

EDITORIAL



**Tampering issue**

**Environmental protection systems are under threat**

Road transport today is arguably as vital to society as blood flowing around the body. However, it is of equal concern to society that the vehicles travelling around the arteries of our cities and countries reduce their emissions levels as much as is technologically possible, towards sustainable and smart mobility. In the last 20 years technology has been able to reduce harmful vehicle emissions on average by 95% thanks to Environmental protection systems (EPS). However, there is increasing clear evidence of illegal manipulation of these systems by vehicle owners. This situation is made possible by the fact that current on-board diagnostic systems (OBD) are not intended to detect extended malicious interventions to vehicle systems.

**EU call to evaluate tampering issue**

The DIAS Horizon 2020 EU funded project ([www.dias-project.com](http://www.dias-project.com)) has combined some of Europe's most knowledgeable and experienced professionals in academia and industry to evaluate the issue and find tangible solutions.

**What does tampering mean for the air quality?**

Even though air quality in Europe has improved over recent decades, the current levels of air pollutants can seriously affect human health and the environment. As an example, NOx contributes to the formation of ground-level ozone, to acid deposition and eutrophication of soil and water and, in particular, NO<sub>2</sub> is associated with adverse effects on human health. Recent research as shown that even a small percentage of tampered vehicles (1%) can lead to a huge increase in NOx fleet emissions in the future (i.e. +60% for 2040).

***Up to 10% of EU5/V and EU6/VI vehicles in the EU are estimated to have been tampered with their EPS.***

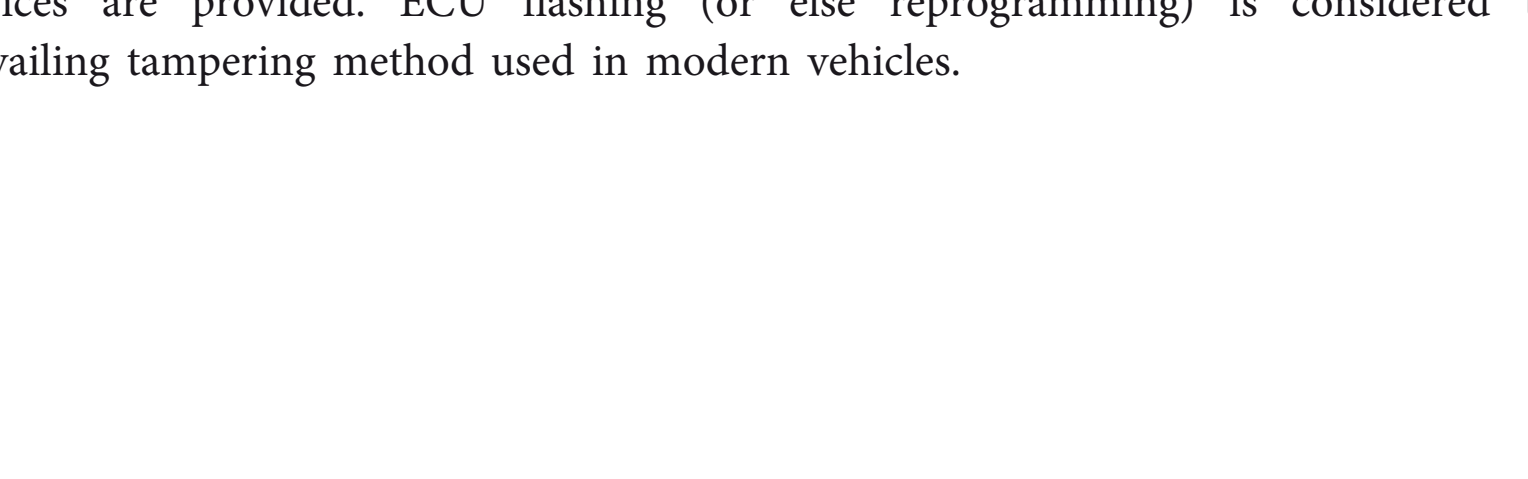
Based on evidence from different roadside inspections and remote sensing emission measurement campaigns in Europe, the share (in %) of tampered vehicle in the European fleet and the ratio of tampered to non-tampered vehicle emissions were evaluated and used to estimate total emissions from the on-road vehicle fleet and the public health burden that can be attributed to tampering. Based on the most realistic estimations and focusing on particulate matter (PM) and nitrogen oxides (NOx) emissions as the two pollutant emissions which are most negatively affected by EPS tampering, over the 2022-2050 period, tampering leads to:

- 3.7 megatonnes (or 20%) additional NOx emissions
- 41 kilotonnes (or 12%) additional PM emissions
- 26,000 additional premature deaths
- 460,000 additional years of life lost

These results represent the maximum theoretical benefits that can be achieved in an ideal case where 100% of the tampering is eliminated by the introduction of anti-tampering legislation. Considering this fact, anti-tampering regulation can deliver a significant contribution to mitigating the health and environmental impacts of road transport.



**Which is the DIAS approach to address this issue?**

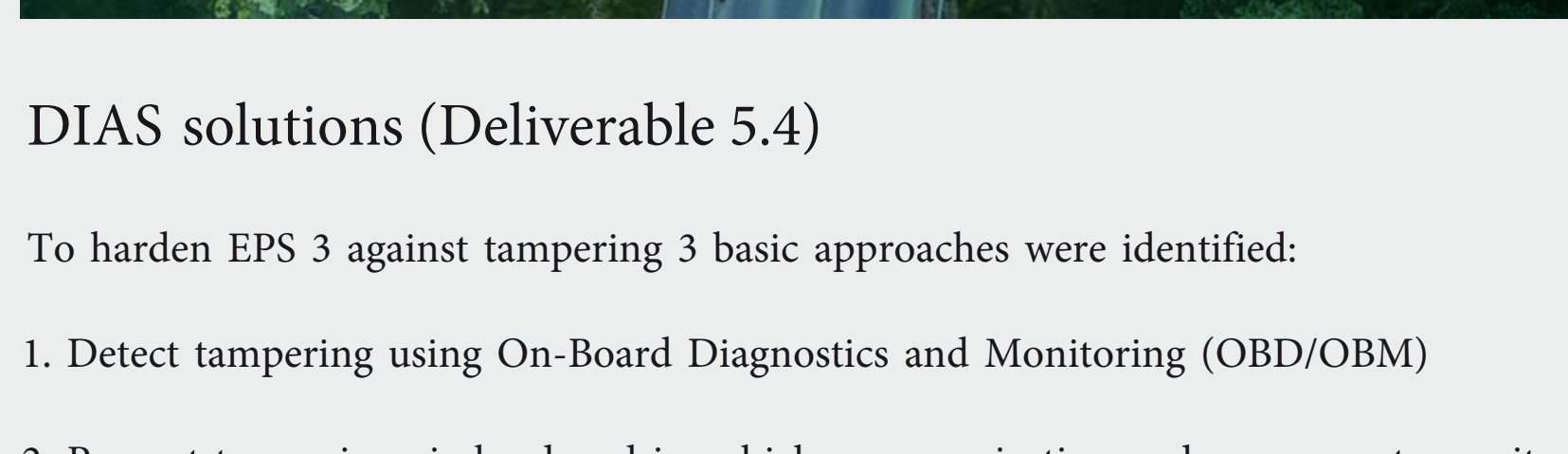


**Deep dive into the tampering market (Deliverable 3.1)**

Tampering (with or without the help of an expert technician) is possible, even for vehicles complying with the current Euro standards and that tampering may result in extreme increases in emissions (tens or hundreds of times, depending on the pollutant). A wide market is available offering tampering devices and services. Indicatively, alone for Selective Catalytic Reduction (SCR) manipulation responsible for NOx reduction in diesel vehicles, there are at least 100 companies worldwide offering kits for purchase with prices ranging from 10 to 500 €. Tampering is mainly done to prevent costs for repair, maintenance or consumables necessary for a durable, effective application of EPS over the lifetime of a vehicle. Various tampering methods and services are provided. ECU flashing (or else reprogramming) is considered the prevailing tampering method used in modern vehicles.

The success rate of the tampering is mixed [50% of the tampering devices and services result in Diagnostic Trouble Codes (DTCs), malfunction indication or driver inducement in DIAS tests]. The effect on emissions also varies depending on the EPS components affected. Finally, it has been shown that for new vehicle models, tamperers need significant time (in the order of years) to find a reliable way to tamper with the targeted EPS.

**How to harden EPS against tampering?**



**DIAS solutions (Deliverable 5.4)**

To harden EPS 3 against tampering 3 basic approaches were identified:

1. Detect tampering using On-Board Diagnostics and Monitoring (OBD/OBM)
2. Prevent tampering via hardened in-vehicle communication and component security
3. Report tampering events and relevant data to appropriate authorities

Technical solutions for detection were identified mainly based on monitoring and plausibility checks of EPS-related signals. Tampering prevention was achieved by securing flashing process, SW execution, key management, and data exchange, and applying intrusion detection system and firewall. At last, in the context of tampering-related reporting options were provided for reporting schemes, infrastructure, and tampering-related compliance certification.

Several layers of defense against currently known and unknown tampering practices were envisioned in the technical solutions identified. One of the challenges to beat future tampering lies in detecting advanced yet unknown simulation techniques designed to hide the modification or intervention in the aftertreatment system components and cheat even the already existing detection systems.

Most anti-tampering solutions were found neutral building upon common automotive technology, published scientific knowledge, worldwide accepted standards and protocols, and EU or non-EU regulatory frameworks. Several of these were also evaluated as simple, low-cost and available in the short-term. The success of DIAS solutions was demonstrated through traditional penetration testing (internal evaluation), but also through two hacking events by independent experts (external evaluation) and no critical remaining vulnerabilities were observed.

**What about future legislation (Deliverable 6.5)?**

Ultimately, an anti-tampering framework was proposed incorporating guidelines for future anti-tampering legislation and engaging several entities involved in anti-tampering. In short:

- European Union Member States enforce the tampering-related EU regulatory framework.
- Vehicle manufacturers provide vehicle anti-tampering solutions for tampering prevention, detection and reporting for and after the Type Approval.
- Type approval and other authorities (i.e. Periodic Technical Inspection, Roadside Inspection) ensure and control the implementation of these solutions.
- Workshops ensure legitimate use of diagnostic tools and report tampering.
- At last, vehicle owners ensure proper and timely maintenance and proper “reverting” actions if tampering is concluded.

**Meet the partners**



**Find more for DIAS:**

- DIAS website: [www.dias-project.com](http://www.dias-project.com)
- DIAS video with an overview of all our activities: <https://www.youtube.com/watch?v=3u6-Oy0Wazo>
- Public material from the final dissemination event: [https://dias-project.com/Publicity/Events/Final\\_Dissemination\\_Event](https://dias-project.com/Publicity/Events/Final_Dissemination_Event)
- Official deliverables: [https://dias-project.com/Deliverables/All\\_WPs](https://dias-project.com/Deliverables/All_WPs)