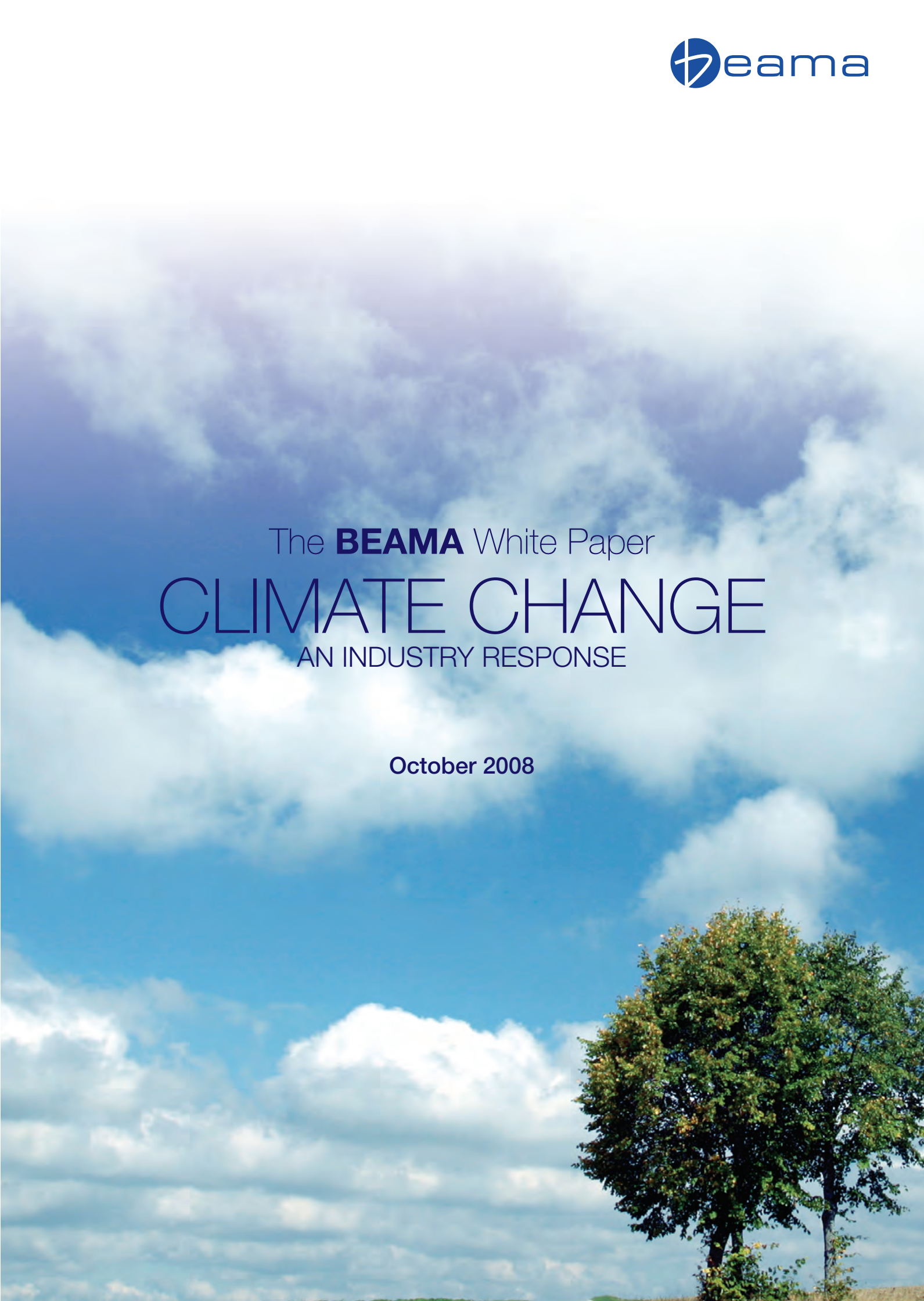
The **BEAMA** White Paper

CLIMATE CHANGE

AN INDUSTRY RESPONSE

October 2008



Contents

		Page
1.0	**Context – Carbon and Climate Change**	**1**
2.0	**BEAMA can influence change**	**2**
2.1	Industry solutions - key to meeting low carbon targets	2
2.2	Europe's growing influence	2
3.0	**Electrotechnical Sector and Its Influence**	**3**
3.1	Why the electrotechnical sector matters in carbon terms	5
3.2	Can BEAMA members' products make a difference?	5
4.0	**Manufacturers Can Reduce Carbon Emissions**	**7**
4.1	Approaches using BEAMA members' products	7
4.1.1	Helping energy end-users to change behaviour	7
4.1.2	New networks and buildings must be lifetime future-proofed for energy use	8
4.1.3	Early fitting of more efficient equipment in existing buildings/networks	8
4.1.4	Driving improvements in industrial energy use	8
4.2	Support for manufacturers is imperative	9
5.0	**Carbon Saving Potential from BEAMA Product Sectors**	**9**
5.1	Main sectors for carbon savings	9
5.1.1	Appliances and their components for specific end uses	9
5.1.2	Electrical transmission and distribution systems	10
5.1.3	Measurement and control equipment	10
5.2	All sectors need to work together	11
6.0	**The Right Framework For Carbon Saving**	**11**
6.1	A real partnership between Government and industry	12
6.2	Data and clear guidance to encourage R&D and reward innovation	12
6.3	Early equipment replacement policies for existing buildings/networks	13
6.4	Government information campaign to stimulate the supply chain	13
6.5	Long term forecast for the UK energy mix and carbon saving policy	14
6.6	Widespread building certification guiding energy saving investment	14
6.7	Improved framework for utility plant specification and investment	14
6.8	Enhanced skills and training focused on energy efficiency	15
6.9	Manufacturers publish performance targets/action plans	15
6.10	Success stories show industry performance and stimulate further action	16
7.0	**Appendix – Stakeholders**	**16**
	Executive Summary	**18**

Introduction

The BEAMA Climate Change White Paper provides a framework for the electro-technical industry, Government and other stakeholders to deliver of an estimated 30% reduction in energy losses and waste from the sector, equating to almost 6% of the UK primary energy demand.

BEAMA will use the White Paper framework to initiate a number of joint projects and programs for different product sectors, working with Government, their agencies and other market players.

The successful outcome of any industry activities has to have three objectives: a reduction in carbon emissions and related energy costs savings; the improvement of customer and client experience; and increased business for UK industry.

Many specific issues are raised in this White Paper, all of which need to be considered by the reader.

A full executive summary can be found on page 18.

1.0 Context – carbon and climate change

Most people are now aware of the growing and very serious threat facing mankind and our planet from man-made global warming causing climate change. This phenomenon is caused by 'greenhouse gas' carbon emissions - mainly carbon dioxide (CO_2) - into the Earth's atmosphere.

Recent estimates suggest that, if no action is taken, climate change will cost global society, up to the year 2200, €74 trillion in current prices (ignoring lost animal and plant species which cannot be costed).

Increasing scientific evidence shows that the pure financial cost to the global economy will be much lower if the global average temperature increase is limited to 2°C, though action will need to happen very fast to stay within that limit. Cutting emissions is the first priority, but if it can be clearly shown that this will – at the same time - save money, then real progress may start to be made.

This has been recently placed into true perspective by the 700-page Stern report, which shows in detail just where global warming will probably lead. Economist Sir Nicholas Stern suggests that global warming could shrink the global economy by 20%, but taking action now could cost just 1% of global GDP. Stern also argues that global warming will cost more than two world wars and the Great Depression together. Worse, large parts of our planet may become uninhabitable. Governments, business and individuals alike have to act NOW.

Therefore, the climate change challenge is becoming increasingly important for BEAMA and its members, which total around 300[1] companies in the UK electrotechnical and allied manufacturing industries. This is because it will affect business profitability and customer relationships. There are many problems to face but there are also many opportunities to increase business.

BEAMA is putting much effort into helping the industry meet the many challenges and make the most of the potential business opportunities. Members and industry stakeholders have been consulted to develop a climate change perspective for the industry. The aim is to combine this industry's traditional strengths of safety and innovation, with the pressing needs that climate change and the fast rising costs of energy demand.

Key to this is the creation of a new dialogue between industry and Government, from which to develop a genuine carbon-saving partnership. How is this to be achieved? The aim of this White Paper is to stimulate discussions and establish how both parties can best develop and integrate the strategies, products and technologies that can achieve the necessary long-term carbon and energy cost savings.

This White Paper focuses on the carbon emissions reductions that can be achieved through use of BEAMA members' products. It also demonstrates that, through reducing carbon emissions, these measures can significantly reduce energy bills and alleviate fuel poverty.

[1] Combined membership of BEAMA, CESA and LIF

2.0 BEAMA can influence change

Climate change is a key issue for BEAMA members, some of which have been involved in the 'carbon' debate for several years, helping their customers and Government achieve challenging carbon targets. Indeed, there have been notable success stories. These include achieving Government objectives, meeting client requirements and delivering value for members. BEAMA believes that these experiences can benefit members, end-users and Government.

It is only very recently that most BEAMA members have seriously discussed energy efficiency and carbon emission reduction strategies in their boardrooms. The scale of the problem is now reflecting itself in the scale of the response. Most boards now accept that 'carbon' is important, and many are clear that their company's future success depends, at least in part, upon being able to adopt clear and successful sustainability policies. The related issues of energy costs and supply security have only increased the importance for all BEAMA members.

2.1 Industry solutions - key to meeting low carbon targets

Support from industry, including that of BEAMA electrotechnical sector members, is vital in helping Government deliver a low carbon economy. To achieve this, BEAMA believes, Government and its agents must regard the industry as partners; not as the opposition. Agreed targets, plus timetables for market and product transformation must be developed in unison to enable low carbon solutions to be delivered without disruption for manufacturers, their clients and consumers. Both as an industry and individually, BEAMA members are already engaged with Government and agencies in many areas, but this must increase.

2.2 Europe's growing influence

Since 2007, the related issues of climate change and energy supply security have begun to dominate activities. Most strategic climate change and energy efficiency policies for the UK now come from Europe, so achieving significant carbon emission reductions will be greatly helped if UK policy makers and industry have enough influence in Brussels. As many BEAMA members are now either part of European-based companies, or have significant business within the EU, BEAMA has long worked in Brussels to provide guidance for all of its members about the impact of European policies.

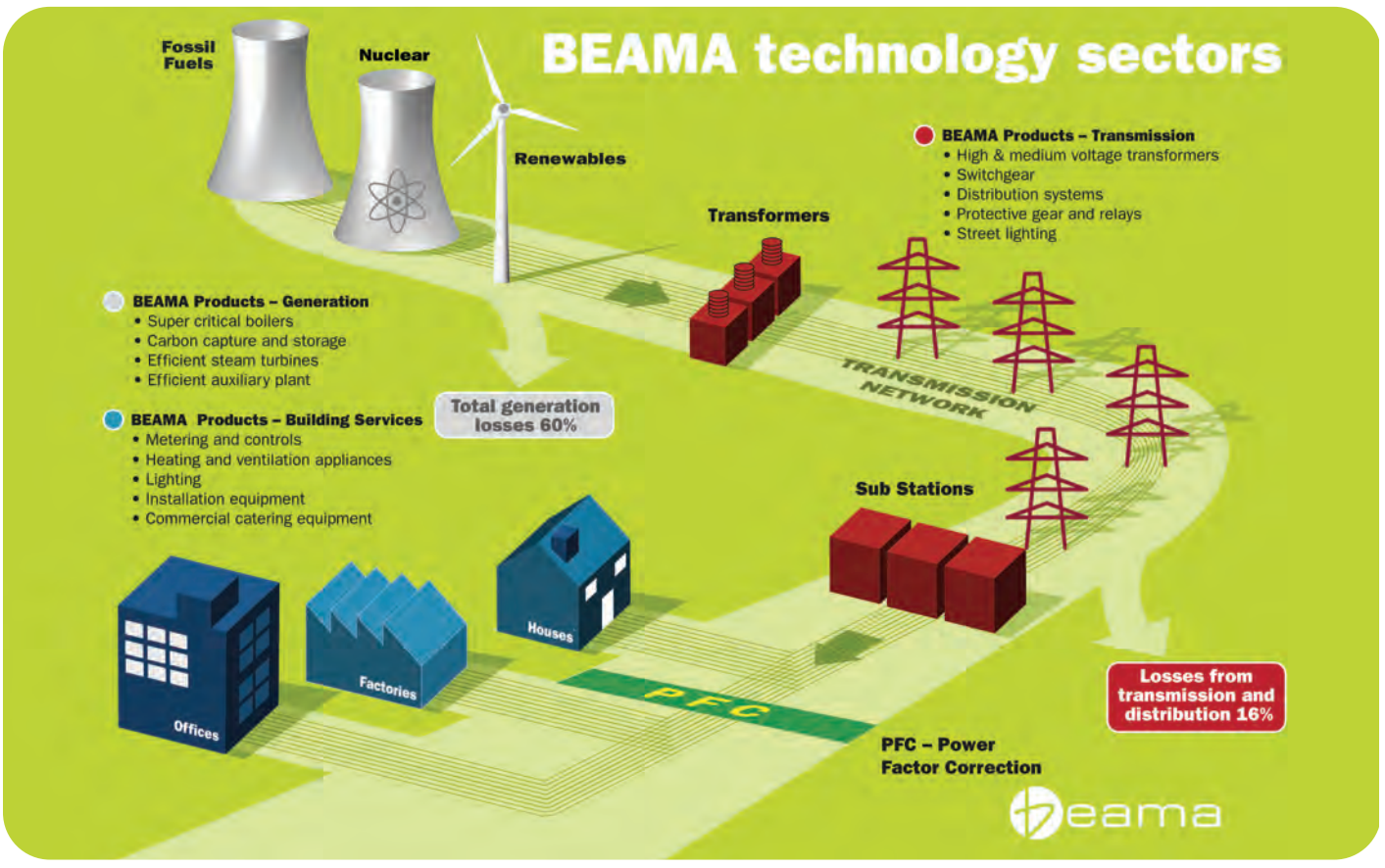
BEAMA also plays an active role in Electra, the major initiative organised by the EC and the European electrical and electronics industry. Electra sets out a framework for EC and industry co-operation to deliver key growth and competitiveness objectives, mainly through sustainability and energy efficiency. BEAMA will be promoting Electra's main themes to the UK Government. In addition to highlighting the UK's role, this White Paper presents Electra philosophy in a UK context.

3.0 The Electrotechnical Sector and its influence

'From the power station to the electric plug and socket' is the range of the UK electrotechnical sector influence, and BEAMA represents most companies involved.

It is important, therefore, to understand the sector in order to understand its importance in terms of UK electricity consumption – bearing in mind that this equates directly to energy consumption and consequent carbon emissions. Most BEAMA members manufacture 'Energy Using Products'. Figure 1 is a representation of the UK electrical supply system, showing where BEAMA members' products fit into it.

Figure 1



BEAMA's membership includes a broad range of technology sectors and also incorporates allied associations, such as the Lighting Industry Federation (LIF) and the Catering Equipment Suppliers Association (CESA) – see Appendix.

BEAMA member products

A Energy Generation

- Carbon capture and storage
- Supercritical boilers
- Efficient steam turbines
- Efficient auxiliary plant

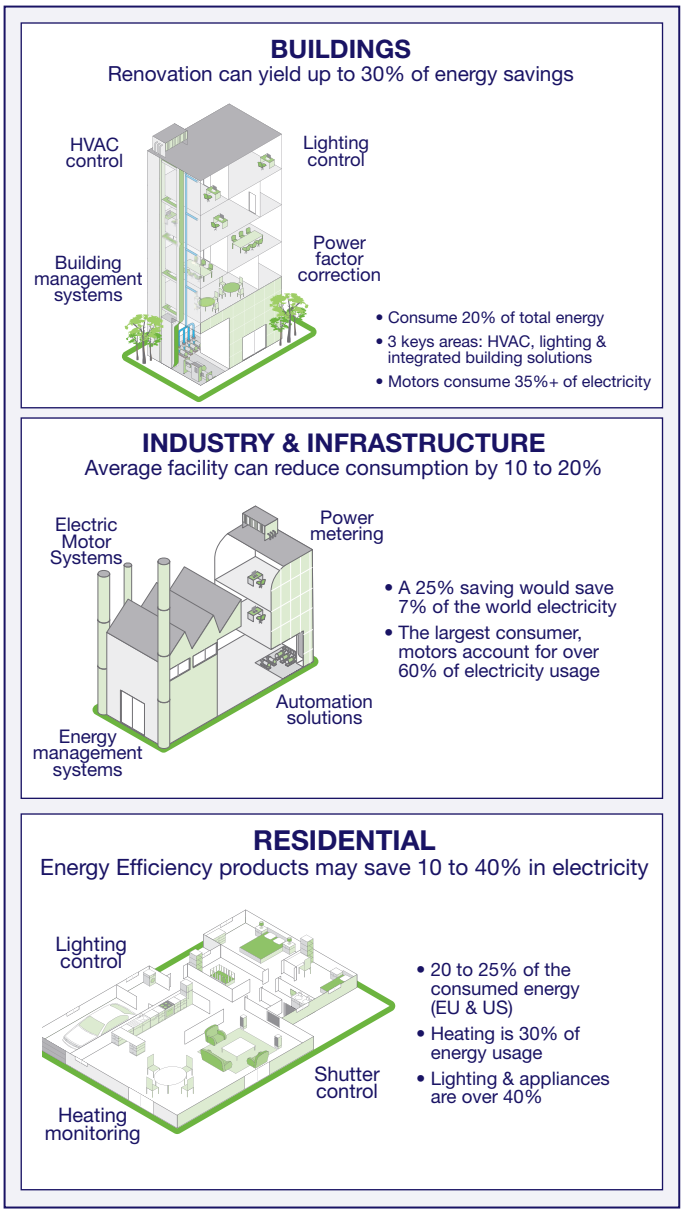
B Electricity Transmission and Distribution

- Transformers
- Switchgear
- Protective gear and relays
- Instrumentation transformers
- High Voltage (HV) transmission
- Medium Voltage (MV) transmission
- FACTS (Flexible AC Transmission Systems)
- HV DC transmission
- Flexible distribution networks
- Street lighting, equipment and controls.

C Domestic, Commercial and Industrial buildings

- Heat pumps (air and ground source)
- Smart utility metering and sub metering
- Building communication systems
- Lighting and lighting controls
- Heating controls for all heating system types
- Mechanical ventilation, including heat recovery
- Electric heating and hot water
- Solar thermal for buildings
- Solar electric (solar PV) for buildings
- Distribution boards, circuit breakers (and other distribution equipment)
- Fuses, consumer units, switch and fuse gear
- Wiring accessories (plugs, sockets), cable management products
- Power factor correction (PFC) equipment
- Communication cabling, busbars and accessories
- Energy and building management systems
  - For industrial and plant
  - For commercial buildings
  - For domestic buildings
- Commercial catering equipment
- Electric motors, and variable speed drives
- Welding equipment

Figure 2



Potential BEAMA related savings that can be achieved in buildings, industry & infrastructure and residential.

3.1 Why the electrotechnical sector matters in carbon terms

BEAMA members provide building and infrastructure technologies and products that influence all generation efficiencies, electricity use and system energy losses, as well as related UK carbon emissions and carbon abatement technologies. A summary of the electrical energy losses is given in Figures 1 and 2.

Losses from generation - The overall fuel efficiency for thermal power plant of all types and ages (excluding cogeneration, which is much more efficient at 80-90%) ranges from 30 – 50%. Therefore, energy losses from electricity generation plants are very large – the average is nearly 60%[2]. Indeed, this loss is greater than the total energy required by UK housing. Note, therefore, that BEAMA members provide much of the equipment for existing and new thermal fossil fuel and nuclear plant, as well as renewable generation power plants.

Losses from transmission and distribution - The transmission and distribution of generated electricity from the power plant to the end-user results in further losses of about 16%[2]. These can be split down further to specific parts of the network

Losses from end-use of electrical equipment - Electricity-using appliances in buildings and industry result in still further losses. These vary from over 80% for certain older lighting products (such as incandescent lamps), to very low for modern transformer and switchgear equipment. Further carbon emissions due to power loss are produced when electrical equipment is not used efficiently or correctly. Being at the end of the energy chain, end-use is particularly significant. Because of the overall losses in that chain, a single unit of electrical energy saved at point of use will save the equivalent of about three units of primary energy (e.g. energy in fuel) that would be needed to generate, transmit and distribute that energy.

Total losses – By the time electrical energy reaches buildings and industry for end-use, it has already lost 67%[2] of the original fuel energy. When used by equipment in those buildings, this can become as high as 90% (more typically around 80%). Therefore, only 20% of the primary energy used to deliver electricity to our homes and businesses is used to perform the required electrical tasks. The rest is wasted.

3.2 Can BEAMA members' products make a difference?

The opportunities for improving the UK electricity industry's energy efficiency are very significant. Information on those areas where savings can be made, and the strategies required to achieve these by Government and industry, form the main part of this White Paper. Potential energy generation improvements are not covered - we concentrate instead on the improvements that can be made to the delivery and end-use of electricity – that is, between power station to appliances and other electricity-using equipment. .

Consultations have indicated that BEAMA members' products could cut the combined losses from transmission, distribution and inefficient end-use by 30%. This equates to almost 6% reduction in overall UK primary energy demand – a very significant amount.

The exemplar on the following page highlights technologies that already contribute to energy savings, but which can be used to achieve a proportion of the estimated 30% improvement.

[2] BERR Energy Flow Chart 2007

EXEMPLARS – ENERGY EFFICIENCY PRODUCTS FROM BEAMA MEMBERS

BEAMA estimates that a 30% reduction in carbon emissions is achievable from the use of our members' products. The carbon emissions will result from a net reduction in the use of electricity, and hence less carbon emissions from the generation of that electricity, as well as from reduced combustion of other fuels (primarily gas) at point of use for heating and cooking.

There are four key areas from which these reduced carbon emissions can be achieved:

- Reduction of losses in the transportation and delivery of electrical energy
- Efficient integration of low carbon equipment
- Improvements in the efficiency of the end use appliances
- Control and monitoring of equipment to reduce excess energy use

There are many products and systems that contribute to the 30% figure; a number of these are outlined below. The figures quoted are, in the main, independently sourced. The overall figure of 30% has been estimated as a total from all of the individual carbon emission savings outlined – it should be noted that the individual savings are not simply cumulative.

Reduction of losses in the transportation and delivery of electrical energy

- Modern high voltage transformers deliver 3% reduction in energy losses compared with the average installed equipment, resulting in a 3% reduction in carbon emissions. These savings will endure for the lifetime of the asset – typically 20 to 30 years, and beyond.
- The phasing of electrical energy can be affected by the operation of equipment with high inductive loads. Out-of-phase electricity leads to a reduction in effective power typically of 5%. The use of capacitor based power factor correction equipment can reduce these losses to almost zero, leading to significant increases in the effective efficiency of networks and equipment, and reducing the carbon emissions for delivering electricity to end users.
- Distribution switchboard rooms in large commercial buildings often produce significant heat losses, and even require additional air-conditioning. The installation of efficient and integrated equipment can reduce losses significantly, and may also reduce the need for air conditioning.

Any reduction in losses makes the carbon efficiency of all electrical equipment and appliances more carbon efficient.

Efficient integration of low carbon equipment

- The increased use of renewable generation equipment in local or buildings networks is a key part of reducing carbon emissions. To maximise the benefits from these technologies, appropriate electrical infrastructures in local and building networks need to be designed and installed. The losses attributable to these inefficiencies are difficult to quantify, but some estimate that up to 15% of the generated zero carbon electricity is lost. Use of appropriate equipment specifically designed for these renewable systems can reduce these losses significantly.
- Extra low voltage equipment and lighting in all buildings has led to the increased use of transformers from mains voltage AC to low voltage DC. The efficiencies of these products vary considerably, and losses can be as high as 25%. There are many opportunities in a number of areas to reduce these losses through the use of more efficient transformers, the use of innovative wiring arrangements, or the use of automated switching equipment.

Improvements in the efficiency of the end use appliances

- The use of variable frequency control fans in ventilation equipment can deliver a 40% reduction in energy usage.
- The switch from AC to DC powered ventilation equipment can deliver 60-65% improved operational efficiency, and better heat exchanger efficiencies can result in a 30% improvement in recovered heat.
- Heat pumps recovering heat from air or ground deliver space heating and hot water at 300-400% higher efficiency than traditional fossil fuel systems.
- The shift from existing installed lighting equipment to low energy Compact Fluorescent Lamps (CFLs), halogen lamps and Light Emitting Diodes (LEDs) can deliver up to 70% reductions.
- The use of electric induction hot plates improves the energy efficiency of commercial cooking by 40-50% compared with conventional gas or electric hobs, and gives an additional indirect energy saving, which is achieved because less heat is generated, so less kitchen ventilation is needed.

Control and monitoring of equipment to reduce excess energy use

- Smart metering systems for electricity, gas and water utilities deliver significant energy reductions. They achieve this by providing information for consumers, by automatically controlling equipment, and by facilitating demand response techniques. Conservative carbon reductions of 5-10% are reported from world examples.
- Advanced heating controls are available for use with all gas heating systems. Independent evidence shows that savings of 6% are achieved compared with traditional well-controlled systems. Significantly higher savings can be achieved by upgrading all systems to minimum levels of control (10-20%).
- Building Automation Systems (BACS) in commercial buildings can save up to 20% of Heating Ventilating & Air Conditioning (HVAC) consumption. Actual efficiency figures depend upon site-specific factors and installation and maintenance.
- Lighting controls using constant dimming and occupancy & time switching for commercial and domestic buildings. Energy use reductions vary, but robust evidence shows on average 20% – 30% reductions in lighting usage.

4.0 Manufacturers can reduce carbon emissions

The main so-called 'greenhouse' gas resulting from mankind's activities that is causing global warming is carbon dioxide (CO_2). Reducing CO_2 emissions is a global target set at the Earth Summit in Kyoto in 1997; within this framework, the EC has set its own target to cut CO_2 emissions by 20% by the year 2020. The UK Government a more ambitious target of 26%. Note that many climate change scientists say that even this is insufficient.

This White Paper proposes solutions that will assist the UK to achieve these objectives whilst maintaining and, possibly, also enhancing the UK electrotechnical industry's performance.

Adopting energy efficiency policies will also improve security of energy supply, reduce running costs for customers, foster industry competitiveness, stimulate growth and support the development of energy efficient technology markets. In short, energy efficiency policies should improve business.

'Eco design' is very important. Here, great care is taken with material specification, reducing energy used in production and transportation, and minimising waste at the product's end of life. However, BEAMA members believe that the most relevant way to reach the common goal is to target energy efficiency in electrical power generation, transmission, distribution and end use applications. Importantly, this also means making better use of electricity by substituting inefficient equipment and systems with more efficient technologies. This is often already technically possible and economically feasible.

However, there are many cases where the best performing equipment is not specified. Reasons include lack of customer awareness, too few Government prescribed performance targets, no stringent minimum performance standards and poor market incentives.

4.1 Suitable approaches using BEAMA members' products

There are several ways in which BEAMA members' products can be used to reduce energy usage:

- By helping energy end-users change behaviour
- Through early replacement of equipment in existing buildings and networks with more efficient technologies
- By future proofing new builds and installations in terms of lifetime energy usage
- By driving improvements in industrial energy use.

All of these, for which BEAMA members can provide assistance, are needed to achieve the overall objectives.

4.1.1 Helping energy end users to change behaviour

Encouraging end-users of electricity to operate equipment, appliances and buildings in more efficient ways will only work properly if they are aware of their energy consumption, and environmental consequences, in the first place. So-called 'smart metering' is important in this respect.

BEAMA has been a leader in promoting the development of smarter metering and building controls that provide this basic information. Using such tools, end-users are more likely to change their habits and make the operational changes that lead to energy savings. However, such equipment can be used still more effectively once other appliances and equipment are linked electronically into it, especially with automatic controls.

BEAMA believes that the development of energy service companies (ESCOs) by energy utilities and other providers should be encouraged. Such organisations can help finance measures, or plant design construction and management. They can also encourage customers to take action in reward for a longer customer relationship tied to asset and energy management.

Although current Government thinking for the Supplier Obligation, post 2011, is less likely to create ESCOs, BEAMA believes that through bringing manufacturers and energy suppliers together, it can propose well-structured ESCOs having appropriate measures and on-going customer support programmes. ESCO business models could, together with smarter control and data systems, lead to a radical change in energy utility customer relationships, resulting in significant energy use and carbon emissions reductions.

The challenge, therefore, is for BEAMA to facilitate the relationship between suppliers, manufacturers and other parts of the electrical supply chain to develop guidelines and best practice for well-focused energy service propositions. BEAMA is well positioned and connected to bring relevant associations and commercial stakeholders together to help meet this challenge.

Recent reports in Europe suggest that use of Demand Response[3] could reduce its energy usage by a very large amount - equal to the total residential energy use of Germany and Spain. BEAMA members, in co-operation with utility partners, would like to explore the potential for new customer tariff offerings that affect time-based electricity consumption, such as shifting demand to night, or restricting energy demand based on price packages and two-way metering communication with the customer, or with smart appliances.

[3] Cap Gemini 2008, Demand Response: a decisive breakthrough for Europe. Where electricity grids are concerned, demand response (DR) refers to mechanisms that manage customers' electricity demand in response to supply conditions. An example might be electricity customers reducing their consumption at critical times, or in response to market prices. This is different from energy efficiency.

4.1.2 New networks and buildings must be lifetime future-proofed for energy use

New installations and buildings must make use of the most energy-efficient equipment. For example, every house on any new housing development should be installed not only with the most energy-efficient equipment, but also with an electrical infrastructure that encourages efficient use. For this reason, modern metering and control systems, plus integration of on- or off-site renewable electricity generation, should complement installed energy efficient products and systems. It is also essential to manage electrical energy delivery from wider networks to individual buildings in the most effective way.

Similarly, if new distribution or transmission networks are established, or major upgrades allowed under the Ofgem Price Control Reviews - perhaps to service a new power station, or to build a private wire or distributed energy network for a local community - these should always be specified using the best and most efficient equipment available. This sometimes already happens, but often, significant energy saving opportunities are lost because the most efficient equipment available from BEAMA members has not been chosen. Bear in mind that inefficient equipment often operates 24 hours a day, 365 days a year, and for 20-30 years or more, so this is very important. BEAMA is ideally placed to help Government set minimum standards for asset renewal and installation, in partnership with industry.

4.1.3 Early fitting of more efficient equipment in existing buildings and networks

The new build sector is important, but it accounts for less than 1% of the existing stock in all segments, so tackling this alone will not achieve the required overall emission reduction targets. Around 80% of the installed networks and building stock for 2020 already exist. Policies must, therefore, focus on existing systems and buildings, as these are clearly the most important in terms of replacing existing equipment with the most efficient technologies.

Note that the types of electrical equipment manufactured by BEAMA members may be installed for 30 years, and sometimes even a century. Replacement at such slow rates will clearly not make an impact on carbon emissions in anything like the timescales that Government is demanding, so policies should be aimed at promoting much earlier equipment renovation or replacement using the most efficient techniques.

Looking at existing networks and buildings, it is crucial that such action is taken because of the sheer magnitude of the changes required. Action is a matter of urgency in the commercial and industrial sectors, and BEAMA believes that well-structured 'Return On Investment' advice packages will be the major breakthrough in encouraging asset replacement. Such packages must put a price on carbon over the product's lifetime, including suitable levies and carbon trading that works as originally intended. They must also broaden the focus from mere capital investment and payback considerations to taking whole life costing into account. Such packages must be developed through dialogue with industry and should provide:

- Advice on the difference between standard and most efficient equipment
- Advice on energy related financial savings linked to energy-based payback
- Advice on projected carbon-related financial savings, linked to carbon pricing and avoided emissions trading.

All such advice must be easy to understand at point of purchase.

4.1.4 Driving improvements in industrial energy use

Industry consumes around 39% of UK delivered electrical energy. The overall energy reduction possible is estimated at in excess of 10%, but there are big differences between industry sectors. For example, potential energy savings of between 30 - 65% are possible for many processes.

The recommended approach for improving energy efficiency in industry is a professional audit of equipment inventory, an assessment of the energy savings potential for all such equipment, and an action plan with monitoring and reporting.

Technologies that improve energy efficiency are readily available - electric motors are installed in all manufacturing plants and consume nearly 70% of the electricity used in industry, yet 88% of motors are not electronically controlled today. Out of these, around half can be equipped with variable speed drives to achieve part load energy savings of up to 50%.

Waste heat recovery has an important role in fostering energy efficiency. Approximately one third of the energy used in industry is heat. Industrial waste heat is generated in many processes and often discharged into the atmosphere. This is pure waste. Whenever surplus process heat can no longer be used downstream processes, producers should consider transforming it into electrical power. Controlled lighting systems, optimised transformer loads, plus better quality and service through using uninterruptible power supplies (UPS) are other technologies that can help achieve energy efficiency targets.

The challenge is to ensure that new investments are based on standards and that existing installations are renewed or retrofitted whenever economically feasible. Investment decisions in energy efficiency measures need to become a strategic management decision; unfortunately, however, productivity or production investments usually come first.

Businesses and associated regulation will, therefore, need to make energy management and energy efficiency as important a topic as quality and safety. It is crucial that end-users also receive better information through metering and monitoring. Reducing or eliminating economic constraints is important, as return on investment is fundamental for industrial organisations, which usually aim to make payback times as short as possible.

4.2 Support for manufacturers is imperative

The only way that many Climate Change driven policies can be successfully implemented is by businesses accepting that they will benefit overall from investment in the development of energy efficient low carbon technologies. Government should accept that energy and carbon emission reductions will only come about through manufacturers achieving profitability by developing, testing and marketing new energy saving products that reduce carbon.

Government should fully support the development and deployment of promising technologies, as only with consistent, long-term Government goodwill, political support, and appropriate funding, will these new technologies become mainstream and deliver the necessary lower carbon future.

So far, BEAMA members have been disappointed with manufacturer incentives for the development of new energy-saving technologies and products - in particular, for the validation of performance to qualify for government related grants, advice delivery and building regulation compliance recognition (i.e. carbon benefits within DEFRA's Standard Assessment Procedure). BEAMA believes that Government must encourage manufacturers through simplifying the 'proofing' process, tax breaks and other incentives, and with clear funding streams that will allow evaluation and development of such new technologies. Funding should also provide for results to be used for national calculation models linked to broader policies such as Energy Performance Certificates, CERT/Supplier Obligation and Building Regulations.

Armed with the confidence of proper Government support, most BEAMA companies will invest in, and market, more efficient products, including 'zero carbon' related offers. BEAMA believes that it is a key role of Government and Regulators to provide the *consistent* legal and regulatory framework for such necessary confidence to develop. It is also necessary in order to work with other organisations in individual supply and distribution markets to ensure there is market pull. Such business opportunity has been the underpinning theme of the Stern report (2006).

5.0 Carbon saving potential from BEAMA product sectors

The potential for energy efficiency gains in BEAMA product sectors varies. This is because of individual functions and primary purposes, and the product or component's interdependency with other technologies. Therefore, BEAMA has identified three main strategic areas where carbon savings can be achieved.

5.1 Main sectors for carbon savings

The main sectors that show real potential for carbon savings that BEAMA has identified are:

5.1.1 Appliances and their components using electrical energy for specific end-uses

Electrical Equipment - The energy saving that can be achieved through improving the operational energy efficiencies of appliances is significant, and there are clear opportunities. Examples include heating, ventilation, lighting and commercial food service applications. Indeed, these have all seen recent operational energy efficiency improvements; more can be achieved. To achieve this, it is vital that the products or systems concerned remain fit for original purpose and suitable for market. Furthermore, any associated efficiency targets must be reasonable, with recognition that potential energy savings can vary greatly between products.

It is essential that agreement be reached with industry from the outset that opportunities to improve are genuinely feasible and must be quantified by standards. Test methodologies should be closely related to product applications, and common methodologies and standards must be established in order to measure, record and report performance criteria in a coherent way.

Also, realistic timescales for sector market transformations are very important for companies aiming to plan, invest, manufacture and promote the new technologies and products.

Components - Some BEAMA members also manufacture components that are parts of appliances – these too can often contribute to efficiency improvements. Some are controls and sensors which manage operation time, temperature or speed; others are electric motors and transformers for a wide range of applications. Often, the appliance improvement is through the better performance of its constituent motor or transformer. Relatively small improvements in the efficiency of such products can bring significant savings on a national scale.

Therefore, it is important to set component efficiency targets, and their effect on overall product performance assessed. It is also essential that industry be given the flexibility to use R&D programmes to achieve this. As part of such R&D work, industry should be able to identify its return on investment. This will allow market forces to operate in harmony with agreed energy saving objectives.

Systems - Where items of equipment subsequently form part of a system, the overall performance of that system must be considered. Loading, operating hours and effectiveness parameters must be clear, so as to substantiate efficiency claims.

Many BEAMA members supply building and energy management systems, which can combine and increase the energy efficiency benefits of individual products.

Regulatory influences - To make planning, investment and the bringing to market of new technologies and products as easy as possible, regulatory stability is needed. There are a number of current and proposed European directives, and UK regulations, seeking to improve the efficiency of products in many sectors. BEAMA and its members are involved in the discussions on many of these proposals. Increasingly, we find that such proposals, coming as they do from different Departments, often contain overlapping, conflicting and sometimes duplicated requirements. Yet all attempt to regulate essentially the same design aspects of similar products.

It is clear that both UK and EU policies in the shape of regulations and directives need to keep to their intended purpose and not creep into other work scope (e.g. confusion between building and product related legislation). BEAMA believes such overlap is the result of policy departments seeking to stake claim to carbon savings at the expense of well-considered policy.

BEAMA looks to the UK Government to understand the industry's need for re-evaluation of such overlapping proposals. Where necessary, the Commission should be told that it is essential to give industry stability so that it can push forward with products that achieve agreed efficiency targets.

5.1.2 Electrical transmission and distribution systems

In a perfect world, electrical distribution systems would allow all generated electrical energy to be available for end-users. However, no such systems exist, as there are losses inherent in all transmission and distribution equipment.

Power losses can be defined as 'the difference between the amount of electricity entering the transmission system and the aggregated consumption registered at the end-user's electricity meter'. All such losses waste money and energy, and also almost always result in extra carbon emission. In the UK, these energy losses are estimated at 16% (BERR Energy Flow Chart). This is currently unavoidable, but the problem needs to be addressed.

Solutions include Network Operators (NOs) changing equipment procurement procedures. Some solutions can be implemented immediately; others require a long-term perspective on the future of the networks. One approach that could be taken up quickly is to ensure that new network equipment purchased is always the most efficient possible. For example, very efficient distribution transformers are easily obtainable, yet lowest first cost is often the main consideration. Such equipment may be installed for at least 20 – 30 years, so it is essential to provide incentives encouraging replacement with energy efficient alternatives as soon as possible.

There could be a tax on equivalent carbon emissions, and other incentives include ensuring that greater emphasis is placed on losses, or adding the cost of carbon to the price of inefficient equipment. Incentives should also encourage investment long term, so that network equipment is not operating well beyond its design life.

Further ahead, transmission and distribution grids need to be energy efficiency optimised, and another longer-term solution is 'Super Grids'. These, using high voltage direct current (HVDC) and 'smart grid' technologies, can improve transmission and the distribution grid flexibility, capacity and energy efficiency. Indeed, there is a need for fundamental grid restructuring, not least because it will eventually have to cope with accepting and collecting electrical power generated from millions of decentralised micro renewable sources spread over Europe and the UK. Note that decentralised power has lower energy losses, because the electricity so generated flows through reduced size of networks. Greater energy security is also a benefit.

However, BEAMA members cannot do all of this on their own. It requires long-term co-ordination from Government and its agencies, probably outside the currently implemented UK five-year review cycle.

5.1.3 Measurement and control equipment

Once electricity is distributed to efficient appliances and electrical equipment, further improvements can be achieved through effective control. This must allow the user's appliances and equipment to perform as designed, while minimising wasteful over-performance. Control products that can automatically operate electricity systems, appliances and equipment as efficiently as possible can deliver the greatest energy savings. Combined with better equipment efficiency and improved distribution, control completes the circle of efficiency gains possible from BEAMA members' products.

Basic control – ensuring that the product or system only runs when required – is common in most buildings. Heating thermostats, for example, automatically turn the heating off when no heat is required. This reduces the energy used in gas-fired systems by 9%, rising to 17% if combined with compatible products. Similar control strategies are used in ventilation systems and, increasingly, in commercial lighting installations.

Higher control levels can be used with 'smarter' systems installed in local energy networks or in buildings. Correctly applied, such technologies can reduce energy use still further. For example:

- Controlling and managing building electrical loads to match the availability of lower carbon electricity available on the grid. This could reduce the need for new generating plant.
- Developing controls such that electrical appliances and equipment use the supplied electrical energy only in the most efficient way, also closely matching the occupancy and behaviours of people in the building (e.g. switching off lights automatically at the end of the working day)
- Establishing a non-proprietary 'open' protocol to ensure communication between suitable controllers and appliances from all manufacturers. This will make the integration of a variety of appliances, controls and other technologies easier, so that they work together to provide optimum comfort for minimum energy input.

5.2 All sectors need to work together

This basic outline of the contribution that BEAMA member's products can bring highlights that it is not just one sector of the industry that can contribute to efficiency gains, and carbon emissions reductions, but all sectors working in all areas of electrical networks and buildings.

The remainder of this White Paper outlines BEAMA and its members' view that Government, industry and wider stakeholders need to develop new approaches to policy and delivery that will lead to the greatest savings and bring the business benefits that they strive for.

6.0 The right framework for carbon saving

BEAMA has identified that the following elements that need to be in place, as part of integrated framework, to move the electrotechnical industry energy efficiency market in the right direction:

- A genuine Government / industry partnership
- Clear guidance encouraging R&D and rewarding innovation
- Policies to drive early equipment replacement in existing buildings and local networks based on lifetime carbon savings
- Government information campaign stimulating the whole supply chain to take carbon saving action
- A long term forecast for the UK energy mix and carbon saving policy
- Widespread building certification that guides energy saving technology investment
- Improved framework for capital plant specification / investment by utilities
- Enhanced skills and training focused on energy efficiency
- Manufacturers publishing sustainable performance targets and action plans
- Case studies and success stories to stimulate further action.

6.1 A real partnership between Government and industry

BEAMA proposes a more proactive and formal 'partnership' with Government. This is currently lacking and the electrotechnical sector's role in tackling sustainability is neither recognised nor encouraged. BEAMA also realises that, in addition to developing energy saving products, the industry must also provide product performance information and likely costs for Government to use. There are various ways in which such a partnership can deliver benefits:

- Industry helps government to shape commercially viable and effective policy that delivers carbon savings proven by real regulatory impact assessments
- Government helps industry by giving sufficient prior warning of impending policy, and by asking for advice where there may be problems (e.g. a lack of trained installers, as was the case with the switch to condensing boilers in the Building Regulations)
- Industry helps government by providing feedback on how the market is delivering.

Below are examples of issues that such a partnership could address:

a) Recognition of the limitations of impact assessments

Greater use of impact assessments should ensure that only cost- and carbon-effective products and measures are regulated for use. However, it is important that Government understands that industry is legally restricted in the financial information it can provide. This is especially so for future products costs, for which there is no current market price, and any discussion by members on potential future costs is restricted by European and UK competition law. There are serious dangers that realistic cost- and carbon-effective measures are will not be regulated, or even encouraged by Government, because of the lack of accurate or legally available data.

b) Public procurement and large scale infrastructure specifications

Partnering for sustainability in the public procurement process can be achieved, but success relies on industry and Government together developing specifications. For example, major national infrastructure projects need detailed specifications for building services and related transmission/distribution infrastructure products and systems.

Indeed, BEAMA members are often involved in large infrastructure projects, and the most efficient products or systems are often not installed, mainly because they are considered too costly. To ensure that end-users and/or purchasers specify the most appropriate efficient technologies, they need incentives. Market mechanisms, such as appropriate carbon pricing and minimum efficiency requirements are good examples. Such measures will help ensure that appropriate current and future technologies can and will be specified.

BEAMA members are willing to work with government to set the framework for best sustainable design and technology specifications for all public procurement projects.

6.2 Data and clear guidance to encourage R&D and reward innovation

Most Government policy relating to carbon saving products requires agreed performance data, but there is often tension between industry claims and the need for government to use independent data. Such data is derived from agreed international standards, which largely underpin proposals from EUP Directive preparatory studies. This is a well-established methodology used in product safety.

BEAMA members regularly organise new product pre-commercial field trials. Trial data can be provided for further performance claim qualification, but data gathering must be carried out using a clear and transparent process to ensure that it follows a Government-agreed method.

BEAMA feels that, in terms of partnership, Government should be more open to using manufacturers' declared performance figures when backed by formally agreed standards. BEAMA would expect to see published field trial guidance notes, which would help ensure that industry's own field trials and end-results are acceptable to policy makers. This would also simplify and speed up the development of policies such as Carbon Emission Reduction Target (CERT) and tools such as Standard Assessment Procedure (SAP) and Simplified Building Energy Model (SBEM).

Companies manufacturing high efficiency products need to prove that their products are different from those of their competitors in terms of performance. Without this, there is no incentive to innovate and sustainability objectives cannot be met. Therefore, if Government wishes to successfully encourage industry to help deliver its sustainability targets, it will need to commit to one or more of the following:

(i) Adequately fund schemes that recognise better performing products in commercially relevant policy tools (i.e. substantial funding for developing national calculation model figures with manufacturers). All schemes should be backed by a transparent competitive procedure for testing and performance ratings

(ii) Ensure that national calculation models only use energy efficiency performance data consistent with that derived from recognised global, European or British Standards, or determined by an EU energy performance label

(iii) Be specific and consistent about required field trial data to support manufacturers claims (i.e. type of data required, scale of trials required).

Manufacturers are driven by R&D budget demands that consider more than just sustainability functionality. Examples include the provision of adequate heat or ventilation, or the incorporation of customer features and benefits, such as a simple user interface (knobs, indicator lights, keypad etc), low noise level or smaller size for space saving. To encourage manufacturers to incorporate carbon saving features, it essential that they are:

(i) Aware of what drives selling of those carbon benefits (i.e. links to policies and incentives)

(ii) Able to understand formal performance measurement tools such as national calculation models, so as to gain earliest possible commercial benefit

(iii) Able to understand the context of carbon savings as a 'marketing currency'

There is much work to be done by industry and Government on this, because manufacturers, Government and customers do not always fully take on board the above issues.

6.3 Early equipment replacement policies for existing buildings and local networks based on lifetime carbon savings

There is considerable scope for the early replacement of equipment in energy networks and in buildings. BEAMA believes that there are many products and systems that could be deployed in the market before existing equipment fails. We believe that there should be an assessment methodology that would allow Government, customers and industry to determine workable options. A range of inputs would be required. The most important of these are the length of time before natural replacement, the carbon emissions 'lost' by the installation over this period, and potential emissions reductions if the equipment was replaced.

It will be important to provide – at point of purchase – clear information on how much energy an appliance or system will save. This will ensure that purchasers consider a product's whole life energy and carbon costs, including the costs of levies and carbon trading. Then, energy costs could be effectively expressed for the product's lifetime. The aim is for potential purchasers to compare the true costs of energy efficient technologies against their less efficient equivalents.

6.4 Government information campaign to stimulate the whole supply chain to deliver carbon saving actions

There has been, BEAMA believes, a missed opportunity. This is because too much Government campaigning has been targeted at householder and business end-users, with not enough being aimed at manufacturers, distributors, merchants and contractors. Only through Government motivating each supply chain level will end-users fully realise carbon saving solutions.

The best way for Government to influence each supply chain segment is to work in partnership with them, and to use the expertise and knowledge of relevant trade associations representing manufacturers, distributors and contractors. BEAMA believes that there is a logical conduit to engage with the supply chain in encouraging its own well-informed marketing campaigns. This is the Energy Saving Trust and the Carbon Trust, using funding and the co-ordination of key messages.

6.5 Long term forecast for the UK energy mix and carbon saving policy

Businesses need time to react to policy changes. This is why it is essential to announce policy direction early and stick to it. Good examples include the long-term commitment to building zero carbon homes in by 2016, the phasing out of incandescent lamps by 2011 and the three year advance notice of the switch to condensing boiler installations in 2005.

There are examples of poor policy direction that have a significant adverse effect on BEAMA members. Most pressing is a need for clarity on centralised energy carbon figures. These affect the way that industry perceives the long-term sustainability of certain technologies, specifically heat pumps and electric heating.

BEAMA members expect the Government to help industry to consider its forward product development strategies appropriately. It is impossible for industry to plan for future product strategies without understanding how these will be judged by Government and agencies.

6.6 Widespread building certification guiding energy saving investment

An effective tool for driving energy efficiency improvements is building certification. However, its potential is likely to be missed if it does not provide a robust framework for such improvements and isn't used as a focal point for other policy interventions. In particular, certification should be structured so that all buildings are capable of being a 'G' (if nothing has been done to improve them) or an 'A' (if all potential improvements are carried out). This is more difficult to implement than the current approach but has clear benefits for all:

- Building owners can see a tangible reward (through a rating increase) for relatively modest work, plus a clear path to reach the highest level.
- The certification will allow industry to communicate with building owners about their current rating and to show tangible improvement to that rating through application of their products.
- Government will be able to set - without political backlash - achievable minimum standards for all properties that apply at, say, point of sale [4]. It can also set fiscal incentives so that higher rated properties are in lower taxation bands.

Certification could be carried out voluntarily using a web-based tool for self-completion so that its impact would be more widespread. Such an approach could be a necessary requirement for individuals and companies receiving government grants, and it would allow a comprehensive database to be built so that policy makers can target specific measures. The database would be continually added to or updated by installers and service engineers, and through formal certification by trained assessors.

6.7 Improved framework for capital plant specification and utility investment

The capital plant situation can best be explained using transformers as an example. Distribution and power transformers are customised products mainly used in power generation and in power grids at various voltages. In such applications, transformer efficiency depends largely on how it is used. When utilities buy transformers, they often choose on the basis of lowest first cost, as already explained in Section 5.1.2. The potential reductions that can be achieved in this sector by substituting old high loss transformers with new high efficiency ones, is high. However, transformers may not be optimised for best energy efficiency. Manufacturers can make efficient transformers, but – as stated earlier - it is for utility purchasers to order them.

Government and Ofgem need to think about how best to provide utilities with incentives. Approaches include ensuring that greater importance is placed on losses, or adding the cost of carbon because of the losses to the price.

Utilities need to invest for the long term, ensuring that the networks are made up of equipment – such as transformers - operating within its normal design life, and suitable for the flexible handling of anticipated extra distributed generation capacity. All inefficient equipment still operating beyond its design life must be replaced by 'state of the art' equipment, phased in and completed by 2020. Moreover, utilities must publicly declare progress on eliminating old equipment.

[4] To extend the example, the current Energy Performance Certificates for housing are based on an overall A to G rating in relation to the whole stock. Setting minimum standards in this context would lead to compulsory demolition for some houses and fiscal incentives for higher rated properties.

6.8 Enhanced skills and training focused on energy efficiency

Industry and Government collaboration on energy saving products and systems will be worth little if these are not delivered in the market place to where they are required, and then correctly installed and maintained. It is crucial, therefore, that the whole electrotechnical industry is sufficiently skilled to ensure the successful introduction of new energy efficient products. BEAMA member companies' work forces must also be suitably skilled. Some such skills will necessarily be new - posing a challenge for any company, but appropriate Government initiated skills and training programmes can help.

Those people working in delivery chains and in the installation industries (electrical wholesalers and electrical contractors respectively) also need appropriate up to date training so that they maximise opportunities. The importance of this is often forgotten.

(i) Operations

Looking ahead, product designers will have a more open brief, less tied to existing materials and current manufacturing techniques. By definition, therefore, operations will need to be much more flexible, and new processes and materials will require workforce skill training at a time when apprenticeships and on-the-job training are at low ebb. This difficulty must be overcome.

In future, processing costs will include carbon content as well as cash cost, and optimisation rules will need to be developed, possibly leading to different strategies. These might include:

- Sourcing policy - partnership, dual and multiple
- Manufacturing policy - make-or-buy, subcontract
- Lean manufacturing - just-in-time, rapid change-over
- Service level - stocking policies, distribution planning, delivery strategy, service or exchange.

More than mere data monitoring will be required. Mathematical algorithms will allow management to quickly evaluate and, if necessary, make suitable changes. All of the above will require a greater workforce skills base at all stages of the operation.

(ii) Market

A new view of the supply chain will emerge with a more integrated specifier/manufacturer/supplier/installer/end-user model. It becomes much more of a closed-loop process when end-of-life treatment or disposal is added, so re-manufacturing, using recycled waste materials, will become a viable option, as follows:

- Upskilling at specifier level – using CPD on products, specifiers will need better knowledge of end-user needs in order to make informed choices
- Distributor/wholesaler stage – using relative product knowledge
- Installer stage – based upon effective installation, testing, troubleshooting and repair strategies
- End-user stage – based upon user instructions, in-use satisfaction monitoring, end-of-life removal and disposal regulations etc.

All of this extra information will have to be communicated around the supply cycle by better-trained personnel.

Training summary

- Involve the human resources professionals from the beginning
- Get involved with industry training initiatives
- Conduct skills needs and gap analyses, plus training needs.
- Understand the training road map.

6.9 Manufacturers publishing sustainable performance targets and action plans

It is important for manufacturers to not only develop and bring to market sustainable technologies, but also to ensure that their own corporate plans work towards reducing carbon emissions through improved efficiency. BEAMA sectors should be more proactive and transparent in this. Furthermore, BEAMA members must demonstrate to Government and other stakeholders, the strides that they are taking in developing and placing onto market innovative sustainability products. They should also give clear guidance on how these products are applied.

6.10 Success stories show industry performance and stimulate further action

It is unrealistic to expect the entire electrotechnical industry to fully commit to delivering on this carbon saving agenda from the outset. Like individual consumers, many organisations will need 'social proof' that the technologies and approaches required are both effective and mainstream, and that others in the industry are already delivering them. Successful case studies will be essential in providing such confirmation, so that all in the industry feel comfortable with playing a part and, ultimately, feel exposed if they are not.

Such successes will also demonstrate to Government that its support for industry is reaping rewards. By making it clear that Government and industry are working together proactively to deliver carbon savings, other individuals and organisations may be convinced that they too must work hard to reduce carbon emissions where they can.

7.0 Appendix - Stakeholders

The following are stakeholders, other actors and initiatives mentioned in this BEAMA White Paper:

GOVERNMENT

- **UK Government - BERR** (www.berr.gov.uk) **-** This is the UK Government's Department for Business which helps ensure business success in an increasingly competitive world.
- **Government Regulators –** These ensure that UK utility companies operate correctly and fairly in terms of delivery of services to end-users and in terms of their legal obligations. Ofgem regulates the UK electricity market.
- **European Commission** (EC - http://ec.europa.eu) - Independent of national governments, the EC drafts proposals for new European laws, which it presents to the European Parliament and the Council.

INDUSTRY

- **UK Electrotechnical Sector –** The electrical and electronics industries in the UK range from electrical power high voltage generation/distribution, though to medium and low voltage industrial and commercial applications for electricity-using equipment, including control systems, right down to electrical wholesalers/distributors, installers and domestic end-users.
- **BEAMA members –** These represent an industry with a turnover of £13bn/year and employing over 137,000 people.
- **Energy utilities –** These, which may be investor owned, publicly owned, cooperatives or nationalised entities, are engaged in the generation, transmission, and distribution of electricity for sale in a regulated market. Note that electrical distribution companies are now known as Distribution Network Operators (DNOs)
- **Electrical wholesalers and distributors –** Electrical products and equipment for electrical systems are sold to electrical contractors and installers at trade prices.
- **Electrical contractors and installers –** These, which range in size from sole traders to large multi-discipline contracting companies, install and sometimes design electricity-using systems found in industry, commerce, retail and domestic premises. They may have obligations under the Building Regulations.
- **Electrical Specifiers –** These specify the electrical products and systems to be used in a given installation. They may also have obligations under the Building Regulations.

RELEVANT ORGANISATIONS AND ASSOCIATIONS

- **BEAMA** (www.beama.org.uk) - The British Electrotechnical and Allied Manufacturers' Association, founded in 1905, represents directly some 150 companies in the UK electrotechnical and allied manufacturing industries.
- **Ofgem** (www.ofgem.gov.uk) - This Government Regulator regulates the electricity and gas markets in the UK.
- **Energy service companies (ESCOs) –** These are a relatively new business concept, offering technical solutions to provide customers with energy savings. The customers pay the ESCO with a part of the saving that has been earned. Ofgem is keen to see ECSOs explore the scope for providing energy efficiency for domestic customers through energy services contracts.
- **Lighting Industry Federation** (LIF - www.lif.co.uk) - The organisation's main aim is to ensure that clients receive the quality of lighting product and scheme design to which they are entitled, and to safeguard the interests of the end-user.
- **Energy Saving Trust** (www.energysavingtrust.org.uk) - This is a non-profit organisation that provides free impartial advice to domestic users. Its advice can help save them money and fight climate change by reducing CO_2 emissions from their homes.
- **Carbon Trust** (www.carbontrust.co.uk) - This was set up by Government in 2001 as an independent company. Its mission is to accelerate the move to a low carbon economy by working with organisations to reduce carbon emissions and develop commercial low carbon technologies.
- **Catering Equipment Suppliers Association** (CESA - www.cesa.org.uk) - CESA represents over 120 companies that supply commercial catering equipment, much of which is electrically-powered.

INITIATIVE

- **Electra –** This is the major initiative organised by the EC and the European electrical and electronics industry. Electra sets out a framework for EC and industry co-operation to deliver key growth and competitiveness objectives, mainly through sustainability and energy efficiency. Go to http://ec.europa.eu/enterprise/electr_equipment/electra.htm

ELECTRICITY END-USERS

- **Electricity end-users (Industry and commerce)** – These, comprising industrial plant, commercial buildings and large retail outlets, use delivered electricity at mainly medium and low voltages. Electricity using equipment is very varied, but includes distribution equipment, factory electrical machines, automation, control and fire & safety equipment, plus lighting and heating.
- **Electricity end-users (domestic) –** These are homeowners using only low voltage supplies for cooking, lighting, heating and entertainment applications.

Executive Summary

1. Carbon emission resulting from fossil fuel-powered electricity generation is causing climate change. The UK Government plans an ambitious target of 26% CO_2 reduction by 2020.

2. Wasted energy wastes money and causes extra carbon emission. Only 20% of the primary (fuel) energy delivered to homes and businesses as electricity is used to perform electrical tasks. The rest is wasted. The costs are borne by final customers.

3. Industry represents around 39% of UK electrical energy. The overall possible energy reduction is estimated at in excess of 10%. Technologies to achieve this are readily available.

4. A single unit of electrical energy saved at point of use will save the equivalent of three units of primary (fuel) energy.

5. BEAMA represents most UK electrotechnical companies. These influence all generation efficiencies, electricity use, system energy losses, plus carbon emissions.

6. Climate change is now a key issue for BEAMA members. BEAMA's extensive experience can benefit members, end-users and Government to deliver a low carbon economy.

7. Europe is increasingly important in terms of strategic climate change and energy efficiency policies for the UK. BEAMA has long experience of working in Brussels.

8. The best way to meet climate change/energy targets is to improve energy chain efficiency through use of more efficient technologies, many of which are available now. BEAMA members' products could cut energy losses equivalent to almost 6% of the UK primary energy demand.

9. New power generation plant and distribution/ transmission equipment should always use the most efficient equipment. It is crucial to start this process now because it is a huge task. BEAMA is ideally placed to help Government set minimum standards for this, in partnership with industry.

10. Longer-term solutions for reducing energy networks' energy losses include optimising grids for energy efficiency, and building 'Super Grids'. Such grids will also have to cope with the collected electricity generated from millions of decentralised renewable sources.

11. Adopting energy efficiency policies will improve energy supply security, cut customers' running costs, foster industry competitiveness, stimulate growth and support new energy efficient technology markets. The clear message is - industrial companies will suffer if they do not follow best practice in equipment replacement.

12. Government support for electrotechnical manufacturers is imperative. So far, BEAMA members have been disappointed with incentives for the development of new technologies.

13. BEAMA believes that the following elements are needed, as part of an integrated framework, to move the electrotechnical industry energy efficiency market in the right direction:

    - A genuine Government / industry partnership
    - Clear guidance encouraging R&D and rewarding innovation
    - Policies to drive early equipment replacement in existing buildings and local networks based on lifetime carbon savings
    - Government information campaign stimulating the whole supply chain to take carbon saving action
    - A long term forecast for the UK energy mix and carbon saving policy
    - Widespread building certification that guides energy saving technology investment
    - An improved framework for capital plant specification / investment by utilities
    - Enhanced skills and training focused on energy efficiency
    - Manufacturers publishing sustainable performance targets and action plans
    - Case studies and success stories to stimulate further action.

Members list

ABB
Actaris
ACV
Air Liquide Welding
AJ Gummers
Allied Insulators Group
Alstom Power
Altecnic
AMEC
Applied Energy
Aqualesa
AREVA T&D
ASTA
ATB Laurence-Scott
ATB Morely Motors
Babcock Networks
Baldor UK
Balfour Beatty Power Networks
Baxi
Bohler Welding
Brook Crompton
Calmag
Cembre
Chatsworth Heating
Consort
Contactum
Control Techniques Dynamics
Converteam
Cotherm
D K Moriarty
Danfoss
De-vi
Diamond H controls
Dimplex
Doosan Babcock Energy
Douglas Industrial
Eaton
Echelon
Electric Heating Company
Electricity Alliance
Electrium
Elster
EMD Drive Systems
Envirovent
ESAB Group
Eswa
Fernox
FKI Swithgear - Hawker Siddeley Switchgear
Greenwood
Hansgrohe
Heatrae Sadia
Honeywell
Horne Engineering
Horstmann
Howden
Howden Power
Hypertherm
Ideal Standard
Interserve Industrial Systems
Invensys
ITW Welding Products
Kamco
Kemppi
Kholar Mira
Landis+Gyr
Legrand Electric
Lincoln Electric
Lucy Electric
Metrode Products
Migatronic Welding Equipment
MK
Mosdorfer CCL Systems
Myson
Nobo
Norfolk Capacitors
Nuaire
Oerlikon
Otter
Overhead Line Fittings
P&B Engineering Co.
Pegler
PFC Engineering
Power Capacitors
Preformed Line Products
PRI
Rectiphase Capacitors
Reliance Water controls
Robinson Willey
Sagem
Schneider Electric
Sciaky Electric Welding Machines
Sentinal
Siemens
Stiebel Eltron
Sunvic
Teco Electric Europe
Thermadyne Industries
Tour Atlantic
Trench
Trianco
Tyco
Tyco Electronics
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working in partnership with

www.lif.co.uk **www.cesa.org.uk**

The Catering Equipment Suppliers association (CESA) and the Lighting Industry Federation (LIF) have contributed to the development of this paper and endorse its findings and recommendations.
The members of each association can be found on the following websites:

www.cesa.org.uk/CESA_Members.asp
www.lif.co.uk/site/manulist.asp

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