

Data Model and Visualization Tool for Packaging Plastics

Introduction



20.11.2019



Discover. Disrupt. Deliver.

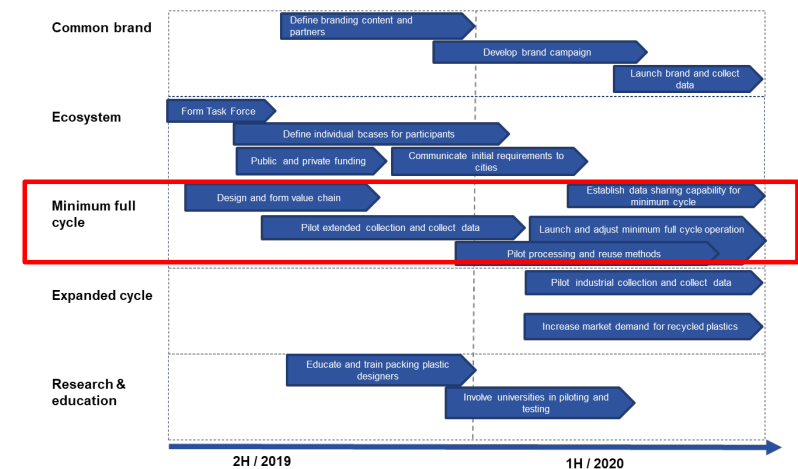
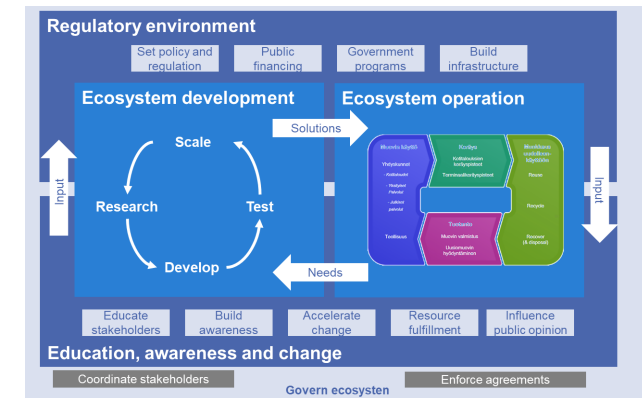
Baseline & Objectives

Situation:

- In the past, Smart & Clean has created an ecosystem operating model and high-level road map for the Full Plastics Cycle
- The first step in the road map is the development of a "minimum full cycle" of packaging plastics
- The aim is to create a better understanding of current packaging plastic flows and the target volumes of recovery streams to achieve the recycling target.
- In addition, there is a need for a modelling tool that enables continuous data visualization and traceability and monitoring of plastic flows and volumes in the future.

Objectives of the project:

- Define a simple data model that provides a reference framework for the collection, processing, and analysis of packaging plastic data and serves as a basis that can be extended to manage data related to other plastic streams
- Develop an Excel tool that can be used to collect, monitor, visualize, and share plastic information internally and externally within the plastic ecosystem to increase collaboration and track results.



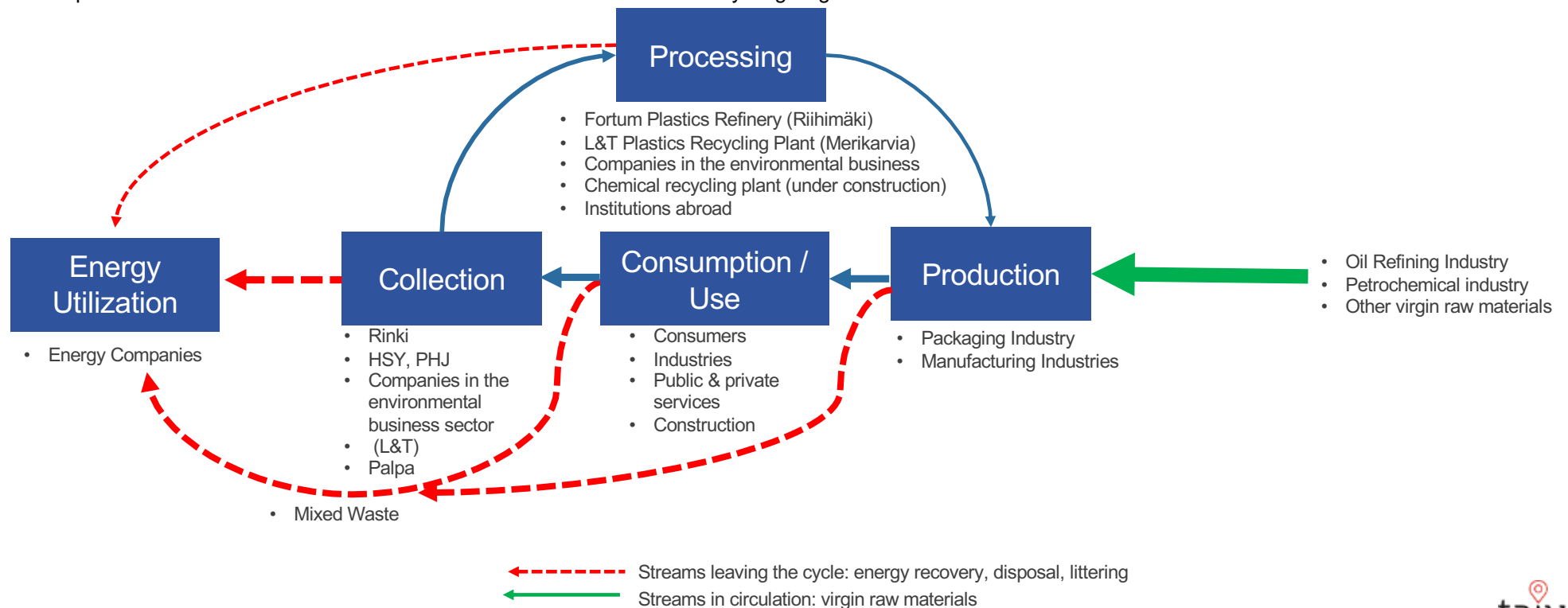
Streams of packaging plastics in the Helsinki Metropolitan Area and Lahti



At present, only a small proportion of all packaging plastics is destined for energy recovery and material recovery.

Key issues to be addressed:

- What are the current volumes for the flows of packaging plastics at different stages of the value chain and in the applications (especially the flows marked with a blue arrow in the figure below)?
- What are the target volumes to reach the recycling target?
- What steps could be taken to increase the utilization streams to reach the recycling target?



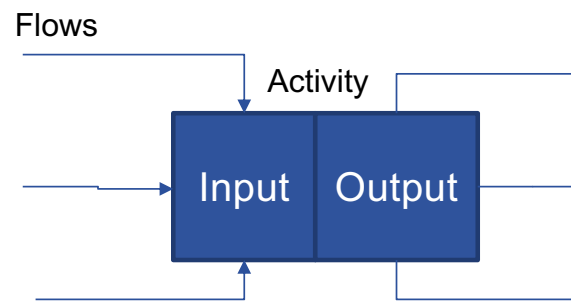
How the tool can help?

The tool provides an overview of the plastics ecosystem landscape and allows for fact-based comparison of options

Main features of the tool

- ❑ Provides an **overview of the plastic circulation volumes** in 2018 based on best available information
- ❑ Provides a **deep-dive view of the four main areas** of the circular model: Production, distribution, collection, processing
- ❑ Capability to **simulate the baseline y-o-y growth** of the plastic volumes per activity
- ❑ Estimates the **regional volumes of Capital area and Lahti** to enable specific actions
- ❑ Enables **creation, testing and comparison of different scenarios** and their overall impact
 - ❑ Forces scenarios to be

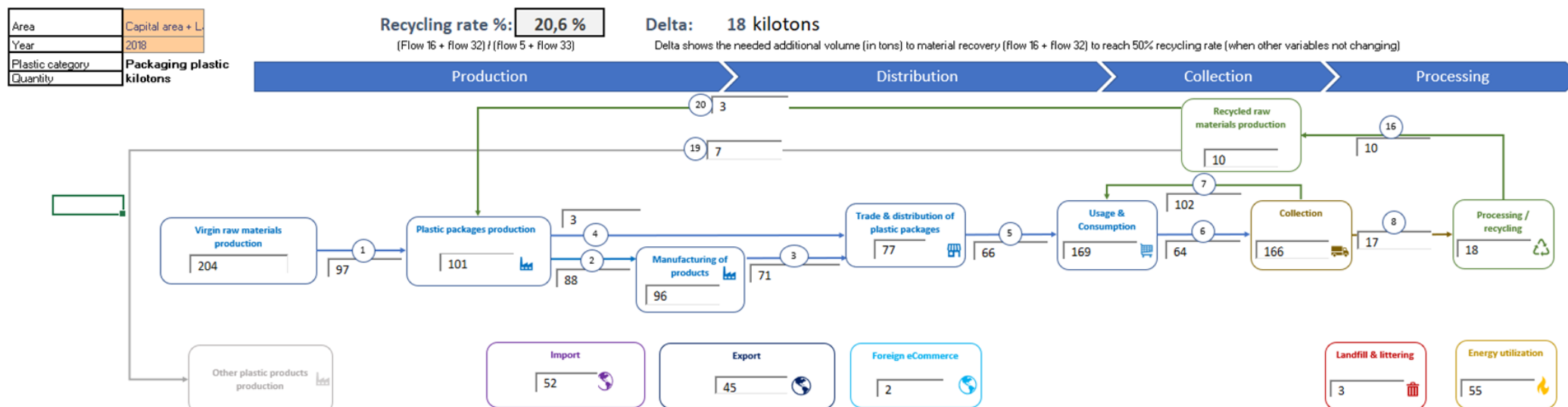
Model operations



Basic operation:

- Model consists of flows and activities which both have a certain volume
- An activity, such as plastics collection, has input and output volumes
- Flows connect activities together and depict how much of the output of one activity is directed to another
- The input flows and the output flows of an activity need to match, otherwise the tool is imbalanced

Current state: Capital area recycling rate is estimated at 20,6%, mostly as significant amount of plastic packages is currently ending up as mixed waste and incinerated

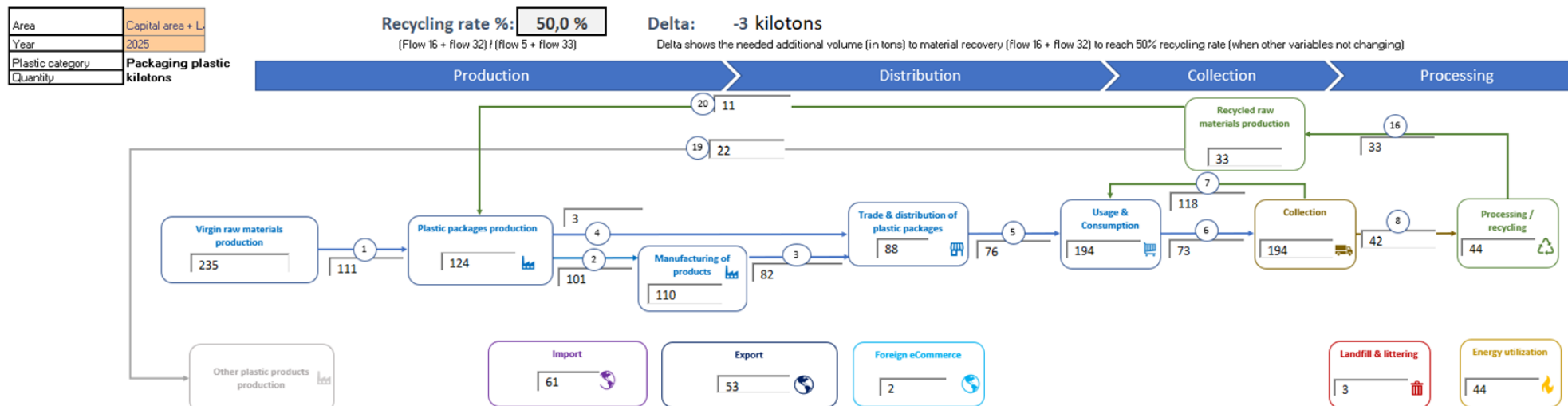


Recycling rate is calculated as follows:

Recycled plastic materials (to domestic & export market)

Trade & distribution of plastic packages (incl. foreign eCommerce)

With reduction of plastic packaging ending up as mixed waste by 40 %, the intended recycling rate can be reached



Key actions needed to reach objective:

- Reduction of plastic packages ending up as mixed waste by 40% and directing it to recycling.
- This leads to an increase of recycled plastic raw materials production which can be used to produce plastic packages and other plastic products.

*) compared to base year 2018

*Includes both actions and estimated normal growth of demand

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Tool use cases

The developed tool provides an overview of the plastics ecosystem landscape and allows for fact-based comparison of options

Follow the status and development of actions

- Timeline (y-on-y) view of volumes and key metrics
- Ability to deep dive on specific industry or function
- Past actions and their effects to be recorded as new annual baseline
- Volumes can be scaled down to regional (Capital area/Lahti level)

Test and define projects and action chains

- Tool enforces creation of action chains: changes in volumes in one part need to be balanced/consumed elsewhere
- Each change in volumes should be defined and justified in writing
- Various different action chains can be defined and compared for efficiency

Compare alternative action chains

- Tool allows for comparison of the efficiency of different action chains
- When an action chain is created, the tool automatically calculates the annual change in plastic circulation
- Action chain effects can be switched on or off, depending on what effects

Define the name, intended actions and objectives of the action chain

Define the impact of the intended actions on the correct row and year (in percentages)

Check what imbalances were created by the changes from the error checking view (Tool provides a hint on what activity to balance)

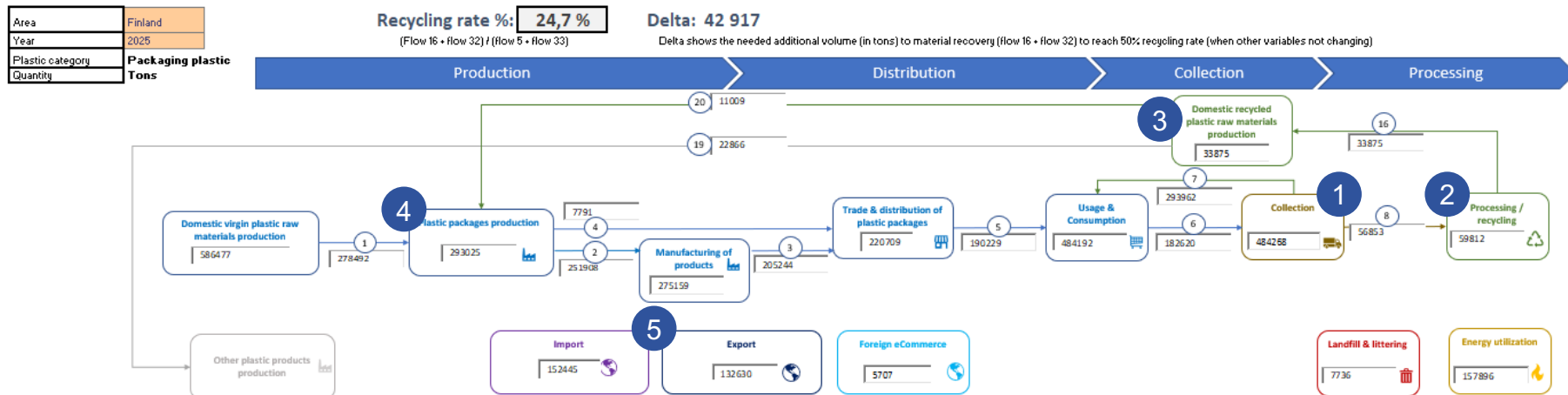
Define the actions needed to balance the material flows (e.g. by changing processing capacity in the downstream)

Once balanced, document and describe actions taken on each row to achieve a balanced action chain.

To test compound effects of the action chain, activate it.

[illegible][illegible]

Example: Action chain creation



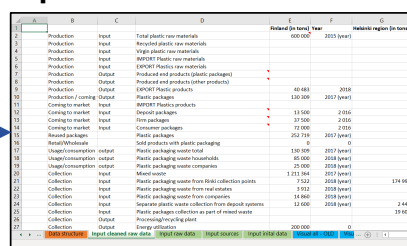
1. Define first action to be taken (e.g. Improvement of collection of plastics from SME sector) and estimate impact
2. As the flow out from collection has increased, the amount of processing and recycling and/or energy utilization needs to be increased accordingly
→ Need to ensure sufficient capacity in processing and and recycling (considering e.g. material quality)
3. As a result of recycling volume changes, the flow to raw material production increases → Need to ensure sufficient demand for increased recycled raw material production and see how the new material can be reutilized
4. If the plastic packages production increases as a result of previous actions, the subsequent flows need to be increased to consider the changes in input
5. Actions may also include changes to import and export (e.g. Taxes or other control instruments) as well as foreign e-commerce to balance the effects

High-level Data Flow

The data model supports the flow of plastics volume data from the data source to the visualization layer and enables the modeling of future scenarios.

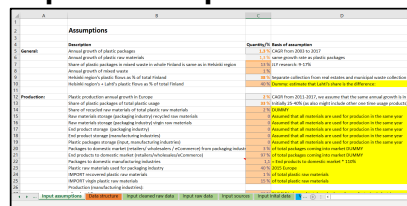
Data Sources

Input raw & cleaned data



Excel spreadsheet showing input raw and cleaned data for plastic waste in Israel, 2019. The spreadsheet includes columns for 'Plastic (in tons)' and 'Israeli region (in tons)'. It lists various plastic waste categories and their corresponding volumes.

Input assumptions

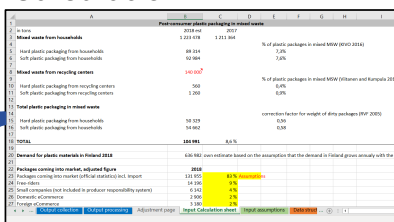


Excel spreadsheet showing input assumptions for plastic waste in Israel, 2019. The spreadsheet includes columns for 'Assumptions' and 'Quantity/Rate of assumptions'. It lists various assumptions related to plastic waste management and their corresponding values.

Input Sheets:

- Collect and classify raw data
- Document key assumptions

Calculation

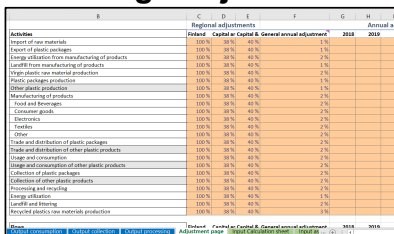


Excel spreadsheet showing calculation results for plastic waste in Israel, 2019. The spreadsheet includes columns for 'Plastic waste (in tons)' and 'Israeli region (in tons)'. It lists various plastic waste categories and their corresponding volumes, calculated based on the input data and assumptions.

Calculation Sheet:

- Merge input data and assumption based data points
- Calculate data output

Modelling / Adjustments

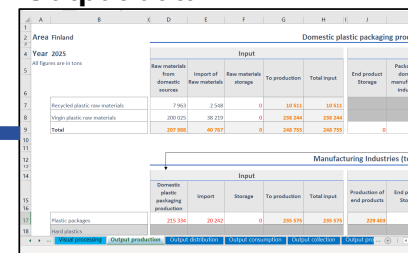


Excel spreadsheet showing modelling and adjustments for plastic waste in Israel, 2019. The spreadsheet includes columns for 'Activities', 'Regional adjustments', and 'Annual adjustments'. It lists various activities related to plastic waste management and their corresponding regional and annual adjustments.

Modelling Sheet:

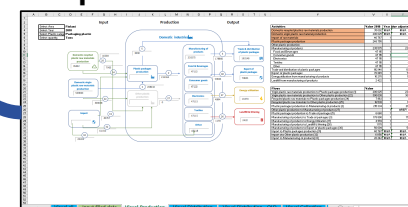
- Adjustment of key parameters to model future scenarios

Output data



Excel spreadsheet showing output data for plastic waste in Israel, 2019. The spreadsheet includes columns for 'Area Israel', 'Year 2019', and 'Domestic plastic packaging production'. It lists various plastic waste categories and their corresponding volumes, calculated based on the input data and assumptions.

Output data visualization



Excel spreadsheet showing output data visualization for plastic waste in Israel, 2019. The spreadsheet includes columns for 'Area Israel', 'Year 2019', and 'Domestic plastic packaging production'. It lists various plastic waste categories and their corresponding volumes, calculated based on the input data and assumptions.

Output Sheets:

- Representing data based on phase in the process
- Visual representation of output data

Scenario Modelling

To enable the modelling of future scenarios as a basis for the planning and prioritization of actions in the broader plastics ecosystem, the model provides modelling capability.

- All input parameters can be adjusted to reflect potential future scenarios
- Scenarios can be turned on and off to test various hypotheses
- Outputs in the data and visual output sheets adjust real-time to the adjusted input parameters
- The model will flag discrepancies in the model, e.g. when input and output streams of an activity do not match due to parameter changes
- Outputs can be compared to the 50% target and base scenario
- The visualization allows a fast identification of key impacts and main material flows

No action scenario and base case			Finland (in tons)	2018	General annual at	2018	2019	2020	2021	2022	2023	2024	2025
Production	Input	Total plastic raw materials	636 982	636 982									
Production	Input	Recycled plastic raw materials (domestic) total	35 002	35 002									
Production	Input	Recycled plastic raw materials (domestic) to packaging industry	7 953	7 953									
Production	Input	Recycled plastic raw materials (domestic) to plastic industry	15 530	15 530									
Production	Input	Virgin plastic raw materials (domestic)	500 063	500 063									
Production	Input	Virgin plastic raw materials (domestic) to packaging industry	200 025	200 025	2 %								
Production	Input	Virgin plastic raw materials (domestic) to plastic industry	300 038	300 038	2 %								
Production	Input	IMPORT recovered plastic raw materials	6 330	6 330									
Production	Input	Recycled plastic raw materials (import) to packaging industry	2 548	2 548	2 %								
Production	Input	Recycled plastic raw materials (import) to plastic industry	3 822	3 822	2 %								
Production	Input	IMPORT virgin plastic raw materials	95 540	95 540									
Production	Input	Recycled plastic raw materials (import) to packaging industry	38 219	38 219	2 %								
Production	Input	Recycled plastic raw materials (import) to plastic industry	57 328	57 328	2 %								
Production	Input	Import of raw materials to packaging industry	40 767	40 767									
Production	Input	Import of raw materials to plastic industry	61 150	61 150									
Production	Input	Total import of raw materials	101 917	101 917									
Production	Input	Virgin plastic raw materials (domestic + import) (plastic packaging industries)	238 244	238 244									
Production	Input	Recycled plastic raw materials (domestic + import) (plastic packaging industries)	10 511	10 511									
Production	Input	Raw materials storage (recycled raw materials), packaging industry	0	0	2 %								
Production	Input	Raw materials storage (virgin raw materials), packaging industry	0	0	2 %								
Production	Input	Total input (packaging industries)	248 755	248 755									
Production	Output	End product storage (packaging industries)	0	0	2 %								
Production	Output	Packages to domestic manufacturing industries (packaging industry)	215 334	215 334	2 %								
Production	Output	Packages to domestic market (retailers/ wholesalers / eCommerce) (packaging industry)	6 660	6 660	2 %								
Production	Output	EXPORT Plastic packages (output, packaging industries)	20 242	20 242	2 %								
Production	Output	Energy utilization (packaging industries)	3 276	3 276	2 %								
Production	Output	Landfill (packaging industries)	1 244	1 244	2 %								
Production	Output	Total output (packaging industries)	248 755	248 755									
Production	Input	Packages from packaging industries (manufacturing industries)	235 534	235 534	2 %								
Production	Input	Import of plastic packages (manufacturing industries)	20 242	20 242	2 %								
Production	Input	Import (packaging and manufacturing industries)	61 008	61 008	2 %								
Production	Input	Storage of plastic packages (manufacturing industries)	0	0	2 %								
Production	Input	Plastic packages production	248 755	248 755									
Production	Input	Total input (manufacturing industries)	235 534	235 534									
Production	Output	End product storage (manufacturing industries)	0	0	2 %								
Production	Output	End products to domestic market (retailers/wholesalers/eCommerce) Manufacturing	178 800	178 800	2 %								
Production	Output	General waste (packaging industries) to end product storage (manufacturing industries)	50 604	50 604	2 %								

Overall plastics material flow – key functionality

The visualization of the overall process flow provides an understanding of the end-to-end plastics flow and allows for a view per year and region.

*Possibility to adjust year and region**

Area	Finland
Year	2018
Plastic category	Packaging plastic
Quantity	Tons

Representation of overall recycling rate and delta to 50% target in tons

Recycling rate %: **22,0 %**

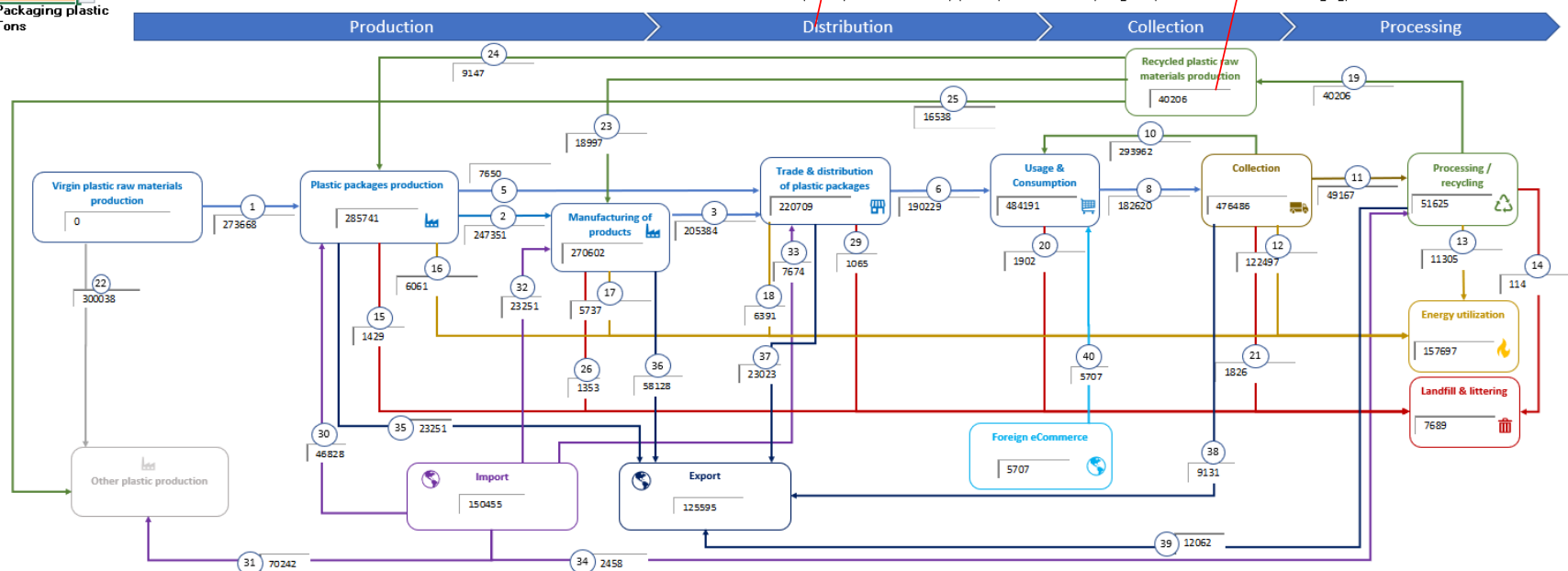
Flow 19 / flow 8

Delta: **44 489**

Delta shows the needed additional volume (in tons) to material recovery (flow 19) to reach 50% recycling rate (when other variables not changing)

Links to deep dive on specific parts of the cycle

View of material volumes per process step and stream



*Currently modelled as a blanket % across all parameters