

Environmental Impact and Environmental Cost Assessment of the POSCO Green building

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ABSTRACT

The purpose of this study is to assess the environmental impact and environment cost on the building materials of POSCO green building. Towards this end, LCA-based environmental impact and environmental cost assessment method was presented, and environmental impact and environmental cost of building materials used for POSCO green building were evaluated using the proposed method. The environmental impact on six environmental impact categories is as follows. Resource depletion potential (RDP), global warming potential (GWP), ozone-layer depletion potential (ODP), acidification potential (AP), eutrophication potential (EP), and photochemical ozone creation potential (POCP) were calculated to be 72,529 kg-Sb_{eq}, 26,093,933 kg-CO_{2eq}, 0.51 kg-CFC-11_{eq}, 136,599 kg-SO_{2eq}, 12,633 kg-PO₄³⁻_{eq}, and 72,492 kg-C₂H₄ respectively. The environmental cost on the POSCO green building has been estimated to be \$735,268 (AP: \$635,654, POCP: \$53,844, RDP: \$24,323, EP: \$20,419, GWP: \$1,022, and ODP: \$6.99).

KEYWORDS: Environmental Impact, Environmental Cost, Building Material, Life Cycle Assessment, Green Building

1. INTRODUCTION

The construction sector uses over 40% of the energy consumed by economic activities in the world, and has produced various environmental problems such as climate change and global warming, etc. Accordingly, the spread of green construction or green building is being promoted as a part of efforts to reduce environmental impacts in construction sector. For the spread of green buildings, it is required to present the benefits of green building clearly, in addition to the improvement of green buildings. This study attempted to present benefits on green buildings by showing environment impacts of building and the damage cost caused by the environmental impact. Accordingly, this study proposed a methodology that can assess environmental impact and environmental cost based on life cycle assessment (LCA). In addition, it is attempted to assess environmental impact and environmental cost of the building by applying the proposed method to POSCO green building. Meanwhile, it is

difficult to assess environmental impact and environmental cost during the life cycle since POSCO green building is under construction. Therefore, this study is intended to assess environmental impact and environmental cost of only the building material based on the bill of quantity.

2. METHODOLOGY

Figure 1 shows the framework for assessing environmental impact and environmental cost. The assessment process consists of four steps (step 1: calculation of energy consumption, step 2: calculation of emission of substance, step 3: environmental impact assessment, step 4: environmental cost assessment), and detailed description by each step is as follows.

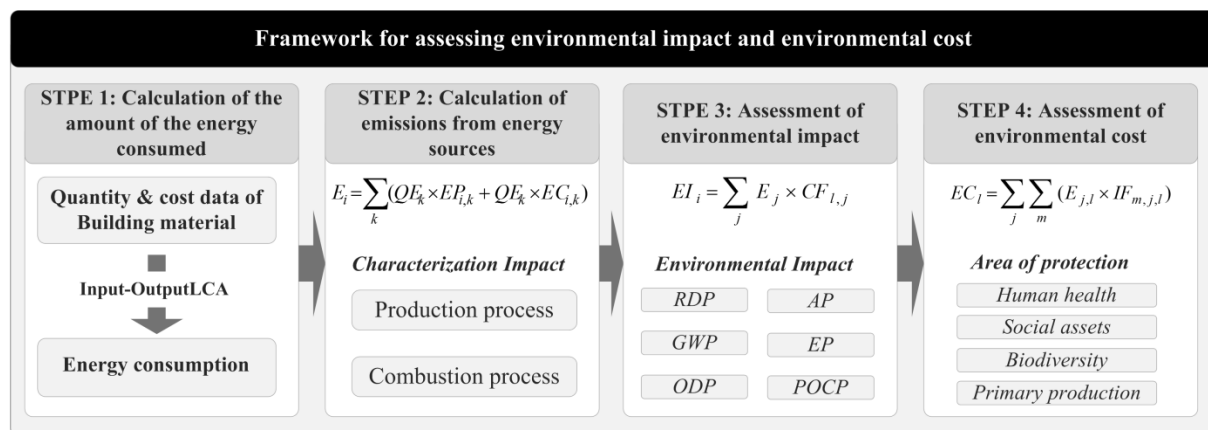


Figure 1. Framework for assessing environmental impact and environmental cost

3. ENVIRONMENTAL IMPACT AND ENVIRONMENTAL COST OF THE POSCO GREEN BUILDING

3.1 Boundary definition

As a test-bed to be constructed for the spread of green building, POSCO green building is a complex building with total floor area of 5,555.55m² in which a total of 116 green building technologies such as geothermal system, rainwater harvesting system and green roof system are applied. In this study, environmental impact and environmental cost by all building materials used in POSCO green building were assessed. Towards this end, quantity of the building materials in construction and maintenance phase was considered. The building life cycle was assumed to have been 40 years, and the quantity of building materials which are used in maintenance phase was calculated using 'Building Long Term Repair Plan and Repair Rate' provided in the Enforcement Rule for the Housing Act.

3.2 Result

Table 2 and Table 3 show environmental impact and environmental cost caused by the building materials used in POSCO green building, respectively. In Table 2, environmental impact by six impact

categories is presented. 26,093,933 kg-CO_{2eq} of GWP turned out to be relatively higher compared with the results of other impact categories. As shown in Table 3, the environmental cost caused by building materials used in POSCO green building was estimated to be \$735,268. The result of assessment was analysed to have had huge damage cost of the following, in this order: AP (\$635,654), POCP (\$53,844), RDP (\$24,323), EP (\$20,419), GWP (\$1,022), and ODP (\$6.99). In terms of environmental impact, GWP is higher than other impact categories, while GWP turned out to be rather lower than other impact categories in terms of environmental cost. Meanwhile, classification according to the area of protection found that the environmental cost occurs in the order of human health (\$342,496), social assets (\$296,746), primary production (\$96,027), and bio diversity (\$0.00006).

Table 2. Environmental impact of the POSCO green building

Classification	RDP (kg-Sb _{eq})	GWP (kg-CO _{2eq})	ODP (kg-CFC-11 _{eq})	AP (kg-SO _{2eq})	EP (kg-PO ₄ ³⁻ _{eq})	POCP (kg-C ₂ H ₄)
Environmental impact	72,529	26,093,933	0.51	136,599	12,633	72,492

Table 3. Environmental cost of the POSCO green building

Classification	RDP (\$)	GWP (\$)	ODP (\$)	AP (\$)	EP (\$)	POCP (\$)
Human health	-	474	4.97	325,910	-	16,107
Social assets	14,173	548	0.1699	246,984	20,419	14,622
Biodiversity	0.0001	-	-	-	-	-
Primary production	10,150	-	1.86	62,760	-	23,115
Total	24,323	1,022	6.99	635,654	20,419	53,844

4. CONCLUSION

In this study, environmental impact and environmental cost of POSCO green building were assessed using the method to assess environmental impact and environmental cost. Environmental impact and environmental cost were calculated respectively by impact category (RDP, GWP, ODP, AP, EP, and POCP). As a result of assessment, a total of \$735,268 was estimated as environmental cost. Analyzing by impact category, environmental cost of AP (\$635,654) was found to be highest, followed by POCP and RDP. In the case of GWP, environmental impact was derived to be highest, but environmental cost was calculated to be the second highest after ODP, which is attributed to the fact that, in KOLID, the damage cost caused by GWP is estimated to be lower than that caused by other impact categories.

Meanwhile, this study has a limitation in that environmental impact and environmental cost of transportation and on-site construction phase cannot be assessed, since POSCO green building is currently in the process of construction. Accordingly, it is required that environmental impact and environmental cost during the life cycle should be assessed by additional collection of energy consumption data in transportation phase, on-site construction phase, operation phase, and etc. after

the construction of POSCO green building is completed.

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