# Extent of L-vehicles tampering and impact on noise and emissions

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LENS L-vehicles Emissions and Noise mitigation Solutions

# Background

L-category vehicles: mopeds, motorcycles, tricycles, and quadri-mobiles.

→ not as strict emission standards and controls by legislation

→ distinct general sound characteristics and peak sound levels

Tampering: any modification that sets the vehicles outside of their approved specifications.

→ such practices are more common among LVs

→ it further contributes to any negative impacts of LVs

# Objectives

- The L-vehicles Emission and Noise mitigation Solutions project assists law enforcement and regulatory authorities to reduce the contribution of L-vehicles to air and noise pollution.

- This work presents a first assessment of the effects that the most common LV tampering methods have on both pollutant and noise emissions, using a qualitative approach.

# Used methods

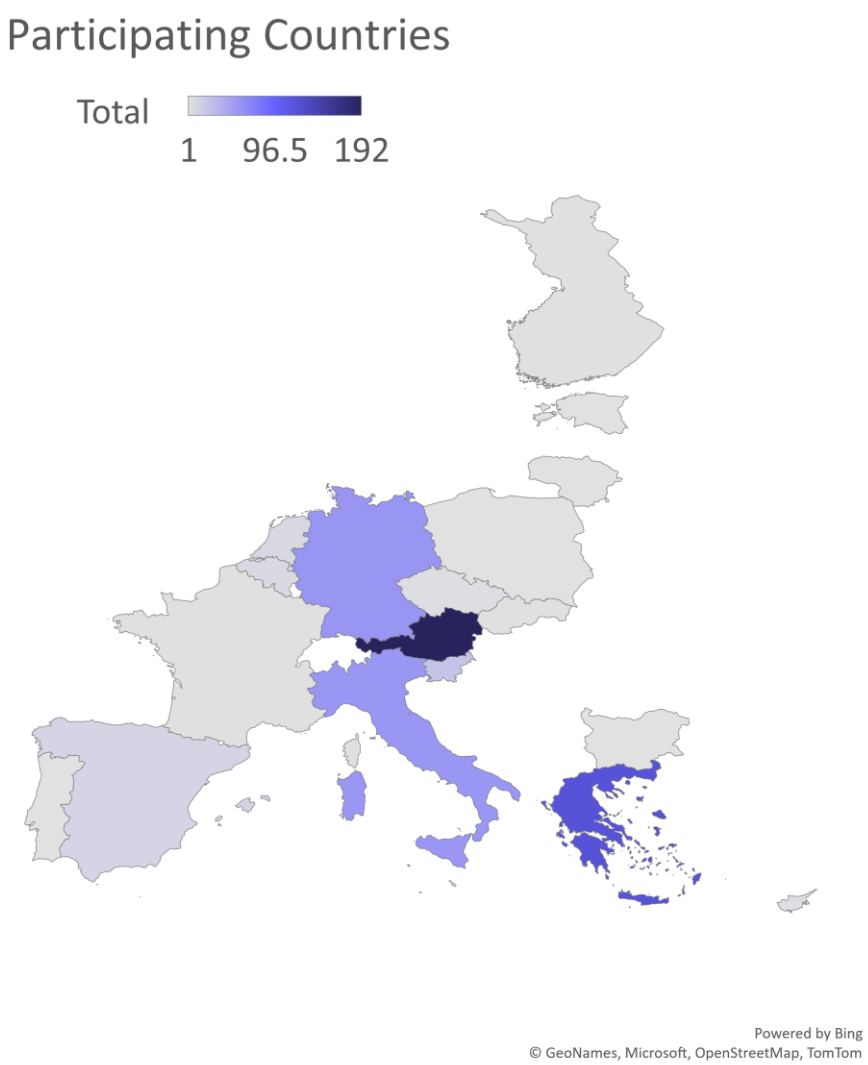
- literature review
- own engineering judgement
- online questionnaires and face-to-face interviews

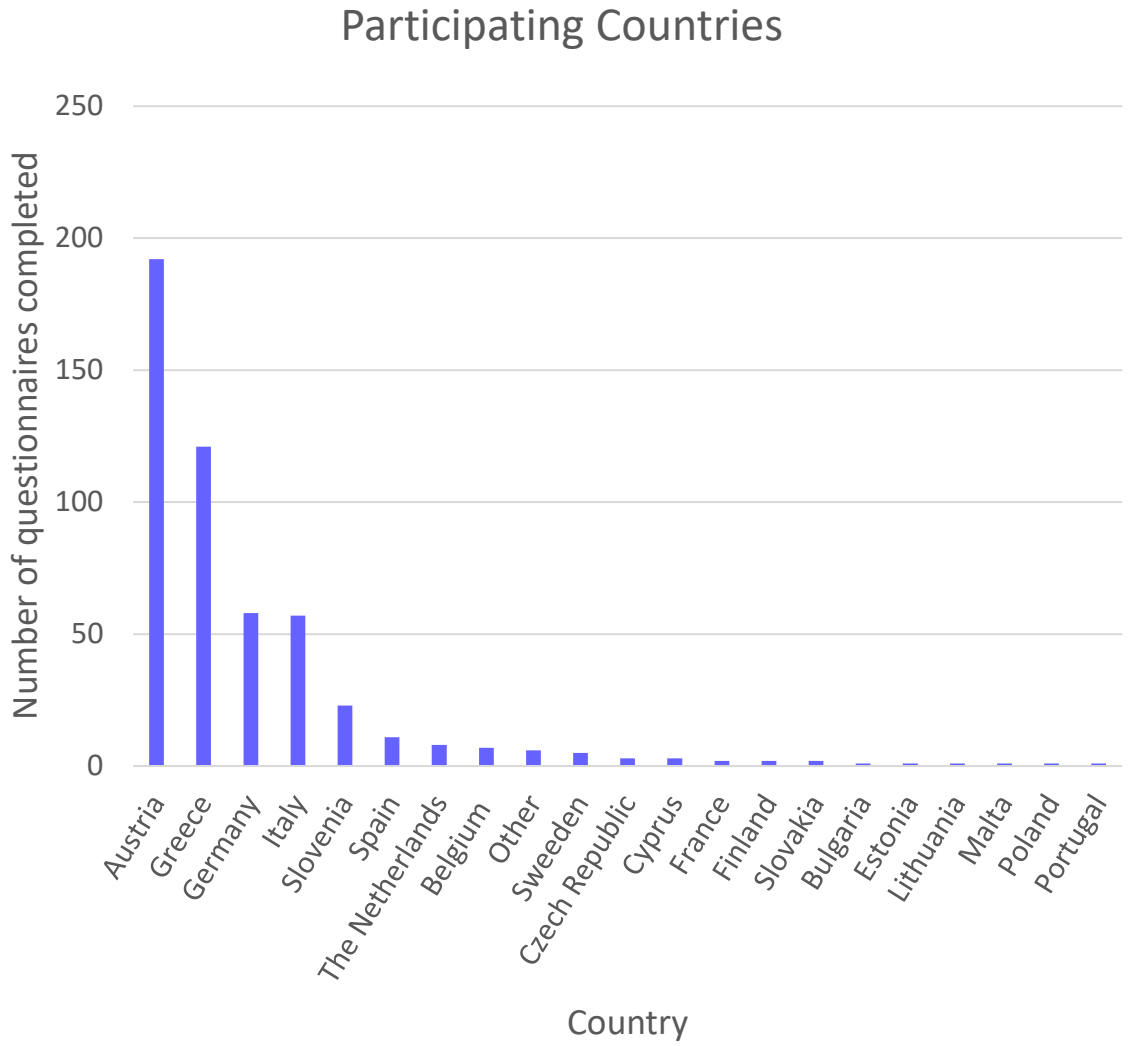
→ **Target group**

motorcycle or LV owners and enthusiasts that had modified their vehicle at least once

| | Online Questionnaires | Face-to-face Interviews | Total |
|---|---|---|---|
| Questionnaires completed | 602 | 64 | 666 |
| No modifications mentioned | 157 | 3 | 160 |
| Reviewed Questionnaires | 445 | 61 | 506 |

# Questionnaire results

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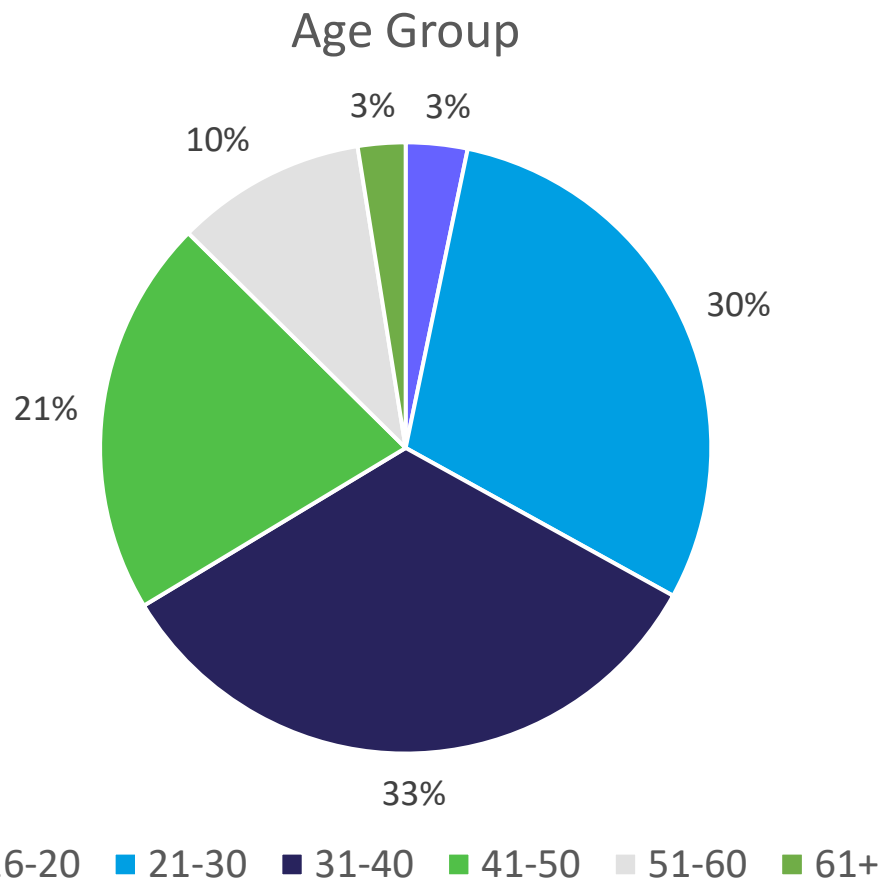
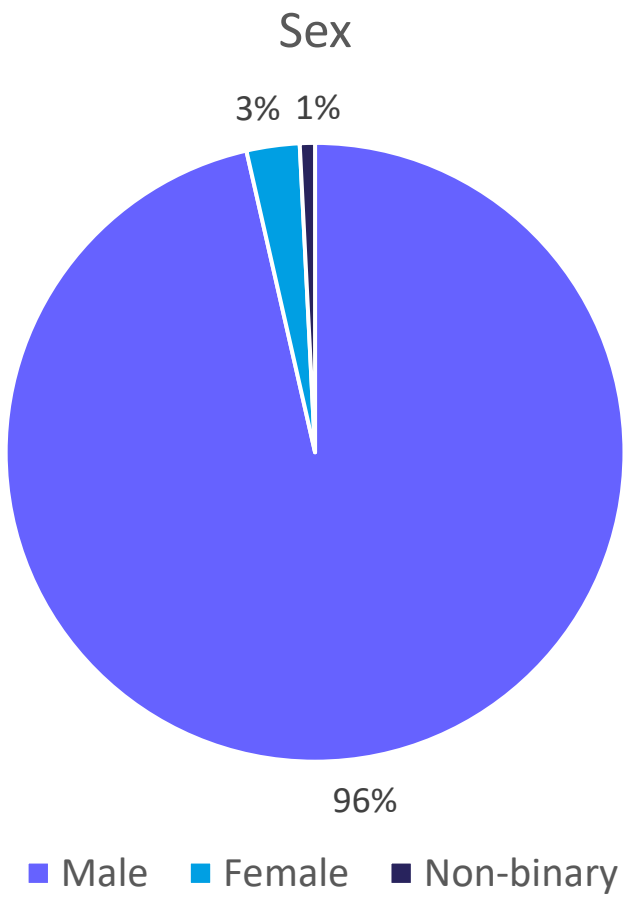
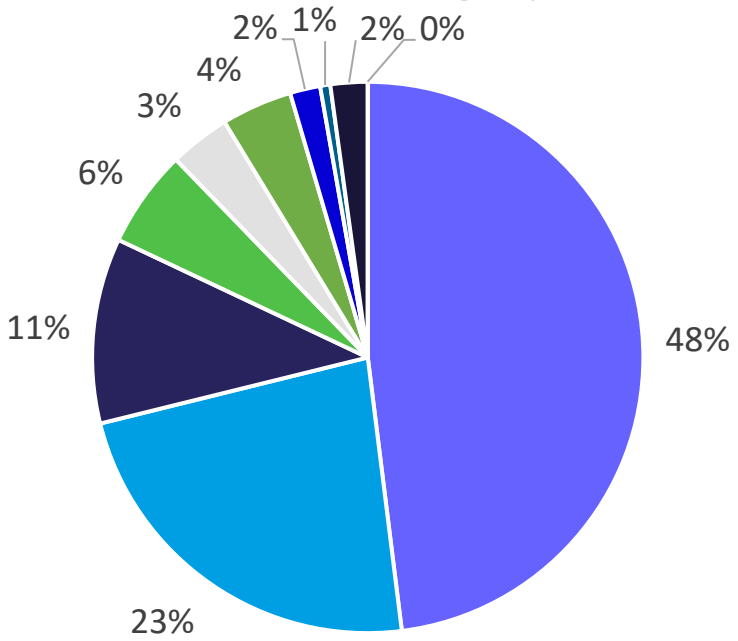

Age Group
3%
3%
10%
30%
21%
33%
16-20
21-30
31-40
41-50
51-60
61+

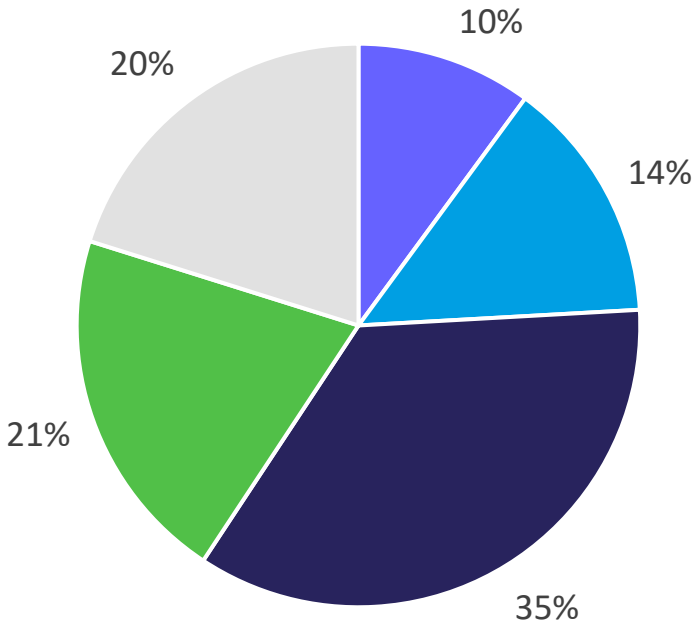

Sex
3%
1%
96%
Male
Female
Non-binary

## Vehicle Category




- Street/Naked/Supersport/Superbike
- On-Off/Touring/Adventure
- Super moto
- Off-road/Enduro
- Scooter
- Cruiser
- Low performance/Commuter
- 4-wheeler/ATV
- Other
- 3-wheeler

## Vehicle Registration Year




- Up to 1998
- 1999-2006
- 2007-2016
- 2017-2020
- 2021-2023

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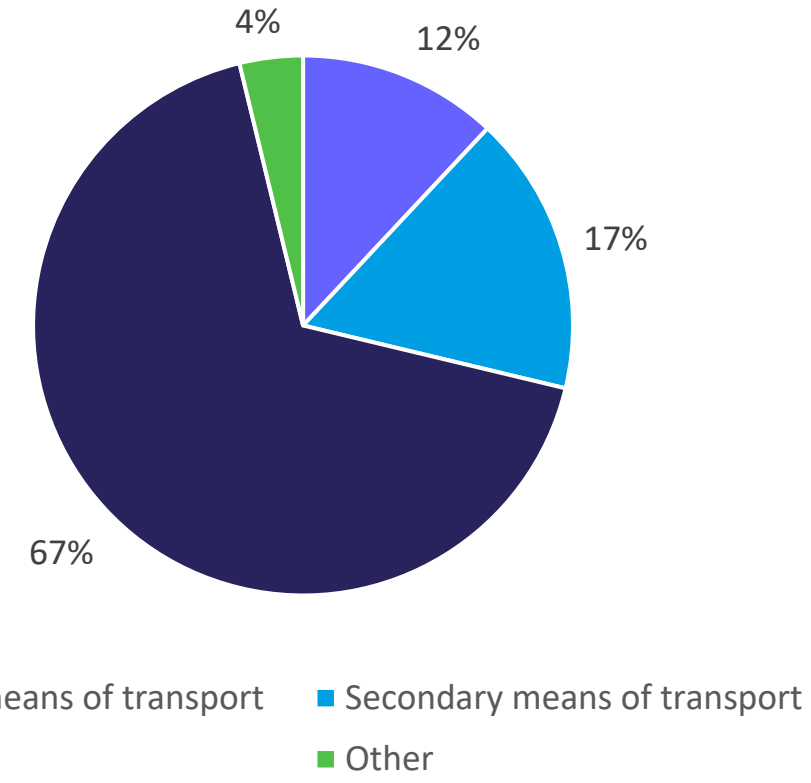
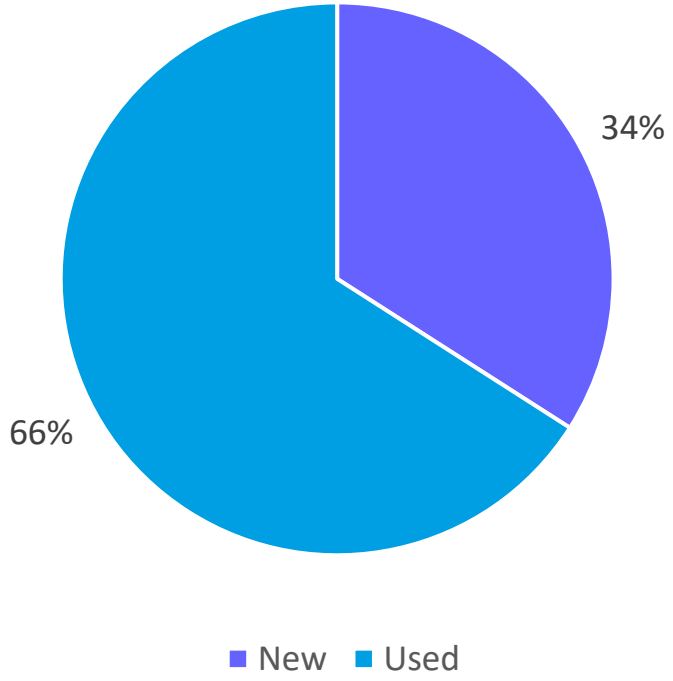
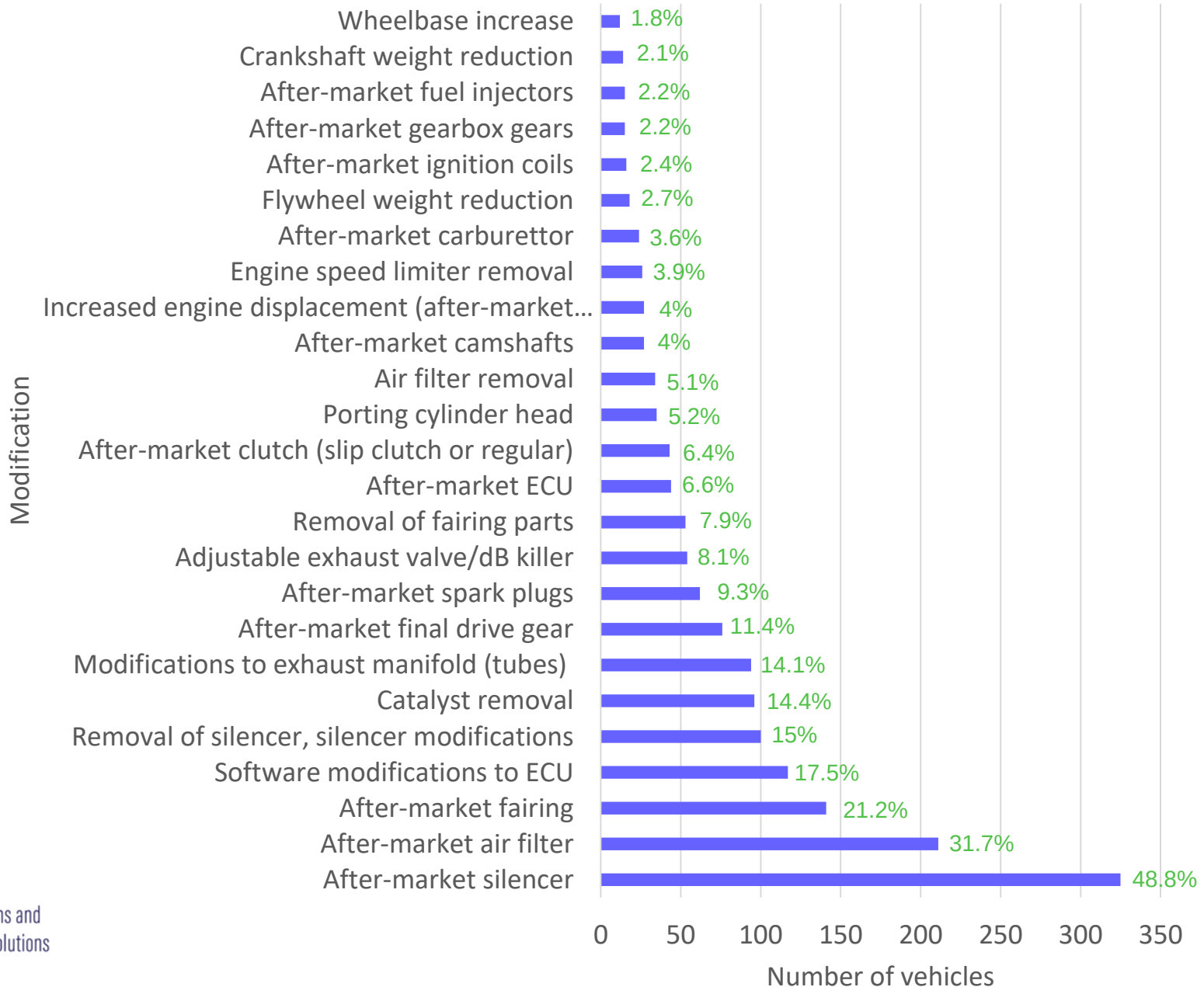
## Most Frequent Vehicle Usage




## Vehicle bought



# Modifications

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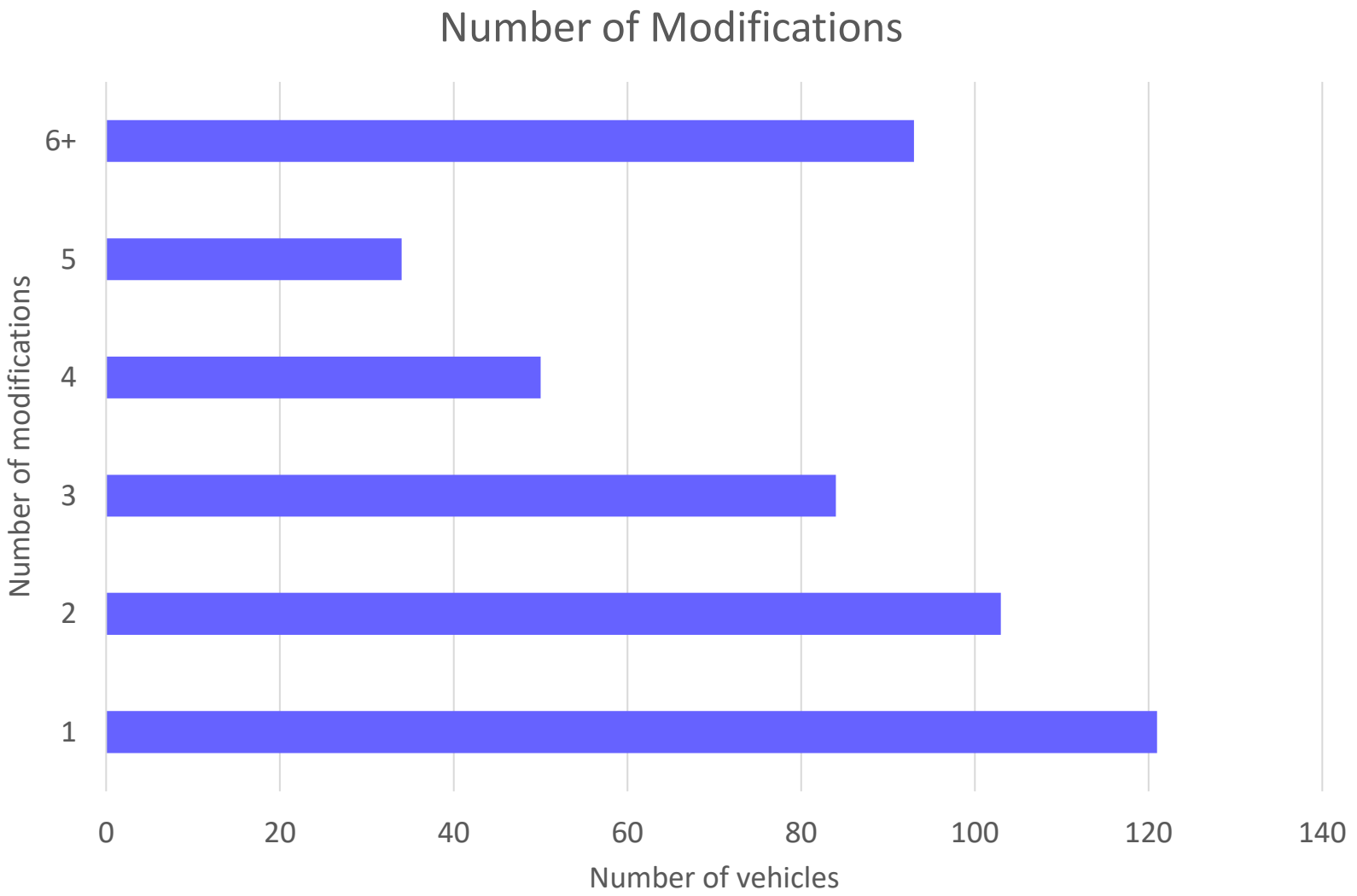
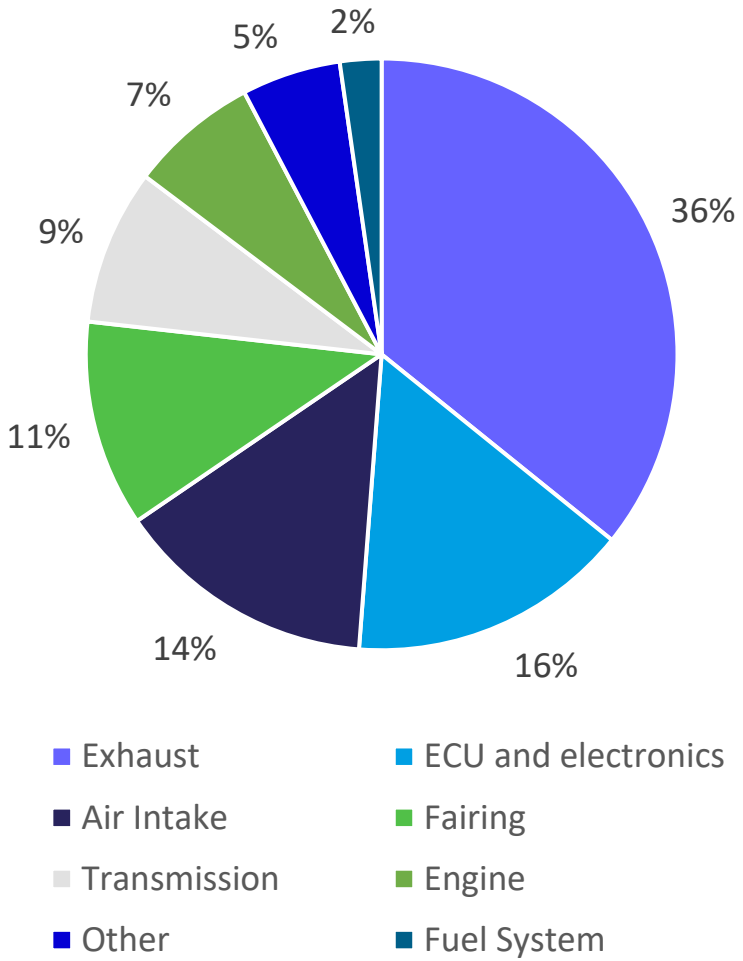
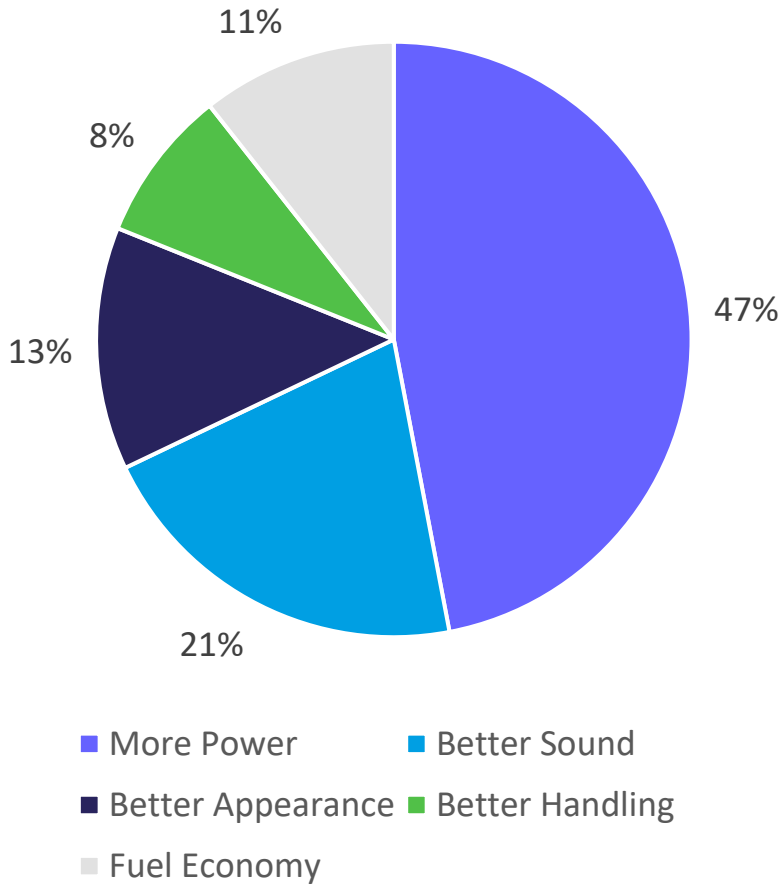

Number of Modifications
Number of modifications
6+
5
4
3
2
1
0
20
40
60
80
100
120
140
Number of vehicles

## Category




## Reason behind Modifications



# Validation of online results by comparing Greek questionnaires

| Question | Most Common Answer | |
|---|---|---|
| | Greek Online questionnaires | Face-to-face interviews in Greece |
| Age Group | 21-50 (72%) | 21-50 (94%) |
| Sex | Male (98%) | Male (100%) |
| Vehicle category | Street/Naked/Supersport/Superbike (35%) | Street/Naked/Supersport/Superbike (41%) |
| Vehicle registration year | 2007-2016 (47%) | 2007-2016 (56%) |
| Vehicle bought | Used (81%) | Used (77%) |
| Vehicle usage | Free time<br>Secondary means of transport (69%) | Free time<br>Secondary means of transport (68%) |
| Modification | After-market silencer<br>After-market air filter (26%) | After-market silencer<br>After-market air filter (34%) |
| Modification category | Exhaust (27%) | Exhaust (41%) |

# Effects table

| Modification | Effect on | | | | |
|---|---|---|---|---|---|
| | CO | $CO_2$ | $NO_x$ | HC | Noise level |
| After-market silencer | - | - | - | - | ↑↑ |
| Removal of silencer | - | -/↓ | - | - | ↑↑↑ |
| Catalyst removal | ↑↑↑ | ↓ | ↑↑ | ↑↑↑ | ↑ |
| Adjustable exhaust valve | - | -/↓ | - | - | ↑↑ |
| Air filter removal | ↓ | - | ↑ | -/↓ | ↑/↑↑ |
| After-market ECU | ↑/↑↑ | ↑↑ | ↑ | ↑↑ | ↑ |
| After-market carburettor | ↑↑ | ↑↑ | ↓ | ↑↑↑ | ↑ |

# Conclusions

1. LV tampering poses a severe problem that may lead to harmful effects, as it deteriorates the pollutant and noise emission performance of LVs.
2. The most common LV tampering modification in the EU is the replacement of the original silencer of a vehicle with an after-market one.
3. The removal of the catalyst, using an after-market ECU or an after-market carburetor has the most significant effects on pollutant emissions of a LV.
4. The removal of the silencer, using an adjustable exhaust valve or removing the air filter of a LV affects its noise levels the most.
5. Anti-tampering measures must be taken to prevent such modifications and decrease their detrimental effects.
6. The main output of this work, the qualitative effects table, could be used as a guide to identify different tampering types and reduce any negative effects on air and noise pollution more effectively.

# *Thank you!*

For more info: https://www.lens-horizoneurope.eu/resources/

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