www.defra.gov.uk

# Policy Brief: Improving the energy performance of air-conditioning products

July 2008

Department for Environment Food and Rural Affairs

Department for Environment, Food and Rural Affairs
Nobel House
17 Smith Square
London SW1P 3JR
Telephone 020 7238 6000
Website: www.defra.gov.uk



This document is available from:
http://www.mtprog.com/cms/whitepaper/

Published by the Department for Environment, Food and Rural Affairs

# A Policy Brief for improving the energy performance of air-conditioning products

## Evidence, analysis, targets and indicative standards

## Overview

1. This Policy Brief represents the outcome of the public consultation on air-conditioning products, which was carried out earlier this year. This is in accordance with the announcement in the Energy White Paper of 23 May 2007 where the Government said it would publish a series of consultation papers setting out its analysis of how the performance of energy using products will need to improve over the next 10–20 years, including proposals for product standards and targets to phase out the least efficient products[1]. This forms part of a wider annual review and policy development process, supporting delivery of the Government's objectives for energy and sustainable consumption and production.

2. To achieve the product standards and targets, a range of measures and approaches is required. These may include: international agreements, European and domestic legislation and voluntary action through the supply chain to enhance markets for the most cost-effective energy efficient goods and services. In the Energy White Paper, the Government announced a range of policies to support delivery.

3. We believe that the standards will provide retailers, manufacturers and service providers with a benchmark to improve the performance of products they provide. In addition, we are encouraging industry to deliver improvements in product standards.

4. This Policy Brief addresses in-use energy consumption and carbon emissions associated with the air-conditioning products shown in the following table in both domestic and non-domestic buildings:

| | |
|---|---|
| Packaged air-conditioning:<br>- Wndow/through the wall units.<br>- Portable (moveable) units.<br>- Mini-split units (single, multi-split and variable refrigerant flow (VRF).<br>- Ducted splits.<br>- Roof-top units.<br>- Packaged indoor units.<br>- Close-control. | Central plant air-conditioning equipment:<br>- Air-cooled chillers.<br>- Water-cooled chillers.<br>- Absorption chillers.<br>- Air handling units (AHUs).<br>- Fan coil units (FCUs). |

5. Air-conditioning electricity consumption accounts for 14.8 TWh per year which is equivalent to 2% of domestic and non-domestic energy consumption.

6. Air-conditioning products use electric motors as components to drive the compressors and fans which they incorporate, and motors account for up to 95% of the energy consumed by these products. A separate Policy Brief has been

[1] See Energy White Paper (23 May 2007), para. 2.102.

developed for motor driven systems. Modelling suggests that air-conditioning products account for 9% of the total energy consumed by motor driven systems. This overlap must be taken into account when estimating energy savings projections.

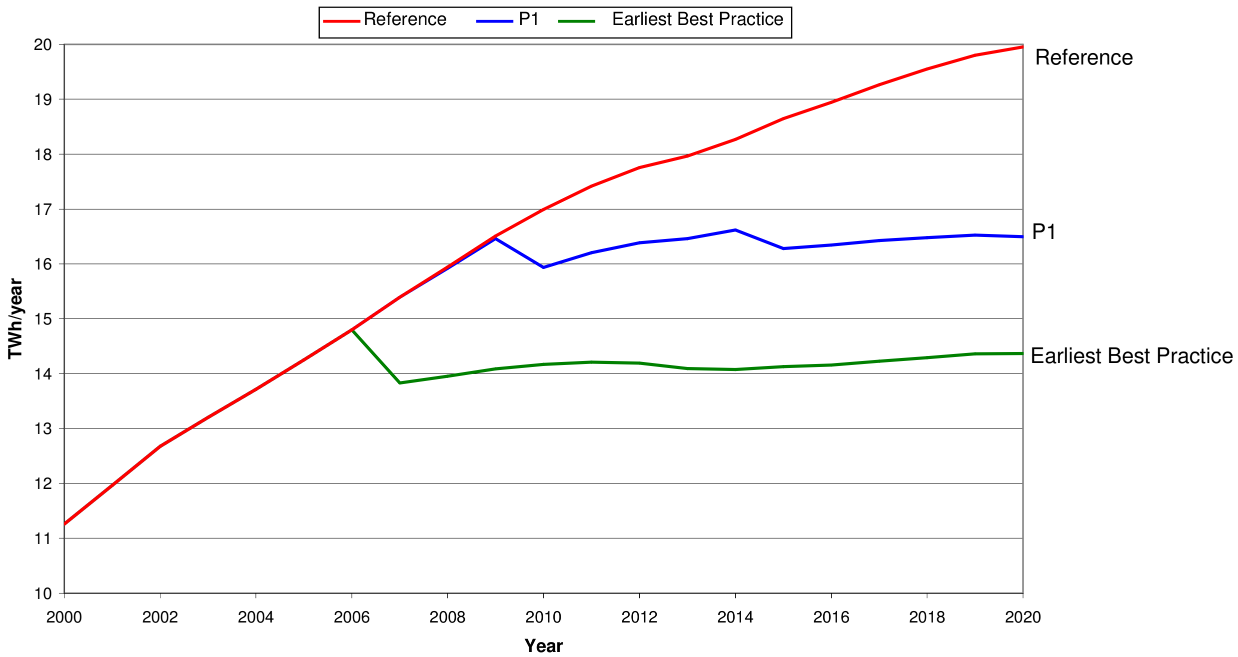
7. Commercial refrigeration products are addressed in a separate Policy Brief.

8. The listed products account for over 95% of the energy use and carbon emissions associated with air-conditioning products (excluding external fans and pumps). Other products related to air-conditioning (eg variable-air-volume (VAV) boxes and chilled beams, and control systems) are thought to be insignificant in terms of energy consumption and are not covered. It is estimated that the latter could increase the total energy consumption of air-conditioning products by no more than 5%.

**How we expect air-conditioning products to contribute to future energy consumption**

9. The following graph shows the Government's projections for energy use by air-conditioning products[2]. The energy used for heating by heat-pump air-conditioners and other reversible cooling equipment is excluded.

**Total energy consumption of UK air-conditioning systems (see scope in paragraph 4)**




[2] In deriving these projections we generally assume an extrapolation of the current service delivery modes, rather than engaging in speculation about major changes in product functionality or mode of service delivery. However, as soon as reliable evidence emerges about a new product or mode of service delivery, the projections are adjusted to take account of these (eg systems based upon refrigerants uncommon in 2007, or a significant shift in the proportion of central to packaged plant).

10. The Reference[3] projection takes into account underlying trends in markets and technologies, and the estimated or implicit impacts of historical and current policy measures. It does not, as yet, take account of the impact of policies announced in the Energy White Paper of 23 May 2007, which are still being developed and are not targeted at specific products (eg the Carbon Emissions Reduction Target (CERT) and successor schemes). The intention is to revise these projections once it becomes clearer how these new policy measures will affect air-conditioning products.

11. The Earliest Best Practice (EBP) projection shows what would happen if all new UK sales were based on the most resource efficient options, taking into account design and production cycles, but not taking account of price or other market barriers.

12. The P1 projection sets a target level of ambition that the Government is proposing could be delivered at a reasonable cost, taking into account such things as current UK and global performance benchmarks, economies of scale and the capacity of the supply chain to take coherent action to deliver more energy efficient products[4].

13. In theory, delivery of EBP would result in energy use falling by 3% to 14.4 TWh[5] by 2020, relative to 2006. This would represent an energy saving of 5.5 TWh (0.7 MtC, 2.5 $MtCO_2$)[6] over the Reference projections for 2020.

14. The proposed P1 target would result in energy use from air-conditioning products falling to 16.5 TWh by 2020. This would represent a 17% energy saving of 3.4 TWh (0.4 MtC, 1.5 Mt $CO_2$)[7] over the Reference projections for 2020.

15. We estimate that the P1 target would be achieved if, on average, products supplied and brought into use each year were to meet the indicative performance

[3] The Reference line or 'REF' is included as a baseline against which progress towards absolute consumption targets can be monitored. It also permits us to measure the impact of market changes in response to published targets and delivered policy measures and to assess the need for additional action. REF is updated to estimate the aggregate impact of existing policy measures, superimposed on underlying market trends, on the supply, sales and use of air-conditioning products – and, therefore, on household energy consumption. The effectiveness of market transformation policy, taken as a whole, may be assessed as the extent to which it modifies REF.

[4] These market-based estimates for P1 are cross-compared with the performance improvements that could be envisaged through a set of ambitious but feasible policy options, over and above those included in the Reference line to check their feasibility. Section 3 of this Policy Brief (Policies, risks and measures) describes these along with the associated risks and proposed strengthening initiatives.

[5] 1 terawatt-hour (TWh) = 1,000,000,000 kilowatt-hours (kWh).

[6] Carbon emissions for electricity are calculated from Government predictions of the electricity generation mix. Oil and gas are converted using standard Government factors. See MTP Briefing Note BNXS01 at www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=150.

[7] However, some of the energy an appliance uses provides useful heat and when this is reduced, the heating system may have to provide more heat (also known as the heat replacement effect, HRE). For air-conditioning products it is assumed that usage does not coincide with heating, so the net carbon reduction taking the HRE into account is 0.4 MtC, 1.5 $MtCO_2$. See MTP Briefing Note BNXS05 for further explanation at: www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=151

standards set out in the Appendix. These P1 targets and product standards take into account:

- Benchmark product designs and technologies.
- Reductions in building heat gains/cooling demands.
- Underlying market and technology trends.
- The scope for delivering policy benefits at reasonable cost.

16. We estimate this market shift could be delivered at reasonable cost. For example, the minimum Energy Efficiency Ratio (EER)8 required for compliance with Building Regulations Part L guidance for mini-split air-conditioners is 2.4. Mini-split air-conditioners are responsible for over half of all packaged air-conditioning energy consumption in the UK. However, the best mini-splits tested and listed by Eurovent Certification9 have a rated EER equal to, or above, 3.2. Furthermore, the very best mini-splits (not necessarily available in the UK) have EERs of around 5.0 for sub-12 kW equipment and around 3.5 for larger equipment. An increase in EER from 2.4 to 3.2 would result in an energy saving of 25% for new products, and an increase from 2.4 to 5.0 would give a saving of over 50%.

17. If we are on track to deliver this target we would expect to see substantial shifts in the market, for example:

<u>2010</u>: All new packaged chillers sold meet on average the 2007 minimum Enhanced Capital Allowance (ECA) criteria for the EER (2.6 for chillers up to 500 kW size).
<u>2010</u>: 50% of new packaged air-conditioners meet on average the minimum criteria for Energy Label class A. This is equivalent to raising the average EER of mini-splits from 2.8 to 3.0.
<u>2015</u>: All new packaged air-conditioners meet on average the minimum criteria for Energy Label class A.

18. Our analysis indicates, in principle, that the P1 target is achievable through normal market mechanisms, supported by policies to be implemented as announced in the Energy White Paper.

19. This is in line with the approach taken in the EU's Framework Directive on the Eco-design of Energy-using Products (EuP), which encourages voluntary actions where appropriate.

20. The Government is committed to working with retailers, manufacturers and suppliers, to overcome barriers that might impede progress, and to promote delivery of these indicative standards more widely in the market. We will, therefore, work with the full range of policies outlined in the Energy White Paper. Where international or domestic measures rely on performance standards, we propose that we should seek to align them with the indicative standards outlined in this Policy Brief, subject to responses from the consultation. In particular we will:

[8] EER is the ratio of the total cooling capacity to the average electrical power input of the unit, expressed in watt/watt.
[9] See Section 3.3.4 for more details.

- Press for EuP measures to adopt performance requirements for air-conditioning products in line with our indicative standards, while acknowledging the Single Market legal base for EuP and recognising that final performance requirements will need to be fully harmonised across the whole of the European Union.
- Review the Building Regulations[10] Part L1 guidance for reducing cooling loads in buildings and raising minimum equipment performance levels in light of our indicative standards.
- Support the ECA criteria for the EER of packaged chillers being raised.
- Work to secure a revision to the current mandatory EU energy labelling regime.
- Use the indicative standards to identify the most appropriate minimum and/or forward looking standards for use in Government procurement.

21. In this Policy Brief, we set our P1 target and indicative standards based on our current understanding of what is necessary and deliverable. That analysis may change over time, for example, if new efficient technologies enter the market faster than expected; or if consumer trends change; or through international or EU action; or through policies on carbon emissions reduction more generally. We intend to maintain a continued active dialogue with businesses in the supply chain. The aim will be to review progress and to annually update this analysis, the P1 target and the indicative standards for air-conditioning products, among others, following consultation and review.

[10] The Building Regulations are devolved to the three Administrations: England and Wales, Northern Ireland and Scotland. *See* Section 3.4.1 for more detail.

# Table of contents

# 1 Status of the Policy Brief

22. This Policy Brief is issued as part of an annual process, as announced in the Energy White Paper, to review and update the Government's published analysis, projections, P1 target and indicative standards for more sustainable products. This updated version takes into account the views received following the first consultation and, so far as possible, addresses substantial issues raised.

# 2 Market overview

23. As set out above this Policy Brief addresses in-use energy consumption and carbon emissions associated with packaged and central plant air-conditioning products in domestic and non-domestic buildings, including:

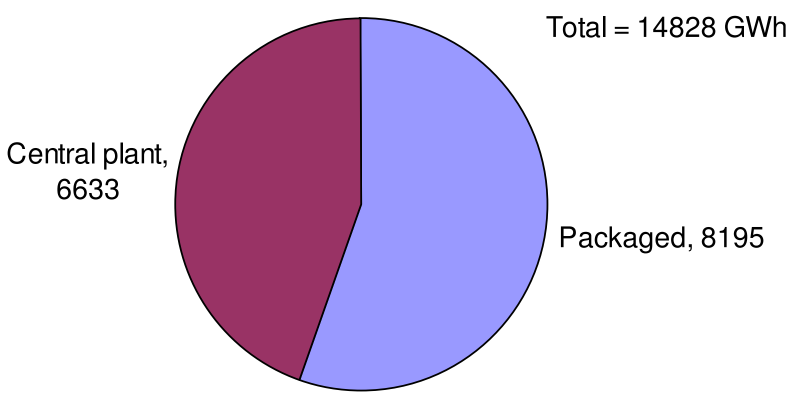
- Discrete packaged and portable comfort cooling units and systems.
- Central plant system equipment including packaged chillers, fan coil units and air handling units.

24. Fans and pumps external to these products are covered separately by the Motor Driven System Policy Brief. See a separate Policy Brief for details of commercial refrigeration products.

## 2.1 Trends

25. Overall the number of installed air-conditioning systems is expected to increase by about 80% by 2020 with a 60% increase in the sector energy consumption. This increase is based on modelled trends in the growth of the number of non-domestic buildings with air-conditioning. The total energy consumption of packaged air-conditioning exceeds that of central plant air-conditioning, as shown in Figure 2.1.

**Figure 2.1 Total energy consumption of packaged and central plant air-conditioning in 2006 (GWh)**



26. Annual growth in sales of air-conditioning products has been around 4% between 2004 and 2006, with the highest growth rates seen by packaged products which account for around 53% (£362 million)[11] of the total market value. Sales of packaged air-conditioning products are particularly sensitive to the weather, especially for smaller products and the hot summer of 2003 caused significant growth in the following year.

27. It is estimated that less than 0.5% of UK homes (about 125,000) have some form of air-conditioning[11]. Even if there is rapid growth, the proportion of electricity consumption due to domestic air-conditioning use is expected to remain insignificant for many years when compared with non-domestic buildings. The incidence of warmer summers and growth in home offices are considered to be important growth factors especially in southern England where climatic and economic factors are strongest.

28. The predicted growth in air-conditioning does not yet take into account the possible impact of hotter summers on both the numbers of buildings with air-conditioning and the hours of use of existing systems. Higher external air temperatures would also cause a reduction in system operating efficiency leading to a further proportional increase in electricity consumption.

### 2.1.1 Packaged air-conditioning

29. Packaged air-conditioning is a diverse range of products which includes the following:

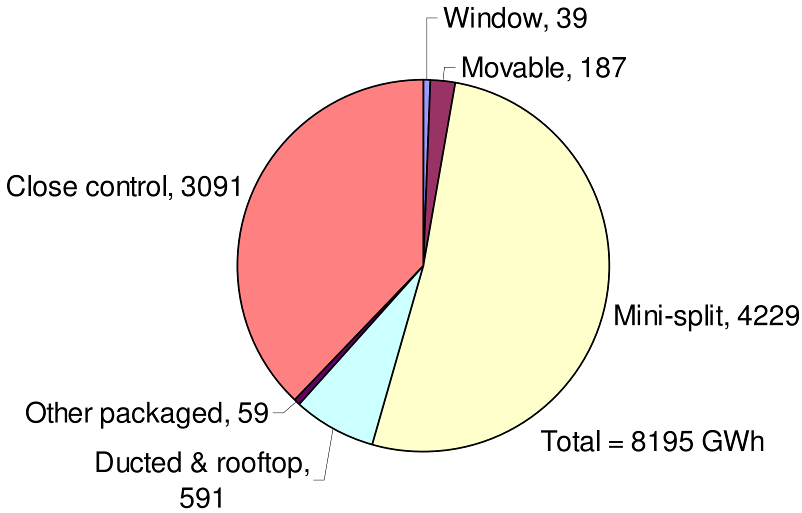
- Window/through the wall units.
- Portable (movable) units
- Mini-split units (single, multi-split and variable refrigerant flow (VRF)).
- Ducted splits.
- Roof-top units.
- Packaged indoor units.
- Close-control.

30. These products range from self-contained individual products (including portable units and some splits), to multi-split systems which are engineered systems comprising a number of individual units (typically an outdoor condenser unit and several indoor units) that require professional design and installation.

31. The chart below shows the split in total annual energy consumption for packaged air-conditioning product categories. Within this packaged market, mini-split units account for more than half the total energy consumption, followed by close-control units. Close-control units cool computer rooms and are often operated on a continuous basis, whereas many of the other types of packaged unit may perhaps only be operated during hot weather to keep building occupants cool. An increasing proportion of packaged air-conditioning is heat pump units and may, therefore, be used for space heating as well.

[11] The UK Air-conditioning Market Development 2007, Market & Business Development (MBD).

**Figure 2.2 Packaged air-conditioning energy consumption in 2006 (GWh)**




32. The demand for portable units is growing rapidly and the value of annual sales increased by 21% between 2002 and 2006[11]. The severity of hot summers has a major influence on sales, so future stock is difficult to predict. Sales of split and multi-split systems are also growing (growth of 19% in value between 2002 and 2006) and there is evidence that these systems are being used in some larger multi-storey office buildings instead of more traditional central plant systems. Close-control units are used for server and switching/telecoms rooms, and sales are linked to the level of economic activity in the commercial sector.

33. Sales of portable units to householders are increasing (anecdotal evidence derived from the increasing number of outlets now stocking them), but we have no data on the volume of sales and usage patterns. Some split and multi-split systems are also being installed in houses, although the numbers are currently thought to be insignificant.

### 2.1.2 Central plant air-conditioning

34. These are engineered systems that are made up of a large number of pieces of equipment or products. Key components include:

- Air-cooled chillers.
- Water-cooled chillers.
- Absorption chillers.
- Air-handling units (AHUs).
- Fan-coil units (FCUs).

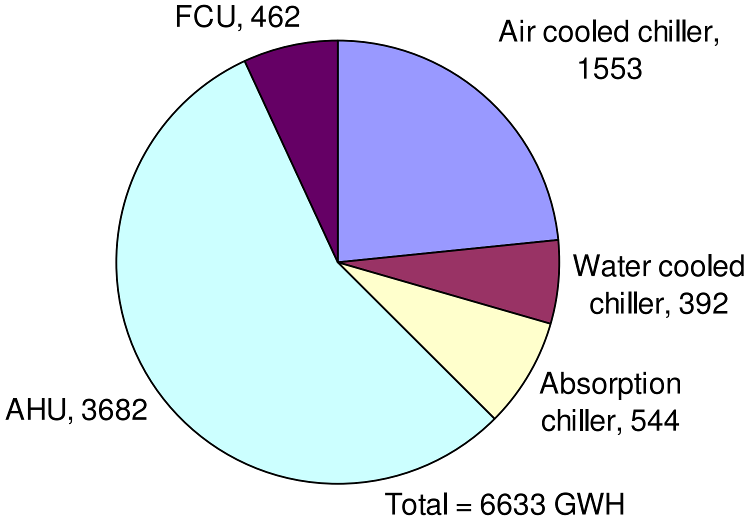
35. There are other products, but they are considered to be insignificant in terms of sales or energy consumption. For example, VAV boxes and chilled beams are widely used for conditioning spaces, but have zero or very low energy consumption. Central plant systems tend to be installed in larger buildings. Each system is essentially a bespoke system tailored to specific building and end user requirements. The type of equipment used in the system, and the overall system design and operational concept is heavily dependent on the experience and knowledge of the designer. This, plus the way the system is operated and controlled, has a far greater

impact on the overall energy consumption than the performance of the individual equipment.

36. Central plant air-conditioning includes all centralised systems that are designed to 'condition' the air in the occupied space of the building. This includes mechanical ventilation only and other hybrid systems. Although fan energy, for fans integral to the system, is included in projections described in this Policy Brief, any heating energy, whether this is by separate heating plant or reversible cooling equipment, is excluded from this Policy Brief.

37. Figure 2.3 shows the split in total annual energy consumption for central plant air-conditioning. AHUs may be used as part of a full air-conditioning system or a mechanical ventilation system. Some buildings may combine a central mechanical ventilation system with packaged air-conditioning units.

**Figure 2.3 Central plant air-conditioning energy consumption in 2006 (GWh)**




38. There is evidence that growth in sales of central plant equipment (eg chillers) has fallen back over the last few years[12]. This may reflect an increasing trend towards packaged equipment rather than a lessening of the growth in air-conditioning. Overall, the sale of central plant equipment is heavily dependent on growth trends in the commercial office market.

39. Sales of absorption chillers have declined since the 1990s and currently represent an insignificant proportion of overall sales and installed systems. However, with the increasing use of CHP to reduce carbon emissions, this trend may be reversed.

40. Standalone fans and pumps are excluded from the sector model for air-conditioning systems as their energy consumption is covered separately in the Motor Driven Systems Policy Brief. However, where a fan or pump is installed in an air-conditioning system product, such as a fan coil unit or air handling unit, then the

[12] European Market for Air-conditioning. Central Plant Air-conditioning. United Kingdom. BSRIA Report 1938/13, September 2005.

energy consumption is included. The major energy consuming component of an air handling unit and fan coil unit is the fan.

## 2.2 Price

41. The range and size of air-conditioning equipment is extremely diverse and the price ranges from around £300 for a portable air-conditioner to over £50,000 for large chillers. In general, the market is extremely price sensitive with manufacturers under pressure to offer products at the lowest possible price. Since efficiency is, to a significant extent, determined by the size of the heat exchanger (larger heat exchanger leads to higher efficiency) and compressor efficiency (including whether it incorporates inverter drive), the initial purchase price for more efficient units tends to be higher, though not the lifetime running cost. Anecdotal evidence suggests that purchase decisions are very rarely made on whole-life costs. Price competition has been exacerbated by growth in Far Eastern manufacturers of packaged equipment. Although price in the UK has been a barrier to improving energy efficiency, many products are also manufactured by North American or Japanese based manufacturers, as well as some in Southern Europe. On a global scale, the UK air-conditioning market is tiny. Much energy efficiency innovation is driven by the North American and Japanese markets. The most energy efficient products are not always marketed in the UK.

42. Table 2.1[13] compares the minimum Energy Efficiency Ratio (EER) values in Australia and Japan with the equivalent energy efficiency label class defined in the Household Air-conditioners Regulations for split and multi-split air-conditioners[14]. The minimum EER required for <4 kW systems in Australia and Japan corresponds to energy efficiency class A in the EU. Minimum standards for the larger units correspond to Class C or D. Products of label E and F constitute around 20% of the 2006 EU market (see Figure 2.4).

**Table 2.1 Comparison of minimum regulatory EER values**

| **Split and multi-split systems** | **Australia (from 1 Oct 2008)** | **Japan** | **Corresponding EU energy label (including UK)** | |
|---|---|---|---|---|
| Rating cooling capacity | Minimum regulatory EER | Minimum regulatory EER | Energy label class | EER required for energy label |
| <4 kW | 3.33 | 3.23 | A | ≥3.2 |
| 4 to <7.5 kW | 2.93 | 3.23 | C | 2.8 to 3.0 |
| 7.5 to <10 kW | 2.93 | 2.85 | C | 2.8 to 3.0 |
| 10 to 18.9 kW | 2.75 | 2.47 | D | 2.6 to 2.8 |

43. Higher efficiency levels than are currently typical in the UK are also achievable for larger plant. Recent technological developments in large chillers, such as magnetic bearing chillers, have greatly improved the full and part-load performance. Annual average EERs can be up to 6, with peak load EERs of 3.6, due to minimal

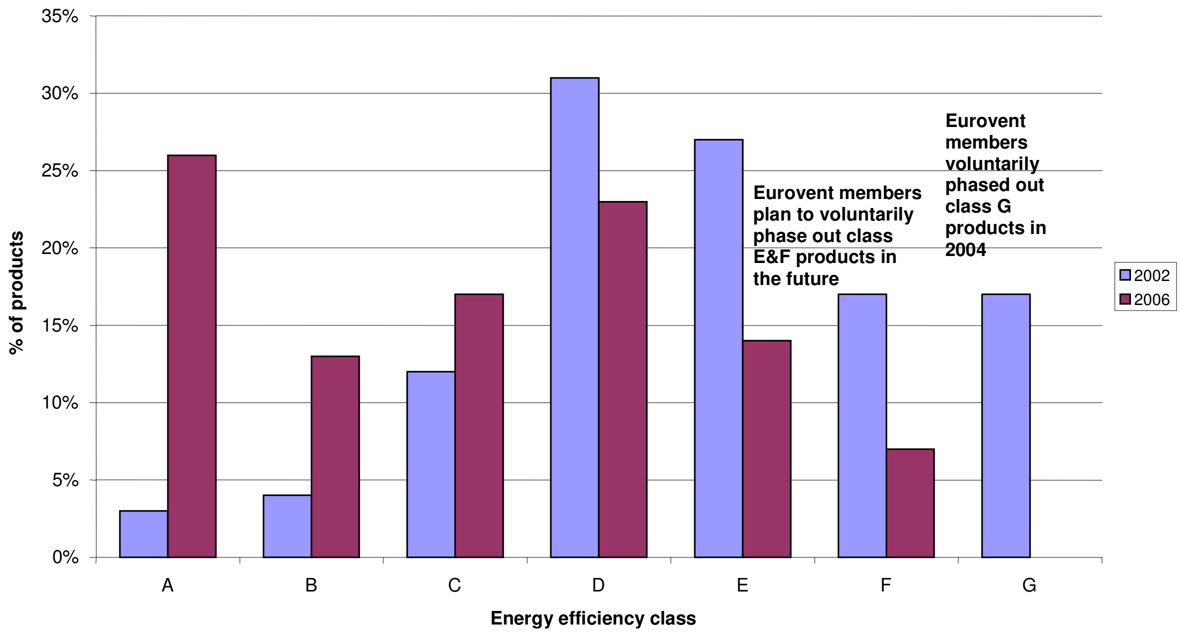
[13] Draft report of Task 1, EuP Lot 10 Preparatory Study on performance of residential room air-conditioners http://www.ecoaircon.eu.

[14] See MTP Briefing Note BNAC29 http://www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=194.

start-up loads and low bearing resistance. Higher capital costs can be recouped by reduced running costs within a short payback period.

44. Within Europe, there has been significant improvement in the energy efficiency of sub-12 kW products listed in the Eurovent database between 2002 and 2006. Figure 2.4[15] shows that in 2006 over 25% (2,306 products) out of a total of 8,959 listed packaged air-conditioners in the sub-12 kW category achieved Class A, compared to less than 5% in 2002. Since 2002, Eurovent has also eliminated Class G and intends to eliminate E and F in the near future.

**Figure 2.4 Packaged AC < 12 kW***




* Eurovent data

## 2.3 Innovation

45. Inverter technology can raise the energy efficiency of new air-conditioning products and systems. Future modelling work will gather information on this technology so that as this technology becomes more prevalent its benefits can be accurately reflected in air-conditioning energy consumption models.

46. An increasing proportion of new packaged air-conditioning are reverse cycle systems and where these are used for space heating in winter they may result in energy savings compared to conventional heating systems. These energy savings will be reflected in modelling of the domestic and non-domestic heating sectors.

47. Innovation is an important factor in market development and is covered more thoroughly in Section 4.1.

[15] Draft report of Task 1, EuP Lot 10 Preparatory Study on performance of residential room air-conditioners http://www.ecoaircon.eu.

# 3 Policies, risks and measures

48. In the Energy White Paper 2007, the Government said it would:

- Take steps within the UK to improve the take up of energy efficient products and work internationally, and through the EU, to stimulate global innovation and competition to raise standards and to bring a greater choice and efficient products to UK consumers.
- Deliver on our Gleneagles G8 commitments to promote international co-operation on product labelling and standards and help develop practical standards to reduce standby power.
- Work with the UK supply chain to encourage delivery of more efficient goods and services.
- Publish a series of consultation papers setting out our analysis of how the performance of energy using products will need to improve between now and 2020, including proposals for indicative product standards and initiatives to phase out the least efficient products.

49. As set out above, our analysis indicates, in principle, that the P1 target is achievable through normal market mechanisms, supported by policies to be implemented as announced in the Energy White Paper.

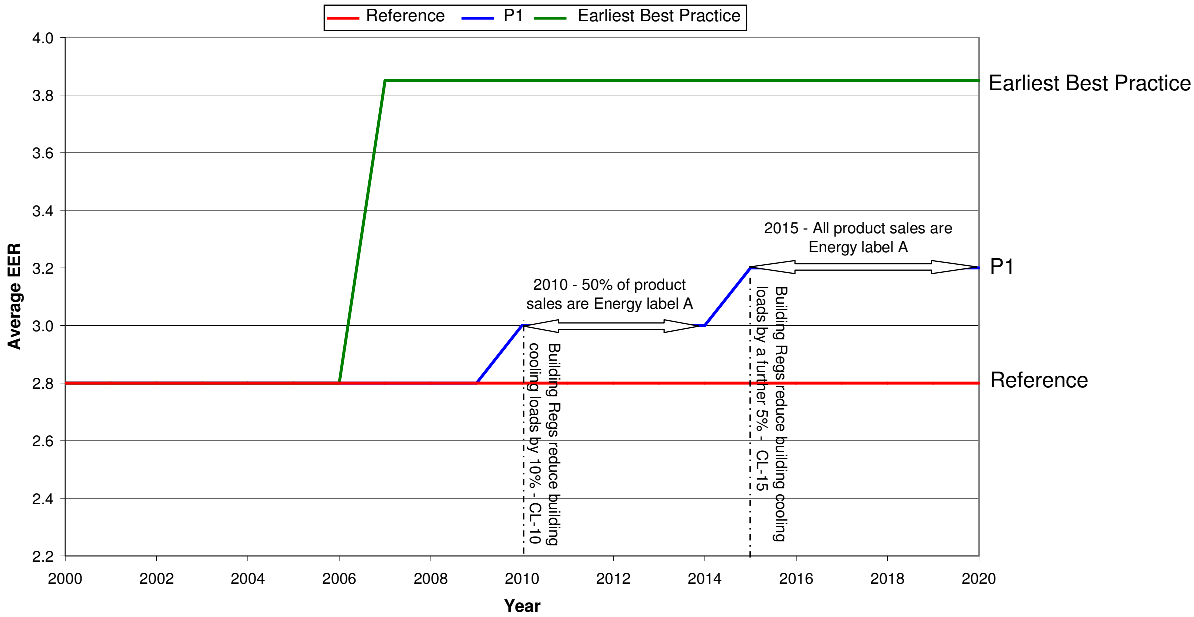
50. In this Section we consider the potential for policy to assist in delivering P1. We identify:

- Policies we believe are already helping to deliver higher environmental performance standards.
- Supporting policies that could assist in delivering P1 in the event that the market fails to deliver it.
- The risks that these policies may not deliver efficiency improvements.
- Further actions that may be necessary to achieve the Government's targets.

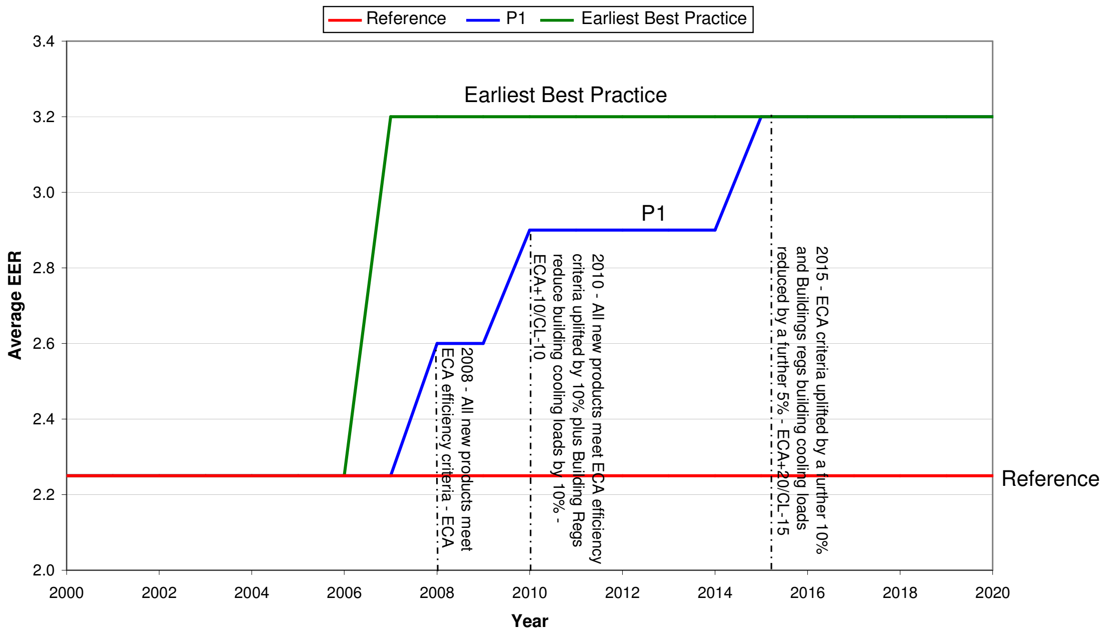
51. Figures 3.1 and 3.2 illustrate how existing policy instruments could support delivery of more efficient new products for two representative air-conditioning product categories - mini-split air-conditioners and air-cooled chillers.

52. The graphs plot the data in the Appendix (ie the indicative performance standards for the basket of new products), which correspond to the P1 projection. Also shown on the graphs are equivalent performance values for the Reference and EBP projections. These illustrate the sales-weighted average performance of new products under the different projections. It should be noted that the policies shown include reductions in building cooling loads which, although they do not raise product energy efficiencies, do reduce system energy consumption.

### Figure 3.1 Indicative energy efficiency (average EER) for mini-split air-conditioners




### Figure 3.2 Indicative energy efficiency (average EER) for air-cooled chillers




## 3.1 Market analysis, projections and targets

Current status

53. This is our first Policy Brief resulting from the consultation process which addresses how the performance of air-conditioning products will need to improve between now and 2020, including proposals for product standards and initiatives to phase out the least efficient products. The intention is to update this analysis on a yearly basis.

54. Tables showing the target average performance levels needed to realise the P1 target are provided in the Appendix. It should be noted that these savings include changes to improve product efficiency and to reduce building cooling loads (system factors). These tables also provide metrics against which developments in the market can be measured.

55. The intention is to monitor progress against the current projection for technology and market development, to consult on the evidence and, annually, to review and update the published analysis and policy response, including indicative product performance standards for new products supplied to the UK market.

**Policy:** Publish and update UK market and technology plans annually.
**Start date:** 2007.
**Reference:** Announcement in Energy White Paper 2007.
**Next deliverables:**
- 2008: Monitor market developments, refine models and consult on possible amendments to this Policy Brief.
- 2008: Publish an updated P1 target and indicative product standards.

Acknowledged risks

56. There is a risk that products will develop in a direction that differs from that which was initially expected in the projections (ie P1 target will not be met). To offset this risk, the Government may consider:

- Whether or not a more ambitious P1 target could be set as part of the review process.
- Pursuing measures designed to further accelerate the use of innovative technologies.

57. Weaknesses in knowledge about market and technology trends, the relationship between the performance of products measured under test conditions and what is achieved in real life could all lead to reduced effectiveness of the policy programme.

58. In addition, failure to gather product data will lead to ineffective policy being established. Further consideration needs to be given to trends in the growth of air-conditioning including the uptake of domestic air-conditioning, and therefore to likely rises in energy consumption as well as efficiency targets. The Government will therefore consider gathering information on consumer procurement and usage of domestic air-conditioning, as a matter of priority.

Strengthening initiatives

- Ongoing: Government will continue to monitor areas to identify where it may be beneficial to strengthen the evidence base on air-conditioning products and systems. In particular, more information will be gathered on the use of domestic air-conditioning.

- Government supports strong EuP minimum performance targets and future amendments of Part L of the Building Regulations should provide stronger incentives to increase the performance of products and systems, including in-use performance.

## 3.2 Engaging the supply chain

### 3.2.1 Supply chain initiatives

Current status

59. In line with announcements in the Energy White Paper, the Government will ask major UK manufacturers and retailers to compete to supply air-conditioning products in line with the indicative standards set out in the Appendix. The supply chain includes: the retailers of packaged systems, the engineering designers of new buildings, and the installation and maintenance contractors.

Acknowledged risks

60. The supply chain initiative may not deliver the Government's P1 target or product standards. The cost of these products might also be unacceptable to the industry.

Strengthening initiatives

- 2008: Government will continue to consider where further actions could be employed to encourage retailers to work to meet a more ambitious P1 target and product standards. This could help to sustain successful supply chain initiatives.
- Government will continue to review opportunities to encourage retail best practice (eg by considering the inclusion of domestic air-conditioners in the Energy Saving Trust's (EST's) Energy Saving Recommended (ESR) scheme for retailers).

### 3.2.2 Metrics: market development

Current status

61. The *Energy Information (Household Air-conditioners) (No 2) Regulations 2005* implementing the European Directive on energy labelling for air-conditioners came into force on 1 August 2005. All new air-conditioners sub-12 kW cooling offered for sale must display an energy label and an energy information sheet showing the product's energy efficiency class on a scale of A to G. This requirement is limited to those air-conditioners offered for retail sale.

**Policy:** Energy Information (Household Air-conditioners) (No 2) Regulations 2005.
**Start date:** 2005.
**Reference:** Statutory Instrument 2005 No 1726.
www.defra.gov.uk/environment/consumerprod/mtp/guidance-notes.pdf
**Next deliverables:**
- 2008: Product compliance testing

Acknowledged risks

62. There is no requirement in this regulation that all sub-12 kW cooling duty products are labelled, except for those offered for retail sale. As such, sub-12 kW products used in the non-domestic market are not required to be labelled (although some manufacturers have voluntarily agreed to extend labelling to all such products). Additionally, labelling requirements may not be consistently applied by all types of supplier for all product types, and the accuracy of labelling has not yet been tested. There is anecdotal evidence that some Internet based UK suppliers are not applying energy labelling.

63. The scope of this labelling requirement is currently limited to sub-12 kW products. This indicates that more than 70% of air-conditioning energy use, including energy used by chillers and other central plant equipment and packaged systems over 12 kW, is not covered by this regulation.

Strengthening initiatives

- 2008: A 'Red-Green Calculator' has been developed for consumer electronic products using a simple points-based currency for ranking the impact of products over their life. The tool returns a red or green verdict on each parameter, product or basket of goods, taking into account sales-weighted averages. This tool could be adapted for packaged air-conditioning products, and used by retailers, manufacturers and service providers to assess and, possibly, to report progress[16].
- The Government will push for the EC to adopt ambitious minimum performance standards which should encourage removal of the worst performing products from the market.
- The Government will ensure that ECA Energy Technology List (ETL) criteria are regularly reviewed so that they maximise the incentive for more efficient products.

## 3.3 EU and international policy actions, programmes and initiatives

64. Most air-conditioning products are internationally traded goods where unilateral UK policy actions may have only a limited impact on the design of products placed on the UK market. Therefore, the Government has committed to work at international level to promote international action to bring forward more sustainable products.

### 3.3.1 International collaboration

Current status

65. The UK is committed to promoting international co-operation on product labelling and standards and, generally, on policy towards more sustainable products.

66. Defra has been instrumental in establishing the International Task Force for Sustainable Products (ITFSP)[17] which seeks to ensure the harmonisation of policy

[16] Additional information on the Red-Green Calculator is available at http://www.mtprog.com/retailer.aspx.

[17] The International (Marrakech) Task Force on Sustainable Products (see www.itfsp.org).

options with those of other countries to maximise impact in a global market led by the supply chain. Defra operates the secretariat for the ITFSP.

67. Within the ITFSP, product working groups called Global Sustainable Product Networks (GSPNs) have been established, and the group with most relevance for air-conditioning products is that for electric motors. The scope includes motors used for large air-conditioning chillers and fans and pumps used in central plant air-conditioning systems. The electric motors GSPN is aimed at developing a comprehensive market transformation strategy to promote efficient industrial electric motor systems worldwide, through harmonisation of test standards, introducing mandatory minimum performance standards and sharing international best practice.

**Policy:** Supporting the ITFSP.
**Start date:** June 2006.
**Reference:** See www.itfsp.org
**Next deliverables:**
• 2008 onwards: Phase II of workplan to agree testing procedures, energy efficiency requirements and label schemes for adjustable speed drives and integrated pumps.

Acknowledged risks

68. There is a risk that commitment to the ITFSP and the GSPNs will not be sustained by all international partners or that insufficient implementation support will be provided.

Strengthening initiatives

- Government will continue to review the effectiveness of this initiative.
- It may be feasible to run the GSPNs on a more informal basis to continue influencing major international partners.

### 3.3.2 Mandatory standards - Framework Directive on the Eco-design of Energy-using Products

Current status

69. The Framework Directive on the Eco-design of Energy-using Products (2005/32/EC) (EuP)[18], adopted in 2005, allows the European Commission to set performance requirements for products placed on the EU market, including air-conditioning products.

70. Among others, preparatory product studies are underway for:

- Residential room conditioning appliances (air-conditioning and ventilation) – Lot 10 (www.ecoaircon.eu).

[18] See MTP Briefing Note BNXS03 at www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=389

- Lot 11 - electric motors 1-150 kW, circulators in buildings, ventilation fans (non-residential buildings).

71. The UK, via the Market Transformation Programme (MTP), has contributed evidence into the preparatory studies and the Government will be pushing for ambitious, but realistic and achievable, standards to be adopted in the individual product measures.

**Policy:** EU Framework Directive for the Eco-design of Energy-using Products.
**Start date:** 2005 (Framework Directive adopted).
**Reference:** http://ec.europa.eu/energy/demand/legislation/eco_design_en.htm
**Next deliverables:**
- 2008: EC adopts regulatory measures for minimum standards.
- 2008/11: Implementation of regulatory minimum standards.

Acknowledged risks

72. It is likely that the scope of EuP, initially, will be limited to sub-12 kW packaged mini-split and moveable air-conditioners that are suitable for residential (domestic) use.

73. Timing for delivery of standards via EuP is uncertain. Delivery of the UK's preferred standards via EuP is also uncertain since the EuP has a Single Market legal base so any final performance requirements will need to be fully harmonised across the whole of the European Union.

74. There is also a significant risk that current regulatory processes will not be able to respond sufficiently nimbly to a rapidly changing market, leading to ineffective regulation and market drivers.

Strengthening initiatives

- The Government will consider the value of including a mechanism for regular review and updating of product criteria in the product implementing measure.
- Ongoing: The Government will continue to monitor the effectiveness of the regulatory processes in question and consider whether to press the European Commission to ensure residential air-conditioning products remain a priority for regulatory action under this Directive. The Government could encourage EuP to (i) widen the scope to include larger air-conditioners including mini-split systems, and (ii) address standby power of packaged air-conditioners. However, the current timetable indicates that an implementing measure will not come into force before 2009, with the phase out schedule beginning in subsequent years. The Government will work with the supply chain in an effort to phase in new standards in advance of this measure (see Section 3.2.1 above).

### 3.3.3 Mandatory standards - F-Gas Regulations

Current status

75. EC Regulation No 842/2006 on Certain Fluorinated Greenhouse Gases (The F-Gas Regulations) came into force on 4 July 2006. The key obligations in the Regulations applied from 4 July 2007 and the main focus is on containment and recovery of F gases.

76. The containment and recovery articles in the Regulation will have an impact on the commercial refrigeration, air-conditioning and heat pump sectors, and on the fire protection sector. It will affect the personnel involved in the installation, servicing and recovery of F gases from these systems, as well as from equipment containing fluorinated greenhouse gas based solvents, high voltage switchgear and fire extinguishers. Operators of relevant systems will have a range of obligations including prompt leakage repair, leakage checking and record keeping, and ensuring appropriately qualified personnel are used.

**Policy:** EC F-Gas Regulation No 842/2006
**Start date:** July 2006
**Reference:** www.berr.gov.uk/innovation/sustainability/fgases/page28889.html
**Next deliverables:**

- 2011 – European Commission report on experience of application of the Regulation and proposals for revisions.

Acknowledged risks

77. There is a risk that the Regulation will not significantly reduce F-gas emissions from air-conditioning systems and therefore will not reduce the impact on greenhouse warming or improve air-conditioning system efficiency.

Strengthening initiatives

- Government will acquire emission data, to the extent possible, for the key sectors covered by the Regulation, to monitor progress in containing emissions.

### 3.3.4 Mandatory standards - Labelling schemes

78. As noted earlier there are at present no mandatory EU labelling schemes for non-domestic air-conditioning products apart from those relating to sub-12 kW air-conditioners, although voluntary certification schemes exist (see Section 3.3.6 below).

79. There are labelling provisions in the F gas Regulation which apply to new equipment being placed on the market for the first time. Existing equipment does not need to be labelled. The Regulation will require certain information to be put on a label whether as an addition to an existing label or as a new label.

### 3.3.5 Mandatory standards - Energy Performance of Buildings Directive

Current status

80. The European Union (EU) Energy Performance of Buildings Directive (EPBD) was published in January 2003. The Directive has far-reaching implications for the owners, operators and developers of all buildings in Europe (both domestic and non-domestic) and will play a key role in the UK in increasing building energy efficiency. Practical implementation of the Directive in the UK has progressed through the updated Approved Documents of Part L of the Building Regulations, among other delivery mechanisms (including the Simplified Building Energy Model (SBEM)).

81. Key provisions of the Directive are:

- Member States set minimum requirements for the energy performance of all new buildings.
- Member States set minimum requirements for the energy performance of large existing buildings subject to major renovation.
- Energy certification of all buildings (with frequently visited buildings providing public services being required to prominently display the energy certificate).
- Regular mandatory inspection of boilers and air-conditioning systems in buildings.

**Policy:** Directive 2002/91/EC Energy Performance of Buildings.
**Start date:** January 2003.
**Reference:** http://europa.eu/scadplus/leg/en/lvb/l27042.htm
**Next deliverables:**
- 2008 - Final implementation of the EPBD in UK legislation.

82. As the EPBD is currently being implemented through UK legislation, this topic is dealt with in Section 3.4.

### 3.3.6 Voluntary product standards and information provision - Eurovent Certification Programme

Current status

83. Sub-12 kW air-conditioners are subject to mandatory energy labelling including the provision of product information (see 3.2.2). However, there are no mandatory requirements for other products except when voluntarily submitted for Eurovent Certification. Eurovent Certification certifies the performance ratings of key air-conditioning and refrigeration products according to European and international standards. Products listed through the Eurovent certification scheme are subject to regular random testing by independent laboratories to verify compliance with their catalogue performance data.

84. The scheme provides a database of product performance data and includes classification of some products according to energy efficiency, originally from Class A (being most efficient) to Class G. Since 2002, Eurovent has eliminated Class G and intends to eliminate E and F for small air-conditioners in the near future. This

industry-led programme provides standardised processes for measuring, reporting and labelling the energy efficiency of air-conditioning products and aims, through voluntary agreement among manufacturers to remove the least efficient products from the market.

**Policy:** Eurovent Certification Programmes for air-conditioning products
**Start date:** Ongoing
**Reference:** www.eurovent-certification.com
**Next deliverables:**
- Ongoing - certification of products and updating of online product database

Acknowledged risks

85. The lack of a EU-wide mandatory energy labelling, apart from for sub-12 kW air-conditioners, means that consumers have to rely on voluntary labels.

86. Poor take-up of voluntary labels makes it difficult for retailers, suppliers and air-conditioning specifiers and users to make informed purchase decisions and weakens other policies.

87. Proliferation of labelling schemes could confuse consumers and create a barrier to trade.

Strengthening initiatives

- The EuP may provide a process for mandatory labelling for some air-conditioning products (see Section 3.3.2). Government will also consider whether to press for the scope of the EuP to be extended to all air-conditioning products and equipment.
- 2008: Government will consider whether to press for the EC (via EC Energy Labelling Framework Directive[19] and the EuP Directive (see Section 3.3.2)) and suppliers to provide harmonised product information.
- Government will also consider extending the EST's ESR products to additional products such as air-conditioning products.

### 3.3.7 Voluntary product standards and information provision - Association of European Refrigeration Compressor and Controls Manufacturers

88. The Association of European Refrigeration Compressor and Controls Manufacturers (ASERCOM), has established a certification for compressors to assist manufacturers of commercial refrigeration and air-conditioning systems. This presents reliable performance data, based on common test methods, in a comparable manner to optimise product selection.

[19] MTP Briefing Note BNXS37 at http://www.mtprog.com/ApprovedBriefingNotes/pdf.aspx?intBriefingNoteID=396

### 3.3.8 Metrics: test and measurement - Test requirements for air-conditioners and chillers

Current status

89. BS EN 1451-2: 2004 provides the performance test requirements for packaged air-conditioners, chillers and heat pumps.

**Policy:** BS EN 14511-2: 2004 Air-conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling.
**Start date:** 2004
**Reference:**
http://www.standardsdirect.org/standards/standards1/StandardsCatalogue24_view_11798.html
**Next deliverables:**
- Ongoing periodic review.

90. Standards also exist for most other individual products used in air-conditioning systems.

Acknowledged risks

91. Standard performance testing does not necessarily reflect the true performance of products under real conditions when installed as part of a complete air-conditioning system in a building. There is also, because UK building air-conditioning mostly operates under part load conditions, a need for agreement on new standards to cover part-load performance.

92. The existing regulations require testing to BS EN14511. This standard allows the EER and Coefficient of Performance (COP)[20] of individual products when tested to be 85% of the manufacturers' declared performance values (this is roughly equivalent to the difference in the performance between a Class B and a Class E product).

93. Assessing energy efficiency when a large number of design parameters are involved, as for air-conditioning systems, can be complicated.

Strengthening initiatives

- Government will consider whether to seek the agreement of suppliers to apply a tighter tolerance for declared values.
- Air-conditioning products are generally applied as part of a larger system, comprising many individual products and compliance with Building Regulations Part L requires the designer/specifier to determine the whole system/building performance. Therefore, individual product standards must take into account the interdependence with the performance of other components and the overall system. This may require the development of system or sub-system based metrics.

[20] COP is the ratio of the heating capacity to the effective power input of the unit.

### 3.3.9 Metrics: test and measurement - Part-load performance test standards

Current status

94. UK building air-conditioning mostly operates under part load conditions. Part load operation can have a significant effect on energy consumption of air-conditioning systems but currently products are rated on the basis of full load tests. The European Committee for Standardization (CEN) has previously prepared a draft development standard on part load testing for air-conditioners and chillers (CEN TS 14825: 2003[21]), but this does not yet have the status of a standard.

95. Where part load performance data are available, Building Regulations Part L Non-Domestic Heating, Cooling and Ventilation Compliance Guide provides a calculation method to give the Seasonal Energy Efficiency Ratio (SEER) for input to the Simplified Building Energy Model (SBEM).

Acknowledged risks

96. Industry may fail to develop harmonised standards for part load testing of air-conditioning equipment.

Strengthening initiatives

- The Government supports development of more appropriate performance test standards that properly address in-use, including part load and seasonal, operation and reduction of the existing permitted performance tolerances. This will allow fairer testing of new technologies such as inverter technology. The Government will encourage BSI and CEN to agree a part load test standard for air-conditioners and chillers.
- The Government will consider whether to continue to review methods of part load test methodology for air-conditioning products and systems for Part L compliance, and if necessary, consider widening the scope to other system components.

## 3.4 UK policy actions, programmes and initiatives

### 3.4.1 Building Regulations Part L

Current status

97. The revision of the Approved Documents that support Part L of the Building Regulations, published in 2006, implements several articles of the EPBD, including Article 3 – a methodology for calculation of the energy performance of buildings and Articles 4 to 6 - minimum requirements for the energy performance of large buildings and the consideration of renewables. These new Approved Documents introduced, for new buildings, a method of compliance based on a calculation of building carbon dioxide emissions.

[21] http://www.bsonline.bsi-global.com

98. To comply with Part L, a separate guidance document[22] specifies the minimum acceptable efficiencies for air-conditioning equipment to be used in new construction, and when replacing existing systems or installing systems during refurbishment. Approved Documents ADL1A and ADL1B (England and Wales, equivalent guidance elsewhere in UK) specify that fixed air-conditioning systems installed in dwellings should be energy label C or better. The Approved Documents require provision to be made to limit heat gains including limiting excessive solar heat gains.

**Policy:** Building Regulations Part L (Conservation of fuel and power).
**Start date:** 2006
**Reference:** Approved Document L1A: Conservation of Fuel and Power (New dwellings) (2006 edition) and related documents available at:
www.planningportal.gov.uk/england/professionals/en/4000000000562.html
**Next deliverables:**
- 2010 and 2015: Revisions of Part L to include further improvements in minimum air-conditioner and chiller SEERs.

Acknowledged risks

99. Delivery of P1 targets may fail because future revisions of Part L may not be sufficiently ambitious in raising the minimum equipment efficiency criteria and in increasing the whole building carbon improvement factor for air-conditioned buildings. Enforcement of Building Regulations may not be sufficient to realise the year on year savings anticipated.

Strengthening initiatives

- The Government will consider whether to propose significant increases in the minimum air-conditioning equipment efficiency criteria and the whole building carbon improvement factor for air-conditioned buildings. The 2006 guidance to compliance with Part L now provides a way of calculating a Seasonal Energy Efficiency Ratio (SEER) from part load performance information, where this data is available. The Government could seek voluntary agreements with industry to provide part load performance data for all relevant air-conditioning products.
- The Government could increase the minimum energy label above class C for fixed air-conditioners in dwellings.

### 3.4.2 Energy Performance of Buildings (Certificates and Inspections) Regulations

Current status

100. UK implementation of the EPBD related to air-conditioning systems includes:

- Provision of an energy performance certificate for all new buildings, and existing buildings when sold or rented.
- Display of an energy performance certificate including both the asset rating and operational rating in the building, for buildings occupied by public authorities or by

[22] Non-Domestic Heating, Cooling and Ventilation Compliance Guide. DCLG, May 2006.

institutions providing public services to a large number of persons, over 1,000 $m^2$ floor area.
- Inspection at regular intervals (not exceeding 5 years) and submission of a report covering efficiency, sizing and possible improvements of air-conditioning systems with an output greater than 12 kW.

**Policy:** The Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007.
**Start Date:** Various (from August 2007 to October 2008), dependent on building type.
**Reference:**
www.opsi.gov.uk/SI/si2007/20070991.htm
**Next deliverables:**
- Implementation from Summer 2007 to 2011.

Acknowledged risks

101. The availability of accredited energy assessors may be insufficient to implement the regulations.

102. A lack of public understanding of the purpose and benefits of this regulation may undermine its value, by removing or reducing public receptiveness to the additional market signals.

Strengthening initiatives

- In the short term, Government may seek to remove any potential barriers to the recruitment and training of energy assessors. In the longer term this supply issue is likely to disappear as confidence in the new profession grows with the progressive introduction of the regulation.
- Government might consider further initiatives to communicate the purpose and benefits of this new information source to the public.

### 3.4.3 Public procurement

Current status

103. The Government published its Sustainable Procurement Action Plan (SPAP) in March 2007, re-affirming its commitment to use Government procurement to drive the market for energy efficient products. Alongside the Action Plan, it published updated and extended standards for an increased range of products that are mandatory for Central Government departments. Defra consulted on energy efficient products which has informed the minimum mandatory standards for this product group in the revised Buy Sustainable Quick Wins (published in July 2008). We are reviewing the approach to setting mandatory standards with the newly formed Centre of Expertise for Sustainable Procurement

104. Guidance on energy efficiency and energy savings as possible assessment criteria in public sector tendering was published in July 2008 as part of the Energy Services Directive. The Directive also sets out a number of options relating to public sector procurement of energy using products, buildings and energy services, which

the Government consulted on during the winter of 2007. The outcome of this consultation will be announced shortly.

105. The NHS (England) published its Sustainable Procurement Action Plan in August 2007. Similar action plans for local authorities are being produced. The Government published its Sustainable Procurement Action Plan (SPAP) in March 2007, re-affirming its commitment to use Government procurement to drive the market for energy efficient products. Alongside the Action Plan, it published updated and extended standards for an increased range of products that are mandatory for Central Government departments. Defra committed to review with stakeholders the range and level of the standards every two years and to publicly consult on mandatory standards for a wider range of products and services. The information set out in these consultation papers will be used to inform the standards proposed for Government procurement. However, this does not currently cover air-conditioning systems.

106. The Government is also committed to identifying stretching-forward looking standards to provide longer-term signals to business and to encourage innovation, for example, through the use of the 'Forward Commitment Procurement' Model[23].

**Policy:** UK Government Sustainable Procurement Action Plan.
**Start date:** 2007.
**Reference:**www.sustainable-development.gov.uk/publications/pdf/SustainableProcurementActionPlan.pdf
**Next deliverables:**
- 2008: Revised Government procurement standards announced.

Acknowledged risks

107. Specifying fixed threshold values in procurement specifications may result in 'lock in' to incumbent technologies by excluding alternative products and lead to innovation being stifled. Outcome-based specifications, along with challenging and progressive threshold values, can help to minimise this.

Strengthening initiatives

- 2008: The Government will consider including standards specifically for the procurement of air-conditioning products, where applicable, within its formal procurement guidelines that are at or above the indicative standards in the Appendix.
- Strengthened leadership and scrutiny of performance on sustainable procurement throughout Government as set out in the SPAP.
- Transforming Government procurement agenda will build procurement capabilities and capacities within Departments and improve delivery of agreed policies.

[23] See www.berr.gov.uk/files/file35312.pdf

### 3.4.4 Product information

Current status

108. In addition to the EU regulations for labelling and providing energy consumption information for household air-conditioners (see Section 3.2.2), ECA is available for products that satisfy specific performance criteria. The products are submitted for listing on the ETL maintained by the ECA Scheme.

109. Inclusion of products on the ETL provides recognition of the manufacturers' efforts towards energy best practice and serves as a consumer energy performance label (but with the caveat that the overall energy performance of an air-conditioning system depends critically on appropriate design and operation as much as, or more than, the performance of individual components).

110. The ETL currently lists 14 refrigeration related products, although some are specific to commercial refrigeration only. The most important products for air-conditioning are:

- Packaged chillers.
- Heat pumps (reversible air-conditioners).
- Evaporative condensers.
- Absorption chillers (as part of CHP systems).

111. The ETL provides an indication of efficiency levels for buyers. But buyers of listed products may also be eligible for a tax break. ECAs can shorten the payback period for energy efficient products by allowing businesses to claim 100% first-year capital allowances against their taxable profits on the capital cost of the equipment.

112. Tax breaks through the ECA scheme may help to offset any price premium for more efficient equipment.

**Policy:** Enhanced Capital Allowance scheme
**Start date:** Ongoing
**Reference:** www.eca.gov.uk/
**Next deliverables:**
- 2009/10: Raise the minimum ECA performance criteria for chillers.
- 2015: Further increase in the minimum ECA performance criteria for chillers.

Acknowledged risks

113. The effectiveness of adopting efficient products, encouraged through schemes such as ECA, depends critically on setting suitably ambitious minimum performance criteria levels, and also on appropriate system design and operation. Although Building Regulations compliance now includes whole building performance requirements, further system guidance may be required.

Strengthening initiatives

- The Carbon Trust will present to Government for its consideration a proposal to increase the ETL qualifying performance criteria for packaged chillers by 10 to 20% in 2008.

### 3.4.5 Voluntary codes of practice

Current status

114. Informal dialogue between Government and industry professional institutions (eg CIBSE and Institute of Refrigeration (IoR)) has encouraged a range of voluntary codes of practice that cover the design, operation and maintain of air-conditioning products and systems and also building cooling loads. These include, for example, CIBSE's Air-conditioning Policy Statement[24], the CIBSE Part L Compliance Toolkit[25] and the IoR Code of Practice for Minimising Refrigerant Emissions[26]. Industry trade organisations (HEVAC, FETA, HVCA) have also published a range of codes and guides that encourage good practice.

115. The building assessment scheme BREEAM allows developers to publicise the environmental qualities of their buildings, including energy use. Choice of the most efficient products will improve the BREEAM rating.

Acknowledged risks

116. Poor uptake of codes of practice will limit the gains in energy efficiency that can arise from better operation and maintenance of air-conditioning and better design of buildings to limit cooling loads. Voluntary codes of practice and agreements relating to products may not include all manufacturers.

Strengthening initiatives

- Ongoing: Government will consider continuing to encourage industry to engage in code of practice and voluntary agreement activities and to provide technical support.
- Government will consider asking the European Commission to consider if it would be appropriate to formally adopt a voluntary forum to discuss best practice potential under the aegis of the consultation arrangements which support the EuP Framework Directive.
- Ongoing: Government will consider continuing to engage with industry to explore the scope for implementing standards in advance of mandatory EuP measures.
- Ongoing: Government will consider whether to press for voluntary codes of practice relating to the supply chain including minimum product efficiency (see 3.2.1).

[24] http://www.cibse.org/index.cfm?go=home.show&PageID=195&TopSecID=16&L1=193&L2=195
[25] http://www.cibse.org/index.cfm?action=showpage&TopSecID=4&PageID=616
[26] http://www.ior.org.uk/ior_technical.php?r=K6EMQWJRAE

- Government will consider promoting the use of BREEAM and encourage BRE to update the standards or increase the credits for the choice of low energy air-conditioning equipment.

## 3.5 Other policies with potential to impact on air-conditioning

### 3.5.1 General energy efficiency information

117. The Government has initiated an 'Act on $CO_2$' campaign to help the general public make the link between their own individual actions and climate change. A carbon calculator at www.direct.gov.uk/actonco2 allows an individual or household to calculate the carbon footprint resulting from their home, appliances and personal travel. It then offers a tailored action plan with simple tips for reducing that footprint. The calculator does not yet include air-conditioning but the action plan does include measures such as thermal insulation which would have an impact on air-conditioning.

### 3.5.2 Promoting pro-environmental behaviour

118. The Government is developing a stronger consumer-facing strategy to promote pro-environmental behaviour, covering the four major consumption impacts of homes, food, personal transport and tourism. This includes setting prioritised behaviour goals (which include better energy management and buying more energy efficient products), audience segmentation and consumer insight, re-organisation of structures and programmes and partnership working. As this work is still in its infancy, there are no air-conditioning product-specific initiatives yet in place, but the broader implications of the policy are potentially significant for all products.

### 3.5.4 Smart metering

119. The Energy White Paper set out a number of policies on energy billing and metering, designed to reduce energy consumption. The Department for Business, Enterprise and Regulatory Reform (BERR, formerly the DTI) recently consulted on the implementation of these policies (the consultation period closed on 31 October 2007). In summary, these are:

- To promote awareness of domestic energy use through a requirement on energy suppliers to present consumption data (preferably in graphical form) on consumers' bills to allow them to compare different periods of energy consumption.
- To provide real-time display units to certain customers so that they can see in real time, and in a way that is relevant to them, how much electricity they are consuming
- To require the installation of smart meters for business customers above a certain energy usage threshold, where it has been proven to be cost-effective.

120. The Energy White Paper also set out the Government's expectation that smart metering would be introduced in the remainder of the business sector and the domestic sector over the next decade.

### 3.5.5 Promoting energy/carbon savings in industry and commerce

121. Since 2001 Climate Change Agreements and since 2005 the EU Emissions Trading Scheme have required industry to improve their energy performance and reduce emissions. This encourages, for example, savings due to the more efficient use of lighting and commercial refrigeration. There are various energy using products covered by MTP that will contribute to the savings required.

122. The Carbon Reduction Commitment (CRC), a mandatory emissions trading scheme aimed at the large non-energy intensive sector, is expected to start in 2010. The CRC will incentivise energy saving measures across 5,000 of the larger commercial and public sector organisations – including retail premises, hotels and offices. As the CRC will cover indirect energy usage by these organisations, it should be expected to add to demand for energy efficient air-conditioning in the commercial sector. Innovation in industrial products in this area may stimulate enhancements in the design and manufacture of domestic products.

# 4 Other potential measures

123. This Section looks towards other measures that may need to be developed to enable the desired average energy performance to be achieved.

124. Air-conditioning is sometimes an aspirational or prestige product especially in commercial property where buildings without it may command lower rental income. Whether Government policy could address this issue is uncertain and also global warming may make the reversal of such attitudes difficult. However, implementation of the EPBD Energy Article 7 Energy Performance Certificates through Part L of the Building Regulations may encourage improvements in the efficiency of air-conditioning systems and reduce building cooling loads.

125. The measures described in this Policy Brief mainly relate to the use of air-conditioning in non-domestic buildings because the use of domestic air-conditioning in the UK is currently very low. However, the Government will monitor the use of air-conditioning in houses by collecting more information on usage and consumer procurement of domestic air-conditioning through the Market Transformation Programme.

126. One of the most fruitful routes to delivery of carbon savings will be through measures that stimulate innovation in products. There are three levels of innovation that have potential to reduce energy used by air-conditioning products in buildings:

- Innovation in building design and operation to minimise air-conditioning cooling loads – for example improved solar control glazing and more efficient IT and lighting.
- Innovation in air-conditioning product design to improve performance – for example inverter technology, part load performance control.
- Technology substitution – for example alternative refrigerants and refrigeration cycles.

127. The Government recognises that air-conditioning should be considered as a system comprising a number of components. In-use factors including operator training and guidance should therefore be important considerations for improving energy efficiency and Government is keen to work with industry on this.

# 5 Potential impacts

128. This Section provides a partial analysis of the more significant potential impacts of the proposals contained herein.

## 5.1 Consumer cost/benefit analysis

129. There is usually a first cost disadvantage in purchasing more energy efficient air-conditioning products and equipment. This higher initial cost will deter consumers and building owners when they are not informed of the potential saving over the lifetime of the product. The current lack of reliable information concerning lifetime energy savings is likely to be a market barrier to the take-up of such products and systems.

130. Initiatives to provide better information to householders and building operators on the more efficient control and operation of air-conditioning products and systems should be low cost with potentially large benefits in terms of reduced energy consumption and improved internal environmental conditions.

## 5.2 Business impacts

131. The principal impact will be increased sales of more energy efficient air-conditioning products and stimulation of manufacturers and suppliers of these products. There will also be stimulation of consulting engineers and contractors who have the knowledge and experience necessary to undertake to provide more energy efficient and possibly more innovative, systems and equipment.

## 5.3 Waste impacts

132. The disposal of portable household air-conditioners is controlled by the Waste Electrical and Electronic Equipment (WEEE) Regulations 2006, requiring these products to be collected separately from household waste. The aim is to avoid these products going to landfill and increase their recycling. In the UK, designated collection facilities have been established to allow householders to return WEEE, free of charge, for recycling. It is not currently anticipated that the move to more energy efficient products will affect the replacement frequency of this type of product.

133. The move to refrigerants with zero ozone depletion potential (ODP) and low greenhouse warming potential (GWP) may result in the premature replacement of refrigerant and in some cases air-conditioning equipment. Any acceleration in the requirements to phase-out these refrigerants, and possibly the replacement of the equipment that contain them, could have significant waste stream impacts.

## 5.4 Health impacts

134. An increase in summertime temperatures leading to increased cooling demands may have a negative impact on the health of occupants of houses and other buildings that experience overheating. The elderly, very young and those with chronic diseases are especially at risk. It is important that new buildings are designed to minimise the risk of summertime overheating and that where air-conditioning is required, sufficient information is made available on the benefits of energy efficient products and systems to minimise energy consumption and operating costs.

135. The increased use of alternative refrigerants that are more environmentally friendly but possibly toxic, such as ammonia, requires greater design effort and more costly equipment to minimise the health and safety impacts.

# 6 Further information

136. The following MTP publications (available from www.mtprog.com) are linked to this Policy Brief and present the underlying evidence base of information such as further explanations, definitions, assumptions and important background information:

BNAC02: The European Directive on energy labelling of household air-conditioners.
BNAC06: Energy efficiency test specification for air-conditioners up to 100 kW.
BNAC18: Modelling the energy consumption of air-conditioning.
BNAC27: Energy efficiency test specification for fan coil units.
BNAC29: The UK Building Regulations as they apply to air-conditioning
BNAC30: Air-conditioning efficiency
BNXS1: Carbon Emission Factors for UK Energy Use

# Appendix
# Indicative performance standards for air-conditioners

137. Tables A1–A12 show the indicative performance standards for new products (including system and building improvements) supplied to UK end-users. This corresponds with the Government's underlying published stock models and projected energy consumption in each sector (the P1 target presented in this Policy Brief). It should be noted that the stated EER values are seasonal average values.

138. These specifications may be used directly in suitable policy instruments (eg the supply chain initiative) and may also provide a metric against which developments in the market can be measured.

139. The underlying stock modelling is subject to an ongoing consultation and review process. More detail on the modelling, current market analysis and data downloads is available via the MTP's What-If tool (http://whatif.mtprog.com)

## Table A1

| Packaged window wall air-conditioners | | |
|---|---|---|
| Year | EER | Annual Full Load Hours Run |
| 2006 | 2.0 | 575 |
| 2007 | 2.0 | 575 |
| 2008 | 2.0 | 575 |
| 2009 | 2.0 | 575 |
| 2010 | 2.3 | 518 |
| 2011 | 2.3 | 518 |
| 2012 | 2.3 | 518 |
| 2013 | 2.3 | 518 |
| 2014 | 2.3 | 518 |
| 2015 | 2.6 | 489 |
| 2016 | 2.6 | 489 |
| 2017 | 2.6 | 489 |
| 2018 | 2.6 | 489 |
| 2019 | 2.6 | 489 |
| 2020 | 2.6 | 489 |

## Table A2

| Packaged mini-split (single split, multi-split and VRF) air-conditioning units | | |
|---|---|---|
| Year | EER | Annual Full Load Hours Run |
| 2006 | 2.8 | 575 |
| 2007 | 2.8 | 575 |
| 2008 | 2.8 | 575 |
| 2009 | 2.8 | 575 |
| 2010 | 3.0 | 518 |
| 2011 | 3.0 | 518 |
| 2012 | 3.0 | 518 |
| 2013 | 3.0 | 518 |
| 2014 | 3.0 | 518 |
| 2015 | 3.2 | 489 |
| 2016 | 3.2 | 489 |
| 2017 | 3.2 | 489 |
| 2018 | 3.2 | 489 |
| 2019 | 3.2 | 489 |
| 2020 | 3.2 | 489 |

## Table A3

| Packaged movable (portable single duct) air-conditioners | | |
|---|---|---|
| Year | EER | Annual Full Load Hours Run |
| 2006 | 2.0 | 250 |
| 2007 | 2.0 | 250 |
| 2008 | 2.0 | 250 |
| 2009 | 2.0 | 250 |
| 2010 | 2.3 | 225 |
| 2011 | 2.3 | 225 |
| 2012 | 2.3 | 225 |
| 2013 | 2.3 | 225 |
| 2014 | 2.3 | 225 |
| 2015 | 2.6 | 213 |
| 2016 | 2.6 | 213 |
| 2017 | 2.6 | 213 |
| 2018 | 2.6 | 213 |
| 2019 | 2.6 | 213 |
| 2020 | 2.6 | 213 |

## Table A4

| Packaged ducted split air-conditioning units | | |
|---|---|---|
| Year | EER | Annual Full Load Hours Run |
| 2006 | 2.2 | 575 |
| 2007 | 2.2 | 575 |
| 2008 | 2.2 | 575 |
| 2009 | 2.2 | 575 |
| 2010 | 2.6 | 518 |
| 2011 | 2.6 | 518 |
| 2012 | 2.6 | 518 |
| 2013 | 2.6 | 518 |
| 2014 | 2.6 | 518 |
| 2015 | 3.0 | 489 |
| 2016 | 3.0 | 489 |
| 2017 | 3.0 | 489 |
| 2018 | 3.0 | 489 |
| 2019 | 3.0 | 489 |
| 2020 | 3.0 | 489 |

## Table A5

| Packaged roof-top systems | | |
|---|---|---|
| Year | EER | Annual Full Load Hours Run |
| 2006 | 2.6 | 575 |
| 2007 | 2.6 | 575 |
| 2008 | 2.6 | 575 |
| 2009 | 2.6 | 575 |
| 2010 | 2.8 | 518 |
| 2011 | 2.8 | 518 |
| 2012 | 2.8 | 518 |
| 2013 | 2.8 | 518 |
| 2014 | 2.8 | 518 |
| 2015 | 3.0 | 489 |
| 2016 | 3.0 | 489 |
| 2017 | 3.0 | 489 |
| 2018 | 3.0 | 489 |
| 2019 | 3.0 | 489 |
| 2020 | 3.0 | 489 |

## Table A6

| Packaged close control units | | |
|---|---|---|
| Year | EER | Annual Full Load Hours Run |
| 2006 | 2.6 | 4380 |
| 2007 | 2.6 | 4380 |
| 2008 | 2.6 | 4380 |
| 2009 | 2.6 | 4380 |
| 2010 | 2.8 | 4380 |
| 2011 | 2.8 | 4380 |
| 2012 | 2.8 | 4380 |
| 2013 | 2.8 | 4380 |
| 2014 | 2.8 | 4380 |
| 2015 | 3.0 | 4380 |
| 2016 | 3.0 | 4380 |
| 2017 | 3.0 | 4380 |
| 2018 | 3.0 | 4380 |
| 2019 | 3.0 | 4380 |
| 2020 | 3.0 | 4380 |

## Table A7

| Packaged (large) indoor units | | |
|---|---|---|
| Year | EER | Annual Full Load Hours Run |
| 2006 | 2.6 | 575 |
| 2007 | 2.6 | 575 |
| 2008 | 2.6 | 575 |
| 2009 | 2.6 | 575 |
| 2010 | 2.8 | 518 |
| 2011 | 2.8 | 518 |
| 2012 | 2.8 | 518 |
| 2013 | 2.8 | 518 |
| 2014 | 2.8 | 518 |
| 2015 | 3.0 | 489 |
| 2016 | 3.0 | 489 |
| 2017 | 3.0 | 489 |
| 2018 | 3.0 | 489 |
| 2019 | 3.0 | 489 |
| 2020 | 3.0 | 489 |

## Table A8

| Air cooled chillers | | |
|---|---|---|
| Year | EER | Annual Full Load Hours Run |
| 2006 | 2.25 | 500 |
| 2007 | 2.25 | 500 |
| 2008 | 2.6 | 500 |
| 2009 | 2.6 | 500 |
| 2010 | 2.9 | 450 |
| 2011 | 2.9 | 450 |
| 2012 | 2.9 | 450 |
| 2013 | 2.9 | 450 |
| 2014 | 2.9 | 450 |
| 2015 | 3.2 | 425 |
| 2016 | 3.2 | 425 |
| 2017 | 3.2 | 425 |
| 2018 | 3.2 | 425 |
| 2019 | 3.2 | 425 |
| 2020 | 3.2 | 425 |

## Table A9

**Water cooled chillers**

| Year | EER | Annual Full Load Hours Run |
|---|---|---|
| 2006 | 3.4 | 500 |
| 2007 | 3.4 | 500 |
| 2008 | 4.1 | 500 |
| 2009 | 4.1 | 500 |
| 2010 | 4.5 | 450 |
| 2011 | 4.5 | 450 |
| 2012 | 4.5 | 450 |
| 2013 | 4.5 | 450 |
| 2014 | 4.5 | 450 |
| 2015 | 4.9 | 425 |
| 2016 | 4.9 | 425 |
| 2017 | 4.9 | 425 |
| 2018 | 4.9 | 425 |
| 2019 | 4.9 | 425 |
| 2020 | 4.9 | 425 |

## Table A10

**Fan coil units**

| Year | Energy use factor[27] | Annual Full Load Hours Run |
|---|---|---|
| 2006 | 1.0 | 3120 |
| 2007 | 1.0 | 3120 |
| 2008 | 1.0 | 3120 |
| 2009 | 1.0 | 3120 |
| 2010 | 0.95 | 3120 |
| 2011 | 0.95 | 3120 |
| 2012 | 0.95 | 3120 |
| 2013 | 0.95 | 3120 |
| 2014 | 0.95 | 3120 |
| 2015 | 0.9 | 3120 |
| 2016 | 0.9 | 3120 |
| 2017 | 0.9 | 3120 |
| 2018 | 0.9 | 3120 |
| 2019 | 0.9 | 3120 |
| 2020 | 0.9 | 3120 |

## Table A11

**Absorption chillers**

| Year | EER | Annual Full Load Hours Run |
|---|---|---|
| 2006 | 0.7 | 500 |
| 2007 | 0.7 | 500 |
| 2008 | 0.7 | 500 |
| 2009 | 0.7 | 500 |
| 2010 | 0.7 | 450 |
| 2011 | 0.7 | 450 |
| 2012 | 0.7 | 450 |
| 2013 | 0.7 | 450 |
| 2014 | 0.7 | 450 |
| 2015 | 0.7 | 425 |
| 2016 | 0.7 | 425 |
| 2017 | 0.7 | 425 |
| 2018 | 0.7 | 425 |
| 2019 | 0.7 | 425 |
| 2020 | 0.7 | 425 |

## Table A12

**Air handling units**

| Year | Energy use factor[28] | Annual Full Load Hours Run |
|---|---|---|
| 2006 | 1.0 | 3120 |
| 2007 | 1.0 | 3120 |
| 2008 | 1.0 | 3120 |
| 2009 | 1.0 | 3120 |
| 2010 | 0.9 | 3120 |
| 2011 | 0.9 | 3120 |
| 2012 | 0.9 | 3120 |
| 2013 | 0.9 | 3120 |
| 2014 | 0.9 | 3120 |
| 2015 | 0.85 | 3120 |
| 2016 | 0.85 | 3120 |
| 2017 | 0.85 | 3120 |
| 2018 | 0.85 | 3120 |
| 2019 | 0.85 | 3120 |
| 2020 | 0.85 | 3120 |

[27] The normalised average specific fan power for Fan Coil Units at the current time (2007) is assumed to be 1, with a 10% improvement shown represented as 0.9 EEF

[28] The normalised average specific fan power for Air Handling Units at the current time (2007) is assumed to be 1, with a 10% improvement shown represented as 0.9 EEF and a 15% improvement shown as 0.85 EEF.