Reduced carbon emissions port of spain

Ports are important infrastructures for economic growth and development. They have strategic importance to a nation, acting as gateways to trade. They also constitute a key node in the global supply chain [1]. At the same time, they are very complex systems, since each port is unique in terms of activities, geography or applicable laws. Most of them are regulated by diverse levels of legislation: global, European, national and local.

In recent years, several attempts have been made to control environmental impacts in ports. "Going green" is a trend for seaports all over the world, and environmental management has become a critical issue in port operations. The advantages of environmental management are not only for customer satisfaction and corporate image but also for cost saving and environment protection [4].

One of the most important environmental impacts in ports is air pollution [5]. Emissions of exhaust gases and particles from ocean-going ships are a significant and growing contributor to the total emissions from the transportation sector. The intensity of air pollution from fuel combustion depends on the activity of the ship. If the ship is in the open sea, maneuvering, or in the dock, the gases emitted will vary, but they always consist of NOx, SOx, CO2 and suspended particles (PM) [6].

Climate change impacts, such as the increase in sea level and of storm frequency, will affect seaports and inland waterway infrastructures. As a consequence, due to the economic importance of the ports, their location (in many instances, in the heart of sensitive environments) and the significant existing infrastructure that links them to inland transportation networks, they need special treatment [10]. Therefore, the topic of climate change in the maritime industry is getting more important every day.

For this reason, this paper presents a review of different initiatives to reduce climate change effects in general and specifically in the maritime sector. After that, the results of a research conducted on different existing methodologies to calculate CO2 emissions in ports are presented, followed by an analysis of their strengths and opportunities for further development. Finally, some conclusions have been drawn.

Climate change is an important global issue, which has become a major focus of attention because of its potential hazards and impacts on the environment [11]. The on-going global climate change has been related to GHG emissions because of the atmospheric warming effect of these emissions [12]. The main GHGs are carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O).

In order to measure the potential contribution of human activities to climate change, an environmental indicator can be used: carbon footprint. Carbon footprint is an environmental indicator that has been developed over the last decade [13,14].

Based on the Parliamentary Office of Science and Technology [15], carbon footprint is the total amount of

CO2 and other GHG emissions which are emitted over the full life cycle of a process or product. The other GHGs are expressed as CO2 equivalent (CO2eq). The carbon dioxide equivalent of a quantity of gas is calculated by multiplying the mass of the gas (in tons), by the gas global warming potential (GWP). GWP value for CO2 is equal to 1 for a 100-year time horizon, for CH4 it is equal to 25 and for N2O it is equal to 298 [12].

Many international initiatives have been taking place for many years in order to control climate change and carbon footprint. Some of the most significant ones are summarized in Table 1 and explained in more detail after the table.

As can be seen in Table 1, in 1979, the World Meteorological Organization (WMO) sponsored the first major international meeting on climate change in Geneva. In this event, concerns about this topic were expressed and first actions discussed [16].

In 1988, the United Nations Environmental Program (UNEP) and World Meteorological Organization set up the Intergovernmental Panel on Climate Change (IPCC), to provide regular scientific assessments of the current climate change situation and assist policymakers to control it [17]. In addition, IPCC published a set of guidelines for National Greenhouse Gas Inventories in 1995. The revised versions of these guidelines were issued in 2006 and updated in 2019 [18,19].

This was followed in 1992 by the development of the United Nations Framework Convention on Climate Change (UNFCCC) in Rio de Janeiro to stabilize GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system [20].