"Long Plan" - One-Family, Solar Powered house for the "Solar Decathlon China - 2018" Competion, Dezhou (China). Winning Project

Energy and Buildings
Available online 29 January 2020, 109824
In Press, Journal Pre-proof

# Optimizing the transition between design and operation of ZEBs:lessons learnt from the Solar Decathlon China 2018 SCUTxPoliTo Prototype

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Received 17 July 2019, Revised 24 January 2020, Accepted 28 January 2020, Available online 29 January 2020.



https://doi.org/10.1016/j.enbuild.2020.109824 

## Abstract

In the context of the worldwide efforts to reduce energy consumptions and carbon dioxide ($CO_2$) emissions related to the building sector, reaching the high performance of a zero energy building (ZEB) has been demonstrated to be feasible, especially when the design phase is supported by integrated simulation-based optimization methods. It is necessary to pay special attention to the transition from building design to building operation and it is hard to find examples of real ZEB buildings where the that are optimized considering design and operation at the same time. In this context, the Solar Decathlon competition is a unique experimental field to advance in research about design, simulation, and optimization of ZEBs.

This study aims at presenting the energy-related scientific aspects behind and beyond the

winner building prototype of the Solar Decathlon China 2018 competition. An optimization-based calibration supported by sensitivity analysis is carried out to calibrate the simulation model of the ZEB prototype, based on data collected throughout the design and construction phase. Then, an original simulation-based optimization method is tailored to the purpose of maximizing the contest score, considering parameters related to both design and operation of the building.

A high level of model calibration was reached, and the contest score was improved by 15 points, helping the ZEB prototype to win the competition. Results demonstrated that the applied methodological framework was able to drive towards optimized and integrated design and operation strategies.

## Keywords

Solar Decathlon; Integrated design; Simulation; Calibration; Optimization; TRNSYS; GenOpt, Matlab; Sensitivity analysis; simulation-based optimization