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Calculating Carbon Footprint in ports through a new Standard Tool: case study applications

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Abstract

One of the main environmental problems in ports is Climate Change and its consequences. Since 1979, many international organizations have been working to control Climate Change. A literature review and a practical research were carried out to set up the basis to create a tool. These studies showed in recent years many ports have started to calculate their Carbon Footprint. However, there is no unified method in ports to do so. In addition, based on the results of the practical research, the development of a practicable tool for the calculation of Carbon Footprint in ports was highly demanded.

Therefore, a new standardized tool was developed and validated by 20 experts. This tool was tested with the existing results of the Port of Oslo and Ports de la Generalitat. The results obtained were in line. Finally, a case study model was created to test all the functionalities of the tool. The calculated emission values were compared with those obtained with the OCCC tool and MITECO tool. The outcomes were very similar with minor changes due to different emission factors. The results of this test process prove that the new tool is suitable to be used by ports around the world.

Keywords: Climate Change, Carbon Footprint, Greenhouse Gas (GHG) emissions, Ports, Case studies

1. Introduction

An important goal to tackle environmental problems and foster sustainable development in the near future is to reduce the generation of GHG emissions from different industrial sectors including ports. According to the International Association of Ports and Harbors [1], the increase of GHG emissions in port operations is the main cause of the impact that these areas have in global Climate Change.

According to the last environmental review of the European Sea Port Organization (ESPO), Climate Change occupied the 2rd position in the ranking of top 10 environmental priorities in ports in 2020 [2]. It is predicted that seaport and inland waterway infrastructures will be affected by the consequences of Climate Change, in ways such as sea level rise and changes in weather or in the storm frequency [3]. Moreover, the International Council on Clean Transportation (ICCT) predicted that GHG emissions from shipping activities will triple by 2050 [4].

All this reflects the importance of this issue in the whole port environmental priorities and the fact that the topic of Climate Change in the maritime industry is getting more importance every day.

Therefore, it is important for ports to calculate, report and control their Climate Change impacts. An indicator that can be used for this purpose is the Carbon Footprint which measures the potential contribution of human activities, including ports, to Climate Change.

As a consequence, the main objective of this paper is to test a new tool developed to calculate Carbon Footprint in ports and validate it to spread its use around the world.

2. Methods

To develop the aforementioned tool, a literature-based research was conducted as well as a practical research. In the first one more than 20 different methodologies used by 15 ports, 3 port terminals and 4 ships were studied in detail. In the second one, a survey was prepared and presented in the Valencia Greenport Congress on 17th and 18th October 2018 gathering answers from 55 participants.

After a deep analysis of the results of both researches, a new tool was developed. It is based on the Intergovernmental Panel on Climate Change (IPCC) [5 and 6], GHG protocol [7] and the World Port Climate Initiative (WPCI) guideline [8].

The creation of this tool was done by the use of the Excel software and Visual Basic. It took into account three scopes of emissions: scope 1 (port direct sources), scope 2 (port indirect sources) and scope 3 (other indirect sources including tenants' sources).

The most common GHGs emissions which are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) were considered in this tool.

Once the first version of the tool was developed, it was sent to 20 experts including environmental port managers, environmental experts and port professionals all around the world. Most of their suggestions were introduced in the tool through different amendments. The final tool, the guidelines and the video can be downloaded from http://eports.cat/carboonfootprint.

This paper presents the results of testing the tool with different case studies. These are presented in the next section.

3. Results

The new tool was tested with some case studies. In first place, a case study with public data from the Port of Oslo (Norway) was used to test the tool [9]. In second place, a case study with data from Ports de la Generalitat (Catalonia, Spain) was selected to test the tool [10]. For both cases, the data necessray to calculate the GHG emissions was available on published papers ([9] and [10]).

In the previous case studies, all the scopes and all the emission sources were not taken into account. In order to test the whole sources of each scope, a case study model port was created using literature information and port expertise. This port was named Bandare-Bid but it is not a real port., but it includes all the emission sources provided by the tool. In this way, all the functionalities of the new tool were tested. These results then were compared with the Catalan Office for Climate Change(OCCC) tool [11] and the tool of the Ecological Transition Ministry (MITECO) of the Spanish government [12], since their guidelines are clear and easy to follow and freely available.

3.1 Port of Oslo

As it can be seen in Table 1, the results achieved by the port of Oslo (by using the ISO14064-1 method [13]) were almost the same as the ones with the new tool. Scope 1 emissions calculated by both tools had minor differences and it was due to the usage of different calculation methods.

The total emissions of scope 2 calculated by the port of Oslo and by the new tool were exactly the same.

Concerning scope 3, only emissions from employees' commuting were calculated in this case study and there was little difference between the results. This difference can be explained by the different calculation methods.

Table 1: Comparison of the Carbon Footprint results with two methods (CO_2eq tonnes)

Scopes	Port of Oslo	New tool
1	594	611
2	463	463
3	288	220
Total	1345	1294

3.2. Ports de la Generalitat

In the case of Ports de la Generalitat, the existing results (by the OCCC tool) were almost the same as the results of the new tool (Table 2). The reasons for the minor differences were due to the usage of different calculation methods.

In scope 3, Ports de la Generalitat considered only emissions from water consumption. In the new tool these emissions are not considered since they are not suggested by any standard guidelines.

Table 2: Comparison of the Carbon Footprint results with the two methods (CO_2eq tonnes)

Scopes	Ports de la Generalitat	New tool
1	36.8	40.2
2	315.6	259.7
3	10.4	-
Total	362.8	299.8

3.3. Bandare-Bid port

This port includes 5 terminals including one container terminal, one fishing terminal, one dry bulk terminal, one liquid bulk cargo terminal and a cruise terminal. In addition, it has an organic chemical industry, a wastewater treatment plant, a waste incineration plant and a power plant which are managed by tenants.

Table 3 shows the result of the emissions carried out by the 3 tools (OCCC, MITECO and new one). As it can be seen, the total emissions obtained with the new tool and the OCCC tool were very similar. The results from MITECO were quite different because this tool does not consider scope 3.

Table 3: Comparison of the Carbon Footprint results (CO_2eq tonnes)

Scopes	New tool	OCCC tool	MITECO tool
1	9073.440	9098.380	528.151
2	475.564	475.564	258.055
3	10384.302	9614.146	-
Total	19,933.306	19,188.090	786.206

Concerning scope 1, the results obtained by the new tool and the OCCC tool were very similar and the results of the MITECO were lower because emissions from port owned vessels are not calculated in this tool.

The result of scope 2 in the new tool and OCCC tool was exactly the same due to the use of the Iranian emission factor for the electricity. On the contrary, in the MITECO tool, there exists a default amount for Spain which is lower than the Iranian one. For this reason, the result of the MITECO tool was lower compared with the other tools.

Concerning scope 3, emissions of this scope are excluded from the MITECO tool. The results obtained by the new tool and OCCC tool were very similar. The slight difference is mainly related to the different emissions factors.

4. Conclusions

One of the main environmental concerns in recent years in ports is CO_2 emissions generated by different activities that are taking place in these areas, which contribute to the increase of Climate Change effects.

After doing a literature review and practical research, it was seen that there was a need to develop a standardized tool to calculate Carbon Footprint in ports. This tool was demanded by the port sector. In this regard, a new tool was developed, verified by the experts and tested with case studies. Real data from Catalonia and Norway were used to ensure that the tool was suitable enough to be used. In addition, a model case study was created to test all the functionalities of the tool.

This tool can be used by all the ports and port sectors all around the world for free. By calculating their GHG emissions and developing programs and strategies to reduce emissions, ports will be able to act more sustainably. This will help ports to achieve their environmental goals which will allow them to improve their performance.

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