



Penoyre & Prasad

# Retrofit for Purpose

Low Energy Renewal of Non-Domestic Buildings

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**Sunand Prasad**

February 2014

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BILL BORDASS

# ENERGY PERFORMANCE IN USE AND GOVERNMENT POLICY

## INTRODUCTION

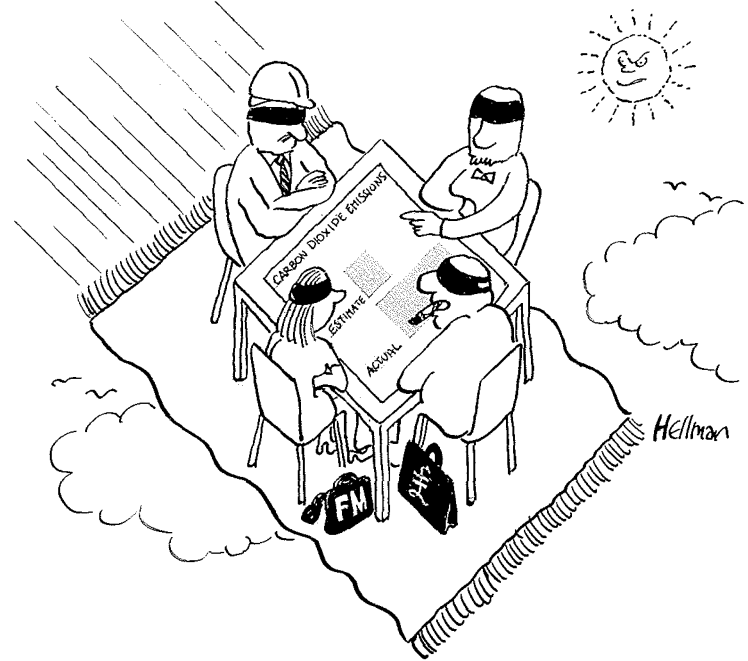
It is the use of buildings, and not the buildings themselves, that expends energy and causes greenhouse gas emissions. Yet Government policy and industry practices have consistently focused on the design and construction of buildings, not what happens once they are handed over. The story of the highly promising idea of Display Energy Certificates shows how a real opportunity to make significant cultural change was lost. The salutary lesson is that the design and construction industry must take the initiative to change practices, starting with a true understanding of how its products actually perform in operation.

## BACKGROUND

The potential for reducing energy demand in buildings is widely recognised. However, while low energy use is claimed for many new buildings, their actual performance often falls well short of design estimates. Annual electricity use can easily be twice the predicted level, while energy consumption for heating varies widely. While the general expectation of the public and the policy-makers is that new must be better, some new and refurbished buildings have higher carbon emissions than their much older predecessors. Fortunately, as the evidence builds (for example, see [www.carbonbuzz.org](http://www.carbonbuzz.org)), there is a growing realisation that these 'performance gaps' really do exist. However, the construction industry and Government are somewhat befuddled as to why and what to do, with committees now pondering matters and threatening to make things complicated and bureaucratic.

Case study evidence of performance gaps has been around for many years, including some publications by the author over ten years ago<sup>1,2</sup> (see Figure 2.1). Sadly, those with the power to change things tended to ignore the warning signals or to dismiss them as anecdotal, at least until very recently. An important reason for this blind spot is that, over the years, neither Government, nor the design professions, nor the construction industry has invested nearly enough in understanding building performance in use and developing it as a knowledge domain, as has been argued by Frank Duffy, past President of the Royal Institute of British Architects (RIBA).<sup>3,4</sup>

Policymakers tend to make the category error that building performance is largely about construction and regulation, not the result of a much wider range of influences, as buildings come into being, are occupied and evolve through time. They also tend to look to the construction industry for solutions. The thinking is reflected in the titles of Government reports and initiatives, including the Egan Report *Rethinking Construction* (1998),<sup>5</sup> the Fairclough Report *Rethinking Construction Innovation and Research* (2002)<sup>6</sup> and in the naming of the Green Construction Board (2011).<sup>7</sup>



**2.1** The cover illustration by Louis Hellman for the author's 2001 publication *Flying Blind*. This shows the designer, builder, facilities manager and owner of a recently completed building all ignoring the evidence of a big difference between estimated and actual performance, what is now known as the performance gap. (The data for the graph shown came from a building that had won a sustainability award.) The publication advocated using energy certificates to disclose actual performance and motivate action. It also expressed concern about the consequences of the fragmentation of the buildings and energy policy that had previously been concentrated in the Department of the Environment

In 1970, the UK Government established a Department of the Environment (DoE), which included the former ministries of Housing and Local Government, and Public Building and Works, so bringing together many of Government's building-related activities. In 1992, DoE also took over the Energy Efficiency Best Practice programme. For a brief period, DoE was a focal point for buildings and energy research. In 1997, things began to disintegrate, starting with the ill-considered privatisation of the Building Research Establishment (BRE), which reported to the DoE. Following the 2001 election, DoE's successor, the Department for Environment, Transport and the Regions (DETR), was further dismembered, eventually ending up as the Office of the Deputy Prime Minister (ODPM). Amongst other things, wider environmental matters went to Defra (the Department for Environment, Food and Rural Affairs), the Energy Efficiency Best Practice programme to the Carbon Trust, while DoE's responsibility for construction sponsorship shifted to the Department of Trade and Industry (DTI), today called Business, Innovation and Skills, BIS). In 2008, the Department of Energy and Climate Change (DECC) was also established. Fragmentation between so many departments has led to confused and disjointed policies about energy and buildings, with no common technical core.

In 2002, the Fairclough Report<sup>8</sup> considered the implications for construction research of the completion of BRE privatisation, with the ending of Government's five-year transitional arrangement, and the transfer of construction sponsorship from the Department of Transport, Local Government and the Regions (DTLR – the successor to DETR) to DTI. The report regarded innovation and research as largely to do with construction and, consequently, the responsibility of the construction industry, which would have to vie with other industries for Government support. That soon led to the closure of the Government's specifically buildings-related research programme, Partners in Innovation.

Meanwhile, the Fairclough Report saw building performance largely as a matter for regulation, with little wider implication or reach. It did, however, identify four roles in which it would be in the Government's interest to fund building research directly: those of regulator, sponsor, client and policymaker. This research would relate to 'issues that go wider than the construction industry': specific mention was made of climate change, energy efficiency and unforeseen circumstances.

Sadly, and in spite of all the evidence, it has been difficult for policymakers to appreciate that building performance concerns much more than construction, and to achieve joined-up Government thinking and action. A recent shaft of light has been the Technology Strategy Board's sponsorship of a programme of about 100 building performance evaluations, which are referred to in the essays by Roderic Bunn, and Rajat Gupta and Matt Gregg. This programme has a finite life, ending in 2014. To avoid a glut of unintended consequences, there needs to be a continuing flow of performance feedback information in the public interest, providing data, connections and insights to support the radical improvements to policy and practice that will be required.

## **BUILDING PROFESSIONALS AND BUILDING PERFORMANCE**

Where does this leave the building professional? To protect society's wider interests, and in return for their protected status, professionals are 'granted the privilege to think' (to use the words of a former chair of the Construction Industry Council, Keith Clarke) and have a responsibility to 'do the right thing' (to quote from the Charter of the Institution of Civil Engineers), going beyond their obligation to whoever pays their fee. The challenges of sustainability now bring professional obligations into sharp focus, with the common interest now at the global scale too. As Malcolm Bull puts it: 'climate change does not tempt us to be less moral than we might otherwise be; it invites us to be more moral than we could ever have imagined'.<sup>9</sup>

A milestone in the history of building performance was the book of the same name,<sup>10</sup> published in 1972 by the Building Performance Research Unit at the University of Strathclyde. History has shown this to have been more epitaph than manifesto. In the same year, Stage M (Feedback) was removed from RIBA's document *Architect's Appointment*, on the grounds that the service could not readily be quantified and clients were unwilling to pay for it. Sadly, this included government clients. However, at the time, government departments still had their building professionals, works departments, research units and the Building Research Establishment, and so had been doing a lot to close the feedback loop, implicitly and explicitly. In the ensuing decades, Government tended to outsource, privatise or abandon these activities, but neither industry nor the building professions put effective alternative feedback systems in place.

Without such feedback, how can building professionals know that they are doing the right thing? Frank Duffy has said: 'Plentiful data about design performance are out there, in the field ... Our shame is that we do not make anything like enough use of it'.<sup>11</sup> Because such follow-through and feedback is far from routine, even now, many people say it can't be afforded. On the contrary, we can't afford to neglect it. Without routinely following through into use and feeding back the experience, how can we test and refine our proposals? We might even end up not improving performance at all, let alone to the radical extent that policymakers have been anticipating.

Professional institutions already require their members to understand and practise sustainable development: surely this must include understanding the outcomes of their own activities? In recent years, things have at last begun to move in this direction: for example, the RIBA Plan of Work 2007 incorporated Stage L (Post practical completion); and two of the RIBA Plan of Work 2013's seven stages relate to use: Stage 6 (Handover and Close out); and Stage 7 (In Use). However, the necessary follow-through and feedback activities are not yet well defined or widely practised.

## **FIVE STEPS TOWARDS BETTER PERFORMING BUILDINGS**

### **Keep things simple and do them well**

Studies in the 1990s, including the PROBE (Post-occupancy Review Of Buildings and their Engineering) series of published post-occupancy evaluations (POEs),<sup>12</sup> revealed that unmanageable complication was the enemy of good performance. At the same time, many basic things one would hope to be able to take for granted (e.g. the thermal integrity of the fabric and the functionality of manual and automated controls) often left much to be desired. The buildings that worked really well tended to have received careful attention to detail: in design, during construction, and before and after handover. Another important ingredient of good performance was an individual (or, better still, several individuals) committed to getting a good result: process alone was no substitute for this leadership.

### **Robust, not fragile buildings**

With dedicated input, complicated buildings can also work well if sufficient effort is put into both their procurement and their management; from briefing through design and construction and on into operation. As PROBE and other POEs have found, the best-performing buildings of this type often had a dedicated client representative who had provided the necessary leadership and insight right through the process. However, as time passed, the performance of some complex buildings that had worked well when monitored in their early lives deteriorated badly; for example, when economic changes caused maintenance and management budgets to be cut, or if skills and understanding were lost when facilities management was outsourced. Better to be simpler and more robust, particularly in the case of public buildings, as more complex tends to mean more fragile. Sadly, over the past decade, buildings and the related legislative requirements have headed off in the opposite direction, becoming ever more complicated. Examples include recently constructed schools: expensive to build, expensive to occupy, and often with large performance gaps not just in terms of energy and carbon, but for occupant satisfaction as well. Theory tends to favour the more complicated

solution over the simple one, but performance in use points to the importance of making things robust, usable and manageable, and paying close attention to detail.

### **Improve the process**

The concept of completing work, handing it over and going away immediately is not fit for purpose for today's buildings. Indeed, the whole procurement process needs to be re-examined, sharpening the focus on clear outcomes from inception right through into use. At present, unfortunately, rather than being maintained and nurtured, the golden thread from design intent to reality is frequently severed as a project moves from stage to stage, sometimes with an almost complete change in players. Given such discontinuities, it is inevitable that performance gaps will open up, targets will be missed, innovations will not work as anticipated, and lessons will not be learned from unintended outcomes.

To help bind things together, the Soft Landings Framework<sup>13</sup> has been developed to allow any project, in any country, with any procurement system, to give more emphasis to outcomes. It reinforces existing processes at five critical stages:

1. inception and briefing
2. managing expectations during design and construction
3. preparation for handover
4. initial aftercare, and
5. longer term aftercare, typically for three years after handover.

The approach works best if one or more members of the project team adopt the role of Soft Landings champions, to help to maintain the focus on outcomes and to support and challenge other team members.

### **Count everything**

Designers tend not to have been very good at estimating actual energy performance in use. Indeed, many have preferred to shelter behind the argument that their calculations are to compare options, not to make predictions. The architect has too often asked the computer modeller or building services engineer: Does it meet the regulations? If the answer is yes, the design proceeds; if not, options are reviewed and changes are made – often adding complication, because this tends to make the sums work better, though not necessarily the building itself. The results of the calculations are often difficult to understand. They have also tended to focus on so-called 'regulated loads', representing the energy end-uses covered by the Building Regulations, i.e. heating, hot water, cooling, ventilation and fixed interior lighting. Moreover, the estimates tend to assume standardised conditions. The numbers for energy use may look good, but the assumptions can be questionable. Often the forecasted consumption is just the tip of the iceberg, particularly in non-domestic buildings, where the energy used by the occupier's equipment and management can easily predominate. Unfortunately, many building designers regard this as nothing to do with them. In practice, however, if the priorities are communicated clearly and early, and the likely outcomes are monitored and managed throughout the procurement process, dialogue can be highly influential. It allows occupiers to take more seriously the specification of their own equipment (e.g. computer and catering equipment); how they use and manage their building; and any support services they engage – all of which can have major effects on in-use performance. Continuing reviews and conversations as a project proceeds will also help designers to make their building and systems more capable of being controlled and managed effectively in relation to the likely patterns of use.

### **Focus on performance in use**

In 2001, in the publication *Flying Blind*,<sup>14</sup> the author argued that building performance needed to be made visible to spur people into action. If the owners and occupiers of a building were required simply to disclose the



annual energy used in operation, this would provide a non-punitive way of starting the transformation to better building energy performance in use. An opportunity came in 2003, when the EU's Energy Performance of Buildings Directive<sup>15</sup> led to the development of Display Energy Certificates (DECs) for non-domestic buildings, based on actual energy use. DECs came into force in England and Wales in October 2008, starting with public sector buildings of over 1,000 m<sup>2</sup>, but have recently been extended in a half-hearted and confusing manner;<sup>16</sup> for example, by requiring eligible commercial buildings to display their theoretical and not achieved performance. Sadly, while DECs have helped to expose the energy performance gap, they have not achieved anything like their potential as a cornerstone for energy and carbon performance improvement. An important reason, discussed below, is that policymakers have not invested in the infrastructure to support DECs properly, or to integrate them with other buildings and energy policy measures, of which there are now far too many.

## HOW NOT TO PURSUE POLICY

### – DISPLAY ENERGY CERTIFICATES (DECs)

After the PROBE project had published its first 16 reviews of the performance in use of recently completed buildings, the team obtained Government funding to review the results<sup>17</sup> and consider the next steps. One outcome was the decision to apply for EU research funding to extend the approach to Europe, with partners from Belgium, Denmark, Germany, Greece, Sweden and the Netherlands. In 2000, a bid for EuroPROSPER (EU Project for Occupant Satisfaction, Productivity and Environmental Rating) was rejected as being too ambitious. A successful resubmission was made by the project leader ESD in 2001, with the scope reduced to offices and concentrating on an operational energy rating and a much simplified assessment of occupant satisfaction.

While the resubmission was being prepared, the Energy Performance of Buildings Directive (EPBD) was progressing through the European Parliament, including proposals for building energy certificates. The revised EuroPROSPER

submission argued that the project could pave the way for building energy certificates based on actual energy use, which would in turn lead to wider interest in other aspects of in-use performance. The research was carried out in 2002–04, with Defra providing UK matching funds through the vehicle of the newly established Carbon Trust. The power and usability of the demonstration energy certification software developed for offices surprised even its originators: it could not only benchmark energy performance automatically but, from a small amount of data, provide an estimated breakdown into end uses, together with an indication of likely improvement measures, including typical costs and savings. These initial estimates could then be fine-tuned by the assessor as necessary, with the software taking care of the calculations.

When it was finally ratified at the end of 2002,<sup>18</sup> the EPBD put more stress on calculated energy ratings. The mandatory requirement to display a certificate was also restricted to public authority buildings and buildings frequently visited by the public of over 1,000 m<sup>2</sup> in usable floor area.

The EPBD's introductory Recitals stressed the great unrealised potential for energy savings, the importance of managing energy demand, the need for regular certification for public buildings, and for certificates to describe 'the actual energy performance situation to the extent possible'. However, apart from the requirement for regular inspections of boilers and air-conditioning installations, the main Articles focused on investment measures and theoretical calculations and contained relatively little on operational measures and actual energy use.

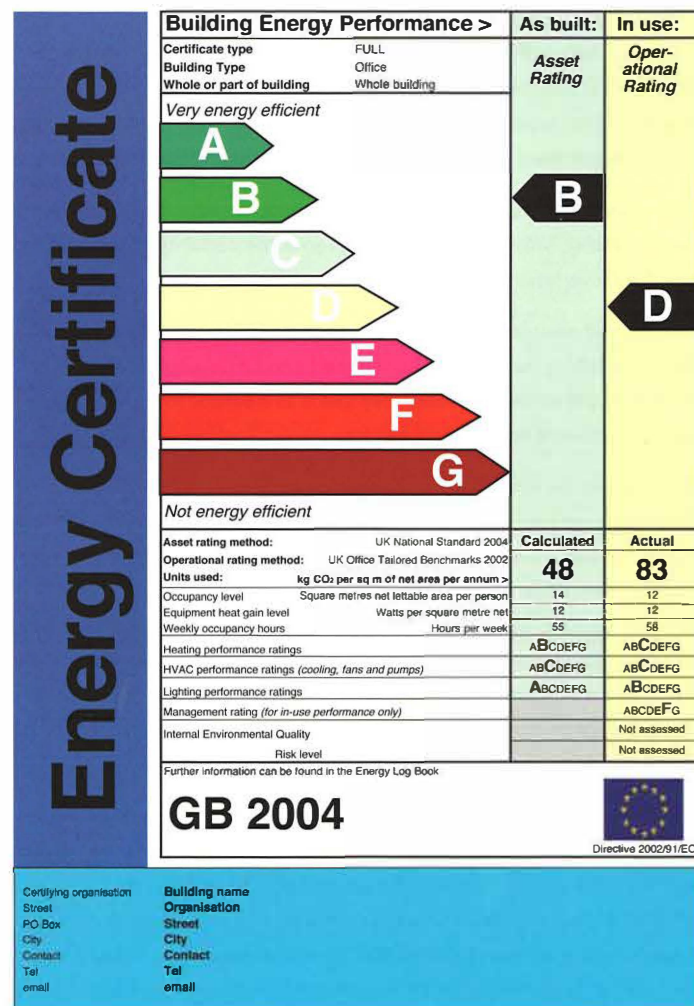
The EuroPROSPER team nevertheless argued successfully in the UK and Europe that, while Energy Performance Certificates for new and empty buildings could only be based on modelled energy performance, for public and commercial buildings in operation, certificates based on actual energy use would be more revealing and cheaper to produce. They could also help to save energy quickly and cheaply, by motivating management to make year-on-year improvements. The energy data required could potentially be

updated automatically by the utility companies, and the results aggregated into portfolio statistics at an organisational level. The EC asked CEN, the European Committee for Standardization, to develop supporting standards for the EPBD: its outputs included standards for both Asset (calculated) and Operational (measured) Ratings.

In the UK, the case for energy certificates based on Asset and/or Operational Ratings was recognised in ODPM's 2004 consultation document for England and Wales,<sup>19</sup> where the EuroPROSPER proposals were widely referenced, including the need for better benchmarks and effective integration with utility metering and billing. One disappointment for the advocates of energy use disclosure was that, while the EuroPROSPER team had proposed a single certificate that showed both Asset and/or Operational Ratings in a transparent manner (see Figure 2.2), and CEN had endorsed it as an option in its draft standard, which became BS EN 15217:2007, ODPM's consultants advised that they should be separate items. Apart from that, the prospects for developing a good Display Energy Certificate (DEC) system looked encouraging, and the approach was also endorsed in the consultation responses. However, the scheme soon ran into difficulties owing to the fragmentation of policymaking about buildings and energy, as outlined below.

The EuroPROSPER team had proposed a substantial investment in benchmarking, to extend the 'tailored' system used for offices to the other public buildings that were the initial focus of display requirements in the EPBD, especially education, health and sports. If the UK had pioneered it, the system could potentially have been adopted across the EU, and perhaps beyond. This might also have had economic benefits for the country but, disappointingly, the international dimension was of no interest to those departments and agencies that had no remit outside the UK.

ODPM said that it could not invest in developing a system and the associated benchmarks until its consultation was complete and a decision had been made on whether or not to proceed with DEC's.



2.2 Proposal by the EuroPROSPER team in 2003 for a two-column energy certificate graphic showing both Asset (calculated) and Operational (measured) energy ratings. A second page gave more technical detail

Although the Carbon Trust had taken over the benchmarking publications from the Energy Efficiency Best Practice programme, at the time it was not interested in benchmarking, also arguing that its remit was not to overlap with what the Government was doing, that certification was ODPM's responsibility and it was not the Carbon Trust's job to prepare the ground for it.

Other funders or supporters were not prepared to put money into benchmarking, unless they could be given some certainty about whether and how the Government was going to use it.

The gas and electricity regulator, Ofgem, told ODPM that to get gas and electricity billing into good shape to feed into DEC's would be an unfair burden on the utilities. Instead, they saw it as a service that individual customers should request and pay for.

With tailored benchmarking proving impossible to fund in 2004, the Usable Buildings Trust then proposed an approach that demonstrated how to get started on DEC's with rudimentary benchmark data.<sup>20</sup> This approach was then used to revise the second EU research project, EPLabel. ODPM offered financial support, starting in April 2005. Unfortunately, an election was called, and the decision had to be deferred pending a new Government. Although the same party stayed in power, the incoming Minister was sceptical about the idea of DEC's on the grounds that two types of Energy Certificate was 'gold plating' an EU Directive.

Fortunately, in June 2006, ODPM (now called CLG, Communities and Local Government, in yet another UK Government department change of name and function) decided that it did make sense to have DEC's and to support EPLabel. However, with 14 countries involved and only a few months left, a massive opportunity was lost for CLG to shape the system. It was also not prepared to adopt and adapt the system that had been developed, seeing that as anti-competitive. Instead, EPLabel helped them with performance requirements and public consultations.

Owing to all the delays, the implementation of an energy disclosure system in time to meet EU deadlines had now become urgent, with a Display Energy Certificate system to be introduced in early 2008, becoming mandatory from October. This meant that benchmarks were needed rapidly, a task assigned to the Chartered Institution of Building Services Engineers (CIBSE), but with no government budget. With the agreement of key stakeholders, simple placeholder benchmarks were developed and published in CIBSE TM46 *Energy Benchmarks*, with the expectation that, once the DEC system was in operation, the Government would provide funds to develop the benchmarks. Unfortunately, at the time of writing, five years later, no funds have been forthcoming, so the whole enterprise of improving building energy and carbon performance rests on insecure foundations.

While DEC's have helped to expose the performance gaps, their implementation has been a disappointment, for three main reasons:

1. The Government seems to regard them as a drag on economic growth, not an evolving window on real energy performance and the anchor for a whole variety of policy and other measures.
2. Despite their importance in providing clarity of communication and furthering of policy objectives, there has been no Government investment in benchmarking for a decade.
3. DEC's have not been extended to private sector buildings, in spite of strong support from influential bodies, including the Confederation of British Industry. Partly, this is because of concern about the benchmarks.

## CONCLUSION

For all the policy interest in improving building energy and carbon performance, we still lack clarity about the key objective: How is this building actually performing? We also lack a set of joined-up policy instruments that can concentrate the actions of all the players involved, from investors through to maintenance contractors, on purposeful improvement and help them to work together.

The situation has been exacerbated in the UK, because policymakers regard going beyond the letter of an EU Directive as 'gold plating' and to be avoided. This line of thinking was powerful for the previous Government, but is pathological under the present one, which has a policy to 'copy through' the clauses of a Directive into British law, without enhancement. This myopic approach creates a confusing jumble of bureaucratic requirements, instead of a well-integrated set of policy measures that can adapt themselves to accommodate new Directives. Instead of converging onto understanding and improving building energy use in operation, our policies circle hopelessly around it.

Whatever Government does, building designers need to become much more familiar with how their buildings work in use. Only then will they understand what they really need to do to improve performance outcomes. Some assistance is now available from Carbon Buzz ([www.carbonbuzz.org](http://www.carbonbuzz.org)) which has been developed with support from the Technology Strategy Board, RIBA and CIBSE. This platform allows people to deposit and share their design and in-use energy data and to identify contributors to the performance gaps. However, to make real progress, we need much more consistent and effective integration between industry and policy measures for reporting and benchmarking building energy performance.

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