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## Editorial

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The need for buildings and infrastructure to be more energy efficient and low carbon is widely accepted. Governments in the UK, Europe and beyond now have incentives, grants and legislation in place intended to foster energy efficient and low carbon development. Progress has, however, been slow up to now, particularly in the UK. Why is this and what can engineers do to improve the situation?

The creation of low energy/low carbon buildings depends on building designers—engineers and architects—developing designs that are cost effective both to build and to operate. This may require a radical rethink of building form to integrate low energy technologies into the building fabric, in addition to the inclusion of proven means of reducing energy consumption.

The technologies available include the relatively simple and proven ones, such as ground source heat pumps (GSHPs), as well as the developing ones such as photovoltaic (PV) systems. The way forward for GSHP systems could be to integrate the in-ground pipe-work into foundation design. PV systems may make a useful and economic contribution to building energy supply if integrated into the design of the building envelope.

The papers in this special issue of *Energy* address both the theory of life cycle energy assessment as well as the practical engineering and cost issues, and also some of the barriers to construction of low carbon, energy efficient buildings. It includes some case studies in the implementation of the various technologies.

The briefing by Jason Gardner describes the design of a carbon neutral building completed at the University of Sheffield. This building uses a combination of GSHPs to provide all the heating and cooling for the building and wind turbines to provide electrical power, including that to drive the heat pumps. The site is relatively exposed, thus making wind power economical. Monitoring of the energy performance of the building is now in progress.

The paper by Neal Prescott addresses the practical issues of creating low energy buildings through attention to construction details. The key issue of energy saving should always be the first priority in any design. Design standards have become much more stringent but the actual

implementation in construction remains a significant impediment to achievement of low energy buildings. Prescott addresses two key aspects of construction: insulation and air tightness.

Olivier Boënnec describes the technology options for the use of GSHPs. These are horizontal ground loops, typically installed under car parks or sports fields, and vertical loops installed in boreholes, more appropriate for city centre sites. An application of particular interest to civil engineers is the installation of the loops in building support piles. Boënnec describes a recent project in which test piles were monitored to study the effect on the structural performance of the piles of the heating and cooling cycles.

Katy Deacon describes the development of a toolkit to assist building designers in assessing the potential for and the economics of various technologies. The paper describes the stages of a project addressed by the toolkit—energy demand, technology options, capital and life cycle costs. Also, an example of the use of the toolkit for design of a school building is outlined. This example shows GSHPs, biomass and PV as the viable options for this particular building.

The paper by Stephen Allen *et al.* presents the results of an integrated appraisal of micro-generators for domestic properties. A rigorous approach is adopted to life cycle appraisal (LCA), explaining the theory of LCA of energy use and carbon accounting. The paper reports on a comparison of micro-wind, PV and solar thermal in various UK urban locations. It concludes that none are commercially viable in today's UK market but this could change, of course, with increasing energy prices. Micro-wind is found to be unattractive in urban areas due to low wind speeds.

The paper by Geoffrey Hammond and Craig Jones describes the development of an inventory of embodied energy and carbon in construction materials. The methodology is described and a shortened version of the inventory is included. The importance of understanding the basis of embodied energy figures is explained and the reasons for the wide variation in quoted values for some common materials are discussed.

In addition to the papers included in this special issue, readers may wish to refer to papers published in earlier issues of *Energy*.<sup>1,2</sup>

## REFERENCES

1. BAHAJ A. S., JAMES P. A. B. and JENTSCH M. F. Photovoltaics: added value of architectural integration. *Proceedings of the Institution of Civil Engineers, Energy*, 2007, 160, No. 2, 59–69.
2. KING D. Innovate Green Office: a new standard for sustainable buildings. *Proceedings of the Institution of Civil Engineers, Energy*, 2007, 160, No. 3, 105–111.