

Life cycle assessment for green bond certified office buildings

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1 Social background

(1)TCFD

Established by Bloomberg at the request of the G20 to consider how the Financial Stability Board will disclose climate-related information and respond to financial institutions. ESG investment, which is an investment made in environmental businesses, is being promoted.

(2)Green bond

It lends funds to environmental businesses certified by a third party at a low interest rate and issues receivables. The business to be financed is evaluated for reducing the burden on the environment by reporting by an external institution.

(3)Carbon pricing

The introduction of carbon charges is being actively considered in Japan and the United States when the national representative changes to a new representative. In Japan, the Ministry of the Environment is conducting research on carbon charges in a research project called S-14. As an example of carbon charges, \$ 125 / t-CO₂ is recommended in the United States.

2 Research background

title	Author	Source	Year	Target	Contents
Life cycle assessment of the building industry: An overview of two decades of research (1995–2018)	Majid	Energy & Buildings	2020	About 20 years of papers on LCA of buildings from 1997 to 2018.	Various types of buildings are being evaluated by LCA. From there, I couldn't find any literature that was cost-effective and led to investment.
日本におけるESG投資の現状と課題	辻本 臣哉	日本IR学会	2019	ESG investment market conditions, performance, future prospects and challenges.	Although it is expected to be effective as a monetary investment, a concrete evaluation for solving environmental problems has not been established.

- > ESG investment is currently viewed as a monetary investment, and no method has been established to measure the cost-effectiveness of environmental improvement effects.
- > In the LCA of the building, various cases have been evaluated up to the integration, but no case has shown the cost-effectiveness of the investment.

3 Purpose of research

- Using LCA, the environmental impact reduced through the green bond business is calculated per GHG emission amount and the amount of damage caused by integration.
- From the environmental impact reduction effect of the green bond business and the carbon charge, the return on investment of the business is measured, and the cost recovery rate is calculated compared to the conventional construction business.

4 Research method

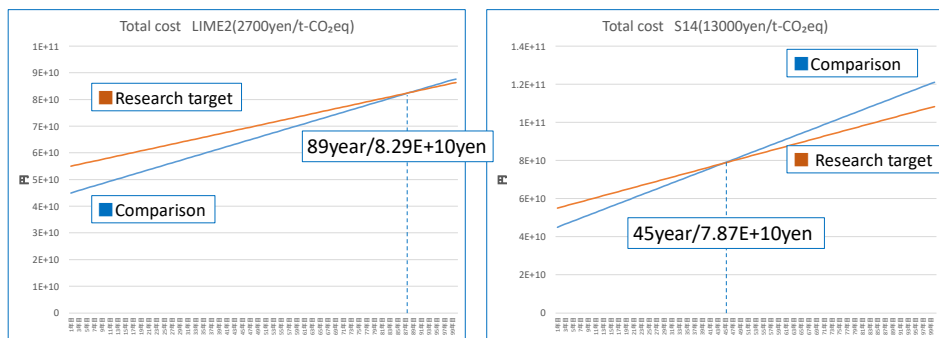
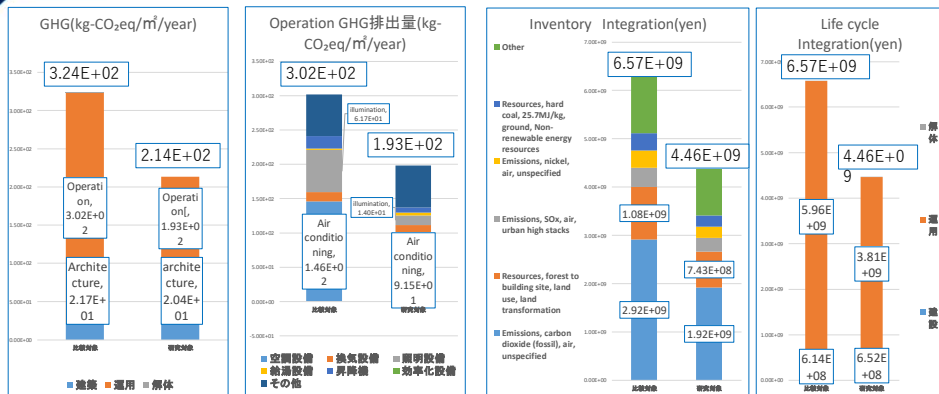
LCA method	
target	Comparison
Energy saving office building	Ordinary building scenario, Building Energy Conservation Law Standard Value, Landfill disposal amount
Functional unit	Total floor area1m ² /YEAR
Evaluation range	From the cradle to the graveyard
Data	Primary data, Ministry of Land, Infrastructure, Transport and Tourism data
Database	IDEA ver2 (SimaPro) , S-14 (Itsubo Laboratory Internal value)
Calculation formula	LCI=Σ(Amount of activity × Database) Characterization=Σ(LCI × LIME2) Integration=Σ(Characterization × LIME2)
Evaluation item	GHG, Integration
Return on investment method	
C	Comparison
Total floor area	100926m ²
Initial cost	55 billion yen / 45 billion yen
Cost	Carbon charges(LIME2, S-14), electricity charges
Carbon charges	LIME2=2700 yen/t-CO ₂ eq, Ministry of the Environment PJ(S-14)=13000 yen/t-CO ₂ eq
GHG	2.15E+04t-CO ₂ eq/year / 3.27E+04t-CO ₂ eq/year
電気料金	2.59E+08 yen/year / 3.43E+08 yen/year

Research target

Target	Energy saving office building
Development area	11491.11m ²
Total floor area	100926m ²
Floors	18 floors above ground
Use	office, Store, Parking
Business owner	Shimizu Corporation
Completion	February, 2020



5 Result



- The GHG emissions per square meter / year were 2.14E + 02kg-CO₂eq for the research target and 3.24E + 02kg-CO₂eq for the comparison target.
- The biggest impact on LC was the use of electricity at the operational stage. Among them, the reduction rate of air-conditioning equipment and lighting equipment was large due to the use of radiant air-conditioning and LED lighting.
- Carbon dioxide was the most influential environmental load in LC, followed by land use.
- In terms of return on investment, a break-even point appeared at 8.29E + 10 yen in 1989 for LIME2 (2700 yen / t-CO₂). The break-even point appeared at 7.87E + 10 yen in the 45th year with S-14 (13000 yen / t-CO₂).
- Considering that the statutory useful life of a building of the same standard is 50 years, the carbon charge of S-14 seems to be more appropriate.

6 Conclusion

- In the building construction business to which the green bond was applied, GHG emissions and the amount of damage to the environment were reduced by comparing the data assuming ordinary construction.
- Above all, it greatly contributes to the reduction of the impact by suppressing the power consumption in the operation stage.
- By applying the carbon pricing monetary data, it was found that the research target leads to cost reduction in the long term compared to the comparison target.
- By using LCA, environmental investment can represent the amount of damage caused by investment, so it is thought that it is possible to visualize investment that can further reduce the amount of damage to the environment.

7 Challenges and limitations

- LCA results may be underestimated due to lack of some data.
- In the return-on-investment analysis, the green bond allocation cost was applied as it is to the environmental measure cost, so there is a possibility of overestimation.
- Although it is desirable to use it as a quantitative index in the green bond guidelines, it does not indicate detailed requirements for the evaluation range and implementation means.
- Since similar studies have not been found at this stage, it is difficult to compare the evaluation range and the validity of the results.