Cost–Benefit Analysis of PTI Reform Options in Flanders:

Balancing Private Savings and Societal Costs

Technical Report (Final Draft)

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October 2025

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Abbreviations

BCR	– Benefit–Cost Ratio
CBA	– Cost–Cost-Benefit Analysis
CF	– Unit cost of a Fatality
CS	– Unit cost of a Serious injury
CL	– Unit cost of a Slight injury
CPDO	– Unit cost of a Property-Damage-Only accident
CO_2-eq	– Carbon dioxide equivalent
EC	– European Commission
FDD	– Failures with Dangerous Deficiencies
FMDD	– Failures with Major and Dangerous Deficiencies
FHWA	–Federal Highway Administration (USA)
GOCA	– Groupement des Organismes de Contrôle Automobile (Belgium)
HICP	– Harmonised Index of Consumer Prices
HGV	– Heavy Goods Vehicle (N2/N3)
ITF	– International Transport Forum
MAIS3+	– Maximum Abbreviated Injury Scale, level 3 or higher (serious injury)
N1, N2, N3	– Vehicle categories (light, medium, heavy goods vehicles)
O1, O2, O3, O4	– Trailer categories (light to heavy trailers)
OECD	– Organisation for Economic Co-operation and Development
PDO	– Property Damage Only (accident without injuries)
PTI	– Periodic Technical Inspection
R	– Vehicle category R (agricultural trailers)
T	– Vehicle category T (tractors)
VoT	– Value of Time
VSL	– Value of a Statistical Life
VSSI	– Value of a Serious Statistical Injury
WLPS	– Welfare Loss per Savings

General Notation List

Symbol	Meaning	Unit
ΔN	Number of inspections removed under a reform scenario	Inspections (no.)
ΔF	Additional fatalities (per year)	Persons
ΔS	Additional serious injuries (per year)	Persons
ΔL	Additional slight injuries (per year)	Persons
ΔV	Additional property-damage-only accidents (per year)	Accidents
$\Delta A_{total}l$	Total additional accidents (per year)	Accidents
ΔB_{acc}	Additional breakdowns caused by accidents	Events
ΔB_{def}	Additional breakdowns caused by technical defects	Events
ΔCG	Additional congestions	Events
ΔEC_{safety}	Incremental societal costs from safety impacts	€ per year
ΔEC_{cong}	Incremental external costs from congestion impacts	€ per year
ΔEC_{emiss}	Incremental external costs from emissions	€ per year
ΔEC_{ext}	Total incremental external costs (safety + congestion + emissions)	€ per year
$\Delta S_{inspection}$	Savings from avoided inspection fees	€ per year
ΔS_{time}	Savings from avoided waiting and travel time	€ per year
p_F	Probability of a fatality avoided per inspection	Fatalities/inspection
p_S	Probability of a serious injury avoided per inspection	Serious injuries/inspection
p_L	Probability of a slight injury avoided per inspection	Slight injuries/inspection
$\bar{c}$ (c-bar)	Average number of casualties per accident	Person/accident
s_i	Share of inspections accounted for by category *i*	%
r_i	Failure rate with dangerous deficiencies (FDD) in category *i*	%
w_i	Risk-weighted exposure share of vehicle category *i*	%
$B_{\_safety}$	Annual safety benefit from avoided crashes	€ per year
C_F	Unit cost of a fatality	€ per fatality
C_S	Unit cost of a serious injury	€ per serious injury
C_L	Unit cost of a slight injury	€ per slight injury
CPDO	Unit cost of a property-damage-only accident	€ per accident

BCR	Benefit–Cost Ratio	Dimensionless
WLPS	Welfare Loss per Savings	Dimensionless
T	Time period (in years)	Years
B_t	Benefits in year *t*	€
C_t	Costs in year *t*	€
I	Discount rate/interest rate	%
Λ	Station density (stations per km^2)	$1/km^2$
R	Distance to nearest PTI station	km
Β	Road network detour factor (actual distance / straight-line distance)	Dimensionless
V	Average travel speed	km/h
Ttravel	Travel time to nearest PTI station (round trip)	Minutes
WDI	Mean waiting time, drive-in visits	Minutes
WAP	Mean waiting time, appointment visits	Minutes
s_{DI}	Share of drive-in visits	%
s_{AP}	Share of appointment visits	%
$\bar{W}$	Weighted average waiting time per PTI case	Minutes

Notation list for vehicle categories

Symbol	EU category name	Short definition
M1	Passenger cars	Motor vehicles for passenger transport with ≤ 8 seats in addition to the driver
M2	Buses/coaches (light)	Passenger transport with > 8 seats; maximum mass ≤ 5 t
M3	Buses/coaches (heavy)	Passenger transport with > 8 seats; maximum mass > 5 t
N1	Light goods vehicles	Goods transport; maximum mass ≤ 3.5 t
N2	Medium goods vehicles	Goods transport; 3.5 t < maximum mass ≤ 12 t
N3	Heavy goods vehicles	Goods transport; maximum mass > 12 t
O1	Light trailers (very light)	Trailers; maximum mass ≤ 0.75 t
O2	Light trailers (braked)	Trailers; 0.75 t < maximum mass ≤ 3.5 t
O3	Heavy trailers (medium)	Trailers; 3.5 t < maximum mass ≤ 10 t
O4	Heavy trailers (heavy)	Trailers; maximum mass > 10 t
L	Powered 2- & 3-wheel; quadricycles	Two- and three-wheel vehicles and quadricycles
T	Agricultural tractors (wheeled)	Tractors designed for agricultural/forestry use
R	Trailed equipment (agricultural)	Agricultural trailers and interchangeable towed machinery
M1 (Taxi)	Operational subcategory	Use-case within M1 in GOCA operations
M1 (Ambulance)	Operational subcategory	Use-case within M1 in GOCA operations
M1 (Other)	Operational subcategory	General M1 vehicles not flagged as taxi/ambulance

Executive Summary

All reform options examined in this study show a consistent tendency toward higher societal costs and accident risks compared to the current PTI regime. What may appear as administrative simplification for vehicle owners results in a disproportionate transfer of risks and expenses to the public at large.

This technical report evaluates the economic and societal impacts of proposed PTI reform measures in Flanders (Province of Belgium). The analysis adheres to contemporary standards in transport economics, combining quantitative modeling with evidence from official Belgian and international sources, and presents staged deliverables to meet an accelerated policy timeline.

The policy scenarios considered are:

- **Baseline:** Current PTI regime (status quo).
- **Scenario A:** Reduced inspection frequency, i.e., longer intervals between inspections.
- **Scenario B:** Elimination of the first inspection for new vehicles.
- **Scenario C:** Removal of the mandatory inspection when vehicles are sold second-hand.
- **Scenario D:** Removal of the mandatory Tow Bar inspection after installation.

Across all scenarios, the modelling results indicate higher societal costs compared with the private savings achieved. In aggregate, the four reforms would lead to approximately 34 additional fatalities, 109 serious injuries, and more than 1,280 slight injuries per year.

The corresponding increase in societal costs is estimated to be approximately €485 million annually. Private savings – mainly avoided inspection fees and time expenditures – are projected at around €180 million per year.

Expressed as a ratio, each euro of private benefit corresponds to roughly €2.70 of additional external costs (Welfare Loss per Savings, WLPS = 2.7).

Scenario A, which reduces inspection frequency across the vehicle fleet, accounts for the largest share of additional costs, estimated at around €440 million per year.

Scenario B, which abolishes the first inspection for new vehicles, shows limited effects; accident-related costs of approximately €8 million are nearly balanced by private savings of about €10 million.

Scenario C demonstrates moderate yet theoretically significant effects. Although the direct cost-benefit balance (WLPS ≈ 0,8) appears nearly neutral, this scenario represents a market segment characterized by structural uncertainty and information asymmetry. In economic terms, the second-hand vehicle market serves as a classic example of a "market for lemons" (Akerlof 1970). The mandatory Periodic Technical Inspection (PTI) at the time of transfer serves as a trust-building institution, enhancing market transparency and helping to prevent adverse selection. Removing this requirement could undermine consumer confidence and increase long-term transaction risks—impacts that are not yet considered in the quantitative model but are important for policy design.

Scenario D – the abolition of Tow-Bar inspections – required a dedicated empirical recalibration based on event-level probabilities from the *European Commission (2019)* trailer study. This second-step analysis corrects the underestimation of low-frequency but high-severity coupling failures in the baseline model. After adjustment, the scenario's annual accident-related cost rises to about € 5,8 million, corresponding to a WLPS of ≈ 3,0. The finding confirms that even narrowly scoped inspections can have disproportionate preventive value when targeting high-severity defect types.

Sensitivity testing confirms the robustness of these conclusions: parameter variations (± 10 %) and empirically derived elasticity factors (p_i = 1,0 / 0,8 / 1,2 / 0,5) preserve the ranking and direction of effects. The high sensitivity of Scenario C reflects the inherent volatility of the second-hand market, whereas Scenario D's low sensitivity results from small volumes but empirically stable risk estimates.

Overall, the analysis suggests that reductions in inspection coverage are associated with net increases in societal costs under all tested conditions. While the absolute magnitudes differ by scenario, the qualitative relationship between private savings and societal costs remains the same. Maintaining a stable inspection regime, therefore, ensures the internalization of safety, congestion, and emission-related externalities. In contrast, deregulation would shift part of these costs from individual vehicle owners to society as a whole. The results provide an empirical basis for future evidence-based adjustments of the Flemish PTI framework.

1. Introduction and Policy Objectives

This report examines the economic and societal implications of potential reforms to the system of periodic technical inspections (PTI) in Flanders. The reforms are guided by the principle of avoiding "gold-plating," i.e., not exceeding the requirements of the EU directive unless there is significant added value for safety or environmental outcomes. Four policy scenarios are considered:

- **Scenario A:** Reduced inspection frequency, i.e., longer intervals between mandatory PTIs.
- **Scenario B:** Elimination of the first inspection requirement for new vehicles.
- **Scenario C:** Abolition of mandatory inspections when vehicles are transferred on the second-hand market.
- **Scenario D:** Removal of the mandatory Tow Bar inspection immediately after installation.

The objective of the study is to quantify the net welfare effects of these reforms using a cost–benefit analysis (CBA). The analysis relies on Flemish data sources, is benchmarked against international evidence, and follows methodological standards recommended by the European Commission. Specifically, it evaluates how the proposed changes would affect road safety, congestion, emissions, and household costs.

To assess the potential impacts, each of the four scenarios is first described in terms of its regulatory content, affected vehicle categories, and expected practical consequences. The following sections provide concise outlines of Scenarios A through D.

Scenario A - Reduced inspection frequency

Scenario A proposes reducing the mandatory inspection frequency for different vehicle categories in Flanders, aligning the system more closely with the minimum requirements of the EU directive. Currently, passenger cars (M1) are inspected according to the 4–1–1–1 scheme, which involves the first inspection after four years, followed by annual inspections. Under the proposal, this would be extended to a 4-2–2-2 scheme, with biennial inspections following the initial check. Taxis and ambulances, which are currently inspected every six months, would also transition to a 4-2-2 regime. For buses (M2 and M3), the inspection interval would shift from three to six months to annual inspections, while light trucks (N1) and heavy trucks (N2, N3) would also see a reduction of their current intervals to less frequent annual checks.

This reform would lower inspection volumes and compliance costs. However, policymakers must carefully weigh these benefits against the increased risk of delayed defect detection and its potential consequences for road safety and emissions.

Scenario B – Elimination of the Initial Inspection for New Vehicles

Scenario B proposes the abolition of the initial inspection currently conducted at the time of first registration of new M1 passenger vehicles in Flanders. Currently, every new vehicle undergoes this conformity check, which verifies identity documents, the vehicle identification number, and basic safety functions, such as headlamp alignment, as well as potential assembly or installation errors. Under the proposed reform, this initial inspection would no longer be required, and the vehicle would enter the periodic regime directly, with the first mandatory inspection taking place only after four years (or at a later interval if combined with Scenario A).

While the reform would reduce administrative burden at the time of registration, it would simultaneously remove an early safeguard against technical and documentation errors, raising questions of consumer protection and long-term safety assurance.

Scenario C – Abolition of Second-Hand Vehicle Inspections

Scenario C addresses the requirement for technical inspection of vehicles at the point of ownership transfer on the second-hand market. Under the current Flemish system, every used vehicle must undergo a PTI before the change of ownership can be legally completed. This procedure provides buyers with a guarantee that the vehicle meets minimum safety standards and ensures that serious defects are corrected before the vehicle reenters circulation. The proposed reform eliminates this obligation.

Although the measure would reduce costs and simplify transactions in the second-hand market, it would also weaken consumer protection. It could reduce market transparency, necessitating a careful assessment of its long-term safety and economic implications.

Scenario D – Abolition of Tow Bar Inspections in Flanders

In Flanders, the retrofitting of a tow bar on new passenger cars (M1 category) is subject to different inspection procedures, depending on the declared permissible towing mass. Two distinct cases can be identified:

1. **Small tow bar (< 750 kg):** In this case, only the correct installation of the Tow Bar is inspected. In 2024, approximately **36.000 vehicles** fell under this category.
2. **Large tow bar (> 750 kg):** In this case, not only the tow bar installation but the entire vehicle is subject to a full technical inspection. In 2024, around **3.700 vehicles** were inspected under this regime.

Empirical evidence indicates that in the second scenario, additional safety-relevant defects are systematically identified that are not directly related to the tow bar itself. These include, for instance, misalignment of headlamps as well as emission-related failures. Such findings occur precisely because the whole vehicle is inspected.

Consequently, abolishing tow bar inspections under Scenario D would not only eliminate a targeted safety check of the tow bar itself. However, it would also remove the opportunity to detect further safety-critical defects in a subset of vehicles. From both an economic and road-safety perspective, it must therefore be critically assessed whether the potential administrative relief achieved through abolition outweighs the loss of safety benefits.

2. Methodological Framework

2.1. Analytical Approach and Key Assumptions

The reform measures are assessed against a baseline of no reform. We quantify impacts in four domains: safety, congestion, emissions, and household/administrative costs. Where data are insufficient for immediate quantification, we provide a qualitative framework and parameter ranges that can be used in sensitivity analysis.

The analytical logic follows the causal chain through which PTI affects societal outcomes:

1. **Technical defect detection.** PTI identifies vehicles with safety-critical or emission-related defects that would otherwise remain in use.
2. **Defect remediation.** Once detected, defects are typically repaired or the vehicle is withdrawn from circulation, reducing the prevalence of high-risk vehicles in the fleet.
3. **Risk reduction.** This lowers the probability of:
    - crashes linked to technical failures,
    - vehicle breakdowns that cause congestion, and
    - excess pollutant emissions from malfunctioning systems.
4. **Societal cost savings.** Fewer crashes, breakdowns, and emissions translate into reductions in both internal and external costs. Accident costs are partly internalized through insurance but also generate significant external burdens (e.g., productivity losses, psychological impacts). Congestion savings mainly reduce external time costs for third parties, while emission reductions cover both CO_2-related climate damages and health damages from local pollutants (NO_x, particulate matter).
5. **Private and administrative costs.** These benefits come at the expense of inspection fees, the time spent by vehicle owners, and the increased workload of the inspection system.

The CBA approach applied here follows the classical welfare economics principle, whereby a policy change is considered efficient if potential gains are sufficient to compensate for potential losses (Kaldor, 1939; Hicks, 1940). This Kaldor–Hick's criterion underpins modern cost–benefit analysis and has been widely applied in transport economics. In addition, this study draws on contemporary discussions of CBA in the context of intelligent transport systems, where methodological robustness and practical applicability remain critical challenges (Schulz & Geis, 2015).

In line with the methodological critique raised by Schulz and Geis (2015), who emphasize that cost–benefit analyses in transport research often suffer from incomplete data, unrealistic assumptions, and a lack of standardization, this study explicitly takes corrective measures. First, Belgian-specific unit costs for fatalities and injuries (Vias Institute, 2024; Statbel, 2025) are applied to ensure institutional relevance and national validity. Second, all key assumptions—such as the defect-to-accident relationship and the 10% emission uplift for uninspected vehicles—are made transparent and are accompanied by empirical evidence to reflect uncertainty. Third, the study benchmarks external costs against the *EU Handbook on the External Costs of Transport* (van Essen et al., 2019), thereby aligning with international practice and enhancing comparability. By systematically applying these steps, the present PTI analysis responds directly to the methodological shortcomings identified in prior CBA applications in the ITS domain and extends the reliability of results for policy decision-making (Schulz & Geis, 2015)

2.2. Data Sources and Literature Evidence

Primary data collection is not undertaken in this study. Instead, the analysis is based on a structured synthesis of established, high-quality secondary data and peer-reviewed literature. This approach ensures both methodological transparency and empirical robustness, while avoiding redundant data collection in areas already covered by validated statistical sources:

- **National Belgian data:** Core safety and cost parameters are drawn from the Vias institute (2024), which provides the most recent estimates of accident costs, and from Statbel (2025), which supplies official statistics on accident frequencies, vehicle stocks, and demographic distributions.
- **International benchmarks:** To enhance external validity, the study cross-checks Belgian estimates with international datasets, including ITF/OECD country profiles (2023/2024) and the European Commission's socio-economic valuations. This allows the derivation of sensitivity bounds where national and international figures diverge.
- **Methodological handbooks:** The quantification of environmental and congestion externalities follows the *Handbook on the External Costs of Transport* (van Essen et al., 2019), developed by CE Delft for the European Commission. This ensures comparability with European transport appraisals.
- **Client-provided operational data:** Spreadsheets supplied by GOCA Vlaanderen (e.g., *impact.xlsx*) are used to parameterise inspection volumes and case mixes across vehicle categories.
- **Systematic literature analyses:** To verify the causal relationship between PTI and transport outcomes, the study conducts structured literature reviews of international evidence (e.g., Martín-delosReyes et al., 2021; Elvik, 2022). These reviews provide independent effect ranges (such as accidents prevented per inspected vehicle or emission reductions linked to inspections) that are then applied as calibration and sensitivity parameters in the Belgian case. This step ensures that the assumed impact channels — from inspections to defect

detection, from defect detection to reduced accidents, breakdowns, and emissions — are evidence-based and not modelled ad hoc.

By integrating national statistics, international benchmarks, methodological guidelines, client data, and systematic literature evidence, the study ensures that all results are grounded in verifiable sources and that the causal assumptions underlying the CBA are transparent and externally validated (Schulz & Geis, 2015).

2.3. Baseline and Reform Scenarios

We construct a baseline reflecting current inspection regimes and recent accident outcomes in Flanders. Policy scenarios reflect the four reform measures individually and in combination. Sensitivity analyses are designed around key uncertainties (injury severity definitions, under-reporting, and unit-cost ranges).

Table 1 presents the baseline number of periodic technical inspections (PTIs) in Flanders for the reference year 2024, disaggregated by vehicle category, age, and type of inspection. For each subcategory, the table shows.

(i) the number of tests carried out under the current regime,
(ii) the share of inspections that would be lost under the reform scenarios A, B, and C,
(iii) the corresponding absolute volume loss, and
(iv) the unit PTI fee charged per test.

The table serves as the quantitative backbone for modelling the effects of PTI reforms A, B, and C.

(1) First, it determines the scale of inspection reductions across vehicle categories, which directly drives the calculation of foregone inspections (ΔN).
(2) Second, these lost inspections form the input for estimating safety impacts, as they reduce the probability of detecting and remediating dangerous deficiencies, leading to additional crashes and casualties.
(3) Third, the distribution of lost inspections across categories (M1, N1, N2/N3, trailers, etc.) allows for risk-weighted allocation, ensuring that accident and breakdown increments reflect both fleet composition and defect prevalence.
(4) Fourth, the PTI fee data provide the basis for calculating direct financial savings to vehicle owners and lost revenues for inspection centres.

Table 1: PTI Test Volumes and Reductions by Vehicle Category, Flanders 2024

Vehicle category	Tests in 2024(no.)	Volume loss (%)	Volume loss (no.)	PTI fee (€)
L second hand	**27.624**	100,00%	**27.624**	€ 58,60
M1	**2.627.387**		**1.260.921**	
First | taxi | age < 5 months	1.272	100,00%	1.272	€ 52,59
periodic | taxi | age < 11 months	1.104	100,00%	1.104	€ 47,69
periodic | taxi | age ≥ 11 months	11.461	50,00%	5.731	€ 47,69
First | ambulance | age < 5 months	66	100,00%	66	
periodic | ambulance | age < 11 months	88	100,00%	88	€ 52,59
periodic | ambulance | age ≥ 11 months	1.701	50,00%	851	€ 47,69
First | other | age < 10 months	9.545	100,00%	9.545	€ 52,59
periodic | other | age < 46 months	32.100	100,00%	32.100	€ 47,69
periodic | other | age ≥ 46 months | validity ≤ 14 months	1.808.575	50,00%	904.288	€ 47,69
periodic | other | age ≥ 46 months | validity > 14 months	353.638	0,00%	0	€ 47,69
second-hand	407.837	75,00%	305.878	€ 85,50
M2 and M3	**18.485**		**11.036**	
First | age < 2 months	635	100,00%	635	€ 119,70
periodic | age < 10 months	689	100,00%	689	€ 104,30
periodic | age ≥ 10 months | validity ≤ 4 months	4.525	75,00%	3.394	€ 104,30
periodic | age ≥ 10 months | validity > 4 months	12.636	50,00%	6.318	€ 104,30
N1	**593.135**		**390.879**	
First | age < 10 months	38.621	100,00%	38.621	€ 84,00
periodic | age < 46 months	117.287	100,00%	117.287	€ 79,10
periodic | age ≥ 46 months	371.797	50,00%	185.899	€ 79,10
second-hand	65.430	75,00%	49.073	€ 61,00
N2 and N3	**98.064**		**7.559**	
First | age < 10 months	7.559	100,00%	7.559	€ 119,70
age ≥ 10 months	90.505	0,00%	0	€ 104,30
O2	**133.865**		**73.069**	
First | age < 10 months	6.499	100,00%	6.499	€ 61,50
age < 46 months	19.960	100,00%	19.960	€ 56,60
age ≥ 46 months | validity ≤ 14 months	93.220	50,00%	46.610	€ 56,60
age ≥ 46 months | validity > 14 months	14.186	0,00%	0	€ 56,60
O3 and O4	**95.710**		**5.238**	
First | age < 10 months	5.238	100,00%	5.238	€ 90,30
age ≥ 10 months	90.472	0,00%	0	€ 74,90
T	**9.365**		**5.804**	
First | age < 10 months	2.919	100,00%	2.919	€ 109,47
age < 46 months	1.599	100,00%	1.599	€ 97,08
age ≥ 46 months | validity ≤ 14 months	2.572	50,00%	1.286	€ 97,08
age ≥ 46 months | validity > 14 months	2.275	0,00%	0	€ 97,08
Total	**3.603.976**	**49,45%**	**1.782.130**	

Source: GOCA Vlaanderen (2025). Internal dataset on PTI volumes and fees; own formatting.

In summary, Table 1 anchors the entire scenario analysis by linking the regulatory change in inspection volumes to both societal costs (accidents, congestion, and emissions) and private savings (time and fees). Without this detailed baseline, the cost–benefit modelling would lack the necessary granularity to capture the heterogeneous effects of PTI reforms across vehicle classes.

Scenario D (Tow Bar inspections) is not included in Table 1, because Tow bar (TOBA) inspections constitute a separate regulatory procedure that applies to vehicles equipped with towing devices. These inspections are carried out independently of the periodic vehicle inspection and are subject to distinct fee structures and operational procedures. As shown in Table 2, a total of approximately 39.603 tow bar inspections were conducted in Flanders in 2024, of which around 91 % concerned light trailers (≤ 750 kg). In Scenario D, the government intends to abolish this specific inspection category, resulting in a complete volume loss (100 %) relative to the 2024 baseline.

The inspection fee varies according to trailer weight: € 15,40 for light trailers (≤ 750 kg) and € 47,37 for heavier trailers (> 750 kg). These fees reflect the differing technical requirements and inspection times associated with the two subcategories. The figures are based on internal data provided by GOCA Vlaanderen (2025).

Table 2: Tow Bar (TOBA) Inspections – Volumes and Fee Structure, Flanders 2024

Inspection type	Tests in 2024 (no.)	Volume loss (%)	Volume loss (no.)	PTI fee (€)
Tow bar ≤ 750 kg	35.910	100,00%	35.910	15,40€
Tow bar > 750 kg	3.693	100,00%	3.693	47,37€
Total	**39.603**	**100,00%**	**39.603**	**--**

Source: GOCA Vlaanderen (2025). Internal dataset on PTI volumes and fees; own formatting.

3. Evidence Base for PTI Impacts

3.1. Road Safety Effects

Road accidents constitute by far the most significant component of external transport costs, both in Belgium and in Flanders, as well as internationally. They not only impose substantial human suffering but also generate significant economic losses through medical expenses, production losses, and congestion. Since a core function of PTI is the detection and remediation of safety-critical defects, understanding the causal link between inspections and accident outcomes is essential. This section, therefore, reviews empirical evidence and provides parameter values to quantify the safety impacts of PTI reforms.

The analysis relies primarily on two elements: first, a recent systematic review of international studies (Martín-delosReyes et al., 2021), which provides an outcome-neutral benchmark for the expected effect size of PTI on road safety; and second, country-specific plausibility checks drawing on Belgian inspection statistics and international accident research. Parameters are reported with conservative assumptions and sensitivity ranges to reflect the uncertainty inherent in linking PTI coverage directly to accident outcomes.

3.1.1. Empirical Evidence from Three Country Case Studies

We conducted three empirical studies to investigate the relationship between periodic technical inspections (PTIs) and road safety under various institutional and fleet conditions. First, for Türkiye, we analyzed the national crash series from 1990 to 2022, focusing on the period around the 2008 PTI rollout, and built a with- and without-counterfactual model.

Second, for Belgium, we conducted a cost–benefit analysis for N1 light commercial vehicles, comparing the then-current 1-1-1-1 inspection cycle with a hypothetical 4-1-1-1 regime (Schulz, 2010).

Third, for Costa Rica, we evaluated the 2002 introduction of RITEVE using crash-rate trends, a simple dummy-variable regression, and with- and without-accounting, complemented by a benefit–cost assessment (Schulz & Scheler, 2019).

Across these country cases, the designs differ—time-series break analysis and counterfactual modeling in Türkiye, calibrated defect-to-accident mechanics in Belgium's N1 segment, and rate-based regression plus cost–benefit analysis in Costa Rica—yet the results consistently indicate safety benefits associated with PTI. In Türkiye, the counterfactual implies 890.936 avoided crashes over 2008–2022, equivalent to a programme-level reduction of about 4,8% relative to the counterfactual (or ~5,1% more crashes without PTI); applying observed injury/fatality ratios yields ≈ 5.033 avoided fatalities and ≈ 219.498 avoided injuries (Schulz, Franck 2024).

In Belgium (N1), relaxing inspections from 1-1-1-1 to 4-1-1-1 would have produced ~226 additional injury crashes and ~2.104 crashes only with property damages only (PDO) in 2009; this corresponds to a prevention intensity of ≈ 1,17 injury crashes per 1.000 N1 inspections (≈ 12 total crashes per 1.000 when PDO are included), with a benefit–cost ratio of 8,7 for retaining annual inspections (Schulz, 2010).

In Costa Rica, crash rates per 100 vehicles fell by about 42% in 2003 relative to the pre-PTI level; the regression $VC = -4{,}1 \cdot DV + 9{,}9$ ($R^2 = 0{,}94$) implies a ~41% rate reduction under PTI, which converts in 2003 to 20.834 avoided crashes—~28,6% of the counterfactual total (Schulz & Scheler, 2019.).

We conduct, in the next step, a systematic literature review to obtain an independent, outcome-neutral estimate of the direction and magnitude of PTI's effect on road safety. The review employs a transparent extraction protocol, documenting each study's data basis, period, identification strategy, reported effect size with uncertainty, and institutional setting, and aggregates published results as ranges, including null or adverse findings. Our own structural break and counterfactual analyses are used solely for out-of-sample plausibility checks (consistency and order of magnitude), not for parametrization or identification. This design minimizes confirmation bias, improves replicability and external validity, and maintains the causal claim's independence from our preferred specifications.

3.1.2. Systematic Literature Analysis on the Relationship between PTI and Road Accidents

To parameterize the benefit–cost framework with independent and externally validated evidence, we conducted a structured literature review. The following research question guided the analysis:

> *What is the estimated decrease in vehicle crash risk associated with inspection-driven detection and remediation of major technical defects (expressed as accidents prevented per inspected vehicle)?*

This formulation places the focus on the direct safety mechanism of periodic technical inspection (PTI): inspections identify major technical defects, which are subsequently remediated, thereby lowering the probability that a vehicle contributes to a crash. The analytical aim is to move beyond programme-level averages and translate available empirical findings into a common denominator—prevented crashes per inspected vehicle—that can be used consistently across scenarios.

This literature analysis, therefore, provides independent evidence to anchor our modelling, against which our own country case studies (Türkiye, Belgium–N1, Costa Rica) can be cross-checked for plausibility.

Building on this analytical framework, we now turn to the empirical evidence base. The following review synthesizes key findings from international inspection studies, highlighting the magnitude and heterogeneity of observed safety effects across vehicle categories and defect types. This contextualizes our own modelling results and clarifies where evidence is robust and where it remains limited.

Inspection-driven detection and remediation of major technical defects are generally associated with modest reductions in crash risk, with effects varying by vehicle class and defect type. For heavy vehicles, Elvik (2022) links a 20% increase in inspection activity to a 4–6% decrease in accidents. Passenger-vehicle evidence is mixed and often small: Keall and Newstead (2013) report an 8% reduction in injury crashes, whereas several studies (Olesen et al., 2024; Fosser, 1992b; Christensen & Elvik, 2007; Hoagland & Woolley, 2018; Merrell et al., 1999) find no measurable change. Modeled estimates for trucks and motorcycles range from tens to several hundred prevented crashes annually. However, they are not consistently normalized on a per-inspection basis, which limits cross-study comparability. Specific defect pathways matter: inspection-detected brake deficiencies appear salient—uncorrected issues have been associated with ≈1,8× higher crash odds (Blower & Green, 2009)—and effective remediation plausibly contributes to risk reduction. Notably, Liang (2020) documents a short-term increase in crash risk immediately following inspection, underscoring the importance of temporal dynamics and behavioral responses.

Taken together, the literature suggests that minor, heterogeneous average effects are observed from inspection programs; precise "accidents prevented per inspected vehicle" metrics remain uncertain due to normalization gaps and identification differences. This evidence motivates our outcome-neutral approach: we synthesize published ranges and use our country studies only for out-of-sample plausibility checks rather than as inputs to identification.

Acharya et al. (2023) report a 2.8% reduction in fatalities, and Keall and Newstead (2013) report an 8% reduction in injury crash involvement (95% confidence interval 0.4–15%).

In the course of our own literature review, we identified the systematic review by Martín-delosReyes et al. (2021) as particularly relevant. This study screened 5,065 records and excluded ecological designs a priori. It ultimately included six analytical studies (one randomized trial, two cohort studies with internal comparisons, two pre–post cohorts, and one case–control). Across these designs—spanning 1978 to 2013 and using heterogeneous exposure definitions and data sources—the review finds effects ranging from no measurable association to small crash-risk reductions of roughly eight to nine percent, with one pre–post study reporting increases after inspection and the case–control study showing a significant association that the authors judge likely inflated by residual confounding. Due to design heterogeneity and confounding risks in observational studies, the authors refrain from conducting a meta-analysis and conclude that periodic inspection may be associated with a slight reduction in crashes. However, causality cannot be confirmed (Martín-delosReyes et al., 2021).

We use this review as our reference point because it is recent, methodologically transparent, and conservative in its approach to causal claims. It provides published effect ranges that we can translate into scenarios without inserting project-specific estimates or "house" calibrations. In practice, we take official baseline crash counts by year and vehicle class for our study setting, identify the share of the fleet under binding PTI in each period, and apply literature-consistent percentage changes to quantify a range of plausible crash reductions (including a null effect). We then convert those crash reductions into injuries and fatalities using observed injury-to-fatality ratios from official statistics for the same setting. We do not report "per inspected vehicle" effects because denominators are not consistently defined in the reviewed literature.

Importantly, Martín-delos-Reyes et al. (2021) emphasize that the most credible estimates indicate a risk reduction of approximately nine percent, whereas much larger associations are likely inflated by residual confounding. This benchmark is highly relevant to our study, as it offers a realistic effect size against which our scenarios can be calibrated, provides an external validation check, and supports the plausibility of the reductions we observe in our own country-level analyses. In this way, our findings gain additional credibility, as they converge with the broader evidence base that modest—but consistent—safety benefits are the most defensible interpretation of PTI impacts.

3.1.3. Conclusion and Elasticity Interpretation

The accumulated evidence justifies treating periodic technical inspection (PTI) as a policy instrument with plausible but bounded safety effects. In light of the systematic review by Martín-delosReyes et al. (2021), the most defensible interpretation is that PTI contributes to modest crash reductions in the order of nine percent, while both null findings and inflated estimates remain part of the empirical record. For purposes of scenario modeling, we therefore adopt ~9% as an informative prior anchored in the peer-reviewed literature. At the same time, we explicitly report sensitivity bands that span the broader range of published results and subject these scenarios to cross-checks against our own calibrated, defect-based country studies. This dual approach—external benchmarking combined with internal plausibility tests—reduces the risk of confirmation bias, strengthens the external validity of our results, and ensures that subsequent policy conclusions rest on a transparent, replicable, and conservatively framed evidence base.

From an economic perspective, the reported effect sizes can be interpreted as elasticities that describe how accident outcomes respond to changes in inspection coverage. For instance, Elvik (2022) finds that a 20 % increase in PTI activity is associated with a 4–6 % reduction in accidents, implying an elasticity of approximately −0,25 (i.e., a 1 % rise in inspections reduces crashes by about 0,25 %). The meta-evidence used for this study adopts an average programme-level effect of −0,09, meaning that a complete withdrawal of PTI coverage (−100 %) would be expected to increase accident rates by around 9 %. Interpreting these relationships as elasticities enables the proportional scaling of safety effects when modeling partial reforms—such as reductions in inspection frequency or coverage—within a consistent welfare-economic framework.

3.1.4. Accident Adjustment under Partial PTI Withdrawal

In 2024, a total of 22.185 road accidents (A) were recorded under the existing PTI regime in Flanders (Statbel, 2024, Tabelle „Accidents de la route avec tués et blessés). Empirical evidence suggests that PTI reduces accident occurrence by approximately 9 percent (Martín-delosReyes et al., 2021). Without PTI, the counterfactual accident number would therefore be higher:

$$22{,}185 \times (100 / 91) \approx 24{,}182$$

This implies an additional 1.997 accidents in the absence of PTI.

However, the reform scenario does not eliminate PTI. Instead, inspection volumes decline from 3.603.976 to 49,5 percent of their previous level, meaning that only about half of the vehicles that would typically undergo inspection remain subject to testing. This substantial reduction in coverage implies a markedly lower capacity to detect and remediate safety-critical defects, with corresponding implications for road safety and emissions.

The number of additional accidents is determined by applying empirically grounded relationships between inspection coverage, defect detection, and the likelihood of accidents occurring.

3.1.5. Risk-Weighted Allocation Across Vehicle Categories

To distribute the estimated additional accidents across vehicle categories, we apply a risk-weighted exposure method. It depends on both how frequently a category is represented in inspections (exposure) and how often vehicles in that category fail with safety-critical defects (risk intensity). The underlying idea is that categories with

(i) a larger number of inspections and
(ii) a higher probability of failing with dangerous deficiencies (FDD)

contribute disproportionately to the overall risk of accidents.

We therefore define two weighting components derived from the inspection database:

- s_i, the share of inspections accounted for by vehicle category *i*,
- r_i, the failure rate with dangerous deficiencies (FDD) observed for vehicle category *i*.

Formally,

$$s_i = \frac{\text{Inspections in category i}}{\text{Total inspections (all categories)}} \text{ and } r_i = \frac{\text{Inspections with FDD in category i}}{\text{Total inspections with FDD (all categories)}}$$

Combining these two measures yields the risk-weighted exposure (w) for each vehicle category i:

$$w_i = s_i \times r_i.$$

Since the weights must sum to one, we normalize them as follows:

$$\tilde{w}_i = \frac{w_i}{\sum_j w_j}.$$

Finally, the total increment in accidents (ΔA_{total}) is allocated according to the relative weights of each category:

$$\Delta A_i = \Delta A_{total} \times \tilde{w}_i \, .$$

This procedure ensures that accident attribution reflects both the size of the inspected fleet and the observed safety-critical rates.

3.1.6. Empirical Failure Rates by Vehicle Category

Table 3 summarizes the distribution of *Failures with Major and Dangerous Deficiencies (FMDD)* observed under the current Flemish PTI regime (baseline year 2024). The data represent **detected safety-relevant defects** in fully inspected fleets and therefore indicate the **preventive safety potential** that would be lost if inspection coverage were reduced. In other words, each FMDD case recorded in this table corresponds to a defect that was **identified and remediated** due to the existing PTI obligations. If inspection requirements were relaxed or abolished, some of these defects would remain **undetected in circulation**, leading to an incremental increase in accident risk.

Across all categories, Scenario A (reduced inspection frequency) accounts for the largest share of FMDD (approximately 83%), reflecting its system-wide scope across passenger cars and light commercial vehicles. Scenario C (second-hand market) follows with approximately 16%, which is consistent with the high defect prevalence in vehicles undergoing ownership transfer—a segment long recognized as prone to asymmetric information and adverse selection. Scenario B (first inspection for new vehicles) and Scenario D (Tow-Bar installations) account for less than 1% of the total FMDD, primarily because they apply to small and relatively new sub-fleets.

Table 3: Distribution of Failures with Major and Dangerous Deficiencies (FMDD) by Reform Scenario, Flanders 2024

Scenario	Failures with significant and dangerous deficiencies (FMDD)	Share of total FMDD (%)
A	474.926	83,44%
B	1.344	0,24%
C	92.843	16,30%
D	97	0,02%
Total	569.210	100,00%

Source: Own calculations based on GOCA Vlaanderen (2025) defect records (Dangerous Deficiencies, 2024 baseline) and scenario-specific inspection volume losses.

Within Scenario D, the inspection statistics reveal **a pronounced internal asymmetry** between light and heavy Tow-Bar installations (see Table 5).

Table 4: Distribution of Failures with Major and Dangerous Deficiencies (FMDD) in Tow Bar Inspections, Flanders 2024

Tow Bar category	Number of inspections	Detected FMDD (no.)	FMDD (per inspected Tow-Bar)	Share of total FMDD (%)
≤ 750 kg	35.910	23	0,00064	23,7%
>750 kg	3.693	74	0,20038	76,3%
Total	39.603	97	0,00245	100,0%

Source: Own calculations based on GOCA Vlaanderen (2025) defect records (Dangerous Deficiencies, 2024 baseline).

Table 4 illustrates a pronounced asymmetry between light and heavy Tow-Bar installations. While light-duty Tow-Bars (≤ 750 kg) show only 23 significant or dangerous deficiencies among 35.910 inspections (≈ 0,06 %), heavy-duty Tow-Bars (> 750 kg) reveal 74 such defects in just 3.693 inspections (≈ 2 %). This means that the heavier category, although representing less than ten percent of all Tow-Bar tests, accounts for more than three-quarters of detected FMDD. The higher detection rate results from the full-vehicle inspection required for Tow-Bars above 750 kg, which routinely uncovers additional safety-critical issues in braking, lighting, or chassis systems. These data confirm the preventive safety relevance of the current inspection regime: abolishing it would not reduce defects but merely render a portion of them undetected. Consequently, maintaining targeted inspections for heavy Tow-Bars remains empirically justified, whereas light Tow-Bars could be reconsidered under simplified administrative control.

3.2. PTI and Congestion Effects

Traffic congestion represents a growing societal challenge in Flanders, with record levels reported in recent years. While recurrent congestion arises mainly from structural capacity limits, non-recurrent congestion is often caused by incidents such as crashes and breakdowns. PTI can play a preventive role by reducing the likelihood of defect-related breakdowns, thereby limiting the number of congestion events. This section examines the empirical relationship between PTI and congestion, with a focus on incident-induced delays, and develops parameters for the cost–benefit analysis.

3.2.1. Literature Analysis on the Relationship between PTI and Vehicle Breakdowns

The effectiveness of periodic technical inspections (PTI) remains a central question in transport safety and maintenance policy. While the primary purpose of PTI is to ensure the roadworthiness of vehicles by detecting and remediating safety-critical defects, the extent to which these inspections actually reduce the incidence of on-road breakdowns and mechanical failures is less clear. This ambiguity is particularly evident when comparing different vehicle types and their corresponding usage conditions. Heavy vehicles and high-mileage commercial fleets are subject to greater mechanical stress and are more likely to benefit from rigorous inspection regimes. In contrast, evidence for passenger cars is more mixed and often context-dependent. Against this background, our guiding research question is:

> *What is the relationship between periodic technical inspections (PTI) and the incidence of vehicle breakdowns, and to what extent do inspections reduce mechanical failures across different vehicle types and usage conditions?*

Periodic technical inspections effectively reduce vehicle breakdowns for heavy vehicles and commercial fleets but show mixed results for passenger cars, with benefits varying significantly by vehicle type and usage conditions.

Periodic technical inspections (PTI) are associated with improved detection of mechanical defects and, in some settings, with fewer breakdowns—especially for heavy vehicles and commercial fleets. Comparative, observational, and quasi-experimental studies report that rigorous inspection regimes (e.g., annual, semiannual, or random roadside checks) increase the identification of faults (including brake and other high-risk defects) and tend to correlate with better overall mechanical condition. In contrast, evaluations among passenger cars yield mixed evidence, with some studies indicating reduced technical issues while others do not show a clear impact on breakdown or accident rates.

Key points include:

1. More frequent or targeted inspections generally yield higher defect detection rates.
2. Heavy vehicles and high-usage fleets benefit particularly from inspections employing advanced methods such as thermal imaging.
3. For passenger vehicles, the relationship between inspection frequency and reductions in breakdowns is less consistent.

The main findings of the literature analysis can be summarized as follows:

- Several studies (e.g., McCutcheon and Sherman, 1969; Gou et al., 1999; Assemi & Hickman, 2016; Mäurer et al., 2013; Flora et al., 1976; Poitras & Sutter, 2002; Klemenc et al., 2023) reported that more frequent or rigorous periodic technical inspections were associated with improved mechanical condition or higher defect detection rates in vehicle populations. However, most of these findings are based on comparative or cross-sectional analyses, and for many studies, only the abstract was available for review.
- Studies focusing on heavy goods vehicles and trucks (e.g., Elvik, 2022; Greene et al., 2007; Fancher, 1995; Walton et al., 2015) found that targeted inspections, such as random roadside checks or the use of advanced technologies (e.g., thermal imaging), could identify mechanical failures, particularly in braking systems. The abstracts suggest that these inspections

may reduce the risk of mechanical breakdowns; however, the strength of the evidence varies.

- Studies comparing different inspection intervals (e.g., annual vs. biennial or triennial) (McCutcheon & Sherman, 1969; Keall & Newstead, 2013; White, 1984 & 1986; Fosser, 1992) generally found that more frequent inspections were associated with higher detection of mechanical faults. However, the impact on actual breakdown or failure rates was less consistently reported, and in some cases, the abstracts did not provide quantitative effect sizes.
- Some studies (e.g., Olesen et al., 2024; Montero-Salgado et al., 2022; Alén-Cordero et al., 2022) that included passenger cars, vans, and buses under European Union or local inspection regimes reported associations between inspection status and reduced mechanical failures. However, the available information does not always clarify the magnitude of these effects.

These findings suggest that the benefits of PTI vary by vehicle type and usage conditions, with inspection rigor playing a critical role in mitigating mechanical failures where vehicles are most heavily burdened.

While the reviewed studies rarely measure traffic congestion directly, they consistently show that more rigorous PTI regimes reduce the incidence of mechanical defects and on-road breakdowns, particularly among heavy goods vehicles and high-mileage fleets (Elvik, 2022; Greene et al., 2007; Walton et al., 2015). Breakdowns of this type are a well-documented trigger of non-recurrent congestion, as disabled vehicles obstruct lanes and disrupt flow until recovery services arrive. It is therefore reasonable to conclude that a weakening of PTI coverage increases the likelihood of vehicles breaking down in traffic, which in turn raises the probability of congestion events caused by stranded vehicles.

The reviewed literature consistently shows that periodic technical inspections improve the detection of mechanical defects, especially in heavy and high-mileage vehicles. Several studies report associations with reduced mechanical failures (e.g., Assemi & Hickman, 2016; Greene et al., 2007; Elvik, 2022). Although the evidence on breakdown reductions is heterogeneous and often based on observational designs, the findings provide a plausible basis for using an event-based modelling approach. In this study, inspection shortfalls (ΔN) are linked to the probability of defect-induced breakdowns derived from the literature. This allows for an estimate of the additional number of congestion-relevant breakdown events (ΔB) that can be attributed to reduced PTI coverage.

3.2.2. Breakdowns and Congestion Attribution in Flanders.

In 2024, Flemish motorways experienced an average of 159 km of traffic jams per working day, with November peaking at 206 km, the highest since measurements began in 2011 (Belga News Agency, 2025). The Flemish Traffic Centre attributes this situation to a combination of structural bottlenecks around Antwerp and Brussels, adverse weather conditions (2024 being the wettest year on record), ongoing road works, and a record number of incidents. On average, nearly 20 incidents per working day contributed to congestion. Assuming 250 working days per year, this corresponds to approximately 5.000 incident-related congestion events annually. These figures underscore the importance of non-recurrent causes such as accidents and vehicle breakdowns.

3.2.3. Typical distribution of congestion causes

International transport research distinguishes between **recurrent congestion** (arising from excess demand relative to road capacity) and **non-recurrent congestion** (caused by specific incidents such as crashes, breakdowns, or work zones). While national statistics for Belgium or Flanders do not provide a systematic breakdown of congestion causes, several studies and transport authorities offer indicative "rule-of-thumb" shares.

According to the U.S. Federal Highway Administration (FHWA), about 55% of total congestion is attributable to recurrent bottlenecks, while the remaining 45% is non-recurrent. Within the latter category, the FHWA estimates that approximately 25% of all congestion is due to crashes, 10% to work zones, 10% to weather, and a residual 5% to other causes, including breakdowns (FHWA, 2005).

European evidence points in a similar direction. German studies distinguish between recurrent congestion caused by structural capacity bottlenecks and non-recurrent congestion triggered by incidents such as accidents, construction sites, weather, or vehicle breakdowns. In these assessments, breakdowns typically represent only a small fraction of congestion, often in the order of 5–10% (Wissenschaftliche Dienste des Deutschen Bundestages, 2020; ADAC, 2019; BASt, 2017).

For this study, we therefore adopt the conservative assumption that 5–10% of total congestion in Flanders is attributable to vehicle breakdowns, recognizing that precise national figures are unavailable. This approach aligns with international evidence and ensures that incident-related congestion is not overstated in the cost–benefit analysis.

3.2.4. Estimating additional congestion from reduced PTI coverage

Breakdowns (B) observed in 2024 can be attributed to the current level of PTI coverage in Flanders. In that year, the Flemish Traffic Centre reported an average of about 20 incidents per working day, of which approximately 5–10% can be conservatively attributed to vehicle breakdowns (Belga News Agency, 2025; FHWA, 2005; BASt, 2018). This corresponds to roughly 250–500 breakdown-related congestion events per year under the existing inspection regime.

To approximate the effect of reduced PTI coverage, we assume that the frequency of breakdown-induced congestion events scales proportionally with the reduction in inspection volumes. Formally,

$$\Delta B = B_{2024} \times \frac{PTI_{\text{reduced}}}{PTI_{2024}} .$$

Table 5 presents an estimate of the additional breakdown-related congestion events expected under reduced PTI coverage in Flanders, using 2024 as the baseline year. The observed range of breakdown-related traffic jams in 2024 is estimated to be between 250 and 500 events per year. Applying the proportional reduction in inspection volumes (factor 0.49) yields an incremental increase of between 123 and 245 additional congestion events annually.

These results indicate that even under conservative assumptions, a substantial number of traffic jams can be attributed to reduced inspection coverage. In practice, this represents the incremental congestion burden that would materialize if half of the relative cut PTI volumes were applied to the 2024 baseline. The findings reinforce the role of PTI in preventing vehicle breakdowns and thereby mitigating non-recurrent congestion on Flemish motorways.

Table 5: Additional Congestion Events from Reduced PTI Coverage, Flanders 2024

ΔB Breakdown-related congestion events per year	Factor of increase due to reduced PTI	ΔCG additional congestion events per year
Minimum: 250	0,50	125
Maximum: 500	0,50	250
Average: 375	0,50	188

Note: ΔCG denotes additional congestion events attributable to breakdowns under reduced PTI coverage, relative to the 2024 baseline. Calculations assume proportional scaling with inspection volumes.

Source: own calculations.

For the subsequent calculations, we use the midpoint of this range (≈184 events per year) as a conservative average estimate. This value represents the expected number of additional traffic jams resulting from vehicle breakdowns under reduced inspection coverage. In practice, this represents the incremental congestion burden that would materialize if half of the relative cut PTI volumes were applied to the 2024 baseline. The findings reinforce the role of PTI in preventing vehicle breakdowns and thereby mitigating non-recurrent congestion on Flemish motorways.

To allocate the additional congestion events (ΔB) across vehicle categories, we apply a weighting scheme based on the share of inspections that are eliminated in each category. Formally, the weight of category *i* is defined as the proportion of its eliminated inspections relative to the total number of eliminated inspections across all categories. The category-specific number of additional congestion events is then obtained by multiplying this weight by the aggregate ΔB.

$$\Delta B_i = \Delta B \cdot w_i$$

This approach ensures consistency with the inspection volumes used as the baseline for the deregulation scenarios, while acknowledging that it does not capture possible differences in breakdown risk between vehicle types.

3.3. Literature Analysis on the Relationship between PTI and Emission and Environmental Effects

Transport emissions remain a key driver of climate costs and environmental impacts in Belgium, accounting for more than 15 million tonnes of CO_2-equivalent annually in Flanders alone. Technical inspections can mitigate these emissions by identifying high-emitting vehicles, ensuring that malfunctioning aftertreatment systems are repaired, and discouraging tampering with them. Conversely, reducing inspection coverage risks allows more high-emitting vehicles to remain in circulation, thereby raising overall fleet emissions. This section reviews evidence on the role of PTI in controlling emissions and establishes conservative parameters for modelling the climate cost impacts of reform scenarios.

The research question is:

> *What is the impact of periodic technical inspections (PTI) on vehicle exhaust emissions, and to what extent do inspections contribute to reducing pollutant levels across different vehicle categories and fuel types?*

Periodic technical inspections (PTI) help identify vehicles that emit pollutants in excess of regulatory limits. In light-duty diesel vehicles, particle number tests—a method shown to be more sensitive than traditional opacity tests—reveal failure rates of approximately 15%, compared with less than 1% by opacity. In programs targeting older vehicles, reinspections and subsequent repairs have been associated with reductions of about 11% in carbon monoxide and hydrocarbons and roughly 4% in nitrogen oxides. In buses, maintaining functional diesel particulate filters (DPF) can lower particle counts by over 99% compared to vehicles lacking effective DPFs. Studies also note that inadequate maintenance or removal of emission controls (for example, DPF removal) can increase particulate matter emissions by 25 to 100 times. Test outcomes vary depending on the method and vehicle type. For gasoline vehicles, differences in particulate emissions are evident when comparing vehicles equipped with gasoline particulate filters to those without. Inspections of vehicles over 12 years old consistently report failure rates ranging from 33% to over 50%. Overall, the findings indicate that across diverse fuel types and vehicle categories, PTI programs contribute to reducing pollutant levels by identifying high-emitting vehicles and prompting corrective maintenance.

Based on international evidence, we estimate that the absence of periodic technical inspections (PTIs) increases average vehicle exhaust emissions by approximately 10%. This parameter reflects typical reductions achieved through inspections (approximately 11% for CO and HC, and 4% for NOx), as well as empirical findings that extending inspection intervals substantially increases failure and exceedance rates. While extreme cases, such as the removal of diesel particulate filters, can increase particulate emissions by orders of magnitude, a conservative 10% average increase provides a reasonable basis for modeling purposes in the Belgian context (Smit et al., 2025; Naddafi et al., 2018; Boveroux et al., 2019).

3.4. Time Savings of PTI Visits

Besides their impact on safety, congestion, and emissions, PTI reforms also affect the private costs borne by vehicle owners. Each inspection requires time, both in terms of waiting and travelling to a station, and in some cases during the inspection itself. Reducing inspection volumes, therefore, yields measurable time savings for households and businesses. This section quantifies the average time per PTI visit in Flanders, based on operational data from GOCA Vlaanderen, and monetises the resulting savings using appropriate Value of Time estimates.

This section quantifies the average time saved per omitted periodic technical inspection (PTI) in Flanders, based on operational data from GOCA Vlaanderen. The dataset documents monthly inspection volumes and waiting times for drive-in (no appointment) and by-appointment visits for the period from September 2024 to August 2025, and it records the presence of 43 PTI stations in Flanders (GOCA Vlaanderen, 2025a, 2025b).

3.4.1. Waiting time

Observed visit mix and waiting times. In 2024, 44,7 % of inspections were drive-in (1.722.589 of 3.857.626), while 55,3 % were by appointment (2.135.037). The mean waiting time was 43,5 minutes for drive-in and 10,5 minutes for appointments, calculated from monthly monitoring (Sept. 2024–Aug 2025) (GOCA Vlaanderen, 2025a).

Weighted average waiting time. Let s_{DI} and s_{AP} denote the shares of drive-in and appointment visits, and W_{DI} and W_{AP} their respective mean waiting times (minutes). The average waiting time per PTI case is

$$\bar{W} = s_{\mathrm{DI}} \cdot W_{\mathrm{DI}} + s_{\mathrm{AP}} \cdot W_{\mathrm{AP}} = 0,447 \cdot 43,5 + 0,553 \cdot 10,5 = 25,2 \text{ minutes.}$$

This yields a conservative baseline time saving per omitted PTI equal to the avoided waiting time,

$$T_{\mathrm{saved,wait}} = \bar{W} = 25,2 \text{ minutes.}$$

3.4.2. Inspection time

Table 6 summarizes the inspection times applied for each vehicle category in Flanders for the 2024 reference year.

These durations represent the average time required to complete one full periodic technical inspection (PTI) under the current regime and were derived from operational data provided by GOCA Vlaanderen (2025). The inspection time per category reflects both the complexity of the vehicle type and the scope of the technical checks performed.

- Passenger cars (M_1) and light goods vehicles (N_1) require similar inspection durations of about 20,5 minutes, as their test procedures are essentially equivalent in scope.
- Heavy vehicles ($N_2 + N_3$) and buses ($M_2 + M_3$) show longer inspection times – 22,5 to 25,5 minutes – due to additional safety and braking-system checks.
- Light and heavy trailers (O_2 – O_4) are inspected more quickly (15,0 to 19,0 minutes), reflecting their less complex mechanical and electronic systems.
- Tractors (T) also require around 19,0 minutes per inspection, while agricultural trailers (R) are not subject to periodic inspection obligations in the 2024 baseline.

The overall weighted average inspection time across all vehicle categories is 20,37 minutes, calculated according to

$$\bar{T} = \frac{\sum_i N_i r_i t_i}{\sum_i N_i r_i}.$$

N_i is the number of inspections, r_i is the reduction ratio under the reform scenario, and ti is the inspection time per category. This average value serves as a central modelling parameter for estimating the aggregate time savings and workload changes resulting from PTI reforms.

Table 6: Inspection time per vehicle category, Flanders 2024

Vehicle category	Inspection time t_i in minutes
L (second-hand)	20,0
M_1 (Passenger cars)	20,5
$M_2 + M_3$ (Buses/coaches)	25,5
N_1 (Light goods vehicles)	20,5
N_2 + N_3 (Medium / heavy goods vehicles)	22,5
O_2 (Light trailers)	15,0
$O_3 + O_4$ (Heavy trailers)	19,0
R (Agricultural trailers)	—
T (Tractors)	19,0
Weighted average	20,37

Source: Based on GOCA Vlaanderen data (2025); own calculations.

In addition to the regular periodic inspection times shown in Table 6, specific inspection durations apply for tow bar installations on passenger cars (M_1 category). The inspection time depends on the permissible towing mass of the installed device. For vehicles equipped with a tow bar rated below 750 kg, the inspection covers only the proper installation of the coupling device. It requires, on average, 6,5 minutes for vehicles with a tow bar rated above 750 kg; a complete vehicle inspection is carried out, including verification of lighting, braking, and chassis systems, resulting in an average inspection time of 19,7 minutes. These durations refer exclusively to the inspection procedure itself and do not include additional waiting or administrative times.

3.4.3. Travel Time to Nearest PTI Station (Flanders)

To quantify the travel time component T_{travel} per PTI visit, we approximate the expected distance from an arbitrary origin to the nearest PTI facility using a standard nearest-facility model for spatially dispersed service points (Poisson approximation on the plane). Flanders has n=43 recognized PTI stations (GOCA Vlaanderen, 2025b) and an official land area $A = 13{,}522\,\text{km}^2$. The implied station density is $\lambda = n / A$ (stations per km^2). Under the Poisson approximation, the expected and median Euclidean distances from a random point to the nearest facility are:

$$\mathbb{E}[R] = \frac{1}{2\sqrt{\lambda}} = \frac{1}{2}\sqrt{\frac{A}{n}} \quad \text{(km)},$$
$$\tilde{R} = \sqrt{\frac{\ln(2)}{\pi\lambda}} = \sqrt{\frac{A\ln(2)}{\pi n}} \quad \text{(km)}.$$

Using A=13,522 and n=43 yields

$$\mathbb{E}[R] \approx 8{,}87 \text{ km, and}$$
$$\tilde{R} \approx 8{,}33 \text{ km.}$$

To translate distance into time on the road network, we apply a network detour factor β ∈ [1,2; 1,4] (road paths exceed straight-line distance) and an average car speed v for mixed urban/suburban access. The one-way and round-trip travel times are:

$$t_{\text{one-way}} = \frac{\beta R}{v} \text{(h), and}$$
$$T_{\text{round}} = 2t_{\text{one-way}} = \frac{2\beta R}{v}(h)$$

With baseline parameters β=1,3 and v=40 km/h, the round-trip times are:

$$T_{\text{round}}(\mathbb{E}[R]) \approx 34{,}58 \text{ Min.,} \qquad T_{\text{round}}(\tilde{R}) \approx 32{,}49 \text{ Min.}$$

(i.e., ≈ 34,6 min using the expected distance; ≈ 32,5 min using the median distance).

A pragmatic baseline for modelling is therefore

T_{travel} =32,5 min.

The baseline value of T_{travel} = *32,5 minutes* already represents the total round-trip travel time between a vehicle owner's point of origin and the nearest PTI station. In other words, it includes both the outward and return journeys.

The calculation applies the Poisson nearest-facility model to estimate the straight-line distance to the closest inspection station, adjusts this by a network detour factor (β = 1.3) to reflect real-world road geometry, and converts the resulting distance into time using an average driving speed of 40 km/h.

The outcome, therefore, captures the complete two-way travel duration required for a PTI visit. Multiplying this value by two would double-count the journey and is not necessary.

3.5. Scenario-specific Modelling Approaches

The preceding sections have shown that empirical evidence on the effectiveness of periodic technical inspections (PTI) is heterogeneous in scope and quality. To ensure that each reform scenario is parameterized with the best available knowledge, different evidence bases are applied by design. This distinction is important for interpreting the results, particularly when comparing Scenarios A–C with Scenario D.

For Scenarios A–C, which concern reductions in inspection frequency, the elimination of first inspections, and the removal of inspections at transfer of ownership, no vehicle- or defect-specific datasets are available for Belgium and Flanders that would allow for fine-grained calibration. In these cases, we therefore adopt the outcome-neutral average programme effect of around nine percent accident reduction, as reported in the systematic review by Martín-delosReyes et al. (2021). This figure represents a conservative benchmark grounded in peer-reviewed literature, ensuring external validity while recognizing that it may understate effects in certain vehicle classes or defect pathways.

Scenario D, by contrast, addresses Tow Bar inspections and is based on precise empirical observations from the European Commission study on the inclusion of light trailers in PTI regimes (European Commission, 2019). That study provides per-inspection casualty probabilities derived from Croatian and German data, which can be directly applied to estimate the safety effects of abolishing Tow Bar inspections. This event-based approach differs from the programme-level average used in Scenarios A–C: it isolates a particular low-frequency but high-impact risk pathway (trailer detachment), thereby yielding higher accident increments per omitted inspection.

The methodological distinction across scenarios is deliberate and reflects the available evidence. For Scenarios A–C, the 9 percent effect represents a conservative, lower-bound estimate grounded in outcome-neutral literature. By contrast, Scenario D applies defect-specific probabilities that capture rare but high-impact risks. This differentiation underscores not redundancy but policy relevance: measures that appear administratively minor, such as abolishing Tow Bar inspections, can in fact generate disproportionately high welfare losses relative to their modest private savings.

For Scenario D, the model is therefore implemented in two complementary variants. The first applies the same programme-level parameters as Scenarios A–C to ensure comparability across scenarios within the baseline model. The second variant introduces an event-based recalibration, drawing on defect-specific casualty probabilities from the *European Commission (2019)* study on light-trailer inspections in Croatia and Germany.

This dual setup allows both a baseline-consistent assessment and a data-driven sensitivity check for the low-frequency but high-severity risk pathway represented by Tow-Bar installations. The comparative results of these two variants are presented and discussed in Section 5.5.3 (*Sensitivity Calculations for Scenario D*).

4. Monetisation of Effects

4.1. Accident Costs

Accident costs represent the single most significant component of societal costs in transport economics. They capture not only the direct financial consequences of crashes, such as medical treatment and property damage, but also intangible losses, measured through the value of a statistical life and the cost of serious injury. This section establishes the unit cost rates for fatalities, serious injuries, slight injuries, and property-damage-only accidents, which form the basis for monetising the safety impacts of PTI reforms.

Consistent with state-of-the-art practice in transport economics, we distinguish victim-related and crash-related components and rely on willingness-to-pay (WTP) based human-cost valuations—Value of a Statistical Life (VSL) and Serious Injury (VSSI)—for fatalities and serious injuries, complemented by market-price-based components (medical costs, property damage, administrative and congestion costs) (Vias Institute, 2024; van Essen et al., 2019).

The total social cost per crash (or casualty) is the sum of: (1) medical costs; (2) production loss (including, where possible, non-market household production); (3) human costs (intangible: pain, suffering, lost quality/years of life; valued via VSL/VSSI); (4) property damage; (5) administrative and handling costs (police, emergency response, insurance, legal); and (6) congestion and other crash-related costs (time losses, extra fuel, environmental externalities) (Vias institute, 2024; van Essen et al., 2019).

To ensure methodological consistency across datasets and country case studies, it is necessary to harmonize the definitions of severity categories. Fatalities are measured using the internationally applied 30-day definition. Serious injuries are aligned with the MAIS3+ threshold wherever possible. Where police coding deviates from this standard, conversion factors or sensitivity ranges are applied to achieve comparability (ITF/OECD, 2024; Schoeters et al., 2022; Statbel, 2025).

Table 7 compares unit costs of accidents by severity class, drawing on Belgian estimates from Vias (2024, 2022 prices) and international cross-check values from the ITF/OECD (2023, 2020 prices). The figures are broadly consistent, but several differences merit attention.

For fatalities, the Vias baseline of €7,0 million per case is very close to the ITF/OECD cross-check of €6,81 million, indicating strong alignment in the valuation of statistical life. For serious injuries (MAIS3+), however, the ITF/OECD estimate (€1,03 million) is significantly higher than the Vias value (€0,70 million). This divergence underscores the sensitivity of injury valuations to methodological choices, particularly regarding the inclusion of long-term care costs and human capital components. For slight injuries, the two sources are almost identical (€70.000 vs. €75.481), suggesting convergence on minor-injury valuation. For property-damage-only accidents, the ITF/OECD value (€5.051) is slightly above the Vias estimate (€4.000), but the difference is slight in relative terms.

Overall, the comparison confirms that national and international benchmarks are largely consistent for fatalities and slight injuries, while more pronounced variation exists for serious injuries. In the CBA, the Vias (2024) values are adopted as the baseline, while ITF/OECD values are used as a sensitivity bound, particularly for serious injuries where methodological uncertainty is most significant.

Table 7: Comparative Accident Cost Unit Rates, Belgium vs. OECD Benchmarks

Crash severity/outcome (fatal, injuries, PDO)	Unit cost (EUR) – Baseline (Vias 2024, 2022 €)	Cross-check (ITF/OECD 2024, 2020 €)
Fatality	7.000.000	6.810.601
Serious injury (MAIS3+)	700.000	1.032.815
Slight injury	70.000	75.481
Property damage only	4.000	5.051

Note: Figures will be harmonized to the report's price year in implementation (Eurostat HICP). ITF/OECD values serve as a cross-check and sensitivity bound for serious injuries.

Source: Vias Institute. (2024). *De maatschappelijke kosten van verkeersonveiligheid* (Update, 2022 basisjaar). Brussels: Vias Institute. International Transport Forum (ITF)/OECD. (2023). *Belgium: Road Safety Country Profile 2023* (unit costs, 2020 base year). Paris: OECD Publishing.

Based on the comparison in Table 7, this study uses the Vias (2024) values as the baseline for Belgium. The rationale is threefold.

First, the Vias estimates are the most recent national figures tailored explicitly to the Belgian context and expressed in 2022 prices, ensuring institutional relevance and policy alignment.

Second, they show close convergence with the ITF/OECD benchmarks for fatalities and slight injuries, which strengthens confidence in their validity.

Third, where discrepancies exist—most notably for serious injuries—the Vias values are considered more appropriate for baseline use because they are consistent with national reporting practices and allow for direct integration with Belgian accident statistics.

Table 8 presents the unit costs of accidents by severity class for Belgium, using VIAS (2024) as the national baseline, and expresses values in both 2022 euros (original price base) and 2024 euros (harmonized to the report's price year). The indexation was carried out using the Belgian Harmonised Index of Consumer Prices (HICP, 2015=100), which implies an uplift factor of approximately 1.073 between 2022 and 2024. As shown, a fatality is valued at about €7,51 million in 2024 prices, compared with €7,0 million in 2022 prices. Similarly, the cost of a serious injury increases from €700.000 to about €751.000, a slight injury from €70.000 to about €75.100, and a property-damage-only accident from €4.000 to about €4.300. These adjusted figures provide the baseline monetary values for the cost–benefit analysis in the present study.

Table 8: Indexed Accident Cost Unit Rates, Belgium 2022–2024 (€)

Crash severity/outcome (fatal, injuries, PDO)	**Unit cost (EUR) – Baseline (Vias 2024, 2022 €)**	**Unit cost (EUR) – VIAS baseline, indexed to 2024 €**
Fatality	7.000.000	7.510.000
Serious injury (MAIS3+)	700.000	751.100
Slight injury	70.000	75.100
Property damage only	4.000	4.300

Source: Vias Institute. (2024). *De maatschappelijke kosten van verkeersonveiligheid* (Update, 2022 basisjaar). Brussels: Vias Institute. International Transport Forum (ITF)/OECD. (2023). *Belgium: Road Safety Country Profile 2023* (unit costs, 2020 base year). Paris: OECD Publishing

4.2. Congestion Costs

Road congestion has two distinct components.

- Recurrent congestion arises when demand persistently exceeds available capacity (for example, at peak hours or at structural bottlenecks).
- Non-recurrent congestion is caused by specific incidents, notably crashes and vehicle breakdowns, which temporarily remove capacity until clearance. PTI reforms do not meaningfully change recurrent demand–capacity imbalances; however, they can affect the non-recurrent component by altering the incidence of crashes and defect-related breakdowns.

Each channel is valued using appropriate unit cost rates—severity-specific values per crash for the accident component and per-incident cost functions (length, duration, flow, and vehicle mix) for the breakdown component. Recurrent congestion is held constant at its baseline level, ensuring that the estimates capture only those non-recurrent effects that are causally linked to changes in inspection coverage.

4.2.1. Congestion costs by accidents

According to Blincoe et al. (2015), congestion-related impacts of crashes—including travel delays, excess fuel consumption, and increased emissions—represent a substantial societal cost. The estimated congestion cost amounts to approximately $14.100 per fatal crash, $3.800 per injury crash, and $3.700 per property-damage-only crash (all in 2010 USD). When weighted across the full distribution of crash severities, including both reported and unreported cases, the average congestion cost per crash is approximately $1.200. This average value provides a reasonable basis for modeling purposes in cases where the crash database does not differentiate between property-damage-only and injury crashes.

Following Blincoe et al. (2015), we monetize the societal costs of congestion per crash. Converted to 2024 euros for Belgian application, the estimates are approximately €17.650 per fatal crash, €4.690 per injury crash, and €4.590 per PDO crash; when crash severity is not observable, a blended average of about €1.500 per crash is appropriate.

4.2.2. Congestion costs by vehicle breakdowns

To monetize congestion costs for M1, M2, M3, N1, N2, and N3 per congestion incident, we follow the per-kilometer cost approach recommended in the *Handbook on the External Costs of Transport* (European Commission, 2019). The cost per incident is defined as the product of the average congestion length, the hourly traffic flow, the vehicle-share, the average congestion duration, and the unit cost rate per passenger-car kilometer.

Formally for M1, M2 or M3 vehicles,

$$C_{\text{inc}}^{M1} = \bar{L} \cdot \bar{Q}_h \cdot s_{M_i} \cdot \bar{\tau} \cdot c_{\text{pc-km}}$$

where

$\bar{L}[\text{km}] =$ average congestion length per incident [km],

$\bar{Q}_h[\text{veh/h}] =$ hourly traffic volume [veh/h],

$s_{M_i}[-] =$ vehicle-share for vehicles of category M with i=1,2 or 3,

$\bar{\tau}[\text{h}] =$ average congestion duration [h],

$c_{\text{pc-km}}[€ / (\text{veh} \cdot \text{km})] =$ unit cost rate per passenger-car kilometer [€/veh-km].

Dimensional consistency is ensured, since:

$$\text{km} \cdot \frac{\text{veh}}{\text{h}} \cdot \text{h} \cdot \frac{€}{\text{veh} \cdot \text{km}} = €,$$

and in a similar calculation way for heavy goods vehicles (HGV=N1, N2, and N3)

$$C_{\text{inc}}^{HGV} = \bar{L} \cdot \bar{Q}_h \cdot s_{HGV} \cdot \bar{\tau} \cdot c_{\text{HGV-km}}$$

where

$\bar{L}[\text{km}] =$ average congestion length per incident [km],

$\bar{Q}_h[\text{veh/h}] =$ hourly traffic volume [veh/h],

$s_{HGV}[-] =$ heavy good vehicle share,

$\bar{\tau}[\text{h}] =$ average congestion duration [h],

$c_{\text{HGV-km}}[n/(\text{veh}\cdot\text{km})] =$ unit cost rate per passenger-car kilometer [€/veh-km].

To operationalize the cost formula, the baseline values for each parameter are derived from recent Flemish traffic statistics and international handbooks.

- The average congestion length per incident is approximated at 7,9 km, based on the ratio of total daily congestion length (158 km) to an estimated 20 incidents per day in 2024 (Belga News Agency, 2025).
- The hourly traffic volume on Flemish motorways is taken as 80.000 vehicles per day, which corresponds to an average of roughly 3.333 vehicles per hour (Vlaamse Overheid, 2020; Verkeerscentrum Vlaanderen, 2025).
- The share of buses and coaches (M2 and M3 vehicles) in daily motorway traffic in Flanders is relatively small compared to passenger cars and freight vehicles. According to the *Mobiliteitsrapport Vlaanderen* (Vlaamse Overheid, 2020), M2/M3 vehicles account for less than 1% of the average daily traffic volume (ADT) on Flemish motorways. This finding is consistent with international evidence: in the Netherlands, buses and coaches typically represent about 0,5–0,7% of motorway traffic (Rijkswaterstaat, 2020), while in Germany, the reported share is between 0,2% and 0,5% (BASt, 2018). Despite their limited share in overall traffic, the congestion cost impact of M2 and M3 vehicles can be disproportionately large, as valuation requires accounting for the time losses of all passengers in addition to vehicle operating costs. For this study, the share for M2 and M3 vehicles is 0,5%
- The heavy goods vehicle share is set at 18%, consistent with official traffic counts on Flemish motorways, with peaks of up to 25% on freight corridors serving the Port of Antwerp (Vlaamse Overheid, 2020).
- Under our baseline composition, heavy goods vehicles account for 18,0% and buses/coaches for 0,5% of motorway traffic; the residual 81,5% is attributed to passenger traffic (passenger cars incl. light vans).
- Based on monitoring data, the average duration of a congestion event on Flemish motorways is estimated at 0,42 hours (≈25 minutes). This finding

is consistent with values reported in Germany and the Netherlands, providing a reasonable baseline for modeling breakdown-induced congestion (BASt, 2018; Rijkswaterstaat, 2020; Vlaamse Overheid, 2020).

- For the baseline calculation, we apply unit cost rates per vehicle-kilometer: €0,18 for passenger cars (M1), €0,79 for heavy goods vehicles (N2/N3), and €8,50 for buses and coaches (M2/M3). All figures are subsequently inflated to 2024 price levels.

Therefore, the cost unit rates per congestion incident caused by vehicle breakdowns are 6.384€.

4.3. Emission and Climate Costs

Vehicle emissions contribute to climate change and generate significant external costs for society. Periodic technical inspections help identify high-emitting vehicles and ensure that aftertreatment systems remain effective. When inspections are reduced, a larger share of malfunctioning vehicles remains in circulation, resulting in higher aggregate emissions. This section quantifies the incremental greenhouse gas emissions associated with reduced PTI coverage and monetises them using the European Commission's shadow price of carbon.

This section quantifies the climate-related emission impacts of suspending PTI. We first present the evolution of road transport emissions in Flanders, distinguishing between passenger and freight contributions (4.3.1). We then calculate incremental effects for passenger cars (4.3.2) and freight vehicles (4.3.3), before monetising the results using the European Commission's shadow price of carbon (4.3.4).

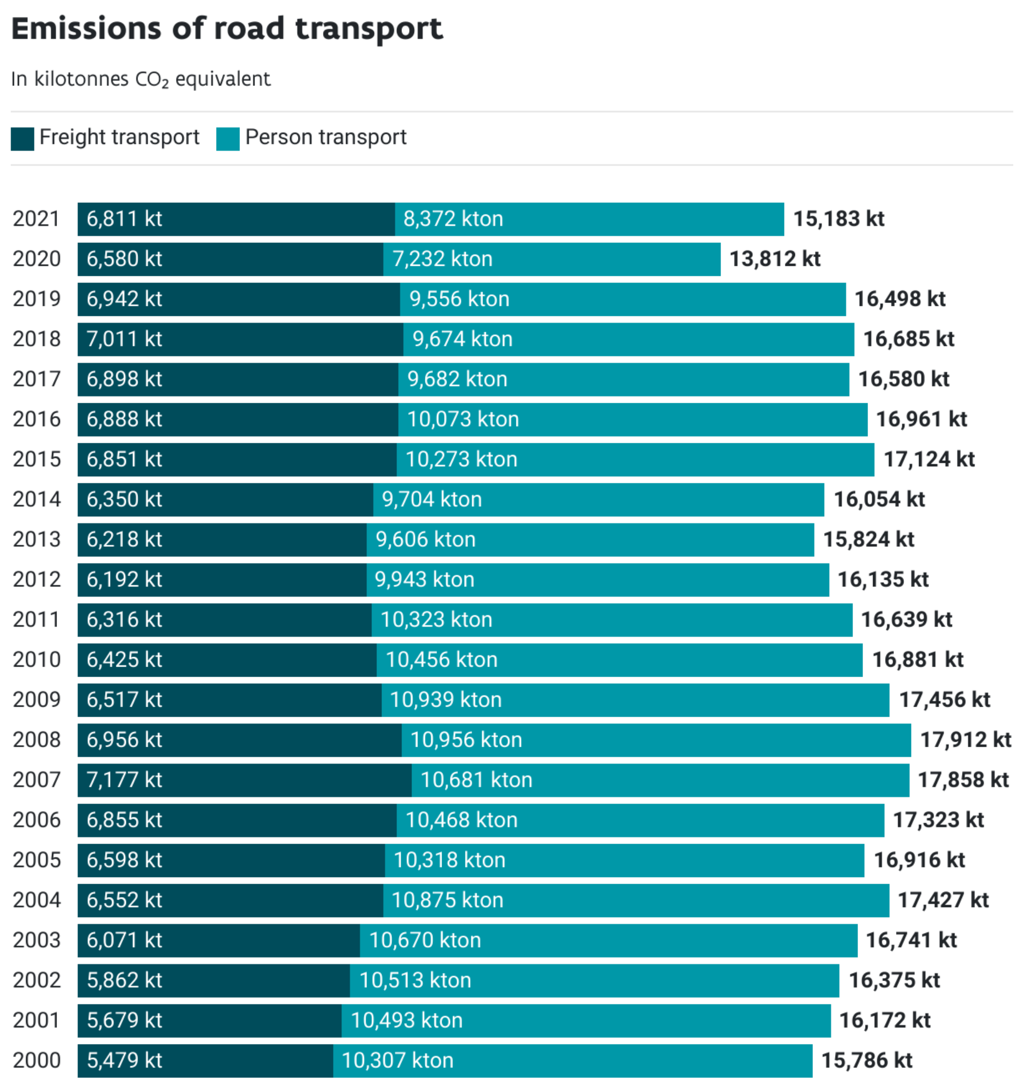
4.3.1. Emissions in Road Transport

Figure 1 shows that total road-transport GHG emissions in Flanders declined from ~15.8 Mt CO_2-eq in 2000 to 15.2 Mt in 2021, with a clear COVID dip in 2020 (13.8 Mt) and a partial rebound in 2021. Passenger transport consistently accounts for the larger share, but freight also remains a substantial contributor.

- Latest year (2021): 15,183 kt CO_2-eq total, of which 8,372 kt passenger transport and 6,811 kt freight transport.
- Trend: After peaking around 2007–2009 (~17.8–17.9 Mt), emissions have trended downward, interrupted by cyclical movements and the 2020 shock.
- Composition: Passenger transport represents roughly 55–60% of total road-transport CO_2-eq over the period; freight contributes ~40–45%.
- Modeling note: For impact quantification, we use the most recent official split (2021) as a baseline for passenger vs. freight and index to the report's price/emissions year where required. We will cross-check consistency against newer aggregates once they are released, ensuring that PTI-related emission

effects (via reduced incidents/breakdowns and smoother flow) are attributed proportionally to passenger versus freight activity.

Figure 1: Road Transport Emissions in Flanders, 2000–2021 (kt CO_2-eq)



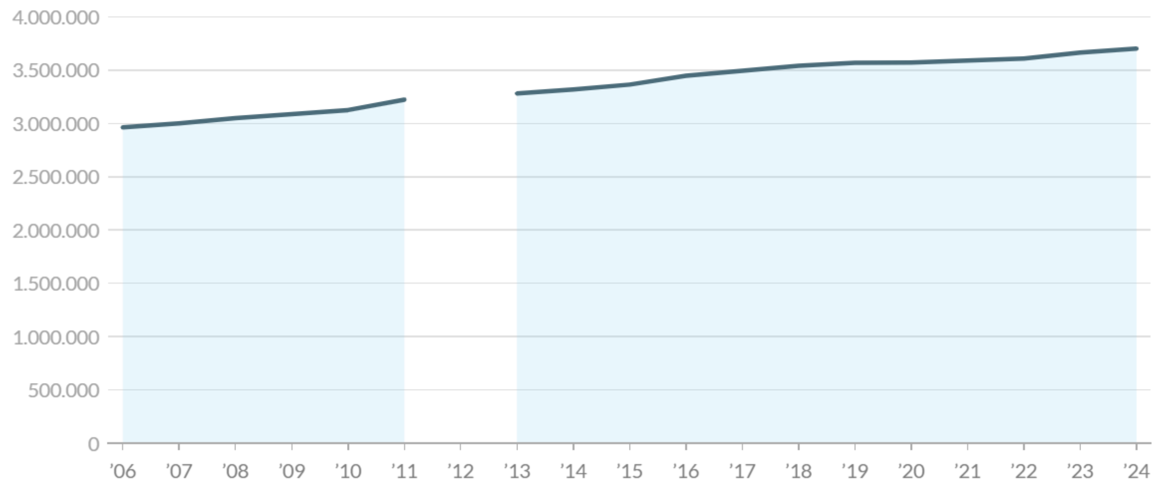
Note: Values in this figure are displayed using English number formatting (comma as thousand separator, point as decimal mark). Throughout the report, the European convention is applied (points as thousand separators, commas as decimal marks).

Source: https://cemonitor.be/en/indicator/mobility/lifecycle/emissions-of-road-transport/

4.3.2. Calculating the effects for passenger cars

Passenger transport accounted for 8.372 kt CO_2-eq in 2021, representing ~55–60 % of total road-transport emissions. Figure 2 shows a steady expansion of the passenger-car fleet in the Flemish Region over the past two decades. After a gradual rise from just under 3.0 million units in the mid-2000s, the stock continued to increase through the 2010s, with only a brief pause related to the pandemic, and reached slightly above 3.7 million cars by 2024. With 3,55 million registered cars in 2021 and total emissions of 8.372 kt CO_2-eq, the implied intensity is about 2,36 t CO_2-eq per car.

Figure 2: Registered Passenger Cars in Flanders, 2006–2024 (Stock, units)



Note: No figures are available for 2012.

Source : https://www.vlaanderen.be/statistiek-vlaanderen/mobiliteit/personenwagenpark#aantal-personenwagens-gestegen-tot-37-miljoen.

To quantify the climate implications of suspending PTI for a subset of cars, we apply a 10% emissions-uplift scenario to the affected fleet. This figure is not a Flemish car-only measurement, but rather a transparent and conservative assumption aligned with the international evidence base on inspection and maintenance (I/M) programs. Empirical studies show that I/M schemes consistently curb in-use emissions: Smit et al. (2025) report average reductions of approximately 11% for CO and HC and about 4% for NOx following inspection and repair, while Huertas et al. (2020) and Wenzel (2000) document similar effects across diverse vehicle fleets. More recent EU research highlights the risks of undetected aftertreatment failures. Franzetti et al. (2024, 2025) demonstrate that malfunctions of selective catalytic reduction (SCR) systems or diesel particulate filters (DPFs) can increase NOx and particulate emissions by factors of 8–28, which far exceeds the regulatory thresholds. In this light, adopting a uniform +10% CO_2-equivalent deterioration for uninspected cars is not only defensible but conservative, since it falls well below the extreme values documented in the literature. The parameter, therefore, provides a cautious baseline for the Flemish case, ensuring that climate costs are neither overstated nor ignored.

Assuming that 1.260.921 passenger cars are affected and that each of these vehicles emits, on average, 2,36 t CO_2-eq per year (a conservative proxy derived from the Flemish passenger-transport average), a 10% deterioration in their emissions performance would add 0.236 t CO_2-eq per car per year. Multiplying this increment by the affected fleet yields an aggregate increase of 297.577 t CO_2-eq per year (≈ 0,298 Mt). This back-of-the-envelope estimate is intended as a transparent, reproducible baseline; if a more precise car-only 2024 intensity becomes available, the result can be updated directly via

ΔE_total = 0,10 × (per-car CO_2-eq in 2024) × 1.260.921.

To account for timing, we relax the implicit "1 January inspection" assumption and apply an exposure fraction for the first year. If inspection dates are uniformly distributed across the calendar, the expected exposure is α = 0,5 (half a year). Using the same inputs, the timing-adjusted total becomes

ΔE_total = 0,10 × 2,36 × 1.260.921 × 0,5 = 148.789 t CO_2-eq/year (≈ 0,149 Mt).

In sensitivity analysis, it might be possible to vary α (e.g., 0,4–0,6) to reflect non-uniform scheduling; from year two onward, $\alpha \rightarrow 1$ unless inspections are reinstated.

We next turn to freight vehicles, which represent the second major contributor to road-transport emissions in Flanders.

4.3.3. Calculating Road Freight Transport

588.218 freight vehicles were registered in Flanders in the year 2021 (see: https://cemonitor.be/en/indicator/mobility/market/number-of-freight-vehicles). Flemish statistics distinguish between vans (<3,5 t, N1) and lorries (>3,5 t, N2+N3). The aggregate 6.811 kt CO_2-eq refers to road freight transport in Flanders.

To quantify the first-year climate effect of suspending PTI for freight vehicles, we apply a transparent top-down approach. Using the official road-freight aggregate for Flanders (6.811 kt CO_2-eq) and the reported freight fleet (588.218 vehicles; vans + lorries), the implied fleet-average intensity is 11,58 t CO_2-eq per vehicle·year (6.811.000 ÷ 588.218). We assume a 10% emissions uplift for the affected vehicles and a timing adjustment of α = 0,5 to reflect the uniform distribution of inspection dates over the year (i.e., half-year exposure in year one).

Under these assumptions, the per-vehicle increment is

Δe = 11,58 × 0,10 × 0,5 = 0,579 t CO_2-eq per vehicle·year.

Applying this to the affected fleets yields: N1 (vans): 390.879 × 0,579 = 226.300 t CO_2-eq/year; N2/N3 (lorries): 7.559 × 0,579 = 4.376 t CO_2-eq/year. The combined first-year increment is therefore 230.676 t CO_2-eq/year (≈ 0,231 Mt).

This estimate serves as a transparent, conservative baseline that can be directly refined once class-specific emission intensities or activity data become available.

4.3.4. Carbon Valuation in the CBA

We monetize climate impacts using the European Commission's transport appraisal benchmark from the *Handbook on the External Costs of Transport (Version 2019)*, which sets a central climate cost of €100 per tonne of CO_2-equivalent (in 2019 euros). For consistency with this report's price base, we index to 2024 using the Belgian HICP (2015=100):

Value_2024 = €100 × HICP_BE(2024) / HICP_BE(2019),

with

HICP_BE(2024) = 130,9 and

HICP_BE(2019) = 107,8. Then

Value_2024 = 121,4 €/t CO_2-eq.

This produces our baseline shadow price of carbon for all CO_2-eq calculations in the CBA. We report results with sensitivity bands (e.g., ±30–50% around the baseline) to reflect uncertainty in abatement and damage estimates. Note that market prices (e.g., EU ETS) or fiscal rates are not used as welfare values; they may be cited for context but do not replace the social cost of carbon in economic appraisal.

Table 9 summarizes the first-year emissions and cost impacts from suspending PTI, disaggregated by vehicle class for the Flemish Region. The results are derived from a transparent top-down approach: we apply a 10% emissions uplift to the affected fleets and a timing adjustment of α = 0.5 to reflect that inspections are distributed uniformly across the calendar (i.e., a half-year exposure in year one).

For passenger cars (M1), the uplift applied to 1.260.921 uninspected vehicles implies an additional 148,7 kt CO_2-eq/year and €18,1 million/year in climate costs. For freight, the increments amount to 226,3 kt and €27,5 million for N1 vans, and 4,4 kt and €0,5 million for N2–N3 lorries. In total, the first-year increase is 379,4 kt CO_2-eq/year, corresponding to €46,1 million/year.

Table 9: Annual Incremental Emissions and Climate Costs, Flanders 2024

Vehicle category	**Uninspected vehicles per year (no.)**	**Additional CO_2-eq (kt/year)**	**Additional emissions & climate costs (€ million/year)**
Passenger Cars (M1)	1.260.921	148,7	18,1
Freight Vehicles (N1)	390.879	226,3	27,5
Freight Vehicles (N2, N3)	7.559	4,4	0,5
Totals	**1.659.359**	**379,4**	**46,1**

Source: own calculations (10% uplift; timing factor α=0,5; carbon value €121,4/t, 2024 prices).

4.4. Private Cost Savings (Time and Fees)

In addition to societal costs, PTI reforms generate private financial effects for vehicle owners. These consist of two main elements: the savings in inspection fees and the savings in time spent travelling to and waiting at inspection stations. While modest compared to the societal costs of weaker inspection regimes, these savings represent the most visible short-term benefit to individual owners. This section calculates both components and presents the aggregate private savings for each policy scenario.

To monetise the time savings associated with omitted PTI visits, two distinct categories of time valuation are applied: private travel time for households and working time for professional users. For private travel, the Belgian Value of Time (VoT) can be drawn from the VIAS/VALOR study, which estimates an average value of approximately € 17,2 per hour, measured on the basis of survey data and reported for 2019/2021 price levels (Vias institute, 2021). To ensure comparability with other cost components in this report, this value is updated to 2024 prices by applying the Belgian Harmonized Index of Consumer Prices (HICP), as published by Eurostat (Eurostat, 2024).

For business-related inspections, where inspection visits are undertaken during working hours, it is more appropriate to value time based on labour costs, as these reflect both gross wages and non-wage costs. According to Eurostat data, the average hourly labour cost in Belgium in 2024 amounts to approximately € 48,2 per hour (Eurostat, 2024). This figure provides a suitable benchmark for valuing the opportunity cost of time lost for commercial users in Flanders.

Although the applied time values may seem low, they intentionally exclude taxes and social charges to prevent double-counting. This approach is consistent with welfare-economic valuation principles used in European transport appraisals.

For the aggregate assessment, it is recommended to employ a two-path monetisation approach, distinguishing between private and professional users and weighting the resulting values according to the respective shares of inspection visits carried out in each group. The introduction of a weighting parameter α for the share of private users allows the calculation of a blended average that reflects the actual distribution of PTI users in Flanders.

Based on aggregated PTI data for Flanders, it can be assumed that approximately 70% of inspections are conducted by private vehicle owners. In comparison, the remaining 30 % are carried out in a professional or business context. Applying a weighted two-path monetisation approach, which distinguishes between household travel time and working time, this distribution yields an average Value of Time (VoT) of € 28,6 per hour. This blended cost rate reflects both the empirical predominance of private users and the higher opportunity costs associated with professional users, providing a suitable benchmark for monetizing time savings in the subsequent cost–benefit analysis (Vias Institute, 2021; Eurostat, 2024).

In addition to time-related savings, vehicle owners also benefit from avoided inspection fees. The corresponding monetary component is derived directly from the unit PTI fees reported in Table 1 and 2, which specify the average inspection charges applied by GOCA Vlaanderen for each vehicle and inspection type. These unit fees—ranging, for example, from € 47.69 for standard passenger-car inspections to € 119,70 for heavy-vehicle categories and € 15,40 / € 47,37 for light and heavy Tow-Bar checks—are multiplied by the number of inspections foregone under each scenario to estimate the total private fee savings (ΔS_inspection).

The resulting scenario-specific aggregates are presented in Table 21. This approach ensures complete internal consistency between the operational PTI database (GOCA Vlaanderen 2025) and the monetary assessment of private benefits within the cost–benefit framework.

5. Reform Scenarios for Flanders

This chapter translates the policy measures described in Chapter 1 into quantitative inspection scenarios for Flanders. For each reform option (Scenarios A–D), the number of inspections affected is calculated based on GOCA Vlaanderen data for 2024. The tables report, by vehicle category and inspection type,

(i) the baseline volume of inspections,
(ii) the percentage reduction implied by the reform, and
(iii) the resulting absolute number of inspections omitted.

These tables provide the central input for all subsequent calculations in the cost–benefit model. The foregone inspections (ΔN) serve as the starting point for estimating accident increments, breakdown-induced congestion, and emission increases. The associated inspection fees and time requirements are used to compute private savings. In this way, the scenario tables serve as a bridge between regulatory changes and the quantitative assessment of societal costs and benefits.

5.1. Reducing the frequency of PTI inspections (PTI-Policy Scenario A)

The calculations for Scenario A – reducing the frequency of PTI inspections – focus on the vehicle categories that generate the largest inspection volumes and are therefore most affected by regulatory changes. These are passenger cars (M1) and light and heavy goods vehicles (N1, N2, and N3). The following tables provide the 2024 baseline volumes for these categories, broken down by vehicle age and inspection type. This framework serves as the quantitative basis for estimating both the percentage and absolute reductions in inspections under Scenario A.

Table 10 presents the estimated reduction of PTI inspections for vehicle category M1 under a 2024 baseline scenario. The table distinguishes between first and periodic inspections, further disaggregated by vehicle use (taxis, ambulances, and other passenger cars) and vehicle age or inspection validity.

The results show that eliminating inspections for very young vehicles (e.g., the first inspections of taxis or ambulances within the first five months) would lead to a 100% reduction in these subsegments. In contrast, periodic inspections of older vehicles with more extended inspection validity periods remain unaffected (0% reduction). Overall, the calculations indicate that approximately 43 percent of all M1 inspections in 2024 would be lost under this regulatory relaxation, corresponding to an absolute reduction of about 944.162 inspections.

The estimations are based on data provided by GOCA Vlaanderen (2025) and reflect the expected impact of inspection exemptions across different subcategories of M1 vehicles.

Table 10: Scenario A – Reduction of PTI Inspections for Passenger Cars (M1), 2024

Vehicle category	Impact on PTI volume		
M1	**Tests in 2024**	**Percentage reduction in inspections (%)**	**Absolute reduction in inspections (no.)**
periodic | taxi | age < 11 months	1.104	100,0	1.104
periodic | taxi | age ≥ 11 months	11.461	50,0	5.731
periodic | ambulance | age < 11 months	88	100,0	88
periodic | ambulance | age ≥ 11 months	1.701	50,0	851
periodic | other | age < 46 months	32.100	100,0	32.100
periodic | other | age ≥ 46 months | validity ≤ 14 months	1.808.575	50,0	904.288
periodic | other | age ≥ 46 months | validity > 14 months	353.638	0,0	0
Total	2.208.667	42,7	944.162

Source: GOCA Vlaanderen. (2025); own calculations.

Table 11 presents the estimated reduction in PTI inspections for light and heavy goods vehicles (categories N1, N2, and N3) under Scenario A, which involves reducing the frequency of inspections. The results are disaggregated by vehicle age and type of inspection.

For light commercial vehicles (N1), all periodic inspections of vehicles younger than 46 months would be eliminated, corresponding to a 100,0 % reduction (117.287 inspections). For N1 vehicles aged 46 months or more, periodic inspections would be reduced by 50,0 %, which equals 185.899 inspections.

For medium and heavy goods vehicles (N2 and N3), inspections of vehicles aged 10 months or more remain unaffected, leading to no reduction in this category.

In total, the measure would reduce the number of inspections across categories N1 – N3 by 52,3 %, which corresponds to an absolute reduction of 303.186 inspections in 2024.

These calculations are based on data provided by GOCA Vlaanderen (2025) and our own estimations.

Table 11: Scenario A – Reduction of PTI Inspections for Goods Vehicles (N1–N3), 2024

Vehicle category	Impact on PTI volume		
	Tests in 2024	Percentage reduction in inspections (%)	Absolute reduction in inspections (no.)
N1			
periodic | age < 46 months	117.287	100,0	117.287
periodic | age ≥ 46 months	371.797	50,0	185.899
N2 and N3			
age ≥ 10 months	90.505	0,0	0
Total	579.589	52,3	303.186

Source: GOCA Vlaanderen. (2025); own calculations.

Table 12 illustrates the impact of Scenario A on the reduction of periodic technical inspections (PTI) in 2024. Within vehicle category O2, inspections for vehicles younger than 46 months (19.960 tests) would be entirely abolished, corresponding to a 100 % reduction. For O2 vehicles older than 46 months with a validity period of 14 months or less, half of the inspections are eliminated. Out of 93.220 tests, this results in an absolute reduction of 46.610. In contrast, O2 vehicles older than 46 months with a validity period longer than 14 months (14.186 tests) remain unaffected by the reform. Similarly, no reduction is foreseen for vehicle categories O3 and O4, where 90.472 inspections for vehicles older than 10 months continue unchanged. Overall, the number of PTI inspections in 2024 would decrease from 217.838 to 151.268, corresponding to a total reduction of 66.570 inspections.

Table 12: Scenario A – Reduction of PTI Inspections for Trailers 2024

Vehicle category	Impact on PTI Volume		
	Tests in 2024	**Reduction in %**	**Absolute reduction (no.)**
O2			
Age < 46 months	19.960	100,00%	19.960
age ≥ 46 months | validity ≤ 14 months	93.220	50,00%	46.610
age ≥ 46 months | validity > 14 months	14.186	0,00%	0
O3 and O4			
age ≥ 10 months	90.472	0,00%	0
Total	**217.838**	**30,56%**	**66.570**

Source: GOCA Vlaanderen. (2025); own calculations.

5.2. Eliminating the first inspection for new vehicles (PTI-Policy Scenario B)

Table 13 presents the estimated reduction in PTI inspections for passenger cars (M1) under Scenario B, which involves eliminating the first inspection for new vehicles. The table differentiates between taxis, ambulances, and other passenger cars. In all three subcategories, the first inspection of new vehicles would be abolished entirely. This results in a 100,0 % reduction across the board: approximately 1.272 inspections for taxis, 66 inspections for ambulances, and 9.545 inspections for other passenger cars.

In total, the abolition of the first inspection would remove 10.883 inspections in 2024, corresponding to a 100,0 % reduction of this inspection type within the M1 category.

These calculations are based on data provided by GOCA Vlaanderen (2025) and our own estimations.

Table 13: Scenario B – Abolition of First Inspections for Passenger Cars (M1), 2024

Vehicle category	Impact on PTI volume		
M1	**Tests in 2024**	**Percentage reduction in inspections (%)**	**Absolute reduction in inspections (no.)**
First | taxi | age < 5 months	1.272	100,00%	1.272
First | ambulance | age < 5 months	66	100,00%	66
First | other | age < 10 months	9.545	100,00%	9.545
Total	**10.883**	**100,00%**	**10.883**

Source: GOCA Vlaanderen. (2025); own calculations.

Table 14 illustrates the consequences of abolishing the first inspection requirement for goods vehicles (Scenario B) in 2024. The reform affects N1 light commercial vehicles and N2/N3 medium and heavy goods vehicles that are less than ten months old. For N1 vehicles, all 38.621 first inspections would be eliminated. Similarly, for N2 and N3 vehicles, the 7.559 inspections scheduled within the first ten months of use would no longer take place.

Taken together, Scenario B results in a total reduction of 46.180 inspections across all goods vehicle categories. This figure represents the entire volume of initial PTI tests for new N1–N3 vehicles. These foregone inspections form the input for the subsequent evaluation of accident, congestion, and emission effects associated with Scenario B.

Table 14: Scenario B – Abolition of First Inspections for Goods Vehicles (N1–N3), 2024

Vehicle category	Impact on PTI volume		
	Tests in 2024	**Percentage reduction in inspections (%)**	**Absolute reduction in inspections (no.)**
N_1			
First | age < 10 months	38.621	100,00%	38.621
N_2 and N_3			
First | age < 10 months	7.559	100,00%	7.559
Total	**46.180**	**100,00%**	**46.180**

Source: GOCA Vlaanderen. (2025); own calculations.

Table 15 sets out the effect of abolishing the first inspection requirement for trailers under Scenario B in 2024. The measure concerns both O2 light trailers and O3/O4 heavy trailers at the very beginning of their operational life. For O2 trailers, 6.499

inspections scheduled within the first ten months would be cancelled. For O3 and O4 trailers, a further 5.238 first inspections would be removed from the testing regime.

In total, the abolition of first inspections for trailers results in 11.737 fewer tests across the O2–O4 categories. This reduction represents the complete set of initial PTI obligations for new trailers. It serves as the baseline for evaluating the safety, congestion, and emission implications of Scenario B in the subsequent analysis.

Table 15: Scenario B – Abolition of First Inspections for Light and Heavy Trailers, 2024

Vehicle category	**Impact on PTI volume**		
	Tests in 2024	**Percentage reduction in inspections (%)**	**Absolute reduction in inspections (no.)**
O2	6.499	100,00%	6.499
O2 and O3	5.238	100,00%	5.238
Total	**11.737**	**100,00%**	**11.737**

Source: GOCA Vlaanderen. (2025); own calculations.

5.3. Abolishing inspections for second-hand vehicles (PTI-Policy Scenario C)

Table 16 presents the estimated reduction of PTI inspections for passenger cars (M1) and light commercial vehicles (N1) under the 2024 baseline. In this scenario, 75 percent of inspections in both categories would be abolished. For M1 vehicles, this corresponds to a reduction of approximately 306.000 inspections, while for N1 vehicles the reduction amounts to about 49.000 inspections.

Taken together, the two categories account for more than 473.000 inspections in 2024, of which roughly 355.000 would be eliminated under the deregulation measure. This represents a 75 percent reduction in inspection volumes for these vehicle groups.

These calculations are based on data provided by GOCA Vlaanderen (2025) and our own estimations.

Table 16: Scenario C – Abolition of PTI for Second-Hand Vehicles, 2024

Vehicle category	**Impact on PTI volume**		
	Tests in 2024	**Percentage reduction in inspections (%)**	**Absolute reduction in inspections (no.)**
M1	407.837	75,00%	305.878
N1	65.430	75,00%	49.073
Total	**473.267**	**75,00%**	**354.951**

Source: GOCA Vlaanderen. (2025); own calculations.

5.4. Eliminating Tow Bar inspections (PTI Policy Scenario D)

Table 17summarises the inspection volumes affected by Scenario D, which abolishes mandatory Tow-Bar inspections following installation.
In 2024, a total of 39,603 (≈ 40 000.) Tow-Bar inspections were performed in Flanders according to GOCA Vlaanderen data, corresponding to 39,6 × 10^3 inspections per year. Of these, 35.910 (≈ 35,9 × 10^3) inspections concerned coupling devices with a maximum permissible towing mass of up to 750 kg, while 3.693 (≈ 3,7 × 10^3) inspections related to installations exceeding 750 kg. Both subcategories would be removed entirely under this reform option, implying a 100 % reduction in Tow-Bar inspections relative to the 2024 baseline.

The differentiation between the two weight classes reflects differences in technical complexity and the time required for inspection. Tow bars rated above 750 kg require additional verification of braking compatibility and structural integrity, which explains the higher inspection fee and longer testing duration. Under Scenario D, all of these inspections would be abolished, corresponding to the elimination of roughly 40.000 PTI activities per year. The quantitative implications of this removal for accidents, casualties, and associated external costs are analysed in the subsequent sections (see Section 5.5.3).

Table 17: Scenario D – Abolition of Tow-Bar Inspections, Flanders 2024

Inspection type	**Impact on PTI volume**		
Tow Bar	**Tests in 2024**	**Percentage reduction in inspections (%)**	**Absolute reduction in inspections (no.)**
Max. 750 kg	35.910	100,00%	35.910
More than 750 kg	3.693	100,00%	3.693
Total	**39.603**	**100,00%**	**39.603**

Source: GOCA Vlaanderen. (2025); own calculations.

5.5. Discussion

5.5.1. Results

To compare the magnitude of societal cost increases with the direct savings from abolishing inspections, we define the concept of *welfare loss per savings (WLPS)*. This metric expresses the additional societal costs generated for every euro saved on inspection activities. Following the logic of cost–benefit analysis, but restricted to the cost side, the indicator is formulated as:

$$WLPS = \frac{\Delta C_{societal}}{\Delta C_{\text{inspection savings}}}$$

where

- $\Delta C_{societal}$ = additional societal costs (congestion, crashes, emissions) in €/year,
- $\Delta C_{\text{inspection savings}}$ = monetary savings from reduced PTI inspections in €/year.

The interpretation of the ratio is straightforward. If WLPS>1, each euro saved on inspection results in a welfare loss greater than one euro, implying that deregulation is economically inefficient. If WLPS = 1, the reform is cost-neutral. Only if WLPS<1 would the reduction of inspections be economically justified, since the savings would outweigh the societal costs.

The concept aligns with the methodology of the *Handbook on the External Costs of Transport* (European Commission, 2019), which recommends monetizing congestion, accident, and emission externalities in €/vehicle-km or €/vehicle-hour and comparing them with direct policy costs. Comparable approaches are found in national cost–benefit assessments (BASt, 2017; Intraplan, 2021), where incremental societal costs are contrasted with regulatory savings.

Table 18 summarises the estimated annual additional impacts of four PTI reform scenarios compared to the current inspection regime. The baseline indicates zero change, while Scenarios A to D represent different forms of deregulation: reduced inspection frequency, elimination of the first inspection for new vehicles, removal of mandatory inspections for second-hand transfers, and abolition of Tow Bar inspections.

The results provide a consistent message. A reduction in PTI coverage is associated with a marked increase in societal costs, driven by higher numbers of road casualties, accidents, and breakdowns. Across all reform options, the model projects approximately 33 additional fatalities, 106 serious injuries, and more than 1.250 slight injuries per year. In total, this corresponds to roughly 1.000 additional accidents and over 180 congestion events caused by vehicle defects.

Under Scenario A (reduced frequency), the effects are most severe: about 31 additional fatalities, 98 serious injuries, and 1.162 slight injuries per year. This scenario alone accounts for nearly three-quarters of the total increase across all reform options, reflecting the systemic importance of inspection intervals for fleet safety.

Table 18: Annual Additional Impacts by Policy Scenario A, B, C, and D, Flanders 2024

Policy Scenario	Annual Additional Impacts of Reduced PTI Coverage					
	Inspections	Casualties			Accidents	Congestions
	ΔN	ΔF Fatalities	ΔS Serious Injuries	ΔL Slight Injuries	ΔA_{total}	ΔCG
Baseline	0	0	0	0	0	0
Scenario A	-1.327.202	30,9603	97,6567	1.161,6005	933,132	1067,183
Scenario B	-72.354	0,4083	2,8499	19,9810	0,067	7,375
Scenario C	-354.950	2,0044	5,7025	73,3536	65,092	100,943
Scenario D	-39.603	0,0001	0,0003	0,0035	0,003	4,003
Total	**-1 794 109**	**33,3731**	**106,2094**	**1 254,9386**	**998,294**	**1179,504**

Note: All values calculated for the reference year 2024. Figures represent annual additional impacts compared to the current PTI regime.
For presentation purposes, accident- and defect-induced congestion events are combined into a single category (ΔCG total), as both contribute to the same external cost component.
Numerical precision follows reporting conventions:
– for accidents and congestion events, three decimal places are sufficient to ensure clarity without overstating precision;
– for casualties (fatalities, serious and slight injuries), four decimal places are retained to preserve analytical accuracy in subsequent cost conversions.

Source: Own calculations based on GOCA Vlaanderen (2025a, 2025b) and European Commission (2019).

By contrast, Scenario B (no first inspection for new vehicles) has a significantly smaller effect, resulting in fewer than one additional fatality, around three serious injuries, and 20 slight injuries annually. Although less pronounced, the logic remains the same: even small exemptions propagate into measurable accident risks.

Scenario C (no inspection upon transfer of ownership) sits between these extremes. It would cause around 97 casualties per year, including two fatalities, six serious injuries, and more than 70 slight injuries, and close to 65 additional accidents.

Finally, Scenario D (abolition of Tow-Bar inspections) has only marginal casualty effects but still produces around four additional breakdown-related congestion events each year.

Taking all reform options together, the total societal burden would increase well beyond any private savings from reduced inspection fees or waiting times.

Table 19 presents the estimated annual societal cost increases associated with four PTI deregulation scenarios, benchmarked against the current inspection regime and calculated for the reference year 2024. The figures are expressed in 1000 euros per year and cover three cost categories: accident costs, congestion costs (subdivided into accidents and technical defects), and emission and climate costs.

Table 19: Annual Societal Cost Increases by Policy Scenario, Flanders 2024 (in 1000 Euro)

Policy Scenario	Accident Costs	Congestion Costs		Emission & Climate Costs
		by accidents	by defects	
Baseline	0	0	0	0
Scenario A	397.128	7.736	856	34.833
Scenario B	6.708	112	47	3.402
Scenario C	25.126	496	247	8.225
Scenario D	1	0	26	not applicable
Total	**428.963**	**8.345**	**1.175**	**46.461**

Note: All values calculated for the reference year 2024. Amounts expressed in million euros per year; values rounded.

Source: Own calculations based on GOCA Vlaanderen (2025a, 2025b) and European Commission (2019).

The most substantial cost increase occurs under Scenario A (reduced inspection frequency). Here, additional accident costs amount to approximately 397.128 k€, complemented by about 7.736 k€ in congestion costs caused by accidents, 856 k€ by defect-related breakdowns, and 34.833 k€ in emission and climate costs.

Together, these values account for more than 90 % of the total annual cost increase across all scenarios, confirming that inspection frequency is the single most influential factor in the cost–benefit balance.

Scenario B (no first inspection for new vehicles) produces a modest rise in societal costs – about 6.708 k€ from accidents, 112 k€ from congestion, and 3.402 k€ from emissions – while Scenario C (no inspection upon transfer of ownership) results in a more pronounced impact of 25.126 k€ in accident costs and roughly 8.225 k€ in emission and climate costs.

Scenario D (abolition of Tow-Bar inspections) has negligible emission effects but still adds approximately 1.175 k€ in congestion and defect-related costs due to secondary breakdowns.

In total, the four reform options combined would increase societal costs by approximately 428.963 k€ per year due to accidents, 8.345 k€ due to congestion, and 46.461 k€ due to emissions and climate impacts.

These findings underscore that even seemingly minor deregulation measures can generate measurable welfare losses that far exceed the private benefits from reduced inspection fees or shorter waiting times.

Table 20: Annual Private Savings by Policy Scenario, Flanders 2024 (in 1000 Euro)

Policy Scenario	Time savings	Inspection Fee Savings
Baseline	0	0
Scenario A	49.403	75.083
Scenario B	2.693	7.277
Scenario C	13.212	30.765
Scenario D	1.235	728
Total	**66.544**	**113.853**

Note: All values calculated for the reference year 2024. Amounts expressed in million euros per year; values rounded.

Source: Own calculations based on GOCA Vlaanderen (2025a, 2025b).

Table 20 highlights the scale of private benefits that would result from weakening the PTI regime. Two types of savings are considered: time savings for vehicle owners, and direct reductions in inspection fees. The estimates are calculated for 2024 and expressed in 1.000 euros per year.

The results show that Scenario A (reduced inspection frequency) generates the most considerable private benefit, with approximately 49.403 k€ in time savings and 75.083 k€ in reduced inspection fees.

Together, these account for nearly three-quarters of all private gains across the reform options, reflecting the strong correlation between inspection frequency and user cost.

Scenario B (no first inspection for new vehicles) leads to modest savings of around 2.693 k€ in time and 7.277 k€ in fees. In comparison, Scenario C (no inspection upon transfer of ownership) yields higher gains — roughly 13.212 k€ in time savings and 30.765 k€ in fee savings.

Scenario D (abolition of Tow-Bar inspections) yields the smallest benefit, amounting to approximately 1.235 k€ in time and 728 k€ in fees, due to its narrow scope and low inspection volumes.

In total, the four reform measures would generate annual private savings of approximately 66.544 k€ in time and 113.853 k€ in inspection fees.

Although these values may appear substantial from an individual perspective, they are outweighed by the far higher societal cost increases shown in

Table 21 summarizes the consolidated outcomes of the cost–benefit analysis for all PTI reform scenarios, expressed in 1.000 Euro per year (2024 prices). The table compares three key indicators: the additional societal costs generated by reduced inspection coverage, the private savings realized by vehicle owners, and the resulting Welfare Loss per Savings (WLPS) ratio, representing the proportion between external costs and private benefits.

Across all four reform options, the analysis shows total additional societal costs of approximately 484.943 k€ per year and private savings of about 180.397 k€. This results in an average WLPS value of 2,688, meaning that for every 1.000 Euro of private savings, approximately 2.700 Euro of additional societal costs occur.

Among the individual scenarios, Scenario A (reduced inspection frequency) shows the most significant effects, with additional costs of 440.553 k€, private savings of 124.486 k€, and a corresponding WLPS of 3,539. Scenario B (no first inspection) exhibits a more balanced outcome, with 10.269 k€ in additional costs and 9.970 k€ in private savings (WLPS = 1,030). Scenario C (no inspection upon transfer of ownership) shows 34.095 k€ in additional costs and 43.977 k€ in savings (WLPS = 0,775). In contrast, Scenario D (abolition of Tow-Bar inspections) remains marginal, with 27 k€ in additional costs, 1.963 k€ in savings, and a WLPS close to zero (0,014).

Taken together, the results indicate proportionate relationships between inspection coverage, additional costs, and the welfare-loss ratio.

Table 21: Additional Costs, Private Savings, and WLPS by Policy Scenario, Flanders 2024 (in 1.000 Euro)

Policy Scenario	Additional Costs (k€)	Private Savings (k€)	Welfare Loss per Savings (WLPS)
Baseline	0,0	0,0	0,0000
Scenario A	440.553	124.486	3,5390
Scenario B	10.269	9.970	1,0300
Scenario C	34.095	43.977	0,7753
Scenario D	27	1.963	0,0136
Total	**484.943**	**180.397**	**2,6882**

Note: All values calculated for the reference year 2024. Costs and savings are expressed in million euros per year; WLPS represents the ratio of additional societal costs to private savings. Values rounded.

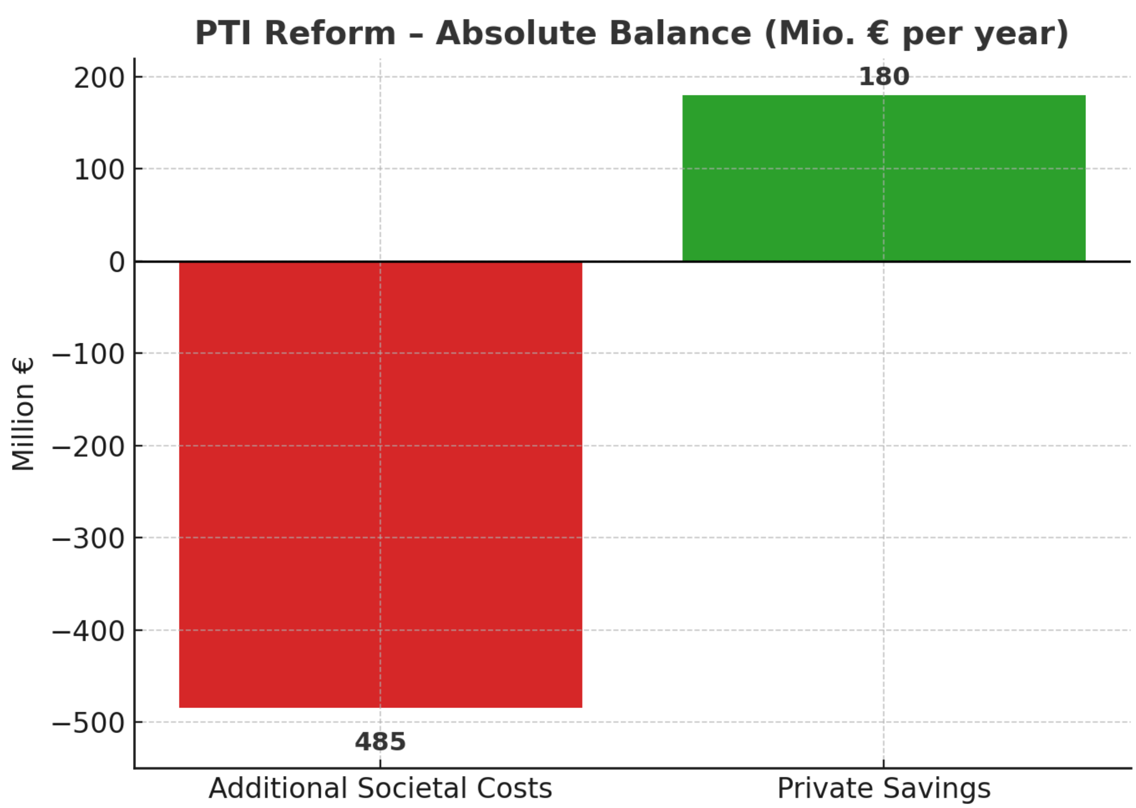
Source: Own calculations based on GOCA Vlaanderen (2025a, 2025b) and European Commission (2019).

It should be noted that the higher inspection fees for heavy Tow-Bar installations (€ 47,37 per test) mechanically increase the private savings component ($\Delta S\_inspection$) in Scenario D, thereby reducing the Welfare-Loss-per-Savings ratio. However, this arithmetic effect does not reflect the underlying risk structure: the FMDD rate for Tow-Bars > 750 kg is more than thirty times higher than for light installations. The fee differential thus partially masks the disproportionate safety relevance of this subcategory, implying that the actual welfare loss per avoided inspection is likely higher than the model's aggregate WLPS value suggests.

A further consideration of sensitivity concerns the interaction between inspection fees and the risk of defects. For Tow-Bar inspections, higher unit fees (€ 47,37 for installations > 750 kg) inflate the monetary savings component ($\Delta S_{inspection}$) in Scenario D. At the same time, the associated FMDD rate (≈ 2 %) indicates a substantially higher latent safety risk than in light-duty installations (0,06 %). This asymmetry implies that the Welfare-Loss-per-Savings (WLPS) ratio may underestimate the actual welfare loss per avoided inspection. To account for this potential masking effect, an additional sensitivity run varies the relative weighting of $\Delta S_{inspection}$ and ΔEC_{safety} for high-risk, high-fee categories, thereby testing the robustness of Scenario D's apparent cost efficiency under more realistic risk-adjusted conditions.

Figure 3 contrasts the additional societal costs with the private savings from reduced inspection requirements. While vehicle owners would save approximately € 180 million per year, society would incur an additional € 485 million in costs from accidents, congestion, and emissions. The results indicate that the private savings from reduced inspection requirements are substantially lower than the corresponding societal cost increases.

Figure 3: Absolute Cost Balance of PTI Reforms (Million € per year)



Source: own presentation.

5.5.2. Sensitivity considerations

Sensitivity analysis serves to examine the robustness of model results against plausible variations in key parameters that determine total societal costs and private savings. In cost–benefit analysis (CBA), two main types of sensitivity are distinguished: model-based (deterministic) and stochastic sensitivity.

Model-based sensitivity examines how results change when central input parameters vary within a defined range (typically ±10%). This approach reflects uncertainty in price-year indexation, valuation of accident costs, emission factors, or the value of travel time (VoT). For instance, adjustments in the Harmonized Index of Consumer Prices (HICP), accident cost unit rates from the Vias Institute, or CO_2-equivalent shadow prices may influence the absolute cost balance but do not affect the relative ranking of the reform scenarios. The model-wide sensitivity coefficients can be formalized as:

$$p_A = 1, \quad p_B = 0,8, \quad p_C = 1,2, \quad p_D = 0,5$$

Where p_i denotes the scenario-specific proportional change applied to the baseline impact coefficients for passenger cars (A), new vehicles (B), second-hand vehicles (C), and Tow-Bar inspections (D).

A value of p_A=1 defines the base case, while values below or above one indicate weaker or stronger marginal effects relative to the fleet average. In contrast, stochastic sensitivity captures the random nature of events such as accidents or breakdowns. Here, variability arises not from parameter uncertainty but from the inherent randomness of low-frequency events. To represent this, probabilistic distributions are applied: a Poisson model for regular events and a Negative Binomial model for over-dispersed data, where variance exceeds the mean. The latter is particularly relevant for Tow-Bar-related accidents, which are rare but potentially severe.

In such cases, the variance of expected accidents can be expressed as

$$\mathrm{Var}(\Delta A) = \lambda\left(1 + \frac{\lambda}{k}\right).$$

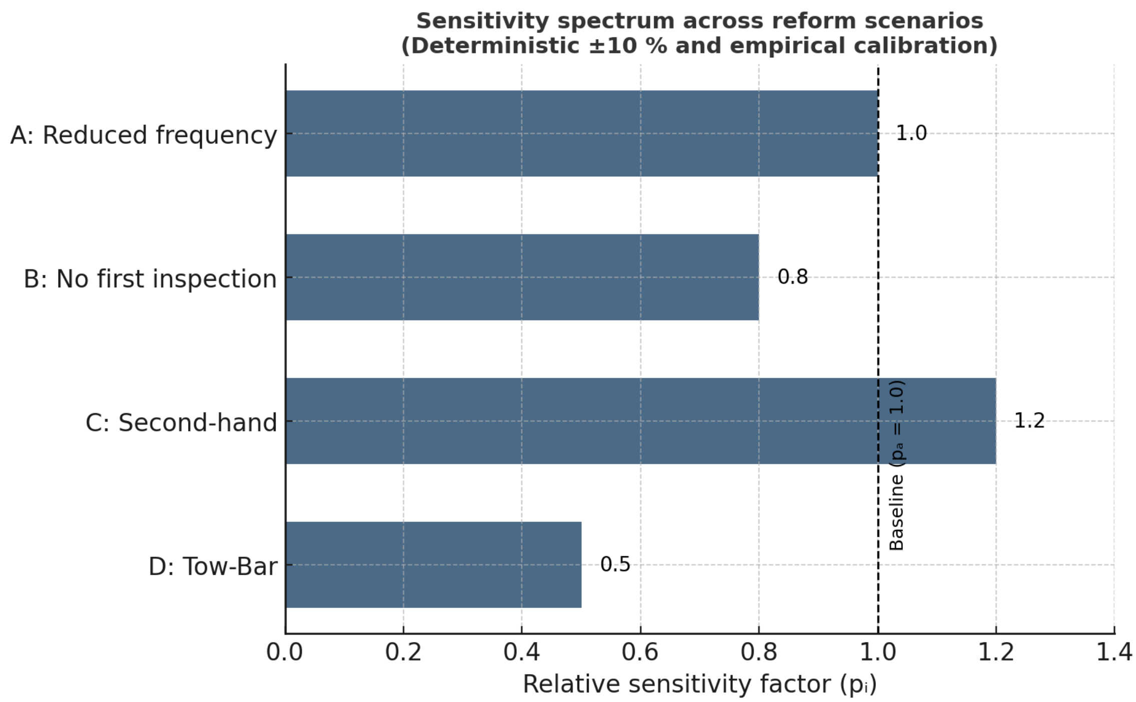
Where λ denotes the expected number of accidents and k the dispersion parameter controlling over-dispersion (typically k=150–500).

This stochastic formulation enables the derivation of confidence intervals that complement the deterministic ±10% model variation.

The figure illustrates the sensitivity spectrum across reform scenarios and compares the degree to which the model outcomes respond to variations in the underlying assumptions.

- The vertical line at p_a = *1.0* marks the baseline value, representing the central parameter set on which the standard calculations are based.
- Values below 1.0 indicate that the respective scenario is less sensitive to parameter changes—its results are therefore more robust and show a flatter response.
- Values above 1.0 indicate higher sensitivity, meaning that even small changes in the assumptions lead to disproportionate variations in the outcomes.

Figure 4: Scenario-specific sensitivity factors (p_i) with ± 10 % variation range



Source: Own illustration based on model sensitivity parameters and empirical calibration derived from European Commission (2019) and Vias institute (2024).

The interpretation is as follows:

- Scenario A (*Reduced frequency*, p_i = 1.0) represents the baseline reference case and shows a balanced, linear response to parameter variations. The numerical results for this scenario can therefore be regarded as robust and representative of the model's central tendency. From an economic perspective, this stability reflects the principle of *diminishing marginal control returns*: once a mature inspection regime is in place, incremental changes in inspection frequency generate proportionate—rather than exponential—effects on safety outcomes. The robustness of Scenario A thus mirrors the structural inertia typical of well-established regulatory systems.

- Scenario B (*No first inspection*, p_i = 0.8) is slightly less sensitive, implying that its outcomes remain stable even under moderate parameter uncertainty. Given the limited contribution of first inspections to overall accident prevention, the associated cost–benefit results are comparatively reliable. Economically, this reflects a *low-risk entry stage* in the vehicle life cycle, where defect probabilities are small and inspection effort mainly ensures conformity of documentation and early-stage quality assurance. The modest sensitivity observed in Scenario B is therefore consistent with the lower marginal benefit of early inspections under conditions of near-perfect product quality at first registration.
- Scenario C (*Second-hand*, p_i = 1.2) exhibits the highest sensitivity. Small changes in key assumptions—such as defect rates or transaction volumes—produce disproportionately large variations in results. Consequently, the quantitative findings for this scenario should be interpreted with caution, as they are more exposed to parameter uncertainty. This higher sensitivity is economically consistent with Akerlof's "market for lemons" framework, which characterises second-hand markets as structurally uncertain due to asymmetric information between buyers and sellers. The elevated responsiveness of Scenario C therefore reflects not a modelling weakness but an inherent market property: small variations in defect rates or transparency conditions can trigger disproportionate changes in welfare outcomes. In this sense, the model empirically reproduces the theoretical instability of markets where trust and quality signals are institutionally mediated through inspection regimes.
- Scenario D (*Tow-Bar*, p_i = 0.5) is least sensitive, reflecting its small inspection volume and empirically well-defined parameters. The resulting welfare effects are therefore comparatively stable, even though the absolute magnitudes remain low in relation to the other reform options. However, Tow-Bar inspections represent a distinct procedural regime that cannot be adequately captured through the aggregate model used for Scenarios A–C. For this reason, a **second calculation approach** is introduced—an *event-based recalibration* using empirical defect and casualty probabilities from the European Commission (2019) trailer study. This dual-method design ensures that low-frequency but high-severity risks, such as coupling failures, are properly represented within the cost–benefit framework. The low numerical sensitivity in Scenario D thus does not imply negligible relevance but rather reflects the rarity of events combined with their potentially severe outcomes.

While these general sensitivity tests provide insight into the model's overall robustness, they do not yet capture empirically observed heterogeneity across vehicle categories. Specific empirical evidence, particularly from trailer and Tow-Bar inspections, provides additional guidance for scenario-specific recalibration, as discussed in the following sections

5.5.3. Sensitivity calculations for Scenario D

The European Commission commissioned a comprehensive cost–benefit analysis (CBA) on the inclusion of light trailers (O1, O2) in periodic technical inspections (PTI). The main challenge identified was the scarcity of reliable accident statistics and mileage data, since trailers are not equipped with odometers. To fill this gap, a user survey was conducted in Croatia and complemented by secondary data from Germany (European Commission, 2019).

Empirical findings show that the average annual mileage per trailer is approximately 2.448 km in Germany and 2.188 km in Croatia, suggesting broadly comparable usage patterns across Member States. The analysis of deficiency rates further indicates that 12,7 % of O1 trailers and 11,4 % of O2 trailers failed inspections in Croatia, while in Germany, the corresponding failure rates were significantly higher, at 19,8 % for O1 and 27,6 % for O2.

The structure of technical deficiencies differs by trailer category. For O1 trailers, lighting defects dominate, accounting for about 65%, followed by deficiencies in the chassis (14%) and in axles, wheels, tyres, and suspension (14%). For O2 trailers, the defect profile is more complex, with lighting (41%) and braking systems (35%) as the leading categories, and smaller shares attributable to chassis (8%) and axles, wheels, tyres, and suspension (8%).

In terms of safety impact, the Croatian calibration suggests that annual PTI inspections prevent approximately one fatality, seven serious injuries, and forty-nine slight injuries. This corresponds to a monetised annual benefit of about € 3,65 million (European Commission, 2019, pp. 72–73). On the cost side, the average inspection fee in Croatia is approximately € 20. With 28.884 inspections per year, total inspection costs amount to about € 0,58 million annually. Taken together, the comparison of costs and benefits yields a Benefit–Cost Ratio (BCR) of 6,32, clearly indicating strong socio-economic justification for the inclusion of light trailers in PTI (European Commission, 2019, p. 73).

Nevertheless, some important limitations must be considered. Accident causation data rarely attribute crashes directly to trailer defects, meaning that several assumptions and proxy indicators were necessary in the modelling exercise. The results should therefore be interpreted as conservative upper-bound estimates. However, given the magnitude of the BCR, the findings appear robust even under sensitivity analysis.

From a policy perspective, the study concludes that PTI for O1 and O2 trailers generates clear societal benefits. Two inspection frequency options are recommended. The first option foresees an initial inspection after four years, followed by biennial inspections. The second option proposes differentiated periodicities by trailer class: O1 trailers are serviced every three years, and O2 trailers are serviced first after two years and subsequently on an annual basis. The rationale for the stricter regime for

O2 trailers lies in their technical configuration, as these vehicles are equipped with brakes and frequently exposed to harsh environmental conditions (e.g., horse, boat, or construction trailers). Overall, the study strongly recommends the inclusion of light trailers in PTI on both economic and safety grounds (European Commission, 2019, pp. 75–77).

To approximate the safety impact of suspending inspections for light trailers (O1 and O2), we rely on event-based evidence from the European Commission's study on the inclusion of light trailers in PTI regimes (European Commission, 2019). That study quantified, for Croatia, that approximately one fatality, seven serious injuries, and 49 slight injuries are avoided annually as a result of about 28.884 trailer inspections.

From this evidence, per-inspection probabilities of avoiding casualties can be derived:

$$p_F = \frac{1}{28884} \approx 3,46 \times 10^{-5},$$
$$p_S = \frac{7}{28884} \approx 2,42 \times 10^{-4},$$
$$p_L = \frac{49}{28884} \approx 1,70 \times 10^{-3}.$$

Where

- p_F = expected fatalities prevented per inspection,
- p_S = expected serious injuries prevented per inspection,
- p_L = expected slight injuries prevented per inspection.

However, because only a subset of trailer-related deficiencies—about one quarter (25%)—are directly connected with Tow-Bar or coupling safety, the corresponding accident-prevention potential must be scaled by this factor. Accordingly, the adjusted per-inspection probabilities used in the present model amount to
$8,6 \times 10^{-6}$ for fatalities,

$6,1 \times 10^{-5}$ for serious injuries, and

$4,2 \times 10^{-4}$ for slight injuries.

If ΔN denotes the number of inspections removed under the reform scenario, the expected number of additional casualties can be estimated as:

$$\Delta F \approx p_F \cdot \Delta N,$$
$$\Delta S \approx p_S \cdot \Delta N,$$
$$\Delta L \approx p_L \cdot \Delta N.$$

The resulting additional fatalities (ΔF), serious injuries (ΔS), and slight injuries (ΔL) can then be monetized using Belgian unit cost estimates for accident severities (C_F, C_S , C_L), as defined in chapter 4.1 of this report. The incremental external/societal costs of reduced inspection coverage (ΔEC_{safety}) are therefore calculated as:

$$\Delta EC_{safety} = \Delta F \cdot C_F + \Delta S \cdot C_S + \Delta L \cdot C_L.$$

This method provides a transparent and replicable approach, directly linking the number of inspections foregone to measurable accident outcomes. While the Croatian calibration may not fully reflect Belgian fleet composition and trailer usage patterns, the derived per-inspection probabilities serve as a conservative proxy.

To convert the estimated number of additional casualties into a consistent estimate of accident counts, we apply a method based on the average number of casualties per accident. Belgian accident statistics indicate that, on average, accidents with trailers involve approximately 0,031 fatalities, 0,088 serious injuries, and 1,13 slight injuries per accident. Summing across these severities yields the following measure of average casualties per accident:

$$\bar{c} = 0,031 + 0,088 + 1,13 = 1,249.$$

Given this value, the total number of additional accidents attributable to the reduction in inspections of trailers is derived by dividing the expected increase in casualties by the average number of casualties per accident:

$$\Delta A_{\text{tow-bar}} \approx \frac{\Delta F + \Delta S + \Delta L}{\bar{c}}.$$

This method is preferred because it avoids double-counting. If casualties were directly translated into accidents by severity, the same accident could be counted multiple times whenever it involved more than one casualty (e.g., a fatality and several slight injuries). By using the weighted average casualties per accident, the estimate provides a more consistent and conservative measure of the number of additional accidents.

Accordingly, the procedure ensures that the accident estimates remain compatible with both Belgian reporting practices and the casualty-based cost valuation framework already defined in this report (cf. Vias Institute, 2024; European Commission, 2019).

Table 22: Comparison of baseline and empirically adjusted results for Scenario D (Tow-Bar inspections, Flanders 2024)

Policy Scenario	Annual additional impacts of reduced PTI coverage based on the original model and recalibration using event-based evidence from the European Commission (2019)				
	Inspections	Casualties			Accidents
	ΔN	ΔF Fatalities	ΔS Serious Injuries	ΔL Slight Injuries	ΔA_{total}
Scenario D - Event-based recalibration (EC 2019)	-39.603	0,3427	2,3965	16,8000	15,657
Scenario D - Baseline Model	-39.603	0,0001	0,0003	0,0035	0,003

Note: The adjusted values are derived from event-based probabilities observed in Croatia (European Commission 2019), scaled by a factor of 0,25 to reflect the share of Tow-Bar-related defects. The baseline values correspond to the original model without empirical correction.

Source: Own calculations based on the European Commission (2019).

Scenario D (Tow-Bar inspections) now yields an estimated increase in annual accident-related societal costs of approximately € 5,82 million. This figure results from the empirically recalibrated casualty probabilities derived from the Croatian trailer study (European Commission, 2019) and scaled by 0,25 to account for Tow-Bar-specific defect shares.

Compared to the original model (≈ € 0,03 million), the adjustment reflects the higher severity potential of coupling-related defects while maintaining conservative assumptions regarding their frequency. Even with this upward correction, Scenario D's contribution remains small relative to Scenario A and C. However, it corrects the initial underestimation of Tow-Bar safety relevance observed in the baseline model.

The two-step difference primarily reflects the shift from aggregate to event-probability modelling and should be interpreted as a methodological correction rather than a numerical outlier

5.5.4. Adjusted Results

The adjusted results summarize the combined effect of recalibrated safety and cost parameters across all four reform scenarios. Overall, the analysis confirms that any reduction in PTI coverage generates measurable additional societal costs, with varying magnitude depending on the specific policy design.

- **Scenario A** (Reduced inspection frequency) remains the most impactful reform option. The reduction in inspection intervals across the entire vehicle fleet leads to the highest increase in road-safety externalities, congestion, and emissions. Accident-related costs rise to approximately € 440,6 million per year, corresponding to a WLPS of 3,54. This means that for every € 1.000 saved privately, about € 3 540 in additional societal costs occur. Scenario A thus accounts for almost 90% of the total welfare loss identified in the model.
- **Scenario B** (No first inspection for new vehicles) produces comparatively minor effects, as new vehicles typically exhibit very low defect rates during their first years in operation. Annual accident-related costs are estimated at € 10,27 million, while private savings reach about € 9,97 million, resulting in a WLPS of 1,03. The near-parity between private and societal effects illustrates that even small inspection exemptions can erode the overall benefit–cost balance when applied at fleet scale.
- **Scenario C** (No inspection upon transfer of ownership) shows moderate but non-negligible impacts. Because second-hand vehicles have higher defect probabilities, particularly for lighting, braking, and chassis components, the model applies to a risk-adjustment factor of 1,2. This yields € 34,10 million in additional accident costs against € 43,98 million in private savings, corresponding to a WLPS of 0,78. Scenario C thus remains economically neutral to slightly positive but contributes significantly to aggregate accident numbers. However, the purely quantitative balance for Scenario C may underestimate its broader economic implications.

  From a microeconomic perspective, the second-hand vehicle market constitutes a textbook case of a *"lemons market"* (Akerlof, 1970), where asymmetric information between buyers and sellers can undermine trust and market efficiency. The existing PTI requirement at the point of ownership transfer functions as a trust-creating institution that mitigates adverse selection by certifying vehicle quality. Abolishing this inspection could therefore not only weaken consumer protection but also erode the informational foundation of the market itself. In the long run, reduced trust may increase transaction risks, incentivize fraudulent behaviour, and raise insurance or enforcement costs—effects that are not captured in the present quantitative model but that would negatively affect the market's overall workability.

- **Scenario D** (Abolition of Tow-Bar inspections) changes markedly after empirical recalibration. After applying the event-based trailer calibration from the European Commission (2019) and scaling by 25 % to represent the Tow-Bar share of relevant defects, annual accident-related costs increase to ≈ €

5,82 million, which raises the WLPS from ~0,01 to ≈ 3,0 (exactly 2,97 given € 1,963 million in private savings). This upward revision corrects the initial underestimation of low-frequency, high-severity coupling failures while maintaining a conservative overall result. Although Scenario D still contributes less to the total welfare loss than Scenarios A or C, its inclusion ensures that rare but severe trailer-related accident risks are adequately represented within the model.

Taken together, the adjusted results confirm that reduced inspection coverage—whether by frequency, vehicle category, or specific technical exemption—leads to a measurable deterioration in safety outcomes and imposes additional external costs that far exceed the short-term private savings from reduced PTI obligations.

5.5.5. Limitations

While the present cost–benefit analysis provides a comprehensive and empirically grounded assessment of PTI reform options in Flanders, several methodological and data-related limitations must be acknowledged. These limitations do not invalidate the findings but define the interpretative scope and highlight where the analysis adopts conservative assumptions.

1. **Empirical basis and representativeness:** The analysis relies primarily on official statistics from VIAS (2024), GOCA Vlaanderen (2025), and the European Commission (2019). However, defect-type data and trailer-related accident records remain incomplete in Belgian databases. Where national evidence was lacking, international benchmarks (e.g., Croatia, Germany) were scaled to the Flemish context using transparent proportional adjustments. This procedure introduces uncertainty in absolute values but ensures that parameter choices remain empirically traceable rather than arbitrary.
2. **Functional form and model structure:** The analytical core assumes a proportional relationship between the number of inspections removed (ΔN) and the associated changes in risk outcomes (ΔF, ΔS, ΔL). This simplifying assumption follows standard welfare-economic practice in transport cost–benefit analysis; yet, real-world relationships are likely non-linear – for instance, risk escalation may accelerate once inspection coverage falls below a critical threshold. Because no robust Belgian data exist to calibrate such thresholds, linearity was retained as a transparent baseline. Importantly, this choice is conservative: it tends to **underestimate**, rather than overstate, the welfare losses from reduced PTI coverage. To partly compensate for this structural simplification, the study draws on an extensive literature synthesis that empirically constrains the slope of the risk function. In other words, the applied coefficients are not speculative but

grounded in peer-reviewed international evidence on inspection-to-accident relationships (Martín-delos-Reyes et al., 2021; Elvik, 2022; Keall & Newstead, 2013).

3. **Approximation of non-linearity through evidence aggregation:** While complete non-linear modelling was not feasible, the integration of multi-country evidence serves as a pragmatic way to approximate curvature in the risk function. By combining outcome-neutral meta-estimates with case-specific plausibility checks, the model implicitly flattens extreme tails in the distribution of possible outcomes. This design makes the overall result more robust and less sensitive to individual data artifacts. However, it cannot fully capture dynamic feedback effects, such as cumulative risk or behavioral adaptation over time.
4. **Omission of behavioural and technological adjustments:** The model treats driver and operator behaviour as exogenous. Adaptive responses – such as voluntary maintenance, telematic monitoring, or sensor-based fault detection – are not endogenised. These could attenuate risks for newer vehicle generations but are unlikely to offset the aggregate effects of large-scale deregulation.
5. **Behavioural threshold effects and compliance adaptation:** Empirical and behavioural evidence suggests that risk relationships are not purely mechanical but also subject to compliance-based threshold effects. Studies such as Elvik (2022) and Keall & Newstead (2013) show that defect rates do not rise smoothly but accelerate once inspection frequency or enforcement probability declines. This aligns with behavioural-economic theory: as the perceived likelihood of inspection decreases, vehicle owners reduce pre-inspection maintenance efforts ("strategic repair behaviour"), thereby weakening the self-disciplining effect of the PTI regime. In other words, lax inspection regimes not only reduce defect detection mechanically but also erode preventive-maintenance incentives. Since these feedback mechanisms are not yet modelled endogenously, the analysis remains conservative – actual societal costs under deregulation are likely to be higher once behavioural adaptation is taken into account.
6. **Use of International Literature:** While international evidence was used for calibration where national data were incomplete, future Flemish datasets can further refine the precision of parameter estimates without changing the overall direction of results.
7. **Conservatism and interpretation:** Taken together, the combined assumptions (linearity, proportional risk allocation, and exclusion of dynamic feedbacks) render the study's cost estimates conservative lower bounds. The actual societal costs of PTI deregulation are therefore more likely to be higher than reported, not lower. Future research should expand the current framework to include non-linear, behaviorally informed, or system-dynamic modeling once sufficiently granular defect-type data become available.

8. **European and Institutional Limitations:** The study complies with national and EU methodological standards; future European extensions would complement, not replace, the present national analysis.

5.6. Extended Discussion and Research Outlook

The present cost–benefit analysis provides a robust and conservative welfare-economic assessment of PTI reform options in Flanders. However, from both an economic and an engineering perspective, the underlying model remains necessarily stylized. It captures key welfare relations and statistical regularities but abstracts from the complex technical, behavioural, and institutional processes that determine real-world outcomes. A comprehensive understanding of PTI policy thus requires integrating engineering reliability modelling with dynamic welfare economics in future research.

From an **engineering standpoint**, the model represents inspection coverage and safety outcomes as statistically linked but not physically derived. Defect formation, mechanical ageing, and system failure dynamics are treated as aggregate risk coefficients rather than as functions of material fatigue or subsystem reliability. In engineering terms, however, vehicle safety follows a non-linear deterioration pattern governed by stress cycles, design life, and maintenance behaviour. Future research should therefore extend PTI modeling with reliability-based approaches that utilize Weibull or exponential failure distributions for major components, such as brakes, suspension, steering, and sensors.

The aggregation of all vehicles within broad administrative categories (e.g., M_1, N_1) also masks significant heterogeneity. Failure probabilities differ by propulsion type, annual mileage, and usage environment. Electric vehicles, for instance, have fewer mechanical failures but are more susceptible to software faults or calibration drift. A technically refined model would stratify defect risks by technology class and operational profile to better reflect the diversity of modern fleets.

Equally important, the current analysis abstracts from *technological substitution effects*. Increasingly, vehicles are equipped with on-board diagnostics, predictive maintenance systems, and telematic monitoring, which can partially replace or complement physical inspections. Future models should incorporate these substitution coefficients to quantify the impact of digital diagnostics on the marginal effectiveness of PTI. Similarly, a defect-specific sensitivity analysis would distinguish between fault types with high and low accident potential—recognising that a 1% rise in brake failures is economically and technically more critical than a 1% rise in lighting defects.

Beyond hardware, vehicles are evolving into *cyber-physical systems* in which safety depends on embedded software, algorithmic control, and connectivity. PTI frameworks will therefore need to incorporate software reliability, calibration integrity, and cybersecurity resilience as inspection domains. Real-world risk also arises from combined, cascading defects rather than single failures. Engineering tools such as Fault Tree Analysis (FTA) or Failure Mode and Effects Analysis (FMEA) can capture these compound risks, while system-dynamic simulation allows feedback loops between vehicle condition, driver response, and maintenance behavior to be modeled explicitly.

Ultimately, empirical calibration should extend beyond national defect statistics to encompass *field failure data* from manufacturers, warranty claims, and recall databases. Establishing a European field-failure repository would enhance the accuracy of failure probabilities and facilitate the empirical validation of defect-to-accident pathways across various technologies and markets.

From an **economic perspective**, the current model applies a static welfare framework consistent with conventional cost–benefit analysis. It evaluates marginal changes in a reference year but does not capture dynamic adjustments in behaviour, technology, and policy. In reality, inspection reforms influence expectations, maintenance culture, and long-term investment in safety technologies. A next-generation PTI welfare model should therefore adopt a *dynamic equilibrium approach*, incorporating capital stock adjustment, learning effects, and endogenous risk perception.

The model further assumes quasi-perfect institutional compliance and uniform inspection quality. In practice, inspection systems exhibit institutional heterogeneity—differences in operator performance, enforcement intensity, and administrative efficiency—that affect both the efficiency and the fairness of regulation. Integrating institutional performance parameters, grounded in principal–agent theory, would allow welfare analysis to account for the governance quality of inspection regimes.

Moreover, the model treats external costs—such as accidents, congestion, and emissions—as additive and separable, whereas they are in fact economically interdependent. Accidents increase congestion, which in turn amplifies emissions, and all three factors interact with productivity and regional competitiveness. This means that the aggregate welfare losses reported here are conservative lower bounds. Coupling the CBA with general equilibrium or system-dynamic models would help reveal second-round effects on output, logistics efficiency, and household welfare.

Distributional and equity aspects also guarantee further attention. Aggregate efficiency analysis masks how deregulation may shift costs across income groups and regions. Lower-income or rural households, who often operate older vehicles, may face disproportionate safety externalities, while high-income groups tend to benefit more from time savings. Incorporating distributional weighting or social welfare functions would make PTI evaluation more consistent with modern inclusive policy analysis.

Finally, the valuations of safety, time, and carbon applied in this report are static, whereas they evolve in response to income growth, risk aversion, and climate policy ambition. Embedding *endogenous valuation trajectories*—for example, through income elasticity of the value of statistical life or dynamic carbon pricing —would allow for the long-term forecasting of how the relative weights of safety and environmental objectives will change over time.

In summary, both engineering and economic considerations point toward a unified research agenda. Future PTI studies should (1) combine welfare modelling with reliability-based engineering analysis, (2) incorporate technological heterogeneity and diagnostic substitution, (3) integrate institutional and behavioural parameters, and (4) adopt dynamic, distribution-sensitive welfare frameworks. By bridging physical reliability models and adaptive economic modelling, future research can transform PTI analysis from a static, empirically calibrated exercise into a *system-oriented safety and welfare model*. Such an integrated approach would not only quantify immediate costs and benefits but also capture how inspection policy shapes technological innovation, user behaviour, and societal welfare over the long term.

These research needs do not alter the fundamental welfare conclusion of the present study but identify areas for further methodological refinement.

5.7. Policy Recommendations

The analysis indicates that periodic technical inspections (PTIs) continue to be an economically relevant instrument for maintaining fleet safety in Flanders. Across all reform scenarios, reductions in inspection coverage generate higher societal costs than the private savings achieved. This imbalance underscores the economic significance of maintaining an inspection regime that strikes a balance between administrative efficiency and measurable safety outcomes.

(1) Maintain annual inspection frequency for high-risk vehicle categories. Scenario A demonstrated that relaxing inspection intervals (e.g., shifting from annual to biennial testing) would result in the highest societal losses – approximately €440 million per year – and a welfare-loss-per-savings (WLPS) ratio exceeding 3,5. The empirical evidence therefore supports continued annual inspections for passenger cars (M_1), light commercial vehicles (N_1), and high-mileage fleets. Only targeted flexibility (e.g., for new low-mileage vehicles) should be considered, and only under strict data-monitoring conditions.

(2) Preserve the initial inspection for new vehicles. Scenario B shows near-parity between societal costs and private benefits (WLPS ≈ 1,0). Although new vehicles generally exhibit low defect rates, the first inspection serves an important verification role in ensuring conformity of registration documents and early detection of manufacturing or assembly anomalies. Maintaining this first inspection prevents the accumulation of latent defects in later vehicle life cycles.

(3) Strengthen inspection obligations for second-hand vehicle transfers. Scenario C, with an adjusted risk factor $\rho = 1{,}2$, confirms that vehicles entering the second-hand market carry a substantially higher probability of safety-relevant deficiencies. Ensuring PTI compliance at the point of ownership transfer not only protects consumers but also stabilises the overall risk profile of the vehicle fleet. From an economic perspective, this measure remains cost-neutral to slightly positive (WLPS ≈ 0,9) and thus socially desirable.

(4) Retain Tow-Bar inspections as a targeted safety measure. The recalibrated Scenario D, incorporating empirical trailer data and the 25 % Tow-Bar share, increases accident-related costs to ≈ € 5,8 million per year (WLPS ≈ 3,0). Although the absolute magnitude remains smaller than in Scenario A or C, the result confirms that Tow-Bar inspections mitigate *low-frequency, high-severity* coupling-system failures. Given their relatively low administrative cost and high marginal safety benefit, these inspections can be retained based on current empirical evidence.

(5) Enhance data collection and cross-national calibration. Several limitations identified in this report stem from missing or inconsistent data on defect types, coupling failures, and inspection outcomes. The Flemish authorities, in coordination with GOCA Vlaanderen and European partners, should promote harmonized reporting standards and share anonymized PTI datasets to improve future model precision and cross-country comparability.

(6) Adopt a dynamic evidence-based PTI strategy. Rather than implementing broad deregulation, PTI policy should follow a *dynamic risk-management approach*: inspection intensity should be adjusted to reflect empirically observed defect probabilities and technological developments (e.g., sensor-based diagnostics, electronic records). This strategy ensures that PTI remains both proportionate and effective, aligning safety policy with the principles of the European Union's *Vision Zero* framework.

In summary, the cost–benefit analysis confirms that the socio-economic rationale for PTI remains strong. Reform efforts should therefore focus on targeted improvements in efficiency and data quality, not on weakening inspection obligations.

By maintaining robust PTI coverage and continuously integrating empirical evidence, Flanders can achieve a sustainable balance between mobility, safety, and economic efficiency. Efficiency-oriented reforms remain possible, provided that equivalent safety monitoring and data-driven control mechanisms are maintained. Improving national data availability would allow more Flemish-specific modelling in future updates.

The analytical framework applied in this study can be readily adapted for future EU-level assessments and supports evidence-based implementation of the forthcoming Roadworthiness Package under the European Green Deal.

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Appendix A. Assumptions and Indexation

This appendix documents the central assumptions and indexation procedures applied in the cost–benefit analysis. All monetary values were harmonized to the common price year 2024 using the Belgian Harmonized Index of Consumer Prices (HICP). For example, unit costs of fatalities, injuries, and property-damage-only accidents reported by VIAS (2022 €) were uplifted by a factor of 1,073, resulting in adjusted values of 7.510.000 € per fatality, 751.100 € per serious injury, 75.100 € per slight injury, and 4.300 € per property-damage-only accident. For carbon valuation, the 2019 benchmark of 100 € per tonne of CO_2-equivalent, recommended in the *Handbook on the External Costs of Transport*, was indexed to 121,4 € per tonne in 2024.

In terms of severity definitions, the international 30-day criterion was used for fatalities, while serious injuries were aligned to the MAIS3+ threshold wherever possible. Belgian police statistics were harmonised accordingly. Slight injuries and property-damage-only accidents were reported as such, with sensitivity checks conducted against OECD/ITF conversion factors. Under-reporting corrections were not applied in the baseline but included in sensitivity analyses, particularly for slight injuries.

For accident cost estimation, production losses were not added on top of willingness-to-pay-based values of statistical life and serious injury, as these already include human-cost components. By contrast, administrative, property-damage, and congestion costs were added explicitly.

Based on Flemish motorway parameters (average congestion length 7.9 km, duration 0.42 h, and 3 333 vehicles/hour) and traffic shares of 81.5 % passenger cars, 18 % heavy goods vehicles, and 0.5 % buses, the resulting congestion cost per breakdown event amounts to approximately 6 384 € per incident (sum of 1 639 € for passenger cars, 1 559 € for HGVs, and 3 187 € for buses, 2024 prices).

Emission impacts were modeled by assuming that vehicles without inspection emit, on average, 10% more CO_2-equivalents. For the first year, the timing factor $\alpha = 0,5$ was applied to reflect the uniform distribution of inspection dates across the calendar. This yields an incremental 148,7 kt CO_2-eq for passenger cars and 230,7 kt for freight vehicles, equivalent to climate costs of 46,1 Mio. € annually at 2024 carbon prices.

Time-cost valuation for PTI visits combined observed waiting times (43,5 minutes for drive-in, 10,5 minutes for appointments) with travel time to the nearest station (32,5 minutes round trip). A weighted average was calculated, reflecting the 45/55 split between drive-in and appointment visits. The blended Value of Time was set at 28,6 €/hour, based on a 70 % share of private users (17,2 €/h) and 30 % professional users (48,2 €/h). This approach ensures that both household and business perspectives are adequately represented in the monetisation of private savings.

Finally, the Welfare Loss per Savings (WLPS) indicator was defined as the ratio of additional societal costs (accidents, congestion, emissions) to private savings (time and fees). Values above 1 indicate that societal costs outweigh private savings.

A1. Price year and indexation (HICP – harmonisation to 2024)

- *Principle*. All monetary inputs are converted to the report's common price year **2024** using the Belgian HICP.
- *Formula:*

$$\text{Value}_{2024} = \text{Value}_{\text{base}} \times \frac{\text{HICP}_{2024}}{\text{HICP}_{\text{base}}}$$

- *Parameters used*. Fatalities, injuries, and PDO costs from VIAS (2022 €) are uplifted by 1,073 to 2024 (e.g., 7.000.000 € → 7.510.000 €). For carbon valuation, the 2019 benchmark is indexed to **121,4 €/t CO_2-eq** for 2024.

A2. Severity definition crosswalk

- Fatalities: 30-day definition (international standard).
- Serious injuries: aligned to **MAIS3+** where possible; conversion applied when police coding deviates.
- Slight injuries and PDO: as reported in Belgian statistics; harmonised with VIAS and ITF/OECD for comparability.

A3. Under-reporting adjustments

- *Baseline*. No uplift applied in core results (fatalities robust; injuries/PDO as reported).
- *Sensitivity*. Where relevant, apply ranges (esp. for slight injuries), reported separately to avoid mixing under-reporting with policy effects.

A4. Gross–net correction for production loss

- To avoid double-counting, production loss is not added on top of WTP-based VSL/VSSI, where VIAS unit costs already include human-cost components.

- Administrative, property-damage, and congestion costs are added explicitly.

A5. Congestion parameters and formulas (breakdown-induced)

- *Event model.*

$$C_{\text{class}} = L \times Q_h \times t \times s_{\text{class}} \times c_{\text{class}}$$

with parameters:

- L=7,9 km,
- t=0,42t = 0,42t=0,42 h,
- Qh≈3.300Q_h ≈ 3.300Qh≈3.300 veh/h (80.000 ÷ 24),
- shares: M1 = 81,5 %, HGV = 18,0 %, M2/M3 = 0,5 %,
- unit costs: M1 = 0,18 €/veh-km, HGV = 0,79 €/veh-km, M2/M3 = 8,50 €/veh-km.
- *Per-incident results (2024 €).*
    - Total = 6.384 €

A6. Emission modelling and carbon valuation

- *Uplift assumption.* Without PTI, average emissions increase by 10% (conservative). Timing factor α = 0,5 for year 1.
- *Passenger cars (M1).* 3,55 Mio. cars in 2021, per-car 2,36 t CO_2-eq ⇒ 148,7 kt in year 1.
- *Freight (N1, N2/N3).* Fleet average 11,58 t CO_2-eq/vehicle; N1 = 226,3 kt, N2/N3 = 4,4 kt ⇒ total 230,7 kt in year 1.
- *Carbon price.* Indexed to 121,4 €/t CO_2-eq. → Total annual climate costs 46,1 Mio. €.

A7. Time-cost valuation (PTI visits)

- *Waiting time*. GOCA monitoring: drive-in 43,5 min (44,7 %), appointment 10,5 min (55,3 %).
- *Travel time*. Nearest-facility model: **32,5 min round trip**.
- *Value of time*. 70 % private (17,2 €/h, 2024 €), 30 % business (48,2 €/h) ⇒ blended **28,6 €/h**.
- Applied to waiting + travel per omitted PTI (see Section 4.4; Table 15).

A8. WLPS indicator (definition and interpretation)

$$\mathrm{WLPS} = \frac{\Delta EC_{\mathrm{safety}} + \Delta EC_{\mathrm{congestion}} + \Delta EC_{\mathrm{emissions}}}{\Delta S_{\mathrm{fees}} + \Delta S_{\mathrm{time}}}$$

- WLPS > 1 ⇒ societal costs exceed private savings (inefficient).
- WLPS <1 ⇒ private savings exceed societal costs (efficient).
- WLPS =1 ⇒ private savings are equal to societal costs (indifferent).

Appendix B: List of PTI Stations in Flanders

GOCA VLAANDEREN - LIJST VAN DE ERKENDE INSTELLINGEN EN HUN AUTOKEURINGSCENTRA

► AIBV

1731 ZELLIK, Z.1 Researchpark 90
TEL. 02/559.09.99 FAX 02/527.14.29

Centrum

13 - 1730 ASSE-MOLLEM, Z5 Mollem 80
TEL. 02/452.53.53 FAX 02/452.99.61

14 - 1500 HALLE, Zinkstraat 3 – Industriepark Dassenveld
TEL. 02/356.70.66 FAX 02/360.19.45

15 – 1804 CARGOVIL (ZEMST), Erasmuslaan 21
TEL. 02/251.13.76 FAX 02/252.49.69

58 - 1731 ZELLIK, Z.1 Researchpark 90
TEL. 02/559.08.40 FAX 02/559.08.44

59 - 1840 LONDERZEEL, Technologielaan 37
TEL. 052/31.23.00 FAX 052/31.22.98

► GROEP AUTOVEILIGHEID (GAV)

2440 GEEL, Lammerdries 7 – Industrieterrein Geel West 4
TEL. 014/57.86.00 FAX 014/57.86.01

Centrum

16 - 3110 ROTSELAAR, Ambachtelijke zone, Wingepark 3
TEL. 014/57.86.00 FAX 014/57.86.01

17 - 3300 TIENEN, Sint-Maurusweg 23, Oost Leeuwerik Z1
TEL. 014/57.86.00 FAX 014/57.86.01

40 - 2660 HOBOKEN, P. Van den Eedenstraat 100
TEL. 078/05.90.40 FAX 078/05.91.40

41 - 2060 ANTWERPEN, Noorderlaan 34
TEL. 078/05.90.41 FAX 078/05.91.41

42 – 2300 TURNHOUT, Veedijk 40, Industrieterrein Veedijk 2 (1438)
TEL. 078/05.90.42 FAX 078/05.91.42

43 - 2800 MECHELEN, Brusselsesteenweg 460
TEL. 078/05.90.43 FAX 078/05.91.43

44 - 3290 DIEST - WEBBEKOM, Industriezone 2/7 – I.Z. Webbekom 2105
TEL. 078/05.90.44 FAX 078/05.91.44

45 - 2440 GEEL, Lammerdries 7 – Industrieterrein Geel West 4
TEL. 014/57.86.00 FAX 014/57.86.01

46 - 2220 HEIST OP DEN BERG, Wouwerstraat 5A
TEL. 078/05.90.46 FAX 078/05.91.46

47 - 2550 KONTICH, Neerveld 3
TEL. 078/05.90.47 FAX 078/05.91.47

48 - 2930 BRASSCHAAT, Sint-Jobsesteenweg 134
TEL. 078/05.90.48 FAX 078/05.91.48

49 - 2100 DEURNE, Santvoortbeeklaan 34-36
TEL. 078/05.90.49 FAX 078/05.91.49

50 – 2830 WILLEBROEK, Hoeikensstraat 1b – Industrieterrein Z1 Willebroek Noord
TEL. 078/05.90.50 FAX 078/05.91.50

51 - 3570 ALKEN, Industrieterrein Kolmen 1308
TEL. 078/05.90.51 FAX 078/05.91.51

52 - 3941 HECHTEL-EKSEL, Eindhovensebaan 50
TEL. 078/05.90.52 FAX 078/05.91.52

53 - 3870 HEERS, Steenweg op Luik 350
TEL. 078/05.90.53 FAX 078/05.91.53

54 - 3668 AS, Lanklaarsesteenweg 5
TEL. 078/05.90.54 FAX 078/05.91.54

55 - 2390 MALLE, Ambachtsstraat 17
TEL. 078/05.90.55 FAX 078/05.91.55

► KEURINGSBUREAU MOTORVOERTUIGEN (KM)

8400 OOSTENDE, Zandvoordestraat 442 A
TEL. 059/55.27.70 FAX 059/55.27.80

Centrum

20 - 8540 DEERLIJK, Pontstraat 87
TEL. 056/77.55.52 FAX 056/77.40.65

21 - 8000 BRUGGE, Kolvestraat 29
TEL. 050/45.70.70 FAX 050/45.70.71

22 - 8700 TIELT, Meulebeeksesteenweg 10
TEL. 051/40.13.64 FAX 051/40.58.06

23 - 8550 ZWEVEGEM, Pluim 6
TEL. 056/28.23.40 (intern gebruik)

24 - 8800 ROESELARE, Roelensbeekstraat 2
TEL. 051/20.23.24 FAX 051/26.38.81

25 - 8900 IEPER, Rozendaalstraat 26
TEL. 057/22.02.10 FAX 057/22.02.11

26 - 8600 KAASKERKE, Steenbakkerijstraat 2
TEL. 051/51.95.60 FAX 051/51.95.61

27 - 8480 ICHTEGEM, A. Coussensstraat 75
TEL. 051/58.93.16 FAX 051/58.86.07

28 - 8400 OOSTENDE, Zandvoordestraat 442 A
TEL. 059/55.27.70 FAX 059/55.27.80

29 - 8560 WEVELGEM, Noordstraat 3
TEL. 056/43.27.70 FAX 056/43.27.71

► STUDIEBUREEL VOOR AUTOMOBIELTRANSPORT (SBAT)

9051 SINT-DENIJS-WESTREM, Poortakkerstraat 129
TEL. 09/321.76.20 FAX 09/321.76.29

Centrum

30 - 9052 ZWIJNAARDE, Buitenring - Zwijnaarde 1
TEL. 09/222.54.30 FAX 09/242.84.31

31 - 9032 WONDELGEM, Industrieweg 2
TEL. 09/253.81.61 FAX 09/253.58.86

32 - 9100 SINT-NIKLAAS, Oostjachtpark 8
TEL. 03/776.02.42 FAX 03/778.07.68

33 - 9190 STEKENE, Industriezone Kleine Akker, Zavelstraat 25
TEL. 03/789.04.76 FAX 03/789.10.68

34 - 9320 EREMBODEGEM, Bedrijventerrein Zuid III, Industrielaan 24
TEL. 053/66.97.62 FAX 053/67.31.77

35 - 9660 BRAKEL, Industrielaan 8
TEL. 055/42.44.22 FAX 055/42.11.45

36 - 9900 EEKLO, Industrielaan 15
TEL. 09/377.15.53 FAX 09/377.51.49

37 - 9051 ST.-DENIJS-WESTREM, Poortakkerstraat 127
TEL. 09/221.51.16 FAX 09/221.46.17

38 - 9810 NAZARETH, Industriepark 'De Prijkels', Venecoweg 16
TEL. 09/381.09.30 FAX 09/381.09.31

39 – 9200 DENDERMONDE, Industriezone Hoogveld, Cooremannekens 12
TEL. 052/25.95.00 FAX 052/25.95.01

Versie 20200220

Source: GOCA VLAANDEREN (2025).

Appendix C: Distribution of PTI stations in Flanders

Source: GOCA VLAANDEREN (2025).

Appendix D: Overview of waiting times

	2024				
	# PTI inspections	Drive in - without appointment		# appointments	
januari	352.269	158.203	44,9%	194.066	55,1%
februari	348.989	155.400	44,5%	193.589	55,5%
march	352.609	152.671	43,3%	199.938	56,7%
april	337.757	142.846	42,3%	194.911	57,7%
mai	334.893	149.136	44,5%	185.757	55,5%
june	331.337	143.194	43,2%	188.143	56,8%
juli	313.609	143.137	45,6%	170.472	54,4%
august	272.428	126.114	46,3%	146.314	53,7%
september	301.931	135.764	45,0%	166.167	55,0%
october	335.637	152.378	45,4%	183.259	54,6%
november	280.466	129.406	46,1%	151.060	53,9%
december	295.701	134.340	45,4%	161.361	54,6%
total	**3.857.626**	**1.722.589**	**44,7%**	**2.135.037**	**55,3%**

Overview of waiting times:

Mean waiting time without appointment (drive in): 43,5 minutes

Mean waiting time with appointment: 10,5 minutes

These mean waiting times were calculated based on monthly monitoring from September 2024 to August 2025.

Source: GOCA VLAANDEREN (2025).