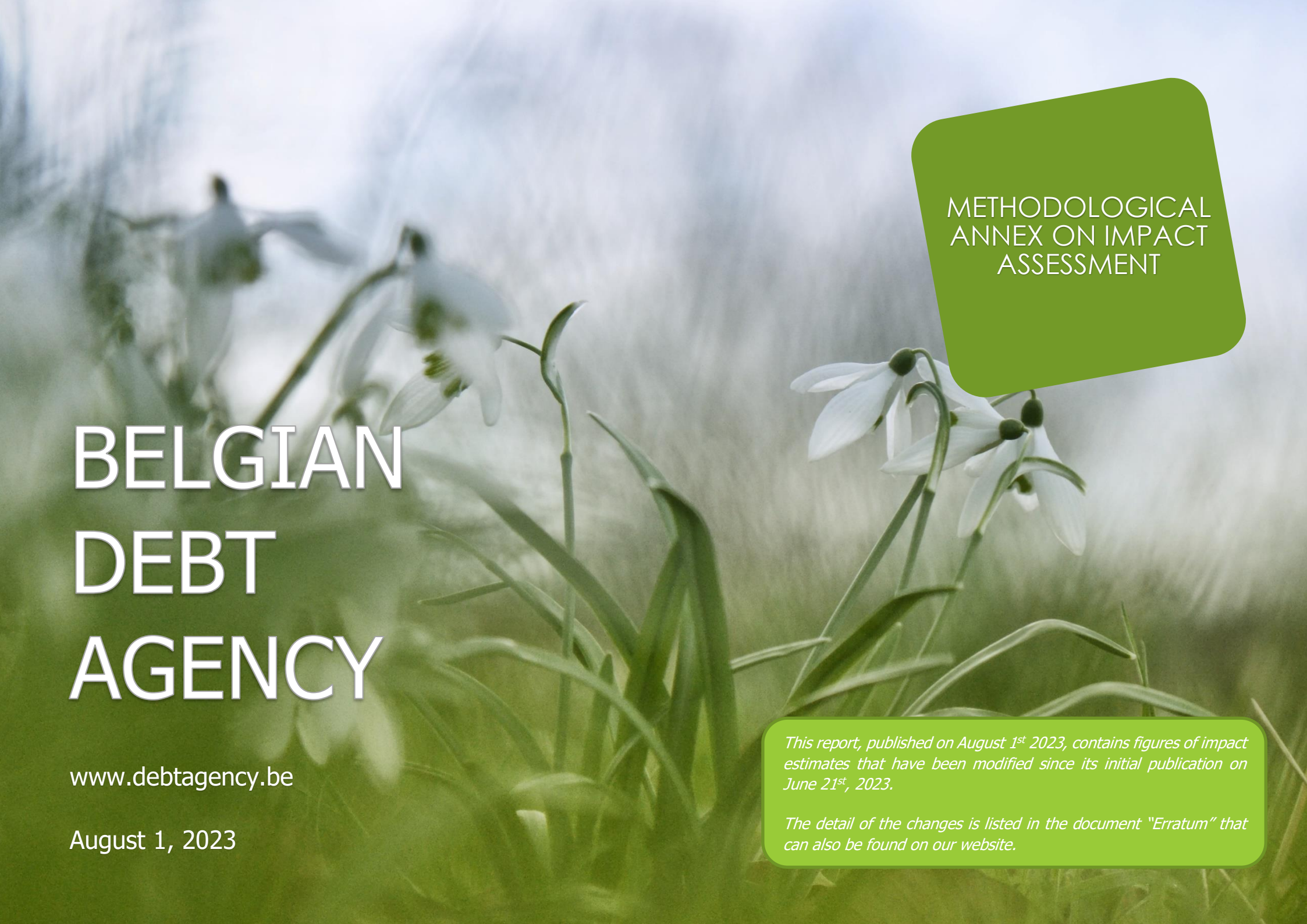

METHODOLOGICAL ANNEX ON IMPACT ASSESSMENT

BELGIAN DEBT AGENCY

www.debtagency.be

August 1, 2023

This report, published on August 1st 2023, contains figures of impact estimates that have been modified since its initial publication on June 21st, 2023.

The detail of the changes is listed in the document "Erratum" that can also be found on our website.

METHODOLOGICAL ANNEX ON IMPACT ASSESSMENT

1. SUBSIDIES TO SNCB (CAPEX) : PURCHASE OF M7 DOUBLE-DECK TRAINS

With regard to the rolling stock investment program of the SNCB/NMBS, based on discussions with the company and data availability, it was decided to consider only the investment in M7 vehicles. Indeed, this investment accounts for a large share of the total eligible investment in "rolling stock".

The commissioning of the M7s will contribute to increasing the energy efficiency of rolling stock and thus to reducing its carbon footprint. In fact, a 20 to 30% energy consumption reduction can be achieved thanks to the higher efficiency of the M7s compared to old trains that reached the end of their operational life. On the other hand, the use of M7 trains on the network's busiest lines, and especially in Brussels, could increase the capacity on these lines.

However, the main purpose of the M7 trains is to maintain railway capacity. In 2020, a second order of 304 M7 trains was placed, in addition to the first 445 M7 trains that were purchased to replace the old trains. The new M7 trains will account for 20% of the overall train capacity, effectively replacing a fifth of the existing train fleet. No increase in capacity due to expenditure financed by 2022 Green OLO on M7 vehicles was included in the assessment and only the energy efficiency gains were taken into account.

Improvement in energy efficiency of M7 trains (per seat)	**25%**	**25%**	**25%**
Avoided CO_2 emissions related to Green OLO over the lifetime of M7 trains [kt]	**3.37**	**75.88**	**74.28**

[1] Source : SNCB, internal calculations. The new M7 trains enable an average saving of 8.5 kt of CO_2 per year over a period of 45 years.

The impact assessment was carried out by comparing emission factors per seat for old trains and new M7 vehicles in order to calculate avoided GHG emissions over the whole lifetime of the M7s (45 years).

As only part of the investment in M7s was made in 2022, a coefficient for the 2022 share of investment in M7s of the total investment in M7s was calculated.

An underlying assumption of the calculations is a stable emission[1] factor for electricity production during the lifetime of the M7 trains. Although the share of renewable energy in total electricity production is expected to increase over the coming years and decades in Europe, the Belgian electricity production infrastructure will most likely have higher CO_2 emissions due to the nuclear phase-out between 2022 and 2035.[2]

Since no clear scenario for electricity production following the nuclear phase out exists, for reasons of simplicity and to avoid double counting (e.g. with the support mechanism for offshore wind production), the evolution of the emission factor was not taken into account in the calculations for the impact assessment.

Overall 153.53 ktCO_2 will be avoided during the whole lifetime of the M7 trains financed by the Green OLO in 2022.

PURCHASE OF M7 DOUBLE-DECK TRAINS	OLO 86 – 2022	OLO 96 – 2022	2021
Allocated amounts of Green OLO to M7 2022 [Meuros]	11.55	259.77	254.31

2. SUBSIDIES TO INFRABEL (CAPEX)

2.1 MAINTENANCE OF RAILWAY INFRASTRUCTURE

Maintaining the railway network through regular maintenance is essential to promote sustainable transportation and minimize the negative environmental effects associated with alternative transport options.

The core of the methodology used to assess the environmental impact of the maintenance of railway infrastructure is inspired by a similar assessment made by SNCF Réseau.[1] It assumes that a lack of investment in the maintenance of a section of the railway network will affect the mean speed of trains on that section and, consequently, a reduction in the mean speed will decrease the attractiveness of rail transport along that part of the network. Therefore, passengers and freight operators will move to other transportation means such as cars or buses for passengers and trucks or inland navigation for freight.

The different sections of the railway network are supposed to be completely renovated according to an annual renovation programme. Therefore, it is assumed that a lack of renovation investment in a given section of the network in a given year will not be offset in subsequent years but only once all the rest of the network has been renovated. In other words, the unrenovated section of the railway network will 'miss its maintenance turn'. Hence, its reliability will be affected until the next 'maintenance turn' occurring after a period equal to the technical lifetime of the equipment (tracks, catenaries, signage), which has been established at 40 years.

To translate this reasoning into figures, the assumptions below were made. The total Belgian railway traffic is homogenously distributed over the whole Belgian network. The annual maintenance investment budget of Infrabel, which is assumed to cover 1/40 of Belgian railway infrastructure, impacts 1/40 of the demand.[2] In the first two years of the period without maintenance there are no impacts. Conditions of the line will only deteriorate from the third year onwards, hence impacting the service conditions of the line. The deterioration of the line implies that the traffic on that section will gradually (linearly) disappear in 20 years' time. Much of the traffic on the lines will be diverted to cars (for passengers) or trucks (for freight), based on a diversion factor of 87% and 100% for passengers and freight respectively.

Between 2019 and 2040, the latest projected railway traffic figures from the Federal Planning Bureau indicate a 30% increase in freight transported by the Belgian railway system, while the number of passengers transported is expected to decrease by 3.3%[3] due to the slowdown in sociodemographic dynamics and the ongoing progression of teleworking.

Results of the long-term outlook for passenger transportation under unchanged policy	2019	2030	2040
Billion passengers-kilometers per year – rail	15.0	15.0	14.5
Billion tons-kilometers per year – freight	6.5	7.5	8.4

Bureau Fédéral du Plan, Perspectives de la demande de transport à l'horizon 2040, avril 2022.

These figures allow the calculation of the total amount of passenger traffic (in terms of pkm) and of freight traffic (in terms of tkm) which is diverted from trains to cars and trucks due to the lack of maintenance investment.

By multiplying these pkm and tkm numbers by the difference between the emission factor of the railway system and that of cars and trucks, the total amount of avoided emissions in the 2022-2045 period was calculated.

Moreover, in the 2018 impact report, a constant passenger road transport emission factor of 101.33 g CO_2/pkm was used to calculate avoided greenhouse gas emissions between 2030 and 2040. However, this edition seeks to improve the methodology and, at the time of writing this report, the EU has announced a ban on the sale of new petrol and diesel cars from 2035.[4] Therefore, this actualised impart report

[1] SNCF Réseau and Carbone 4, Carbon Impact of rail infrastructure investments, 2017.
[2] Infrabel, internal calculations
[3] Bureau Fédéral du Plan, Perspectives de la demande de transport à l'horizon 2040, Avril 2022, p. 5
[4] Reference : EU ban on the sale of new petrol and diesel cars from 2035.

considered updated emission factors that take into account these bans and the increasing electrification of the vehicle fleet for passengers.[1]

New emission factors considered **Emission factors / Years**	2022	2030	2040
Passenger road transport [g CO_2 / pkm]	**112.46**	**81.20**	**23.95**
Railways, passengers [g CO_2 / pkm]	16.30	16.30	16.30
Railways, freight [g CO_2 / tkm]	7.00	7.00	7.00
Freight road transport [g CO_2 / tkm]	70.00	70.00	70.00

Old emission factors in previous version

Emission factors / Years	2019	2030	2040
Passenger road transport [g CO_2 / pkm]	**124.11**	**101.33**	**101.33**
Railways, passengers [g CO_2 / pkm]	16.30	16.30	16.30
Railways, freight [g CO_2 / tkm]	7.00	7.00	7.00
Freight road transport [g CO_2 / tkm]	70.00	70.00	70.00

The share of these emissions related to the Green Bond allocated amount of investment in maintenance amounts to 635.79 ktCO_2.

MAINTENANCE OF RAILWAY INFRASTRUCTURE	
Allocated amounts of green OLO 2022 [Meuros]	774.74
Avoided CO_2 emissions related to Green OLO 86 over the lifetime of maintenance investments [kt]	14.21
Avoided CO_2 emissions related to Green OLO 96 over the lifetime of maintenance investments [kt]	319.73
Avoided CO_2 emissions related to Green OLO 2021 over the lifetime of maintenance investments [kt]	301.85
Total avoided CO_2 emissions related to Green OLO 2022 over the lifetime of maintenance investments [kt]	**635.79**

3. TAX EXEMPTIONS AND DEDUCTIONS TO PROMOTE CLEAN TRANSPORTATION

3.1 EXEMPTION FOR REIMBURSEMENT OF COMMUTING BY PUBLIC TRANSPORT

According to FPS Mobility figures, in 2021 the large majority (64,6%) of commuting between home and work was done by car.[2]

This expenditure covers the total exemption (for taxpayers who declare their professional costs on a lump sum basis) of a reimbursement paid by the employer for the costs of commuting, provided that this transfer is made by public transport.

[1] Calculated by the Federal Planning Bureau for 2019, 2030 and 2040. A simple linear regression analysis was conducted among the various emission factors to obtain intermediate values between the ones available.

[2] SPF Mobilité et transports, Enquête fédérale sur les déplacements domicile-travail 2021-2022, p. 9

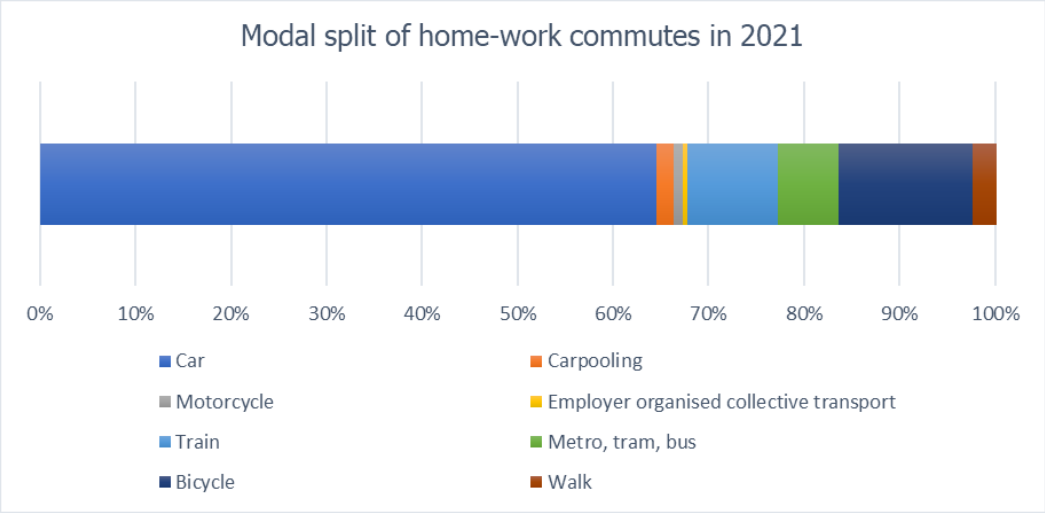

Figure 1 : Modal split of home-work commutes in 2021, Belgium [1]

As a first step for the impact assessment, the number of commuters that would not have used public transport without the reimbursement was estimated based on the price elasticities from a FPB study.[2] Then, based on the average distances travelled by commuters and the transport mode used before switching to public transport, an estimate of the emission reduction was calculated using the differences in emission factors.

The reference situation is established by considering the modes of transportation that people are using in the absence of public support. This includes cars, motorcycles, walking, biking, and other modes, each having different emission factors. With the implementation of tax exemptions, people shift towards alternative modes of transportation such as trams, metros, buses, and trains. These modes may have lower or higher emission factors compared to the previous modes used. It's important to note that cars constitute the largest portion of the baseline.

Overall, thanks to the funding from the OLOs, the CO_2 emissions avoided in 2022 were estimated at 241 kt of CO_2eq.

EXEMPTION FOR REIMBURSEMENT OF COMMUTING BY PUBLIC TRANSPORT	2022
Mpkm travelled by train due to policy	1642.70
Mpkm travelled by bus, tram and metro due to policy	617.98
Pkm travelled by train, bus, tram, metro due to policy from ex-car users [%]	83%
Avoided CO_2 emissions related to Green OLO 86 – 2022 [kt]	6.24
Avoided CO_2 emissions related to Green OLO 96 2022[kt]	140.35
Avoided CO_2 emissions related to Green OLO 2021 [kt]	94.74
Avoided CO_2 emissions related to Green OLO [kt]	**241.33**

3.2 BICYCLE ALLOWANCE

The impact assessment for this expenditure was carried out in three steps. First, we obtained the bicycle pkm since 2016.[3] Second, we calculated what share of those km are due to the policy and travelled by previous car drivers (rather than public transport users). Finally, we applied the difference in emission factors between cars and bicycles. We do not measure any emission reduction for the switch by public transport users to bicycles.

Only a share of the people switching from cars to bicycles do so because of the allowance they get. In addition to providing an allowance, many companies also implement other measures to encourage cycling.

[1] SPF Mobilité et transports, Enquête fédérale sur les déplacements domicile-travail 2021-2022,(online) https://mobilit.belgium.be/sites/default/files/documents/publications/2023/Rapport_WWV_2021-2022_FR_corrigendum.pdf, p. 9

[2] Coraline Daubresse et al. Description et utilisation du modèle PLANET, 2018.

[3] Base index = 2016.

Overall, thanks to the funding from the OLOs, the measure is found to have avoided 42 kt of CO_2eq in 2022.

BICYCLE ALLOWANCE	2022
Mpkm travelled by bicycle due to policy	430.27
Pkm travelled by bicycle due to policy from ex-car users [%]	67%
Avoided CO_2 emissions related to Green OLO 86 – 2022 [kt]	1.36
Avoided CO_2 emissions related to Green OLO 96 2022[kt]	30.55
Avoided CO_2 emissions related to Green OLO 2021 [kt]	10.09
Total avoided CO_2 emissions related to Green OLO in 2022[kt]	**42.0**

4. REDUCED PACKAGE CHARGE FOR USING INDIVIDUAL REUSABLE DRINK PACKAGES

The assessment of the reduced package charge was done in terms of avoided CO_2eq emissions and avoided extracted materials. Based on the charges for re-usable containers and no2n-reused containers an estimation of the reused containers (1000l) was carried out.

As a first step, a reference scenario was established where reuse is at zero: all beverage packaging is used only once. This implies that all the beverage containers are produced with primary and/or recycled materials according to the actual recycling rate for this kind of glass. Then a reuse scenario was established, where we take into account that glass packaging is all used 7 times. But the first time it is used, it needs to be produced. So 1/7 of the beverage containers are assumed be produced with primary or recycled material (according to the actual recycling rate for this kind of glass).

For each scenario, we calculated the materials needed, emissions related to the production and re-use of glass as well as the glass waste that will end up in the environment. The impact on GHG emissions is assessed based on emission factors ($kgCO_2eq/1000l$) linked to the type of production (new or recycling) and to the kind of collection (deposit system or collection point).[1] For reused bottles, emissions are only linked to the collection (we assume a deposit system) and to the washing of the bottles. The inputs in terms of materials and energy used took into account recycling rates in Belgium as well as the limit for the use of recycled materials when producing new glass bottles. The estimation of glass waste in the environment is based on the collection system implemented in Belgium, where 98%[2] of the waste is collected while the remaining 2% is disposed of in landfills, leading to environmental impact. The amount of waste glass can be measured either in terms of weight (tonnes) or in terms of the number of items. In the latter case, an average weight is considered to estimate the number of containers that end up in the environment.

With regard to the total results, only the share that is due to the allocated amount of the tax expenditure to Green OLO was taken into account.

The reduced packaging charge is estimated to have avoided 135 kt of CO_2eq in 2022 as well as 104 kt of sand, 41 kt of lime and 34 kt of caustic soda along with 7 kt of glass released into the environment. In terms of quantity, this translates to approximately 28 million items being spared from ending up in the environment.

REDUCED PACKAGING CHARGE FOR USING INDIVIDUAL REUSABLE BEVERAGE CONTAINERS	OLO 86 – 2022	OLO 96 - 2022
Allocated amounts of Green OLO [% of total tax expenditure]	4.26	95.74
Avoided CO_2eq emissions related to Green OLO [kt]	5.73	128.95

[1] Simon, B., et al., Life cycle impact assessment of beverage packaging systems: focus on the collection of postconsumer bottles, Journal of Cleaner Production (2015), http://dx.doi.org/10.1016/j.jclepro.2015.06.008

[2] Source : https://closetheglassloop.eu/record-collection-of-glass-containers-for-recycling-hits-78-in-the-eu/

Avoided use of materials related to Green OLO [kt]:		
• Sand	4.409	99.221
• Lime	1.76	39.688
• Caustic soda	1.49	32.601
Avoided glass in the environment [kt]	0.30	7.07
Avoided glass in the environment related to Green OLO [M number of items]	1.16	27.18