Sustainable engineering

Sustainability, in engineering terms, means slightly different things to different people. Brian Tinham talks to engineering leaders for some guidance and practical ideas

Paul Caddick: don't trust the hype

'Sustainability': that word is rising up the engineering agenda even faster than 'environmental' did before it. The latest development was last month's release of the Engineering Council's new guidelines on sustainability. Others, however, have included revised thinking on the use of renewables in all sorts of applications and new efficiency initiatives around several plant types – all suddenly in the name of 'sustainability'. It may be good and worthy stuff, but perversely, an issue for us, as practicing engineers, is to separate the wheat from the chaff.

None of us wants to rubbish the good intentions of those many who claim to be intent on building a better future, founded on a sustainable planet, rather than one concerned only with growth. However, questioning some of the current rush to 'greenwash' anything that moves looks like a healthy starting point. Consider, for example, micro-renewable power generation. Just a few short months ago, we were being encouraged to bolt wind turbines on to the roofs of everything from offices to industrial facilities. Now, evidence suggests that this and similar technologies are not working as efficiently as their hype suggested.

Despite claims that wind turbines can provide 30% of a house's energy needs, consultancy Encraft reveals that, on average, the reality is 3%. More embarrassingly, Encraft's research (which was funded by the British Wind Energy Association and the UK government) reveals that the worst-performing micro-renewable turbine installation's payback was a disappointing 40 years – in terms of its ability to generate 'clean' electricity, as set against the requirements of its own manufacture. Which is one of the reasons for DIY chain B&Q's withdrawal of wind turbines last February.

Engineering Council

Electrical engineering group CLM's managing director Paul Caddick uses the findings to make a case for his company's power correction techniques, which, he insists, offer far more to improve organisations' green and sustainability credentials. "Power-factor correction can immediately shave at least 11% off an otherwise-normally billed site per month," he says. His point: a power quality survey will quickly identify ways to achieve real energy savings, requiring, at most, harmonic filters, voltage regulators or power-factor correction equipment. "And it will provide indirect solutions to reduce machinery wear," he adds.

With that caveat aired, however, let's look at what's happening that does make sense. First up is EC[UK]'s new sustainability guidelines, which state that "a purely environmental approach is insufficient". EC[UK] makes the point that engineers work "in a broad context that encompasses social, ethical, environmental and economic challenges". Its six new guiding principles (see panel, left) are aimed specifically at helping us all to achieve what it terms 'sustainable development', in line with our professional obligations and in a way that "ensures

EC[UK]'s principles for engineers

1 **Contribute to building a sustainable society, present and future**
Engineers have a responsibility to maximise the value of their activity towards building a sustainable world. They should recognise potential impacts that may be global and long-lasting...

2 **Apply professional and responsible judgement and take a leadership role**
Engineering is a profession with a strong ethical dimension, with engineers having an important role in providing solutions for poverty, under-development and environmental degradation. So engineers should Identify all issues and options to the decision maker...

3 **Do more than just comply with legislation and codes**
In seeking sustainable solutions, complying with current legislation, codes and environmental protection regulations may not be sufficient. So engineers should strive to go beyond the minimum wherever possible, anticipating future legislation...

4 **Use resources efficiently and effectively**
Engineers have a stewardship role, with respect to resources, and a responsibility to society. They should adopt strategies for re-use, recycling, decommissioning and disposal...

5 **Seek multiple views to solve sustainability challenges**
The increasing complexity of sustainability challenges means that engineers working alone cannot solve all the challenges. Utilise cross-disciplinary knowledge and diverse skills...

6 **Manage risk to minimise adverse impact to people or the environment**
Engineers are routinely involved in planning and managing projects. Engineers should harness their skills to minimise damage to people or the environment from engineering processes and products...

Go to www.engc.org.uk/sustainability for full details

this goal is integrated into all engineering activity".

Note that the new guidance replaces the code of practice 'Engineers and the Environment' from 1993. Note also that EC[UK] defines the goal of sustainable development as: "To enable all people throughout the world to satisfy their basic needs and enjoy a better quality of life, without compromising quality of life for future generations."

Andrew Ramsay, EC[UK] chief executive, puts it thus: "In the past, engineers solved problems and were tasked with making things that were economically viable and commercially effective – but they were kept in the corner to do so. Today, it's vital for society that engineers feel empowered to challenge their briefs where they may affect sustainability of the enterprise or society."

Different thinking

For him, the starting point is that qualified engineers are competent and perfectly able to make considered decisions. "What we're doing, with the six principles, is centring that, so that the right decisions are made, even if they are uncomfortable. Think about emissions and the carbon intensity of fuels – there could well be a short-term economic argument for managing the status quo on plant, but the longer-term solution might be to go for a more efficient boiler or a different fuel mix," explains Ramsay.

And think about some supposed green replacements for transportation: "Electric or hydrogen-powered vehicles may sound good, but what about the infrastructure we need to create? The cost of providing energy at the wheel of an electric bus or car, in terms of sustainability, is not just its carbon footprint at power stations, compared to petrol or diesel," says Ramsway.

He also gives the example of plant maintenance – stating that EC[UK] is asking engineers to think beyond taking advantage of technologies for predictive maintenance. "We want them to lift their eyes above that and think about more sustainable replacements – in terms of the processes involved in manufacturing them, where they were made and the issues around using them."

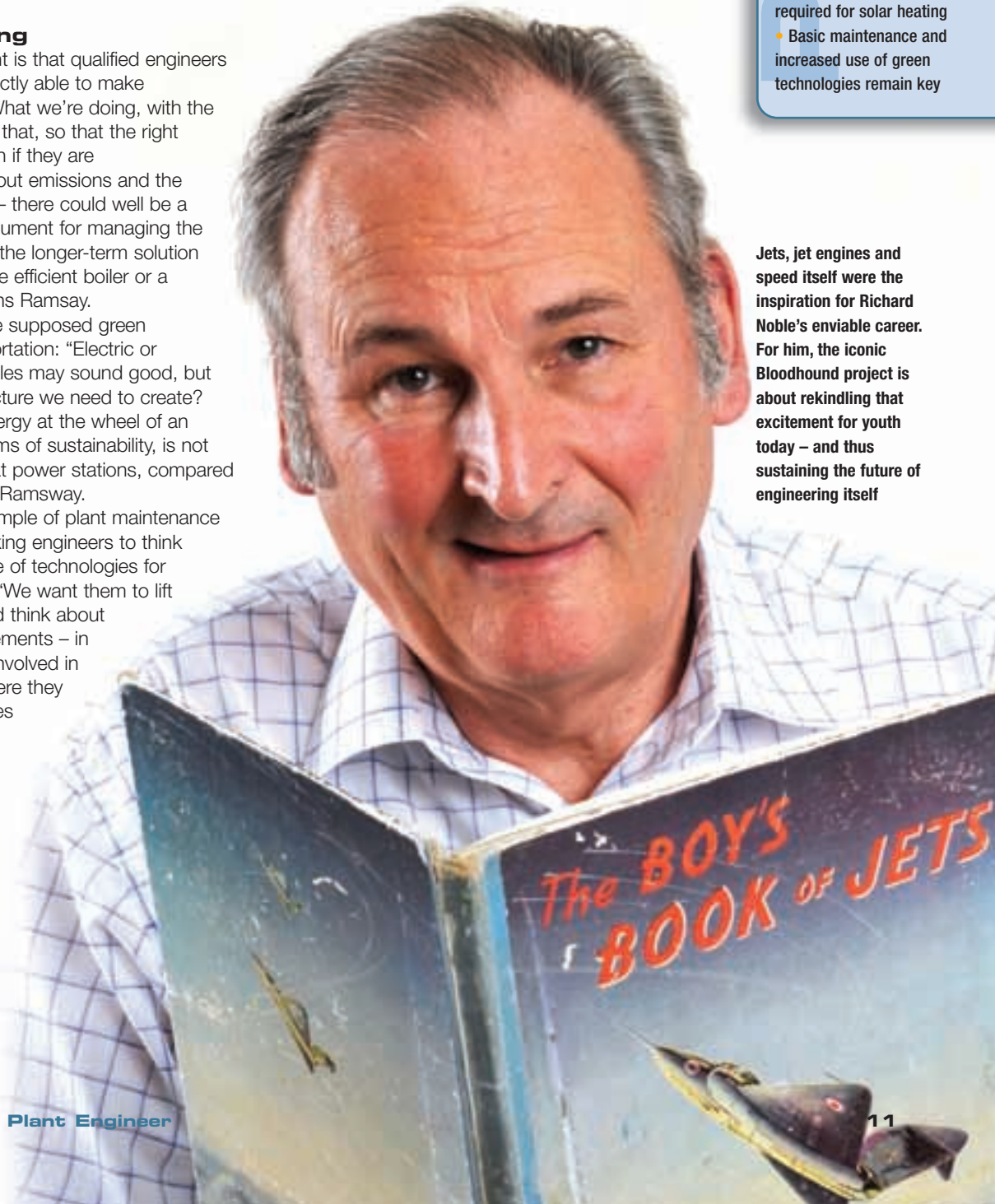
And we only have to remind ourselves of the West's appetite for components produced under licence in, say, China, and its resulting massive programme of coal-fired power station construction – hardly in the spirit of what we know as sustainable development.

Meanwhile, Richard Noble OBE – adventurer, self-taught engineer, and the man behind the Thrust SSC world land speed record holder and now the Eurofighter engine-powered 1,000mph Bloodhound – has another take on sustainability. His concern is the sustainability of engineering itself. He makes the very valid point that entire generations of engineers inspired into the profession by iconic projects such as the Vulcan, TSR2 and the moon landing (doesn't seem like 40 years ago, does it?) are retiring fast.

"Lord Mandelson makes it clear that he believes the City and its financial engine will be down for the next 20 years, and the opportunities for Britain are in engineering, research and export. So we've got to deal with the problem of recruiting large numbers of new engineers. And the way you do that is to excite

Pointers

- A purely environmental approach is insufficient, according to the EC[UK]'s new guidelines
- Plant engineers are encouraged to abide by the six new guiding principles (left)
- Engineers must feel empowered to challenge their briefs and to advise
- Sustaining engineering itself is another key issue
- 17,000 engineers will be required for solar heating
- Basic maintenance and increased use of green technologies remain key



Jets, jet engines and speed itself were the inspiration for Richard Noble's enviable career. For him, the iconic Bloodhound project is about rekindling that excitement for youth today – and thus sustaining the future of engineering itself

Practical opportunities

Sustainability is not just about reducing carbon emissions, saving energy or minimising our consumption of the world's resources – but these make a very good starting point. So, given the importance of timely maintenance in making the best of the above (assuming existing plant fits sustainability criteria or just has to stay), it's worth being aware of some useful opportunities.

Hardcat, for example, has launched the Hardcat Inspection Tool (HIT) – a bit of a misnomer, since it's an asset management system – claimed to enable low-cost preventive maintenance. What's clever is that it uses barcodes to track plant status and communicate asset information (such as when repairs are required or have been performed, or health warnings) all online. The company says training takes five minutes and could transform small plants' maintenance.

Meanwhile, don't forget variable speed drives (VSDs). Lafarge Cement's works in the Peak District (below) provides an excellent example. Two 132kW Mitsubishi variable speed drives are now being fitted to complete that site's energy efficiency programme, bringing all major axes under speed control and reducing total power consumption by an estimated 15%. The latest two are on fans used for cooling the clinker as it exits the kiln – formerly under damper control.

With motor speeds now turned down to match exact air-flow requirements, savings will be significant. Remember, air-flow is proportional to the cube root of the motors' energy usage, so 50% flow requires 12.5% power. Remember also the value of soft starts and the more recent breed of intelligent motor controls, aimed at cutting energy for motors where speed must not vary, but load does – such as on escalators and stirrers where VSDs are not ideal. Keith Wyatt, general manager at energy firm Somar, says his firm's Integra assesses motor load every half second and automatically adjusts the power. "Effectively, we're continuously resizing installed motors electronically, so they always have the supply they need – no more, no less," he explains.

Returning to Lafarge and its VSDs, site engineer Mark Bramley says: "Another big advantage of the new setup is that we can improve the accuracy of the airflow control loop. The iris damper and actuator proved problematic. Now we can connect the inverters directly to a controller to optimise the air-flow for maximising heat recovery in our clinker coolers." Lafarge's plant is now using Mitsubishi drives throughout its mill, rotary kilns, pumps, fans, conveyors, feedwater, apron feeds and all other critical axes.

Finally, we need to consider some 'back to basics' stuff. Bearings specialist NSK, for instance, points to its cost-saving programme, aimed initially at food processing plants – a so-called value-adding service that starts with a site survey and runs through problem applications, lubrication, current procedures, training and the rest, with a view to finding savings and improvements – invariably with a knock-on effect that nods towards sustainability. It's not difficult, and the company reckons that one confectionery plant is now saving £24,640 of materials and energy per annum as a direct result. Not bad.

It's much the same with compressed air. Boge general manager David Burton recommends heat recovery from compressors, where feasible, as another sustainability solution. He suggests a needs analysis, set against the average running time of the compressor(s). As for the engineering, Boge's Duotherm now offers a standard heat recovery system for oil-injected screw compressors, with heat exchangers connected directly into the oil circuit – so relatively simple to install.

Then again, Airchannel, Atlas Copco, CompAir, ErergAir and others also urge consideration of everything from ultrasonic leak detection to optimising system pressure, matching air generation more closely to demand, ensuring compressors are working at their optimum speed and efficiency, and (obviously) operating compressors only when they are needed.

Meanwhile, Spirax Sarco, GEM and others continue making the case for steam trap audits and regular assessment. Again basic stuff, but they worked for Barry Aspey, utilities manager at Heinz's Wigan factory, who reckons the site will shave more than 4% from its energy bill in the next three years. Spirax Sarco engineers survey the site every six months, highlighting any traps that need maintenance from teams at Heinz. "If the savings estimates are correct, the contract … should help us reduce our carbon emissions by 200 tonnes a year," enthuses Aspey.

Left: Andrew Ramsey, EC[UK]. Right: Paul Jackson, ETB

them when they're at school age – with a spectacular project that rekindles that interest."

They're views very much shared by the ETB (Engineering & Technology Board). Chief executive Paul Jackson says Sector Skills Council figures show a massive requirement for new engineering talent. "The UK will need 17,000 engineers for the solar heating industry alone. Some heating engineers will have to be re-skilled because, for example, of the complexity of boilers feeding energy back to the grid in micro generation projects.

"But we're also going to need tens of thousands of highly skilled, practical engineers in renewables, nuclear, transport etc, qualified to Level 3 and potentially eligible for EngTech status." And hence ETB's focus on initiatives such as the Big Bang Fair, the Young Scientist and Engineer Competition, the 'Engineers make it happen' campaign, its soon-to-be-launched Academy of Engineering projects, centred on schools – and Richard Noble.

Bloodhound will be huge

Noble concedes that Bloodhound doesn't sound like sustainable development ("It will consume a lot of engineering talent and fuel, produce substantial quantities of CO_2 and only exist for two or three years"). However, he argues two points. "First, we're trying to create maximum speed from minimum energy, so we're about developing very efficient use of vehicle-carried energy. It's a huge global lesson on engineering, linking FEA [finite element analysis], CFD [computational fluid dynamics], vehicle stability etc, and making all that available to everyone.

"Second, though, we're reaching out with the project to our youth – to follow what we're doing and be inspired. We've launched the '1K Club', which already has 1,050 schools as members, so the magic thing is it's happening. Now we need more people on the education side and more engineers to come forward as ambassadors for change. This is going to be huge. The original Thrust SSC 'Mach 1 Club' was massive: it contributed about 20% of the cost of that project. The Internet has grown 30 times since then, so Bloodhound is on track to be 30 times the scale of a Formula One team today." PE