STOCK IN USE IN THE URBAN MOBILITY SYSTEM. AN EXERGY APPROACH

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Around 75% of European population lives in urban and metropolitan areas[1], causing not only a size increase of cities but also a mobility demand growth. Nowadays 2,7 daily trips per person are made[2] and the consequence of this effect can be shown in the 7% increase of the passenger-kilometer indicator since last decade[3]. Moreover, 49% of urban daily trips are made using private vehicles with the negative associated impact[4.] Some of the most known problem are: Traffic jams, which costs are estimated in 80.000 M€/year[5]; GHG emissions, where urban mobility generate 23% of CO_2 emissions or traffic accidents, where urban mobility is responsible for 38% of fatal urban traffic collisions[6].

Nevertheless there is a critical impact not yet taken into account which needs to be equally assessed, namely the natural resources availability to guarantee a sustainable supply of the raw materials required to manufacture transport systems and their associated infrastructures. Indeed, only in the EU motorization rates have grown up to 11,7 %[7] from 2005 to 2013 and the vehicle average age has also increased to an average of 9,65 years[8]. These figures show the large amount of cars that will be demanded in the near future.

Besides, conventional fuel vehicles will likely soon be replaced by "eco-friendlier" ones, consuming less or even not oil at all. Accordingly, alternative fuel vehicles such as Hybrid Electric Vehicles (HEV) or Electrical Vehicles (EV) will play a key role, as corroborated by the 62,2% and 34,7% sales increase in the third quarter of 2015, respectively. Yet even if such vehicles seem to be more respectful with the environment, they contain a very important amount of critical raw materials such as rare earths that may put at risk the electrification of the vehicle sector.

In this paper a new assessment methodology based on exergy analysis to quantify the impact of different types of vehicles is presented and compared with conventional LCA approaches. The assessment methodology uses the so called exergy replacement cost (ERC) indicator to assess the criticality of the materials used. The ERC represents the useful energy that would be needed to return minerals from the most dispersed state (the bedrock) to their original conditions (of composition and concentration in the mineral deposits). Dispersing a scarce and critical mineral such as platinum or neodymium has a much higher replacement cost than that of iron for instance, and in the final accounting the first minerals have a greater weighting, even if the quantities used to manufacture vehicles are much lower.

By means of this approach the exergy contained in the stock in use of urban mobility systems is assessed. This information is very valuable for automobile manufacturers and urban planners to guarantee the future adoption of really urban mobility sustainable policies.

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[1] http://www.eea.europa.eu/themes/urban
[2] http://www.emta.com/IMG/pdf/barometer2013-150326.pdf
[3] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2011:0358:FIN:EN:PDF
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[5] SEC (2011) 358
[6] http://eur-lex.europa.eu/resource.html?uri=cellar:82155e82-67ca-11e3-a7e4-01aa75ed71a1.0011.02/DOC_3&format=PDF. Brussels 17.12.2013.
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