



# Circular Materials Policy & Strategy Advice

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Connecting people and knowledge



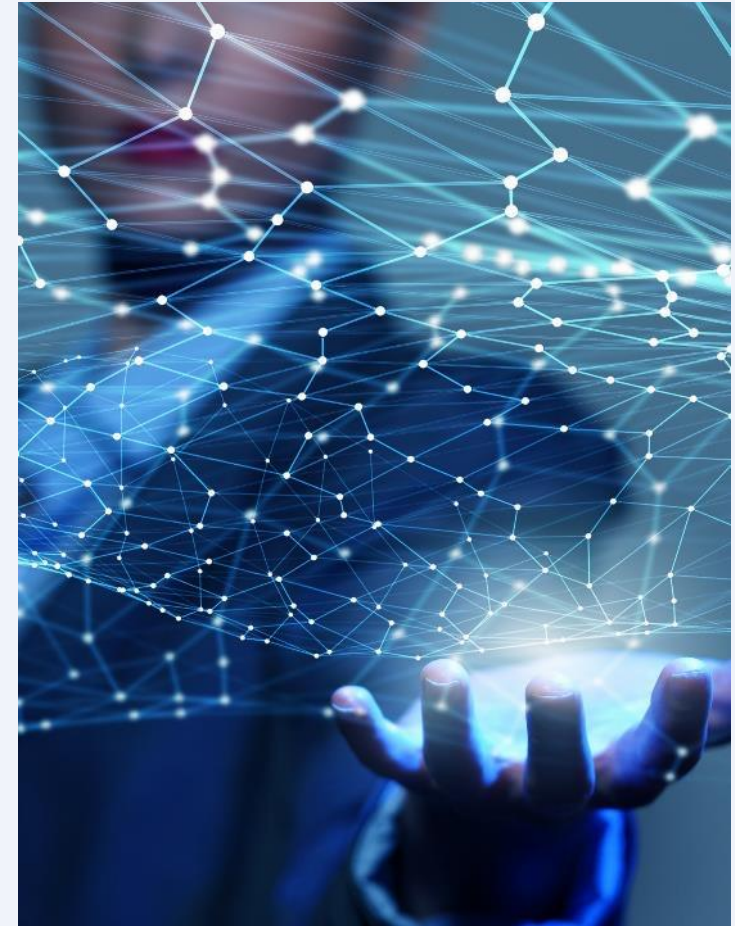
Creating innovations



Sustainably strengthening business competitiveness



Sustainably strengthening well-being across society



# Circularity in a changing global context

Circular material transitions do not take place in isolation. They are shaped by major global challenges that increasingly affect policy choices and industrial strategies:



## Climate change and environmental degradation

Reducing emissions, resource use and environmental impacts across value chains



## Geopolitical tensions

Increasing uncertainty in global supply chains and trade relations



## Strategic autonomy for materials

Securing access to critical material and reducing external dependencies



## Competitiveness and affordability

Ensuring that transitions remaining economically viable for society and industry

**These challenges reinforce the need for system-level insight into material and product value chains.**

# What this means for policy & strategy

Complex trade-offs, no single-objective solutions

Policies and strategies for circular materials must navigate trade-offs between:



## Cost & Affordability

Circular transitions must remain economically viable and socially affordable. Policies and strategies affect production costs, consumer prices and investment needs and therefore directly influence competitiveness and public acceptance.



## Climate & Environmental performance

Material production and use are major contributors to greenhouse gas emissions and environmental damage. Circular strategies aim to reduce life-cycle impacts but require system-wide assessment to avoid shifting burdens between stages, regions or materials.



## Circularity & resource efficiency

Improving circularity reduces dependence on primary and imported raw materials and supports strategic autonomy. However, higher material retention does not automatically lead to lower costs or emissions, making trade-off analysis essential.

# From system complexity to policy and strategic decisions

## Complex Challenge

Policy makers & industry face complex material systems where interlinked and uncertain impacts on cost, climate and circularity make it hard to prioritise and sequence decisions.



## TNO Circular modelling

We turn challenges into analysable scenarios and quantify system-wide impacts with TNO Circular models, enabling transparent and evidence-based insights across value chains.



## Expert Insight & Advice

Expert insight puts model results in context, translating quantitative outcomes into policy-relevant and actionable options for government and industry.



**This approach ensures that decisions are informed by evidence, while remaining in real-world feasibility.**

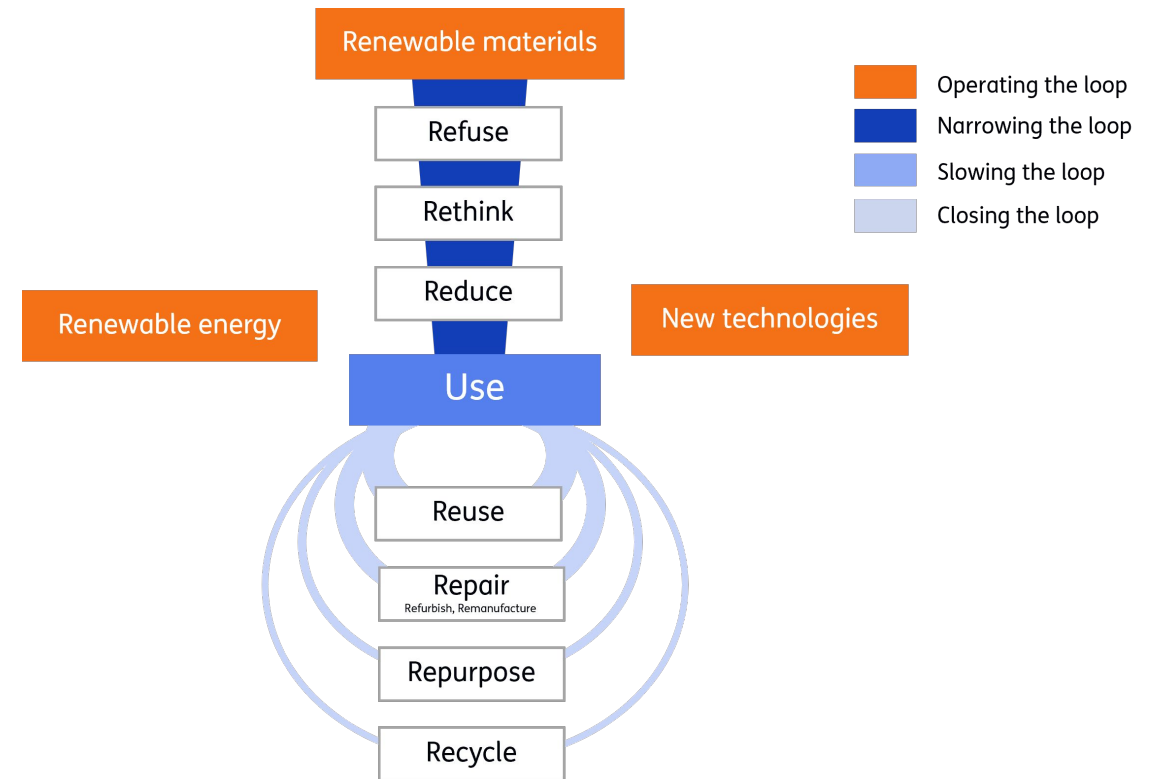


## The Circular Industrial Transformation System (CITS) model

Explores the role of materials in the transition towards a circular, carbon neutral and resilient economy, to make informed decisions on strategies and policy measures.

CITS is used to:

- Analyse future demand, stocks-in-use and waste generation
- Track material flows across value chains
- Assess impacts on cost, climate and circularity
- Compare alternative transition pathways



# What type of questions CITS can answer



Competitiveness &  
Affordability



Climate & Environmental  
performance



Circularity & resource  
efficiency

Technology

How much virgin material production can be avoided through circular strategies?

How much environmental impact can be avoided through changes in energy mix?

Policy

How robust are policy measures under different scenarios?

What is the effect of policy measures on the Dutch circularity goals and environmental impact goals?

Value Chain

What are the most impactful leverage points to reach circularity goals within this value chain?

What are the effects of applying multiple policies to the value chain?

Sector

What volumes and types of material-containing products are expected to reach end-of-life in the coming years?

Which products in my portfolio have the highest circularity potential?

# An example of applying the CITS model

**Circularity and greenhouse gas assessment of the plastic packaging and beverage carton system in the Netherlands until 2050**

**Authors:**

Paul Stegmann, Sietske Lensen, Sjoerd Herlaar,  
Anna Schwarz, Esther van den Beuken



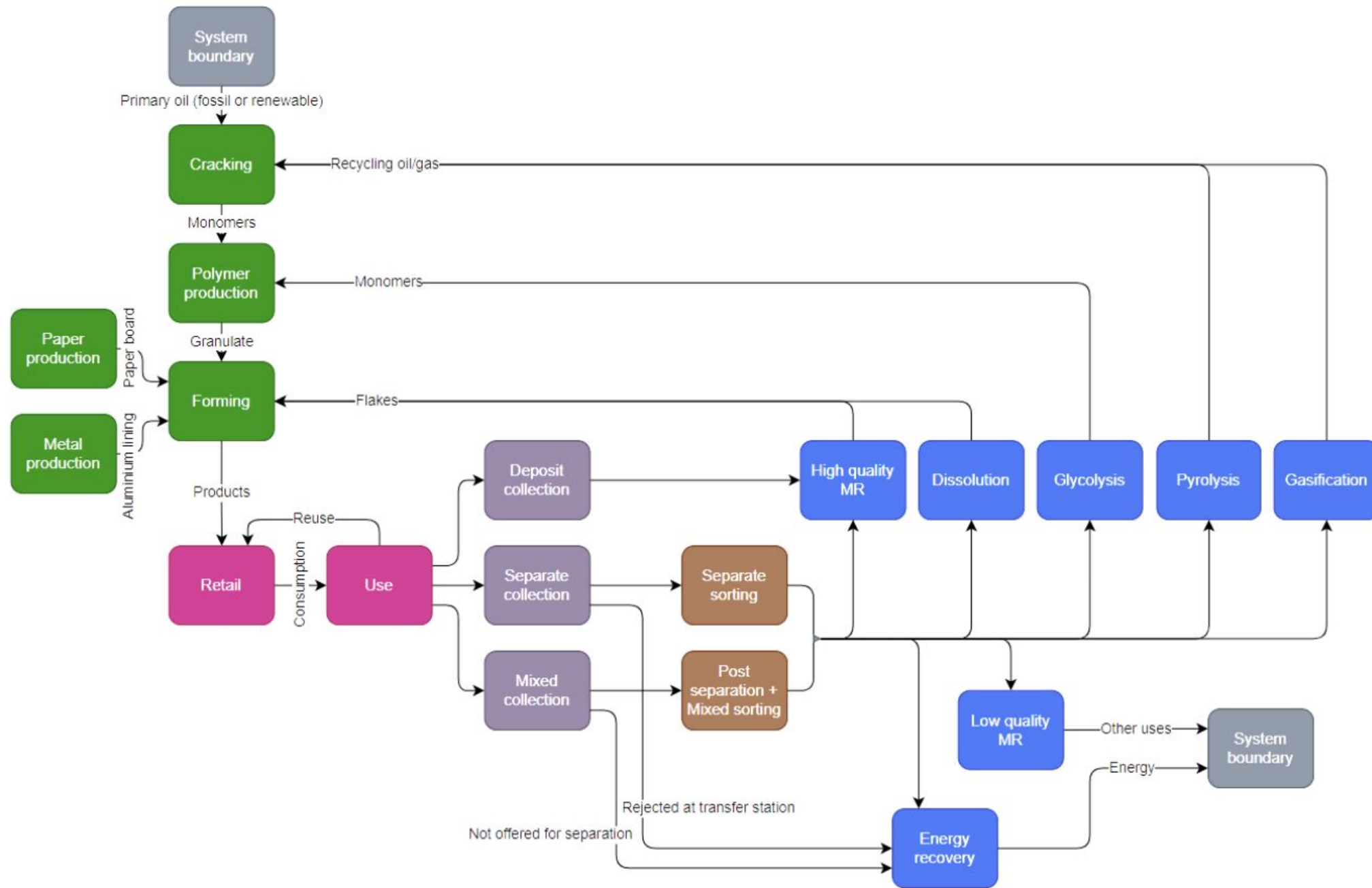
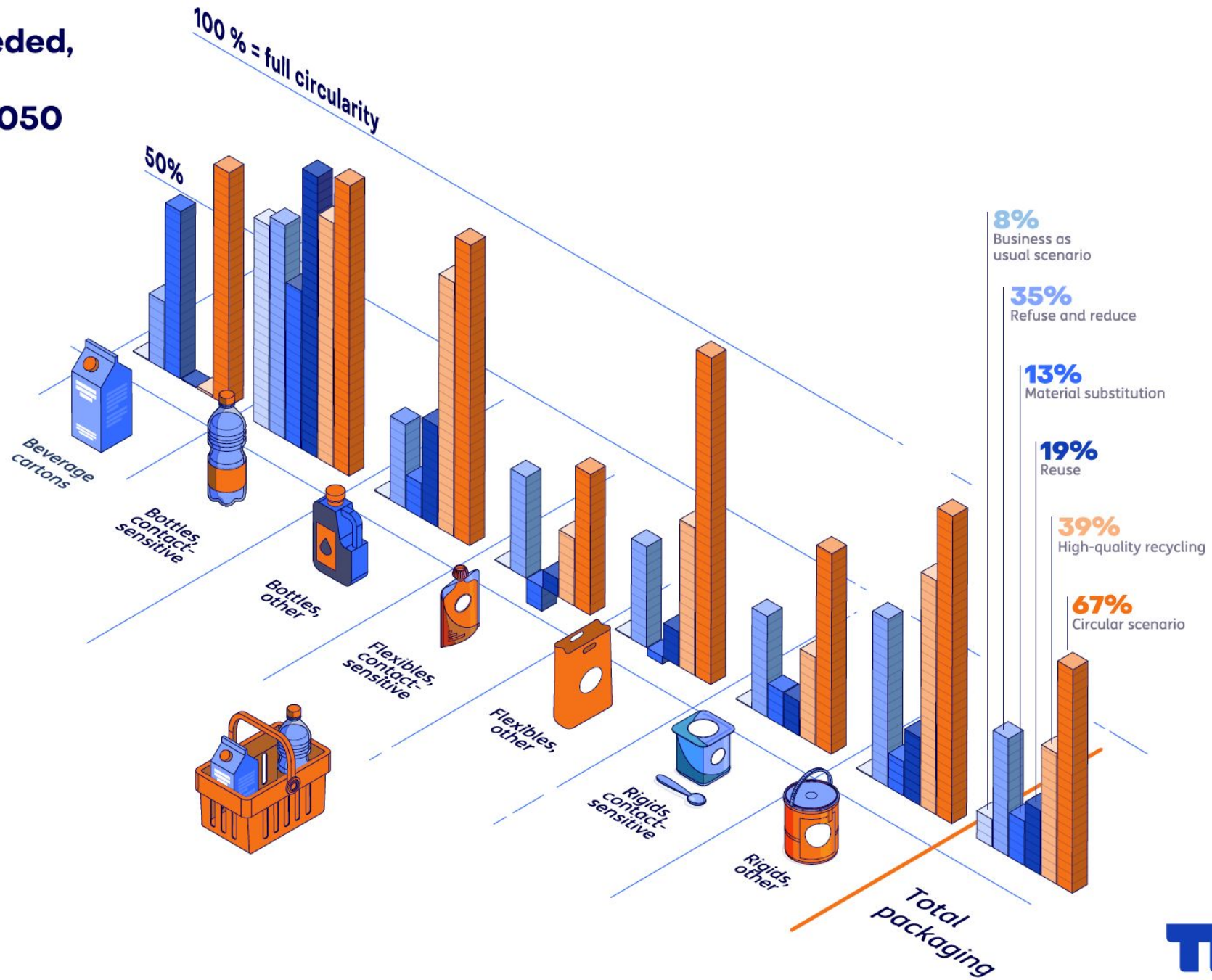


Figure 2.2: The analyzed packaging system, or scope of the Material Flow Analysis

# All strategies are needed, to come close to the circularity goals by 2050

## % Avoided primary material per scenario and packaging type

-   Business as usual scenario
-   Refuse and reduce
-   Material substitution
-   Reuse
-   High-quality recycling
-   Circular scenario

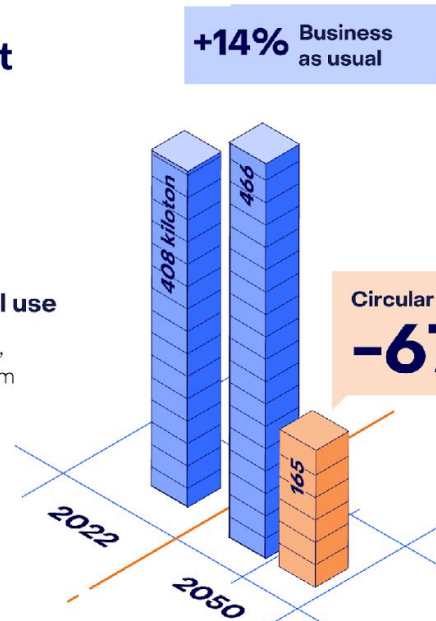




# Primary material use & GHG-emissions for plastic packaging beverage cartons in the Netherlands

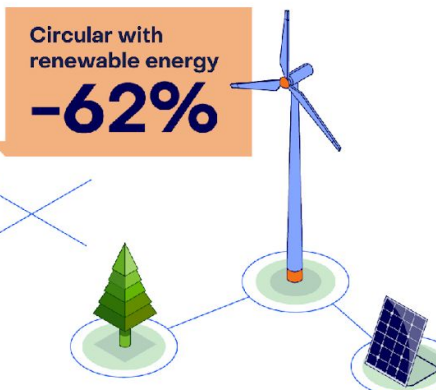
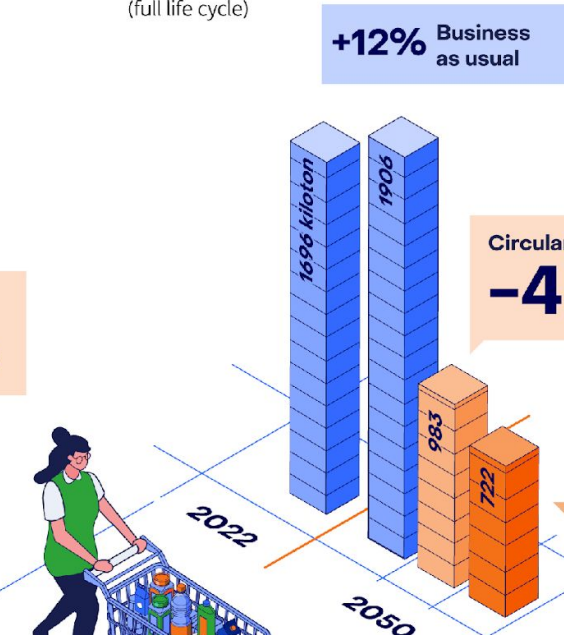
**Circular strategies can substantially reduce the impact of consumer packaging**

**Primary material use**  
in kiloton virgin plastic, cardboard & aluminium



**Greenhouse gas emissions**

in kiloton CO<sub>2</sub>-eq. (full life cycle)



## Conclusion

- Potential of circular strategy differs per packaging type.
- High quality recycling and Refuse & Reduce seem to have most potential.
- Bottles and rigids (non-contact sensitive) can come close to phasing out primary material use.
- Contact-sensitive packaging and flexibles most difficult to make circular.

# Questions we can answer for you

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## Cost & Affordability

Which circular strategy has the highest cost effectiveness?

## Climate & Environmental performance

What are the circularity & environmental effects of governmental policy X on your value chain(s)?

## Circularity & Resource efficiency

What volumes and types of material-containing products are expected to reach end-of-life in the coming years?

# 5 step plan

1

Assess together the potential strategies/scenarios.

2

Share your data with us, confidentially (material flows, material types, etc.).

3

We complement that with our data on technology, energy, policy & we model the value chain(s).

4

CITS calculates the impact of your circular & sustainable strategies/scenarios.

5

Together we determine the most effective circularity and/or sustainability strategie(s).

OR

5

Calculate the impact of new policy.

# Supporting circular material transitions with insight

The circular transition requires complex decisions. Policy makers and industry need to prioritise measures and investments while accounting for system-wide effects across materials, products and value chains.


TNO supports these decisions by combining knowledge and expert interpretation. This enables strategic insight that makes supports prioritisation.

From circular ambition to informed action.



# Any questions?



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