ANALYSIS OF CHALLENGES IN THE CURRENT FLOW OF CONTROLS AND IN THE ICT SYSTEM-CO2 EMISSIONS ANALYSIS [D 3]

Drafted by: Gregorio Barbieri, Agnese Tonola, DIR-SPEI

Project Partner: PP3

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1.1 Analysis of CO_2 emissions produced by shippers and control bodies

The calculation of the CO_2 emissions produced by the control activities was carried out by identifying all control bodies with their respective offices, the premises of the visiting points and the premises of the shippers. Then, using a georeferenced system, the distance between the visiting points and the control bodies was calculated.

Furthermore, for the estimation of CO_2 emissions, the following assumptions were made:

- Each person who must carry out a check leaves from his or her respective office, goes to a single control point and returns to his or her own premises;
- Each person who must carry out a check, every day, goes to each of the 9 visiting points;
- Each subject who must carry out a check operates for 200 days a year (conventional working days in a year).

To consider the heterogeneity of the vehicles available, as a first approximation it was assumed that all control bodies use Euro 5 class cars, while as regards the type of fuel used, simulations were carried out with different fuels such as:

- Petrol;
- Diesel;
- LPG;
- Methane (CNG).

Finally, two different traffic conditions were considered:

- Urban: simulates poorly flowing traffic conditions, during which the operating conditions of vehicles are characterized by low efficiency and high fuel consumption;

- Total: simulates free-flowing traffic conditions, during which vehicles operate with an operating point closer to the optimal one with higher efficiency and lower fuel consumption.

To calculate the distances travelled by the shippers and the Control Bodies in the visiting points, the georeferenced positions of the various subjects were identified and entered on the ArcGIS system, through which the road routes were calculated.

Starting from these data, the total kilometres travelled by the various operators have been calculated with the following assumptions:

- Each person goes to each visit point on a single trip (round trip without intermediate stops);

- Each person goes to all 6 visiting points;

- Each person operates for 200 days a year.

The calculations show that, overall, the 122 shippers travel 2,231,317 km a year to go to all 6 visiting points.

Overall, the 6 control bodies travel 120.101 km a year to go to all 6 visiting points.

In one year, all the operators going to the 6 visit points cover a total of 2,351,418 km.

The total kilometres travelled by the 6 control bodies were then calculated, assuming an alternative route. Specifically, it was assumed that each control body goes to all 6 visiting points in a single trip, ie without returning to its headquarters after each visit point.

In this case, the 6 control bodies travel a total of 41,429 km a year (about 34% less than in the previous scenario) to go to all 6 visiting points.

To estimate the CO_2 emissions, the emission coefficients developed by ISPRA (http://www.sinanet.isprambiente.it/it/sia-ispra/fetransp) were used. These coefficients provide the specific emission of CO_2 (g / km) produced by various classes of medium-sized cars, powered by different fuels and in different traffic conditions. The coefficients are shown in the following table.

Table 1 CO_2 emissions values

CO_2 emissions values	
Fuel	**gCO_2/km**
Urban_Petrol	247.36
Petrol_total	169.94
Urban_diesel	241.09
Urban_diesel	175.24
Urban_LPG	220.66
Total_LPG	172.32
Urban_CNG	256.94
Total_CNG	178.78

The following table show the main results on the annual quantities of CO_2 produced.

Table 2, Estimation CO_2 emissions per year

Estimation CO_2 emissions per year				
Fuel	Freight Forwarder		Control Authorities	
	Total distance covered	Kg CO_2	Total distance covered	Kg CO_2
Urban_Petrol	2231317	551948	120101	29709
Petrol_total		379193		20410
Urban_diesel		551948		29709
Urban_diesel		391024		21047
Urban_LPG		492353		26501
Total_LPG		384511		20696
Urban_CNG		573325		30859
Total_CNG		398921		21472

The study carried out shows how the quantities of CO_2 emitted vary significantly both according to the type of fuel used and the traffic. In particular, the largest emissions occur in busy traffic conditions.

Under the assumptions made, it is estimated that CO_2 emissions in a year are between 600,000 and 400,000 tons of CO_2.

Subsequently, the CO_2 emitted by the control bodies was also estimated in the hypothesis that they go to all 9 visiting points in a single trip.

Table 3, CO_2 emissions by control bodies with two different travel modes

<table>
<tr><th colspan="5">CO_2 emissions by control bodies with two different travel modes</th></tr>
<tr><th rowspan="2">Fuel</th><th colspan="2">Single trip</th><th colspan="2">Round trip</th></tr>
<tr><th colspan="2">Total distance covered</th><th colspan="2">Kg CO2</th></tr>
<tr><td>Urban_Petrol</td><td rowspan="8">120101</td><td>29709</td><td rowspan="8">41429</td><td>10248</td></tr>
<tr><td>Petrol_total</td><td>20410</td><td>7040</td></tr>
<tr><td>Urban_diesel</td><td>29709</td><td>9988</td></tr>
<tr><td>Urban_diesel</td><td>21047</td><td>7260</td></tr>
<tr><td>Urban_LPG</td><td>26501</td><td>9142</td></tr>
<tr><td>Total_LPG</td><td>20696</td><td>7139</td></tr>
<tr><td>Urban_CNG</td><td>30859</td><td>10645</td></tr>
<tr><td>Total_CNG</td><td>21472</td><td>7407</td></tr>
</table>

In this second simulation, the CO_2 emissions produced by the control bodies are between 10,600 and 7,000 kg of CO_2 per year. These values are equal to about 65% less than in the previous simulation and show how CO_2 emissions are strongly influenced by the distance travelled and consequently the total kilometres travelled.

1.2 Analysis of CO_2 emissions produced by heavy vehicles

This paragraph will analyse the emissions produced by heavy transport vehicles that operated in the port of Livorno throughout 2019.

This analysis is subject to many uncertainties and assumptions deriving from the lack of exact data on the sources of emissions, ie heavy transport vehicles. In fact, in addition to the difficulty of identifying the exact number of vehicles that operated in the port of Livorno, other uncertainties are due to the lack of information on the activities carried out within the port areas (quantity of cargo transported, distance travelled, etc.) , and the type of fuel used by the vehicles themselves. The lack of this information makes it difficult to estimate the exact amount and type of fuel consumed by the various heavy transport vehicles and consequently the corresponding CO_2 emissions.

Using the AdSP-MTS GTS3 (Gate Transit Security) software, it was possible to collect data relating to heavy transport vehicles that handle containers in Terminal Darsena Toscana (TDT), Galvani, Valessini and Zara port gates. Starting from these data, it was possible to estimate the emissions produced by heavy duty traffic.

To estimate the CO_2 emissions produced by heavy vehicles, it was assumed that each vehicle travels the route from the Livorno motorway exit to the various gates, and then from the various gates to the respective loading/unloading areas.

It was also assumed that all the means of transport analysed use diesel fuel as fuel. Lastly, the emission coefficients developed by ISPRA (http://www.sinanet.isprambiente.it/it/sia-ispra/fetransp) were used to estimate CO_2 emissions. These values provide the specific emission of CO_2 (g / km) produced in different traffic conditions, in particular, two different traffic conditions were used to simulate the emissions inside the port areas and outside. The coefficients are shown in the following table.

Table 4, g CO_2/Km values per area

Area	g CO_2/Km
Inside the port	983.6
Outside the port	626.2

The port gates where the heavy vehicles have gone through are four:

- Terminal Darsena Toscana gate;
- Varco Valessini;
- Varco Galvani;
- Varco Zara.

The distances between the port gates, the motorway toll booth and the boarding areas are shown in the following table.

Table 5, estimated distances

Gate	Motorway distance (km)	Loading point distance (km)
TDT	8.2	1.3
Valessini	8.2	1.7
Galvani	6.1	1.5
Zara	6.5	2.5

In relation to the heavy vehicles covered by this analysis, in 2019 there were 117601 heavy vehicles entering the port areas and 131305 heavy vehicles leaving the port areas, for a total of 248906 transits. The following table shows the data relating to the transits made in the various gates.

Table 6, emissions sorted per port gates

Gate	TDT	Valessini	Galvani	Zara
# In 2019	46153	2836	67987	625
# Out 2019	59447	24	68122	3712
# Total transits 2019	105600	2860	136109	4337

The data shows that the gate with the highest number of transits was the Galvani gate with about 55% of all recorded transits, while in second place there is the TDT gate with about 43% of all transits.

As for CO_2 emissions, these have been estimated by multiplying the kilometres travelled by each single heavy vehicle by the corresponding emissions' values. As mentioned above, the emission coefficients vary depending on whether the vehicle is located outside the port area or inside.

Outside the port area, in fact, heavy vehicles move at a higher and more constant speed, it follows that the engines operate at an operating speed closer to the optimal one characterized by a higher efficiency and a consequent lower consumption of fuel and therefore lower emissions. On the other hand, inside the port areas, heavy vehicles move at a slower speed, the engines operate at an operating speed further away from the nominal one, and consequently there is greater fuel consumption and emissions.

The following table shows the total kilometres travelled by heavy vehicles entering the Livorno port gates and the respective CO_2 emissions expressed in tons.

Table 7, Emissions heavy duty vehicles in

Emissions heavy duty vehicles in		
Gate	**Total distance travelled (km)**	**Total emissions (Ton CO_2)**
TDT	438454	296
Valessini	28076	19
Galvani	516701	360
Zara	5625	4

Overall, the vehicles entering the Livorno port gates in 2019 generated almost 680 tonnes of CO_2, 53% related to heavy vehicles entering the Galvani gate and 43.6% by heavy vehicles entering the TDT gate.

The following table shows the total kilometres travelled by heavy vehicles exiting the Livorno port gates and the respective CO_2 emissions expressed in tons.

Table 8, Emissions heavy duty vehicles out

Emissions heavy duty vehicles out		
Gate	**Total distance travelled (km)**	**Total emissions (Ton CO_2)**
TDT	564747	381285
Valessini	238	163
Galvani	517727	360739
Zara	33408	24238

In relation to the heavy vehicles leaving the Livorno port gates, overall, in 2019 they generated about 766 tons of CO_2. About 50% of total emissions were produced by heavy vehicles leaving the TDT gate and 47% by those from the Galvani gate.

Finally, the following table shows the total kilometres travelled by heavy vehicles both in and out of the Livorno port gates and the respective CO_2 emissions expressed in tons.

Table 9, Total emission trucks 2019

Total emission trucks 2019		
Gate	**Total distance covered**	**total Emissions (Ton CO_2)**
TDT	1003200	677
Valessini	28314	19
Galvani	1034428	721
Zara	39033	28
Total	2104975	1446

Under the assumptions made previously, it is estimated that the heavy vehicles covered by this study, which passed through the 4 port gates analysed in the port of Livorno in 2019, emitted a quantity of CO_2 equal to approximately 1446 tons of CO_2. This value is only indicative and serves to indicate an order of magnitude of the phenomenon.

Of this, it is estimated that about 50% (721 tons) was emitted by heavy vehicles in transit at the Galvani gate, and about 47% (677 tons) by heavy vehicles in transit at the TDT gate.