

Editorial

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The four papers in this issue of *Engineering Sustainability* present different snapshots into the role of engineering in creating a sustainable future, including retrofitting what we already have or building with less. The first two papers focus on retrofitting to reduce carbon dioxide emissions; the former in wastewater treatment and the latter in housing. The last two papers focus on planning and carbon dioxide accounting. The papers look wider than purely technical solutions to better plan and set targets for a sustainable built environment, by reducing surface water run-off and carbon dioxide emissions respectively.

The first paper by Byrns *et al.* (2013) responds to the challenge set by new standards for the UK water industry which have led to around an 8% increase in energy use in 2 years, and over half of whose carbon dioxide emissions are in wastewater treatment (WWT). This paper focuses on how this can be partially addressed by improving the anaerobic digestion (AD) process used in two thirds of WWT, as well as for treating food waste and in food process industries.

The paper investigates AD's potential future: a technology that already produces between four and five times less carbon dioxide emissions than either aerobic digestion (composting) or incineration of sewage sludge. As its carbon dioxide is concentrated and uncontaminated it is also easier to capture and reuse. This future might see algal biomass production co-located onto sewage treatment plants or methane production 'turbo-charged' by pumping back carbon dioxide to encourage micro-organism growth. While still at the demonstration stage, the former is noted as being able to increase power output by 18% and cut carbon dioxide emissions by 70%. Together this would be a factor-four reduction in CO₂/kWh. It sounds like the future of energy from waste will be small, retrofitted and biologically advanced.

The second paper by McGrath *et al.* (2013) summarises new work evaluating the effectiveness of a different retrofit: comparing the actual performance of a 'low-carbon' new build with a house refurbished to Passivhaus standards. Although the retrofit was to a higher standard and the end-use benefits might have been over-estimated (conflating the carbon dioxide benefits of reuse with material recycling) the greater benefits of the retrofit still stood out.

However, I found myself questioning the conclusions which suggest that retrofit is equally good as new build – or does Figure 8 show a payback in half the time? Would in-use impacts still 'far outweigh' construction impacts if these reduced towards zero over the timescale required by our climate targets or if a zero-carbon new build had been considered? And should 'pay-back' of new build be measured against our current housing performance?

While embodied carbon dioxide of retrofit reduces in-use emissions, new-build homes only really pay back a carbon dioxide benefit if in-use renewable energy generation also offsets the embodied carbon dioxide of construction, such as proposed by Zedfactory (www.ecobuild.co.uk/visit/2013-highlights/zedlife.html). The paper by McGrath *et al.* could be seen to challenge Boardman *et al.* (2005) and Hammond and Jones (2008) who proposed rebuild rather than retrofit for our worst performing houses. I urge you to read this paper and see what conclusions you draw from an interesting piece of research.

Next, Hubert *et al.* (2013) also compare two case study alternatives – in this case assessing the benefits of sustainable urban drainage systems (Suds). Although Planning Policy Statement 25 (DCLG, 2006) has now been replaced by the new National Planning Policy Framework (DCLG, 2012) this work is still timely as more developments are proceeding on greenfield sites now the priority to build on brownfield has been removed. I was interested to read how Suds reduced both capital cost but also parking in the case study. This relates to the One Planet Living framework (BioRegional, 2013), where achieving best practice in one area of sustainability often challenges how we consider others. This made me reflect on the interplay between improved buildings and behaviour change needed to deliver the benefits in the second paper above. Finally, I was left reflecting on the scope to use Suds to retrofit our existing built environment, especially where high surface water flows often block existing drainage systems.

The final paper by Sampson *et al.* (2013) analyses the overall carbon dioxide impact of reusing brownfield land, showing that soil washing can be a lower carbon dioxide solution. The whole-life carbon dioxide approach taken extended the life-cycle assessment boundaries to include all supply chain emissions, which PAS 2050 (BSI, 2008) notes are often not included. It also

quantifies the embodied carbon dioxide of a construction plant for the first time and shows how considering such upstream emissions, including the embodied carbon dioxide in fuel, increased the construction's total 'carbon footprint' by 70%.

Applying this approach to the construction's overall carbon footprint would increase it far beyond the ballpark of 10% of all UK emissions estimated by the UK government (Morrell, 2010). This would allow the full carbon dioxide impact to be considered in construction decision-making – including that embodied in plant for transport and on-site activities, and in equipment used to produce construction products.

These papers challenged me to reflect both on the scale of construction's carbon dioxide impact and how some of the best ways of reducing it require a shift of focus towards retrofitting existing solutions and buildings, or building with less. The first three papers' examination of AD, home retrofit and Suds, together with the whole-life analysis in the last paper, go beyond tweaking designs towards sustainability to propose new approaches that respond to the scale of the climate challenge set out by the Climate Change Act 2008 (2008) and others. The editorial panel welcome any comments you have on this (or other) issues of *Engineering Sustainability*. In the meantime, happy reading!

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