REDUCING PLASTICS POLLUTION: A COMPREHENSIVE, EVIDENCE-BASED STRATEGY FOR SOUTH AFRICA

Stafford, W.H.L., Russo, V., Oelofse S.H.H., Godfrey, L., and Pretorius, A.

(Presented by **Valentina Russo** on behalf of the Team)

10 November 2022, Cape Town
South African Plastic Pact Conference

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

CSIR
Touching lives through innovation

Technical assistance:

PEW

UNIVERSITY OF OXFORD

Thought partners:

Plastics | SA

The SA Plastics Pact

Plastic pollution problem in South Africa

- Growing plastic consumption ~ 3% per annum
- Backlog in waste collection services ~ 37% of households do not have a weekly waste collection service (StatsSA)
- Collected waste is disposed of to “landfills” – many are non-compliant with legislation and do not effectively contain plastic waste
- South Africa has a rich policy landscape to facilitate the management of waste, including basic city cleansing and waste collection, and the adoption of the waste hierarchy (since 1999)
- Existing measures have been ineffective in curbing growing plastic pollution, with increasing mismanaged waste leaking to the environment

Five UNRECONCILED Propositions

1. Ban
2. Bio-solutions
3. Recycle
4. Burn or Bury
5. Clean-up

- How do strategies perform on environmental, economic and social indicators?
- How applicable are they to materials AND geographies?
- How do these strategies interact?
- What costs and investments are required?
- How quickly can they be implemented?

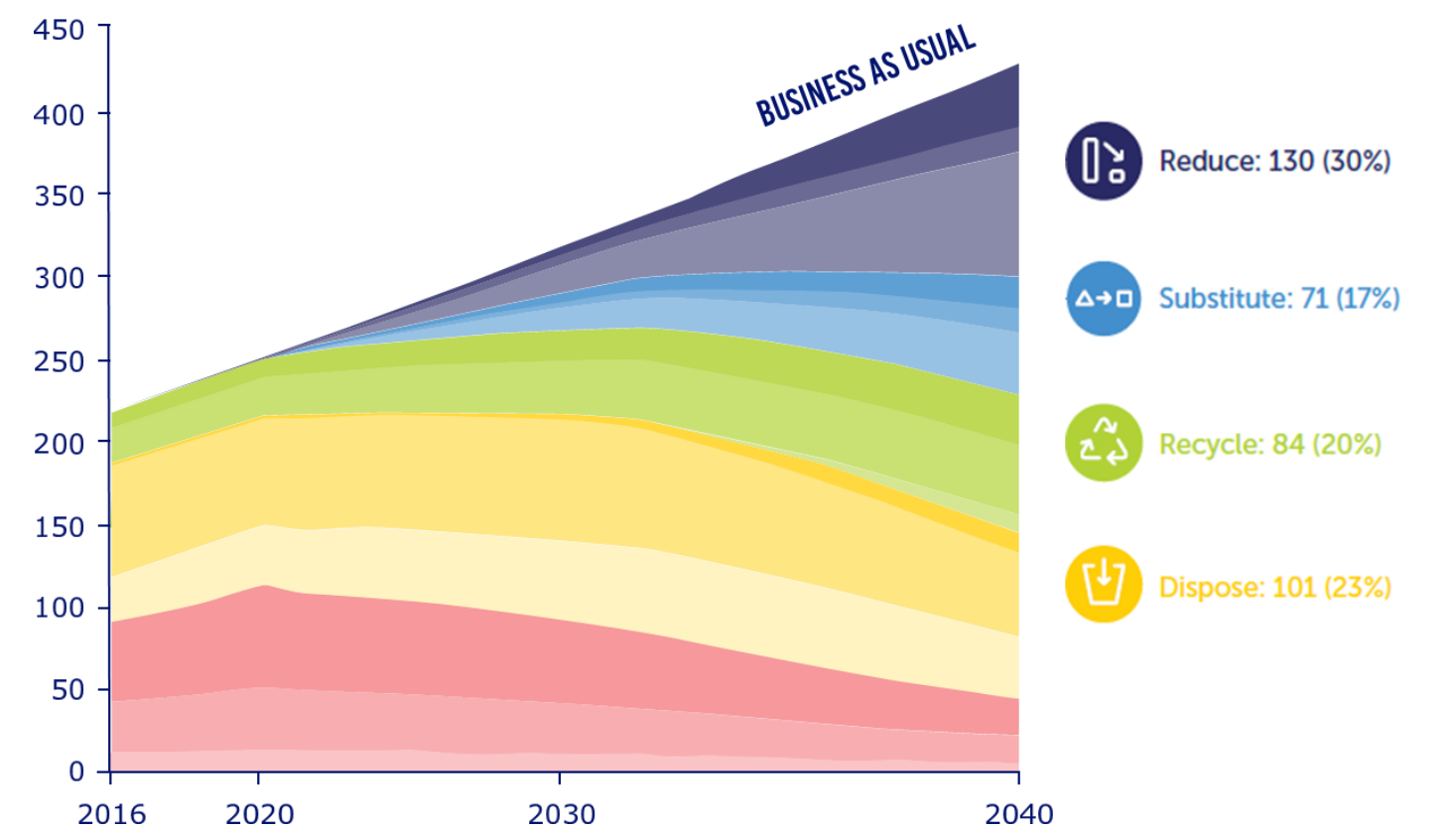
THE PEW CHARITABLE TRUSTS

SYSTEMIQ

Global study showed there are No “Silver Bullets”

- The ‘Breaking the Plastic Wave’ study (2020) provided the first global, comprehensive assessment of pathways towards stopping ocean plastic pollution - available at *pew.org/32JK0dp*

MT/Y of plastic under the System Change Scenario



THE PEW CHARITABLE TRUSTS

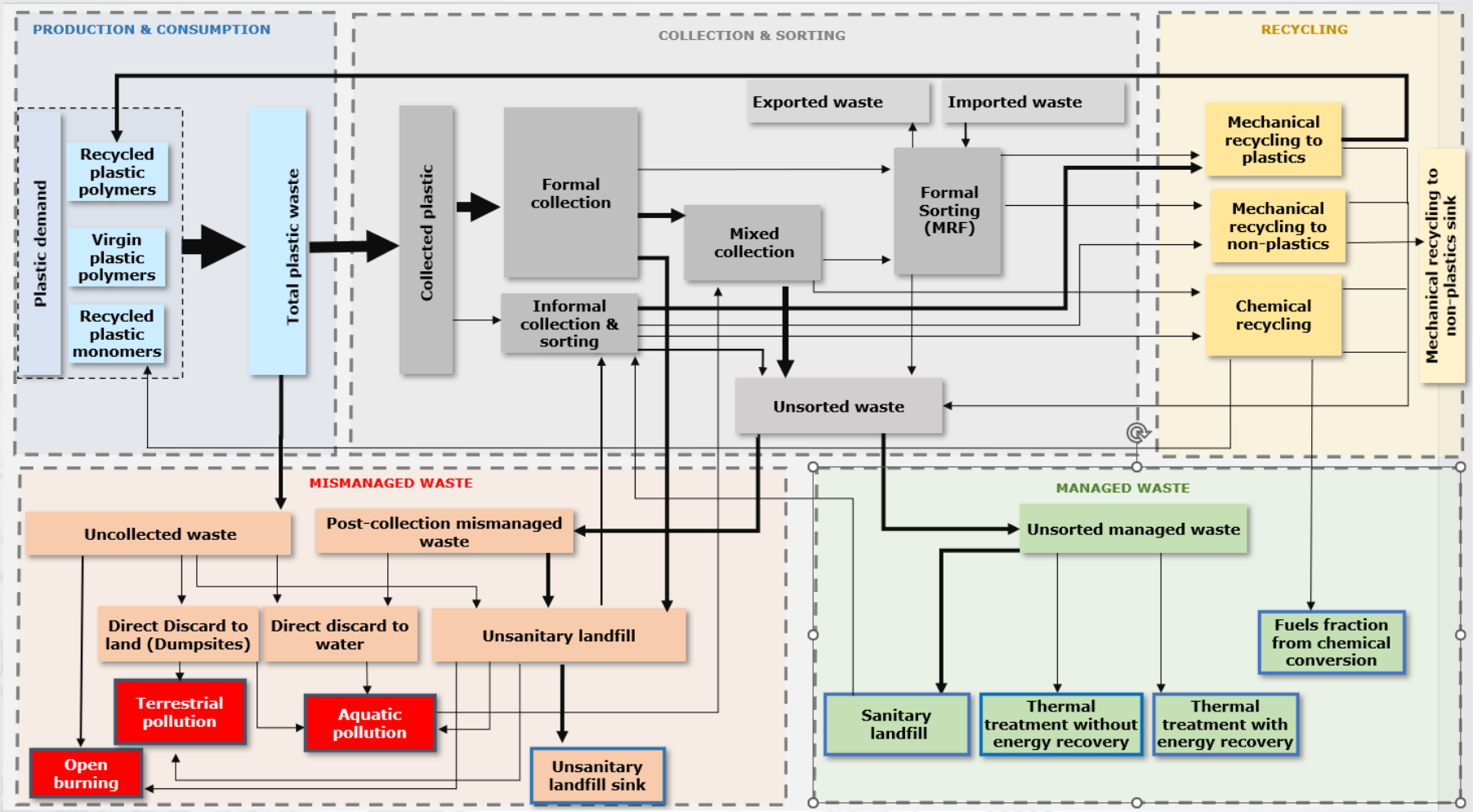
SYSTEMIQ

Application of the Global Model to South Africa

1. FOCUS ON SOLUTIONS
2. SCIENTIFIC RIGOR
3. SYSTEM-WIDE MODEL
4. DATA DRIVEN

- The CSIR approached PEW and Oxford University to test the application of the global model to the country-level scale
- Research questions:
  1. Can the Pathways Tool be successfully applied to the local scale, and to a developing country context, such as South Africa?
  2. Based on the application of the Pathways tool, what should South Africa's evidence-based response be to addressing plastic pollution?

Plastics mass flows – South Africa System Map



Adapted from "Breaking the Plastic Wave" (2020) Global Model available at *pew.org/32JK0dp*

CSIR
Touching lives through innovation

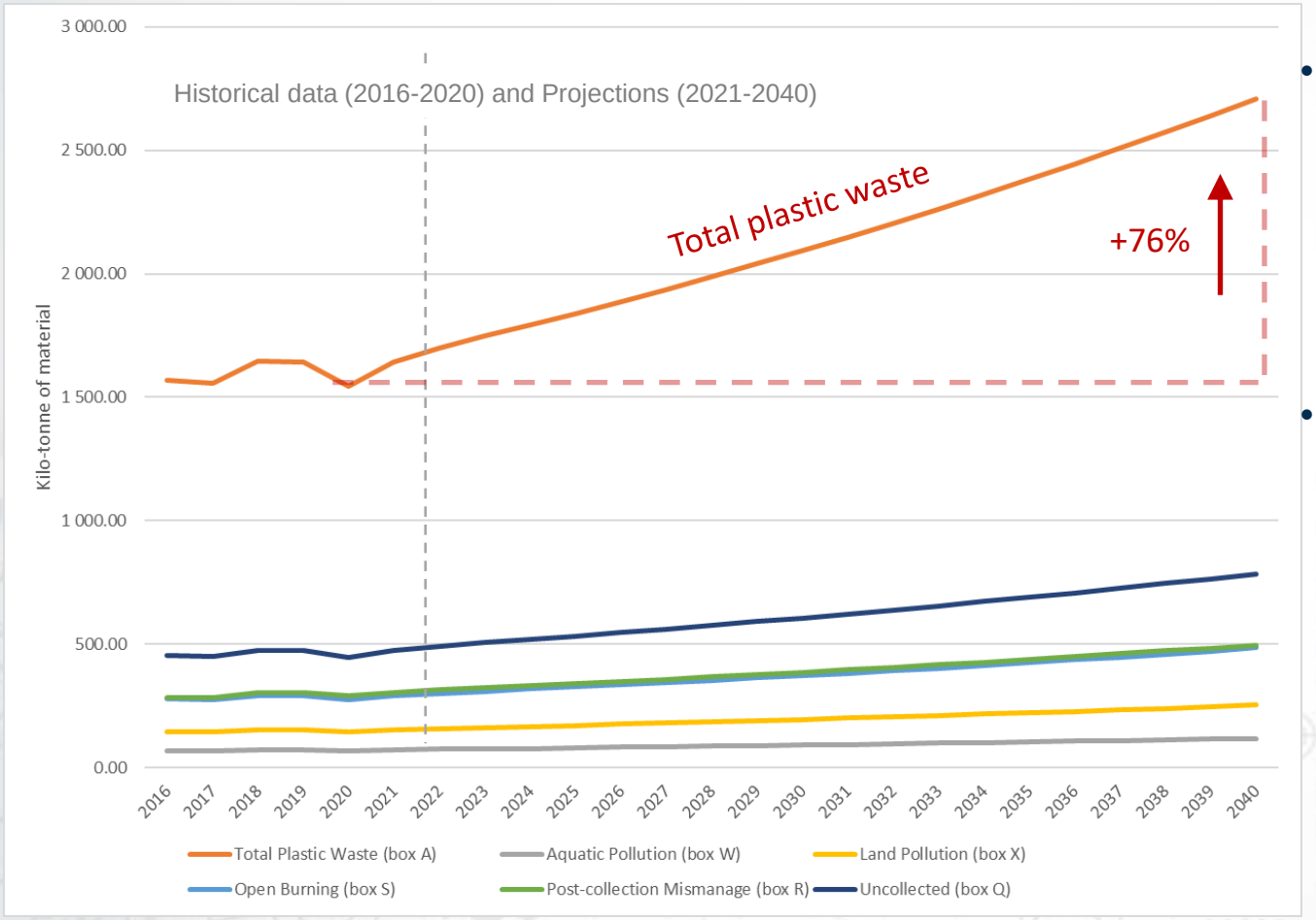
Plastics and system data

- The Pathways Tool is a data intensive tool –
  - Available data was obtained from various sources – government, industry, academia
  - Data gaps were filled through default archetype data (global study), verified by local experts
  - All data was assigned uncertainty levels, which were propagated through the model
- Each scenario was run for the period 2016-2040 –
  - Existing waste and plastics data was used for the period 2016-2020 (last year for which we have data points for South Africa)
  - After which predicted annual data has been inferred, based on industry and waste sector trends

Scenarios for modeling plastics pathways

- The team modelled three different future scenarios –
  1. **Business-as-Usual (BAU) Scenario** with plastics production and consumption set to grow ca 3% pa to 2040, i.e., if we simply continue along the current path
  2. **Extended Producer Responsibility (EPR) Scenario** – a strategy of increasing collection and recycling**,** aimed at achieving South Africa's five-year EPR targets (2023-2027) for plastic packaging
  3. **Optimal System Change Scenario** – a scenario that trade's off between economic and environmental considerations, i.e., minimizing plastic pollution, GHG emissions and costs, while maximising jobs for South Africa

Business-as-Usual (BAU) Scenario



- Under the BAU Scenario plastic pollution will near double in South Africa (~76% increase from 2020 levels)
- Due to waste mis-management plastic waste leaks to the environment; where it causes air pollution from open-burning (275kt), land pollution (145kt) and 68kt aquatic pollution (freshwater and marine)

EPR Scenarios - development

EPR \ Flows	Collected plastics	Mechanical recycling	Mixed Collection	Formal sorting (Dirty MRF)	Formal sorting S@S (Clean MRF)
EPR_1	☑	☑			
EPR_2	☑	☑	☑		
EPR_3	☑	☑		☑	
EPR_4	☑	☑	☑	☑	
EPR_5	☑	☑			☑
EPR_6	☑	☑		☑	☑

Baseline scenario based on improvements on collection and recycling rates only

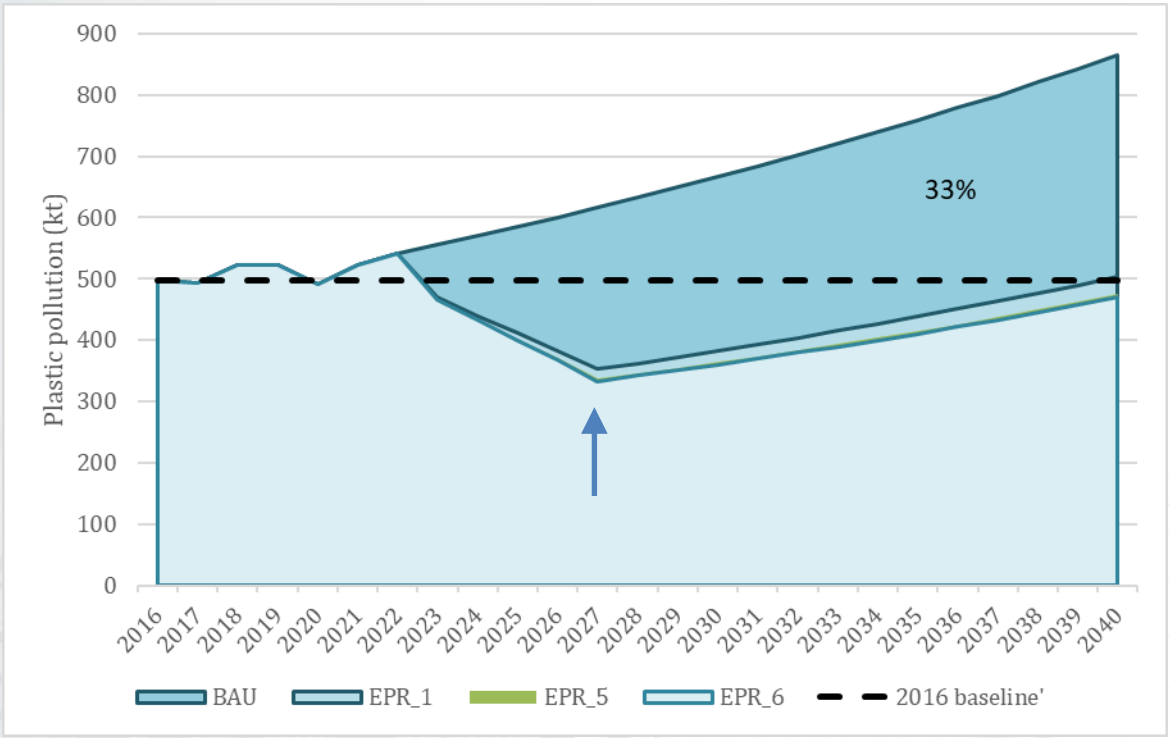
Aimed at improving the managing and sorting of the mixed plastic waste only

Improved collection pattern (S@S) and improved sorting of Mixed waste to avoid the unintended consequence of increased post-collection mismanaged waste (PCMPW)

Improved collection patterns (S@S) so to have enough plastic waste collected for recycling

All EPRs achieve collection targets and only EPR 5 and EPR 6 provide enough plastic waste collected for recycling to meet the recycling targets and avoid the increase of PCMPW

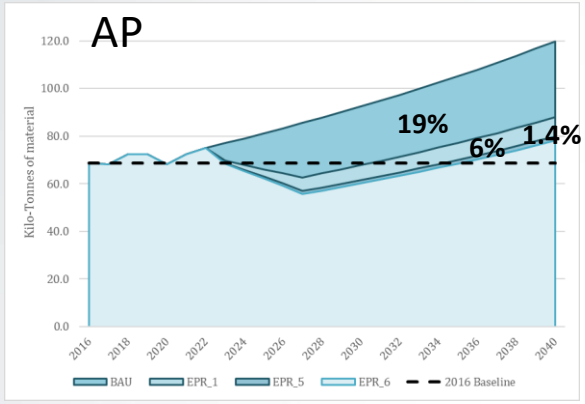
EPR Scenarios – total plastic pollution

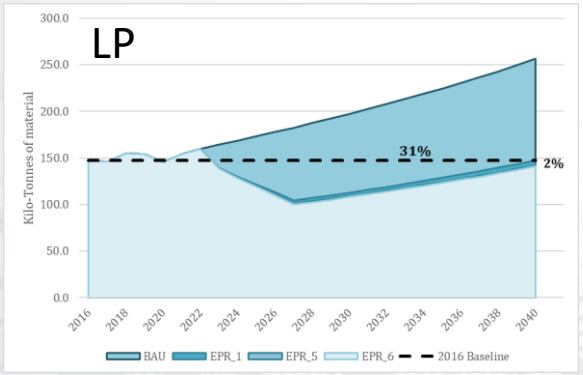


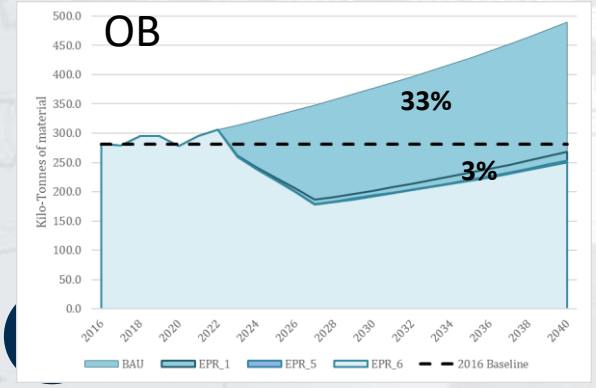
- Meeting the 5-year EPR targets (to 2027) is predicted to reduce the total plastic pollution by 31 (EPR1) -33 (EPR6)% over the period 2023-2040
- This is largely due to a sizeable decrease in uncollected waste by 2040, which will be cumulatively reduced by 50% by 2040

The collection and recycling rates reached in 2027 were kept constant (as % of flows) for the period 2028-2040 under an assumption that no future changes are made to the regulated EPR targets. The EPR scenario provides a conservative approach, with greater potential for impact should the targets be adjusted upwards by Government after 2027.

EPR Scenarios – Pollution flows to the environment

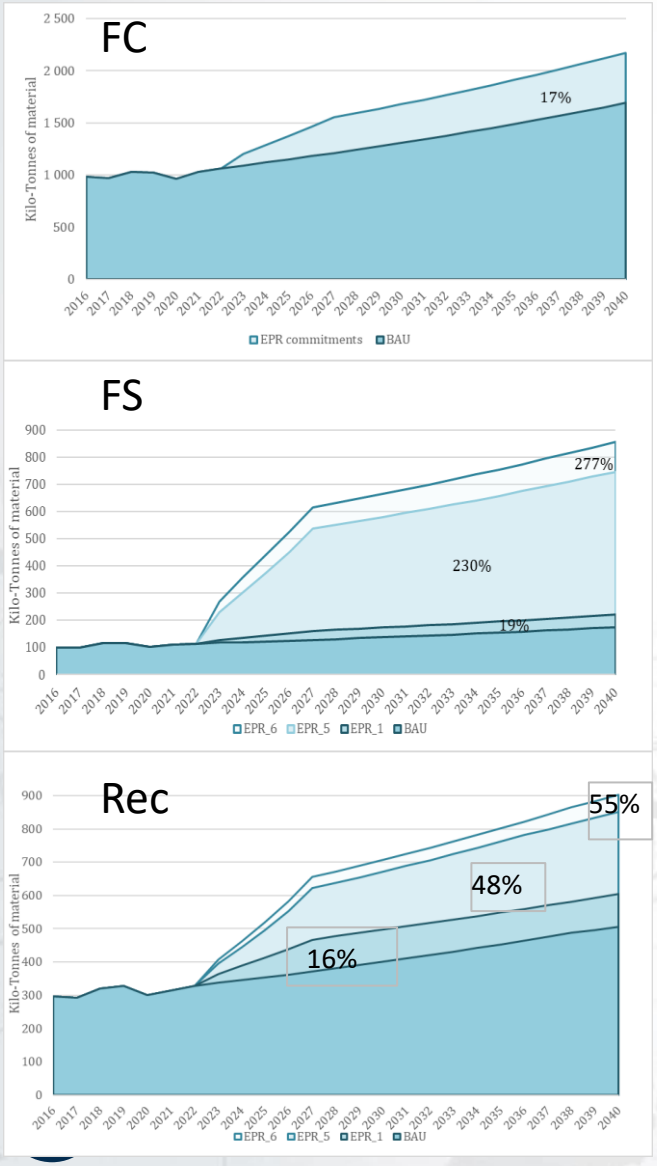






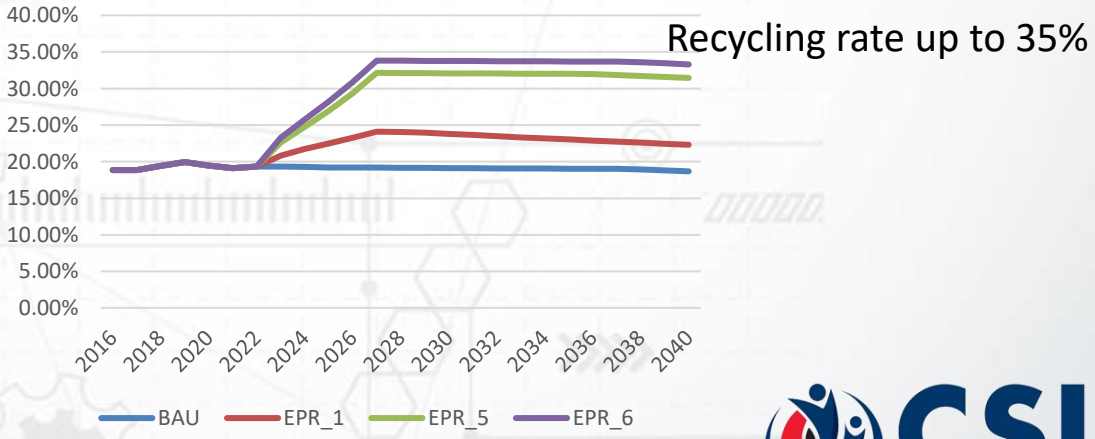
- Meeting the 5-year EPR targets results in:
  - 19 (EPR1) -25 (EPR6)% reduction in aquatic pollution from BAU
  - 31 (EPR1) -33 (EPR6)% reduction in plastic pollution to land from BAU
  - 33 (EPR1) -35 (EPR6)% reduction in plastic pollution to air (open-burning) from BAU
- In real terms these pollution flows would in 2040 be the same or slightly higher than in 2020
  - The EPR scenario creates a "stabilization wedge" for plastic leakage to the environment between 2016 and 2040
- EPR will be only partially effective in reducing plastics pollution – other strategies are needed

EPR Scenarios – Collection, sorting and recycling



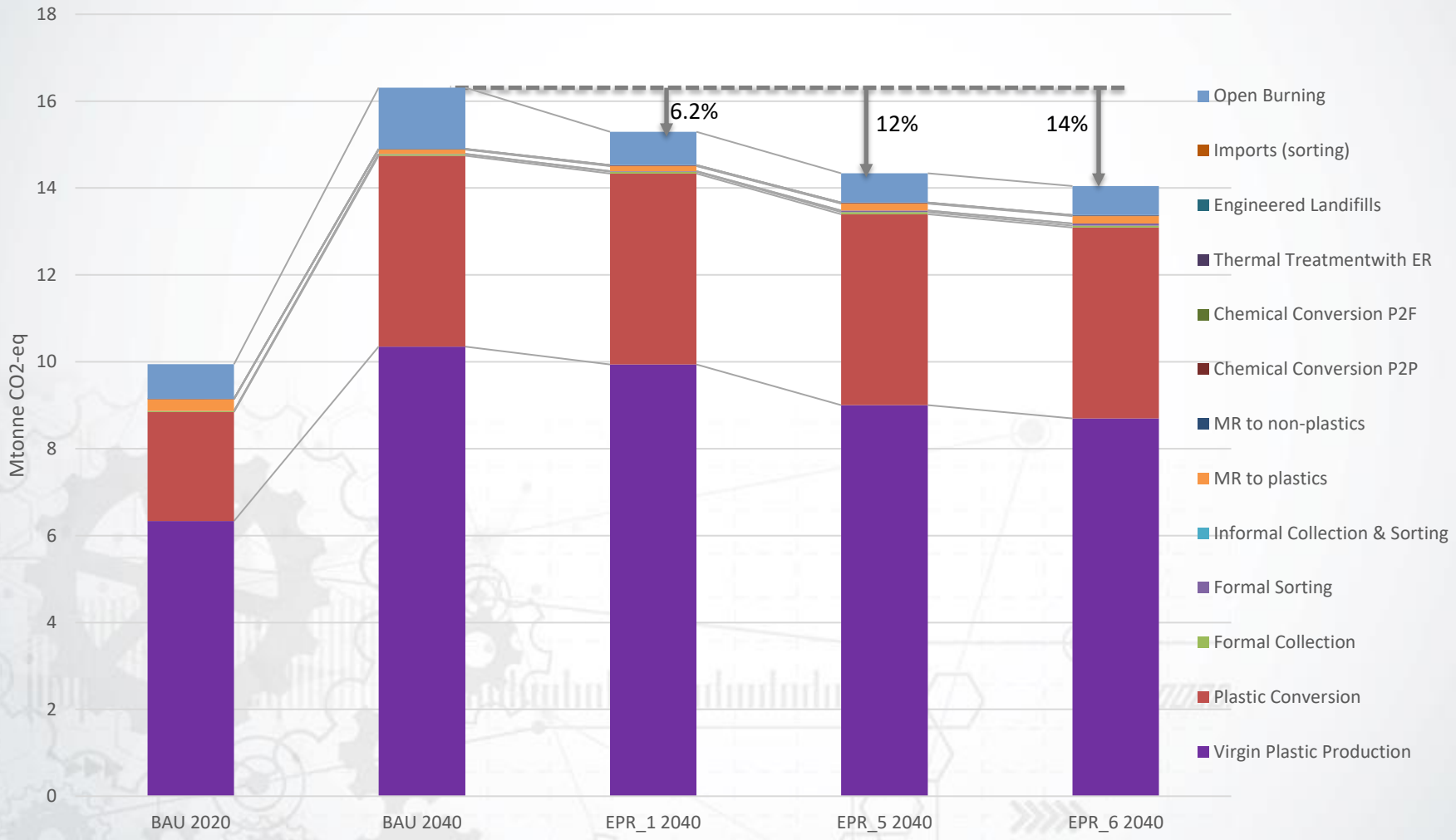
Meeting the 5-year EPR targets results in:

- A ~6500 kt increase in formal collection from BAU
- Between 4000-12500 kt increase in formal sorting from BAU
- Between 1500-5300 kt increase in recycling from BAU



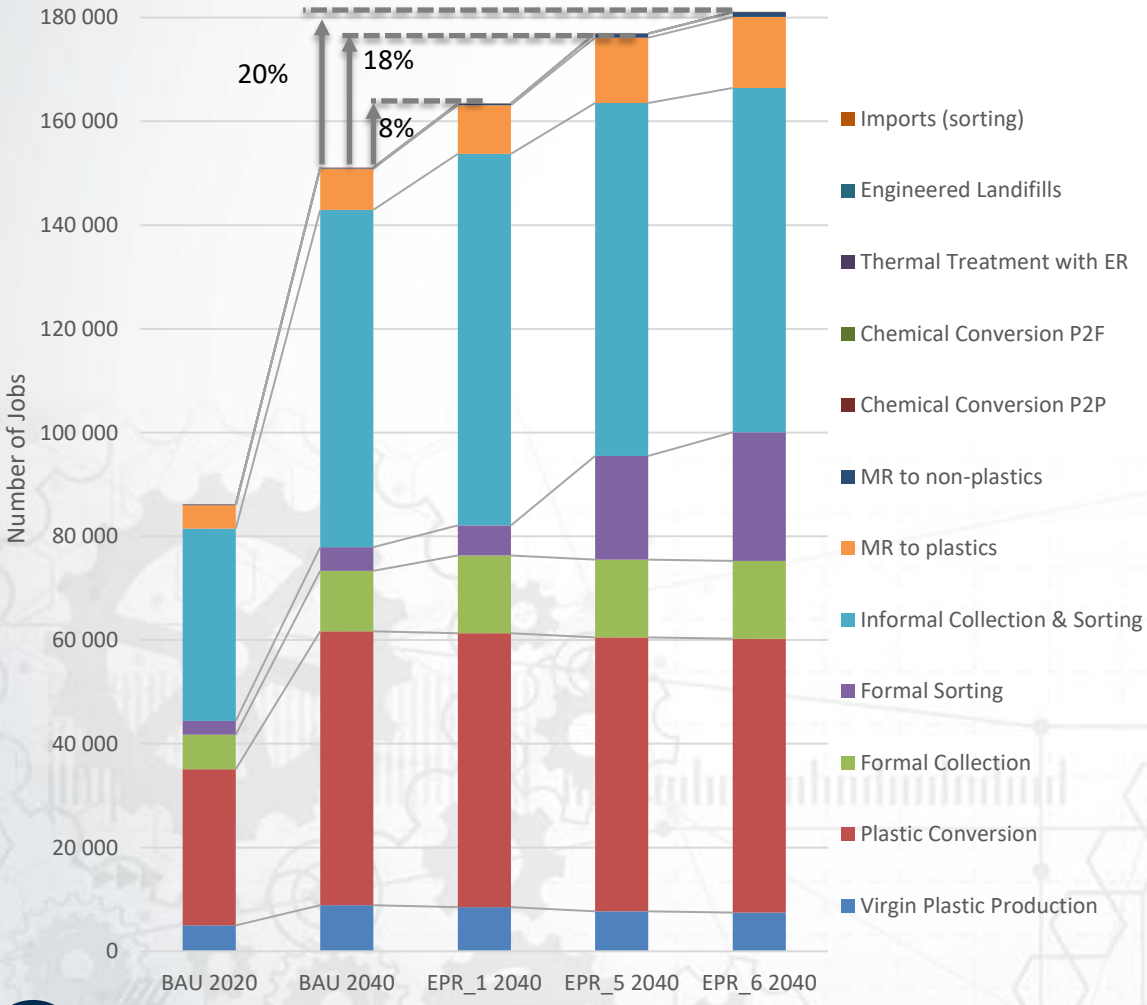
CSIR
Touching lives through innovation

EPR Scenarios – GHG emissions



CSIR
Touching lives through innovation

EPR Scenarios – Jobs creation

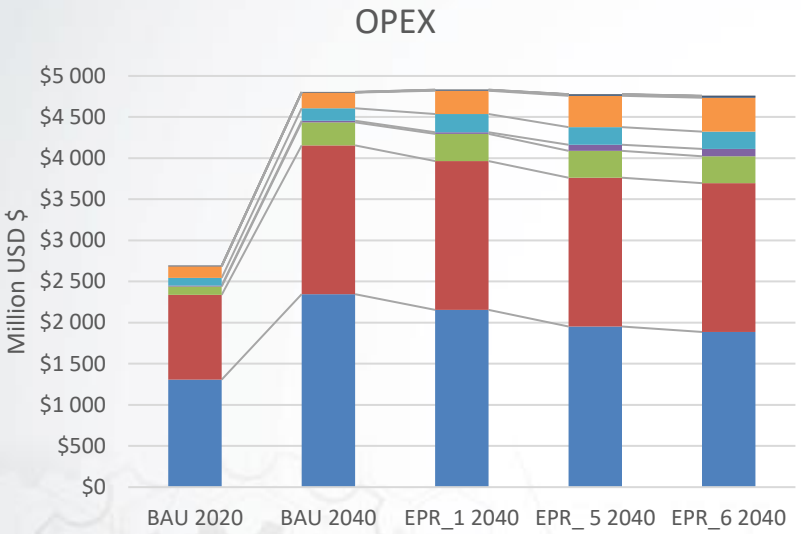


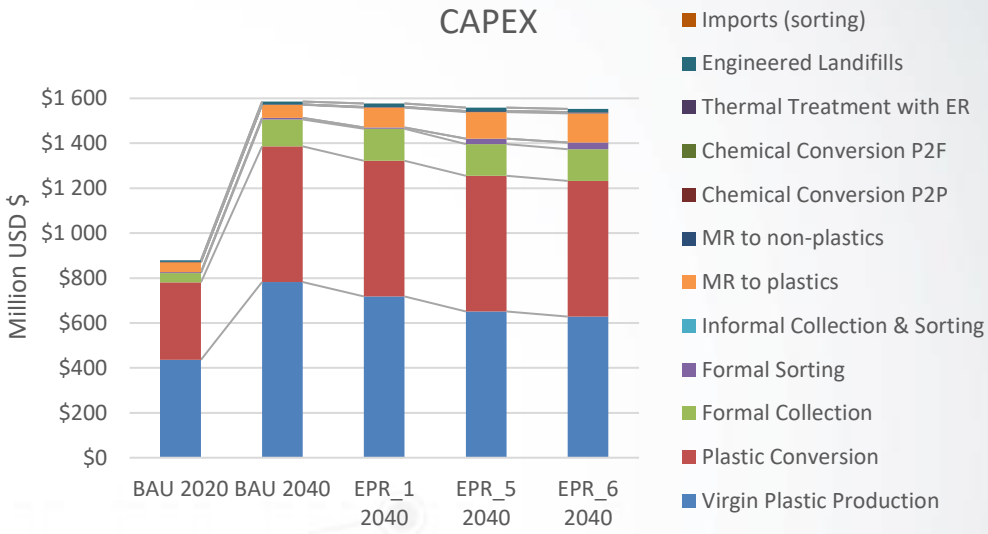
Meeting the 5-year EPR targets results in 8-20% increase in job:

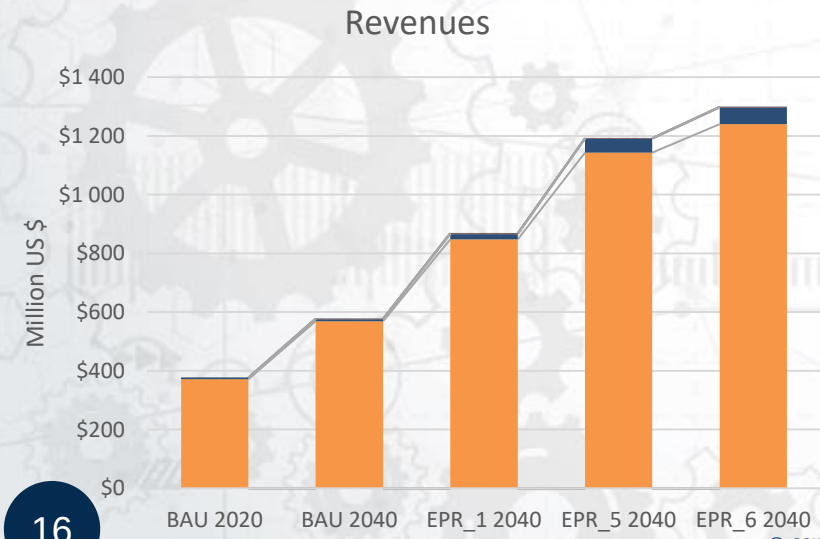
- 2.2 % formal collection
- 0.8-13.6% formal sorting
- 1-4% in recycling (mainly Mechanical recycling)

Improving formal collection, sorting and recyclate production will erode some jobs in virgin plastic production (~1%) across the ERPs

EPR Scenarios - Costs

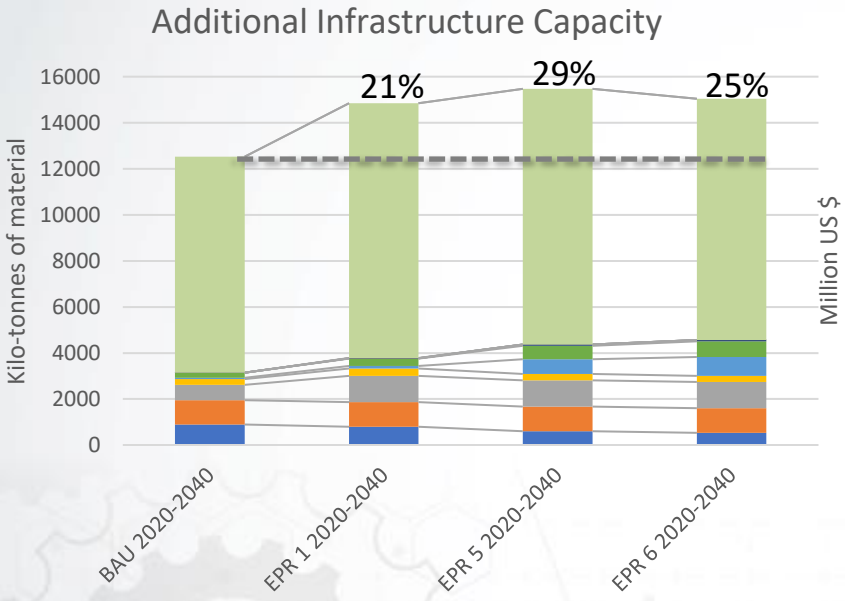


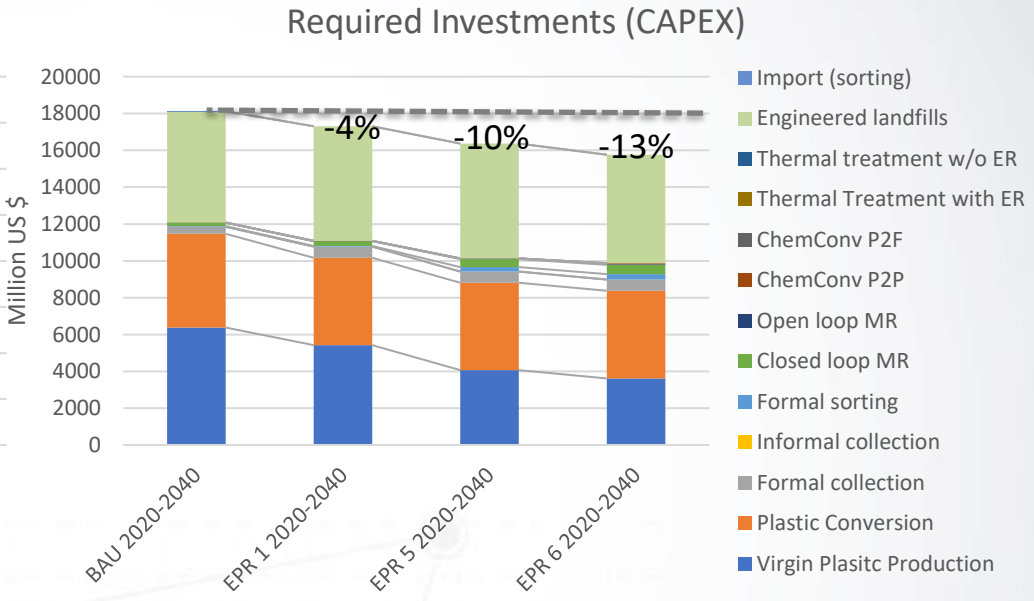




- Overall OPEX and CAPEX present small reduction (1-2% across all EPRs) when compared to BAU
- Noticeable OPEX and CAPEX reduction (4 to 10%) in the production of virgin plastics when more recyclate replaces the demand of polymers
- Potential revenues generation up to 125% from recyclate production

EPR Scenario – What is needed to achieve the targets





- Additional infrastructure capacity needs are mainly related to disposal of plastic waste in engineered landfills (77% for BAU vs 70% for EPR 6); Main contributor to the decline in EPRs is less plastic waste to be disposed thanks to improvement in overall collection and sorting of mixed waste (dirty MRFs)

- Required Investment overall decrease between 2020-2040 are mainly due to a decrease in virgin plastic production (avoided CAPEX in infrastructure) which is replaced by more recylcate being produced; in terms of investments, it will require a $ 1 415 million (EPR 6 formal collection + sorting + recycling).

CSIR
Touching lives through innovation

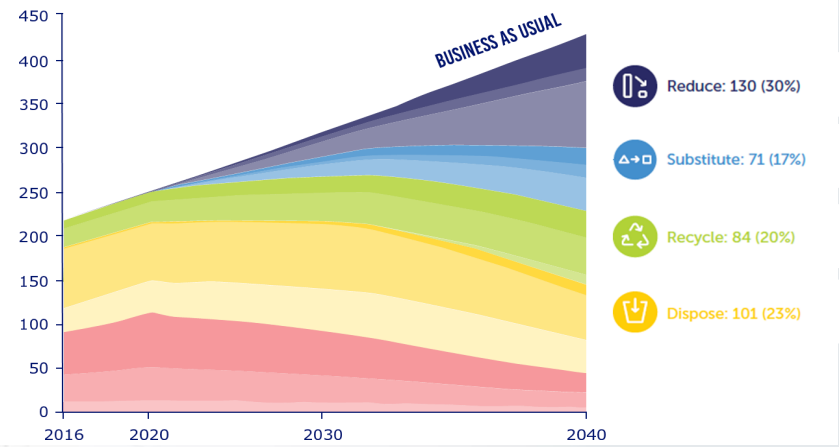
EPR Scenarios – Main findings

- **EPR overall benefits:** pollution reduction of 33%, potential GHG emission reduction of 14%, potential Job creation up to 20%, Potential Revenues generations up to 125%), OPEX and CAPEX showed small reduction

- Need to improve collection and sorting pattern (S@S and Dirty MRFs) to achieve EPR targets and avoiding unintended consequences

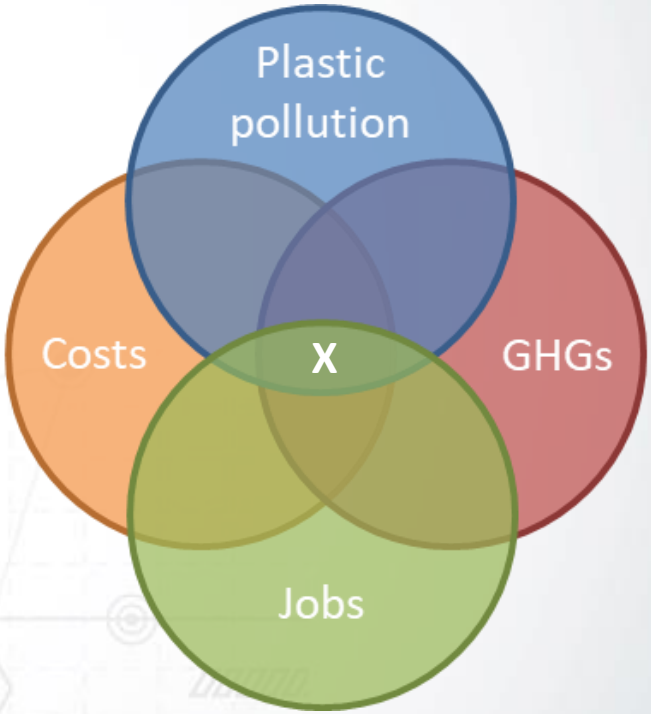
- It is a conservative approach, and it needs further adjustment beyond 2027 to avoid sliding backwards

- It addresses only the **Recycling Wedge**

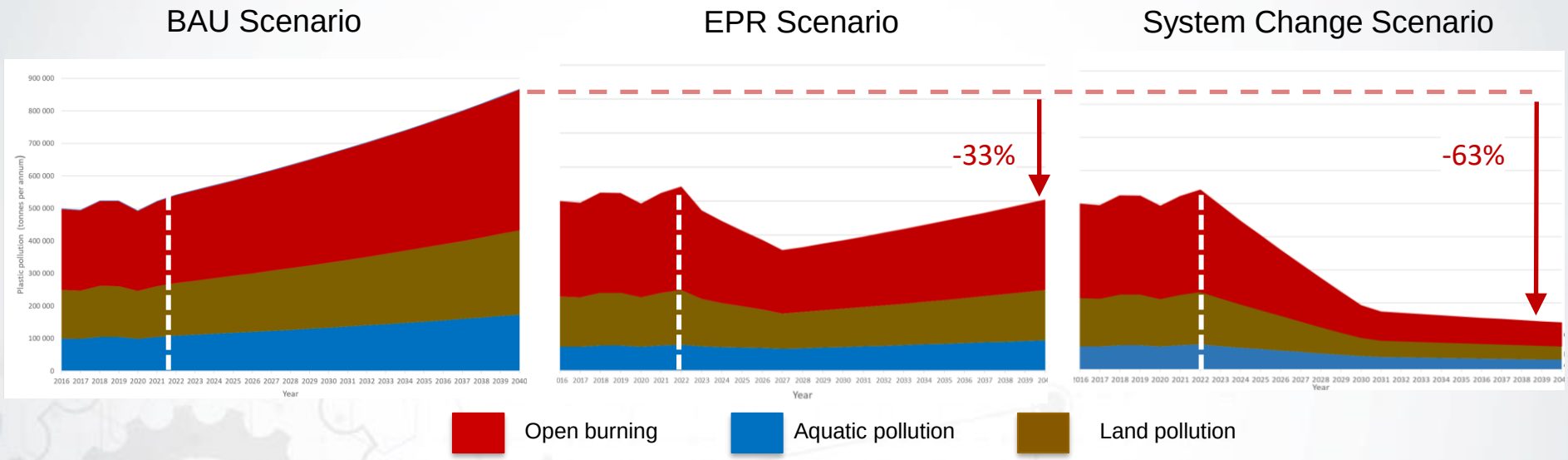


Optimal System Change Scenario

- We often hear statements like –
  - "*Addressing plastic pollution will come at a significant cost*"
  - "*Reducing plastic production and consumption will result in job losses*"
- For this reason, we modelled a scenario that sought to find a "sweet-spot" between least plastic leakage, lowest GHG emissions, at lowest cost, with highest jobs – a trade-off between reducing pollution with infrastructure costs and jobs

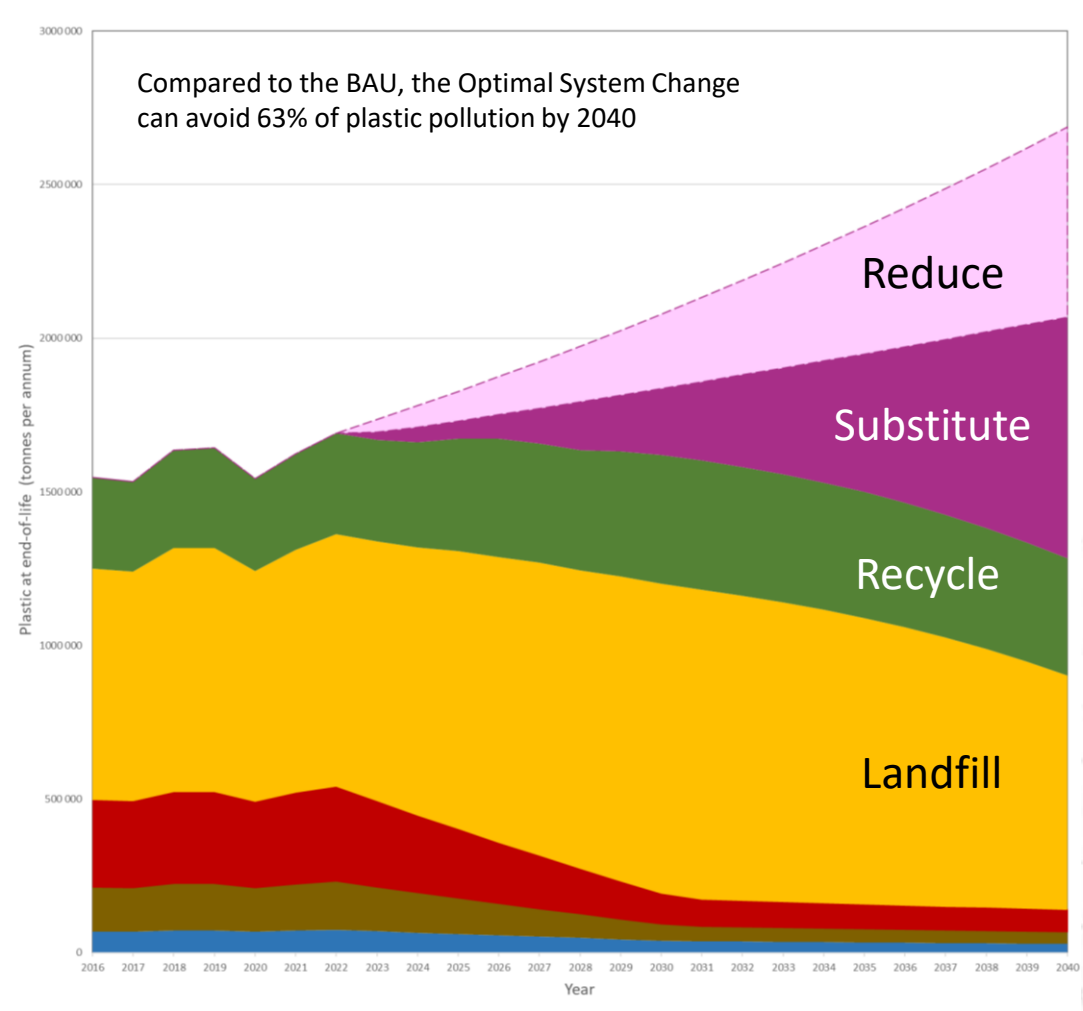


Optimal system change scenario



- As with the global study, the modelling for South Africa shows that there is no single solution to address the plastic pollution problem
- An Optimal System Change intervention requires combined strategies of reducing plastic demand, increasing plastics waste collection and recycling, and increasing the safe disposal of plastics to sanitary landfill, in order to achieve a 63% reduction in plastics pollution, compared to the BAU scenario

Optimal system change scenario



- The Optimal System Change requires both “upstream” and “downstream” interventions and a combination of –
  - Plastic demand decreases by 2.57% per annum
  - Collection increases by 4.85% per annum
  - Recycling increases by 4.87% per annum
  - Disposal to sanitary landfill increases by 3.36% per annum

Optimal system change scenario

- The Optimal System Change scenario can avoid 63% total plastic pollution over the period 2023-2040, compared to the BAU –
  - Aquatic pollution is reduced by 56%
  - Land pollution is reduced by 66%
  - Air pollution from open-burning by 63%
  - GHG emissions are reduced by 37%
- Reduces the cost by 67% as a result avoided capital investments in infrastructure for plastic production, conversion and disposal
- Increases jobs by 3% (excludes possible jobs from alternative material production) compared to BAU

The Optimal System Change has a marginal effect on jobs in the plastics value chain; since job losses are associated with reducing plastic demand, while job gains are associated with increased collection and recycling.

Key recommendations

- A **combined strategy** is required to **reduce** plastics consumption, increase **collection** and **recycling** of all recyclable plastic materials and **properly dispose** of plastics in sanitary landfills (combination of policies and measures)
  - **Strategic interventions** are required to **reduce plastic demand** (re-use, new delivery models, eliminate and substitute with alternative materials)
  - **Management interventions** to **improve waste collection** and management by addressing service backlogs in all municipalities; improve the collection efficiency for all plastics, with the introduction of **waste separation at source** to ensure quality material for recycling
  - Improve landfills so that they are **compliant with legislation** and effectively **contain plastics *in situ***
- Requires a **collaborative approach** between all stakeholders, and a commitment to support the necessary changes across the entire plastics value chain, with **immediate action**

Next steps

- Technical report is being finalized for a November 2022 release
  - Funded by the Department of Science and Innovation and the CISR and will be made publicly available on the Waste Research, Development and Innovation Roadmap website *https://wasteroadmap.co.za/research/grant-046/*
  - It is hoped that the study provides a sound evidence-base to inform South Africa's response to addressing plastic leakage to the environment – engage public and private sectors on the details of the report, and the implications in terms of specific actions to be taken
  - Guide South Africa's input to the INC and the development of an international legally binding instrument on plastic pollution
- The CSIR will launch #SolvePlasticsAfrica, a Science, Technology and Innovation Hub aimed at providing evidence-based solutions to addressing plastic pollution in Africa, through various modelling capabilities
  - Work with other African countries in applying the Pathways Model to understand plastic flows and plastic pollution interventions in-country

Thank you

Dr Eng Valentina Russo

Senior Engineer | Sustainability, Economics and Waste RG | CSIR

Email: VRusso@csir.co.za
Web: www.csir.co.za

Valentina Russo | LinkedIn

CSIR
Touching lives through innovation