Factors influencing energy performance of modern conservatories

L Bektashi-Brown and D Bond
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by L Bektashi-Brown, D Bond (TRL)

Prepared for: Project Record: Call 1-032
Innovation Voucher Knowledge Provider Panel
Client: RPS Limited
(Dave Blakeman)

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**Contents Amendment Record**

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**Executive summary**

Environmental issues such as climate change have become a major concern over the last decade as the scientific evidence has been increasingly alarming over the global warming and its impacts on the environment, society and the economy.

The UK Climate Change Act adopted in 2008 establishes a target of at least 80% reduction in greenhouse gas emissions by the year 2050 in comparison to the 1990 baseline. All sectors will need to contribute to reducing global warming, including the construction sector. RPC Limited have developed the RoofWright tool for designing conservatories and as part of the continuing development of this tool have asked TRL to examine the potential for carbon modelling to be introduced to the future versions of this programme.

TRL have undertaken a desktop review of the parameters that need to be considered when integrating carbon modelling into conservatory design. The review covered the existing relevant building regulations, research literature and existing building and construction technologies and methodologies on the subject. As a result, a range of parameters were identified to be considered for inclusion in the improved version of the company’s software. These were further organised into three groups, namely, technical parameters (those currently regulated by the existing building regulations), design features (those chosen on an individual basis), and geographical and environmental aspects (those covering, e.g. specifics of location and orientation). Based on these findings, recommendations were made for the ways to improve energy performance of conservatories through incorporating energy/carbon calculations into the conservatory design software using the identified parameters.
Abstract

Environmental issues such as climate change have become a major concern over the last decade as the scientific evidence has been increasingly alarming over the global warming and its impacts on the environment, society and the economy.

The UK Climate Change Act adopted in 2008 establishes a target of at least 80% reduction in greenhouse gas emissions by the year 2050 in comparison to the 1990 baseline. All sectors will need to contribute to reducing global warming, including the construction sector. RPC Limited have developed the RoofWright tool for designing conservatories and as part of the continuing development of this tool have asked TRL to examine the potential for carbon modelling to be introduced to the future versions of this programme.

TRL have undertaken a desktop review of the parameters that need to be considered when integrating carbon modelling into conservatory design. The review covered the existing relevant building regulations, research literature and existing building and construction technologies and methodologies on the subject. As a result, a range of parameters were identified to be considered for inclusion in the improved version of the company’s software. These were further organised into three groups, namely, technical parameters (those currently regulated by the existing building regulations), design features (those chosen on an individual basis), and geographical and environmental aspects (those covering, e.g. specifics of location and orientation). Based on these findings, recommendations were made for the ways to improve energy performance of conservatories through incorporating energy/carbon calculations into the conservatory design software.

1 Introduction

1.1 Background to the issue

Conservatories have long been a popular element of home improvement providing additional space in a home for a lower cost than a traditional house extension. However, since the issues of energy efficiency have become high on the government’s and businesses’ agenda in the 1990s, conservatories have potentially been viewed as energy liabilities. With the adoption of The UK Climate Change Act in 2008, improvement of energy performance of modern conservatories can be viewed as part of the country’s commitment to decrease its carbon emissions by at least 80% of the 1990 level, by 2050 (Climate Change Act 2008). This is all the more important that nearly 28% CO₂ emissions in the UK are the result of the energy consumed by dwellings (CLG, 2007b). From this point of view, conservatories can play an increasingly important role in the construction and building industry in light of the Government’s policy to achieve zero carbon emissions by 2016 (Department of Trade and Industry (DTI), 2007) (see Figure 1-1).
Until recently, the main concern regarding building conservatories has been heat loss through the fabric of the extension such as the windows, walls and roof. However, recent years showed closer attention being paid to the issues of heat gain and the lack of ventilation during the warm season of the year. This issue has been increasingly on the agenda as the construction industry concentrated on improving insulation methods and technology, particularly in light of climate change.

Being regarded as ‘passive’ design features, conservatories are often cooled in summer (more frequently in places such as the US) and heated in winter in order to provide residents with the desired levels of comfort (Babcock and Irving, 2003; Chappells and Shove, 2004). In light of the current climate changing trends, Orme and Palmer (2003) stressed out that too much accent placed on high levels of insulation and air-tightness of buildings carries the danger of dwellings being easily overheated in the future. While this may not necessarily be the case for the UK climate, attention should nevertheless be paid to the findings of the latest UK Climate Change Projections (Murphy et al., 2009) which suggests that, should the existing climate change trends persist, by 2080 the average summer mean temperatures would increase by 2.5°C in the Scottish islands and by 4.2°C in parts of southern England.

According to Jenkins et al. (2008),

"[i]t is very likely (>90% probability) that man-made greenhouse gas emissions caused most of the observed global average temperature rise since the mid 20th century."

As further elaborated in Adapting to Climate Change (DEFRA, 2009), if the ‘high emissions’ scenario is followed by the UK, average summer temperature could increase by 5°C, and even the ‘low emissions’ path could result in a 3°C rise in southern England. This raises the question of how could the energy performance of conservatories be improved in order to minimise (and possibly avoid in the foreseeable future) these measures without losing the quality of life. Using artificial cooling systems to cool in such cases would diminish all efforts to build carbon efficient homes therefore other ways to
solve this issue should be investigated, such as developing and using new technologies as well as natural ways of supporting the energy exchange in buildings (e.g. ventilation).

Energy performance of conservatories depends on a number of factors. Thus, a research into this issue showed that among the most influential of such factors are the way the conservatory is being used by the occupants, its heating/cooling regime, as well as issues of coupling between the conservatory and the house involving insulation and heating/cooling regime in the attached house (Babcock and Irving, 2003). Many of these factors could (and should) be taken into account at the designing stage which can result in buildings improved, becoming more energy efficient and comfortable for the occupiers.

1.2 Aim and Objectives

In fulfilling its mandate as a software provider for construction and manufacturing industries, RPS Limited is committed to helping its clients achieve best outcomes by providing more sustainable and efficient solutions through its software products. One of such products is RoofWright, a tool to help design modern conservatories on an individual basis. By expanding the range of parameters used by this application to include not only dimensional, design and quantity survey features but also those directly related to improving energy efficiency of dwellings, RPS Limited are hoping to be able to offer their clients a product that would allow them to design not only original but also highly efficient and sustainable conservatories.

The current research aims at outlining opportunities for the improvement of the energy efficiency of conservatories designed by RSP Ltd, through the introduction of new dimensions to the software application used by the company. This is achieved through the following objectives:

- Review the existing relevant building regulations, research literature and building and construction methodologies to identify the main areas in which software improvement could take place;
- Identify a range of parameters which could be introduced to the existing company software to help design more energy efficient conservatories.

1.3 Structure of the report

Following chapters describe the main components of the current research. Chapter 2 of the report describes the methodological approach used in the study, and Chapter 3 introduces and discusses the findings of the research. Finally, Chapter 4 presents the conclusions and recommendations of the research.
2 Methodology

A desktop survey was utilised in this study as the main research method. Information was collected from various sources, including current relevant building regulations, research literature and existing building and construction technologies and methodologies (see Appendix A for the list of the key sources used in the current research). These allowed for the identification of parameters that could then be fed into the company’s software to improve the design of their conservatories.

The research relied heavily on the data from construction and building companies that are already using certain parameters in designing windows and, possibly, conservatories. One of such instruments developed and applied by Pilkington North America is the Heat Gain Calculator (Pilkington North America, 2001) which provided the current research with valuable information on parameters used by the construction and building industry to solve the problem of energy performance of buildings.

During the present research a number of parameters were identified that could potentially be utilised for energy/carbon calculations in the conservatory design software. These parameters were further grouped according to their nature, namely technical parameters, design, and landscaping features. Thus, parameters used to describe, e.g. the type of glass and size and position of overhangs were regarded as technical, while the design parameters included, for instance, the shape and size of the conservatory. Finally the landscaping parameters covered such additional features as geographical orientation and planting.

In addition, a number of relevant software products were identified to provide RPS Ltd with examples of the directions and future steps in the process of improvement their conservatory design software.
3 Energy/carbon efficiency calculations potentially applicable to modern conservatories

This chapter presents the findings of the research and covers the existing building regulations, the key parameters used in carbon calculations of dwellings in the UK, as well as additional parameters applied to the energy efficiency calculations within the construction industry.

3.1 Existing building regulations and energy/carbon efficiency assessment procedures applicable to conservatories

The key legal document applicable to designing and construction of conservatories in the UK is Part L of Building Regulations, which defines conservatory as an extension which

“a. has not less than three quarters of its roof area and not less than one half of its external wall area made from translucent material; and

b. is thermally separated from the dwelling by walls, windows and doors with U-value and draught-stripping provisions at least as good as provided elsewhere in the dwelling.”

(Department for Communities and Local Government (CLG), 2008)

A number of regulations and standards apply to conservatories, the most important of which are Part L1A and Part N of the current Building Regulations (Office of the Prime Minister (ODPM), 2006a, c). A full list of relevant legislative and regulatory documents, as well as guidance and other publications can be found in Appendix A.

The way energy performance of conservatories is assessed depends on their floor area as well as certain design features of the dwellings they are attached to (see Box 3-1).

Box 3-1 General guidance on including conservatories in performance assessments of dwellings

Conservatories and substantially glazed spaces

3.32 If a conservatory is built as part of the new dwelling, then the performance of the dwelling should be assessed as if the conservatory were not there. The guidance in Approved Document L1B should be followed in respect of the construction of the conservatory itself. This means that the thermal separation between dwelling and conservatory must be constructed to a standard comparable to the rest of the external envelope of the dwelling. Note that conservatories with a floor area not exceeding 30m² and built at ground level are currently exempt from the Building Regulations, except the glazing requirements of Part N, and the requirements of Part P if the electricity used in the conservatory is obtained from the same source as, or from inside, a dwelling.

3.33 If any substantially glazed space forms an integral part of the dwelling (i.e. there is no thermal separation and by definition the space is therefore not a conservatory), then the space should be included as part of the new dwelling when checking against the five compliance criteria.

(CLG, 2008)
While it could be the case that a large proportion of modern conservatories (attached to dwellings) would not require energy performance assessment under Part L of Building Regulations, for the purpose of improving the energy efficiency of modern conservatories, such assessment could still be carried out using the existing calculation methods commonly applied to dwellings. These methods are explained in detail in the Standard Assessment Procedure (SAP) adopted by the UK Government as the national methodology for calculating the energy performance of dwellings (Department for Environment, Food and Rural Affairs (DEFRA), 2008). The calculations are based on the energy balance and take into account various factors that influence energy efficiency, such as energy consumption per unit floor area, energy costs of space and water heating, ventilation and lightning, types of materials used in construction, and insulation. The calculations are set out as a number of sequential entries in the form of a worksheet, leading to the overall energy efficiency (i.e. energy consumption and production rates, kWh/year) being calculated for the given dwelling. Based on these, the Dwelling CO₂ Emission Rate value for each dwelling in question is calculated using the relevant pre-calculated CO₂ factors for each type of energy consumed or produced by the dwelling. Some of the most relevant of these calculations are listed in Table 3-1 below.

Table 3-1 Standard Assessment Procedure (SAP) calculations potentially applicable to modern conservatories

<table>
<thead>
<tr>
<th>Title and reference of SAP</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix L Energy for Lighting</td>
<td>Takes into account fixed low-energy outlets as well as daylighting</td>
</tr>
<tr>
<td>Appendix P Assessment of internal temperature in summer</td>
<td>Provides a method for assessing the propensity of a house to have high internal temperature in hot weather. Covers, among others, solar shading and overhangs.</td>
</tr>
<tr>
<td>Appendix R Reference values</td>
<td>Provides a set of reference values for the parameters used in SAP calculations to establish a target CO₂ emissions rate when demonstrating compliance with regulations for new dwellings</td>
</tr>
<tr>
<td>Appendix S/S5.4 U-values of floors next to the ground</td>
<td>Allows for floor U-value calculations for, among others, conservatories.</td>
</tr>
<tr>
<td>Appendix S/S5 Conservatory</td>
<td>Explains how conservatories are treated in the calculations.</td>
</tr>
<tr>
<td>Appendix S/S5.4 Windows and doors</td>
<td>Introduces U- and g-values of windows and U-values of doors, including those for conservatories (when applicable).</td>
</tr>
<tr>
<td>Table 5 Lighting, appliances, cooking and metabolic gains</td>
<td>Calculation of gains based on the total floor area (TFA)</td>
</tr>
<tr>
<td>Table 6a Solar flux (W/m²)</td>
<td>Solar Flux is the amount of energy obtained from sunlight</td>
</tr>
<tr>
<td>Table 6b Transmittance factors for glazing</td>
<td>Transmission of light from outside to inside often a percentage.</td>
</tr>
<tr>
<td>Table 6c Frame factors for windows and doors</td>
<td>Proportion of frames to glazing.</td>
</tr>
<tr>
<td>Table 6d Solar and light access factors</td>
<td>Used if the element can be shaded by buildings or trees etc</td>
</tr>
<tr>
<td>Table 6e Default U-values (W/m²K) for windows, doors and roof windows</td>
<td>Used to show overall performance of an element the lower the figure the less energy is lost.</td>
</tr>
<tr>
<td>Table 12a CO₂ emissions for individual heating systems (including micro-CHP) and community heating without CHP</td>
<td>Explains calculations for CO₂ emissions from various heating systems, which could be used to calculate heating-related emissions of conservatories</td>
</tr>
</tbody>
</table>

3.2 Carbon Efficiency Calculation Parameters

The issue of energy flow (or, in other words, heat loss and gain) between any conservatory, the dwelling it is attached to, and the surrounding environment is complicated and depends on a number of factors. Diagram in Figure 3-1 below provides some basic information on the heat flows in and out of a conservatory (the diagram uses the lean-to style of conservatories as an example).

![Diagram of energy interactions between conservatory, dwelling, and environment]

**Figure 3-1 Representation of Table 3.2 of energy interactions between conservatory, dwelling and the environment.**

Source: Developed by TRL based on the parameters identified in the course of the project (see subsequent sections)

The diagram allows for some key parameters to be specified and further used to inform the conservatory design process of the energy saving opportunities of the final product. Such parameters are listed in Table 3-2 which is based on Standard International units of Energy transfer and dimensions.
### Table 3-2 Parameters to be considered in carbon efficiency calculations for conservatories

<table>
<thead>
<tr>
<th>Type of Element</th>
<th>Potential design units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conservatory fabric (Heat Loss)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Thermal Resistances of the Fabric</strong></td>
<td></td>
</tr>
<tr>
<td>Glazing</td>
<td>Thermal Conductivity ((k) \ \text{W/(m·K)})</td>
</tr>
<tr>
<td>Frames (glazing bars)</td>
<td>Thermal Resistance ((R) \ \text{R} = l/ k (= \text{thickness of material in meters}))</td>
</tr>
<tr>
<td>Frames (roof)</td>
<td>U Value ((\text{W/m² K}))</td>
</tr>
<tr>
<td>Walls (i.e. brick/block with cavity and insulation)</td>
<td></td>
</tr>
<tr>
<td>Doors (to house / to garden)</td>
<td></td>
</tr>
<tr>
<td>Floor (heat loss from the perimeter of the floor)</td>
<td></td>
</tr>
<tr>
<td><strong>Surface Areas and Volumes</strong></td>
<td></td>
</tr>
<tr>
<td>Surface area of individual conservatory fabric elements</td>
<td>Square Meters (\text{m}^2)</td>
</tr>
<tr>
<td>Volume of enclosed space</td>
<td>Cubic Meters (\text{m}^3)</td>
</tr>
<tr>
<td>(Source: SI units)</td>
<td></td>
</tr>
<tr>
<td><strong>Design Temperatures</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature outside (i.e. average temperatures winter, Summer/Spring Autumn)</td>
<td>Degrees °C or Degrees Kelvin °K (degrees Kelvin better for calculation as there are no negative numbers to contend with). (Source: SI units)</td>
</tr>
<tr>
<td>Design temperature of conservatory (dependent on activities to be undertaken in conservatory)</td>
<td></td>
</tr>
<tr>
<td>Design temperature of house (i.e. may gain free heat from house or lose heat to house)</td>
<td></td>
</tr>
<tr>
<td><strong>Solar Gain</strong></td>
<td></td>
</tr>
<tr>
<td>Latitude (how close to equator)</td>
<td>Solar Irradiance at the Earth (Solar Constant)=1,367.6 (\text{W/m}^2)</td>
</tr>
<tr>
<td>Orientation and angle of glazing</td>
<td>(Source: Wolfram Alpha Search Engine)</td>
</tr>
<tr>
<td>Resistance of glazing or other materials to solar gain</td>
<td>i.e. Manchester 53 Degrees, 28 minutes, 30 seconds North (N53° 28’ 30’’))</td>
</tr>
<tr>
<td>Availability of shading via blinds etc.</td>
<td>Solar resistance %</td>
</tr>
<tr>
<td>Availability of natural ventilation/mechanical ventilation/ Air conditioning</td>
<td>Solar shading %</td>
</tr>
<tr>
<td>Total energy balance (Heat loss + Heat gain To maintain design temperature)</td>
<td>Total Heat loss kWh + total Heat Gain kWh</td>
</tr>
<tr>
<td><strong>Carbon Dioxide / Carbon Calculation</strong></td>
<td></td>
</tr>
<tr>
<td>Type of Element</td>
<td>Potential design units</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Heating or Cooling Energy Source</td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td>Electricity Grid 0.537 kg/CO₂ per kWh Green Tariff = (as for Electricity Grid unless Renewable Obligation Certificates (ROCs) and Levy Exemption Certificates (LECs) are not sold on by supplier to a third party then can be 0.)</td>
</tr>
<tr>
<td>Electricity Green Tariff</td>
<td>Gas 0.185 kg/CO₂ per kWh</td>
</tr>
<tr>
<td>Gas</td>
<td>Fuel Oil 0.267 kg/CO₂ per kWh</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>LPG 0.214 kg/CO₂ per kWh</td>
</tr>
<tr>
<td>LPG</td>
<td>Wood Pellets 0.025 kg/CO₂ per kWh</td>
</tr>
<tr>
<td>Wood Pellets</td>
<td>Unit of Carbon Dioxide CO₂ /44 x 12 = the Carbon Equivalent</td>
</tr>
<tr>
<td>Conversion from Carbon Dioxide to Carbon</td>
<td>(Source: Energy and Carbon Conversions, 2008 Update, Carbon Trust)</td>
</tr>
</tbody>
</table>

Findings of the present survey into energy performance of conservatories, supported by the existing Building Regulations, a number of research publications, and technical information applied in practice by leading construction companies world-wide (technical, design and landscaping elements that could be potentially introduced to the conservatory design software are highlighted in bold) are presented below. These findings describe in detail a number of parameters which could be taken into account in designing more energy efficient conservatories. The parameters are grouped into three categories, namely technical, design and landscaping parameters, and covered under the respective sub-sections below.

3.2.1 **Technical aspects/parameters:**

This group of parameters covers specifications currently dealt with under the UIK building regulations.

- **Coated and tinted glass.** Using such technical aspects as *coated glass products* reflecting solar heat, and *tinted glass* which absorbs heat energy, can also help regulate heat flow in and out of conservatories (see Table 3-3 below).
### Table 3-3 Solar Radiant Heat properties of Pilkington Insulight™ (with 6mm Pilkington K Glass™ inner pane and 16mm airspace - unless indicated)

<table>
<thead>
<tr>
<th>Solar Radiant Heat Shading Coefficient</th>
<th>Direct Transmittance</th>
<th>Reflectance</th>
<th>Absorptance</th>
<th>Total Transmittance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6mm</td>
<td>0.69</td>
<td>0.15</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>9mm</td>
<td>0.68</td>
<td>0.15</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>12mm</td>
<td>0.67</td>
<td>0.15</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>15mm</td>
<td>0.66</td>
<td>0.15</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>18mm</td>
<td>0.65</td>
<td>0.15</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>21mm</td>
<td>0.64</td>
<td>0.15</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>24mm</td>
<td>0.63</td>
<td>0.15</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>27mm</td>
<td>0.62</td>
<td>0.15</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>30mm</td>
<td>0.61</td>
<td>0.15</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Based on: Pilkington North America, 2009

With 13mm airspace and 4mm Pilkington K Glass™ inner pane.
• **Building specifications for glass.** There are various glass types currently in use in the building and construction industry. These glass types differ in a number of parameters, such as **thickness of the glass**, **U-value**\(^1\) for the summer and winter months, exterior and interior reflectance, and **light transmittance**\(^2\), as well as **solar heat gain coefficient (solar resistance)**\(^3\). The colour of the tint can also affect the overall energy performance of the conservatory as it often affects the energy performance of fenestration areas (see Table 3-4).

<table>
<thead>
<tr>
<th>Glass Type</th>
<th>Colour</th>
<th>Cool In Summer</th>
<th>Warm in Winter</th>
<th>Permanent Self Clean</th>
<th>U Value W/m²K</th>
<th>Solar Resistance</th>
<th>Light Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfect Day Super</td>
<td>Blue</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>1.2</td>
<td>63%</td>
<td>51%</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1.2</td>
<td>63%</td>
<td>51%</td>
</tr>
<tr>
<td>Perfect Day Thermal</td>
<td>Blue</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1.2</td>
<td>59%</td>
<td>56%</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>1.1</td>
<td>53%</td>
<td>58%</td>
</tr>
<tr>
<td>Perfect Day Clean</td>
<td>Blue</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>2.6</td>
<td>55%</td>
<td>53%</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>2.8</td>
<td>55%</td>
<td>53%</td>
</tr>
</tbody>
</table>

Source: Eurocell, 2008

- **Glass unit filling.** Filling the window packet, as well as the roof sheets, with either **air or argon** also affects the parameters covered in Table 3-4.

- **Glass unit insulation.** Upgrading units to include **Warm Edge Spacer Bar** can also help improve the thermal performance of the unit and, subsequently, of the conservatory itself (Eurocell, 2008).

- **Insulation between the conservatory and the adjacent building.** In the conditions of the UK climate, insulation plays a crucial role in ensuring high energy performance of buildings. The requirements of Part of the Building Regulations include insulation between the conservatory and the building (ODPM, 2006a, b). Improved insulations can contribute to energy efficiency of conservatories, however, the options available would be limited. One of the ways to improve energy efficiency of conservatories is providing improved insulation standards through, e.g. specifying more layers or walls in the polycarbonate systems used in the roofs (the current market norm is a 3-wall system – see Babcock et al, 2003). Another way to improve insulation is to use more advanced “soft-coat low-E” glazing, which reduces solar gain but makes little additional difference to the heating energy demands (Babcock and Irving, 2003).

- **Triple glazing.** Some further reduction in heat loss can be achieved through application of triple glazing. Thus, a triple glazed (4mm panes), argon filled, low-e (\(\varepsilon = 0.1\)) window system would provide a U-Value of 1.4W/m²K as compared to 1.9W/m²K of a double glazing system (Forbes, 2007).

- **Heating arrangements.** Part of the current Building Regulations requires conservatories to be fitted with **independent temperature and on/off controls of any heating systems** to avoid negative effects on the overall energy efficiency of the adjacent dwellings (ODPM, 2006b).

---

\(^1\) U Value “is a measure of thermal efficiency; the lower the figure, the more thermally efficient” (Eurocell, 2008).

\(^2\) Light Transmittance “is a measure of the amount of light passing through the glass; the higher the figure, the more light is transmitted” (Eurocell, 2008).

\(^3\) Solar Resistance “is a measure of resistance to the energy of the sun; the higher the figure, the greater the resistance to solar heat gain” (Eurocell, 2008).
3.2.2 **Design features**

This section deals with (often optional) components of conservatories usually chosen on an individual basis.

- **Occupancy patterns.** A study carried out by Babcock and Irving (2003) applied thermal modelling to analyse energy performance of modern conservatories of two types and two sizes. The study showed that the energy flow, and subsequently energy performance of conservatories, depend on a number of factors the most important one being the intended occupancy pattern of the conservatory. Figure 3-2 shows changes in carbon emissions of a small lean-to conservatory depending on the heating pattern of the rest of the attached house.

![Figure 3-2 Heating carbon emissions for different N-facing small lean-to conservatories](image)

Source: Babcock et al, 2003

**Notes:**

- "No winter user" – no heating is ever used in the conservatory which is shut during the winter months. The adjacent house is heated by electric panels to 18°C morning and evening five days a week, and also for the rest of the day at weekends.
- "Weekend user" - the conservatory is occupied and heated by electric panels to 18°C for seven hours on each weekend day only and is closed when not in use. The house is heated as per the "no winter user" scenario.
- "Heavy user" - the conservatory is occupied and heated by electric panels to 18°C seven hours a day seven days a week and is closed when not in use. The house is heated using the "no winter user" weekend heating regime for all seven days of the week.
- "Opened user" - the conservatory is permanently open to the house and heated to by electric panels 21°C for seven hours a day. The house heating follows the "heavy user" scenario.
- "Extension" - the conservatory is replaced by a conventional "brick and block" extension of the same size and shape, heated by the house gas fired central heating system to 21°C as per the "heavy user" scenario.

- **Style and size.** The next important factor to take into account in relation to energy efficiency of conservatories is their *style and size* (see Figure 3-3 below). The study by Babcock and Irving (2003) showed that the amount of energy
needed to heat the conservatory directly depends on the size of the conservatory, while the style has little influence on it. According to the authors’ findings, energy used to heat the conservatory to 21°C is double that of heating it to 18°C (in the latter case, a large proportion of heating is provided through solar gains) (Babcock and Irving, 2003).

Figure 3-3 Effect of style, size and heating setpoint on N-facing conservatories

- **Ventilation.** It should also be mentioned that certain styles of conservatories can produce heat traps. Thus, heat trap conditions can be easily generated when sloped glazing meets a vertical wall in lean-by conservatories. In this case, sunlight passing through the glass is first absorbed on the wall surface and then released to heat the air inside the conservatory (Pilkington North America, 2005). One of the ways to avoid such situation is to envisage a ventilation system that would prevent the hot air from accumulating.

- **Solar control features.** A number of design features could help regulate heat loss and gain. Thus, insulating blinds can be used to help build a barrier that would prevent the heat from escaping through the window glass. However, these should be applied with caution as in summer they can easily create heat trap conditions when temperature differences are larger than allowed by the technical specifications of the window glass, which may cause breakage (Pilkington North America, 2005). Interpane and internal blinds, together with external solar shading, solar control glazing, and solar control film are also successfully used in achieving and controlling shading. Table 3-5 below presents a summary of performance of different type shading systems taking into account the orientation of the windows.
Table 3-5 Summary of Performance Data for Different Shading Systems

<table>
<thead>
<tr>
<th>Shading System</th>
<th>Best for</th>
<th>Relative solar total transmittance</th>
<th>Summer</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear double glazing, no shading</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Overhang</td>
<td>S</td>
<td>0.55</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>Light shelf</td>
<td>S</td>
<td>0.51</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td>External louver: shut open</td>
<td>H</td>
<td>0.04</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>0.26</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td>Tinted glazing SEWH</td>
<td></td>
<td>0.71</td>
<td>0.68</td>
<td></td>
</tr>
<tr>
<td>Heat mirror glazing SEWH</td>
<td></td>
<td>0.66</td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td>Window film</td>
<td>SEWH</td>
<td>0.51</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>Reduce window area</td>
<td>Any</td>
<td>0.50</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>Mid-pane venetian: shut open</td>
<td>NSEW NSEW</td>
<td>0.43</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td>Fixed mid-pane louvres</td>
<td>H</td>
<td>0.37</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>Curtains</td>
<td>Any</td>
<td>0.50</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>Venetian blind: shut open</td>
<td>Any</td>
<td>0.57</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Roller blind</td>
<td>Any</td>
<td>0.43</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td>Reflective roller blind</td>
<td>Any</td>
<td>0.34</td>
<td>0.33</td>
<td></td>
</tr>
</tbody>
</table>

Window types: N=north, E=east, S=south, W=west, H=horizontal

Source: Orme and Palmer, 2003

- **Profile angle.** This parameter is used to “establish the position and dimensions of overhangs and also to determine the penetration of the sun’s rays into a room or the length of a shadow cast by an opaque object” (Pilkington North America, 2001).

### 3.2.3 Geographical and environmental factors

This section describes relevant environmental and geographical aspects of building conservatories.

- **Geographical orientation.** This aspect plays an important role in control over the amount of sunlight, and thus heat, received by the conservatory (Pilkington North America, 2001). Solar control is better maintained if windows face True South or near so. Thus, orientation (of the house and, subsequently, of the conservatory) could also play an important role in designing conservatories helping achieve better energy performance results. It is claimed that taking into account solar orientation of windows (in this case, of the conservatory) can reduce the so-called greenhouse effect in buildings (Pilkington North America, 2001).

In all climates, north- and south-facing glass can be more easily shielded and can result in less solar heat gain and less glare than can east- and west-facing glass. During site selection, preference should be given to sites that permit **elongating the building in the east-west direction** and that permit **orienting more windows to the north and south** (ASHRAE, AIA, IESNA, USGBC, and US DoE, 2006).

- **Geographical location.** In calculating energy efficiency of conservatories, special attention is often given to heat gains, particularly in the view of climate change. Greenhouse effect, i.e. heat gain by conservatories in the summer may not have been as much of an issue in the UK so far. However, global climate change trends and the experience of recent years suggest that this issue should by no means be overlooked in designing and construction of buildings, including conservatories with their ability to trap solar energy. Heat gain and loss are both
affected by a number of environmental factors many of which would be difficult to take into account in every individual case (e.g. the length of solar radiation, the intensity and angle of incidence, difference between indoor and outdoor temperatures, and velocity and direction of air flow on either side of the fenestration surfaces). One of the existing relevant methodologies applied by Pilkington is the Heat Gain Calculator which lists Solar Heat Gain Factors for various glass types at different hours of the day throughout the year as well as for various latitudes based on the definition of solar heat gain as "transmitted and absorbed solar energy" (Pilkington North America, 2001, p27).

- **Sun factors.** The effects of shading during various times of the year are identified by the means of the Sun Angle Calculator – a method developed by then Libbey-Owens-Ford Company (now Pilkington North America) and applicable to all latitudes within the United States. The Calculator takes into account such factors as the angle of the sun above the horizon, the bearing of the sun, and the angle of incidence of the sun relative to the surface under consideration. The Calculator helps, among others, regulate shading and utilise the sun as a source of supplementary heat (Pilkington North America, 2001).

  *Bearing of the Sun and true altitude* – information on these two parameters, together with the profile angle, transmitted into drawings, is used (e.g. by Pilkington North America) to design the overhang that would be capable of preventing the conservatory from overheating in summer while letting in increased amounts of sun light through the rest of the year (Pilkington North America, 2001).

- **Landscape gardening features.** Solar heat gain is most efficiently controlled on the outside of the building (ASHRAE *et al*, 2006). Overhangs are most effective for reducing solar gain from south-facing windows. However, such alternatives as trees, shrubbery, trellises and screens used as lateral controls can also have a very similar effect (Pilkington North America, 2001).

### 3.3 Relevant software

A range of software applications are used in the UK, as well as worldwide by various manufacturers, that deal with technical specifications of windows. Among such software are, for example, Standard Assessment Procedure (SAP) and Reduced Data SAP (RdSAP) programmes approved for use in connection with building regulations and energy performance certificates for new dwellings (for the list of these programmes see 0, Appendix D and Appendix E).

Some of this software could provide a useful start to the process of extracting the most relevant parameters and incorporating them into the existing conservatory designing software.

Another programme which could prove to be of high relevance is Pilkington Spectrum, which is a Windows-based model to calculate glass performance features of single, double, triple and quadruple glazing, and secondary glazing or double window configurations. Among the specifications calculated through the programme, are:

- “Light and solar properties (transmittance, reflectance, absorptance, g value, etc.) in accordance with EN 410
- Centre pane U value in accordance with EN 673 (with an option to display the U value to two decimal places)
- Sound insulation values measured in accordance with EN ISO 140-3 or generally accepted values from EN 12758
• Ultra violet (uv) transmittance and colour rendering index (Ra) in accordance with EN 410
• Other properties (e.g. pendulum body impact resistance, fire resistance, resistance to manual attack, etc.)” (Pilkington North America, 2009).

As the research showed, a number of parameters exist that can be used to enhance the existing conservatory design software to include energy performance calculations for the conservatories. This new modelling aspect of the software could help design more energy efficient products in response to the challenges of climate change and reducing carbon emissions. The next Chapter summarises the findings of the present research and draws recommendations based on these findings.
4 Conclusions and Recommendations

This report is a desktop study of the potential issues surrounding the development of energy/carbon efficiency models to be applied in the process of designing conservatories.

The following recommendations are based on the assumption that conservatories are built taking into account minimum specifications set out in the relevant Building Regulations Part L, and summarise some of the extra steps that could be taken in order to further improve energy performance of conservatories.

In the process of designing conservatories, it is important that certain factors are taken into account if higher energy/carbon efficiency is to be achieved.

1. **Size and shape calculations need to be incorporated into the conservatory design process.** Size and the shape of the conservatory will play a major role in defining its heating/cooling requirements (see Figure 3-3). Therefore incorporating some, even basic, calculations based on the shape and main dimensions of conservatories, into the design software could be used, for example, as a starting point in the process of designing company's products and could potentially assist the company's clients in making decisions regarding the major design issues. This might involve a further research into the subject in order to enable a more precise energy/carbon modelling of conservatories.

2. **Identify the temperature regime of the conservatory.** The design temperature of the conservatory, its geographic location (including latitude, potential for external shading by buildings and planting, and local climate parameters) and orientation will have a major impact on the choices of building fabric, ventilation, additional heating and cooling required. Of these, taking into account geographic aspects and orientation of conservatories might prove particularly difficult as there are no commonly known and widely available methods to take such parameters into account in energy/carbon calculations. It might be necessary to undertake a further research into ways of introducing such factors into conservatory design software and particularly presenting them in terms of energy/carbon efficiency values.

3. **Consult software and calculation methods applied by various conservatory designers and manufacturers worldwide.** This approach could provide RPS Ltd with valuable information on ways various factors can be translated into energy efficiency calculations (see, e.g. Appendix D and Appendix E, and Pilkington North America, 2001). This can be especially useful for such parameters as, e.g., latitude and external shading, which may be difficult to translate into energy efficiency terms and which therefore may require specific expertise and capacity to do that.

4. **Introduce energy specifications of various building materials used in construction of conservatories to the company software.** This would help build a more comprehensive picture of energy/carbon advantages and disadvantages of using each particular material (more specific information on such specifications can be found in the documents listed in Appendix C). RSP Ltd may benefit from an additional research that would consolidate the existing knowledge of the types of materials used in building conservatories worldwide and their relevant specifications that directly affect the energy performance of these materials and, subsequently, of the conservatories.

5. **Where possible, seek to minimise the need for additional active heating or cooling.** This particular aspect will have a significant impact on the amount of total carbon emitted by a conservatory, therefore it is vital to ensure the design of conservatories utilises a feasible amount of available techniques and technologies to address this issue. Using solar gains/shading/natural ventilation...
and carbon-free or low-carbon sources of energy for heating/cooling should be considered.

6. **Take into account geographical and environmental factors.** While such design elements as, e.g., trees and trellises are not directly related to designing conservatories and often require specific knowledge and skills, it might be useful for RPS Ltd to consider the opportunities of resolving at least some of the cooling problems through such features. Although incorporating such factors in the company software might prove uneconomic, providing advice on at least some of these aspects would no doubts increase the environmental performance of the products of the company thus ensuring high quality of services provided by the company to its clients. Additional research or consultation might be required in order to consider all pros and cons of taking onboard landscaping issues.

7. **Take into account all of the major energy transfers when designing a conservatory.** Once these interactions are identified and taken into account by calculating their impact, the potential need for fossil fuels for additional heating and cooling will be known and this will provide the information required to calculate the carbon impact of the conservatory.

8. **Introduce results of calculations in terms of both kWh and tonnes of CO\textsubscript{2}/carbon of emissions.** Of these, the amount of energy expressed in kWh could be further converted into monetary values in order to show the potential clients the direct implications of the chosen conservatory design. The carbon emissions indicator could be used by the Company as an internal monitoring indicator to provide information on the quality, and potential for further improvement, of their products, which could be particularly important in light of the UK’s international commitments and customers need for better value of their larger purchases.

Overall, there are a number of ways in which the conservatory design software could be improved to reflect on the energy/carbon efficiency issues. There is a clear need in collecting more data on the existing similar software packages, if any, namely what parameters they use and in what ways, but also how efficient they are from the point of view of achieving the goal of energy conservation. Also looking into the possibilities of applying some of the relevant SAP calculations to conservatory design, even though average conservatories are not normally covered by these calculations, might provide useful information on how these calculations could be altered to become conservatory-specific.

It would also be useful to look into the cost implications of introducing energy efficiency parameters into the company software, from the point of view of both the company and its clients, particularly as technology can be costly. The accent should be placed first of all on what the company is already using in their design and construction, e.g. different types of glass, glazing, or unit filling, but also on the features that could be introduced at no or minimum extra cost, such as consideration of landscape. This would create a solid basis for any further improvements to the conservatory design software and secure its success given the current climate change trends and related issues.
Acknowledgements

The work described in this report was carried out in the Centre for Sustainability (C4S) of the Transport Research Laboratory. The authors are grateful to Ausra Jurkeviciute who carried out the technical review and auditing of this report.

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<http://www.pilkington.com/europe/uk+and+ireland/english/building+products/pilkington4architects/tools/pilkington+spectrum.htm>
### Glossary of terms and abbreviations

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>Carbon Dioxide</td>
</tr>
<tr>
<td>RdSAP</td>
<td>Reduced Data Standard Assessment Procedure</td>
</tr>
<tr>
<td>RPS Limited</td>
<td>Rapid Prototyping Systems Limited</td>
</tr>
<tr>
<td>SAP</td>
<td>Standard Assessment Procedure</td>
</tr>
<tr>
<td>TFA</td>
<td>total floor area</td>
</tr>
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## Appendix A  Key sources of literature used in the current research

<table>
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<th>Type of source</th>
<th>Author, Year</th>
<th>Title</th>
<th>Web address</th>
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|                     | ODPM, 2006         | The Building Regulations 2000: Approved document L1A: Conservation of fuel and power in new dwellings  
Approved document L1B: Conservation of fuel and power in existing dwellings  
<table>
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<tr>
<th>Year</th>
<th>Author(s) and Title</th>
<th>URL</th>
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<tr>
<td>2003</td>
<td>Control of overheating in future housing - design guidance for low energy strategies</td>
<td></td>
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</tbody>
</table>
Appendix B  List of relevant legal and regulatory acts,  
guidance and other publications

Source: ODPM, 2005.

Legislation
- Building Act 1984 (as amended)
- Sustainable and Secure Buildings Act 2004
- The Building (Approved Inspectors etc.) Regulations 2000
- (as amended)
- The Building (Local Authority Charges) Regulations 1998
- The Party Wall etc. Act 1996

Approved Documents
- Published by TSO, 2003.
- Amendments 2000 to the Approved Documents: Published by TSO, 2002.

Other Publications
• Safety in the installation and use of gas systems and appliances. HSE November 1998.
• A Guide to Determinations and Appeals
• Building Control Performance Standards
• New rules for electrical safety in the home
• Solid Fuel, Wood and Oil Burning Appliances. Get them checked, sweep your chimneys, and be safe
• The Party Wall etc. Act 1996 Explanatory Booklet
• Your Garden Walls, Better to be SAFE…
• The above publications are subject to change. An up-to-date list can be found on the ODPM website.
• Gas appliances. Get them checked – Keep them safe
• Landlords: A guide to landlord’s duties: Gas Safety (Installation and Use) Regulations 1998
• Radon – a guide for homebuyers and sellers
• Radon – a guide to reducing levels in your home
• Radon – You can test for it
• Radon – a householders guide
• Protocol on Design, Construction and Adoption of Sewers in England and Wales – produced in support of Approved Document H listed above
• Building Regulations and Historic Buildings – Balancing the needs for energy conservation with those of building conservation: an Interim Guidance Note on the application of Part L.
• Need a plumber or builder…?
• Part A – A step-by-step guide to getting work done on your home
• Part B – Organisations which can help you get work done on your home
Appendix C  European/British standards and codes of practice (in addition to those listed in Appendix A)

Source: Pilkington United Kingdom Ltd., 2008

**BS EN 572**: Glass in Building - Basic soda lime silicate glass products
- Part 1: 2004 Definitions and general physical and mechanical properties
- Part 2: 2004 Float glass
- Part 3: 2004 Polished wired glass
- Part 4: 2004 Drawn sheet glass
- Part 5: 2004 Patterned glass
- Part 6: 2004 Wired patterned glass
- Part 7: 2004 Wired or unwired channel shaped glass
- Part 8: 2004 Supplied and final cut sizes
- Part 9: 2004 Evaluation of conformity / Product Standard

**BS 952**: Glass for glazing
- Part 1: 1995 Classification
- Part 2: 1980 Terminology for work on glass

**BS EN 12600**: 2002: Impact test method and classification for flat glass. This has replaced BS 6206 for glass only.


**BS 6262**: Glazing for buildings
- Part 1: 2005 General methodology for the selection of glazing
- Part 2: 2005 Code of Practice for energy, light and sound
- Part 3: 2005 Code of Practice for fire, security and wind loading
- Part 4: 2005 Code of Practice for safety related to human impact
- Part 5: 2005
- Part 6: 2005 Code of Practice for special applications
- Part 7: 2005 Code of Practice for the provision of information

**BS 6180**: 1999: Code of practice for barriers in and about buildings

**BS 5516**: 2004: Patent glazing and sloping glazing for buildings.
- Part 1: 2004 Code of practice for design and installation of sloping and vertical patent glazing
- Part 2: 2005 Code of Practice for sloping glazing


**BS 5357**: 1995: Code of practice for installation of security glazing

**BS EN 356**: 2000: Glass in Building - Security Glazing - Testing and classification of resistance against manual attack. This is the European Standard for anti-bandit glass which will gradually replace BS 5544.


**BS 6399**: Loading for buildings
Published Project Report

BS 6340: Shower units
  • Part 3: 1985 Specification for prefabricated shower enclosures and shower cabinets

BS EN 14072:2003: Glass in furniture test methods

BS 7376:2004: Specification for inclusion of glass in the construction of tables or trolleys

BS 7449:1991 (1997): Specification for inclusion of glass in the construction of furniture, other than tables or trolleys including cabinets, shelving systems and wall hung or free standing mirrors.

BS EN 12354-3

BS EN ISO 717: Rating of sound insulation in buildings and of building elements
  • Part 1: 1997: Airborne sound insulation
  • Part 2: 1997: Impact sound insulation

BS 5821: Methods of rating the sound insulation in building and of building elements

BS 8213: Safe cleaning of windows

BS EN 1279: Glass in buildings. Insulating Glass Units.
  • Part 1: 2004 Generalities, dimensional tolerances and rules for the system description.
  • Part 2: 2005 Long term test method and requirements for moisture penetration
  • Part 4: 2002 Methods of test for the physical attributes of edge seals
  • Part 5: 2005 Evaluation of conformity.
  • Part 6: 2002 Factory production control and periodic tests.


BS 6993: Thermal and radiometric properties of glazing
  • Part 2: 1990 Method for direct measurement of U value (Thermal Transmittance)

BS 874: Methods for determining thermal insulating properties
  • Part 3: Section 3.1: 1987 Guarded hot-box method
  • Part 3: Section 3.2: 1990 Calibrated hot-box method

BS EN 12567: Glass in Building - Determination of thermal transmittance (U value) - Calculation method
  • Part 1: 2000 Complete windows and other projecting windows.
  • Part 2: 2005 Roof windows and other projecting windows.

BS EN 410: 1998 Glass in Building - Determination of luminous and solar characteristics of glazing

BS 476: Fire tests on building materials and structures
  • Part 3: 2004 Classification and method of test for external fire exposure to roofs.
  • Part 6: 1989 Method of test for fire propagation for products
  • Part 7: 1997 Method for classification of the surface spread of flame of products
  • Part 10: 1983 Guide to the principles and application of fire testing.
  • Part 20: 1987 Method for the determination of the fire resistance of elements of construction (general principles)
• Part 21: 1987 Method for the determination of the fire resistance of loadbearing elements of construction
• Part 23: 1987 Methods for the determination of the contribution of components to the fire resistance of a structure.
• Part 32: 1989 Guide to full scale fire tests within buildings.
• Part 33: 1993, ISO 9705 : 1993 Full-scale room test for surface products
• These standards will be replaced by a number of European Standards over the next 5-10 years. These will be:

**BS EN 1363: 1999 Fire Resistance tests**
- Part 1 General requirements.
- Part 2 Alternative and additional procedures.

**BS EN 1364: Part 1 - walls including glazing.**

**BS EN 1634: 2000 Fire resistance tests for door and shutter assemblies.**

This will bring in 3 classifications for fire resistant products:
- **E** - Integrity
- **EW** - Reduced Heat Radiation
- **EI** - Insulation

**BS EN 14600:2005 Doorsets and openable windows with fire resisting and/or smoke control characteristics.**
Requirements and classification.

**BS 5588: Fire precautions in the design, construction and use of buildings**
- Part 0: 1996 Guide to fire safety codes of practice for particular premises/applications
- Part 1: 1990 Code of Practice for residential buildings
- Part 2: 1985 Code of Practice for shops
- Part 3: 1983 Code of Practice for office buildings
- Part 7: 1997 Code of Practice for the incorporation of atria in buildings.
- Part 9: 1999 Code of Practice for ventilation and air conditioning ductwork
- Part 11: 1997 Code of Practice for shops, offices, industrial, storage and other similar buildings.
- Part 12: 2004 Managing fire safety

**BS EN 357: 2004 Glass in building. Fire resistant glazed elements with transparent or translucent glass products.**
Classification of fire resistance.

**BS 8000: Workmanship on building sites**
- Part 7: 1990 Code of practice for glazing

**EN 12150-1 Thermally toughened soda lime silicate safety glass**
- Part 1: Definition and description
- Part 2: Evaluation of conformity/Product standard

**EN ISO 12543-1** Laminted glass and laminated safety glass
- Part 1: Definitions and description of component parts
- Part 2: Laminated safety glass
- Part 3: Laminated glass
- Part 4: Test methods for durability
- Part 5: Dimensions and edge finishing
- Part 6: Appearance

**EN 14449** Laminted glass and laminated safety glass - Evaluation of conformity/Product standard

**EN 1096-1** Coated glass
- Part 1: Definitions and classification
- Part 2: Requirements and tests method for class A, B and S coatings
- Part 3: Requirements and test methods for class C and D coatings
- Part 4: Evaluation of conformity/Product Standard

**EN 1036-1** Mirrors from silver coated float glass for internal use
**EN 1036-2: 2009** Mirrors from silver coated float glass for internal use
- Part 2: Evaluation of conformity/Product Standard

**EN 1863-1** Heat strengthened soda lime silicate glass
- Part 1: Definition and description
- Part 2: Evaluation of conformity/Product standard

**EN 14179-1** Heat soaked thermally toughened soda lime silicate safety glass
- Part 1: Definition and description
- Part 2: Evaluation of conformity/Product standard

**EN 12898** Determination of the emissivity

**EN ISO 14438** Determination of energy balance - Calculation method

**EN 12758** Glazing and airborne sound insulation - Product descriptions and determination of properties

**EN 13501-2** Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services.

**EN 13541** Security glazing - Testing and classification of resistance against explosion
Appendix D  SAP 2005 (SAP version 9.81 – applicable from 6 April 2008) - List of SAP programs tested by BRE* and approved by CLG, SBS and DFPNI for use in connection with building regulations and energy performance certificates for new dwellings

Source: DEFRA, 2008

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Contact name</th>
<th>Address, telephone, fax, e-mail, website</th>
<th>Program name</th>
<th>Program version</th>
<th>TER / DER</th>
<th>E&amp;P</th>
<th>E&amp;P</th>
<th>E&amp;P</th>
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</thead>
<tbody>
<tr>
<td>1. National Energy Services Ltd (NES)</td>
<td>Roger Jones</td>
<td>The National Energy Centre, Dairy Avenue, Knowhill Milton Keynes MK6 9HA Tel: 01908 672787 Fax: 01908 852108 <a href="mailto:roger.jones@nesltd.co.uk">roger.jones@nesltd.co.uk</a> <a href="http://www.nher.co.uk">www.nher.co.uk</a></td>
<td>NHER Plan Assessor</td>
<td>4.0.x</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>2. Elmhurst Energy Systems Ltd</td>
<td>Stephen O’Hara</td>
<td>Unit 15 St John’s Business Park Lutterworth Leicestershire LE17 4HB Tel: 08700 860490 Fax: 08700 850491 <a href="mailto:stephen@elmhurstenergy.co.uk">stephen@elmhurstenergy.co.uk</a> <a href="http://www.elmhurstenergy.co.uk">www.elmhurstenergy.co.uk</a></td>
<td>EES SAP Calculator</td>
<td>2005.015x</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>3. SDR</td>
<td>Stephen O’Hara</td>
<td>Unit 15 St John’s Business Park Lutterworth Leicestershire LE17 4HB Tel: 08700 860490 Fax: 08700 850491 <a href="mailto:stephen@elmhurstenergy.co.uk">stephen@elmhurstenergy.co.uk</a> <a href="http://www.elmhurstenergy.co.uk">www.elmhurstenergy.co.uk</a></td>
<td>SuperHeat (not available to new users)</td>
<td>6.30x</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
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<tr>
<td>Organisation</td>
<td>Contact name</td>
<td>Address, telephone, fax, e-mail, website</td>
<td>Program name</td>
<td>Program version</td>
<td>TER / DER</td>
<td>EPC</td>
<td>Date of approval</td>
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<td></td>
</tr>
<tr>
<td>9. Knauf Insulation</td>
<td>David Khan</td>
<td>Knauf Insulation PO Box 10 Stafford Road SI Helene Merseyside WA10 3NG Tel: 01744 76855 <a href="mailto:david.khan@knaufinsulation.com">david.khan@knaufinsulation.com</a></td>
<td>Knauf Insulation SAP 2005 Calculator</td>
<td>3.1.x</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
<td>14/11/08 (Scot EPC 02/02/09)</td>
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NOTES

1. "TER / DER" indicates whether the software calculates the target and dwelling emissions. "EPC" indicates whether the software produces an energy performance certificate.

2. "x" in the version number may be incremented for minor updates that do not affect the calculated results. The software approval applies to any "x".

3. The list of programs is complete as at the date at the top of the page. Additional programs are added to the list from time to time.

4. ✗ indicates that SAP 9.81 is not yet fully incorporated.

5. ✧ subject to linkage to accreditation scheme.

For further information on SAP and RdSAP see: [www.bre.co.uk/sap2005](http://www.bre.co.uk/sap2005)
### Reduced Data SAP 2005 for existing dwellings (RdSAP version 9.82), to be used from 22 September 2008 (1 November 2008 in Scotland): List of RdSAP programs tested by BRE* and approved by CLG, BSD and DPFNI for use in connection with energy performance certificates for existing dwellings

<table>
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<tr>
<th>EPC Report</th>
<th>Proc</th>
<th>Ew</th>
<th>Ew</th>
<th>Original</th>
<th>Date of approval</th>
<th>Program name</th>
<th>Program version</th>
<th>Address</th>
<th>Contact</th>
<th>Organisation</th>
<th>Web address</th>
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<td>Yes</td>
<td>Yes</td>
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<td>30/01/08</td>
<td>T您的组织</td>
<td>3.5</td>
<td>9.82</td>
<td>9.82</td>
<td>9.82</td>
<td>9.82</td>
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<tr>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>2.x</td>
<td>30/01/08</td>
<td>T您的组织</td>
<td>3.5</td>
<td>9.82</td>
<td>9.82</td>
<td>9.82</td>
<td>9.82</td>
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<tr>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>2.x</td>
<td>30/01/08</td>
<td>T您的组织</td>
<td>3.5</td>
<td>9.82</td>
<td>9.82</td>
<td>9.82</td>
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*Source: DEFRA, 2008*
<table>
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<tr>
<th>Organisation</th>
<th>Contact name</th>
<th>Address, telephone, fax, e-mail, web address</th>
<th>Program name</th>
<th>Program version</th>
<th>EPC</th>
<th>Date of approval</th>
</tr>
</thead>
</table>
| 4. Elmhurst Energy Systems Ltd    | Stephen O’Hara   | Unit 18, St Johns Business Park, Lutterworth, Leicestershire, LE17 4HD  
Tel: 01572 550490  
Fax: 01572 550491  
stephen@elmhurstenergy.co.uk  
www.elmhurstenergy.co.uk       | EES Web RdSAP  | 2005.017a                   | Yes  | Yes  | Yes  | 30/01/00 |
| 5. Northgate Information Solutions| Rachel Goodman    | 2 Oakfield Road, Clifton, Bristol, BS8 2AL  
Tel: 0117 906 4404  
Fax: 0117 970 6997  
dea@northgate-is.com  
www.northgate-ispublicservices.com | Northgate RdSAP | 1.4.0.12                  | Yes  | Yes  | Yes  | 30/01/09 |
| 6. Property Tectonics              | David Braegeirde | Heywood hall, Bolton Road, Pendlebury, Manchester, M27 8UX  
Tel: 0161 764 9977  
manchester@property-tectonics.co.uk | Lifespan RdSAP | 1.5.1               | Yes  | Yes  | Yes  | 30/01/09 |
| 7. Handheld Systems                | Support           | Handheld Systems Ltd, Charles House, Princes Court, Beam Heath Way,  
Nantwich, CW5 8TQ  
Tel: 0870 622 0905  
www.ps-energy.co.uk             | PS Energy      | 5.0.x                   | Yes  | Yes  | Yes  | 30/01/09 |
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<thead>
<tr>
<th>Date of approval</th>
<th>EPC</th>
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<th>Program name</th>
<th>Contact</th>
<th>Organisation</th>
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</thead>
<tbody>
<tr>
<td>20/03/08</td>
<td>Yes</td>
<td>3.2.4</td>
<td>Storma Flood</td>
<td>Neil Breakley</td>
<td>Storma Flood Ltd</td>
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<tr>
<td>30/01/06</td>
<td>Yes</td>
<td>3.2.4</td>
<td>Rice EPC Water</td>
<td>John Rogers</td>
<td>Rice EPC Water</td>
</tr>
</tbody>
</table>

NOTES

1. *X* in the version number may be incremented for minor updates that do not affect the calculated results or data on EPC. The software approval applies to:

   a. Storma Flood
   b. Rice EPC Water

2. The list of programs is complete as at the date at the top of this page. Additional programs are added to the list from time to time.
Factors influencing energy performance of modern conservatories

Environmental issues such as climate change have become a major concern over the last decade as the scientific evidence has been increasingly alarming over the global warming and its impacts on the environment, society and the economy.

The UK Climate Change Act adopted in 2008 establishes a target of at least 80% reduction in greenhouse gas emissions by the year 2050 in comparison to the 1990 baseline. All sectors will need to contribute to reducing global warming, including the construction sector. RPC Limited have developed the RoofWright tool for designing conservatories and as part of the continuing development of this tool have asked TRL to examine the potential for carbon modelling to be introduced to the future versions of this programme.

TRL have undertaken a desktop review of the parameters that need to be considered when integrating carbon modelling into conservatory design. The review covered the existing relevant building regulations, research literature and existing building and construction technologies and methodologies on the subject. As a result, a range of parameters were identified to be considered for inclusion in the improved version of the company’s software. These were further organised into three groups, namely, technical parameters (those currently regulated by the existing building regulations), design features (those chosen on an individual basis), and geographical and environmental aspects (those covering, e.g. specifics of location and orientation). Based on these findings, recommendations were made for the ways to improve energy performance of conservatories through incorporating energy/carbon calculations into the conservatory design software.

Other titles from this subject area

PPR057 Optimising the use of recycled and secondary aggregates in Hampshire. C R Sowerby, J Lovell and J M Reid. 2005

PPR058 Hampshire County Council: material resources strategy - construction waste and soil. C R Sowerby and J M Reid. 2005


PPR178 M27 trial of highway noise barriers as solar energy generators. D R Carder and K J Barker. 2007