NALED

EPR Study: Upgrading Household Recycling Collections in Serbia

29th March 2022

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Introduction

EPR System Upgrade for Serbia that:

- **meets recycling targets**
- **ensures producers meet the costs of packaging recycling**
- **ensures that the costs of the system to producers are efficient**

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Agenda

1. EPR Scheme and Impacts
2. Operational Design Recommendations
    1. Preferred collection system
    2. Methods of collecting glass
    3. Other recommendations
3. System Design Recommendations

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EPR Scheme Impacts

EPR Principles

- **Coverage of recycling services**
  - **From 28% -> 100%**
- **Convenience**
  - **Provision of door-to-door services**
  - **Inclusion of rural areas in door-to-door service provision**
- **Standardisation**
  - **Common collection approach and standard set of targeted materials**

Collection System Recommendation

- **Alongside a Deposit Return System that includes glass in scope**

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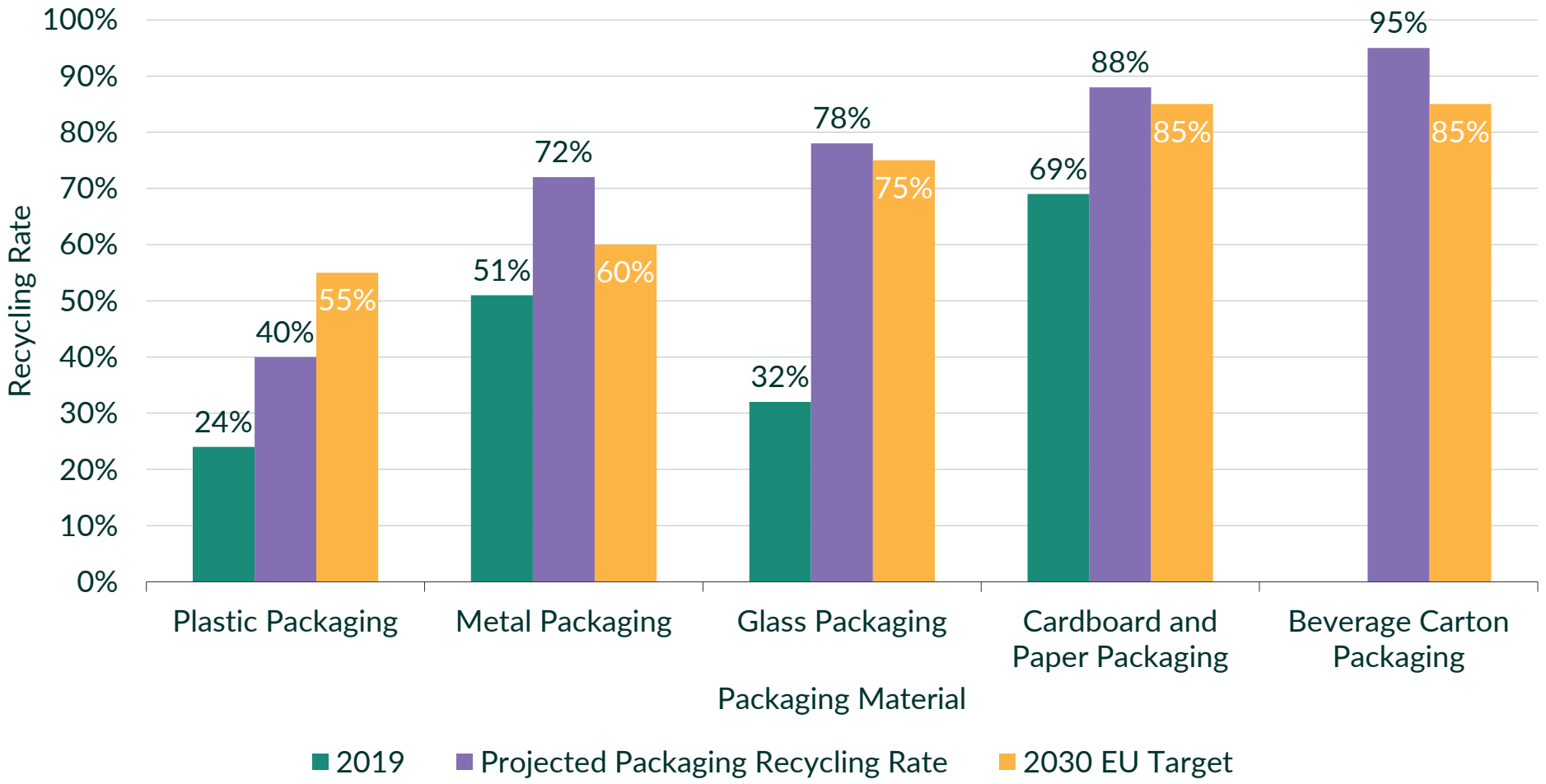
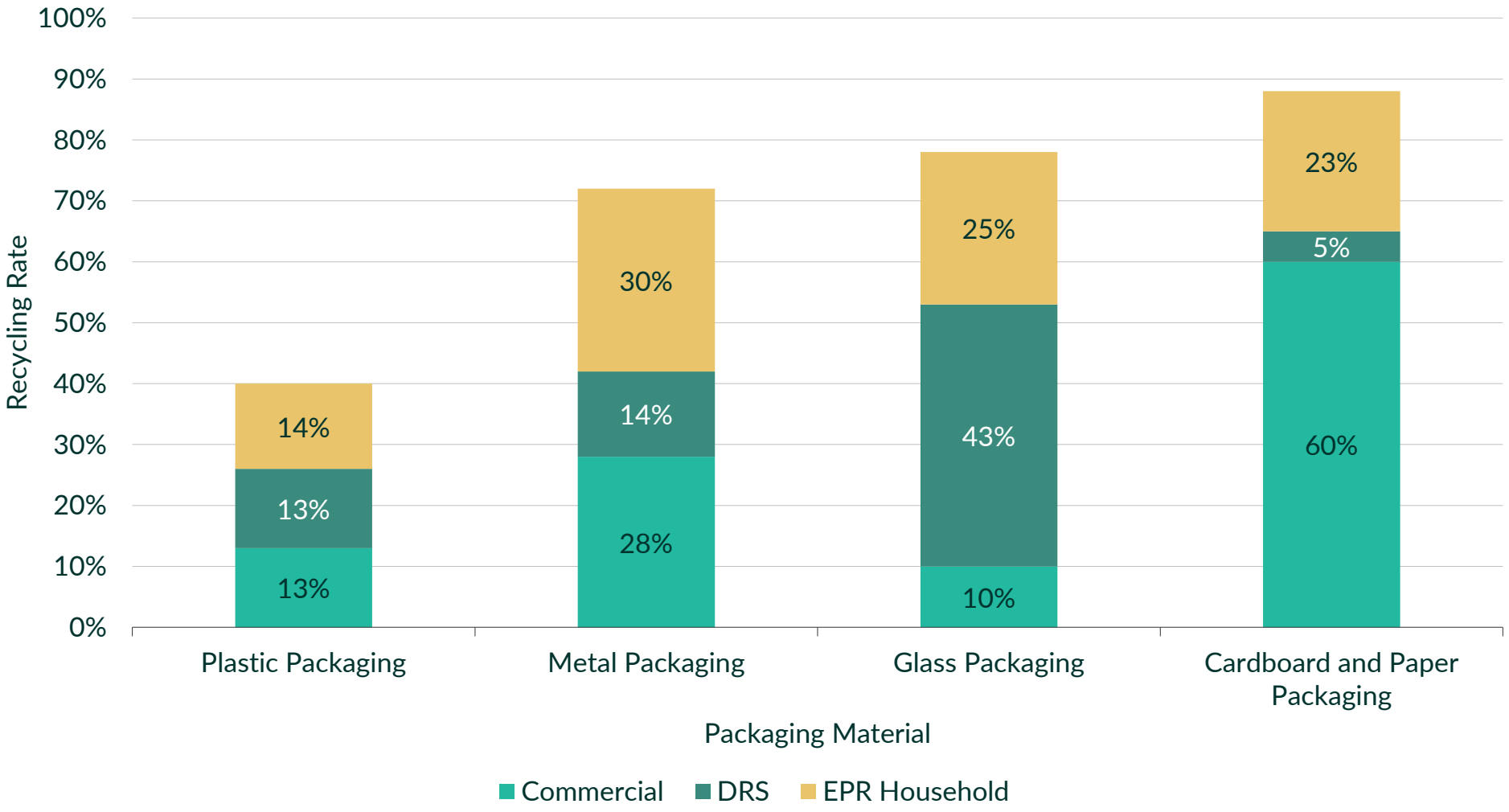
Projected Recycling Rates



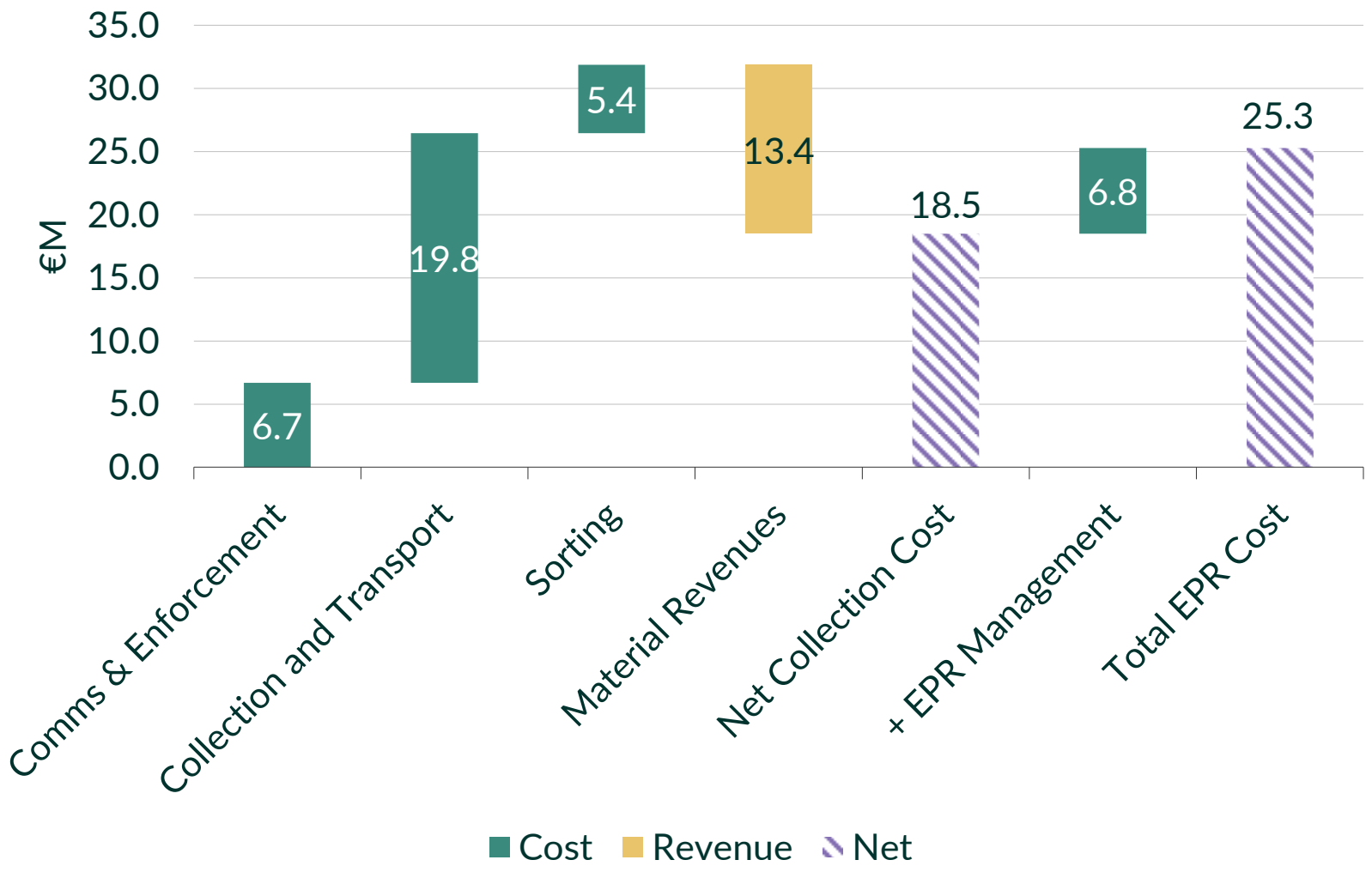
Projected Recycling Rates



Benefits

- **Reduction in GHG emissions**
  - **230-330 ktCO2e / 94-130 kgCO2e/hhld**
- **Jobs**
  - **500-1000 + supply chain**
- **Municipal residual savings**
  - **€4-6M / annum**
- **Secondary raw materials**

Costs

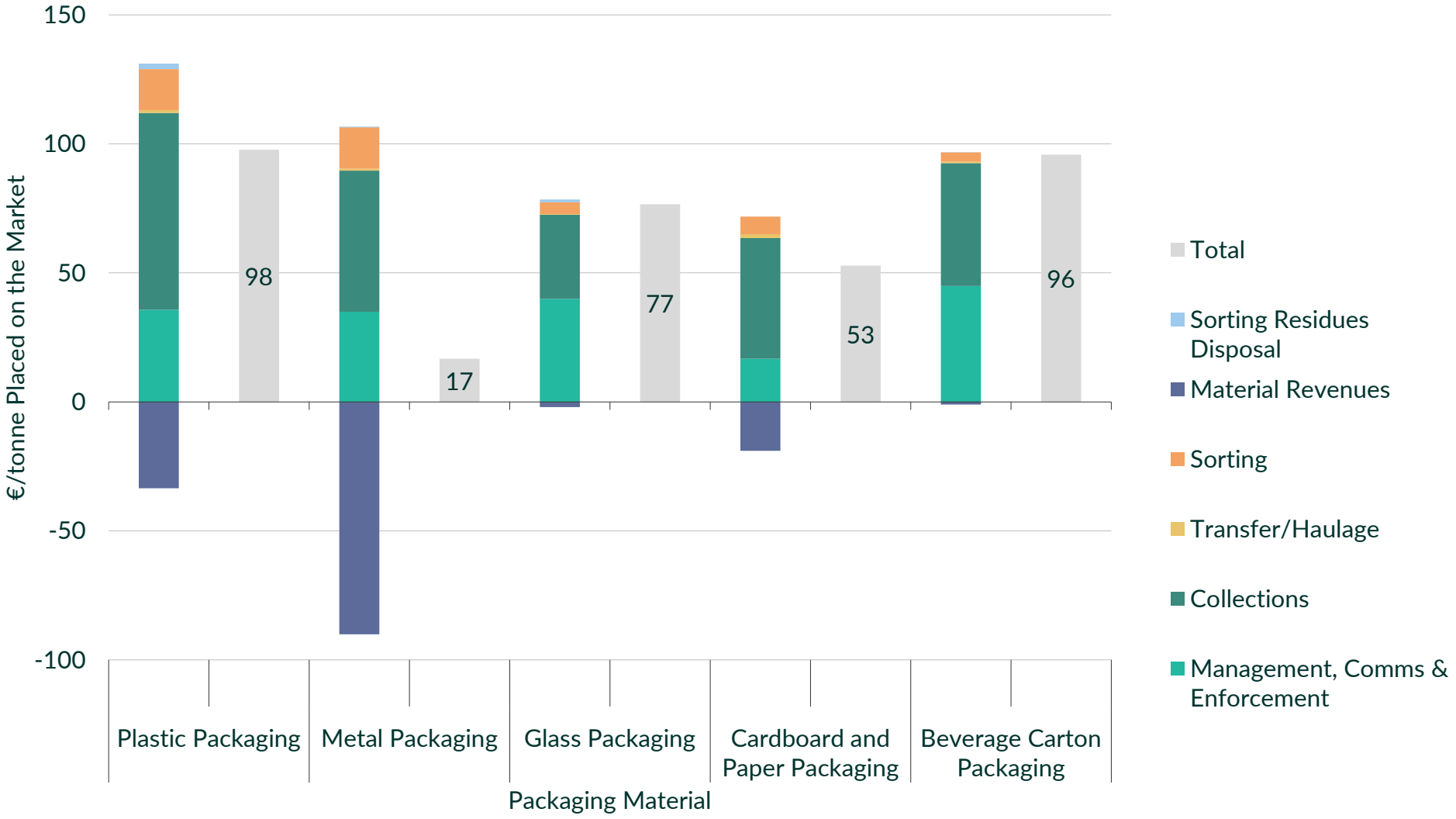

35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
€M
6.7
19.8
5.4
13.4
18.5
6.8
25.3
Comms & Enforcement
Collection and Transport
Sorting
Material Revenues
Net Collection Cost
+ EPR Management
Total EPR Cost
Cost
Revenue
Net

Capital Investment

	Capital Requirement
Collection Vehicles	232
Wheeled Bin	2562k
1100l Containers	87k
Sorting Capacity	71 kt containers 131 kt cardboard/paper

Investment Requirement	
Vehicles	€28M
Container Capital	€57M
Sorting Facility Capital	€19M
Total Capital Requirement	€104M

EPR fees


150
100
50
0
-50
-100
€/tonne Placed on the Market
98
17
77
53
96
Plastic Packaging
Metal Packaging
Glass Packaging
Cardboard and Paper Packaging
Beverage Carton Packaging
Packaging Material
Total
Sorting Residues Disposal
Material Revenues
Sorting
Transfer/Haulage
Collections
Management, Comms & Enforcement

Operational Design
Key Recommendations

Collection System Options

Mixed Dry Recycling

Dual Stream: Paper/Cardboard and Containers

Three Stream: Paper/Cardboard, Plastics/Metals, Glass

%

CO_{2e}

€

☆☆☆

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Recycling Rate

%

€

CO2e

☆☆☆

	Mixed Dry	Dual Stream	Three Stream	EU 2025/2030 Targets
Card/Paper	**86%**	**88%**		75/85%
Glass	**79%**		**81%**	70/75%

Quality

%

€

CO2e

☆☆☆

- **Dual stream improves quality of paper stream, reducing glass, food contamination, and plastic film in paper outputs**
  - **Benefit for recycling rates (avoiding losses in pulping) and recycled content (quality input material)**
- **Glass quality benefit from separate glass, but majority of benefit obtained from the deposit system**

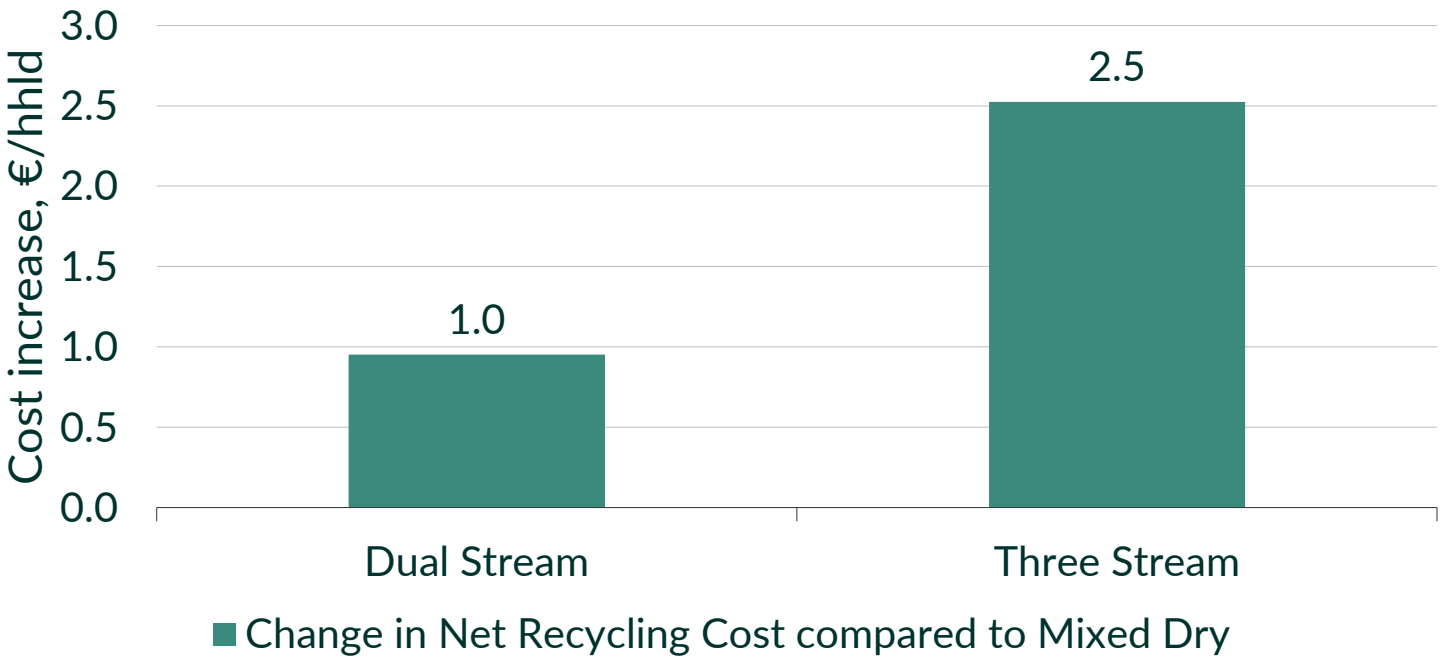
Cost

%

€

CO2e

☆☆☆


Cost increase, €/hhld
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1.0
2.5
Dual Stream
Three Stream
Change in Net Recycling Cost compared to Mixed Dry

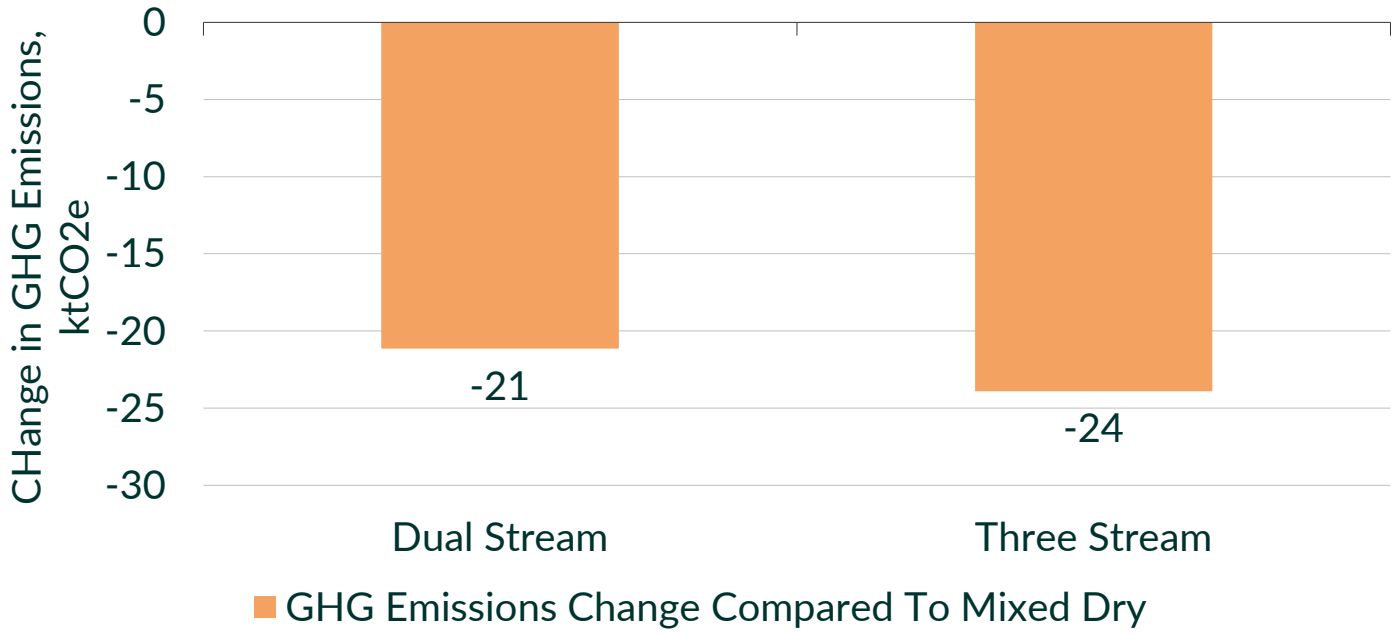
GHG Emissions Benefit

%

€

CO2e

☆☆☆



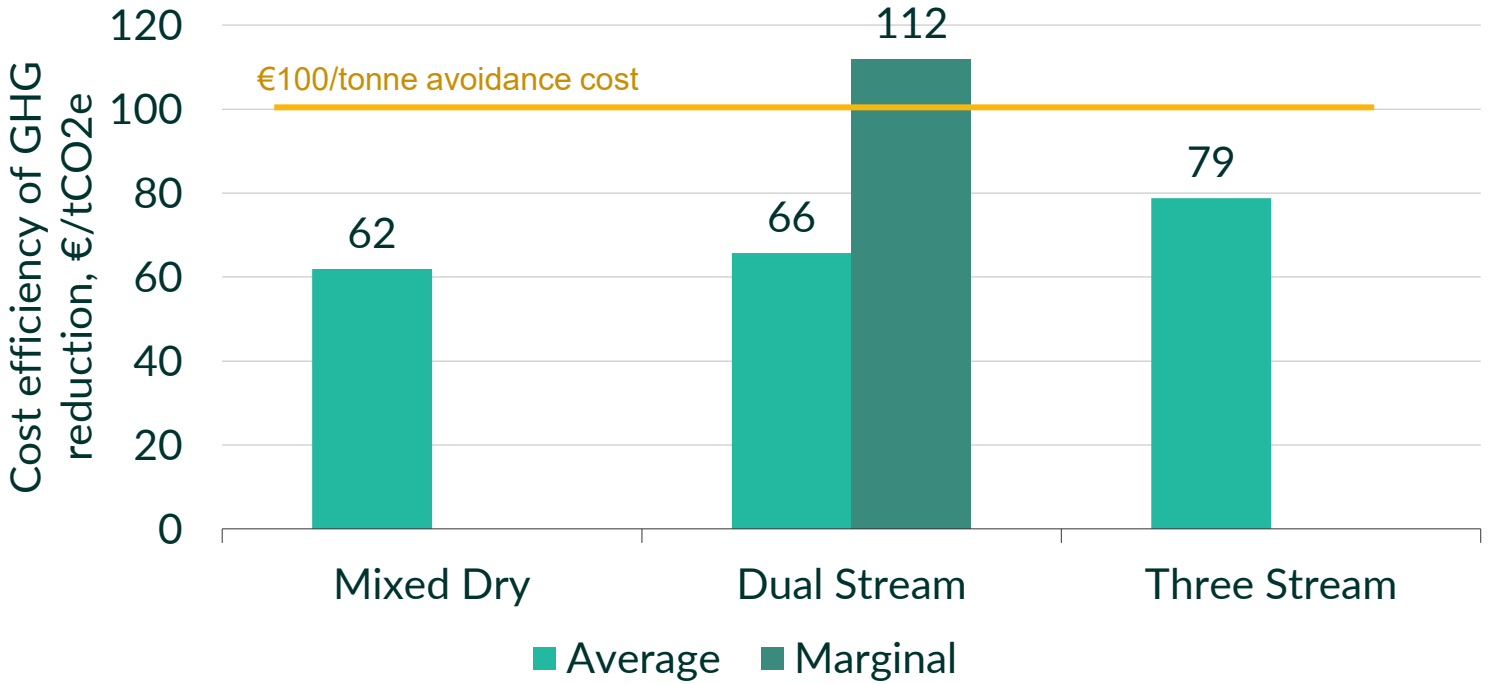
€/CO2e

%

€

CO2e

☆☆☆


Cost efficiency of GHG reduction, €/tCO2e
120
100
80
60
40
20
0
€100/tonne avoidance cost
62
66
112
79
Mixed Dry
Dual Stream
Three Stream
Average
Marginal

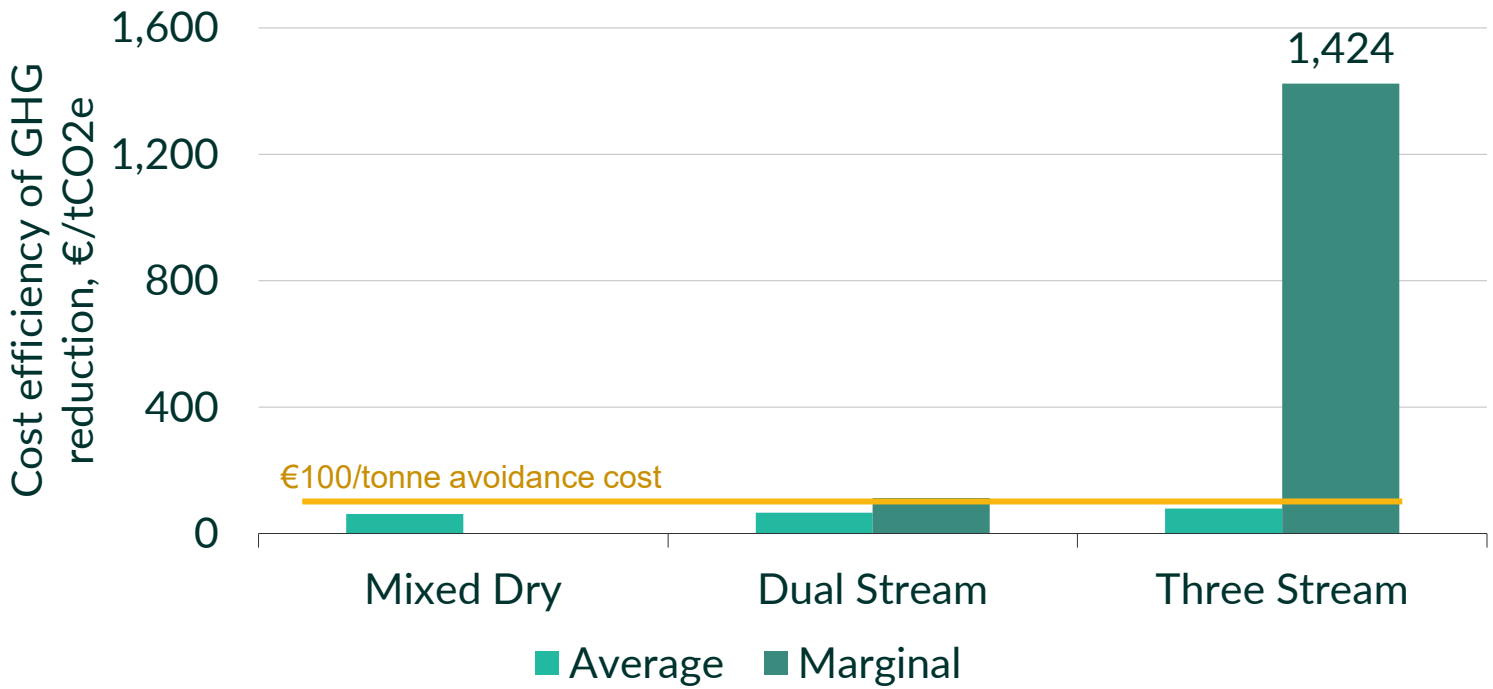
€/CO2e

%

€

CO2e

☆☆☆


Cost efficiency of GHG reduction, €/tCO2e
1,600
1,200
800
400
0
1,424
€100/tonne avoidance cost
Mixed Dry
Dual Stream
Three Stream
Average
Marginal

Recommended preferred option

- **Separating paper and cardboard out has clear justification on basis of targets and environmental impact relative to cost.**
  - **Delivers majority of environmental benefit**
  - **Preserves material quality of papers and plastic films**
- **Separation of glass is expensive for the additional benefits.**
  - **Without DRS, three stream system may be needed to meet glass recycling targets.**

Glass: Methods of Collection

Comparing Collection Approaches for Glass

Recommendation vs 3 stream with DRS excl Glass

	Dual Stream; DRS with glass	Three Stream; DRS without glass	Difference
Glass Packaging Sorted for Recycling Rate	78%	62%	-16%
EPR Recycling Net Collection Cost per Household	€ 7.4	€ 9.2	€ 1.8
DRS Recycling Net Collection Cost per Household	€ 10.1	€ 8.5	-€ 1.7
Residual Disposal Cost Saving per Household	-€ 2.4	-€ 2.3	€ 0.1
System Net Cost per Household	€ 15.1	€ 15.4	€ 0.3
Net GHG Emissions Savings from Recycling per Household	-51.5 kgCO2e	-51.2 kgCO2e	0.3 kgCO2e

- **Lower recycling rate**
- **Increased net costs**
- **Reduced GHG emissions benefit**

Separate Collection of Glass in Cities

Recommendation vs glass collection in cities only

	Dual Stream	Three Stream	Hybrid (Glass collections in Belgrade and Other City Municipalities)	Hybrid (Glass collections in Belgrade only)
Recycling Rate of Glass Packaging	78%	79%	78%	78%
Net GHG (Kg CO_2 per Hhld)	-22.1	-23.2	-22.8	-22.3
Net Recycling Collection Cost per Hhld	€7.4	€9.0	€8.2	€7.6
Marginal Cost of Additional GHG Emissions Compared to Dual Stream	n/a	€1,424	€1,111	€535

- **No change to recycling rate**
- **Increased net costs**
- **Increased GHG emissions benefit**

Dual Stream Glass Risks

- **Aggregate cheaper but less desirable outcome for glass**
  - **~23kt output from sorting plants, little current market for aggregate**
  - **Low likelihood risk, impact 53% glass recycling rate**
  - **Possible mitigation**
    - **Incentivising market**
    - **Cleaning up sorting plant glass output**

Glass Summary

- **Recommendations**
  - **Include glass in DRS scope**
  - **EPR Plan A: dual stream with MRF-sorted glass**
    - **Further engagement with industry about the potential to utilise recycled glass in aggregate;**
    - **Further exploration of the business case for a glass clean-up facility located within Serbia, including identification of potential off-takers for recycled glass for uses other than container manufacture.**
  - **EPR Plan B: bring site glass collection**
- **Separate glass collection is still only recommended for Serbia:**
  - **If circular resource recovery becomes primary policy goal for glass**
  - **Without glass in scope of DRS**

Other Recommendations

Mixed Waste Sorting

- **Can make significant contribution**
  - **Plastic recycling rate**
  - **Emissions benefit**
- **Make EPR subsidy available**
- **However, to support the business case**
  - **Taxes on waste disposal**
  - **Food waste collections**
  - **Improved compositional information**

Wider Waste Policies

- **Waste Policies**
  - Deter use of residual containers for recyclable materials
  - Communications and enforcement
  - Organic waste collections
- **Producer Policies**
  - Recyclability of plastic packaging

System Design Recommendations

System Design Recommendations

- **Cost recovery**
  - **Producers should cover 100% of net necessary costs. Only approach that will ensure adequate collection and sorting to meet targets.**
- **Cost coverage**
  - **Costs met by producers should go beyond WFD to include;**
    - **Costs of managing remaining packaging in residual to incentivise switch to more recyclable packaging;**
    - **Clean up costs of all littered packaging to ensure brands aren't damaged by association with litter.**

System Design Recommendations

- **Collection**
  - Municipalities should maintain responsibility for collection of HHW aligned to national standard
  - Changing would risk creating efficiencies and problems with coordination
  - Necessary costs should be paid by producers
- **Sorting**
  - Municipalities responsible for sorting with option to opt out and revert to PRO
  - Collectors should deliver high quality materials subject to deductions
  - Sorting facilities should deliver materials suitable for onward processing
  - Producers should pay municipalities necessary costs

System Design Recommendations

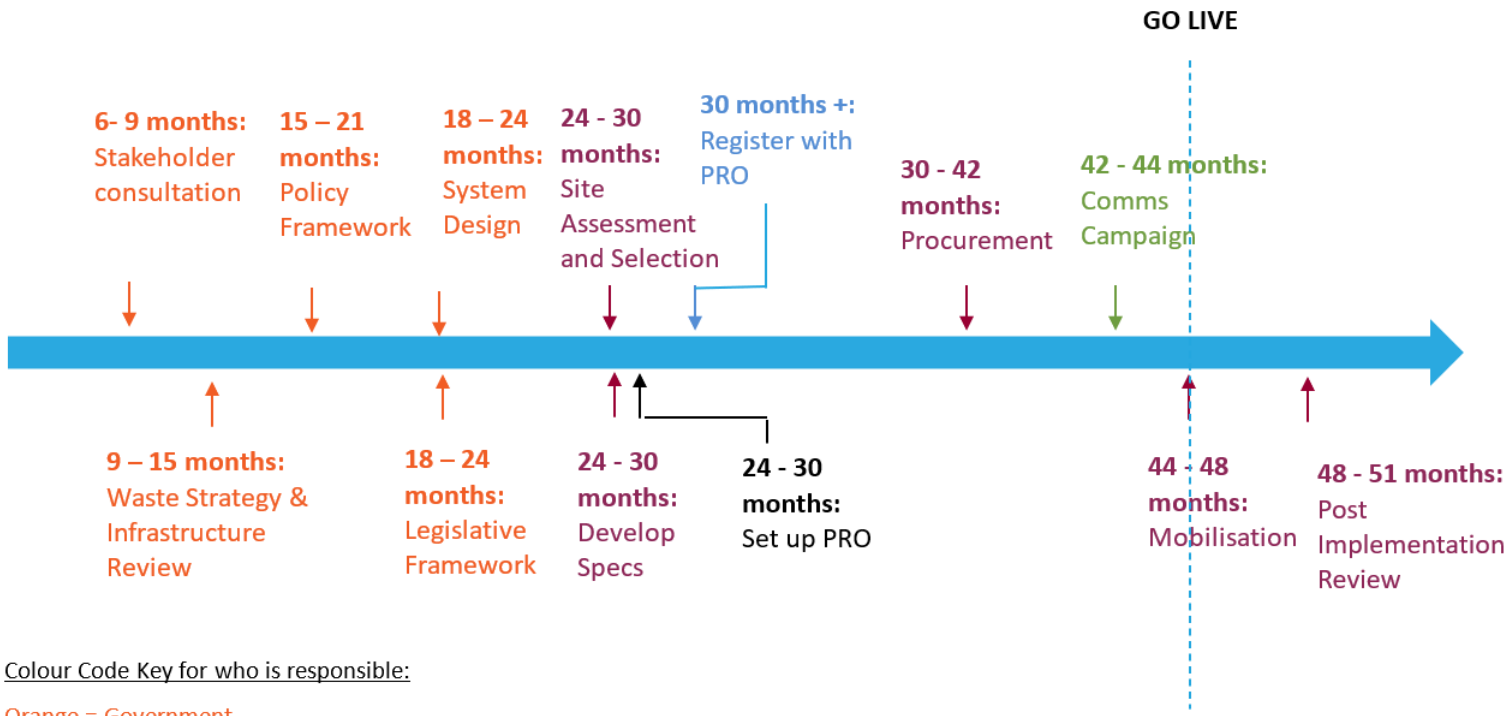
- **Material Sales**
  - **Responsibility for material sales should sit with producers**
  - **Greatest incentive to maximise value from the sale of materials**
  - **Can build expertise and economies of scale**

System Design Recommendations

- **Governance**
  - **Few advantages of competing PRO's**
  - **Single PRO reduces admin costs**
  - **PRO must be transparent about costs and performance**
  - **The legislation must put regulation in place to minimise risk of collusion/monopolistic behaviour**
- **Legislation**
  - **Government should take lead on preparation and consultation**
  - **Roles, responsibilities and enforcement**

Implementation

Implementation Plan



Colour Code Key for who is responsible:

Orange = Government

Purple = Municipalities

Green = Government and Municipalities

Blue = Producers

Black = PRO's

- **Significant upgrade to EPR system can be achieved within a three/four year process but this should be viewed as the minimum period needed from the point of decision to proceed with the system, due to the time required for legislation, planning and installation of infrastructure.**

Establishing a DRS in Serbia

29 March 2022

Dr Chris Sherrington, Jade Kelly, Orla Woods,
Victoria Ventosa
Eunomia Research and Consulting Ltd.

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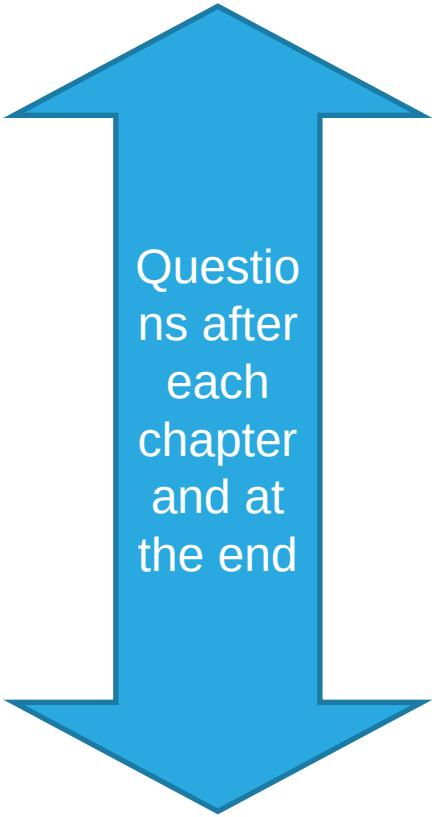
Agenda

1. **Introduction**
2. **Scenarios**
   - Traditional vs Smart DRS
   - Sensitivities
3. **Data inputs**
   - Limitations & Assumptions
4. **Cost modelling**
   - Break down of system costs
5. **Additional impacts**
   - Environmental
   - Social
6. **Implementation**
   - Roadmap
   - Governance



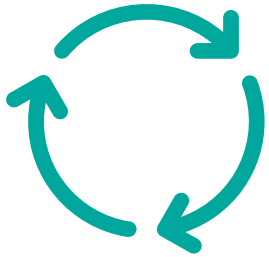
Introduction

Objectives

- Comprehensive study on introduction of DRS in Serbia
  - Organizational, managerial, financial and operational aspects

Methodology

- Modelling work based on inputs/outputs
- Not related to a pilot study within Serbia
- Assumptions are strong – but



Scenarios

Scenario 1: Conventional DRS

- There are a number of DRSs established in the Europe and other countries (e.g. several US States, provinces of Canada and Australia
- Deposit is paid by consumers when the beverage is purchased. Once empty, the consumer takes it back to a return point. The RVM scans barcode to determine if the container is part of the DRS system. If so, take the container and get the deposit back

Picture source: Tomra

- No Smart DRS has been implemented > theoretical work
- Therefore **two** Smart models
  - Low/High cost assumptions
- **Serialisation** of each container, costs unknown
- Return locations
  - Not just retail, more locations and more convenient
  - Relies on smartphones
- Return technology
  - Simplified RVM, Smart Bin, RFID containers

Assumptions of Smart DRS

- Less fraud but higher loss rates
- Return rate could be higher
- More complex logistics
- Reduced infrastructure (no counting centres)
- Additional costs of printing label or ID
- Potentially cheaper producer fees?

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Smart DRS return technology

Example:
Smart bin

The smartphone scans the container via the app

The smart bin authenticates: should the hatch open?

- Based on customer ID, whether the bottle is redeemable and RFID geo-referencing

The hatch opens after communicating with the phone app

- Bluetooth or via RFID

3 scenarios + 4 sensitivities

	Central Scenario	Sensitivities
Materials included	Plastic, cans, glass and cartons	Plastic and cans only Plastic, cans and cartons Plastic, cans and glass
Wines and Spirits	Included	Excluded
Deposit level	5 RSD	Multi-level (4 / 5 / 6 RSD)
Return Rate	90%	Low (88%) and High (92%)

Allows for variation testing of central model for potential improvements and determine system variability

Data inputs

Data inputs and limitations

How?

Data for sensitivities was limited and sometimes contradictory (multi-level, wines & spirits) so assumptions have been extrapolated where necessary

POM data provided by NALED members, so calculations were made to determine a “rest of the market” figure

No well-established DRS for beverage cartons

There are no real-world systems to base assumptions and results on Smart DRS

Data Inputs: Packaging POM

	Glass	Plastic	Metal	Bev Cartons	Total
Placed on Market, million	158	1,072	232	359	**1,821**
Redeemed, million	142	965	209	323	**1,639**
Placed on Market, tonnes	33,496	26,811	3,654	4,303	**68,263**
Redeemed, tonnes	30,146	24,130	3,288	3,872	**61,437**
Overall Return Rate	90%	90%	90%	90%	**90%**

POM data received by NALED members

Data inputs: Key Assumptions

Return rate

- 90% for central model, same in all scenarios
- Sensitivity analysis
- Important – strong bearing on system costs and revenues

Losses

- % of containers that do not enter the recycling process

Fraud

- Unique item coding (Smart DRS) potentially reduces chances of fraud

Return locations

- Conventional DRS only retailers, HORECA and petrol stations
- Smart DRS includes more locations

Shopping Centres
Workplaces
Education
Sports & Leisure
Religious Centres
Transport Hubs
Major Outdoor Events
Parks and Open Spaces
Town Halls and Government Buildings
Museums
Recycling Centres

Return locations and return technologies

	Conventional RVM	Manual (with scan)	Manual (no scan)	Simplified RVM	Smart Bin	RfID Enabled Container
Large Retailers						
Small Retailers						
Petrol Stations & HORECA						
Recycling Centres						
Shopping Centres, transport hubs, outdoor events						
Workplaces, education, town halls, government buildings, museums						
Sports and leisure, parks and open spaces, religious centres						

Conventional DRS | Smart DRS | Both

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Costs of return technologies

	Conventional RVM	Manual (with scan)	Manual (no scan)	Simplified RVM	Smart Bin	RfID Enabled Container
Capital Cost, €	15,000 - 28,000	50	-	5,000 - 10,000	1,676 – 3,500	210
Installation Fee, €	2,000	-	-	750	400	26
Annualised Cost of Capital, €[3]	2,938 – 5,185	18	-	906 - 1,693	327 - 614	37
Other Annual Costs (Servicing, Renovation, IT etc.), €	2,500	0	-	504 - 507	251	0
Total Annualised Cost, €	**5,438 – 7,685**	**18**	-	**1,409 – 2,200**	**577 - 865**	**37**
Conventional scenario, number of units	1,842	-	20,327	-	-	-
Smart scenario, number of units	1,100 – 891	16,857 – 19,394	-	1,985 – 6,450	2.015 – 10,663	2,557 – 20,486

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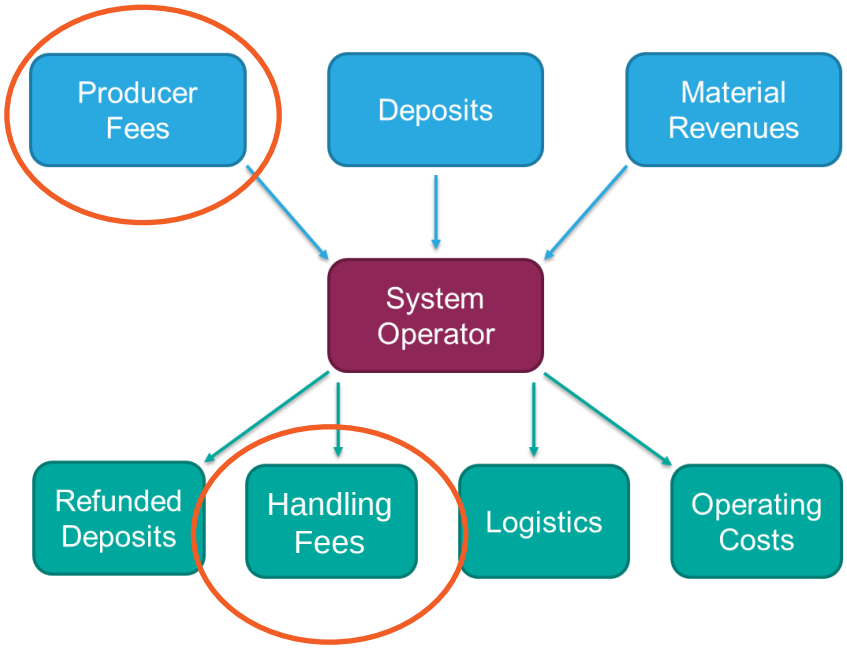
System Income and Outgoings



Producer Fees represent highest income stream and handling fees the highest cost area.

Presentation of results

- Annual costs in year 3, after the ramp-up period
  - The 90% return rate will not be reached in year 1 and year 2
- All investment costs have been annualised, shown in Handling fees
  - Counting centres over 5 years
  - Return technology over y years (except manual with scanning over 3 years)
  - CSO setup costs over 7 years

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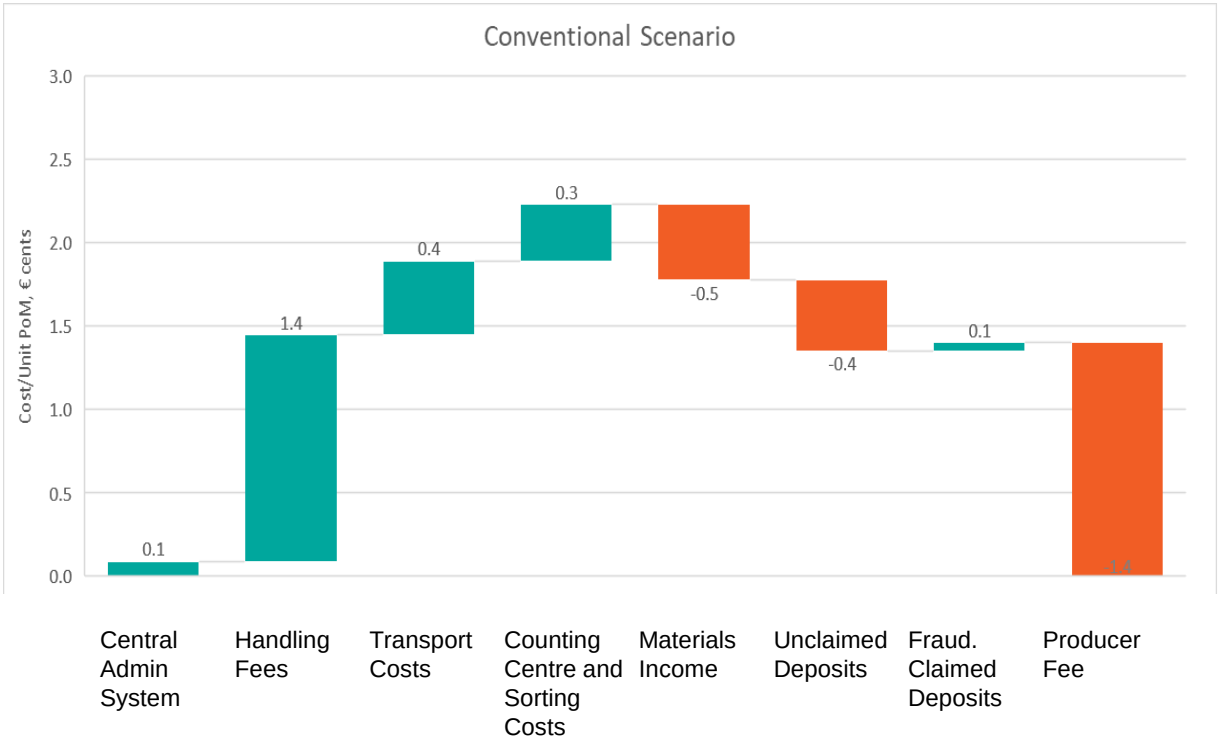
Results

Summary of system costs - Conventional



1.4 € cents producer fee

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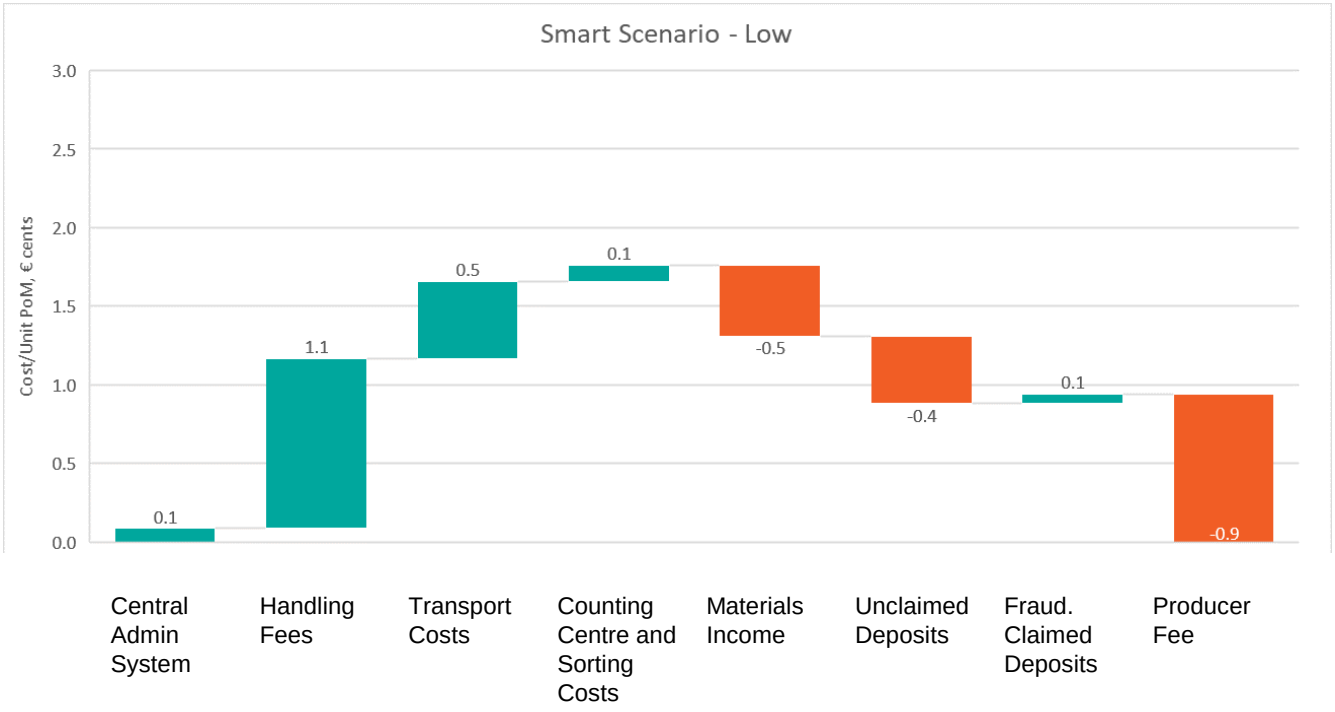
Summary of system costs – Smart Low



0.9 € cents producer fee

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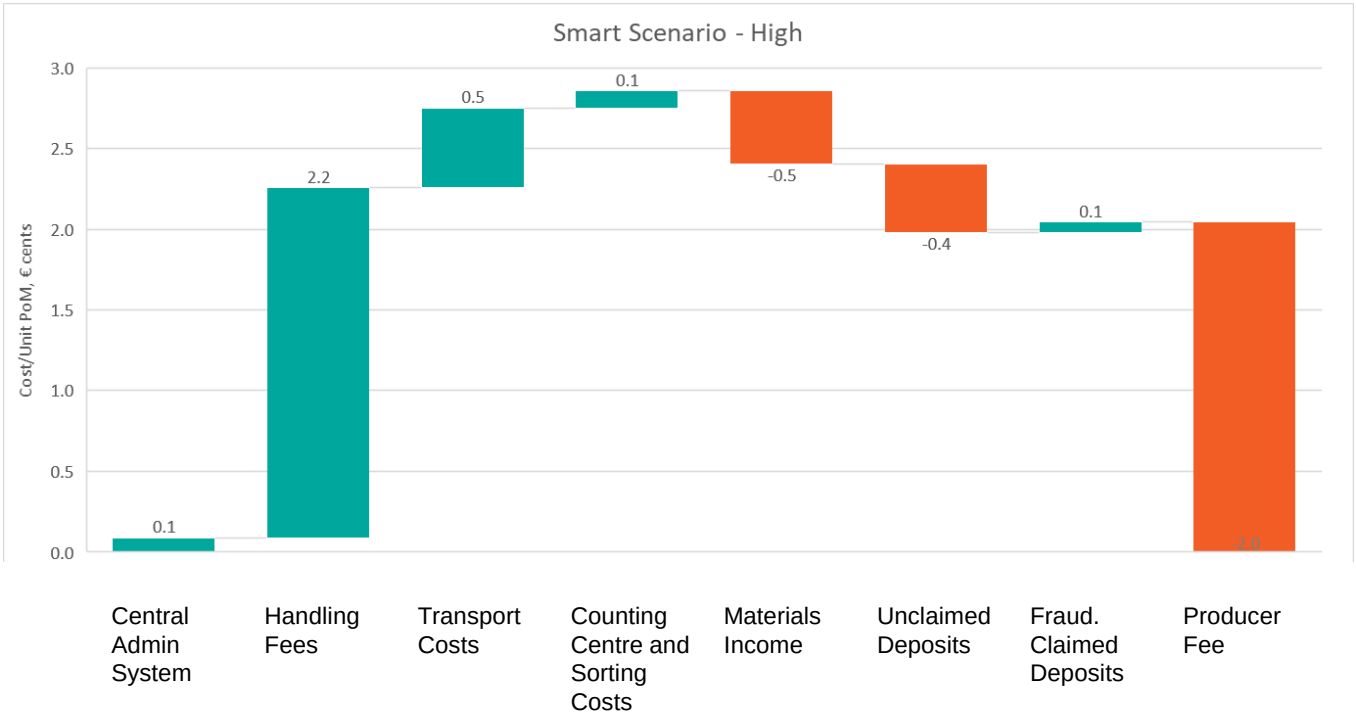
Summary of system costs – Smart High



2.0 € cents producer fee

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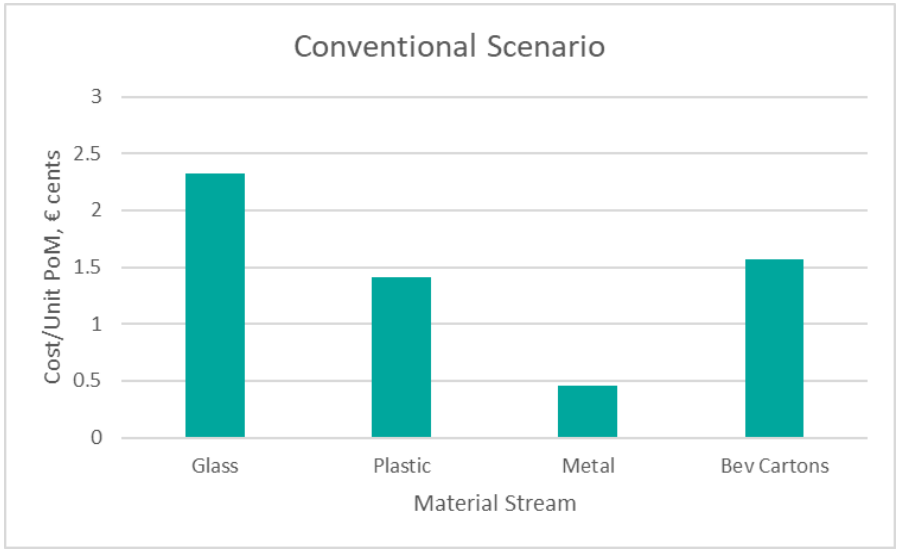
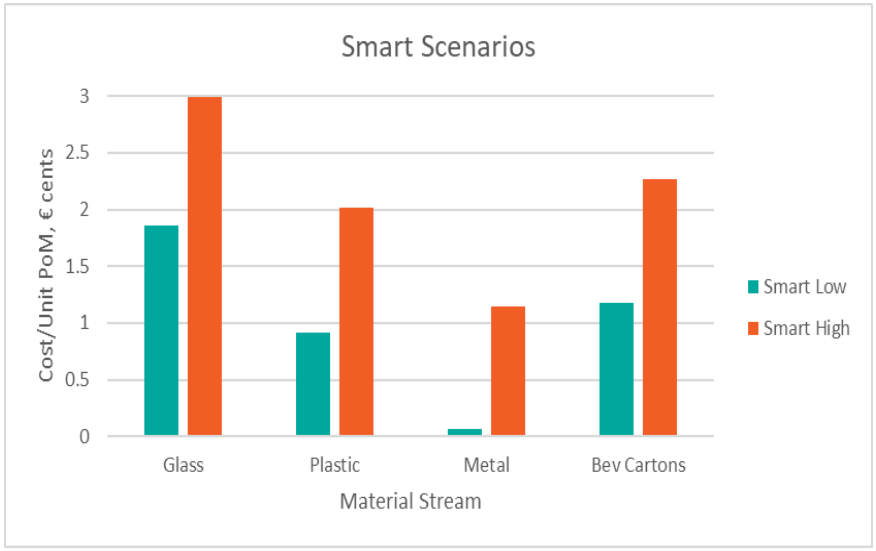
Summary of costs

Item	Conventional scenario		Smart scenario - Low		Smart Scenario - High	
System Operator Costs	Total Cost, € million	Cost/Unit PoM, € cents	Total Cost, € million	Cost/Unit PoM, € cents	Total Cost, € million	Cost/Unit PoM, € cents
Central Admin System	1.6	0.1	1.6	0.1	1.6	0.1
Handling Fees	24.7	1.3	19.7	1.1	39.5	2.2
Transport Costs	8.1	0.4	8.9	0.5	9.0	0.5
Counting Centre and Sorting Costs	6.2	0.3	1.9	0.1	1.9	0.1
Materials Income	-8.3	-0.5	-8.3	-0.5	-8.2	-0.5
Unclaimed Deposits	-7.7	-0.4	-7.7	-0.4	-7.7	-0.4
Fraudulently Claimed Deposits	0.9	0.1	1.1	0.1	1.2	0.1
Net Cost	**25.5**	**1.4**	**17.2**	**0.9**	**37.2**	**2.0**
Funded by Producer Admin Fee	**-25.5**	**-1.4**	**-13.5**	**-0.9**	**-30.9**	**-2.0**

Results – Producer fees per material stream





Average fee for the system similar to plastic values

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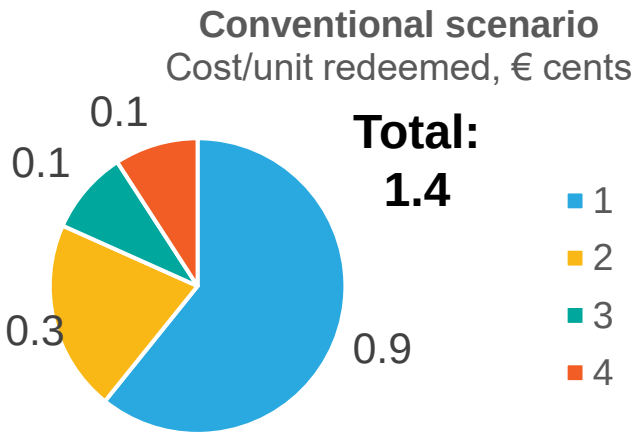
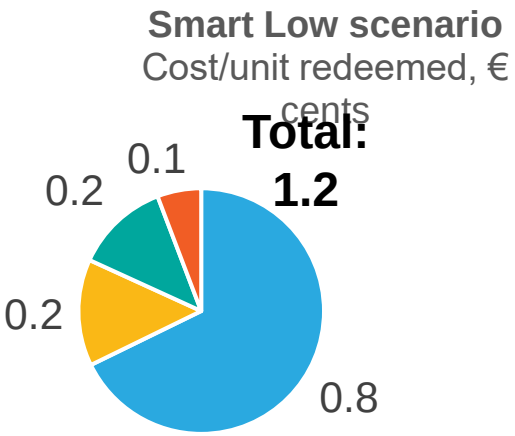
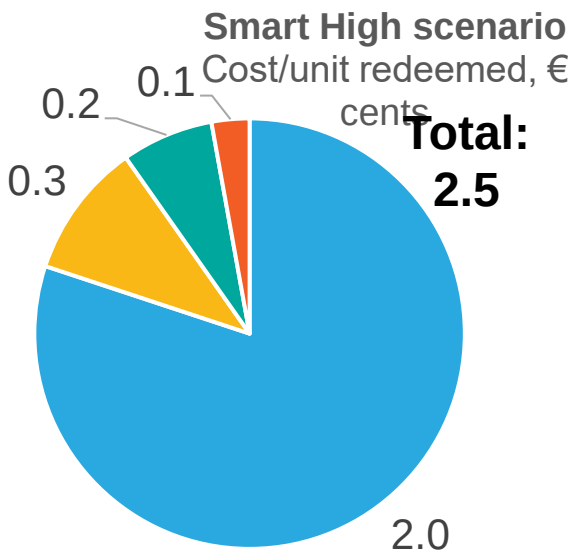
Results - Summary of Handling Fee per scenario







- **Infrastructure** is the biggest component of the handling fee, more than half in all cases
  - In the Smart scenario, the uncertainty around infrastructure is reflected in the wide range of 0.8 to 2.0
  - Infrastructure includes the annualised costs of purchasing and setting up the equipment
- **Labour** is the smallest component, with more relevance in Conventional

Sensitivities *(conventional / smart high - low)*

	Central Scenario	Sensitivities	Comments
Materials included	Plastic, cans, glass and cartons **1.4 / 0.9 – 2.0**	Plastic and cans only = **1.2 / 0.8 – 1.7** Plastic, cans and cartons = **1.3 / 0.8 – 1.5** Plastic, cans and glass = **1.3 / 0.8 – 1.7**	Re-dimensioning of the model infrastructure for each case
Wines and Spirits	Included **1.4 / 0.9 – 2.0**	Excluded **1.4 / 0.9 – 2.1**	Maximum difference of 1.5% Recommended to include
Deposit level	5 RSD **1.4 / 0.9 – 2.0**	Multi-level (4 / 5 / 6 RSD) **1.6 / 1.1 – 2.2**	No advantage to multi-level fee
Return Rate	90% **1.4 / 0.9 – 2.0**	Low (88%) and High (92%) **2pp variation leads to 5% to 11% variation of producer fees**	Very sensitive aspect

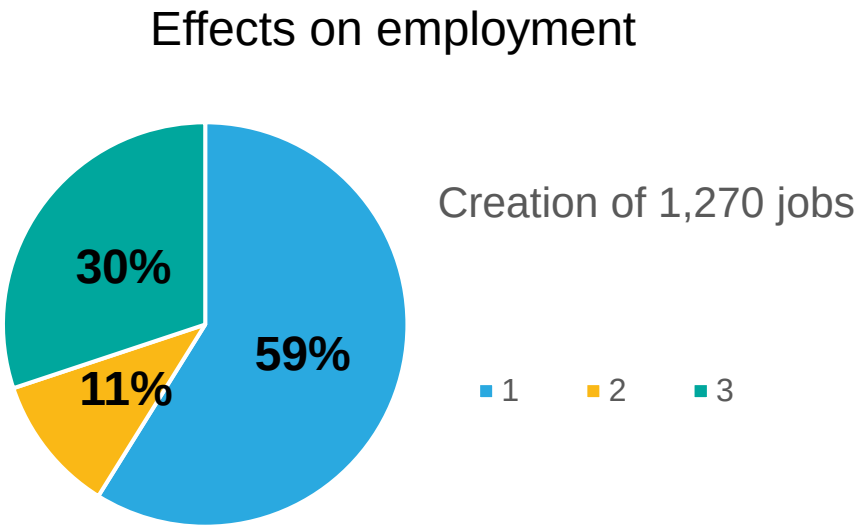
Environmental and social impacts: effect of DRS

Recycling of additional beverage containers

Reduction in disposal of beverage containers

Additional collection and transportation of containers to recyclers

Reduction in littering (wellbeing and community benefits)



Recycling rates

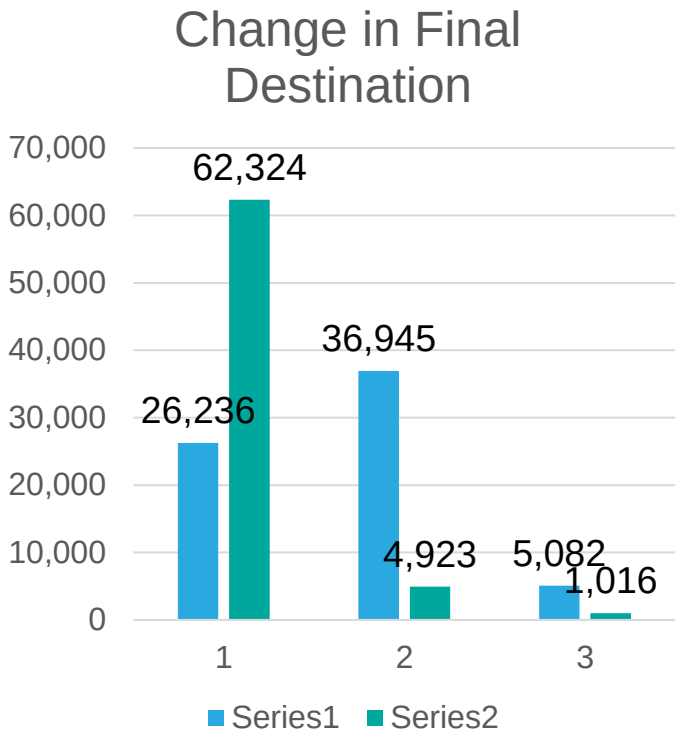
	Performance against National Targets	Performance against EU Targets		
	2019	2022	2025	2030
Paper/cardboard	+10%	+4%	-5%	-15%
Plastic	+12%	0%	-16%	-21%
Glass	-11%	-14%	-38%	-43%
Metal	+7%	+4%	+1%	-9%
Wood	+9%	+3%	-1%	-6%

Assumption that under DRS target beverage containers reach 90% collection rates and 88%-90% recycling rates (small losses). This is dependent on the recycling infrastructure in Serbia, especially for beverage cartons.

Environmental and social impacts: effect of DRS

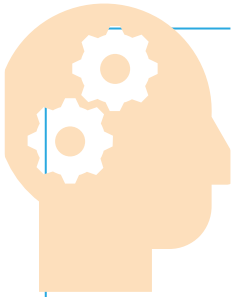
Area	GHGs, kt	Monetised Benefits, €m		
		GHG	Air Quality	Total
Recycling	-45	-1.5	-0.5	-2.0
Disposal	-3	-0.1	0.0	-0.1
Transport - Collections	14	0.7	0.0	0.7
Total	**-35**	**-0.9**	**-0.5**	**-1.4**

Savings from recycling and disposal are higher than the additional transport emissions from collections



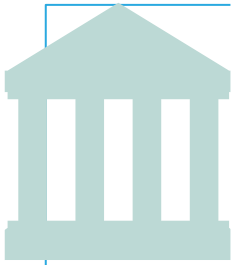
Implementation

Governance



Central System Operator

- One organisation responsible for system operation (finances, data, logistics) & success
- Centralised, industry-owned and operated
- The collective interests of all industry players should be represented



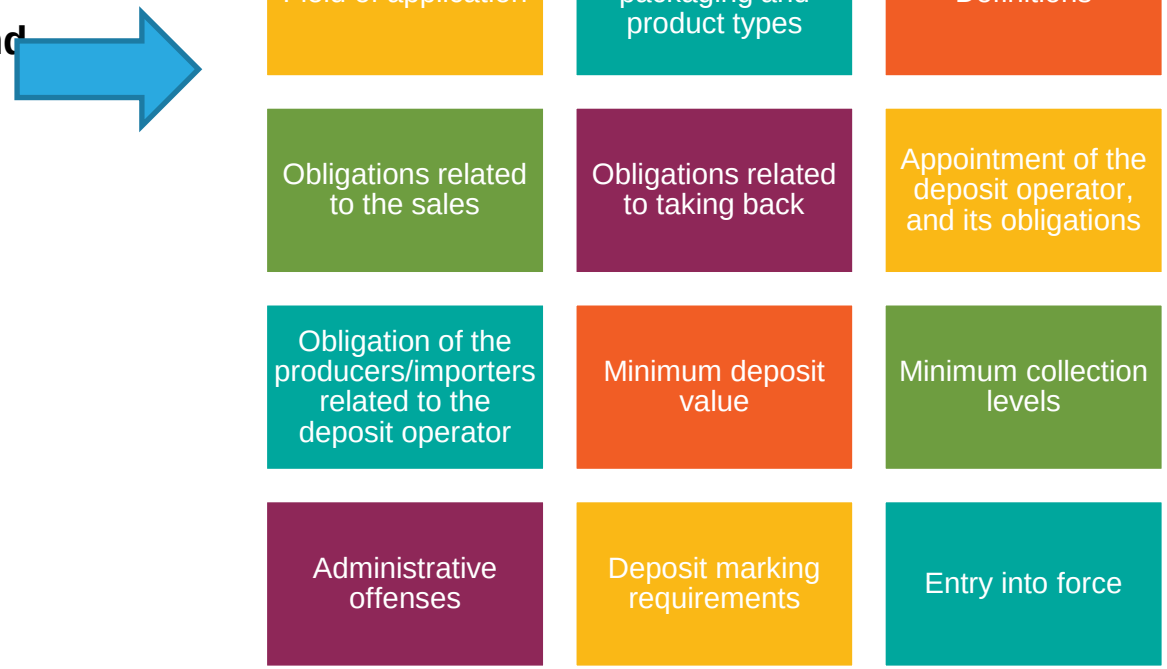
Role of government

- Government sets target return rate
- Government provide oversight and auditing
- CSO provides evidence (data) to government of meeting the targets

Legislation

- The most common way so far: through **Acts of Laws on Packaging and Packaging Waste**

- However, Norway introduced a Beverage Container Tax which reduces with increased recycling rates, so the industry decided to introduce DRS



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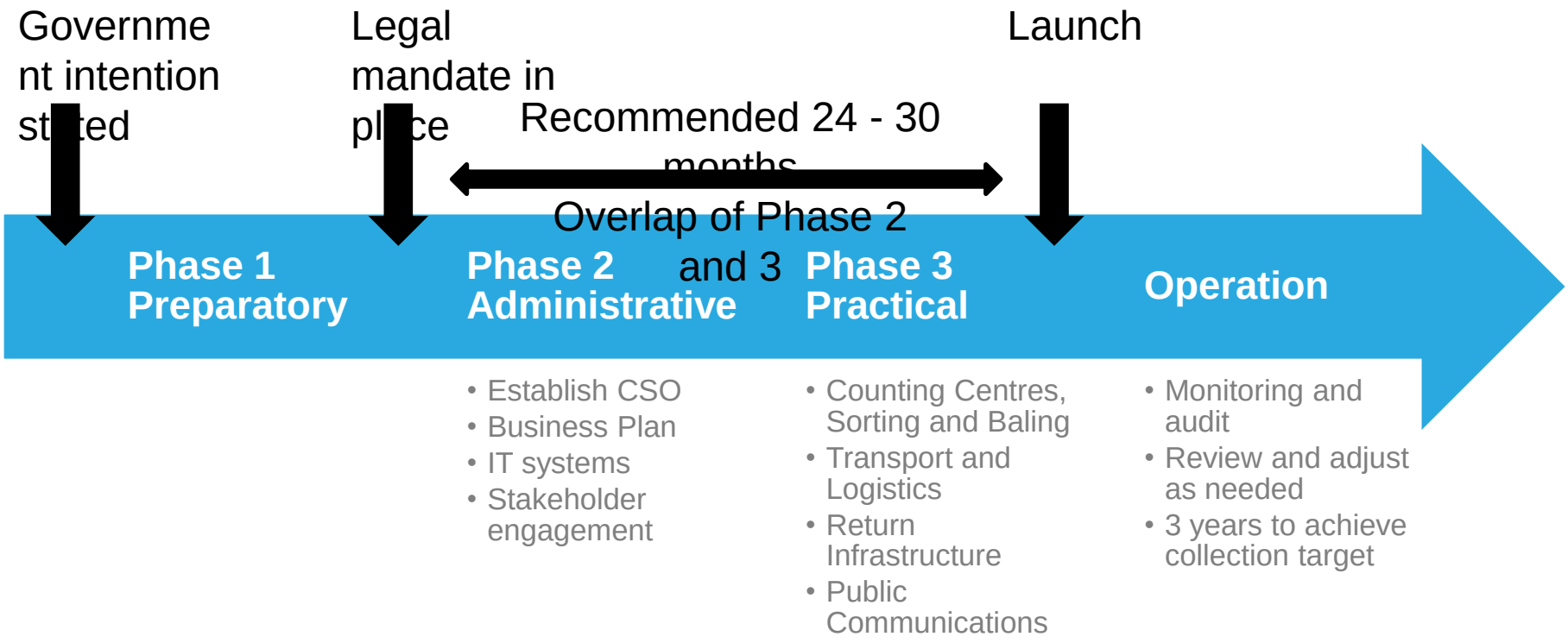
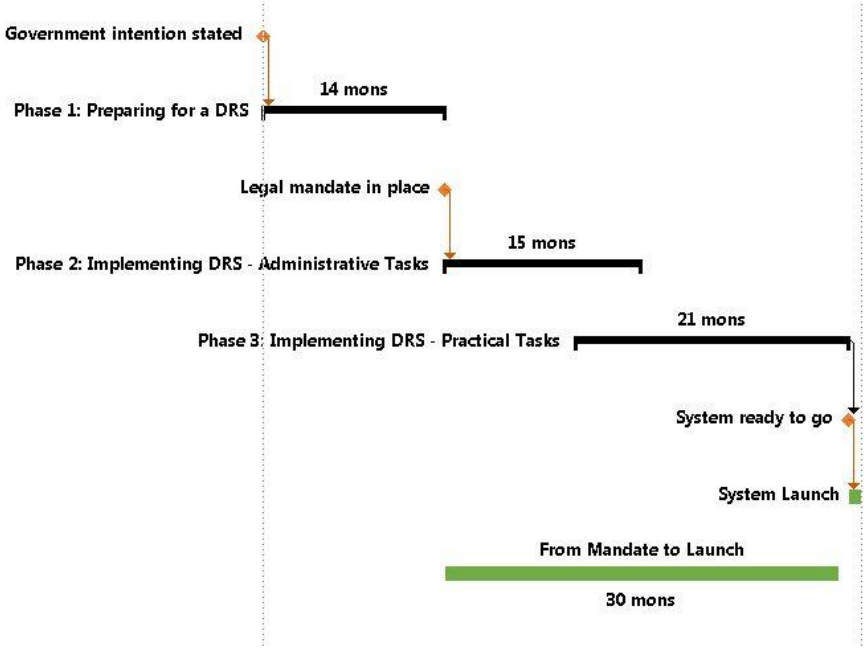
Implementation timelines



Implementation timelines



Primary factors that can slow down implementation

Lack of cooperation

- Stakeholders may prolong discussions and/or steer the DRS in line with their commercial interests

Unfamiliarity with DRS

- Stakeholders need time to come on board with the project

Population

- Affects the practical implementation of counting centres and return locations

Several countries decided to implement a DRS in the same year

- Sourcing the raw materials for RVM components could be problematic if a large number of RVMs are ordered in a short time frame

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Implementation recommendations

BEST PRACTICES

- Simple legislation
  - CSO has parameters but scope for industry creativity
- Detailed feasibility study
- Well appointed CSO CEO and senior team
- Coordinated stakeholder dialogue
- Clear producer and retailer obligations
- Clear tender process for infrastructure and transport

CHANGES AFTER IMPLEMENTATION

- Deposit structure and value
  - Flexibility to increase if return rates are falling
- Return infrastructure
  - Could be supplemented if targets are not met
- Retailer handling fees
  - Revised annually
- Target return rates
  - Monitor and audit

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Glossary

- AQ = Air Quality
- CSO = Central System Operator
- DRS = Deposit Return Scheme
- EPR = Extended Producer Responsibility
- GHG = Greenhouse Gas (emissions)
- HORECA = Hotels, Restaurants and Cafes
- POM = Placed on the Market
- RVM = Reverse Vending Machine

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