"The Role of Material Recovery Facilities (MRFs) in the Circular Economy"

Illinois Circularity Conference

Tuesday, October 14, 2025 at 11:00 am

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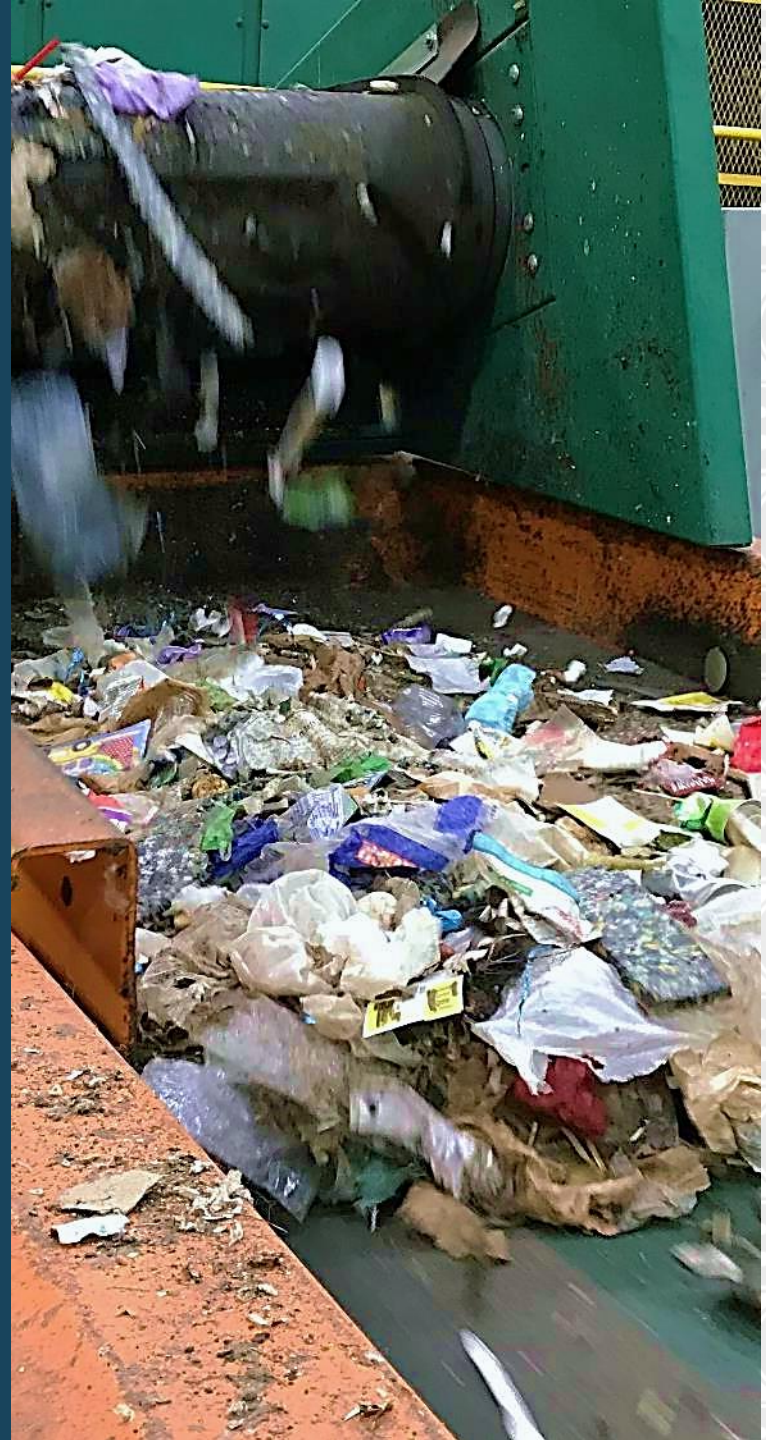
Today's Agenda



Introduction

1. Circularity
2. Technologies
3. MRF Data
4. Possibilities
5. Challenges

Questions/Contact Info

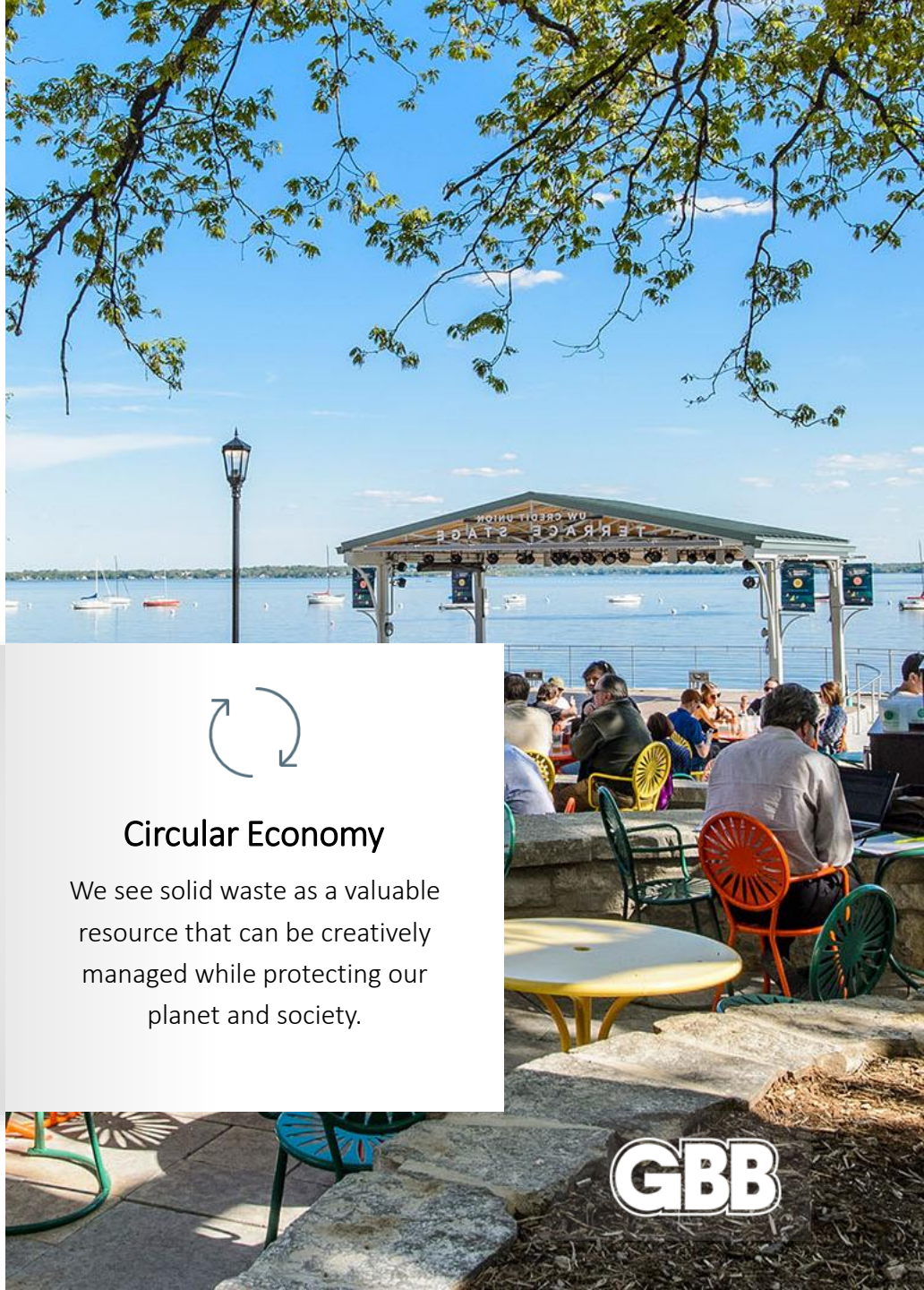
Our Story

GBB is an international solid waste management consulting firm that helps public- and private-sector organizations craft practical, customized and technically sound solutions for complex solid waste management challenges.

Since 1980, GBB has been a trusted resource at the forefront of the industry, creating success stories that integrate smart planning with effective management of solid waste services. Our staff enables our clients to do more with less.

Our Vision

We believe in a world where discarded materials are used as resources rather than wasted – for the benefit of communities and the environment.



Communities

We are guided by our principles of quality, value, ethics, and results to help communities of all shapes and sizes.

Environment

We believe effective management of solid waste is an imperative that directly affects our planet- both today and far into the future.

Circular Economy

We see solid waste as a valuable resource that can be creatively managed while protecting our planet and society.

Our Comprehensive Services

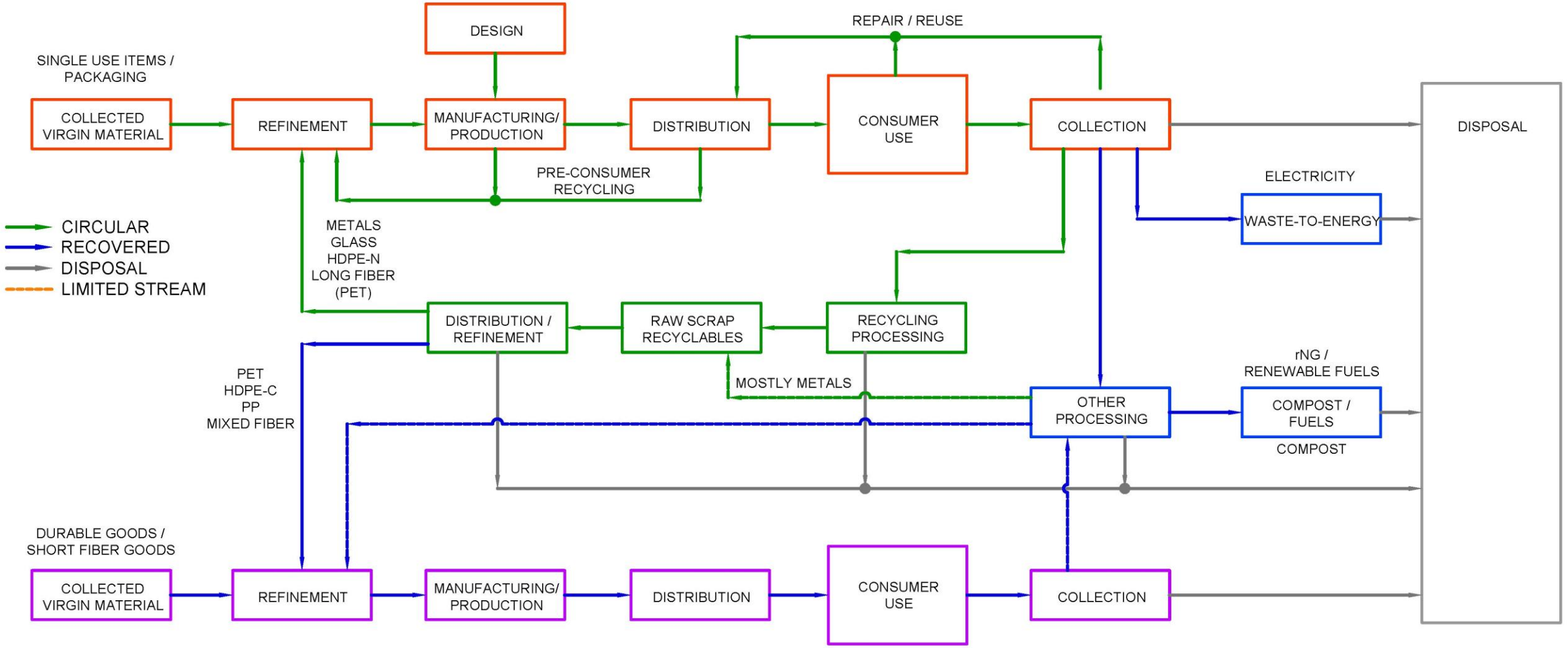
Circularity and MRFs

“Like all major transitions in human history, the shift from a linear to a circular economy will be a tumultuous one. It will feature heroes and pioneers, naysayers and obstacles, and moments of victory and doubt. If we persevere, however, we will put our economy back on a path of growth and sustainability. Many years from now, people will look back on it as a revolution.”
– Frans van Houten (CEO of Philips Healthcare)

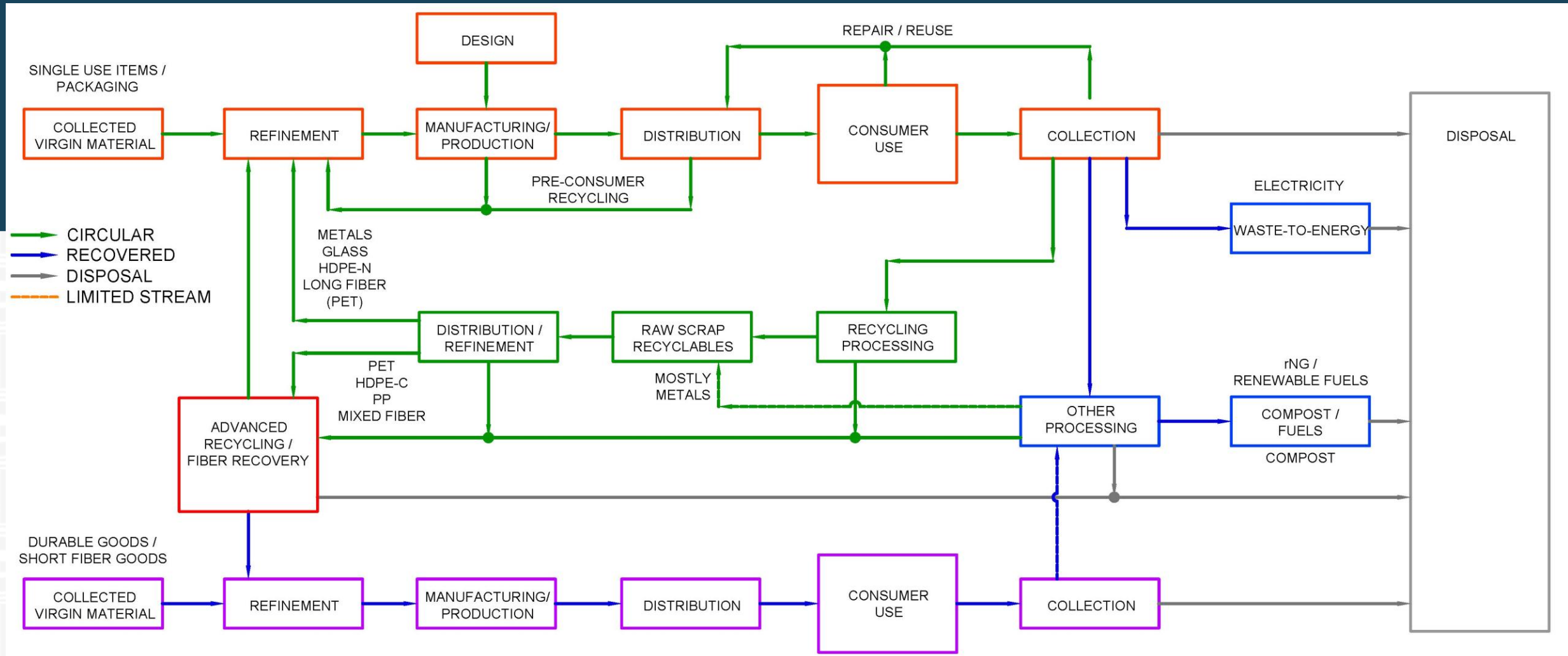
Circular Economy and Recycling

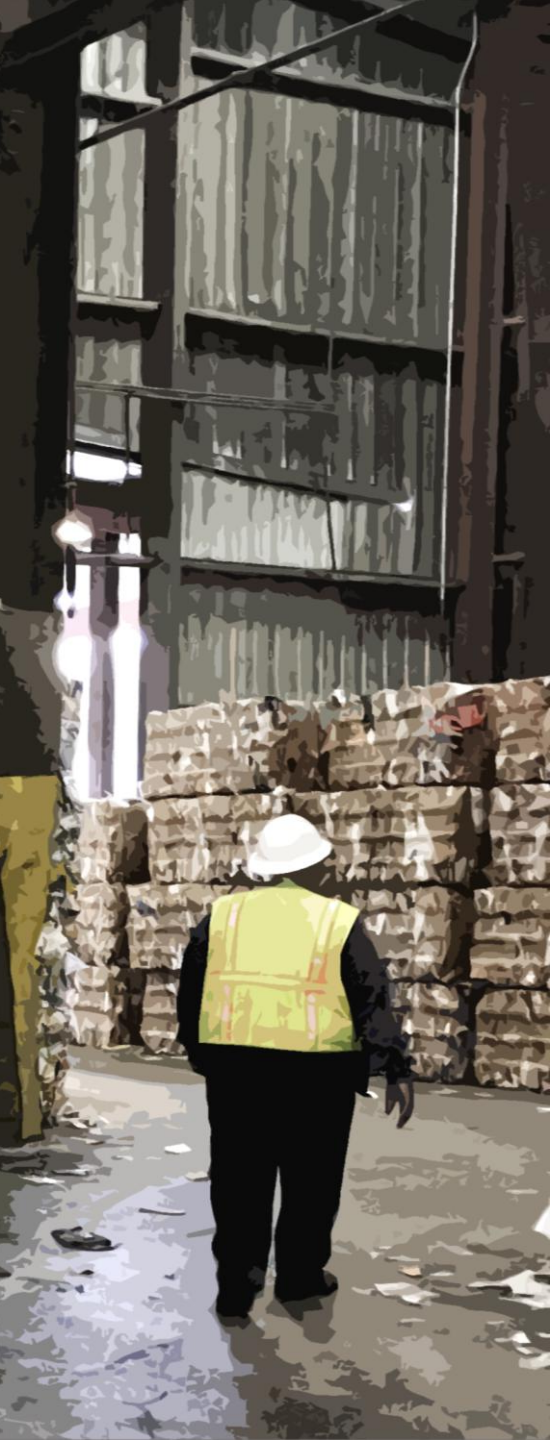
The Idealized Goal

Circular Economy and Recycling
Current Infrastructure and Process

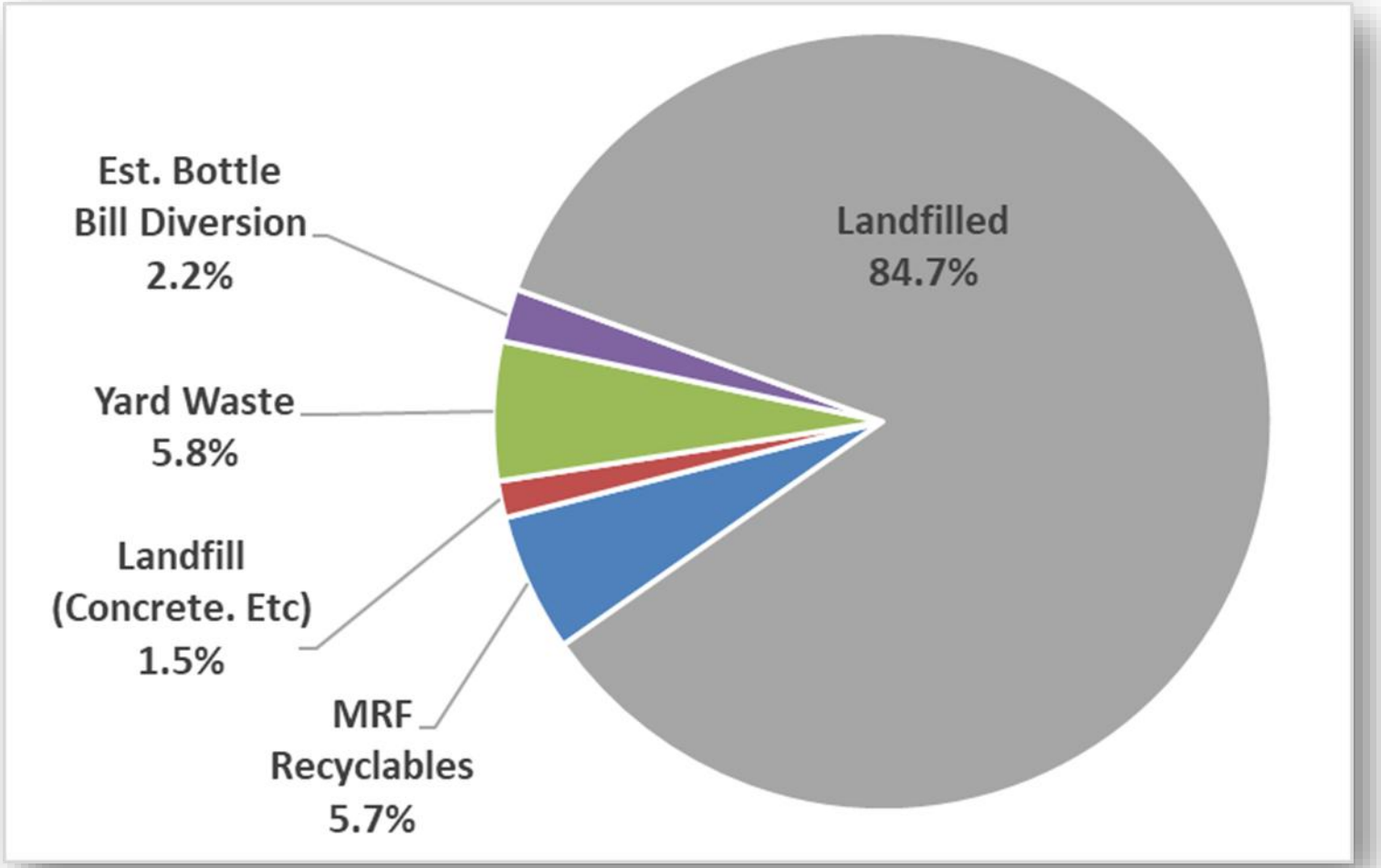


Circular Economy and Recycling
Future Infrastructure and Process

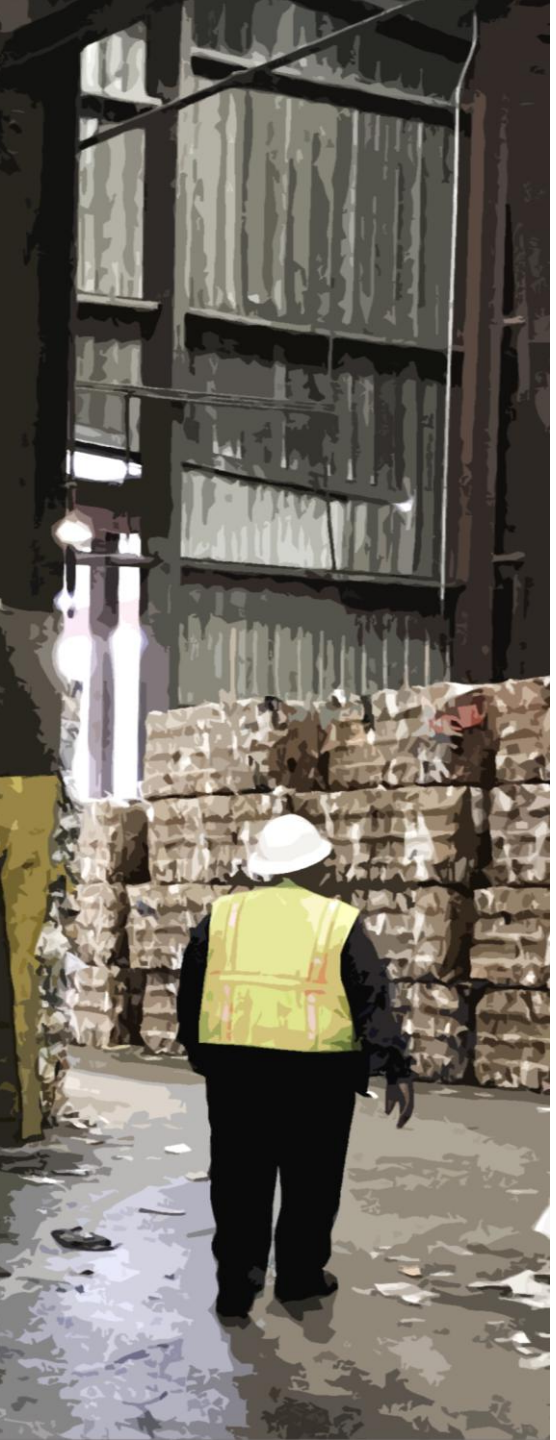




Current Collection and Processing



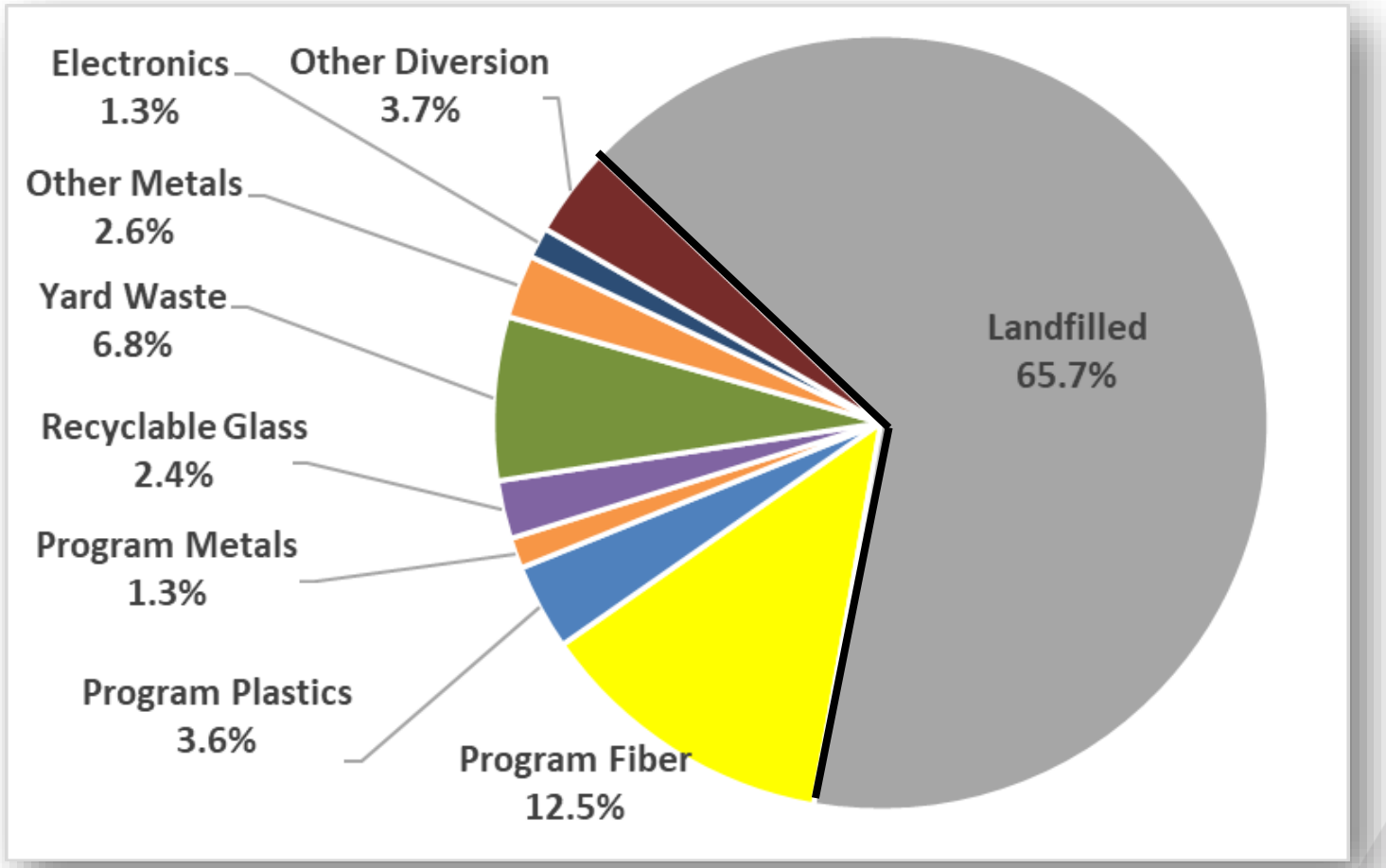
Source: GBB – Kent County, MI 2021



Ideal Collection and Processing

What is All Program Materials (MRF) Were Recovered

34.3%



Source: GBB – Kent County, MI 2021

Technologies

"Any sufficiently advanced technology is indistinguishable from magic.“
- Arthur C. Clarke (Author)


CP mfg
CAUTION
DO NOT
OPERATE
DANGER


GEH2
GREEN EYE
OPTICAL SORTERS
GEA2
GREEN EYE
OPTICAL SORTERS


MSSI4A


Folgers
Downy
Tide


DIET
PEPSI

MRF Data

"We are drowning in information but starved for knowledge.“
- John Naisbitt (Autor of Megatrends)

Basic MRF Operating Data

Daily Operating Report

i. Throughput (Daily Deliveries)
ii. Commodity Production (tonnage, bale counts)
iii. Residual (tonnage, disposal or rerun)
iv. Uptime/Downtime (reasons for downtime)
v. Labor Utilization (number and location)
vi. Maintenance (regular, unscheduled, lock-out/tag-out)
vii. Pictures (feedstock, residual, bales, maintenance)


GEH2
GREEN EYE
OPTICAL SORTERS
GEA2
GREEN EYE
OPTICAL SORTERS

What we do

Greyparrot Analyzer is an **AI waste analytics system** that tracks and reports insights on waste flows in recovery facilities

Camera unit

AI Integration

Dashboard

We reveal 7 layers of detail

yparrot

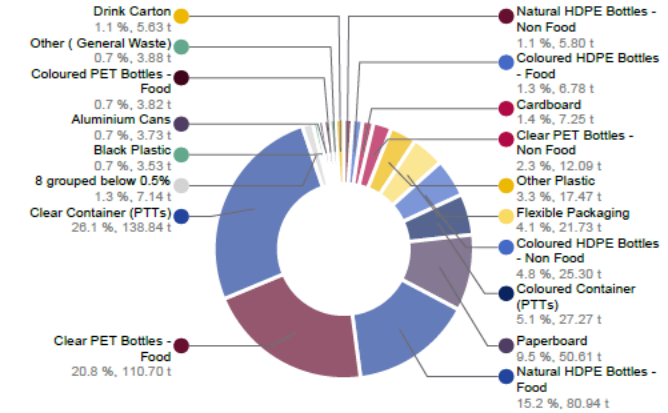
Summary report

greyparrot

Customer name	Demo	Mode	Mass
Generated by	Gaspard Duthilleul	Generated on	19/03/2024 15:38
Analyzer	Infeed (17DCD8)	Time start	31/01/2024 23:01
Scenario	High Granularity	Time end	29/02/2024 22:55

Total mass	532.51 t	Throughput while belt moving	1.23 t/h
Duration	28d 23h 54m 18s	Throughput for duration	0.77 t/h

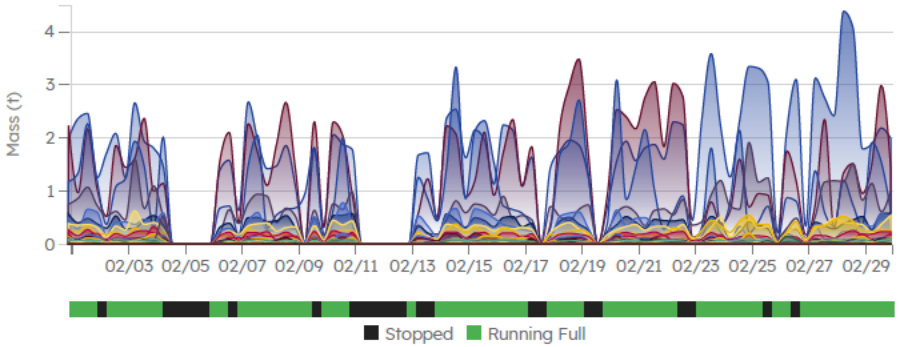
Material composition



Belt status

- Belt Running Full
  17d 23h 17m 36s (61.3%)
- Belt Running Empty
  1h 2m 24s (0.1%)
- Belt Stopped
  10d 23h 19m 10s (37.4%)
- Analyzer offline
  8h 15m 8s (1.2%)

Mass

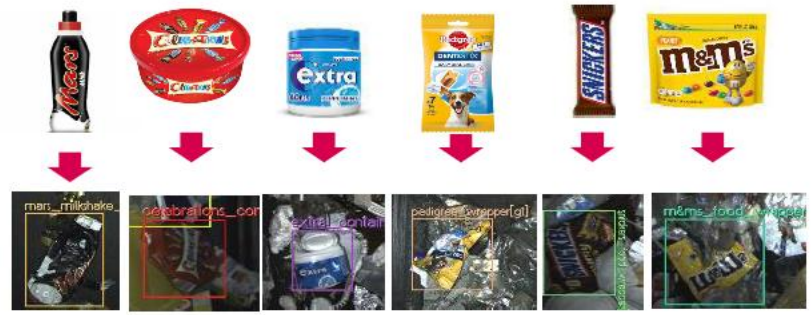


Introduce transparency: Tracking waste packaging

Brand and SKU data are automatically detected with AI

- 1800+ SKUs, around 3m items
  - From international and local brands
  - Up to 30+ SKUs for one single brand
- Flexibility to expand by:
  - Brands
  - Waste streams
  - Geographies

MARS



DANONE
ONE PLANET. ONE HEALTH

COLGATE-PALMOLIVE

greyparrot

Possibilities

“We cannot solve our problems with the same thinking we used when we created them.”
– Albert Einstein

SortFlow AI MAPPER v2.3

Let’s first take a look at the PET line performance.

Welcome, Luc Mallin...

PROCESS | CHART | AVAILABILITY | PRODUCTION | REVENUE LOSS | CONFIG | REPORT

Shift selected: Day shift 2nd January 2025

Plastic Recovery Facility (P1)

Jan 02, 2025 / 07:00 - Jan 02, 2025 / 18:00

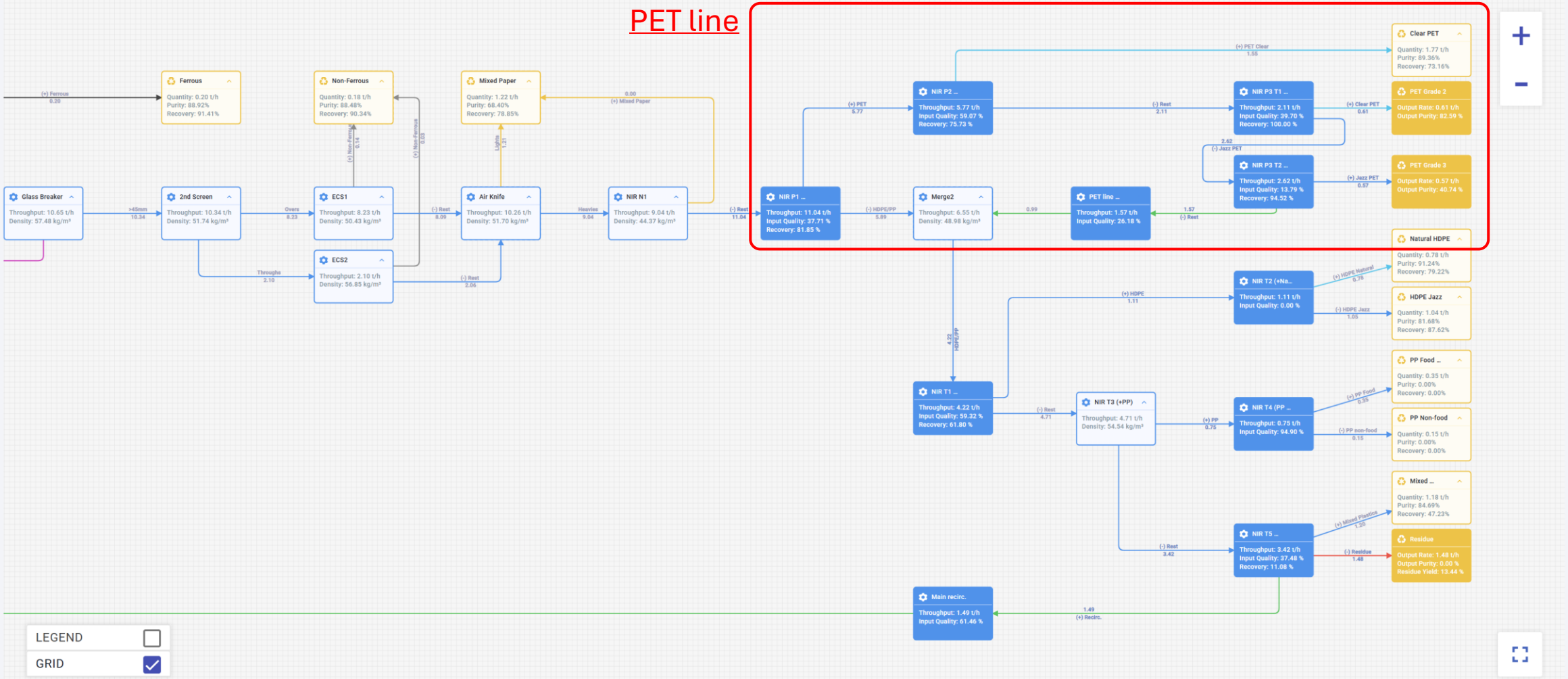
Live

Refresh Project

Load Project

4 Optical Sorters + 3 AI cameras
to measure output quality and reirculation

PET line



LEGEND ☐

GRID ☑

SortFlow AI MAPPER v2.3

"Live" refers to real-time data retrieved and processed directly from Optical Sorter P1.
"Baseline" represents data derived from mass balance calculations within the SortFlow Process model.

Welcome, Luc Mallin...

PROCESS

REPORT

Plastic Recovery F

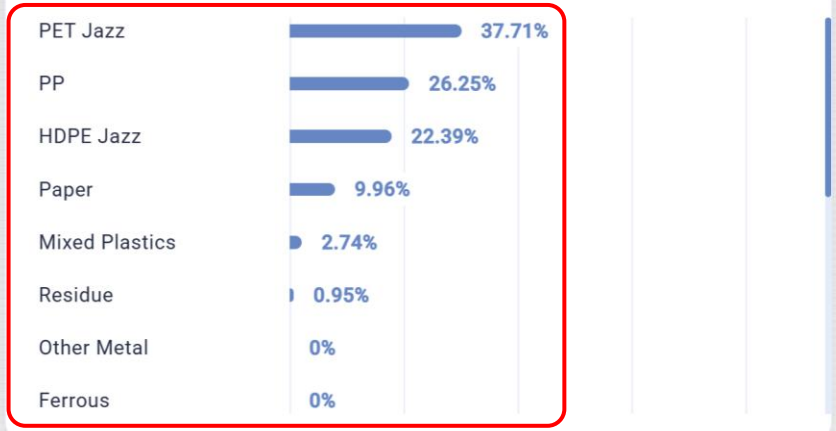
Live

Refresh Project

Load Project

NIR P1 (+PET)	Live	Baseline	Difference
Tonnage (tonnes)	121.43	104.06	17.37
Throughput Rate (t/h)	11.04	9.47	1.57
Target Material (%)	89.09	73.71	15.38
Input Quality (%)	37.71	26.85	10.86
Recovery performance (%)	81.85	90.00	-8.15
Equipment Utilisation (%)	157.70	135.23	22.47

Material Breakdown



Material breakdown is determined based on the input to the machine. However, by integrating data from multiple capture points, we can calculate performance indicators like Recovery.

SortFlow AI MAPPER v2.3

English | Welcome, Luc Mallin...

PROCESS | CHA | REVENUE LOSS | CONFIG | REPORT

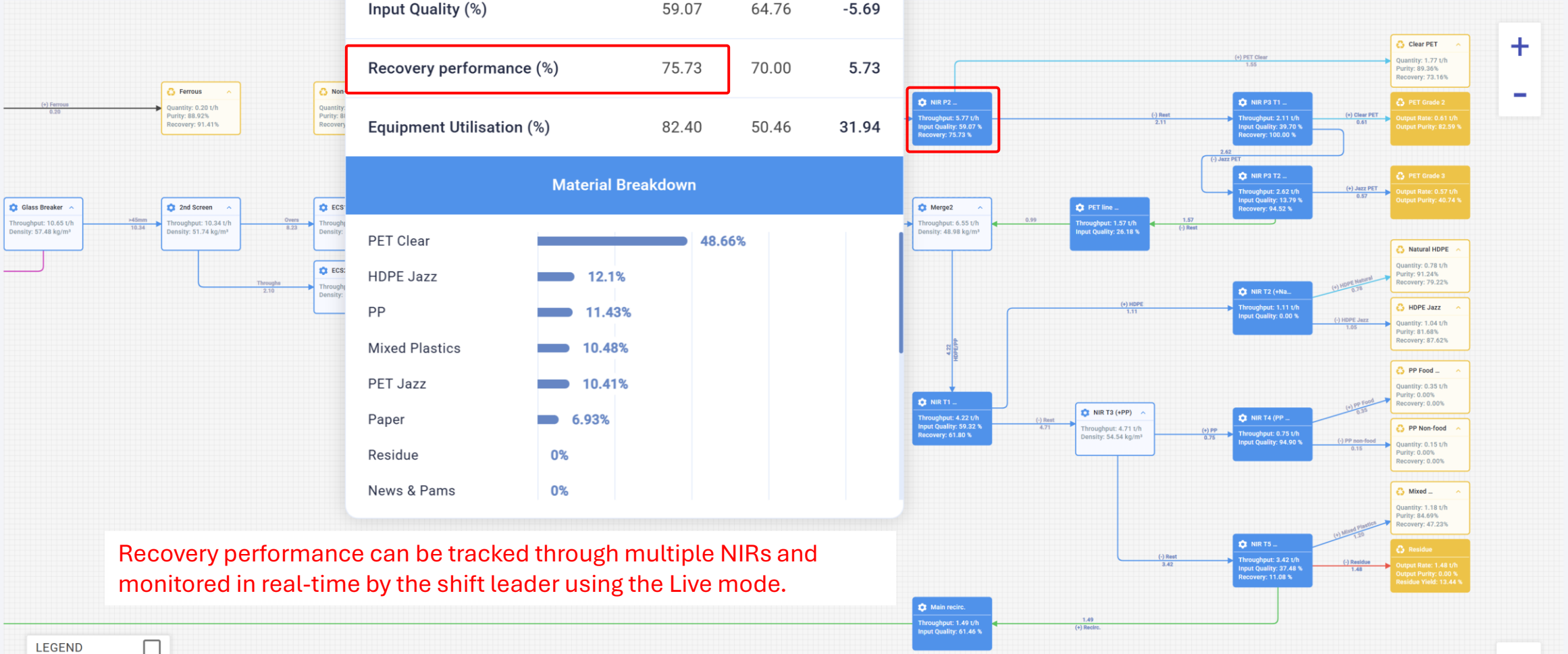
Plastic Recovery Facility (P1)

Refresh Project | Load Project

NIR P2 (+Clear PET)	Live	Baseline	Difference
Tonnage (tonnes)	63.45	38.83	24.62
Throughput Rate (t/h)	5.77	3.53	2.24
Target Material (%)	93.07	74.69	18.38
Input Quality (%)	59.07	64.76	-5.69
Recovery performance (%)	75.73	70.00	5.73
Equipment Utilisation (%)	82.40	50.46	31.94

Material Breakdown

PET Clear	48.66%
HDPE Jazz	12.1%
PP	11.43%
Mixed Plastics	10.48%
PET Jazz	10.41%
Paper	6.93%
Residue	0%
News & Pams	0%



Recovery performance can be tracked through multiple NIRs and monitored in real-time by the shift leader using the Live mode.

PROCESS ION REVENUE LOSS CONFIG REPORT

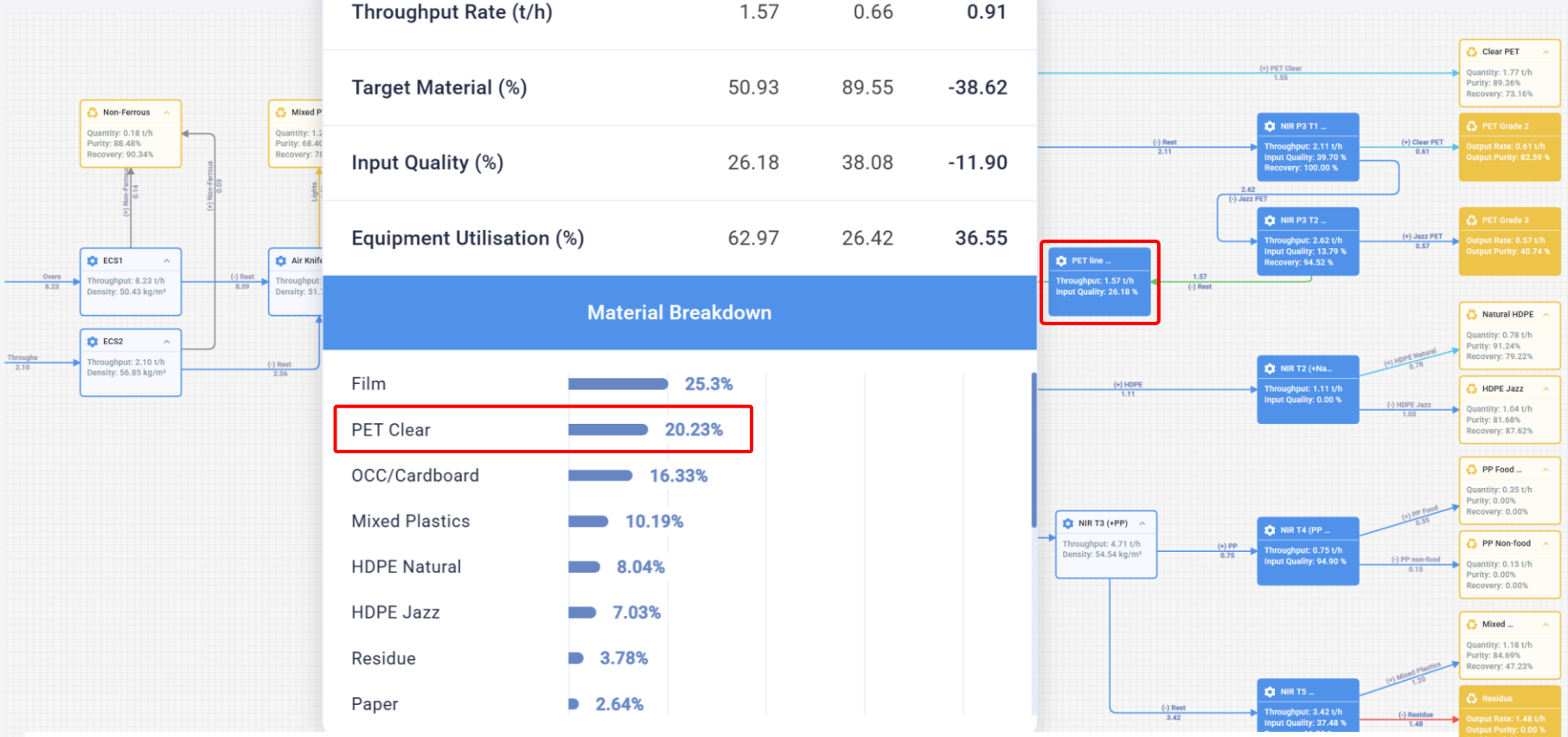
Plastic Recovery Facility

Refresh Project Load Project

PET line recirculation	Live	Baseline	Difference
Tonnage (tonnes)	17.32	7.26	10.06
Throughput Rate (t/h)	1.57	0.66	0.91
Target Material (%)	50.93	89.55	-38.62
Input Quality (%)	26.18	38.08	-11.90
Equipment Utilisation (%)	62.97	26.42	36.55

Material Breakdown

Film	25.3%
PET Clear	20.23%
OCC/Cardboard	16.33%
Mixed Plastics	10.19%
HDPE Natural	8.04%
HDPE Jazz	7.03%
Residue	3.78%
Paper	2.64%



An AI camera is used here to monitor and measure PET line recirculation. We observe that a significant amount of Clear PET has been missed by the PET NIRs. This material will ultimately reach NIR T5, where it has one last chance to be recovered and return to the process. In this deployment, we also evaluate the performance of NIR T5 and the main recirculation.

Plastic Recovery Facility (P1)

Jan 02, 2025 / 07:00 - Jan 02, 2025 / 18:00

Extract

Apply

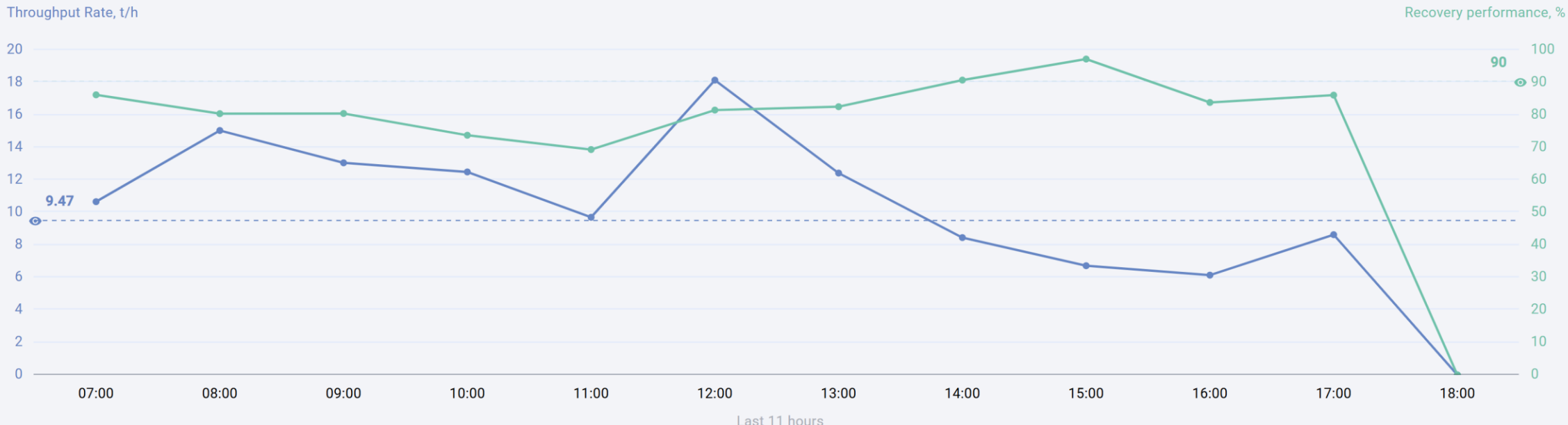
Process item 1: NIR P1 (+PET)

Criteria *: Throughput Rate, t/h

Process item 2: NIR P1 (+PET)

Criteria *: Recovery performance, %

We can analyse the variation of performance throughout the shift.
Here we're looking at the impact of Throughput on Recovery performance for NIR P1.
It also possible to combine criteria from 2 different capture points on the same graph.



Plastic Recovery Facility (P1)

Jan 02, 2025 / 07:00 - Jan 02, 2025 / 18:00

Extract

Apply

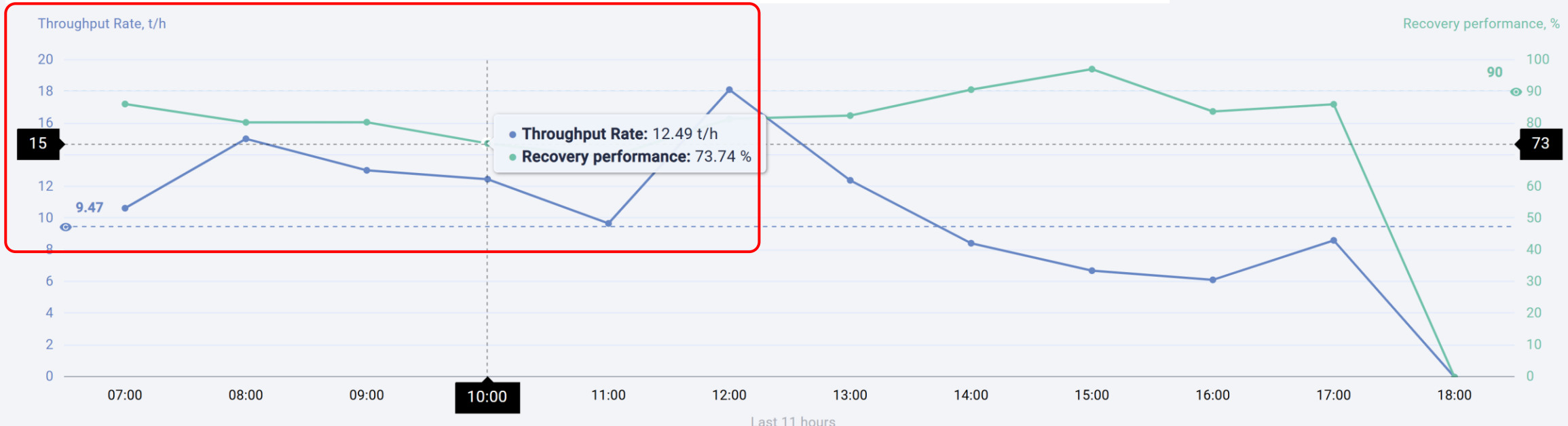
Process item 1: NIR P1 (+PET)

Criteria *: Throughput Rate, t/h

Process item 2: NIR P1 (+PET)

Criteria *: Recovery performance, %

During the first half of the shift, we observed that the throughput exceeded the maximum recommended level, negatively impacting PET recovery performance, which dropped to the 70% range.

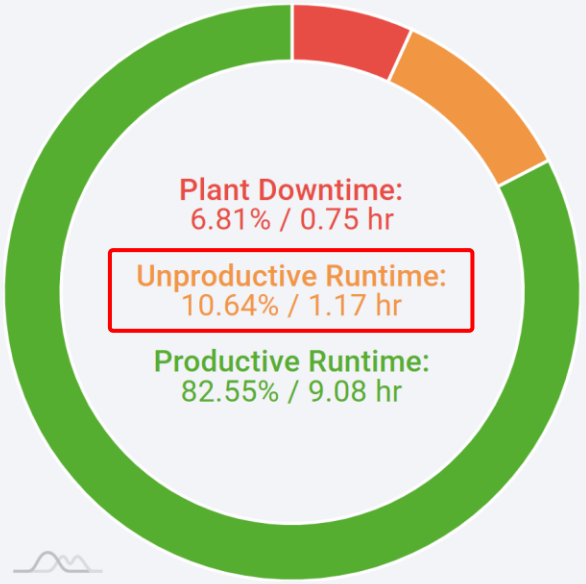


Another approach to evaluating shift performance, enabled by leveraging live data, is tracking unproductive runtime occurrences. These occur when only some machines are supplied with material, potentially signaling infeed or performance issues. Additionally, this method can be used to detect jams when operating the application in Live mode.

PROCESS CHART

Plastic Recovery Facility (P1)

Jan 02, 2025 / 07:00 - Jan 02, 2025 / 18:00



	Plant Downtime	Unproductive Runtime	Productive Runtime
Number of occurrences	2	10	10
Total	0.75 hr	1.17 hr	9.08 hr
Shortest	0.33 hr	0.08 hr	0.08 hr
Longest	0.42 hr	0.33 hr	2.00 hr

Plant Availability Timeline

Unproductive Time (hours)

Here, we evaluate the quantity and quality of residue output, as well as the operational losses it represents, using data from an AI camera.
To determine **revenue loss**, we calculate the difference between the unrealised revenue from target material lost to residue and the associated disposal costs.
Residue yield is estimated indirectly using NIR P1, the earliest capture point in the process.

Plastic Recovery Facility (P1)

Apply

Output Product*: Residue
Captured Against: NIR P1 (+PET)
Residue Cost (£) *: 150

13.44	16.32	44.34	3 824.76
Residue Yield (%)	Residue Tonnage (tonnes)	Residue Purity (%)	Revenue Loss (£)

Proxy Capture Point Tonnage (t): 121.43
Proxy Capture Point Target Material (%): 89.09

Material	Quantity (tonnes)	Breakdown %	Price per tonne	Unrealised Rev.	Disposal Cost	Revenue Loss
PET Clear	1.82	11.15	£ 300	£ 546.00	£ 273.00	£ 819.00
Non-Ferrous	0.59	3.61	£ 1178	£ 694.73	£ 88.50	£ 783.23
Ferrous	1.83	11.21	£ 178	£ 325.74	£ 274.50	£ 600.24

Challenges

“Often when you think you're at the end of something, you're at the beginning of something else.”
— Fred Rogers

What are the challenges we face?

- Rapid changes in technology. How do we decide when is the right time to jump in?
- Scalability. What works best for rural and small communities?
- Extended Producer Responsibility (EPR) variations from State to State.
- Who is going to process all the data? Is the data quality uniform throughout the program?
- What role does advanced technologies play?

Thank You!

Steven Schilling, P.E.

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"The multidisciplinary elements of the materials management industry inspire me with the possibility to create far-reaching change toward more sustainable, resilient, and socially just communities."