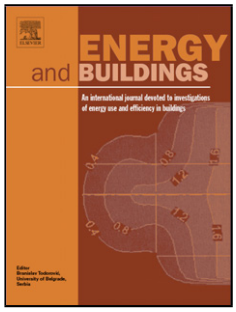

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PII: S0378-7788(17)31197-0
DOI: http://dx.doi.org/doi:10.1016/j.enbuild.2017.07.087
Reference: ENB 7827

To appear in: *ENB*

Received date: 4-4-2017
Revised date: 10-7-2017
Accepted date: 30-7-2017

Please cite this article as: Bin Huang, Ke Xing, Stephen Pullen, Carbon Assessment for Urban Precincts: Integrated Model and Case Studies, Energy and Buildingshttp://dx.doi.org/10.1016/j.enbuild.2017.07.087

Carbon Assessment for Urban Precincts: Integrated Model and Case Studies

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Abstract. The building sector is the largest contributor to global greenhouse gas (GHG) emissions. Over the years, sound tools have been developed to support the life-cycle assessment of building carbon emissions performance. However, most of these tools have been primarily focused on building-scale modelling and evaluation, leaving the emissions related to infrastructure and occupant activities as well as the carbon offsetting from implementing district-scale renewable energy systems, often neglected. The uptake of macro perspective carbon evaluations at the urban precinct level has been slow due to various barriers such as system boundary definition, quantification of complex inter-building effects, availability of comparable data, integrated modelling and uncertainties related to occupants' life styles. This research developed an integrated life-cycle model to support the precinct-scale evaluation of carbon footprint for a comprehensive understanding of the emission profile. This is expected to further support low carbon planning and (re)development of urban precincts. The model structure is underpinned by four major components at the precinct level, i.e. embodied, operational and travelling associated carbon emissions, as well as the carbon offsetting from solar energy harvesting. The utility of the proposed methodology is demonstrated through preliminary case studies on representative suburban precincts in Adelaide, South Australia. Comparative studies and scenario analysis are also involved to identify the critical elements affecting the overall carbon performance of urban precincts.

Keywords. life-cycle emissions, inter-building effects, precinct, integrated modelling, carbon offsetting.

1. Introduction

Taking up around 2.5% of the planet's landmass, cities contribute significantly to natural resource consumption and discharge considerable volumes of waste [1] and to study these phenomenon, cities and urban areas can be subdivided into precincts. Since there are many definitions of a precinct, a planning perspective is adopted where a precinct is taken to be an urban area with clearly defined geographical boundaries and a subdivision of the city with specific functional features (e.g. business, administrative, medical, residential, etc.). The (re)development and operation of objects within a precinct including different buildings and infrastructure, consume significant natural resources and produce large environmental burdens. As a significant part of such burdens, greenhouse emissions (or carbon dioxide equivalent, hereafter: carbon) associated with the use of fossil fuels and non-renewable energy in exploiting natural resources as well as consuming goods and services for socio-economic needs, are commonly accepted as the main contributor to global climate change. Statistics compiled by the International Energy Agency indicate that more than one third of global carbon emissions can be attributed, both directly and indirectly, to the construction, operation and maintenance of precinct objects [2]. In Australia, the building sector accounts for about 36% of the overall carbon balance [3]. With respect to human activities, transportation is found to be the largest contributor to global carbon