Consulting

Unesda and EFBW
Understanding the economic and environmental impacts of tethered caps

Strictly Private and Confidential

30 November 2018

pwc

Contents

Context

On 25th May 2018, the European Commission proposed a Directive on the reduction of the impact of certain plastic products on the environment

On 25th May 2018, the European Commission (EC) proposed a Directive on the reduction of the impact of certain plastic products on the environment. Its main objective is "the prevention and reduction of plastic marine litter from single use products (SUP) items and fishing gear". It aims to achieve this by "defining specific waste prevention and waste management objectives and measures in relation to single use plastic products that are most found on the beaches in the [European] Union and fishing gear containing plastic."

One of the SUPs targeted by the Directive is plastic beverage containers (including their caps and lids). The Directive proposes several measures to reduce marine litter arising from these items including voluntary action and information campaigns, extended producer responsibility (EPR) and a 90% collection target for all Member States. More specifically, for plastic drinks bottles, caps and lids, the measures proposed are:

- Information campaigns which aim to incentivise consumers to use alternatives to single-use beverage containers and ensure caps and lids are not littered, and voluntary actions to reduce the use or sale of single-use plastic drink bottles or installing refillable schemes
- Extending EPR fees in Member States for plastic beverage containers so that they cover a larger share of the costs incurred through the lifecycle
- A 90% separate collection target by 2025 for all Member States for all SUP placed on the market in a given year by weight. To achieve this objective Member States may establish deposit-refund schemes (DRS) or separate collection targets for relevant EPRs
- Product design requirements for beverage containers set out in Article 6 which are intended to ensure that their caps and lids with a significant part made of plastic remain attached to the container during its use and waste stage so that such waste does not leak into the environment.

The main objective of the proposed Directive is to prevent and reduce plastic marine litter from the top 10 most frequently found SUP items

The EC's rationale for its proposed Directive is as follows:

- The amount of marine litter in the oceans and seas is growing and the problem is transboundary in nature.
- Joint international action is needed but the EU has a responsibility to tackle marine litter originating from within it.
- Plastic makes up a very large proportion of marine litter items based on beach counts. In the EU, SUP items represent about half of all marine litter items found on beaches: the 10 items most commonly found account for 86% of the total - the EC Directive focuses on these items. This includes plastic caps and lids from beverage containers.
- Plastic marine litter is persistent and has a detrimental impact on ecosystems, biodiversity and (potentially) human health: it also has adverse effects on (economic) activities such as tourism, fisheries and shipping and represents the loss of a potentially valuable material to the economy.
- Its impacts are growing as more plastic litter accumulates in the oceans and seas.

Although existing environmental and waste management policies are expected to slow the growth of marine litter, the EC believes that further policy measures are needed to address concerns about damage to ecosystems, biodiversity and human health as well as wider economic impacts.

The main objective of the proposed Directive is to reduce plastic marine litter from the 10 most frequently found SUP items.

The mandatory tethering of the caps and lids of plastic beverage containers is seen by the EC as one element of the policy measures to achieve this objective.

Against this context, we were commissioned to examine three aspects of the EC's proposals relating to Article 6

Against the context set out above, PricewaterhouseCoopers (PwC) was commissioned by Unesda (Union of European Union Soft Drinks Association) on 9th October 2018, working closely with EFBW (European Federation of Bottled Water), to review and evaluate the impacts of the EC's proposal in Article 6 of the Directive to introduce a mandatory requirement to apply tethered caps and lids to all plastic beverage containers.

We were asked to examine three specific issues and this report summarises the key findings of our research and analysis:

- Assess **what contribution plastic beverage caps and lids make to marine litter,** especially from SUP

- Estimate the potential **financial and economic costs to producers of soft drinks and water of introducing mandatory tethered caps**

- Assess the **potential unintended impacts of introducing plastic tethered caps and lids**

Our work focuses on the implications of Article 6 for bottlers of soft drinks and bottled water

Some important limitations apply to our research and analysis that reflect its scope.

We focus on:

- The policy measures envisaged within Article 6 of the proposed Directive as set out in May 2018
- The implications for bottlers and their suppliers of plastic bottles and caps and lids
- Soft drinks and bottled water
- The implications for the EU28 as a whole, noting that the proposed Directive may affect third countries.

This means that we have not:

- Undertaken a full Impact Assessment of the proposed Directive: instead we focus on specific aspects of particular relevance to Article 6
- Reviewed in detail the EC's work to assess the likely costs of implementing the policy measures included within the proposed Directive outside Article 6
- Considered the wider implications across the value chain, including the impact on consumers, for example in terms of product acceptance and safety
- Assessed the EC's work to estimate the potential benefits of the Directive as a whole
- Included the impact on producers of other beverages that may use plastic beverage containers and caps such as juices, milk and beers, including those packaged in cartons
- Considered the impact on plastic manufacturing and processing that occurs outside the EU even if the products of these activities feed into the packaging stage of the European soft drinks and packaged water value chain.

Our approach is based on in-depth consultations with industry experts (including engineers and plant managers) as well as site visits and review of secondary sources

No established technologies which have been widely accepted by consumers currently exist for addressing all the requirements of Article 6 (i.e. tethering the caps and lids of plastic beverage containers). More specifically, we understand that no solution currently exists for carbonated drinks, and, although products exist for still drinks, their market take up is limited. This means that the solutions we have considered are necessarily hypothetical.

This has influenced our approach to the research and analysis:

- We have worked with industry experts, engineers and plant managers – including bottlers and plastic cap/lid and bottle suppliers – to understand the bottling process and the likely impacts arising from addressing Article 6
- We have conducted site visits to assess the cost implications of Article 6 which have enabled us to see how the bottling process would be affected and to conduct in-depth interviews with experts employed within the affected supply chains (cap converters and preform (what is used to make the bottle) manufacturers) to assess the cost implications
- We have supplemented this with a review of other evidence, including the EC's analysis and other secondary sources.

Our report is structured in four further sections

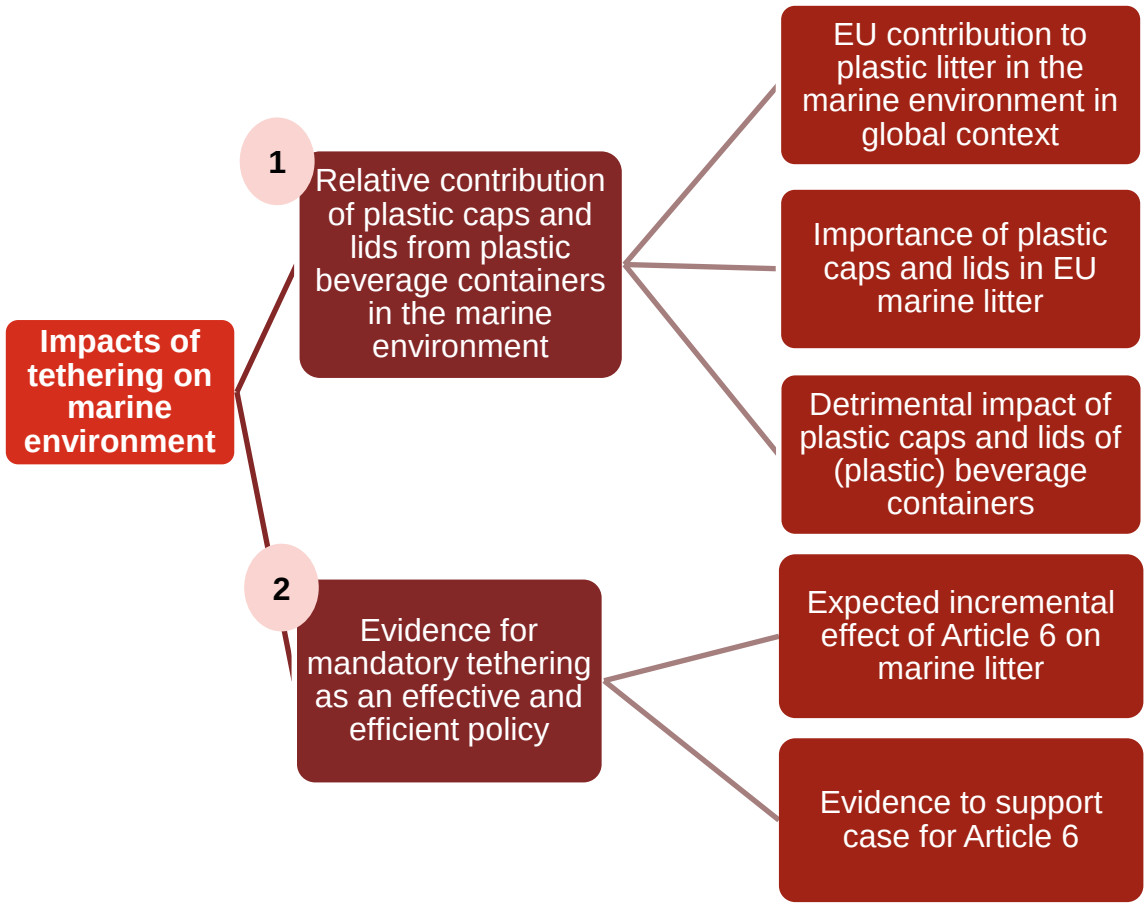
Our report is structured in four further sections:

- **Section 2** examines briefly the evidence of the contribution of plastic beverage caps and lids to marine litter in the EU, especially from SUP, and assesses the implications for the EC's rationale for introducing mandatory tethering
- **Section 3** analyses the potential financial and economic costs to producers of soft drinks and bottled water of introducing tethered caps
- **Section 4** assesses the potential unintended impacts of mandating tethered plastic caps and lids on the volume of plastic waste and the associated environmental impacts
- **Section 5** summarises the eight key conclusions of the work.

In addition, we provide further details on the assumptions and sources underlying our analysis in the Annex and References.

Understanding the impact of plastic caps from soft drinks and bottled water on the marine environment

Our analysis focuses on two key issues, each with a set of subsidiary questions



This section of our report analyses the evidence used by the EC to support its proposal of Article 6 in the Directive. This evidence is presented in the EC's Impact Assessment (IA) alongside the proposed Directive.

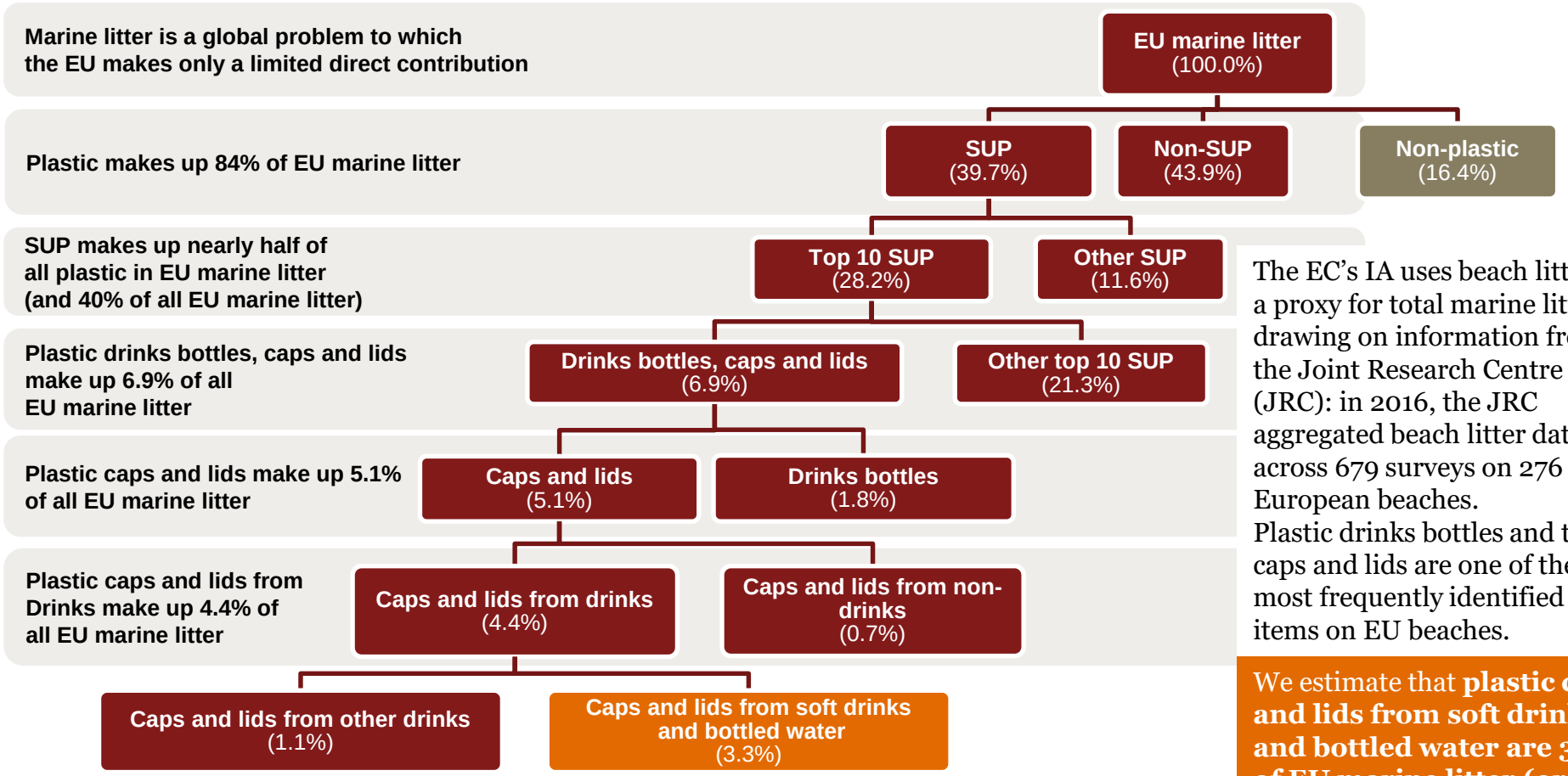
Our research and analysis have focused on analysing the robustness of the evidence which the EC has used to support the imposition of mandatory tethering of the caps and lids of plastic beverage containers (bottles).

We have focused on two key issues:

1. The relative contribution of plastic caps and lids from plastic beverage containers (bottles) compared to other types of litter found in the marine environment
2. The strength of the evidence for mandatory tethering as an effective and efficient policy for reducing the impact of SUP.

Based on beach litter clean up data, caps and lids from plastic soft drinks and bottled water contribute 3.3% of EU marine litter by count

EU marine litter based on beach litter clean ups, million count (2016, % of EU marine litter)



The EC's IA uses beach litter as a proxy for total marine litter drawing on information from the Joint Research Centre (JRC): in 2016, the JRC aggregated beach litter data across 679 surveys on 276 European beaches.
Plastic drinks bottles and their caps and lids are one of the ten most frequently identified SUP items on EU beaches.

We estimate that **plastic caps and lids from soft drinks and bottled water are 3.3% of EU marine litter (or 12% of top 10 SUP)**

Sources: Eunomia / ICF (2018), European Commission Impact Assessment Part 1/3 (2018), Industry reports

The EC's Impact Assessment considers four options for addressing plastic drinks bottles, caps and lids

Evidence to support the EC's Impact Assessment shows that marine litter can damage ecosystems, biodiversity, human health and (economic) activities such as tourism, fisheries and shipping but it is difficult to attribute to particular types of SUP.

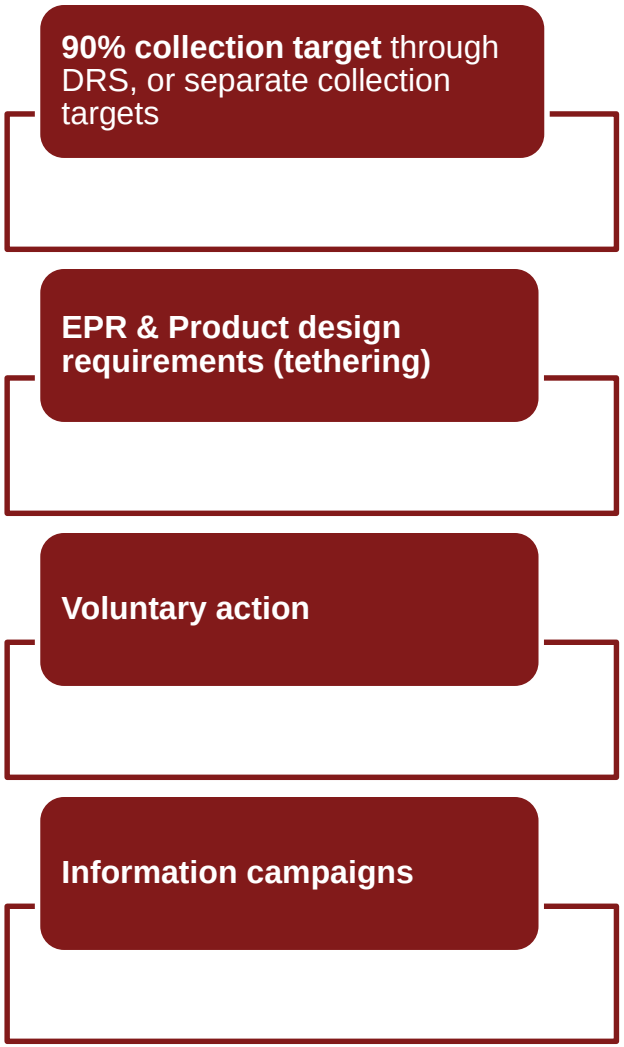
For plastic bottles and caps, the EC has considered the policy measures illustrated.

The EC's analysis shows that, for plastic bottles and caps, the proposal for a 90% collection rate for SUP for Member States through deposit-refund schemes (DRS) or by establishing separate collection targets for relevant EPR schemes is by far the most effective way of reducing the volume of plastic litter from bottles and caps in the marine environment.

The EC's analysis appears to imply that both producers and consumers may gain from the introduction of the combination of product design requirements (tethering) and EPR.

Furthermore, it does not consider the impact on consumer welfare and the impact on producers focuses on turnover not value added.

The EC's policy proposals in ***Article 6 are based on the premise that the costs to producers are at most small but they are not – we assess the potential costs of tethering to producers in the next section***



Understanding the costs of Article 6 to producers

Our approach to estimating the costs of Article 6 is based on understanding the potential changes to the bottling process from receiving materials (caps and preforms) to filling and labelling bottles

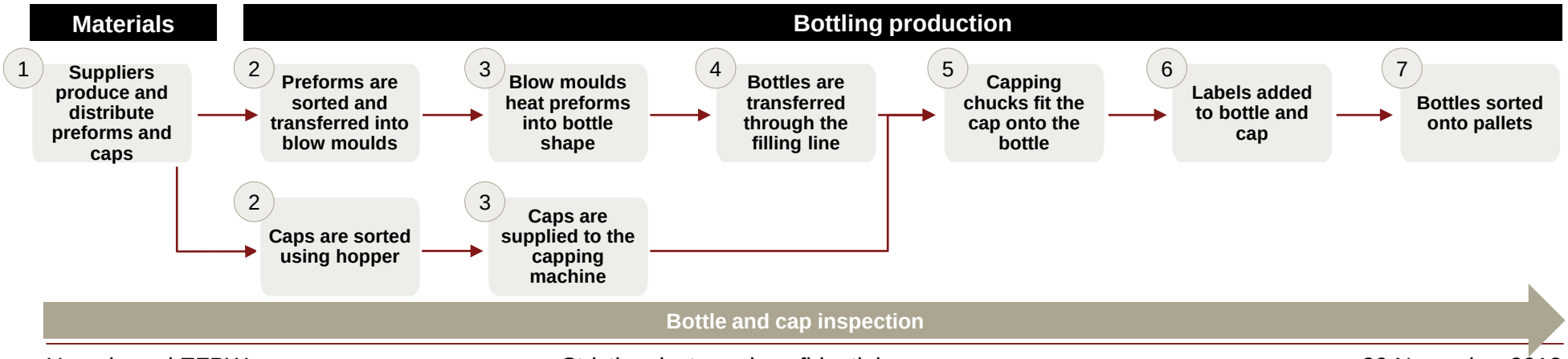
Our approach to estimating the economic costs associated with Article 6 for bottlers is based on understanding the bottling production process from receiving materials to filling and labelling bottles: we do not consider the wider value chain.

The figure below illustrates **the seven steps in producing a soft drink or bottled water**:

1. Cap converters and preform (i.e. a preform is used to make a bottle and is specific to bottle neck and weight) manufacturers (suppliers) produce and distribute preforms and caps (also referred to as closures): the moulds and machinery are specific to the type of cap and preform (i.e. type of bottle neck and weight) (Step 1)
2. Preforms are transferred to blow moulds and caps are sorted using a 'hopper' machine: the process is specific to the type of cap and bottle neck in use (Steps 2)
3. Blow moulds heat the preforms into bottles and caps are supplied to the capping machine: these processes are configured for specific necks and caps (Steps 3)
4. Bottles are then transferred through the filling line: this process is specific to the bottle neck type because the transfer machine holds the bottles by the neck (Step 4)
5. Capping chucks fit the caps onto the bottle: this step is specific to the type of caps (Step 5)

6-7. Labels are added and bottles are sorted into pallets for distribution (Steps 6 and 7).

In summary, **the configuration of the process and the equipment used are specific to the preform (i.e. bottle neck) and cap type**.



We conducted site visits and in-depth consultations with industry experts to understand the potential changes in the bottling process required under two scenarios related to Article 6

We consulted industry experts to understand what changes may be required in the bottling process as a result of Article 6.

No established solutions for tethered caps which have been widely accepted by consumers currently exist for addressing all the requirements of Article 6. No solution (tethered cap) currently exists for carbonated drinks, and, although some products exist for still drinks, their market take up is limited. This means the solutions we have considered are hypothetical. We have defined two potential scenarios:

- In **Scenario 1**, we assume that a tethered cap will be developed that will fit all existing neck types (preforms)
- In **Scenario 2**, we assume that a solution for a tethered cap will be developed which also requires a neck change (i.e. preform change). This is based on conversations with experts who believe that a tethered cap will also require a heavier bottle for stability and consumer safety.

To assess the cost implications of the two scenarios, we conducted site visits to understand how the bottling process would potentially be affected. We also conducted in-depth interviews with experts employed within the affected supply chains to assess the cost implications.

In Scenario 1, only the stages that involve the caps would require reconfiguration or replacement – for example, the machinery that screws caps on bottles.

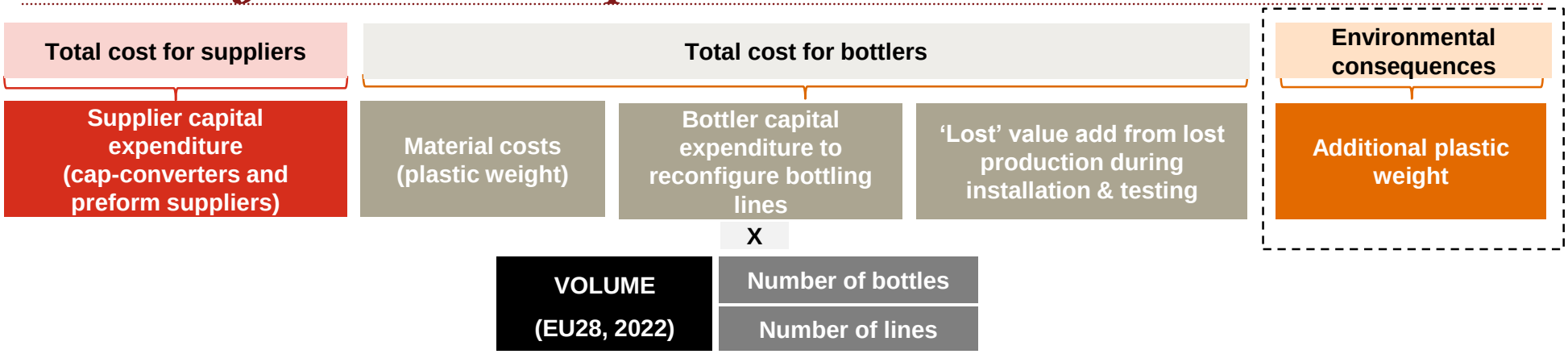
In Scenario 2, more stages will require change to adapt the process and machinery to both new caps and new preforms (i.e. new bottle necks).

The table below illustrates the changes required at each stage of the bottling process under each scenario.

Elements of the bottling process requiring change

Stage	1	2	3	4	5	6	Other
Scenario 1: Assumes cap change only	• Cap-form injection moulds	• Cap hopper	• Cap delivery system		• Capping chucks • Capper modifications	• Labeller changep arts	• Camera inspection systems
Scenario 2: Assumes change in both cap and preform (i.e. neck)	• Cap-form injection moulds • Preform injection moulds	• Cap hopper • Preform transfer system	• Cap delivery system • Blow moulder moulds	• Fillers and rinsers	• Capping chucks • Capper modifications	• Labeller changep arts	• Camera inspection systems • Conveyor belts

Our approach to estimating the costs is based around understanding the costs of the changes for each bottling line and how many lines will be impacted



In thinking about the cost implications of the changes, we identified the costs that would be incurred and grouped them into three categories:

- **The additional costs incurred by suppliers** (cap converters and preform manufacturers): one-off capital costs to reconfigure their machines (e.g. injection moulds) to manufacture new caps and/or preforms
- **The additional costs incurred by bottlers**:
  - Recurrent costs of additional **material** as a result of additional plastic for the tethered caps and/or new preforms
  - One-off **capital investments** to reconfigure the bottling line
- **'Lost' value added**: the reduction in the sector's economic contribution as a result of lost production during **installation and testing** of bottling lines after reconfiguration**.**

The drivers of the costs are sometimes **the number of bottling lines** (e.g. capital expenditure) and sometimes the **volume of bottles filled** (e.g. material cost).

Our cost estimates are based on evidence and assumptions gathered during our site visits and consultations with industry experts

Our cost estimates:

- Are based on an estimate of the average annual production of different types of bottling line: this drives both the estimated number of lines impacted by Article 6 and, therefore, capital investment costs but also drives the estimated 'lost' production during reconfiguration
- Assume that the transition for both carbonated and non-carbonated drinks will occur in 2022; we test the likely impact on cost if this transition is deferred to 2024
- Include the impact of Article 6 on soft drinks and bottled water in plastic beverage containers (bottles) but exclude other beverages, for example juices and dairy product but also beverages packaged in cartons
- Do not account for any long-term loss in production due to reduced speed of lines and do not consider substitution effects (e.g. change in consumer behaviour).

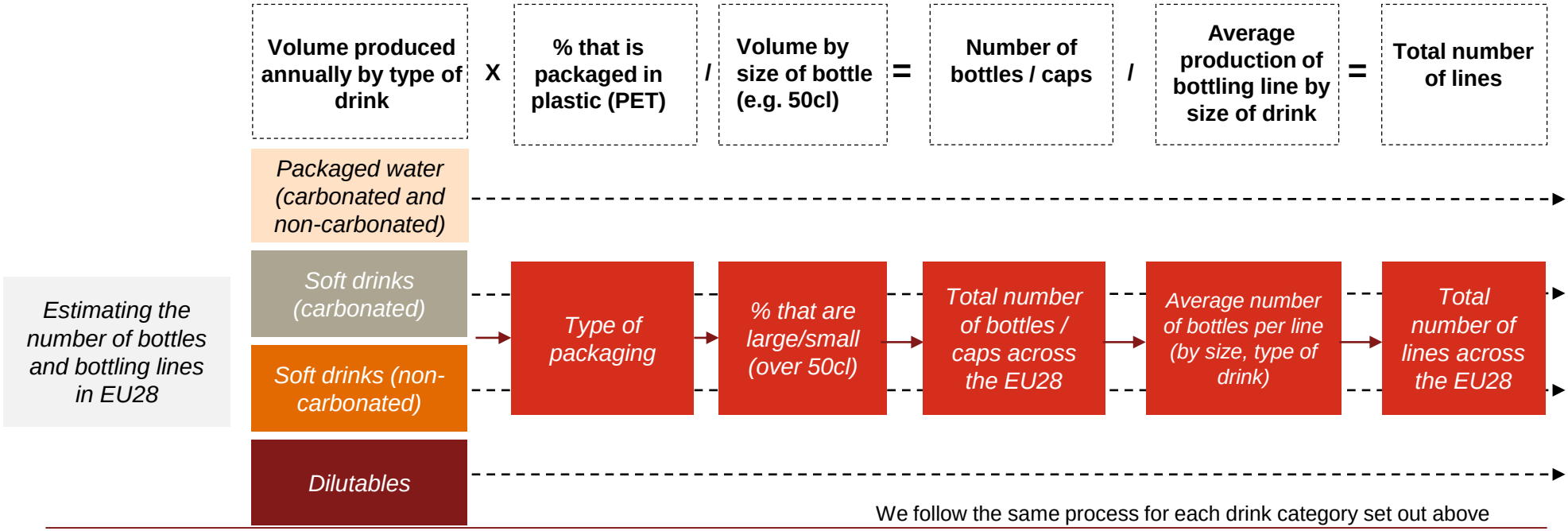
For these reasons, the results presented in this report take a prudent view on the potential cost implications of Article 6 for bottlers and their suppliers.

Our first step is to estimate the number of bottles and bottling lines impacted by Article 6

We first estimate the **number of bottles** and **number of bottling lines** that will be affected across the EU28 as a result of Article 6 by 2022. We use information on the volume of production (million litres) by type of drink and size of bottle and the share of plastic (PET) packaging in 2017 from Global Data. We use historical annual growth rates to forecast the volume of production in 2022. We then divide the production volume by the average size of bottles to estimate the total number of bottles (and caps) in 2022.

Based on discussions with industry experts, we estimate the average number of bottles produced by a bottling line in a given year. We divide our estimate of the number of bottles by the average number of bottes produced by a bottling line in a year to estimate the number of bottling lines that will need to be reconfigured.

Our approach to estimating the number of bottles and bottling lines impacted by Article 6



Key principles to estimating total costs for bottlers to meet the requirements of Article 6

Key principles

Our 'unit cost' estimates reflect the potential economic costs associated with reconfiguring bottling lines to meet the requirements of Article 6 by 2022.

We distinguish the potential economic costs of Article 6 between:

- Those that will be incurred by suppliers (and eventually passed-on to bottlers)
- Those that will be incurred by bottlers directly.

We estimate two types of economic costs:

- Resource costs associated with expenditure by bottlers and their suppliers which include:
  - One-off capital investments to reconfigure bottling lines and replace assets no longer capable of producing products that comply with Article 6
  - Recurrent material costs
- Opportunity costs which we estimate as 'lost' value added (if production ceases or is slowed during reconfiguration to meet the requirements of Article 6) which reduces the sector's economic contribution.

We do not assess the potential costs across the wider value chain (e.g. on consumers).

Interpretation of our cost estimates

Our cost estimates need to be interpreted with care as they do not account for:

- The value of any existing assets that become "stranded": this would arise if parts of bottling lines that have not reached the end of their economic lives need to be written-off because they have no alternative use with Article 6
- Any substitution effects which may occur during downtime and or testing phases (as consumers switch to products which use other types of packaging)
- Any long terms loss (or increase) in line efficiency following reconfiguration to meet Article 6 requirements.

It is also important to consider how far, if at all, bottlers and their suppliers would incur any of the costs under a business as usual scenario (i.e. in the absence of the requirements of Article 6):

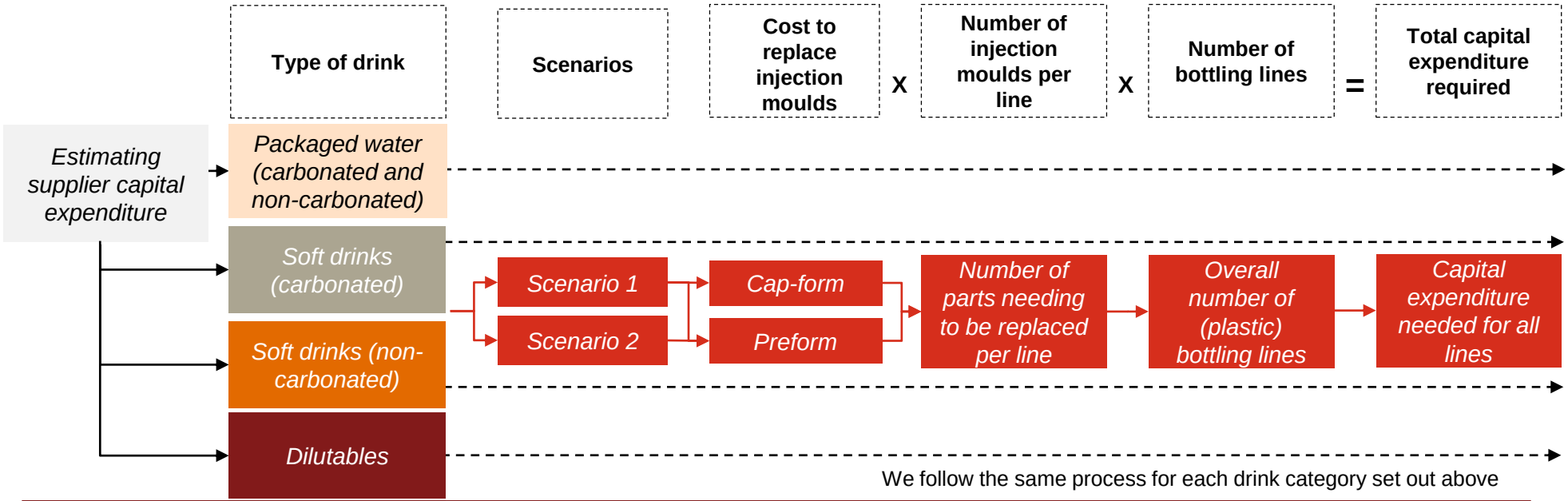
- We recognise that bottlers and their suppliers regularly undertake maintenance and upgrading of their production processes, however, our interviews with them suggest that the reconfiguration required by Article 6 goes well beyond this
- Moreover, bottlers' ability, in particular, to absorb some of the costs is influenced by their size and the amount of time they have to transition: it is possible that larger bottlers may be better able to manage their production, although this could involve additional logistics costs which we have not assessed.

We estimate the capital expenditure requirements for cap and preform suppliers

The first element of cost we consider is the additional *capital expenditure* that *suppliers* of caps and preforms will need to invest to enable bottlers to meet the requirements of Article 6. For suppliers of caps and preforms, we estimate these costs by considering the costs required to replace injection moulds for caps and preforms (Scenario 1 and 2 respectively); suppliers will need to invest in reconfiguring and/or replacing injection moulds for caps and / or preforms. We then identify the number of moulds that will need to be changed. Finally, we multiply our estimate of the number of moulds per line by the total number of bottling lines to estimate the total supplier capital expenditure requirements.

These costs represent one-off capital investments incurred by suppliers. We expect that most of these costs will be 'passed-on' to bottlers and that some of these costs would not be incurred in the absence of Article 6 since they are associated with reconfiguration for new bottle necks or cap types rather than maintenance or upgrading of their production processes.

Our approach to estimating supplier capital expenditure for suppliers

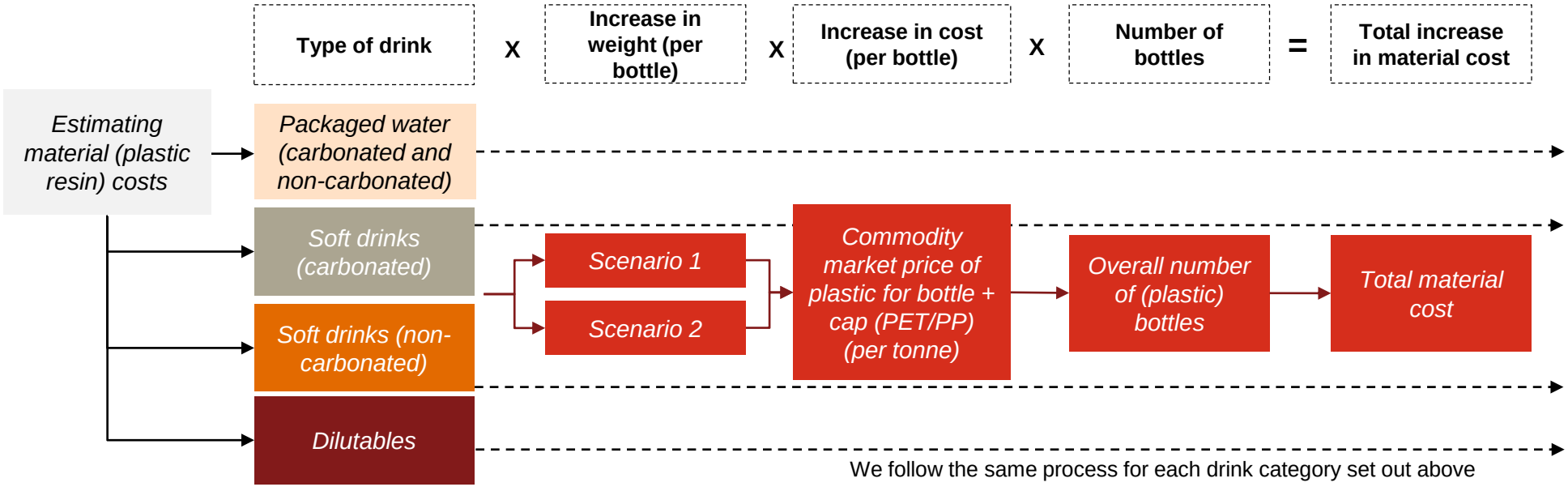


We estimate recurrent additional costs to bottlers of additional material (i.e. plastic resin) as a result of tethered caps

The second element of cost we consider is the additional *material cost (i.e. plastic resin)* that *bottlers* will face to meet the requirements of Article 6. To estimate this cost, we developed different scenarios with industry experts that define the potential increase in weight of both the cap and the preform by type of drink. We then multiply the expected weight increase per scenario by the cost of PP/PET resin on the commodity market to estimate the additional material cost per bottle. Finally, we multiply this additional material cost by the overall number of bottles produced to estimate the total material cost to bottlers across the EU28.

This material investment represents a recurrent cost to bottlers due to the additional plastic resin required under both hypothetical scenarios. This additional cost would not be incurred under business as usual (i.e. in the absence of Article 6).

Our approach to estimating bottler material cost



We estimate the capital investments required by bottlers to reconfigure their bottling lines

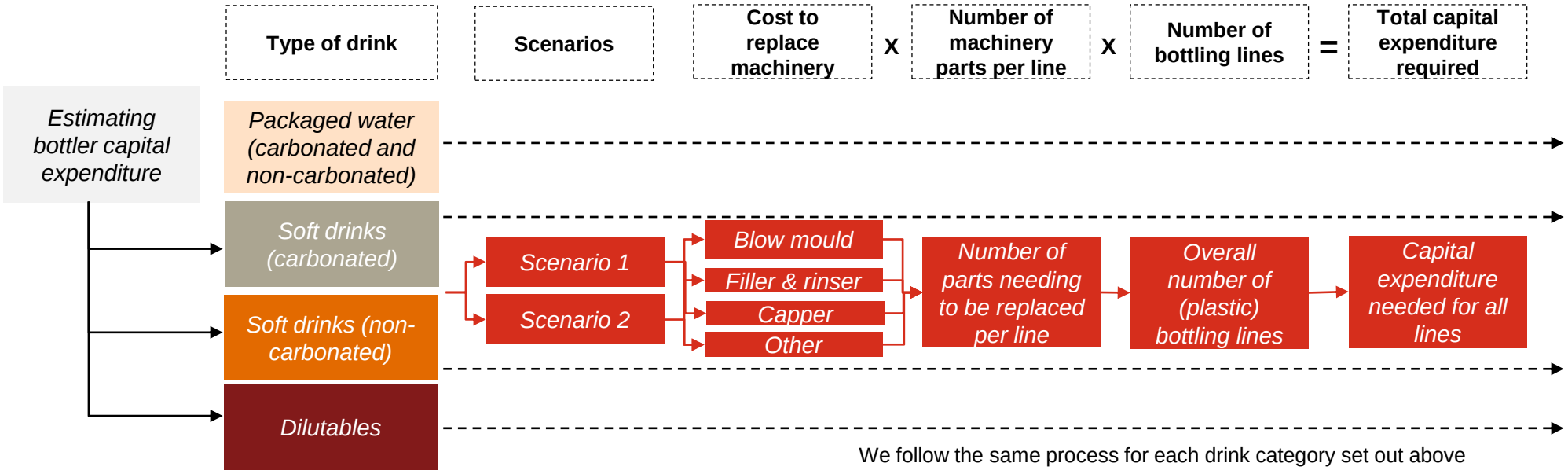
The third element of cost we consider in our analysis is the *capital expenditure* that *bottlers* will need to undertake to meet the requirements of Article 6.

To estimate this cost, we visited bottling plants and spoke to industry experts to understand the elements of the production line that would need to be reconfigured at each stage of the process under our two different scenarios.

We then obtained cost estimates for each part of the machinery that would require reconfiguration and estimated the number of machinery parts per line to derive the average capital investment required by bottlers by line.

Finally, we multiplied these capital expenditures by the total number of bottling lines to estimate the total one-off capital investment required by bottlers under our hypothetical scenarios across the EU28.

Our approach to estimating bottler capital expenditure



Finally, we estimate the cost of 'lost' value added during bottling line reconfiguration and testing

The final element of cost we consider within our analysis is the '*lost' value added* that *bottlers* incur during periods of downtime and testing (e.g. the amount of GVA that the industry cannot contribute to the economy during reconfiguration of bottling lines).

To clarify, we define these periods as:

- The amount of time that the line cannot run due to new machinery being installed (downtime).
- The length of time required before the bottling line can reach its pre-installation speed and efficiency (testing).

To assess the cost of these, we look at the downtime and testing period required under both scenarios to estimate the number of bottles not produced. We look at installation and testing especially for reconfiguration to meet the Article 6 requirements rather than usual maintenance and upgrading of the bottling lines.

We then multiply the number of bottles by the value added per bottle to estimate the total value added 'lost' during this period of downtime and testing across the EU 28.

We also note that our estimates do not account for any long-term loss of speed/efficiency or substitution effect (i.e. we assume no change in long-term speed of the line after installation and testing).

Finally, we note that our results are based on an estimate of the average number of bottles produced by a line per year. The estimate has two effects on the estimated 'lost' value added:

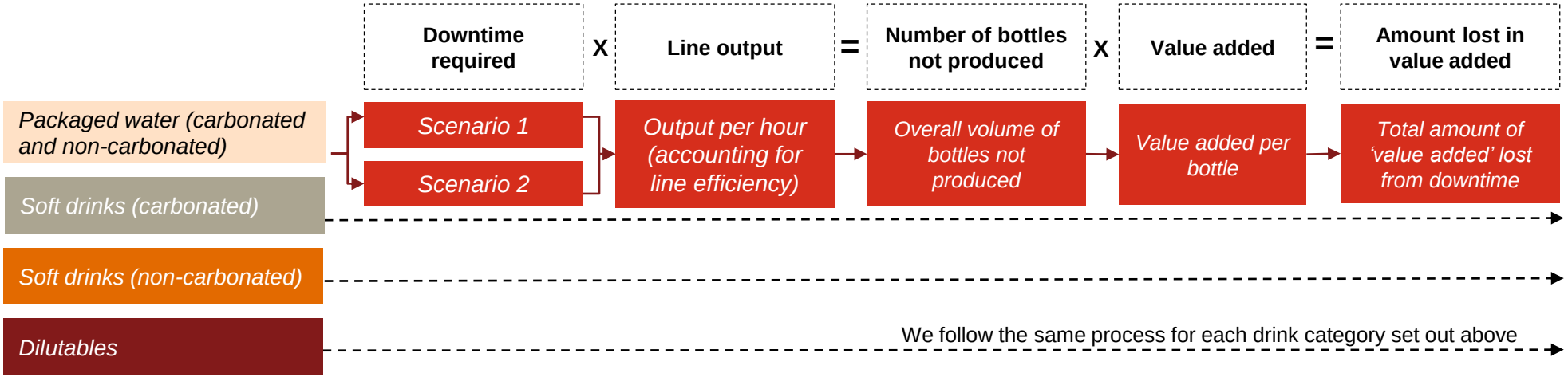
- A higher line production would imply less overall number of lines in the EU28 that would be impacted by Article 6
- A higher line production would imply a higher number of 'lost' production during reconfiguration.

These two effects work in the opposite direction.

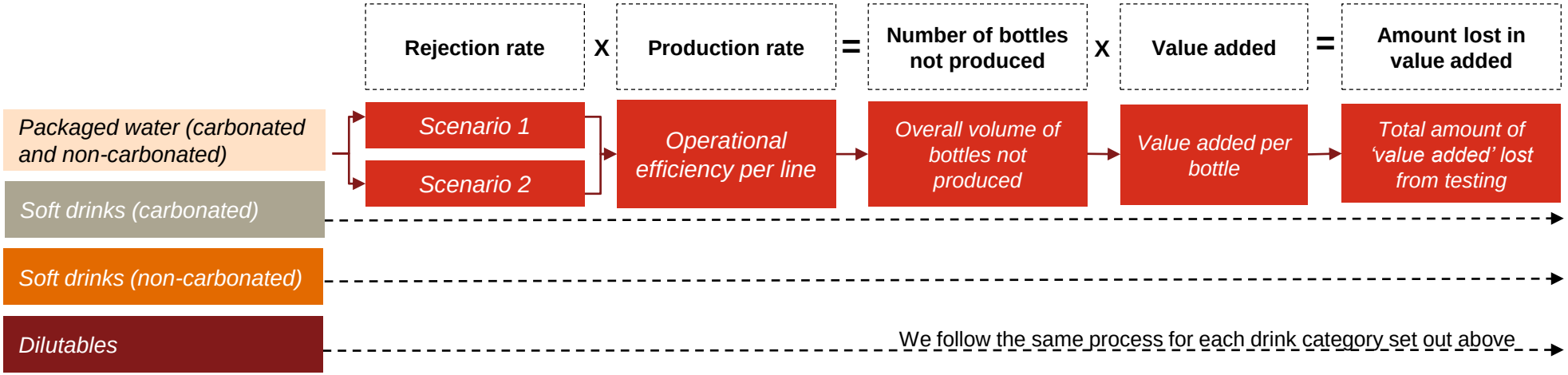
For further details of our approach to estimating 'lost' value added, please see the next slide.

Our approaches to estimating the cost of 'lost' value added during bottling line reconfiguration and testing are slightly different

Our approach to estimating the cost of bottling line downtime (Stage 1)

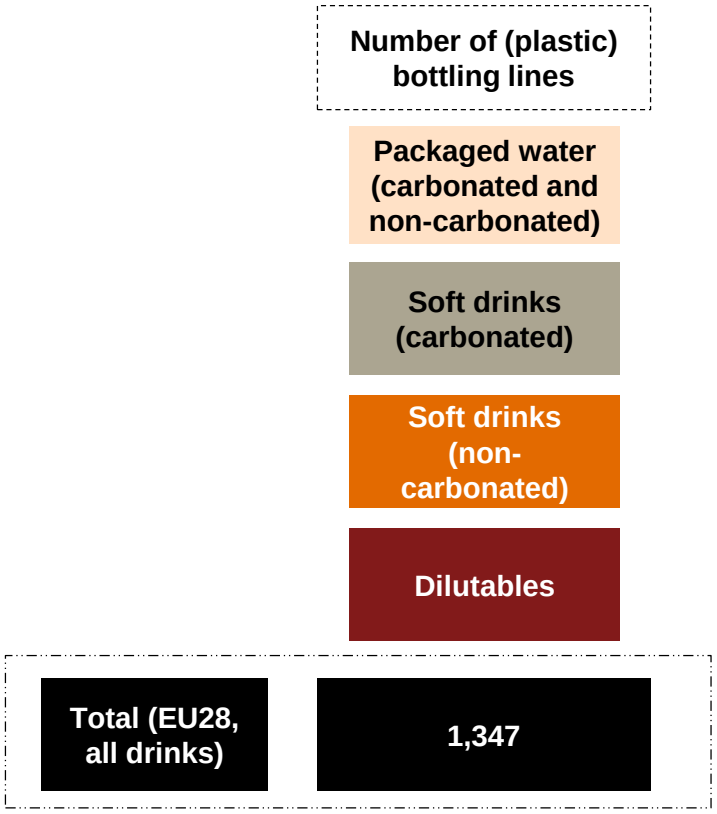


Our approach to estimating the cost of bottling line testing (Stage 2)



In 2022, we estimate that 1,350 bottling lines for soft drinks and water packaged in plastic bottles could be impacted by Article 6 across the EU28

Number of (plastic) bottling lines, EU28 (2022)



To estimate the number of (plastic) bottling lines that will be impacted by Article 6 in 2022 we:

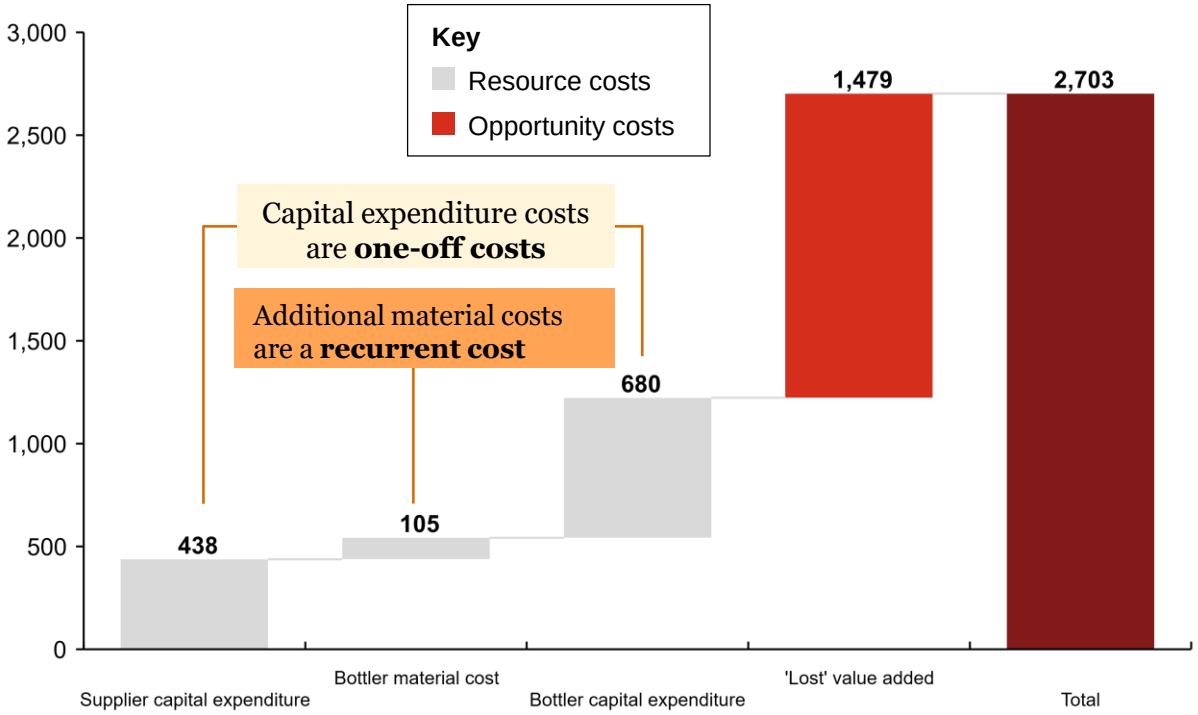
- Use information on the volume of production (million litres) in the EU28 by type of drink (packaged water – carbonated and non-carbonated, soft drinks – carbonated, soft drinks – non-carbonated, and dilutables) and size of bottle from Global Data
- We forecast the volume of production (million litres) in 2022 using the historical annual growth of each type of drink
- We then divide the total volume of production by an average size for small (less than 500ml) and large (more than 500ml) bottles to estimate the total number of (plastic) bottles produced in the EU28 in 2022
- Based on discussions with industry experts, we estimate the average number of bottles produced by a (plastic) bottling line in a given year. Although this will likely differ by producer, type and size of drink, we use *76m bottles per line* annually as a representative figure across the industry.

This results in an estimated **c. 1,350 (plastic) bottling lines** for soft drinks and bottled water will be impacted by Article 6 in 2022. Assuming a line capacity of c. 25% (50m or 100m bottles per line) lower or higher would result in 1,700 and 1,000 bottling lines respectively.

Source: Global Data, Interviews with industry experts, PwC analysis

With only a change of cap (Scenario 1) mandated tethered caps could cost the industry an estimated ~€2.7bn, with gross value add from 'lost' production constituting over half of this cost

Breakdown of industry costs in Scenario 1 (€m, 2017 prices, 2022 year of policy implementation)



Minimum cost (€m)	202	67	471
Maximum cost (€m)	674	143	889

Source: Global Data, Interviews with industry experts, PwC analysis

Under Scenario 1 (where only the cap requires changing), we estimate that industry costs would be approximately **c. €2.7bn.**

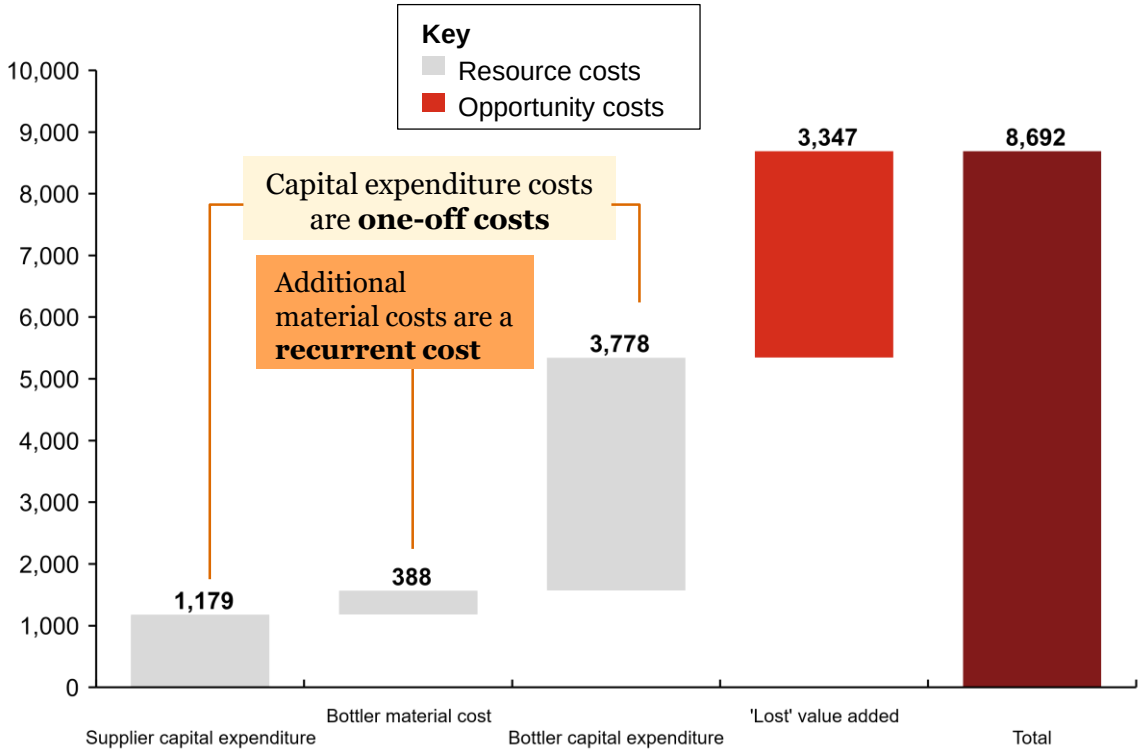
The ***'lost' value added*** is the largest proportion at **c. €1.5bn** (**c. 55%**). This excludes any substitution effect which may occur during the period (e.g. if consumers switch to cans instead of PET bottles). It also assumes no change in the long-term speed of the line after installation and testing periods. A decrease in speed would represent a significant cost for bottlers: for example, we estimate that a 1% reduction in line output per hour across all lines would increase the lost production by approximately c. **€486m**.

The second and third largest elements of cost are ***bottler and supplier capital expenditure*** **(c. 41%)** - which we estimate at approximately **€680m** and **€438m** respectively across the EU28.

The ***material cost to bottlers*** constitutes the smallest percentage of overall cost at **c. €105m** (**c. 4%**) – this cost will recur year on year.

With both a cap and a neck change (Scenario 2), the cost of Article 6 to bottlers could be ~€8.7bn, with capital expenditure from bottlers accounting for c. 45% of the total figure

Breakdown of industry costs in Scenario 2 (€m, 2017 prices, 2022 year of policy implementation)



Minimum cost (€m)	808	348	2,169
Maximum cost (€m)	1,549	428	5,388

Source: Global Data, Interviews with industry experts, PwC analysis

In Scenario 2 (where both the cap and neck form require change), we estimate that the cost to industry could be **c. €8.7bn**.

Unlike in Scenario 1, the ***capital expenditure*** required by bottlers constitutes the largest percentage of the overall figure (**c. 43%**) – at c. **€3.8bn**. It constitutes a higher proportion than in Scenario 1 due to the increased capital expenditure required by bottlers to modify their lines.

Similarly, we estimate that ***suppliers*** will have to ***invest*** **c. €1.2bn** in Scenario 2.

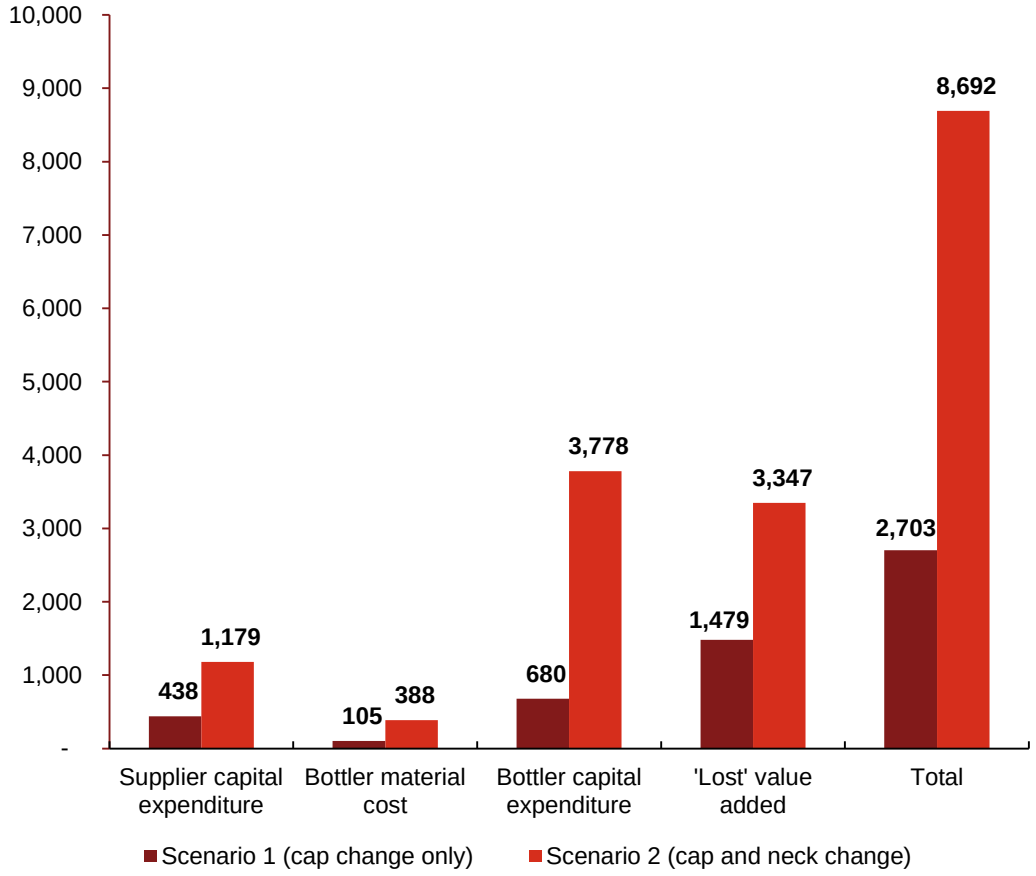
The 'lost' value added during downtime and testing periods increases to **€3.3bn** in Scenario 2, though as mentioned above this constitutes a lower proportion of overall cost than in Scenario 1 (**c. 39%**).

As with Scenario 1, the ***material cost to bottlers*** constitutes the smallest percentage of total cost (**c. 5%**) – at around **€388m** with an estimated range of €348m to €428m driven by the assumptions on the additional weight for the neck and cap in Scenario 2.

As with Scenario 1, the estimate of 'lost' value added does not take into account any substitution effects or long-term loss in line speed.

With both a cap and a neck change (Scenario 2), the cost of Article 6 to bottlers could be over three time times more compared to a cap change only (Scenario 1)

Breakdown of industry costs in Scenario 1 and Scenario 2 (€m, 2017 prices, 2022 year of policy implementation)



The cost of Article 6 to the soft drinks and packaged water industry depends on the type of cap solution identified.

If the industry cannot avoid a solution that requires a change in both the cap and the neck-form, then it will cost an additional **c. €6.0bn** to implement.

The biggest increase will be:

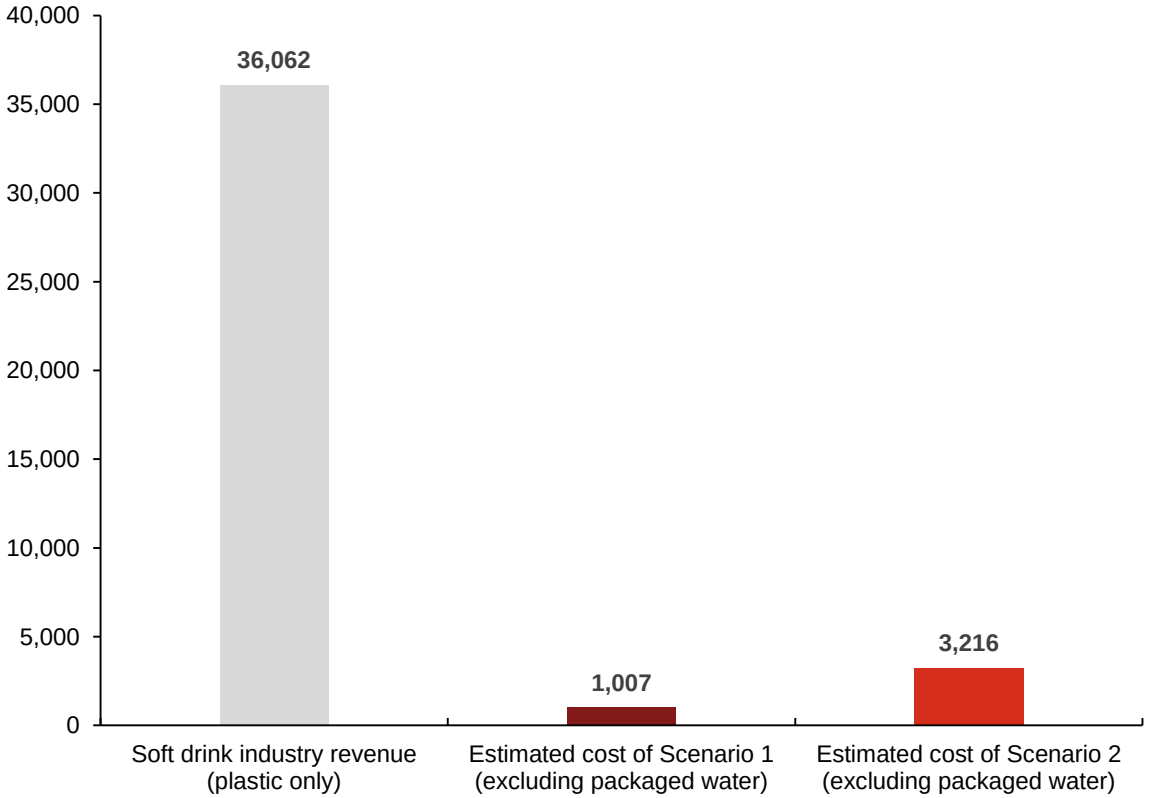
- Bottler capital expenditure – which we estimate will increase by **c. €3.1bn** between the two scenarios due to the scale of the change that would be required in the bottling process
- 'Lost' value added that would increase by **c. €1.9bn** driven by the additional downtime and testing needing on bottling lines
- The capital investment required by suppliers would increase by almost **€741m** between Scenario 1 and Scenario 2.

We estimate that the recurrent material cost to bottlers could rise by **c. €283m** between the two scenarios, driven by the additional plastic resin used in the preform under Scenario 2. It would still be the smallest proportion of total cost (**c. 4%**).

Source: Global Data, Interviews with industry experts, PwC analysis, Unesda (2016)

The estimated costs for soft drinks bottlers associated with Article 6 could constitute c. 3 – 9% of the soft drink industry's annual turnover

Comparison of soft drink industry annual revenue and estimated cost of Scenario 1 and Scenario 2 (2017 prices, €m)



Source: Global Data, Unesda (2016), PwC analysis

We have compared the estimated costs to soft drinks bottlers with their annual sales across the EU28 based on Unesda's socio-economic report which estimates the direct revenue for the soft drink industry in 2016 at **€52.5bn**.

We then use information from Global Data on the volume of production by type of packaging to estimate the share of soft drinks packaged in plastic containers (**c. 69%**).

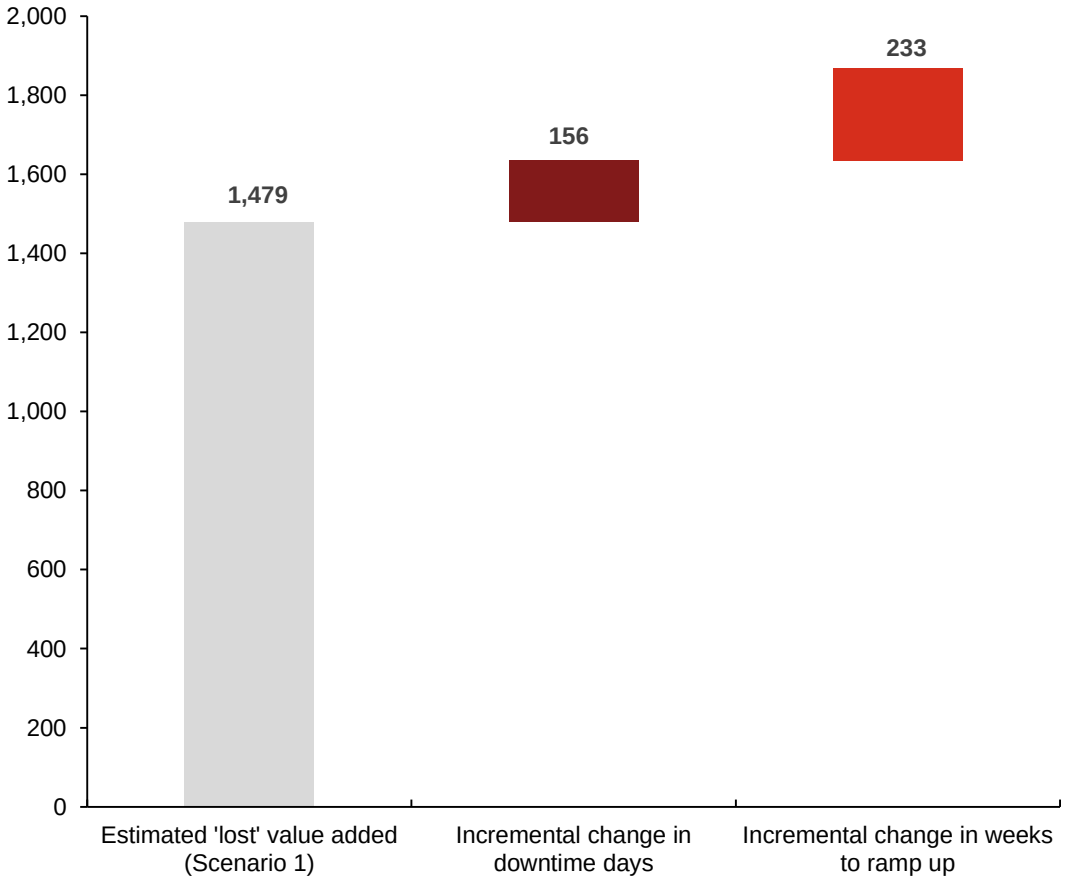
We then multiply the total direct revenue for the industry by the share of plastic containers for soft drinks to estimate soft drink industry (plastic only) revenue to be **c. €36bn.**

We then compare this with our estimates of total costs for soft drinks bottlers only under Scenario 1 (c. **€1.0bn**) and Scenario 2 (c. **€3.2bn**).

Our analysis shows that, depending on the tethering solution developed, Article 6 could cost the soft drinks industry between **3%** (Scenario 1) and **9%** (Scenario 2) of its annual sales.

The scale of the estimated 'lost' value added depends on the duration of the reconfiguration to meet Article 6 requirements

Marginal increase in 'lost' value add during downtime and installation period (€m, Scenario 1, 2017 prices, 2022 year of policy implementation)



The chart shows how the estimated 'lost' value added would change if:

- Downtime increases (or decreases) by one day (i.e. the value of bottles produced in one day)
- The duration of the testing phase increases (or decreases) by one week (i.e. the value of bottles that will not be produced as a result of lower line efficiency and utilisation during testing).

We estimate that:

- An *additional day of downtime for line reconfiguration* to meet Article 6 requirements would add *€156m* in 'lost' value added by increasing the number of bottles lost
- An *additional week for testing* the bottling line before it reaches its pre-installation speed would add *€233m* in 'lost' value added
- The estimated cost in terms of 'lost' value added associated with an additional day of downtime or an additional week of testing is the same in Scenarios 1 and 2.

Extending the transition period to 2024 is likely to have a lesser impact in terms of value added as a result of 'lost production' …

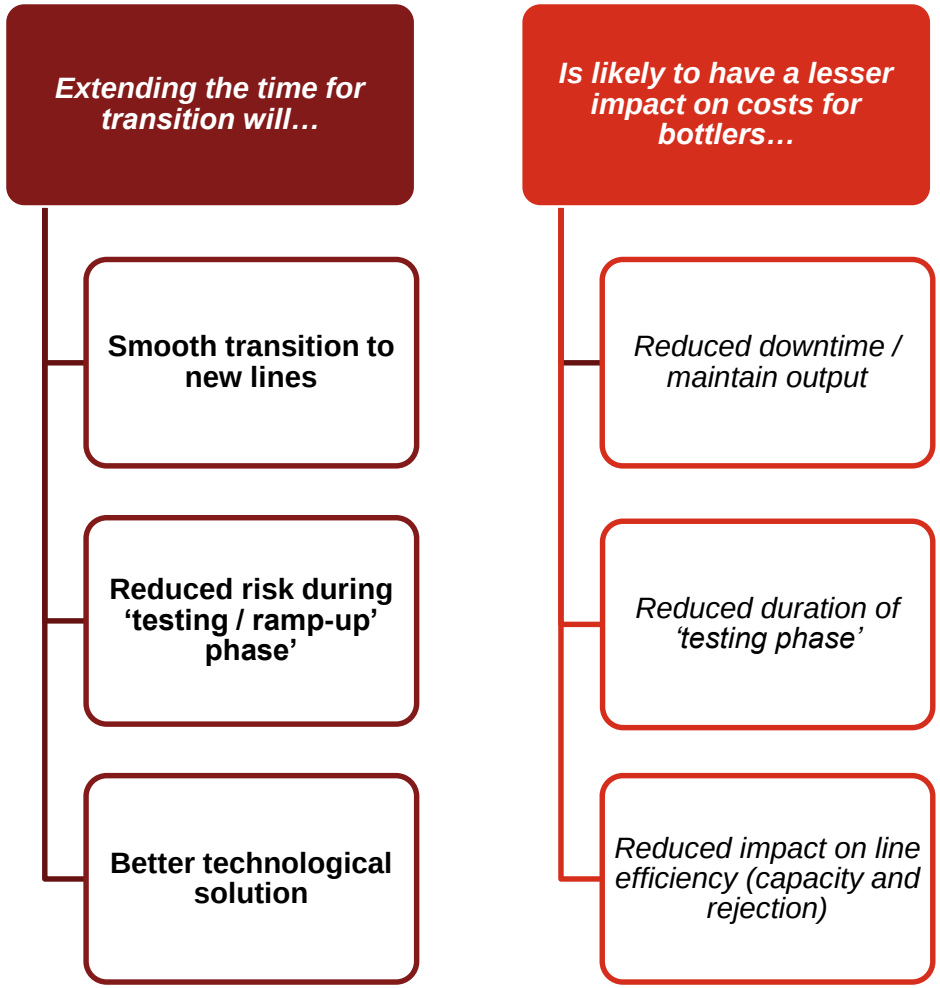
Our analysis assumes that the transition for both still and carbonated drinks occurs in 2022 (i.e. the proposed transition year for bottled water). This is based on interviews with industry experts and plant managers who suggested that the transition will happen together.

We have assessed the impact of extending the transition period for Article 6 to 2024 for both carbonated and still products focusing on the potential impact on our estimate of the 'lost' value added.

Extending the transition year is likely to reduce the costs for bottlers and suppliers by:

- **Smoothing the transition to new lines** (e.g. more time to prepare stock to reduce the burden of downtime)
- **Reducing potential line stoppages and risk of bottle rejection** during the 'testing' phase of production (e.g. more time to trial different solutions)
- **Providing the industry the opportunity to develop a better technological solution**.

This will reduce both the number of bottles 'lost' during downtime and testing (i.e. lower the estimated 'lost' value added) and the overall estimated cost for both bottlers and suppliers to meet the requirements of Article 6.



We have tested four sensitivities to illustrate the potential benefits of an extended transition period…

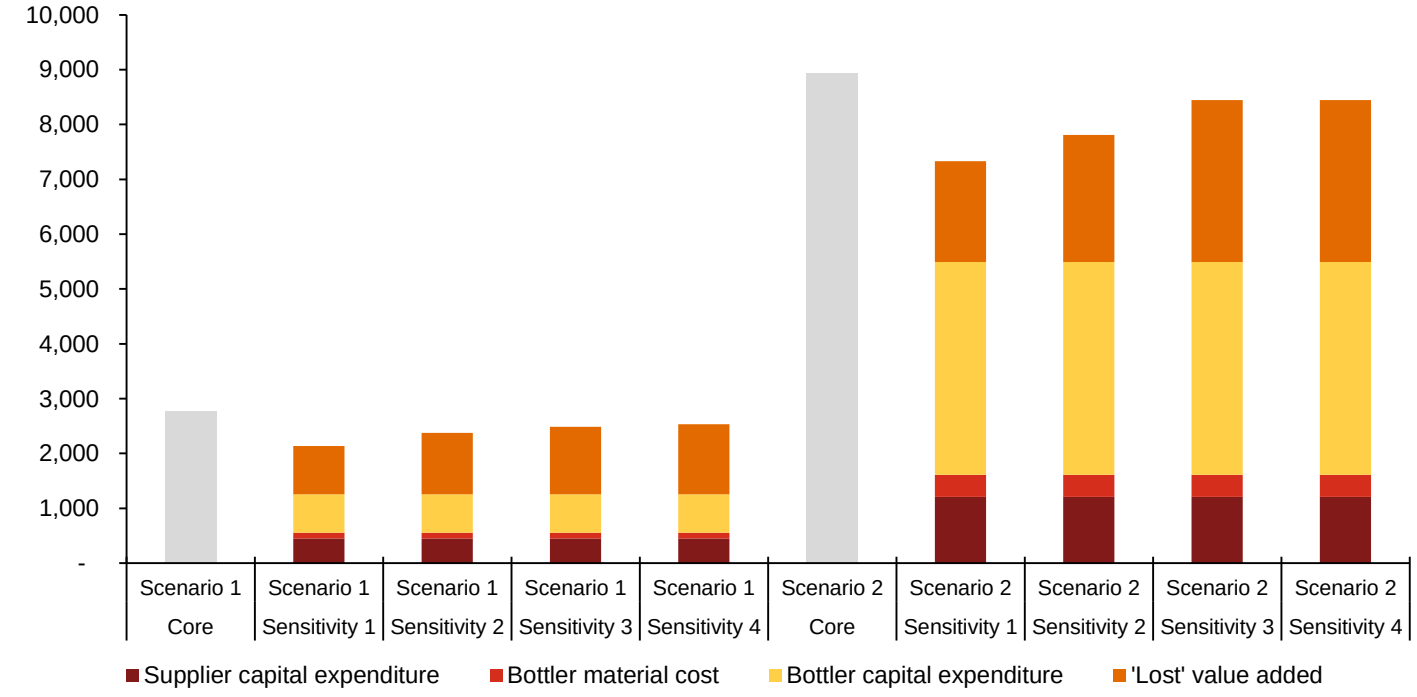
Element of productivity	Scenario	Core (2024)	T1	T2	T3	T4
Downtime days	**1**	5	2.5	2.5	5	5
	2	14	7	7	14	14
Weeks taken to reach pre-installation line output	**1**	2	1	2	2	1
	2	4	2	4	4	2
Initial productivity after installation	**1**	50%	50%	50%	70%	50%
	2	50%	50%	50%	70%	50%

To examine the potential benefits of extending the transition period to 2024, we test four sensitivities which affect the different elements of production:

- **Sensitivity 1 (T1)** – halves the number of downtime days required to install and /or reconfigure new machines and the number of weeks needed for the line to reach its pre-installation speed
- **Sensitivity 2 (T2)** – halves the number of downtime days required to install and / or reconfigures new machines
- **Sensitivity 3 (T3)** – increases the baseline productivity of the line after the installation period to 70% in week 1 (instead of 50% in the baseline)
- **Sensitivity 4 (T4)** – halves the number of weeks needed for the line to reach its pre-installation speed.

Overall we estimate that extending the transition to 2024 could reduce costs for bottlers by c. 5% to 23% - with the extent of cost savings dependent on the installation and testing benefits…

Breakdown of industry costs under different sensitivities (€m, 2017 prices, 2024 year of policy implementation)



	Scenario 1 Core	Scenario 1 Sensitivity 1	Scenario 1 Sensitivity 2	Scenario 1 Sensitivity 3	Scenario 1 Sensitivity 4	Scenario 2 Core	Scenario 2 Sensitivity 1	Scenario 2 Sensitivity 2	Scenario 2 Sensitivity 3	Scenario 2 Sensitivity 4
Productivity cost (€m)	1,519	880	1,120	1,232	1,280	3,436	1,839	2,318	2,957	2,957
Total cost (€m)	2,775	2,136	2,375	2,488	2,535	8,928	7,330	7,809	8,449	8,449

We illustrate the potential cost savings for the industry if the transition period is extended to 2024.

The largest cost saving is outlined in Sensitivity 1 (T1), where both the downtime and testing period are halved from our baseline estimate. This reduces the total cost by **23%** and **18%** in Scenario 1 and Scenario 2 respectively.

Sensitivity 2 (T2) shows the second largest reduction in total cost (**14%** and **13%** in Scenario 1 and Scenario 2 respectively). This implies that any changes to the number of downtime days have the largest impact on estimated 'lost' value added.

Understanding the unintended environmental consequences of Article 6

We have also estimated the unintended the environmental impacts of using more plastic in order to tether caps to bottles

We have also examined the potential environmental consequences of Article 6 on the basis of the two scenarios we used to assess the economic costs:

- **Scenario 1 (cap change only):** Only the cap of the bottle increases in weight
- **Scenario 2 (cap and neck change)**: Both the cap and the bottle increase in weight

The additional plastic resin required per bottle is summarised in the table.

Production and processing of the additional plastic creates environmental impacts. We have used existing life cycle analysis data to estimate selected impacts and the value of the associated environmental externality.

Average change to cap and bottle weight from the tethering scenarios

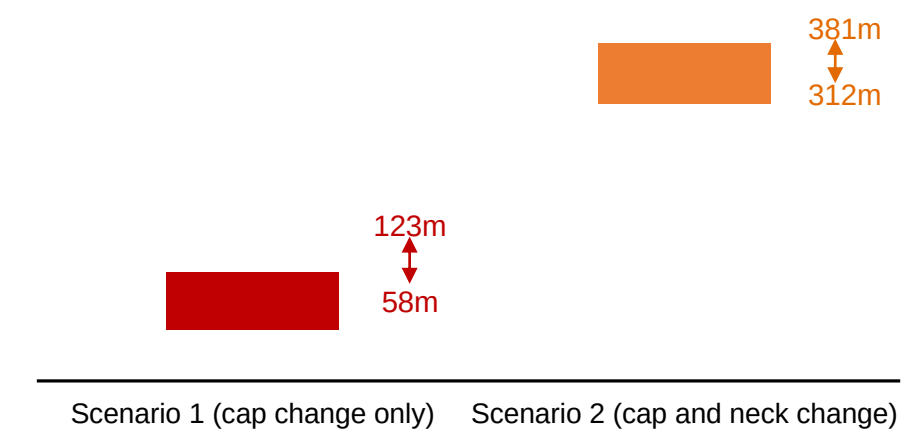
		Increase in cap weight (g) - PP	Increase in bottle weight (g) - PET
Scenario 1	**Carbonated**	0.5 – 1.2	No change
	Non-carbonated	0.3 – 0.6	No change
Scenario 2	**Carbonated**	0.5 – 1.2	1.23 – 1.3
	Non-carbonated	0.3 – 0.6	1.47

Estimate weight change of PET & PP per bottle	X	**Estimate volume of production in 2022**	X	**LCA (lifecycle assessment) impact data* for PET & PP**	X	**Value to society of environmental impacts in 2017 prices (€)**	=	**Total value to society (€)**
Average change in volume of plastic from tethering cap to bottle for both: • *Bottle (PET)* • *Cap (PP or Polypropylene)*		*Total change in volume of plastic (for both PET and PP)*		*Impact on selection of environmental indicators from production and processing of extra plastic*		*Environmental externality cost of the societal impacts of climate change*		*Total estimated value of environmental impacts*

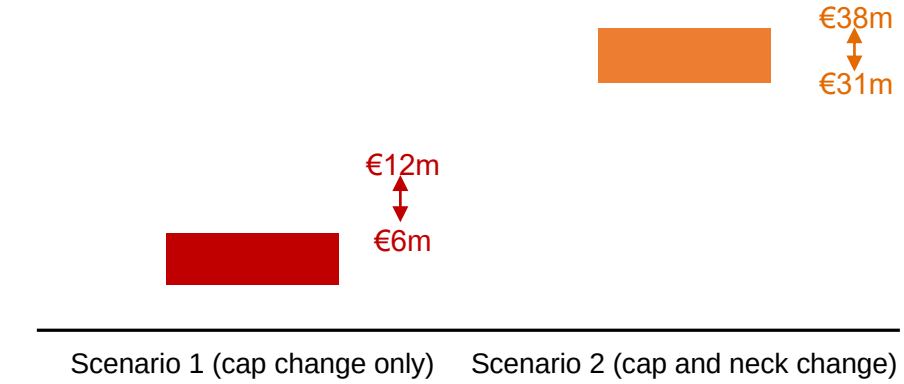
**LCA sources available in appendix*

We estimate that mandatory tethering will result in 58m to 381m kg more CO2 eq. with a recurring social cost of €6m - €38m per annum

Greenhouse gases produced by additional plastic (kg CO2 eq)



Cost of climate change externality (€, 2017 prices, 2022 implementation)



Tethering caps to bottles **will increase the weight of plastic used** for the cap or bottle or both.

Production of the additional plastic has negative environmental impacts: the most important is the impact on climate change through the creation of an additional **58m – 381m kg CO2 eq. or a social cost of €6m - €38m** (see charts).

Whilst the additional greenhouse gases are the biggest unintended environmental impact of the Article 6 requirements, mandatory tethering will have other, albeit relatively small, environmental impacts, for example on air pollution in the form of particular matter and acidification.

Conclusions

Eight key conclusions have emerged from our analysis

1. Litter from caps and lids from plastic drink bottles of soft drinks and packaged water **contribute 3.3% of EU marine litter** (or 12% of the top 10 SUP in EU marine litter)
2. The EC's analysis suggests **that a 90% collection target is the most effective way of reducing marine litter from plastic drink bottles caps and lids**
3. The EC's **policy proposals in Article 6 are based on the premise that the direct costs to bottlers and suppliers are at most small** – and that consumers will not be disadvantaged
4. We estimate that Article 6 could cost **cap and preform suppliers** between **€438m and €1.2bn** in **one-off capital investment**
5. We estimate that Article 6 could cost **bottlers between €680m and €3.8bn in one-off capital investment** and **between €105m and €388m in material costs**
6. **Bottlers could lose an estimated €1.5bn to €3.3bn in gross value added from 'lost' production** during reconfiguration of lines across the EU
7. We estimate that **extending the transition to 2024** could **reduce costs for bottlers by c. 5% to 23%** – with the extent of cost savings dependent how the extension will affect installation and testing for reconfiguration
8. Mandatory tethering will also have **unintended environmental consequences** by creating **an additional 58m to 381m kg CO2 eq. or a social cost of €6m - €38m.**

Annex

Modelling assumptions: volume and cost estimation

Modelling assumptions: volume and cost estimation (1/4)

To estimate the cost of Article 6 to bottlers and suppliers, our model uses key assumptions across different areas, including:

- Volume
- Supplier capital expenditure
- Material cost to bottlers
- Bottler capital expenditure
- 'Lost' value added during installation and testing periods.

These assumptions have been obtained from a number of different sources, including:

- Unesda
- Global Data
- Eurostat
- Discussions with industry experts
- Site visits to bottling plants.

In the following slides, we detail the core assumptions used within the different elements of cost.

We also disaggregate these by Scenario, and provide the relevant source of this information.

In the case of supplier and bottler capital expenditure, we also provide the range of cost estimates that the model assesses.

Modelling assumptions: volume and cost estimation (2/4)

Element of cost	Specific item	Scenario 1	Scenario 2	Source
Volume	Number of litres produced in 2017 in EU28 in PET	c. 90.3bn		Global Data (2017)
	Average size of PET bottles	0.4 for under 50cl 1.2 for over 50cl		Assumption
	Annual growth rate (% per annum)	Water: 2.48%, Soft drinks (carbonated): -1.27%, Soft drinks (non-carbonated) 1.08%, Dilutables: -0.89%		Global Data (2017), historical trend
	Average number of bottles per line	76m bottles per line (weighted average between type and size of drinks)		Discussions with industry experts
Supplier capital expenditure (per line)	Cost of cap-forms	€150,000 - €500,000	€150,000 - €500,000	Discussions with industry experts
	Cost of preforms	N/A	€450,000 - €650,000	Discussions with industry experts
	Total Capital expenditure	€150,000 - €500,000	€600,000 - €1,150,000	Discussions with industry experts

Modelling assumptions: volume and cost estimation (3/4)

Element of cost	Specific item	Scenario 1	Scenario 2	Source
Material cost to bottlers	Increase in cap weight (g/bottle)	CBD: 0.5g – 1.2g Other: 0.3 – 0.6g	CBD: 0.5 – 1.2g Other: 0.3 – 0.6g	Discussions with industry experts
	Increase in neck weight (g/bottle)	N/A	CBD: 1.2 – 1.3g Other: 1.5g	Discussions with industry experts
	Cost of PET per tonne	€1900/tonne	€1900/tonne	Plastic price (PCI-index), October 2018
Bottler capital expenditure (per line)	Cost of replacing blow mould	€120,000 - €300,000	€500,000 - €1,200,000	Discussions with industry experts
	Cost of replacing filling machine	€150,000 - €200,000	€600,000 - €2,200,000	Discussions with industry experts
	Cost of replacing capper	€80,000 - €160,000	€210,000 - €250,000	Discussions with industry experts
	Cost of replacing other machinery	N/A	€300,000 - €350,000	Discussions with industry experts
	Total Capital expenditure	€350,000 - €660,000	€1,610,000 - €4,000,000	Discussions with industry experts

Modelling assumptions: volume and cost estimation (4/4)

Element of cost	Specific item	Scenario 1	Scenario 2	Source
Bottler productivity (Stage 1: Installation)	Downtime installation (days)	See core report for figures		PwC site visits / Discussion with industry experts
	Number of bottles produced per week	1.4m	1.4m	PwC calculation based on Global Data / Discussion with industry experts
	Average value added per bottle (€)	0.48	0.48	Eurostat sector data, PwC analysis
Bottler productivity (Stage 2: Testing)	Acceptance rate (baseline, week 1 after installation, week 2 after installation)	NCD – 99.90%, 99.70%, 99.75% Other: 99.95%, 99.85%, 99.88%	NCD – 99.90%, 99.70%, 99.75% Other: 99.95%, 99.85%, 99.88%	Discussion with industry experts
	Line productivity rate post-installation (baseline)	See core report for figures		Discussion with industry experts
	Weeks taken for line to meet pre-installation speed	See core report for figures		Discussion with industry experts

Modelling assumptions and approach: estimating the unintended environmental consequences

Modelling assumptions and approach: estimating the unintended environmental consequences of Article 6

To estimate the unintended environmental costs of Article 6 to society, our model uses key assumptions across different areas, including:

- Volume
- Type of plastic
- Life-cycle impact assessment (LCA) sources across EU28
- Social valuation of environmental externalities
- PwC's approach to LCA analysis.

These assumptions have been obtained from a number of different sources, including:

- Unesda
- Global Data
- Eurostat and ECB
- Literature review
- Discussions with industry experts
- Site visits to bottling plants.

In the following slides, we summarise the core assumptions used and our approach to valuing environmental impacts.

Our approach to estimating the unintended environmental consequences is based on some key assumptions with associated limitations

Key assumptions

- Bottles and caps are homogenous for all EU28 countries (same production process)
- Life-cycle impact assessment (LCA) sources provide a good representative of the EU28 countries
- 25% of bottle production is rPET
- EU28 inflation is forecasted at 1.8% (Source: ECB)
- The social cost of carbon increases by 3% annually as per IPCC guidelines
- The straight average of valuation coefficients across the EU28 countries is representative of the EU28 as a whole and the combination of locations where PET and PP is produced and processed for drinks packaging
- The costs of the externalities are based on PwC valuation coefficients, more information on the approach can be found in "PwC (2015), Valuing corporate environmental impacts: PwC methodology paper". Available at: https://www.pwc.co.uk/sustainability-climate-change/assets/pdf/pwc-environmental-valuation-methodologies.pdf

Limitations

- The PP LCA is measuring the PP resin and excludes the moulding process of the bottle caps and tether. Therefore the impacts associated with the additional plastic used for the cap are likely to be an underestimate.
- The technical solution for tethering is uncertain and likely to differ between carbonated and still drinks. Our analysis is based on two scenarios which are our understanding of the most likely outcomes from talking to a range of drinks packaging producers, preform producers and cap (closure) producers. Consequently the exact marginal plastic weights are uncertain and the results have been provided as a range.
- The impact of plastic on the marine environment is not well known and therefore the impacts of the additional waste are limited in existing LCA analysis.

References

References

- Eunomia, '*Assessment of measures to reduce marine litter from single use plastics*' (2018). Available at: http://ec.europa.eu/environment/waste/pdf/Study_sups.pdf
- European Commission, '*Proposal for a Directive of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment*' COM (2018) 340 final. Available at: https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52018PC0340
- European Commission, '*Impact Assessment – Reducing Marine Litter: action on single use plastics and fishing gear*' (2018), 254 final. Available at: http://ec.europa.eu/environment/circular-economy/pdf/single-use_plastics_impact_assessment.pdf
- Global Data, '*Soft Drinks Market Insights Database*' (2018).
- JRC Technical Reports, '*Top Marine Beach Litter Items in Europe*' (2017). Available at: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC108181/technical_report_top_marine_litter_items_eur_29249_en_pdf.pdf
- Plastics Europe, '*Eco-profiles*'. Available at: https://www.plasticseurope.org/en/resources/eco-profiles
- PwC Valuation Coefficients for the social cost of environmental externalities
- Unesda, '*Socioeconomic Impact Report*' (2018). Available at: https://www.unesda.eu/socioeconomic/
- Valentino, G, '*Life Cycle Assessment of PET bottles: closed and open loop recycling in Denmark and Lombardy region*' (2017). Available at: https://www.politesi.polimi.it/bitstream/10589/136151/3/2017_10_Valentino.pdf