NP4006

TOWARDS NET-ZERO-ENERGY HIGH –RISE RESIDENTIAL BUILDINGS IN AUSTRALIA

Research Question

What is the breakdown of the Energy demand of a high-rise residential building for Australia's climatic conditions? What are the best pathways to achieving a net-zero energy building in this context?

Future work will explore the synergy in energy efficiency by coupling of a Photovoltaic-Thermal (PV-T) panel and a Heat Pump for hot water.

Answers to these questions will contribute to net-zero energy designs for high-rise residential buildings in Australia and reduce GHG emission from the building sector that consumes around 40% of final energy use (IEA, 2013).

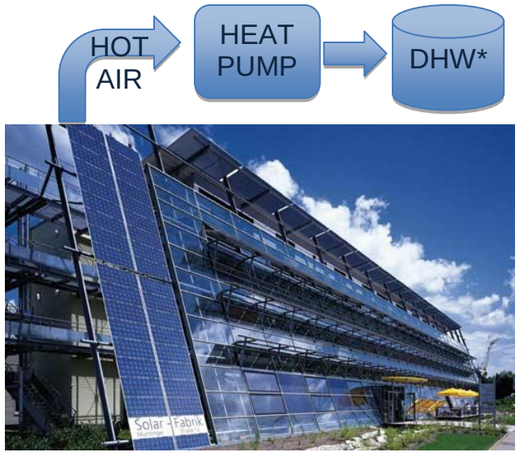

Figure 1: Building Integrated PV coupled with DHW (Auzenet, et al 2013)

- DHW = Domestic Hot Water

Methodology

Building Energy Simulation (BES) software (e.g. TRNSYS, Sefaira) is used to establish a model of the building, PV-T, and the heat pump. The system will be optimised in the simulation environment.

Smart-grid data will be used to fine tune the model. A computer model of a PV/T will be designed, coupled with Domestic Hot Water (DHW).

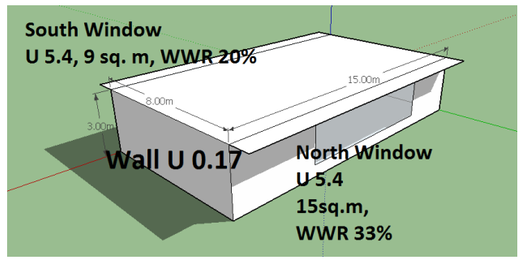

Figure 2: Base model.

Results

Sefaira simulation results of the base model after optimising shading, insulation, window size and lighting are shown below:

	Energy (kWh/m2)
Annual energy	53
Annual space cooling	12.27
Annual heating	10

Figure 3: Simulation result from Sefaira, my research targets to reduce the heating energy

Results show that by optimising the shading, summer sun may be avoided and winter sun can be let in, resulting in better thermal performance. Double glazed windows, low emissivity coating and insulation keep the summer heat out and winter heat in. Residential occupancy and lighting load (3W/m^2) were considered. Passive design techniques resulted in an energy demand as low as 53 kWh/m^2 /year.

These are initial results. The model will go through further optimisation to reflect actual energy situation and various building systems such as BIPV.

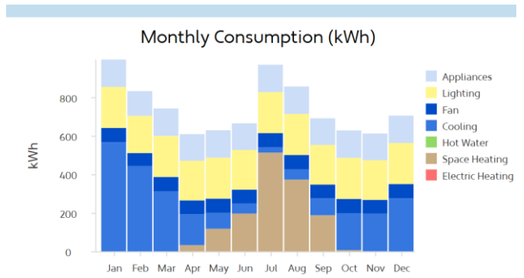

Figure 4: Simulation result from Sefaira

Currently the result of this model is transported to another model in TRNSYS in which the PV-T and Water heating are coupled together. The system will be optimised and is expected to further reduce energy demand for water heating. This model is at a very early stage.

Conclusions

Current results highlight the significant proportion of heating and cooling load of an energy-optimised residence in Sydney's climate. The next step of the research will explore building systems and quantify the amount of energy-savings achieved by strategies such as PV and coupling of PV-T and DHW.

Anticipated impacts

The system is expected to result

- higher efficiency from PV
- lower heating-demand,
- facilitate net zero energy building
- Lower energy cost for tenant
- Less emission, better environment
- Modified building regulation

This research will help CNCA cities, e.g Sydney and Melbourne, achieve NZEB high rise residential building and reduce overall GHG emission. This may also result in new energy performance benchmarks for state and commonwealth regulations for building construction (BASIX, BCA).

Further information

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Reference

Auzenet, E, Guiavarch, A, Lokhat I,, 2013 – REHVA Journal, 'Improving the energy efficiency by coupling of a heat pump and hybrid PV-T panels'.

IEA (International Energy Agency), (2013) *World Energy Outlook 2013.* Transition to sustainable buildings OECD/IEA Paris