CO2 emissions from the production of bicycles in China and Europe: a preliminary comparison

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Introduction

The estimation of greenhouse gas emissions from the production of bicycles in Europe and elsewhere worldwide, and the possible transportation of the same in Europe, is considerably complex, since it requires several cycles to assess the supply of raw materials, production of manufactured goods, and transportation of the same at the consumer.

This type of assessment can be made with the technique of LCA (Life Cycle Analysis - Life cycle analysis), which is a methodology that considers a comprehensive view of the production system, in which all the stages of transformation, from the extraction of materials first to the disposal of end of life, are included in the analysis as participating in the function for which they are designed. An approach called "from craddle to grave", which provides assessments for different categories of impact of particular relevance, such as emissions of greenhouse gases, emissions of toxic substances on human health , emissions of acidifying compounds or responsible for the production of photochemical smog.

This approach requires data specific to the different production processes, and provides some of these in the absence of the use of specific databases.

Methodology

Referring to this type of assessment for accurate and quantitative estimates of uncertainty defined margins, after you make some preliminary assessments on the following aspects

1. higher emissions of CO2 from the production of steel industry of China, compared to European production;

2. higher emissions of CO2 from the production of aluminum industry of China, compared to European production;

3. emissions from maritime transport from China to Europe.

1 - More CO2 emissions from the production of Chinese steel industry, compared to European production

At present, no complete data is available, updated and reliable information on emissions from the production of steel and aluminum in various parts of the world. On the one hand, the lack of data is linked to the absence of rigorous accountability systems of production and inventories of emissions in emerging and developing, the other impetuous growth of production in emerging countries like China , which causes an increaring level of pollution as there are vey few raw materials producers with advanced technology in parallel with the vast majority whose raw materials production means are very traditional, polluting and cost much more energy.

An analysis of average emissions from steel production in various local contexts can be derived from a paper by Hidalgo et al. (2005) Technological prospects and analyzes CO2 emissions trading in the Iron and Steel industry: A global model, available in the literature [1].

In this work are evaluated energy consumption and emissions specifications for various steel production technologies: open-hearth furnace (OPH), conventional blast furnace / basic oxygen furnace (BOF), blast furnace advanced / basic oxygen furnace (BOFA) conventional electric arc furnace (EAF), advanced electric arc furnace (EAFA), Smelting reduction process (SRP), direct reduction process (DRP) is also provided estimates of the overall mix of technologies and products in different countries, for the years 2000 , 2010, 2020 and 2030, with the corresponding values of CO2 emissions.

The data provided in Figure 2 and Figure 7 can be estimated for the year 2010, an average emission factor from the steel production of 1.1 t CO2 / t product for the European Union, against a value of 2.1 t CO2 / t product for China.

It yields a difference of emission factor of 1 kgCO2/kg steel produced.

Given a quantity of 7 kg per bike, it is estimated that more CO2 emissions from steel production in China than in Europe, amounting to 7 kgCO2/bicicletta.

2 - More CO2 emissions from aluminum production industry of China, compared to European production

For the case of aluminum, the emission was estimated considering emissions from the production of electricity needed to process, it is a very energy-intensive process, it can be assumed that differences in emissions related to production from the field the first is less important. Not having known the different processes used, nor the proportion of material produced from waste material and scrap, you have made a conservative estimate considering only differences in CO2 emissions from electricity production.

Considering an average consumption of 15.3 kWh per kg of Al [2], and considering the average emission factors from the production of electricity amounted to 745 and 351 for China gCO2/kWh gCO2 for the EU-27 [3] we obtain a difference in the issue produced for the production of 6 kg of aluminum CO2/kg aluminum.

Given a quantity of 6 kg per bike gets, it is estimated that more CO2 emissions from aluminum production in China than in Europe, amounting to 36 kgCO2/bicicletta.

3 - Emissions from maritime transport from China to Europe

Emissions from shipping were estimated by comparison between the values of emission factors, in terms of CO2 per kg "tx mi" delivered in international maritime transport, seen from different sources.

The international databases used to provide the LCA values varying between 8.8 gCO2/txkm (Ecoinvent database, the process "Operation, transoceanic freight ship") to 18 gCO2/txkm (U.S. LCI Database process, "Transport, ocean freighters, residual fuel oil powered "), including a possible return trip with a reduced load.

A review of emission factors of freight carried in the study "2010 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting: Methodology Paper for Emission Factors" [4] provides for the transport container values from 12.5 to 36 gCO2 / txkm and vary depending on the size of the ship, and considering an average load of 70%, with an average of 16 gCO2/txkm.

The European Agency for the Environment [5] considers an average value for the shipping (at shorter distance), equal to 18 gCO2/txkm.

Based on the above data, we assumed a value of 16 estimated gCO2/txkm.

It is considered a distance of about 15,840 kilometers, taking as reference the route Shanghai-Genoa

It is assumed the transport of bicycles in 60 containers of twenty feet, weighing 2.5 tons, which adds a weight of bicycles transported approximately 1 ton (17 bicycles x 60). The resulting total weight of 3.5 tons per container, equivalent to 58 kg / bicycle.

The resulting CO2 emissions from transport of a bicycle 15 kg, multiply by 2 because the empty containers are returned in 90% of cases, then we get a quantity of 30 kgs of C02 emissions into unnecessary to import a bike from China.

Summary

A preliminary estimate of the increased emissions of CO2 from the production of bicycles in China is 73 kgCO2/bicicletta, with contributions from more than 7 kg emissions for the production of steel, 36 kg higher emissions from the production of aluminum and 30 kg from transport by ship.

As an example, assuming an issue avoided by a mile by bicycle made of 150-200 g CO2 emissions that would have netted about 700-1000 km of bike use in place of the car.

The value found is considered a preliminary estimate that the average values found in the international scientific literature. A more accurate estimate can be made with a detailed study, which considers the actual production cycles and the specific mode of transport.

Bibliografia

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