A Novel Weighting Method in LCIA and its Application in Chinese Policy Context

Hongtao Wang, Ping Hou, Hao Zhang and Duan Weng

Abstract Under given political environmental targets, if explicit and comprehensible conclusions could be reached via weighting method, LCA would play a much more crucial role for enforcement of environmental policies. A couple of distance-to-target weighting methods were proposed for this purpose, but the meaning of weighting was still questionable. Taking Chinese “Energy Conservation and Emission Reduction (ECER)” political targets as an example, a different distance-to-target weighting method was proposed, so-called ECER method. The method was tested by a LCA case study on comparison of three desulfuration technologies in float glass production, in which explicit and exclusive conclusions were delivered, i.e. dry process is better than wet process and semi-dry process. And, the differences between ECER and other “distance-to-target” methods were discussed.

1 Introduction

Many weighting methods have been proposed in order to deliver a single score and explicit conclusions in LCA studies, which is always desirable for decision making [1]. Among them, distance-to-target weighting methods, such as EDIP method [2] and ecological scarcity method [3], developed weighting factors according to international or national political environmental targets. Under given political environmental targets, if explicit and comprehensible conclusions could be reached via these weighting method, LCA would play a much more crucial role for enforcement of these environmental policies.

For example, EDIP method defines a weighting factor of a certain flow or impact as the ratio of its actual amount in reference year to its target amount in target year as stated in environmental policies. Ecological scarcity used the square of the ratio as the weighting factor. Then the weighting factors are multiplied by the life cycle results of a case study to produce a single score. The motto in such weighting

H. Wang (✉)
Tsinghua University, Beijing, China
Sichuan University, Chengdu, China
e-mail: wanght.scu@gmail.com

P. Hou • H. Zhang
Sichuan University, Chengdu, China

D. Weng
Tsinghua University, Beijing, China
method is "the bigger is the ratio (distance), the bigger is the weighting factor, and therefore the more important is the flow or impact category". However, the meaning of weighting in these methods seems ambiguous. Although weighting factors were derived from policy targets, the single score or the difference of the single scores of alternative options failed to show to what extent the political targets are fulfilled. And, an opposite example can be found in China. In Chinese national “Energy Conservation and Emission Reduction” policy for 11th five-year plan (2006-2010), a much more harsh target had been assigned to reduction of SO\textsubscript{2} emissions than reducing energy use (see Table 1), so a bigger weighting factor would be given to SO\textsubscript{2} than energy use according to above weighting methods. However, the SO\textsubscript{2} target was easily over fulfilled in 2010, but the energy use target was almost failed. This example shows that a bigger "distance" does not always imply it’s a harder target to be achieved and a bigger weighting factor should be assigned. The reason lies in the fact that policy-makers had thought through the improvement potentials and feasibility before they made the targets.

Taking Chinese “Energy Conservation and Emission Reduction (ECER)” political targets as the example, a different distance-to-target weighting method was proposed in section 2, so-called ECER method, to overcome the problems as above mentioned. The method was tested by a LCA case study on comparison of three desulfuration technologies in float glass production in section 3. Moreover, the differences between ECER and other “distance-to-target” methods were discussed in section 4.

2 ECER method

2.1 Transform original political targets into comparable targets

In the Chinese “Energy Conservation and Emission Reduction (ECER)” policy, quantitative national environmental goals are given as mandatory targets. In the eleventh national five-year plan (2006-2010), the targets are announced as in Table 1. However, those original targets are defined a little bit differently, so they need to be transformed into a comparable way first, i.e. in terms of “reduction rate per GDP in 5 years”, and then be used in the ECER scoring formula.

For example, the target of GHG emission reduction per GDP (gross domestic product) by 40-45% is in the period of 2006 to 2020. Assuming the reduction rate is constant then the reduction target from 2006 to 2010 would be 17%. The