not considered for the elasticity calculations as the impacts of the Covid-19 pandemic and Ukraine war can interfere with the result. The time period of 2007 to 2009 are controlled for due to the impact of the global financial crisis on prices and production. Further, since the elasticities are based on historical data, they are limited in terms of their interpretation as they only cover price/production changes which have occurred in the past. For instance, if a levy were to increase the price of a product by a greater level than what has been historically observed, then these elasticities may not accurately depict the response of the market to such price changes. Given these uncertainties, the 95% confidence interval produced by the elasticity estimation was used to develop a elasticity range for each product (where data is available).

The table below provides the estimates of the elasticities at an aggregated level. The elasticities are based on estimates at NL level and gap-filled with EU level data where NL level values are unreliable. Both elasticities for imports and exports follow similar trends: (commodity) polymers tend to be more substitutable than plastic products. This is an expected result, as the homogeneity of polymers makes them easier to substitute with foreign equivalents. In some cases, the lower bound for the elasticity is negative[182], which is not a viable results, so the lower bound is limited to 0.

Table 0-2 Estimated elasticities, based on weighted average of PRODCOM level values

Product	Import elasticity	Export elasticity	Trade elasticity*
Primary fossil plastics	**2.6 [0.4-4.8]**	**2.8 [1.2-4.4]**	**2.8 [1.0-4.5]**
PE-LD/LLD	3.7 [0-7.4]	3.8 [2.1-5.5]	3.8 [1.8-5.7]
PE-HD/MD	3.7** [0-7.4]	3.3 [0.9-5.8]	3.4 [0.8-5.9]
EPS	2.3 [1.4-3.2]	2.9 [1.7-4.1]	2.8 [1.6-3.9]
ABS,SAN	0.5 [0.0-1.1]	1.6 [0.3-2.9]	1.5 [0.3-2.7]
PVC	3.5 [0.1-6.9]	3.4 [1.0-5.7]	3.4 [0.7-5.8]
PET	1.7 [0.7-2.8]	2.7 [0.9-4.6]	2.6 [0.9-4.4]

[181] *Tokarick, S. (2010). A method for calculating export supply and import demand elasticities.*

[182] *The lower bound can be negative because the 'true' value of the elasticity is very low, meaning the range will go below zero, or the estimation of the elasticity is a very large range, such that is includes very high value but also very low (negative values). In all cases, the elasticity cannot be below zero.*

PP	2.7 [0.9-4.4]	2.7 [0.9-4.4]	2.7 [0.9-4.4]
PMMA	1.8 [0.2-3.5]	1.9 [0.9-3.0]	1.9 [0.8-3.1]
PA	0.6 [0.1-1.1]	1.7 [0.5-2.9]	1.6 [0.4-2.7]
PUR	1.9 [1.4-2.4]	0.6 [0.0-1.3]	0.8 [0.1-1.7]
Processed plastic products	**1.2 [0.5-1.8]**	**1.8 [0.8-2.8]**	**1.5 [0.7-2.3]**
Packaging	1.1 [0.5-1.7]	2.1 [0..9-3.3]	1.7 [0..7-2.7]
Building/Construction	1.1 [0.5-1.7]	1.7 [0.9-2.5]	1.4 [0.7-2.1]
Automotives Electronics	n/a, use processed plastic product sector average		
Household articles	1.2 [0.7-1.7]	1.3 [0.4-2.2]	1.3 [0.5-2.1]
Agriculture	1.2 [0.6-1.9]	2.0 [1.1-2.9]	1.5 [0.8-2.3]
Other	1.4 [0.6-2.3]	1.4 [0.6-2.2]	1.4 [0.6-2.3]

**Weighted average of the import and export elasticities based on share of domestic production which is for the domestic market (competing with imports) and exported.*
***No value available for HDPE for import elasticity, value for LDPE used as proxy*

Particularly, the elasticity for exports is slightly higher than import elasticities as expected, though they are fairly similar. This may be due to the methodological restraints of estimating the export elasticity based on EU level data. As the EU is an integrated market, exports within the EU might face similar price sensitivities as domestically supplied products. Therefore, products exported outside of the EU may face higher price sensitivity than estimated in this study. About 90% of Dutch polymer production (NACE 20.16) is exports, of which 70% are to EU27+3 countries.[183] Therefore, about 27% of polymer production is for non-EU27+3 countries. About 50% of Dutch plastic product production (NACE 22.2) is for export and 60% of that for non-EU countries. Therefore, about 20% of plastic production is for non-EU countries.

To estimate the total impact of production leakage (imports and exports), both elasticities were used, using a weighted estimate of the total production leakage (e.g. 10% of Dutch polymers are for domestic use / 90% are exported; 50% of Dutch plastic products are for domestic use / 50% are exported).

These estimates are fairly comparable to other estimates of the Armington and price elasticities calculated specifically for the Netherlands by other studies. Namely, estimates of the Armington elasticities in literature specifically for the Netherlands range from 1.4-1.7 for the chemical sector (NACE 20) and 0.3-1.6 for the rubber and plastics sector (NACE 22) and further the export elasticities for the Netherlands range from 2.0 for the chemical sector and 1.6 for the rubber and plastics sector (see table below).

Table 0-3 Estimates of armington and export elasticities from literature, specifically for the Netherlands

Elasticity	Sector/product covered	Value	Source
Armington elasticity	All sectors	1.4-3.8	Bajzik, J. et al (2019)
Armington elasticity	Chemical (20)	1.4-1.7	Aspalter, L (2016)
Armington elasticity	Rubber & Plastic (22)	0.3-1.6	Aspalter, L (2016)
Export elasticity	Chemical (20)	2.0	DNB (2018)
Export elasticity	Rubber, Plastic and non-metallic mineral products (22&23)	1.64	DNB (2018)

[183] CBS (2021). Invoer en uitvoer CBAM-producten 2017-2019.

B. Price differentials of virgin fossil and circular polymers

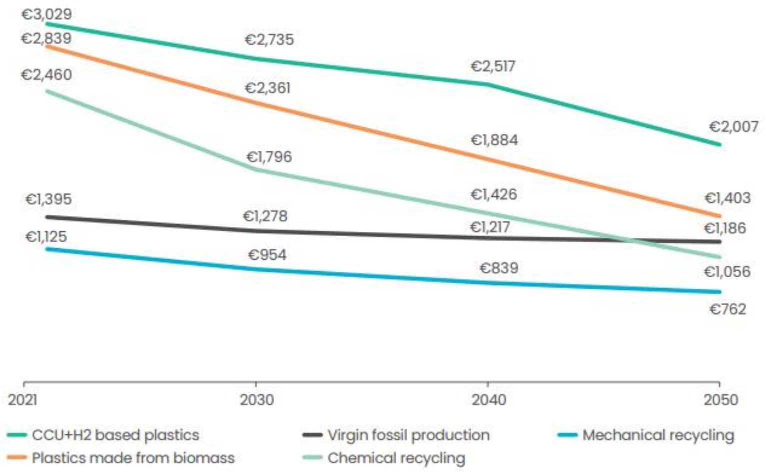
The table below provides an overview of the price differentials used for bio-based and mechanical recyclate. Prices of bio-based polymers and mechanical recyclate are not publicly available for specialised plastics (PUR, ABS/SAN, PA, PMMA). However, these other polymers are specialised, which tend to have lower price sensitivity, meaning there is less risk of production leakage. At the same time, typically the use of speciality polymers are in applications with high quality requirements (e.g. automotives, electronics), making them less substitutable with circular polymers in those applications.

Table 0-4 Price differentials of virgin fossil, bio-based and mechanically recycled polymers based on the most recent public data available

	Share of virgin fossil processed polymers in 2022[184] (%)	Bio-based polymers[185]	Mechanical recyclate (*high quality*)[186] (Oct 2024)
PE	46%	+500 EUR/t	+800-900 EUR/t
PP	21%	+1,100 EUR/t	+800-900 EUR/t
PVC	11%	+3,800 EUR/t[187]	No public data available
PET	3%	+1,300 EUR/t	+400-500 EUR/t
PS	1.0%	+800 EUR/t	No public data available

The future price of chemical recyclate will depend on the technological advancement of chemical recycling. Currently, chemical recycling is much more expensive than virgin fossil polymer production (see figure below). For chemical recyclate, the price differential use in this study is based on the Plastics Europe's Roadmap[188], where the cost of chemical recyclate is about 75% higher than virgin fossil polymers. This is expected to reduce to 20% higher by 2040.

Figure 0-1 Evolution of operating costs for the production of polymers 2021-2050



Source: Plastics Europe (n.d.). The plastics transition.

[184] *Excluding other thermoplastics and thermosets*
[185] *Based on CE Delft (https://ce.nl/wp-content/uploads/2022/09/CE_Delft_220281_Een_nationale_belasting_op_primair_fossiel_plastic.pdf) , adjusted for inflation*
[186] *ICIS (2024). Europe Petrochemicals Transform to thrive.*
[187] *Partners for Innovation report (2023)*
[188] *Plastics Europe (n.d.). The plastics transition.*

C. Calculation of tax base for Variant 3 (standard gap levy)

With a gap levy, all processors will need to comply with the standard (27.5%), without the ability to be compensated by processors with additional circular processing. As the current circular polymer use is concentrated amongst a few processors, basing the tax base for the gap levy on the current circular share (~15%) would be an underestimate of the tax base. On the other hand, if we assume that no processors process any circular polymers, this would be an overestimate of the tax base, as there are some processors which do. To provide an estimate of what extent processors would not meet the standard, previous literature[189] concerning the standard was considered. It is important to note that this previous literature is not fully representative of the Dutch plastics processing market and therefore may not provide a full picture of the entire market. However, it is a better starting point compared to using the sector level values for circular share (which would lead to an underestimate of the tax base). From this literature, it is approximated that about 18.5% of production will not meet the standard by 2030 and therefore taxed. This estimation is illustrated in the table below. For instance, 37% of processors do not process any circular polymers, therefore 27.5% of their production would be subject to the levy; for 40%, 0-15% (average 8%) of processed polymers are circular. The total weighted average of the virgin fossil polymers taxed would be 18.5%.

Table 0-5 Calculation of % of virgin fossil polymers taxed for Variant 3

A. % of current circular plastics (2023)	0%	0-15%	15%-30%	30%-100%	Total *(weighted average based on C)*
B. Average % of circular plastics processed (Average of A)	0%	7.5%	22.5%	65%	15%
C. % of surveyed processors	37%	40%	6%	17%	100%
D. % of processed polymers taxed (27.5% - B)	27.5%	20%	5%	0%	18.5%

Source of survey data: Partners for Innovation (2023). Gevolgen nationale norm circulaire plastics.

[189] *Partners for Innovation (2023). Gevolgen nationale norm circulaire plastics.*

D. Comparison with CE Delft study on a plastic levy

In 2022, CE Delft conducted a study for the Dutch Ministry of Infrastructure and Water Management to estimate the impact of the implementation of a national tax on virgin fossil polymers, in terms of the economic and environmental impact. This study provides a similar analysis with regards to the impact of a national tax on virgin fossil polymers, however, there are a few key difference which make it difficult to compare the results of these two studies. The table below provides an overview of these differences and the consequences on the comparability of the results.

Table 0-6 Comparison of the methodology of this study and the CE Delft study on a plastic levy

	CE Delft study	Trinomics study	Consequence on comparability
Year	2022	2025	Since the publication of the CE Delft study, there have been development in the Dutch plastic industry (e.g. production loss, decline in virgin fossil polymer prices). There have also been more recent studies concerning the Dutch plastic industry. These recent developments have been taken into account in this study.
Levies analysed	1. Levy on polymers for processing 2.Levy on plastic products	1. Levy on processed polymers 2. Levy on produced polymers 3. Standard gap levy	Both Variants 1 from the CE Delft and Trinomics study are the most similar, though the CE Delft study taxes the producers of polymers for the Dutch market (supplier), whereas Variant 1 in this study taxes the Dutch processors of polymers (buyers). In this sense, the tax base is more similar than the other variants, but who directly pays the levy differs. The other variants from the studies are very different and cannot be compared.
Exports	Exempted	No exemption	For this study, there is an additional leakage effect from exports, potentially leading to greater reduction in domestic production. Further, the tax base in this study can be larger, as it includes exports.
Exemptions	1. No additional exemptions beyond exports and circular polymers 2. Plastic products which are made of 100% circular polymers. Plastics for automotives, electronics, household and other purposes. Partial exemption for building/construction and agricultural plastics	All circular polymers are exempted (including post-industrial recyclate). Other thermosets/thermoplastics and polycarbonate are exempted.	Variations in the exemptions leads to differences in terms of the size of the tax base.
Tax base under levy (before leakage or substitution)	1. Processed polymers = 2400kt 2. Plastic products = 1150kt	1. Processed plastics = ~1,070 kt 2. Polymers = ~3940 kt 3. Processed plastics (gap levy) = 325 kt	The size of the tax base is a key difference in the methodology. Particularly for Variant 1, in this study, the tax base is smaller. This is mainly because this study is based on more recent data from Conversio, where the total processed polymers in the Netherlands is ~2,300 kt, where this value also includes polymers which are exempted (circular, other thermoplastics/ thermosets). Additionally,

	CE Delft study	Trinomics study	Consequence on comparability
			production loss since 2022 has been taken into account. With a smaller tax base in this study compared to the CE Delft study, given the same levy rate, a lower impact of the levy would be expected.
Levy rates analysed	1. 100, 500 and 800 EUR/t of polymer on the Dutch market (either produced domestically or imported) 2. 100, 500 and 800 EUR/t of plastic product made from virgin fossil polymers	1. 640 and 920 EUR/t of processed virgin fossil polymers in NL 2. 320 and 150 EUR/t of produced virgin fossil polymers in NL 3. 1,000 EUR/t of processed virgin fossil polymers in NL beyond the allowed limit according to the standard	The levy rates used for each study vary, though remain in the same range (100-1,000 EUR/t). As the levy rate is one of the determinants of the expected production leakage and substitution from the levy, the choice of different levy rates makes the results less comparable.
Time period	2030	2025-2040	The levy rates in this study are based on the average annual tax revenue from 2028-2040 reaching the budget requirement in Variants 1 and 2, whereas the CE Delft study only looks at the results in 2030.
Trade elasticities	The CE Delft study uses the WorldScan model, which also uses Armington elasticities. The WorldScan elasticity estimates are much higher than the ones used in this study (8 for the chemical, plastics and rubber industry (NACE 20-22)), as the WorldScan estimates are used at a global scale. Further, a more recent study by Netherlands Bureau for Economic Policy Analysis (CPB) estimated relatively lower (global) elasticities for the chemical sector, namely the estimates for the chemical sector (NACE 20-21) ranging from 1.3-1.8 and for the plastics and rubber sector (NACE 22) -0.1-10.6. They explain in their report that a possible reason for the disparity in their elasticity estimates for the chemical sector is that the WorldScan model uses a higher aggregated sector classification, the underlying data is from a different time period as well as additional methodological differences.	Developed new estimates compared with literature on Netherlands-specific estimates (trade elasticities at product level). While the WorldScan model used by the CE Delft study is at a global scale, the model developed for this study is specific to the Netherlands, therefore, these elasticities may not be representative for this study. Armington elasticities are not the same for all countries (Olekseyuk, Z. et al, 2014; Bajzik, J. et al, 2019).	Both studies use different values for price sensitivities. This is a key diversion in the studies, as the modelling of the production leakage effect is different. In this study, we use trade elasticities which are on average lower than that of the CE Delft study, but estimated per product and specific to NL/EU products. However, the CE Delft study is using a CGE model which simulates the global impact of policy changes. In this study, the model is focused specifically on the Netherlands, with a narrower scope of impact estimation (Dutch polymer and plastic industries only).
Sector granularity	Polymer producers & processors	Polymer producers & processors and product/product group level where available	The CE Delft study estimates the average production leakage effect across the sector, whereas this study considers the impact at the product level.
CO2 emissions reduction factors	Recyclate: -3.2 ktCO2e/kt of mechanical and -3.1 ktCO2ekt of chemical Bio-based: -2ktCO2e/kt	*Same as CE Delft study*	n/a
Cost pass through	100%	100%	n/a

F. Definition of the profiles

The approach to define the profiles is to be as coherent as possible with the quantitative analysis performed in Task 3, so as to apply the methodology used there to each of the profiles and hence reach quantitative results.

Profiles are defined as **combinations** of categories (Low / Medium / High) for the following two indicators:

- Susceptibility to production leakage;
- Techno-economic capacity to be substituted by 'circular' (bio-based / recycled) polymers.

Each of these indicators is detailed in one of the paragraphs below.

G. Susceptibility to production leakage

It is considered that this susceptibility depends upon:

- The elasticity of the product: the higher the elasticity, the higher this susceptibility to production leakage;
- The value of the levy compared to the total value of the product: the higher the share of the levy compared to the price of the product, the higher the susceptibility to production leakage.

The **elasticities** are, as per the Methodology for Task 3:

- The Armington elasticity for imports;
- The export elasticity.

Since the Methodology for Task 3 provides two values (low and high) for each elasticity, the **arithmetic mean** between the low and high value of that elasticity was used. These mean elasticities are then combined as per the share of Dutch production intended for internal or external use, as follows:

Combined elasticity =

[(share of Dutch production being exported) x (mean 'export elasticity')] +

[(share of Dutch production being sold in the domestic market) x (mean 'import elasticity')]

For a given product made of plastic (subject to the levy) and of other materials (not subject to the levy), the applicable levy would be equal to:

Applicable levy = (mass of plastic) x (levy rate)

= (share of plastic in the total mass of the product) x (mass of the product) x (levy rate)

Whereas the price of the product is equal to:

Price of the product = (mass of the product) x (price per kg of the product)

The impact of the plastic levy can be expected to rise together with the ratio of the applicable levy to the price of the product, i.e. to:

Share of levy in the product price = Applicable levy / Price of the product

= [(share of plastic in the total mass of the product) x (mass of the product) x (levy rate)] /

[(mass of the product) x (price per kg of the product)]

= [(share of plastic in the total mass of the product) x (levy rate)] / (price per kg of the product)

Hence, an indicator of the susceptibility of a product to production leakage was chosen: :

Indicator of susceptibility to production leakage =

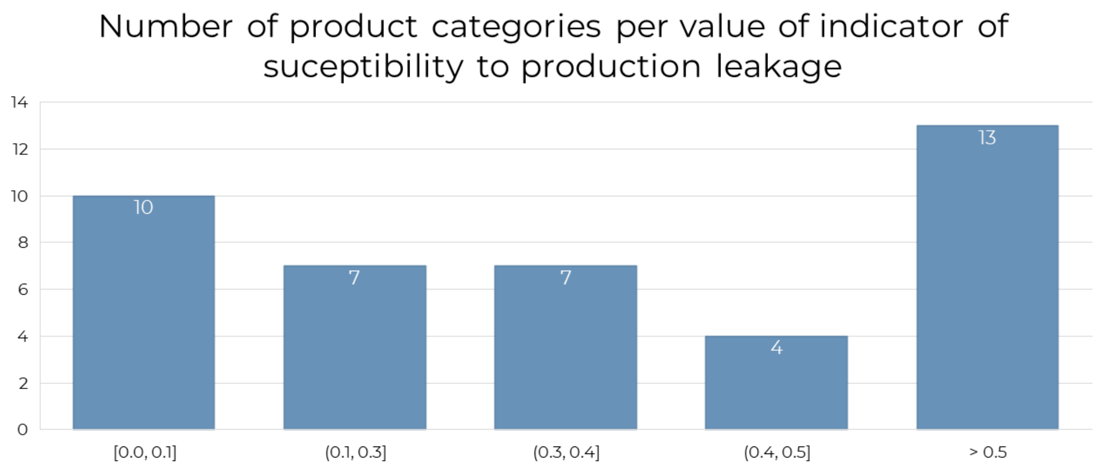
(Combined elasticity) x (share of plastic in the total mass of the product) / (price per kg of the product)

The unit for this indicator is: (kg of plastic) / EUR.

Considering the distribution of the values for that indicator as displayed in the figure below, the products are allocated to one of the three classes as follows:

- Indicator below 0.25 kg plastic /EUR : Low;
- Indicator between 0.25 and 0.5 kg plastic /EUR: Medium;
- Indicator above 0.5 kg plastic /EUR: High.

Figure 0-2 Distribution of values for the Indicator of susceptibility to production leakage



Based on the values recorded for Task 3, this indicator takes the values displayed in the table below. The table also shows the class of susceptibility to production leakage of each product.

Table 0-7 Values of the indicator of susceptibility to production leakage for polymers and for plastic products

Product	kg of plastic / EUR	Class of susceptibility to production leakage
Virgin fossil polymers		
PE-LD/LLDE	3.23	High
PE-HD/MD	3.72	High
EPS	1.57	High
PS	1.45	High
ABS,SAN	1.00	High
PVC	2.01	High
PET	2.01	High

Product	kg of plastic / EUR	Class of susceptibility to production leakage
PP	2.67	High
PMMA	0.67	Medium
PA	0.39	Medium
PUR	0.19	Low
Plastic processed products		
Monofilaments	0.59	High
Pipes and hoses of PE	0.31	Medium
Pipes and hoses of PP	0.09	Low
Pipes and hoses of PVC	0.35	Medium
Pipes and hoses, other	0.10	Low
Plates, sheets, foils, strips and strips of PE	0.37	Medium
Plates, sheets, foils, strips and strips of PP	0.46	Medium
Plates, sheets, foils, strips and strips of PVC	0.27	Medium
Plates, sheets, foils, strips and strips of PET	0.43	Medium
Plates, sheets, foils, strips and strips of PS	0.41	Medium
Plates, sheets, foils, strips and strips of PUR	0.14	Low
Plates, sheets, foils, strips and strips, other	0.05	Low
Sacks and bags of PE	0.56	High
Sacks and bags, other	0.34	Medium
Boxes, trays and crates	0.21	Low
Bottles	2.44	High
Packaging, other	0.33	Medium
Flooring of PVC	0.64	High
Building/Construction, other	0.09	Low
Kitchen and tableware	0.14	Low
Hygiene and toiletries	0.23	Low
Fittings for furniture	0.18	Low
Plates, sheets, foils, strips and strips, self-adhesive	0.28	Medium
Other processed plastics	0.12	Low

H. Substitution with circular plastics and environmental impacts

The substitution of fossil-based polymers with circular polymers is more complicated than the substitution of domestic production by imports of the same products. It also depends on several factors such as technical feasibility, economic feasibility from the perspective of the circular polymer producers as well as polymer processors, and the market availability of circular polymers. For the analysis, the additional complication is that the data availability on circular polymers is more limited than that of virgin fossil polymers.

The techno-economic feasibility of the substitution of fossil polymers by 'circular' alternatives has been assessed as per the methodology defined below and relies on the data and analysis summarised in Table 0-9 below.

For polymers

The techno-economic potential to be substituted by circular (bio-based / recycled) polymers is computed as the maximum value between the technical potentials of:

- Mechanical recycling;

- Chemical recycling;
- Bio-based plastics;

to substitute for fossil-based polymers, considering all applications of that polymer (this means that it is not sufficient to have a high substitution rate for one application of the polymer for the whole production of the polymer to be considered as "Substitutable to a good extent" by 'circular' polymers).

The Table 0-9 in the Annex below describes, for all polymers in scope, the examples found by the consultant team in its literature review of commercially-available products, in which the rate of polymers from post-consumer recycling (mechanical or chemical) or the bio-based content (together: the 'circular' content) is quantitatively stated (this implies that vague environmental claims such as "green" or "sustainable" were not considered).

A given 'circular' alternative is considered as economically viable, and hence included in the qualitative assessment below of the substitutability of the fossil polymer by 'circular' alternatives only if the price difference between the 'circular' alternative and the fossil polymer is below a given threshold. The threshold that was chosen by the consultant team is 1 500 EUR / tonne, commensurate to the higher values of the 'plastic levy' potentially implemented (around 500 EUR / tonne) and with the price premium currently observed for some recycled polymers when compared to fossil polymers (which is in the range of 1 000 EUR/tonne[190]). If the price difference is below this threshold, or if no data is available on the price of the 'circular' alternative, this 'circular' alternative is included in the assessment of the substitutability of the polymer. The table hence also provides the difference between the price per tonne of the fossil polymer and that of its 'circular' alternatives, when the consultant team has been able to identify a source for that price. Considering the volatility of market prices for materials, the value is rounded to the closest hundred of euros per tonne.

The table deduces qualitatively from these economically viable examples the category to which the polymer belongs, among the following ones:

- Almost completely substitutable: for almost all applications of the polymer, the 'circular" (i.e. post-consumer recycled or bio-based) content is 100% or close to 100%;
- Substitutable to a good extent: for most applications of the polymer, the 'circular" (i.e. post-consumer recycled or bio-based) content lies between 50 and 80%;
- Poorly substitutable: for most applications of the polymer, the 'circular" (i.e. post-consumer recycled or bio-based) content is below 50%.

The latter category 'Poorly substitutable' means that there is very limited techno-economic possibility for that polymer to increase its 'circular' content beyond that being specified by the Circular Plastic Standard ', which is equal to 30%, even in presence of a high 'plastic levy'.

The results of the qualitative assessment performed in detail in the Table 0-9 of the Annex are provided in the table below.

[190] *See slide 31 of a presentation of October 2024 made at the EPCA conference on the petrochemical industry: https://epca.eu/sites/epca.eu/files/event-documents/Web_EPCA58_Day2-3-241009_ICIS_Final.pdf*

Table 0-8 Category of substitutability of fossil polymers by 'circular' alternatives (mechanical or chemical recycling, bio-based polymers)

Polymer acronym	Polymer full name	Category of techno-economic substitutability by 'circular' alternatives
PE-LD/LLDE	(Linear) Low Density Polyethylene	Almost completely substitutable
PE-HD/MD	High Density Polyethylene	Substitutable to a good extent
EPS	Expandable Polystyrene	Substitutable to a good extent
PS	Polystyrene	Almost completely substitutable
ABS,SAN	Acrylonitrile Butadiene Styrene	Substitutable to a good extent
PVC	Polyvinyl Chloride	Poorly substitutable
PET	Polyethylene Terephthalate	Almost completely substitutable
PP	Polypropylene	Substitutable to a good extent
PMMA	Polymethylmethacrylate (Acrylic)	Poorly substitutable
PA	Polyamide	Almost completely substitutable
PUR	Polyurethane	Poorly substitutable

I. For plastic products

When the nomenclature for **plastic products** specifies the polymer in which it is made, the technical potential for substitution by a circular alternative to fossil polymers of that polymer is provided for the product. Several plastic products, on the other hand, do not specify the polymer of which they are made, so that the value of that substitutability by 'circular' alternatives cannot be specified for that product.

J. Table analysing the techno-economically realistic rate of substitution of fossil-based polymers by circular alternatives

Table 0-9 Techno-economically realistic rate of substitution of fossil-based polymers by circular alternatives

Polymer	Description	Mechanical recycling substitution rate	Comments on Mechanical Recycling	Chemical recycling substitution rate	Comments on Chemical Recycling	Bio-based plastics substitution rate	Comments bio-based	Category of techno-economic substitutability
ABS,SAN	Acrylonitrile Butadiene Styrene	50-70%	Mechanical recycling is the most common method of ABS recycling. ABS products with recycled content in the market typically contain 50-70% recycled ABS content. [191]	25-60%	Breaks down ABS plastic waste at the molecular level using chemical processes like depolymerisation. Products (for automotive parts) available in the market contain 25-60% chemically recycled ABS.[192]	50-100%	Content of bio-based ABS in alternative ABS products in the market varies from 50-100% for of bio-attributed content for all applications (automotive, construction, electronics, household, toys, etc)[193]	Substitutable to a good extent
PMMA	Polymethylmethacrylate (PMMA) (Acrylic)	30%	Shredded and reprocessed, but mechanical recycling often results in reduced quality, therefore chemical recycling is normally preferred.[194] Some products in the market used in applications such as building/ construction, automotive, electronics, and household contain mechanically recycled PMMA ranging from 30-100% recycled content.[195196]	30-50%	PMMA is recycled into its monomer form, Methyl methacrylate (MMA) r-MMA) which can then be re-polymerised. However, the quality of the scraps impacts the final r-MMA purity.[197] Products with r-PMMA in the market currently have 30-50% share of r-PMMA[198] [199,200] although technical feasibility can be much higher.[201] Regulatory measures and costs limit the use of r-MMA[202203]	25-30%	Products available in the market contain MMA monomer from 25-30% plant-derived raw materials.[204]	Poorly substitutable
PA	Polyamide	100%	It can be processed into pellets for non-critical applications but may lose quality. [205] Current practices combine mechanical and chemical recycling (see comments chemical recycling (CR))	100%	Depolymerised into monomers (e.g., caprolactam for Nylon-6) using thermal depolymerisation or enzymatic methods. Products available in the market are made of 100% r-PA (e.g., loopamid)[206] for a variety of applications	70-100%	Alternative products in the market contain approx. 70% of bio-based plastics. For some applications (textiles) bio-attributable content can reach up to 100% [207]	Almost completely substitutable

[191] *See for Example https://www.terplastics.com/; https://www.ineos-styrolution.com/Product/Styreco-Mod_ID30060062_lang_ko_KR.html*
[192] *ABS Solution with Recycled Content for Automotive Interior and Exterior Applications. (n.d.). Retrieved from https://www.trinseo.com/solutions/acrylonitrile-butadiene-styrene-abs/magnum-eco-abs*
[193] *Nylanden, N. (2024). Replacing ABS plastic sustainably. Retrieved from https://www.sulapac.com/blog/replacing-abs-plastic-sustainably/*
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[196] *Kunststoff-Rezyklate. (2024). Retrieved from https://pekutherm.de/en/produkte/kunststoff-rezyklate/#*
[197] *De Tommaso, J., & Dubois, J.-L. (2021). Risk Analysis on PMMA Recycling Economics. Polymers, 13(16), 2724. https://doi.org/10.3390/polym1316272*
[198] *CORDIS(2018). Second generation Methyl MethAcrylate (MMAtwo): MMAtwo Project: Fact Sheet: H2020: CORDIS: European Commission. Retrieved from https://cordis.europa.eu/project/id/820687*
[199] *MMAtwo Project. https://www.mmatwo.eu/*
[200] *ALTUGLAS™ R-Life Resins. Retrieved from https://www.trinseo.com/solutions/acrylic-resins/emea-and-apac-pmma-resins/altuglas-r-life-resins*
[201] *PMMA can be depolymerised thermally to provide a high effective yield (70–90%) of monomer of high purity (>90%),*
[202] *Recent regulatory changes have made thermal depolymerization of PMMA less viable due to challenges in disposing of lead-contaminated dross and bans on using r-MMAr in food-contact products and paints. https://www.sciencedirect.com/science/article/abs/pii/S1359431102001151?via%3Dihub*
[203] *Capital and operating costs are strongly affected by the purity required for the recycled MMA https://www.sciencedirect.com/science/article/pii/S0956053X23002830#b0110*
[204] *Roehm products overview. Retrieved from https://www.roehm.com/en/products*
[205] *Zheng, L., Wang, M., Li, Y., Xiong, Y., & Wu, C. (2024). Recycling and Degradation of Polyamides. Molecules, 29(8), 1742. https://doi.org/10.3390/molecules29081742*
[206] *https://www.loopamid.com/global/en*
[207] *Genomatica. (2023). Retrieved from: https://www.genomatica.com/nylon/*

Polymer	Description	Mechanical recycling substitution rate	Comments on Mechanical Recycling	Chemical recycling substitution rate	Comments on Chemical Recycling	Bio-based plastics substitution rate	Comments bio-based	Category of techno-economic substitutability
PS	Polystyrene	98% (accounting for partial use for electronics)	Available technologies have demonstrated high-purity recyclability of polystyrene through mechanical recycling, proving the viability of achieving purity levels that exceed 99.9%[208] [209] 100% for insulation[210] *40% for electrical appliances*	50%	It can be converted back into styrene monomer via pyrolysis. BASF produces *Styropor Cycled* using chemical recycling. Exact recycled content isn't specified, but production saves at least 50% of CO2 emissions compared to conventional Styropor®[211].	80-95%	Via feedstock cracking (bio-feedstock is separated into its primary monomer building blocks). These monomers are used to replace virgin polystyrene. Products available in the market have a bio-based composition of 80-95 %[212]	Almost completely substitutable
PUR	Polyurethane	25-100%	Shredded PUR can be reused but altered properties limit its use.[213] *Polytech* contain 25% of mechanically recycled PUR[214]. *Purman* applications include 100% mechanically recycled PUR.[215]	20%	Stable PUR compounds are broken down at high temperatures, e.g., with diols or carboxylic acids, to obtain polyols or chemical PUR precursors. [216] Polytech has 20% of chemically recycled content.	15-30%	Polytech products can contain 15% of plant-based raw materials [217]. Other formulations include 20-30% bio-based PUR[218]	Poorly substitutable

[208] *INEOS Styrolution Retrieved from: https://styrolution-eco.com/high-purity-mechanical-recycling-of-polystyrene-styrolution-ps-eco.html*
[209] *Polygood- The good plastic company. Retrieved from: https://polygood.com/material-sourcing-and-composition/*
[210] *Understanding the EU Packaging and Packaging Waste Regulation (2024). Retrieved from https://bewi.com/news/understanding-the-eu-packaging-and-packaging-waste-regulation-ppwr-proposal/*
[211] *BASF- Styropor. Retrieved from: https://www.styropor.com/portal/basf/en/dt.jsp?setCursor=1_1227161&page=styropor-ccycled-for-stressless*
[212] *TRINSEO - Bio-based, Bio-attributed and Bio-degradable Plastics. (n.d.). Retrieved from https://www.trinseo.com/solutions/bioplastics-biodegradable-plastics*
[213] *Polyurethane-Recycling: PCR Engineering. (2024). Retrieved from https://www.pcr-eng.com/en/polyurethane-recycling*
[214] *Polytech (2023.).Polytech's recycling of polyurethane transport interfaces chosen as Top 50 Sustainability projects in Denmark Retrieved from https://www.polytech.com/news/polytech-s-recycling-of-polyurethane-transport-interfaces-chosen-as-top-50-sustainability-projects-in-denmark/*
[215] *purman.furni - Recycled PU Furniture. (2024). Retrieved from https://purman.com/applications/purman-furni/*
[216] *Polyurethane-Recycling: PCR Engineering. (2024). Retrieved from https://www.pcr-eng.com/en/polyurethane-recycling*
[217] *Polytech (2023.) Retrieved from https://www.polytech.com/news/polytech-s-recycling-of-polyurethane-transport-interfaces-chosen-as-top-50-sustainability-projects-in-denmark/*
[218] *https://www.bio4eeb.eu/products/*

Polymer	Description	Mechanical recycling substitution rate	Comments on Mechanical Recycling	Chemical recycling substitution rate	Comments on Chemical Recycling	Bio-based plastics substitution rate	Comments bio-based	Category of techno-economic substitutability
PE-LD/LLDE	(Linear) Low Density Polyethylene	36% (taking into account variation across different applications)	PE - LLDE is melted and turned into new products. LLDPE mech. recycling is challenging due to blending with other plastics and films jamming equipment.[219] In addition, it is frequently contaminated requiring cleaning and sorting. Available products in the food industry contain 30% of recycled LLDPE[220] 10% for electrical applications (insulation) [221] 100% for construction applications[222], 10% for toys[223], Not permitted to produce recyclate for use in contact sensitive materials[224] (only 42% of packaging is applicable)[225]	-	PE – LLDE is broken down into its constituent chemical building blocks which are then used to produce new polymer products. However CR is currently less common than mechanical recycling (which itself faces significant hurdles as explained under comments on mechanical recycling (MR)) *Currently, there is no reliable information available on specific PE-LD and PE-LLDE products, nor on the substitution rates achievable exclusively through CR*	80-100% *Lower when taking global production constraint into account*	Biomass-based PE matches mineral oil-based PE, allowing direct substitution in use and disposal [226]. Examples of products include Braskem bio-based LLDPE (produced from sugar-cane) - *I'm green™ LLDPE SLH 118[227] SYNDIGO™ Recycled Polyethylene* suitable for food applications Main applications of bio LLDPE include food and beverage packaging, cleaning products and toys with a bio-based content range of 80% to 100%[228]	Almost completely substitutable

[219] *Arkema (2023). How to improve the LLDPE mechanical recycling process?.*
[220] *Berry (2023). Retrieved from https://www.berryglobal.com/en/news/articles/berry-includes-food-grade-recycled-content-in-flexible-plastic-packaging*
[221] *Understanding the EU Packaging and Packaging Waste Regulation (PPWR) proposal. (2024). Retrieved from https://bewi.com/news/understanding-the-eu-packaging-and-packaging-waste-regulation-ppwr-proposal/*
[222] *Understanding the EU Packaging and Packaging Waste Regulation (PPWR) proposal. (2024). Retrieved from https://bewi.com/news/understanding-the-eu-packaging-and-packaging-waste-regulation-ppwr-proposal/*
[223] *Understanding the EU Packaging and Packaging Waste Regulation (PPWR) proposal. (2024). Retrieved from https://bewi.com/news/understanding-the-eu-packaging-and-packaging-waste-regulation-ppwr-proposal/*
[224] *https://www.rivm.nl/bibliotheek/rapporten/2024-0099.pdf*
[225] *https://publications.tno.nl/publication/34642495/Mz4Pwl/TNO-2024-R10938.pdf*
[226] *Biokunststofftool (n.d.). Bio-PE. Retrieved from https://biokunststofftool.de/materials/bio-pe/?lang=en#1549361074391-c27c5512-0aa3*
[227] *(N.d.). Retrieved from https://www.braskem.com.br/imgreen/my-environmental-impact*
[228] *About our Portfolio*

Polymer	Description	Mechanical recycling substitution rate	Comments on Mechanical Recycling	Chemical recycling substitution rate	Comments on Chemical Recycling	Bio-based plastics substitution rate	Comments bio-based	Category of techno-economic substitutability
PE-HD/MD	High Density Polyethylene	48% (taking into account variation across applications)	Not permitted to produce recyclate for use in contact sensitive materials[229] (only 42% of packaging is applicable)[230] Involves breaking HDPE into smaller pieces, which are then melted and remoulded into new products. Mechanical recycling is more straightforward and cost-effective for less contaminated waste streams Recycled HDPE is commonly used to produce bottles for beverages and household products. Examples include Borcycle recycled HDPE[231], *PontEurope*[232], *Cirplus* [233] products 50% for packaging[234] 30% for pipes[235]	-	HDPE is mainly recycled using MR. Currently, there aren't in the market specifically marketed as containing chemically recycled PE-LLDE. Despite its efficiency in producing high-quality recycled HDPE, chemical recycling is currently not economically viable for large-scale [236] Currently, there is no reliable *information available on specific PE-HD and PE-MD products, nor on the substitution rates achievable exclusively through CR*	35%-95% *Lower when taking global production constraint into account*	Bio-based high-density polyethene has the same properties as conventional HDPE. Multiple products are available in the market today including, GILAC [237]. Also, Braskem's Green PE has a bio-based content for HDPE reaching 96% . 35- 90% (food/ beverages containers and films. FKuR's granulate enables beverage crates with 62% bio-based content- Coveris produces biomass-based PE films for the food/agri industry ranging 35-85%[238]) 40% foamed articles 94 - 96% bottle caps[239] > 95 % tubes, profiles[240]	Substitutable to a good extent

[229] *https://www.rivm.nl/bibliotheek/rapporten/2024-0099.pdf*
[230] *https://publications.tno.nl/publication/34642495/Mz4Pwl/TNO-2024-R10938.pdf*
[231] *https://www.borealisgroup.com/products/product-catalogue/borcycle-ab2681-99*
[232] *https://www.ponteurope.com/sustainability-recycled-hdpe/*
[233] *https://cirplus.com/materials/R-HDPE*
[234] *Understanding the EU Packaging and Packaging Waste Regulation (2024). Retrieved from https://bewi.com/news/understanding-the-eu-packaging-and-packaging-waste-regulation-ppwr-proposal/*
[235] *Understanding the EU Packaging and Packaging Waste Regulation (2024). Retrieved from https://bewi.com/news/understanding-the-eu-packaging-and-packaging-waste-regulation-ppwr-proposal/*
[236] *Polymers, A. (2024). Deciphering the Future of HDPE Recycling - Accel Polymers. Retrieved from https://accelpolymers.com/deciphering-the-future-of-hdpe-recycling/*
[237] *https://www.gilac.com/en/content/38-bio-based-hdpe*
[238] *https://fkur.com/en/bioplastics/im-green-polyethylene/im-green-ldpe-stn-7006/*
[239] *https://fkur.com/en/bioplastics/im-green-polyethylene/im-green-hdpe-sge-7252ns/*
[240] *https://fkur.com/en/bioplastics/terralene/terralene-hd-3722/*

Polymer	Description	Mechanical recycling substitution rate	Comments on Mechanical Recycling	Chemical recycling substitution rate	Comments on Chemical Recycling	Bio-based plastics substitution rate	Comments bio-based	Category of techno-economic substitutability
PP	Polypropylene	58% (taking into account variation across applications)	Not permitted to produce recyclate for use in contact sensitive materials[241] (only 42% of packaging is applicable)[242], 100% for construction applications, 100% for crates, pallets, 20% for microwave applications, 100% for flower pots, 30% for automotives	-	*Currently only available at a smaller scale compared to mechanical recycling.* [243] *There is no reliable information available on specific PP products, nor on the substitution rates achievable exclusively through CR*	30-75%	Bio-based polypropylene (PP) currently contains approximately 30% bio-based materials, with potential increases to 75% in the coming years depending on technological advancements.[244] 33% buckets, food containers, cups [245246]	Substitutable to a good extent
EPS	Expandable Polystyrene	15-80%	Mechanically recycled EPS is currently produced by different companies for a variety of applications, including BASF Neopor® F 5 Mcycled™ (10% recycled content) suitable for applications in buildings, [247] Products can have recycled content ranging from 15-80%: , Packaging (15%), Insulation(15-80%)[248], Food/ contact-sensitive packaging (10%)[249]	-	Chemical recycling of EPS is less common than mechanical recycling because it is generally more expensive, complex, and requires specialised equipment, making it less economically viable. [250] Additionally, it often has a higher environmental impact due to the use of hazardous chemicals and generation of by-products.[251] However, CR does have the advantage of handling contaminated EPS more effectively.[252]	55-100%	100% - façade insulation, roof insulation .(BioFoam® looks the same in structure and has almost the same properties as EPS)[253] 55% for other applications with products such as Expancel BIO replacing conventional EPS for a wide range of products[254]Most of the products currently marketed as bio-EPS use additives to accelerate the breakdown process[255]	Substitutable to a good extent

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[241] *https://www.rivm.nl/bibliotheek/rapporten/2024-0099.pdf*
[242] *https://publications.tno.nl/publication/34642495/Mz4Pwl/TNO-2024-R10938.pdf*
[243] *Chemical recycling. (2023.). Retrieved from https://www.neste.com/products-and-innovation/plastics/chemical-recycling*
[244] *Bio-PP. (n.d.). Retrieved from https://biokunststofftool.de/materials/bio-pp/?lang=en#1549359483669-39be668d-2c42*
[245] *https://fkur.com/en/bioplastics/terralene/terralene-pp-3509/*
[246] *https://fkur.com/en/bioplastics/terralene/terralene-pp-4732/*
[247] *BASF SE (2025) Admin. (n.d.). Retrieved from https://styrenicfoams.com/portal/basf/en/dt.jsp?setCursor=1_1229983*
[248] *Understanding the EU Packaging and Packaging Waste Regulation (2024). Retrieved from https://bewi.com/news/understanding-the-eu-packaging-and-packaging-waste-regulation-ppwr-proposal/*
[249] *Minimum in line with targets set in EU Packaging and Packaging Waste Regulation*
[250] *García-Sobrino, R., Cortés, A., Sevilla-García, J. I., & Muñoz, M. (2024). Sustainable Multi-Cycle Physical Recycling of Expanded Polystyrene Waste for Direct Ink Write 3D Printing and Casting: Analysis of Mechanical Properties. Polymers, 16(24), 3609. https://doi.org/10.3390/polym16243609*
[251] *Hattori, K. (2015). Recycling of Expanded Polystyrene Using Natural Solvents. Retrieved from https://www.intechopen.com/chapters/47821*
[252] *EUMPES (n.d.). Recycling EPS. Retrieved from https://eumeps.eu/topics/recycling-eps*
[253] *https://www.bio-basedbouwen.nl/producten/biofoam-isolatie-korrels/*
[254] *Expancel® BIO microspheres. (n.d.). Retrieved from https://www.nouryon.com/products/expancel-microspheres/expancel-bio-microspheres/*
[255] *https://allequard.com/materials/biodegradable-foams/*

Polymer	Description	Mechanical recycling substitution rate	Comments on Mechanical Recycling	Chemical recycling substitution rate	Comments on Chemical Recycling	Bio-based plastics substitution rate	Comments bio-based	Category of techno-economic substitutability
PVC	Polyvinyl Chloride	25-100%	Involves grinding and reprocessing PVC waste. Contaminants can reduce the quality. 25-60% for PVC pipes[256][257], 40-57% profiles[258], 60-100% for windows, gutters, façade cladding, electric insultation, non-food films, 10-30% electrical applications	100%	Only a few products available in the market are manufactured by using 100% chemically recycled PVC for most applications.[259] MR of PVC is typically preferred over CR due to its lower cost, simplicity, and energy efficiency. [260]	20-100%	Instead of fossil resources, the required amount of bio-naphtha or biogas is used for PVC resins (including pipes, profiles, medical products) [261], produced 100 per cent from plant-based raw materials.[262] 100% for PVC pipes, fittings and valves[263][264]	Poorly substitutable
PET	Polyethylene Terephthalate	90-100%	90% for food packaging[265] 100% for ISBM bottles	-	Chemical recycling of PET, while able to handle contaminated PET and produce high-purity monomers, is still developing and faces higher costs and complexity. [266]	30%	BIO-PET is max 30% bio-based for all applications, with plant-derived monoethylene glycol (MEG) replacing fossil-derived MEG.[267][268]	Almost completely substitutable

[256] *https://publicaties.vlaanderen.be/view-file/26820*
[257] *Lahl U, Zeschmar-Lahl B. More than 30 Years of PVC Recycling in Europe—A Critical Inventory. Sustainability. 2024; 16(9):3854. https://doi.org/10.3390/su16093854*
[258] *The right material. (n.d.). Retrieved from https://www.schueco.com/de-en/investors/comprehensive-solutions/decarbonisation/the-right-material*
[259] *Hexamoll® DINCH - ccycled™. (n.d.). Retrieved from https://products.basf.com/global/en/cp/hexamoll-dinch-ccycled*
[260] *Lewandowski, K., & Skórczewska, K. (2022). A Brief Review of Poly(Vinyl Chloride) (PVC) Recycling. Polymers, 14(15), 3035. https://doi.org/10.3390/polym14153035*
[261] *KEM ONE - Bio-attributed PVC*
[262] *Bio-attributed PVC: A breakthrough for sustainable plastics. (n.d.). Retrieved from https://www.renolit.com/en/blog/bio-attributed-pvc-a-breakthrough-for-sustainable-plastics*
[263] *https://www.pipelife.com/service/news-and-projects/2023/built-to-last-and-evolve-the-trends-challenges-and-opportunities-for-pvc-piping-solutions.html*
[264] *https://www.gfps.com/en-vn/about-us/media-center/news-details.html/news/gfps/2021/hq/industry-sustainability-leader--gf-piping-systems-introduces-bio-attributed-pvc-to-its-portfolio-to-reduce-co2-footprint*
[265] *https://publicaties.vlaanderen.be/view-file/26820*
[266] *ChemPET: Chemical PET recycling. (2023). Retrieved from https://garbo.it/en/chempet/*
[267] *https://fkur.com/en/bioplastics/eastlon/*
[268] *Bio-PET. (n.d.). Retrieved from https://biokunststofftool.de/materials/bio-pet/?lang=en*

Annex 4 – Data sources

Table 0-10 Data sources used in this study

Type of data	Use	Data source(s)
Production and processing of polymers	• Production and processing of polymers in the Netherlands per application types and polymer type, including recycled and bio-based polymers	Conversio (2024)
Sold production, exports and imports	• Value and volume of domestic production, imports and exports per PRODCOM • Estimation of price elasticities • Estimation of prices of products at PRODCOM level of domestic production and imports (Value/Volume)	Eurostat (2024) CBS (2024)
Trade adjustments for re-exports	• Share of domestic production meant for export/domestic use • Share of imports meant for domestic use/re-exports	CBS (2016)[269] CBS (2024)[270] CBS (2021)
Company financial data	Sector-level total revenue, operating expenses and gross value added (to calculate tax revenue as a % of operating expenses/gross value added)	CBS (2024)
CO2 emissions factors of polymers	Calculating CO2 emissions reduction from substitution of virgin fossil polymers with circular polymers	CE Delft (2022)
Global Bio-based production capacity	Total global production capacity of bio-based polymers per polymer type, 42% of current capacity is unused	European Bioplastics (2024)
Techno-economic circular polymer capacities	Maximum rate of substitution per polymer type with recycled and bio-based polymers	See Table 0-9
Circular polymer price differentials	Price differentials between virgin fossil and circular polymers	See Table 0-4
Price Indices	Inflation corrections	CBS (2024)

[269] *~90% of domestic production of polymers is destined for export*
[270] *~50% of domestic plastic product production is destined for export*

Annex 5 – Overview of EU legislation on CE and plastics

Table 0-11 Overview of the most relevant EU legislation on ciruclar economy and plastics

Legislation	Description
European Strategy for Plastics in a Circular Economy	As a key component of the 2015 Circular Economy Action Plan, this strategy was introduced in 2018 and defines a vision a circular plastics economy by covering the following aspects: design for recyclability, boosting demand for recycled plastics, improvements of separate collection and sorting, establishing a clear regulatory framework for bio-based plastics. The strategy also aims to reduce single-use plastics, promote investment in recycling infrastructure, and foster innovation in bio-based and biodegradable plastics.
Single-Use Plastics (SUP) Directive (Directive (EU) 2019/904)	An important EU legislation is the SUP Directive, established in 2019. It aims to reduce the environmental impact of ten specific plastic products (such as cutlery, straws, etc.) by banning or restricting their use (such as for cigarette butts, plastic bags, etc.). It mandates circular design, extended producer responsibility (EPR) schemes, improving labelling and awareness campaigns. Specific targets are the separate collection of 90% plastic bottles by 2029 and the incorporation of 30% of recycled plastic in all plastic beverage bottles from 2030. The directive also encourages to include bio-based and biodegradable plastics in sustainability considerations. Related regulations are the Directives on Packaging, and Plastic Bags.
Packaging and Packaging Waste Regulation (PPWR) (Regulation (EU) 2025/40)	The PPWR establishes a new set of requirements in line with Europe's waste rules that cover the entire packaging life cycle – from product design to waste handling. The new rules will include: • Restrictions on certain single-use plastics, • Minimising the weight and volume of packaging and avoiding unnecessary packaging. • 2030 and 2040 targets for a minimum percentage of recycled content in packaging. • A requirement for take-away businesses to offer customers the option to bring their own containers at no extra cost. • Minimising substances of concern.
Plastic Bags Directive (Directive (EU) 2015/720)	The Plastic Bags Directive is an amendment to the Packaging and Packaging Waste Directive to improve the sustainability of the consumption and use of lightweight plastic carrier bags. It requires the reduction of use of plastic bags per person and/or the introduction of economic instruments, such as fees or taxes.
Waste Framework Directive (Directive 2008/98/EC)	The Waste Framework Directive establishes the principles of a waste management hierarchy, prioritising prevention, reuse, recycling and recovery over disposal. It defines how to distinguish waste and by-products, and introduces the polluter pays principle and EPR. It sets targets for the reuse and recycling of household and municipality waste as well as for waste from construction and demolition.
Ecodesign for Sustainable Products Regulation (ESPR) (Regulation (EU) 2024/1781)	ESPR is relevant since it addresses the release of nano- and microplastics and the amount of (plastic) waste generated. It also promotes the use of recycled and bio-based materials.
Directive on the promotion of the use of energy from renewable sources (Directive (EU) 2018/2001) (*Indirect relevance*)	While primarily focused on renewable energy, the Directive on the promotion of the use of energy from renewable sources also promotes the use of bio-based materials. It sets sustainability criteria for bioenergy production, which includes the use of biomass for bio-based plastics and can thus cause competition to its use for plastics.

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