

BNM08: Developing supply chain initiatives to improve pump systems efficiency in the UK

Version 1.1

This Briefing Note and referenced information is a public consultation document and will be used to inform Government decisions. The information and analysis form part of the Evidence Base created by Defra's Market Transformation Programme.

Executive summary

Pumps are one of the largest users of electrical energy in industrial and commercial applications within the UK. There is significant energy saving potential associated with pumping systems; however, to date limited measures have been implemented that will realise these savings. Whilst some energy savings may be achieved through measures affecting the pump, greater savings will be realised through measures that affect the whole pumping system.

The pump industry has identified the pump supply chain as being the most effective channel through which energy efficiency considerations may be applied in the process of market transformation.

Table 1 *Requirements for stakeholders participating within a supply chain initiative* summarises how a supply chain initiative might work.

1 Energy consumption by industrial and commercial pumps in the UK

Pumps are the single largest motor-driven users of electricity in industrial and commercial applications in the UK. They consume about 47.24 TWh of electricity, which represents some 32% of all electric motor consumption in industry and commerce.

The number and types of pump applications are large and diverse, ranging from water utility supplies through industrial and chemical processes, and agriculture, to heating and cooling applications in buildings. There are over 68 different generic pump types available on the market; however, the most dominant is the rotodynamic (centrifugal) pump. Figure 1 illustrates the UK pump market for the most popular types¹ whilst Figure 2 shows a breakdown of pump energy use by sector.

¹ Source: EC SAVE Study on Improving the Energy Efficiency of Pumps, February 2001 (Table 3.1).

Figure 1 The UK pump market split by pump type

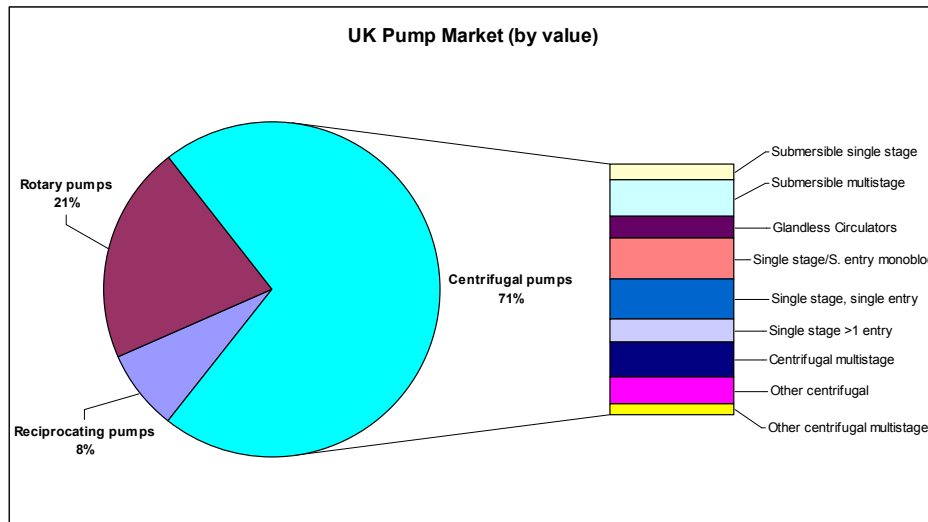
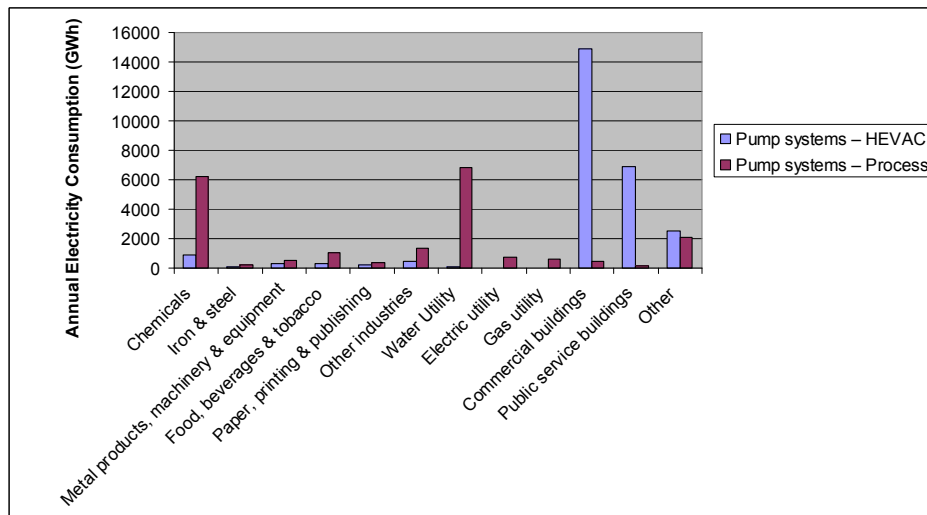


Figure 2 Pump energy consumption split by sector and application (Process or HEVAC)²

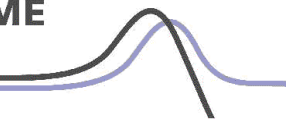


2 How energy savings may be achieved in pumping systems

The following provides a brief synopsis of how energy savings may be achieved in typical pumping systems:

- a) Component-based measures (between 4% and 10% savings may be achieved):
 - Improvements to the pump design.
 - Use of high efficiency motors.

² Some of the reference data are now considered to be outdated and further studies are currently being conducted to update the MTP Evidence Base in this regard.



b) System-based measures (up to 37% savings may be achieved):

- Design – ensuring appropriate velocities by selecting correct pipe diameters, and reducing turbulence by minimising use of sharp bends, valves and other restrictions. Minimising recirculation and bypass arrangements. Ensuring operating pressure is maintained at the lowest acceptable value.
- Pump selection – ensuring the correct pump is selected for the application such that it operates as near as possible to its best efficiency operating point (BEP).
- Controls – ensuring the pump is switched off when it is not doing useful work. Using variable speed or other controls in applications where there are varying flow rate or pressure requirements.

Appendix 1 lists additional sources where further guidance can be found on how energy savings in pumping systems may be achieved.

3 Energy saving potential for pumps in the UK

Most pumping systems offer some scope to realise energy savings; however, in practice the greatest potential lies with rotodynamic pumping systems. Within this group the most accessible energy savings are in pump systems for clean water and chemical applications³, representing some 53% of pump energy consumption (also see Appendix 3).

Through implementing market transformation measures to effect energy savings in these pumping systems, a total energy saving potential (EBP⁴) of 10 TWh in 2020 is demonstrated, whilst the actual savings achievable in 2020 (P1⁵) will be in the region of 7 TWh.

The market transformation measures consist of a mix of the measures listed above, and are presented as 'Supply Chain' measures and 'Labelling' measures. Figure 3 shows the effect on energy consumption by pumps brought about by the proposed market transformation measures, whilst Figure 4 shows the energy saving potential of the two measures.

³ Source: EC SAVE Study on Improving the Energy Efficiency of Pumps, February 2001; also see http://www.pumps.org/public/pump_resources/save_study.htm

⁴ Energy Best Practice: The maximum theoretical energy saving potential assuming 100% uptake of measures.

⁵ Policy Scenario: The realistic energy saving potential through implementation of policy measures

Figure 3 Energy consumption by pumps after the effect of market transformation measures

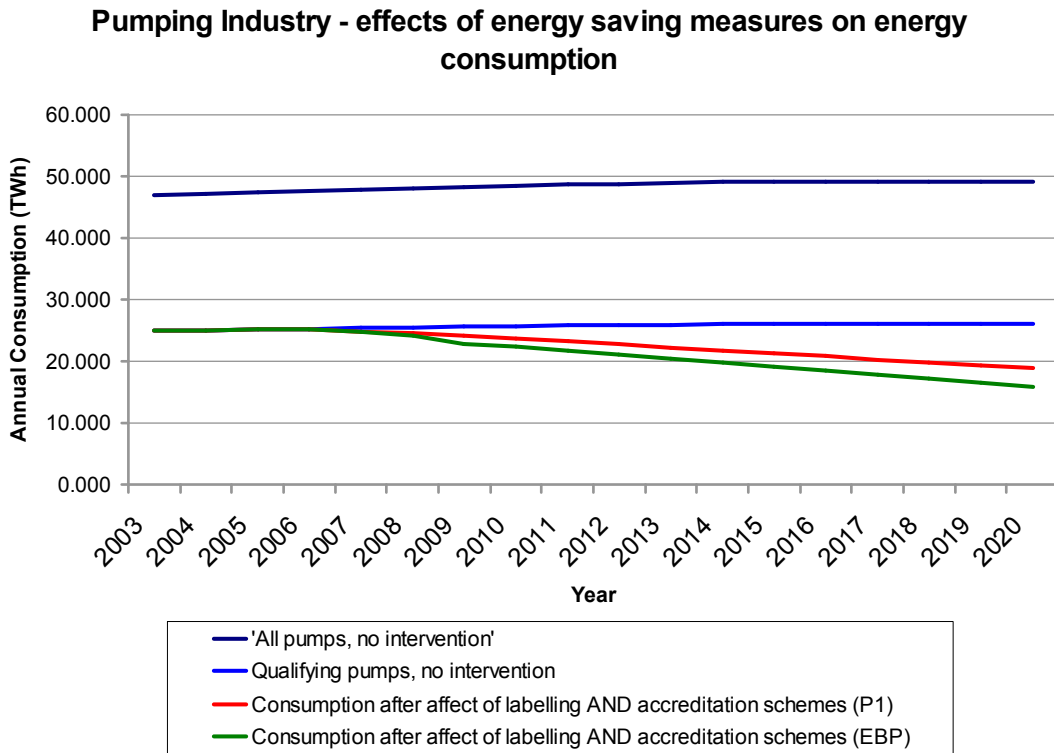
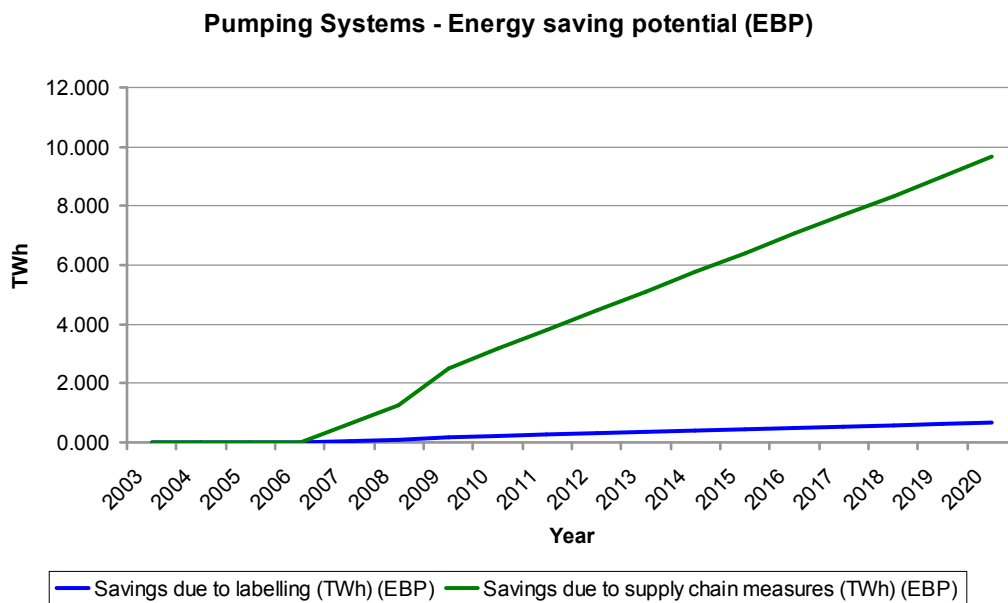
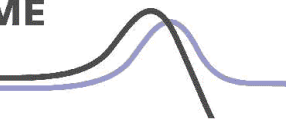


Figure 4 Energy saving potential due to labelling and supply chain measures





4 Existing policy measures that may affect pump system efficiency

Measures in the UK include:

1. Enhanced Capital Allowance (ECA) scheme – ECAs for high efficiency motors, variable speed drives and integrated motor drive units. An ECA allows businesses to write off the whole cost of their investment against their taxable profits of the period during which they make the investment.
2. Climate Change Agreements (CCAs) – top level agreements that may incentivise companies to examine pumping systems. A CCA is an agreement between an eligible company and Defra that gives an 80% discount to the Climate Change Levy in return for a targeted reduction in energy use.
3. Carbon Trust audits – companies with energy bills >£50k may receive free on-site energy audits. This is a top down approach where the audits examine all the company operations and do not necessarily focus on pumping systems.
4. Carbon Trust Accreditation scheme – award scheme for companies that achieve energy savings. An organisation's energy performance is evaluated in a number of areas, and organisations which meet the standards required by the scheme can go on to become accredited, gaining a prestigious award and public recognition.

Whilst these policy measures may influence pumps and pump system efficiency, they have not been specifically designed to target pump systems. Consequently, a large part of the pump market is being overlooked, including the high volume, lower product value area of the pump market.

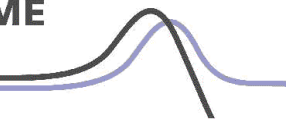
Measures in Europe include:

1. Europump⁶ has successfully devised a labelling scheme for circulating pumps sized 2.5 kW and smaller. This scheme assumes an agreed range of duties against which the circulating pumps are measured.
2. In Denmark⁷, pumps of a requisite efficiency level may be included on the electric power companies' list of energy efficient pumps. Each energy advisor will advise companies and housing associations in their area of the country about the possibilities for savings through using energy efficient pumps. The Danish Electricity Saving Trust produces a set of purchasing guidelines which are mandated for all purchases of energy-consuming equipment in the public sector.
3. Currently, the European Commission is running a number of preparatory studies under the EuP Directive which seek to identify design measures that could be applied to products to reduce their environmental impact, including energy consumption. One of the studies is pertinent to the pumping industry namely: **Water Pumps (in commercial buildings, drinking water pumping, food industry, agriculture)**. Interested stakeholders are encouraged to engage with the study⁸.

⁶ See <http://www.europump.org>

⁷ See <http://www.sparepumpe.dk/index.asp?language=2>

⁸ See <http://www.ecomotors.org>



4. The Motor Challenge Programme, now called 'DEXA-MCP', is a European Commission initiative to aid industrial companies in improving the energy efficiency of their electric motor-driven systems. The Challenge focuses on compressed air, fan and pump systems (see **Appendix 2**).
NB. This programme contains measures similar to items 3 & 4 listed in the UK policy measures.

As in the UK, these European policy measures are limited in their coverage and large parts of the pump market are being missed.

See **Appendix 2** for further information on policy measures implemented or proposed in the above mentioned and other countries.

4.1 Considerations for implementing policy measures

When examining policy options to improve pump system efficiency, the following should be considered:

Component-based measures:

These could include either incentives to raise the top end of the market or mandatory minimum standards to cut off the bottom end of the market. In order to implement such measures, products must be classified in a manner that will allow their performance to be measured. This is relatively easy to achieve for components such as motors, transmissions and components within the pipeline; however, it is considerably more difficult for the pump as there may be a significantly variable range of duties to which it could be applied, with a corresponding impact on efficiency. For this reason the European SAVE study developed a pump procurement methodology in the form of a guide: *Europump Guide to Pump Efficiency for Single Stage Centrifugal Pumps*⁹. Unfortunately, this guide is difficult to use without training and appears to have been little used.

System-based measures:

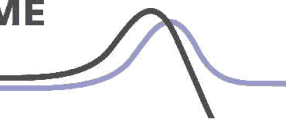
It is within the whole pumping system that the greatest energy saving potential may be realised. However, it is rare for any two pump systems to be the same and therefore any system-based measure must be generic in nature. To date no performance measures have been identified that could satisfactorily be applied to pump systems. (It may, however, be possible to define performance measures within more closely defined environments such as building HEVAC systems, an example of which are the Building Regulations (Part L2) which define a performance measure for fan systems – namely 'Specific fan power'¹⁰).

4.2 The pump industry's response

Further consultation with the pump industry in the UK (British Pump Manufacturers Association (BPMA)) has confirmed that a procurement approach to pump systems (in addition to the procurement of pumps methodology recommended by the SAVE study) will be the most effective route to achieving energy efficiency, especially in the

⁹ See http://www.pumps.org/public/pump_resources/save_study.htm or <http://www.europump.org>

¹⁰ See <http://www.planningportal.gov.uk/england/professionals/en/1115314231806.html>



high volume, lower cost products market which is currently missed by existing policy measures.

In developing a procurement-based approach the following barriers must be overcome:

- a) Purchasers and end-users are in the main ignorant about energy efficiency in pumping systems.
- b) Purchasers tend to base their procurement decisions on lowest initial capital cost rather than life-cycle cost considerations.
- c) Suppliers in competitive markets are under pressure to maximise returns and consequently minimal effort is spent on energy efficiency (and life-cycle cost) considerations.
- d) Plant operators' priorities are to maintain productivity and they are hesitant to trial measures where there may be a perceived risk to product quality or throughput.

As pumping applications are diverse and the range of pumping equipment and systems supplied is large, consideration should be given to designing suitable measures to suit the different market sectors (eg tenders for large, high value pumping systems will more easily warrant energy efficiency and life-cycle cost considerations, whereas for low cost 'over the counter' products (<GBP200 – where GBP is the UK pound) it is difficult to justify time performing efficiency calculations). In addition, there are several players within the pump supply chain, including manufacturers, wholesalers, specifiers, system designers, installation contractors and purchasers. Each work to their own priorities and in many instances energy efficiency and life-cycle cost considerations will be overlooked, or not passed from one party to the next.

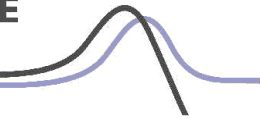
For these reasons the pump industry has proposed the development of a set of best practice measures appropriate to, and adopted by each player within the supply chain. In conjunction with these measures will be associated tools such as selection guides (see Appendix 1).

Consideration will be given to ensuring that the measures, whilst not being onerous, will ensure seamless implementation of best practice throughout the whole supply chain.

Underpinning these measures is the need to deliver education to both the purchaser and the end-users (unlikely to be the same person), as ultimately they are the ones who drive the market. A system purchased against life-cycle cost considerations will be both energy efficient and cost less to run over the life of the system.

The declared goal of the BPMA is:

'The British Pump Manufacturers, Pump Industry Association's Sustainable Energy Strategy is to change the habits of pump users in the way that they purchase and operate pumps so that their energy use is minimized.'



4.3 Ensuring market uptake of the proposed measures

In order to ensure adequate adoption of these proposed measures, both industry and policy-makers should consider the following:

- The proposed best practice measures could be developed into a set of industry-agreed performance standards.
- Recognition should be accredited to parties that implement the measures.
- Purchasers should be encouraged to purchase products only from suppliers who meet the requirements of the agreed performance standards.

5 How a supply chain initiative might work

Table 1 outlines the framework under which a procurement-based (supply chain) initiative might be implemented. Embedded within the initiative are measures to educate all participants, who in turn will inform purchasers and enable them to make informed purchasing decisions based on life-cycle cost considerations.

The initiative should be developed such that all procedures developed will achieve widespread recognition within industry and stakeholders signing up to participate could become accredited parties. Measures to monitor and maintain the integrity of the initiative will also be developed.

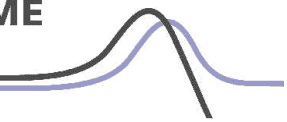
In the long term the procedures should become recognised standards; purchasers will then be able to specify equipment/installations supplied to these standards.

MARKET TRANSFORMATION PROGRAMME

Supporting UK Government policy on sustainable products

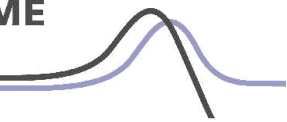
Table 1 Requirements for stakeholders participating within a supply chain initiative

	Pump Manufacturers	System Designers and Specifiers	System Suppliers and Installers	Pump Users
All Product Types	Develop energy efficiency training material in modular format for designers, specifiers, suppliers and installers of pumping equipment.			i) Train purchasers and operators on energy efficiency and life cycle cost considerations.
	Develop common format for efficiency information (system and component) to be presented on all tenders for work.			
	Develop Best Practice design and guides for the supply and installation of pump systems with variations if required for low cost-medium and bespoke products.			
	Develop pump selection tools.	Adopt and use pump selection tools.		ii) Train purchasers to interpret energy related bid material presented at time of purchase.
	Develop tools to estimate system efficiency.	Adopt and use tools to estimate system efficiency.		iii) Develop procedures to ensure regular monitoring / auditing of systems is implemented.
	Develop system auditing tools to verify new build and existing installation continued efficiency			
Low cost product market	Develop common format for product efficiency information to be presented on the product, E.g. labelling schemes for small pumps, such as the Europump circulator labelling scheme.		Develop 'system' data sheet to be left on site which details efficiency aspects of the system.	
Medium cost and bespoke product market	Develop common format for product efficiency information to be presented in the pump quotation E.g. data sheets focused on efficiency & LCC aspects for bespoke units	Develop common format for efficiency information (system and component) to be presented on all tenders for work.		
			Develop recognised procedures to measure actual system efficiency.	
			Commission system, measure efficiency and leave commissioning data sheet on site.	



Related MTP information

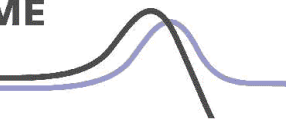
Policy Brief: **UK Energy Consumption Of Industrial Electric Motor Systems**



Appendix 1

Resources and training tools available to the pump industry and users when considering energy efficiency improvements

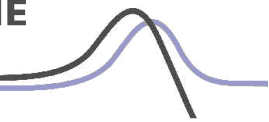
Owner	Category	Synopsis	Link
Europump	Electronic database	ProMot (Promotion of Efficient Electric Motor Systems): Web-based database of supplier information, compares product efficiencies.	http://www.europump.org/
US Department of Energy	Software selection tool	The Pumping System Assessment Tool (PSAT): Developed for the Department of Energy's (DOE) Best Practices Program, this is designed to assist engineers and facility operators in preliminary assessments of pumping system operating efficiency.	http://www1.eere.energy.gov/industry/bestpractices/psat.html
Europump	Database	EuroDeem: European Database of Efficient Electric Motor Systems (plans exist to extend coverage to pumps).	http://www.europump.org/
Europump	Report	SAVE Study Report: Study On Improving The Energy Efficiency Of Pumps Report on the study commissioned to examine improving the energy efficiency of pumps.	http://www.europump.org/
Europump	Guide	Selection Guide: European Guide to Pump Efficiency for Single Stage Centrifugal Pumps The SAVE Study produced a guide to aid selection of single stage centrifugal pumps for energy efficiency.	http://www.europump.org/
Europump / Hydraulic Institute	Guide	Pump Life Cycle Costs: A Guide to LCC Analysis for Pumping Systems describes essential pumping system components and shows, step-by-step, the considerations necessary to specify, design and operate the system for minimum life-cycle cost.	http://www.europump.org/
Europump / Hydraulic Institute	Guide	Variable Speed Pumping - A Guide To Successful Applications: Guide explaining the benefits of using variable speed control in pumping applications.	http://www.europump.org/
The Carbon Trust	Guides	Good Practice Guides: GPG249 Energy savings in industrial water pumping systems GPG344 Variable speed driven pumps GPG170 Reducing water pumping costs in the steel industry GPCS162 High efficiency motors on fans and pumps GPCS170 Variable speed drives in a chemical plant GPCS300 Energy savings by reducing the size of a pump impeller GPCS358 Installation of variable speed drives and small submersible pumps GIR062 Chemical industries checklist	http://www.carbontrust.co.uk/energy/takingaction/publications.htm
Europump	Guide	System Efficiency - A Guide for Energy Efficient Rotodynamic Pumping Systems is the latest publication from Europump, the European pump manufacturers association. The guide gives instruction on how to optimise energy consumption within rotodynamic pumping systems, covering basic plant layout, pipework configuration and restrictions, liquid velocity in pipework, system characteristics and pump selection, and pump/system control.	http://www.europump.org/
BPMA / Hydraulic Institute	Guide	Video: Energy Reduction in Pumps and Pumping Systems	http://www.bpma.org.uk/guides.asp?sec=BPMA_Shop
Europump	Guide	Attainable Efficiencies of Volute Casing Pumps Guide No 2	http://www.europump.org/
Europump	Guide	Operating Rotodynamic Pumps Away from Design Conditions Guide No 3	http://www.europump.org/
BPMA	Training Programme	BPMA Training: Structured training programme for members.	http://www.bpma.org.uk/page.asp?node=6&sec=Training



Appendix 2

Policy measures associated with pump systems implemented in the UK and other countries

Owner	Category	Synopsis	Link
The Carbon Trust	Financial incentive	Enhanced Capital Allowance scheme – includes single speed motors, variable speed drives and integrated motor drive units.	http://www.carbontrust.co.uk/
The Carbon Trust	Programme	Energy auditing programmes.	http://www.carbontrust.co.uk/
The Carbon Trust	Programme	Energy Efficiency Accreditation scheme (for end-users).	http://www.carbontrust.co.uk/
Europump	Labelling scheme	Labelling scheme for domestic circulator pumps.	http://www.europump.org/
CEMEP	Labelling scheme	Labelling scheme for single speed motors.	http://www.cemep.org/cemep/organization/lvac/English.pdf
Europump	Programme	DEXA: Follow on to Motor Challenge Programme (MCP). MCP promotes energy reduction through publications and conferences, and applies pressure for improvement in motor driven systems.	http://energyefficiency.jrc.ec.eu.int/motorchallenge/about.htm or http://www.europa.eu.int/comm/energy/intelligent/projects/doc/slides/dexa-mcp.ppt or www.europump.org
Europump	Programme	ECOPUMP: voluntary energy labelling scheme for domestic circulators. The Europump initiative to promote energy saving and environmental protection. Includes training and awareness activities.	http://work.sitedirect.se/sites/europump/europump/p4169/files/Ecopump_statements.pdf
Hydraulic Institute, USA	Training programme	Pump Systems Matter: A national pump systems educational initiative called Pump Systems Matter™ (PSM). This programme places a primary focus on pump systems education and outreach, and addresses energy savings and total cost of ownership.	http://www.pumpsystemsmatter.org/ or http://www.pumps.org/public/pump_resources/energy/psm.htm
Danish Electricity Saving Trust	Purchasing guidelines, selection advice	Pumps of a requisite efficiency level may be included on the electric power companies' list of energy efficient pumps. Each regional energy advisor will now advise companies and housing associations about the possibilities for savings by using energy efficient pumps. The Trust's purchasing guidelines are now mandated for all purchases of energy consuming equipment in the public sector.	http://www.sparepumpe.dk/index.asp?language=2



Appendix 3

Energy saving potential within pumping systems¹¹

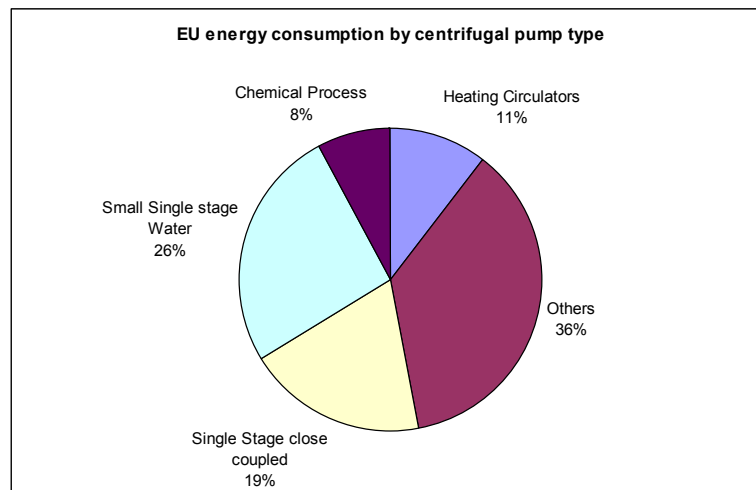
Table 2 Energy saving potential within a rotodynamic pumping system

Measure	Saving potential (%)
Selecting higher efficiency pump	3
Selecting better sized pump	4
Better installation/maintenance	3
Better system design	10
Better system control	20
TOTAL	40

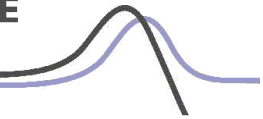
Table 3 SAVE/Europump data on energy consumption by pumps

Pump Type	Energy consumption (%) (Europe)
Single Stage Water	26.5
Single Stage Close Coupled	19
Single Stage Chemical	7.5
Heating Circulators	11
TOTAL	64

Figure 5 Chart showing split of energy consumption by type of centrifugal pump



¹¹ Source: Europump/European Commission SAVE Study, Improving the Energy Efficiency of Pumps.



Changes from version 1.0

Minor editorial and formatting changes in order to make the document comply with MTP style guidelines.

Consultation and further information

Stakeholders are encouraged to review this document and provide suggestions that may improve the quality of information provided, email info@mtprog.com quoting the document reference, or call the MTP enquiry line on +44 (0) 845 600 8951.

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