Editorial

Dermot Roddy CEng, FIET

Director, Sir Joseph Swan Centre, Newcastle University, Newcastle upon Tyne, UK

‘What is the best answer? It all depends on what you want to be best at. The pages of energy publications are full of claims that someone has found the best way of solving the world’s energy problems. For some, it is all about providing the cheapest energy to the world’s most prosperous countries; for others, the emphasis is on national energy security, rather than cost; and for others still, it about the most affordable way of providing energy to the world’s poor. Many people are driven by tackling climate change and are looking for the lowest-carbon solution, while those with the related, but different, agenda of conserving the earth’s resources will say renewables are ‘best’. The discipline of optimisation theory says that you have to start by defining the objective function to be optimised and the constraints that you are prepared to accept. This issue of *Energy* comes at the question in three different ways.

Holden and Twinn (2011) address the question of how best to achieve a zero-carbon home. Their Lighthouse building is, of course, an exhibition house, not a maritime construction! They set out to design a two-bedroom detached house which supplies as much energy annually from renewable sources as it uses. They constrain themselves further by setting out to achieve that balance separately for electricity and for heat, and by accepting no off-site annual contribution to renewable energy. The photographs show how different the house is compared to a ‘normal’ design. The most striking feature of their solution is the huge reduction in space heating demand resulting from argon-filled triple glazing and very high levels of wall, roof and floor insulation – which may reflect the business interests of the client company (Kingspan). On the energy supply side they have solar PV for electricity, a wood pellet boiler for winter heating and solar thermal heating for summer along with a substantial, heavily insulated heat store. Carbon embodied in construction materials is not factored into the optimisation, although it is fairly low.

The paper flags up some interesting opportunities which may be of interest to entrepreneurial readers. No-one markets a small enough automatic biomass boiler (2 kW) for such a house. A more affordable triple-glazing solution is probably feasible. There is a shortage of people with expertise in achieving air tightness and avoiding thermal bridging. They also flag up a number of issues with approaching zero-carbon homes in this way. The PV solution will not work to the required extent on houses above two storeys or on terraced housing with

over-shading. They also make a case for accepting a proportion of off-site renewable energy, which is being considered by the UK Government as they finalise the definition of ‘zero-carbon’ for all new homes from 2016 onwards. Of course, as a one-off design with an immature supply chain, the Kingspan exhibition house design would not be ‘best’ on a straight capital cost optimisation.

What is the ‘best’ way of lighting commercial and domestic buildings? Do we want maximum light energy per unit of electricity consumed? Or do we want a quality of light which renders colours faithfully as under daylight conditions? Or the most aesthetically pleasing colour? Moram (2011) points out that these questions cannot be ignored when 20% of the world’s electricity is used for lighting, the associated carbon dioxide emissions are three times higher than for world aviation and 1.6 billion people have no access yet to electric lighting. Her paper provides a clear explanation of why the current generation of ‘low energy light bulbs’ (which are compact fluorescent tubes) fall short of customer expectations. In comparisons with other lighting technologies it considers not only the light-producing element itself but also the associated colour-modifying phosphors, light direction arrangements, voltage conversion equipment and control circuitry – looking at cost, lifetime, energy consumption, heat sink requirements and compatibility with dimmer control circuitry and presence-detection systems. The paper charts the development of light emitting diode (LED) technology from the simple red LEDs of thirty years ago through to the present day. She sets some targets that need to be achieved if LED lamps are to make a large-scale market breakthrough in the next five to ten years and reduce our electricity consumption by 15%, while identifying some intriguing niche applications for the shorter term. However, the paper contains some words of warning about consumer trust and the temptation to misrepresent what the technology can already achieve with respect to, for example, device lifetime – which takes us back to the question: what is the technology ‘best’ at?

The final paper in this issue by Gerber *et al.* (2011) takes a rigorous mathematical approach to optimising the UK’s power generation system in the context of the targets that have been set for 2030. It takes as its starting point the target set by the Climate Change Committee to reduce the carbon intensity of grid electricity from 560 gCO₂/kWh today to

70 gCO₂/kWh in 2030. Clearly there are many who do not accept that starting point because their idea of ‘best’ is quite different. Nevertheless, from that starting point they go on to identify a generation mix for 2030 which achieves that figure as an annualised target. Not surprisingly, it contains a large proportion of offshore wind, onshore wind, nuclear, tidal barrage, coal with CCS and gas with CCS. It builds on work reported in previous issues of *Energy* by Gross *et al.* (2007) and Gerber *et al.* (2010) regarding the need for spinning reserve for wind. They then formulate a constrained optimisation problem for unit commitment and optimum dispatch, looking at the two most extreme weeks of the year on a half-hourly basis. It is interesting to see quantitative conclusions concerning the optimal amount of demand management and the optimal amount of wind energy curtailment required under extreme circumstances, as well as the CO₂ prices that are required in order for the 2030 targets to be hit under operational conditions. And then the proponents of electric vehicles will say that the assumed demand figures are too low and lay claim to an even ‘better’ answer.

Of course, once you have decided what you want to be best at, you still have a tricky landscape to negotiate in order to find someone to fund the work and suitable partners to work with. The briefing paper by Hardy (2011) provides an excellent summary of the remits of the various bodies that fund different aspects of energy innovation and an entry point to a very useful web-based navigation tool.

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