Accepted Manuscript

Energy-efficiency building retrofit planning for green building compliance

Yuling Fan, Xiaohua Xia

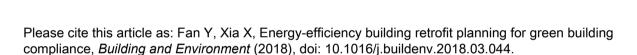
PII: S0360-1323(18)30179-3

DOI: 10.1016/j.buildenv.2018.03.044

Reference: BAE 5378

To appear in: Building and Environment

Received Date: 19 October 2017
Revised Date: 12 March 2018
Accepted Date: 26 March 2018



This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



ACCEPTED MANUSCRIPT

Energy-efficiency building retrofit planning for green building compliance

Yuling Fan*, Xiaohua Xia

Department of Electroical, Electronic and Computer Engineering, University of Pretoria, Pretoria 0002, South Africa

Abstract

To promote sustainable development and expedite the progress on moving to a green building sector, the government of South Africa has developed an energy performance certificate (EPC) standard for buildings. A building is required to obtain a certain rating from the EPC in order to comply with the country's green building policy. Therefore, finding optimal retrofit plans for existing buildings are essential given the high investments involved in the retrofit of buildings that do not currently comply with the policy. This paper presents an optimization model to help decision makers to identify the best combination of retrofit options for buildings to ensure policy compliance in the most cost-effective way. The model determines optimal retrofit plans for a whole building in a systematic manner, taking into account both the envelope components and the indoor facilities. A roof top PV system is utilized to reduce the usage of electricity produced from fossil fuels. The model breaks down the long-term investment into yearly short-term investments that are more attractive to investors. Tax incentive program available in the country is taken into account to offset the long payback period of the investment. Economic analysis is also built into the model to help decision makers to make informed decisions. The retrofit of an existing office building is taken as a case study. The results show that 761.6 MWh energy savings and an A rating from the EPC can be obtained with a payback period of 70 months, which demonstrates the effectiveness of the model developed.

Keywords: Building retrofit, energy performance certificate, green building compliance, rooftop PV system, economic analysis.

Nomenclature

- α_1 power load densities of people (W/m²)
- α_2 power load densities of lightings (W/m²)
- α_3 power load densities of appliances (W/m²)
- $\overline{C}_f(M)$ the absolute value of the cumulative cash flow at the end of the M-th month (\$)
- β_t budget allocated in year t for retrofit (\$)
- $\delta(t)$ coefficient taking the values from Table 1
- $\Delta W(t)$ difference of humidity ratio between the inside air and outdoor air in year t (kg/kg)
- η_p efficiency of the p-th solar panel alternative

 η_s average solar energy to electrical power conversion efficiency

 λ_j thermal conductivity of the *j*-th alternative of the external wall insulation materials (W/m°C)

 λ_k thermal conductivity of the k-th alternative of the roof insulation materials (W/m°C)

 ζ_a allowance rate set by the government

 ζ_t tax rate for general businesses in South Africa

 A_l^{pv} area of the *l*-th solar panel alternative (m²)

 A_p^{pv} area of one solar panel of the p-th alternative (m²)

 A_e available roof area for the PV power supply system installation (m²)

 A_{flr} areas of the floor of the building (m²)

 A_q gross area of the building (m²)

^{*}Corresponding author. Email: ylfan.up@gmail.com.

دريافت فورى ب متن كامل مقاله

ISIArticles مرجع مقالات تخصصی ایران

- ✔ امكان دانلود نسخه تمام متن مقالات انگليسي
 - ✓ امكان دانلود نسخه ترجمه شده مقالات
 - ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
 - ✓ امكان دانلود رايگان ۲ صفحه اول هر مقاله
 - ✔ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
 - ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات