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ARE YOUR MOTORS UNDER CONTROL?

The importance of control and automation in maximising the system efficiency of motor driven systems

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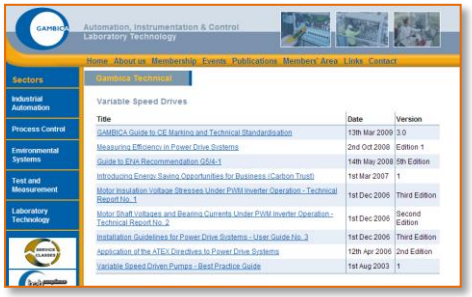
About GAMBICA

GAMBICA is the UK Trade Association for the Control, Automation and Instrumentation industry

Representing manufacturers and suppliers of motor control equipment

www.gambica.org.uk



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Power Shortage Risks

"*there will be a significant reduction in electricity supplies ... estimated margins decline from around 14% to 4% by 2015/2016*"

-Ofgem
Electricity Capacity Assessment (Oct 2012)

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The Generation Game

Efficiency biggest resource

"*In many ways, energy efficiency can be seen as Europe's biggest energy resource*"

-European Commission
Energy Efficiency Plan 2011

Keeping the Lights On?

Instead of worrying about keeping the lights on, we should be thinking of ways to switch the lights off

Intelligent control to maximise energy efficiency

Buy Now or Pay Later

"*If you need a machine and don't buy it then you will ultimately find that you have paid for it but don't have it*"

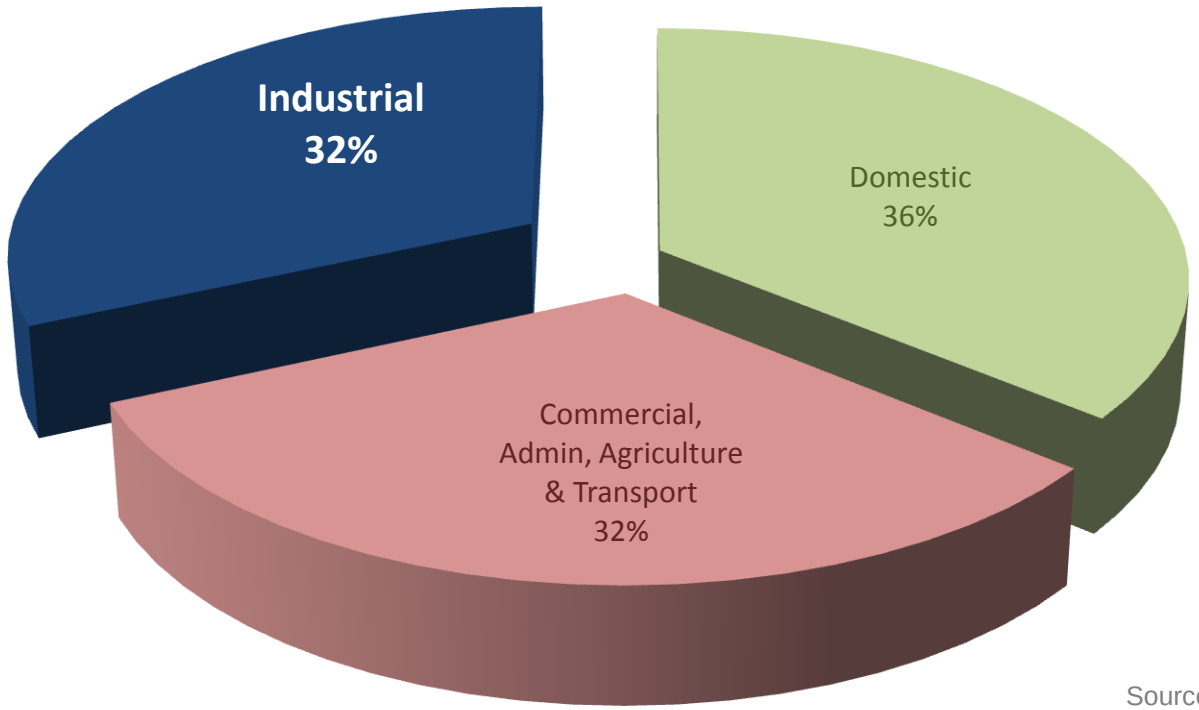
-Henry Ford

Buy Now or Pay Later

As true today as it was then

What you save by not investing in efficient systems, you lose multiple times in energy costs

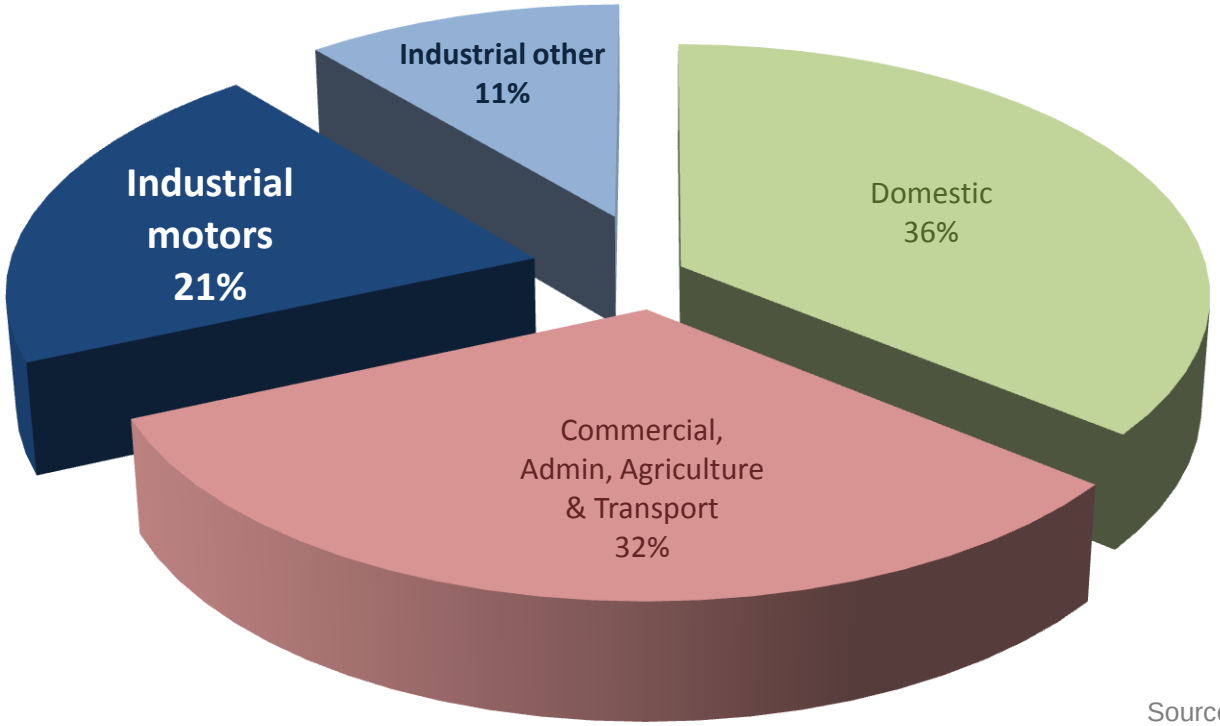
Industrial Energy Use



Source: DECC

Industrial Electricity accounts for about one third of the UK consumption

Industrial Energy Use



Source: DECC

21% of UK electricity consumption is by industrial electric motors

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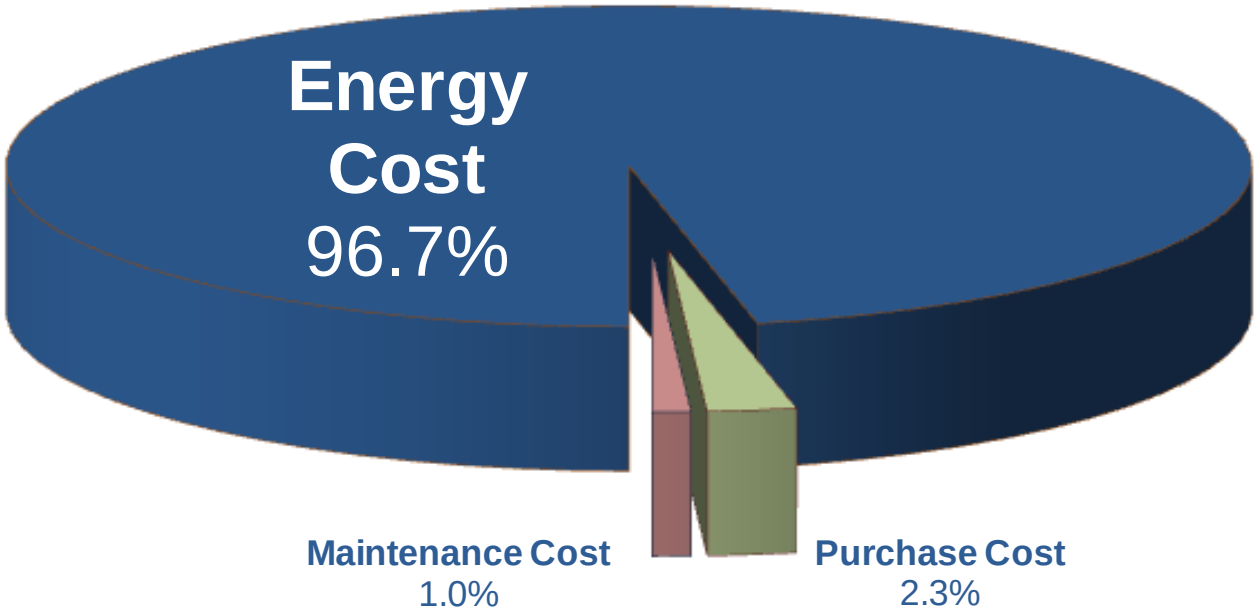
Lifetime cost is mostly energy



Source: Almeida, EuP Lot11

- 11kW IE3 Motor
- 4000 hours per year
- 15 year lifecycle

Lifetime cost of a car

- BMW 320i SE Saloon
- £26,195 purchase cost
- 44.8 mpg
- 15,000 miles per year
- £1.36 per litre

- **Purchase cost - £26,195**
- **Annual running cost - £2,067 – 7.9% of purchase**

- **10 year running cost - £20,670 – 79% of purchase**

- **10% less efficient costs £230 per year extra – 0.9% of purchase cost**

Lifetime cost of a motor

- 11kW IE3 motor
- £675 purchase cost
- 4,000 hours per year

- **Purchase cost - £675**
- **Annual running cost - £1,865 – 276% of purchase**

- **10 year running cost - £18,650 – 2763% of purchase (over 27 times the cost to buy)**

- **10% less efficient costs £207 per year extra – 31% of purchase cost**

Imagine your car is a motor

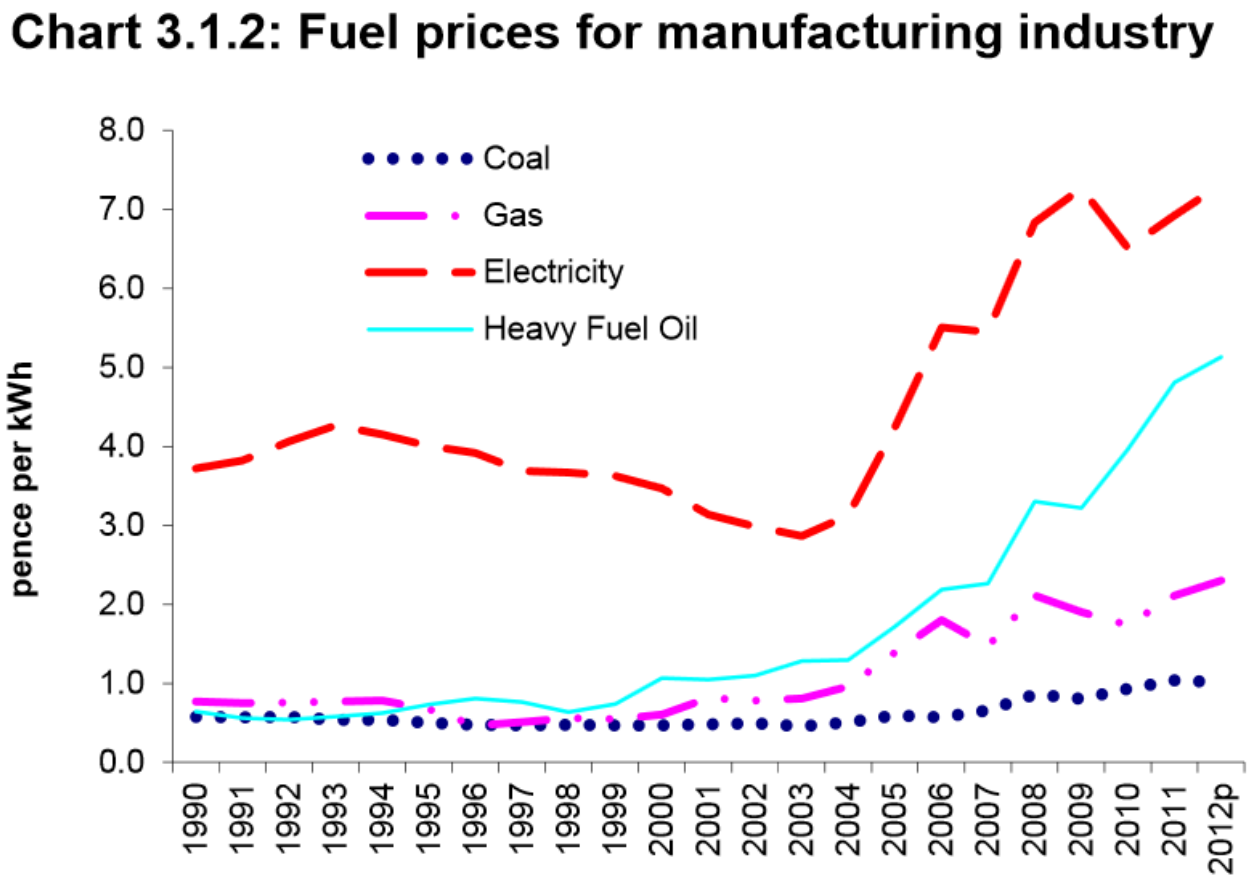
- BMW 320i SE Saloon
- £26,195 purchase cost
- ~~44.8 mpg~~ **1.3 mpg**
- 15,000 miles per year
- £ 1.36 per litre

- **Purchase cost - £26,195**
- **Annual running cost -** ~~£2,067~~ **£72,500**

- **10 year running cost -** ~~£20,670~~ **£725,000**

- **10% less efficient costs -** ~~£230~~ **£8,000 per year extra**

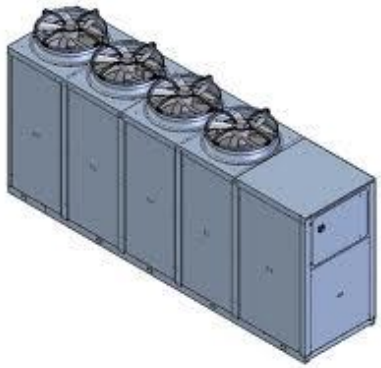
Rising Energy Prices



Electricity costs have more than doubled since 2004

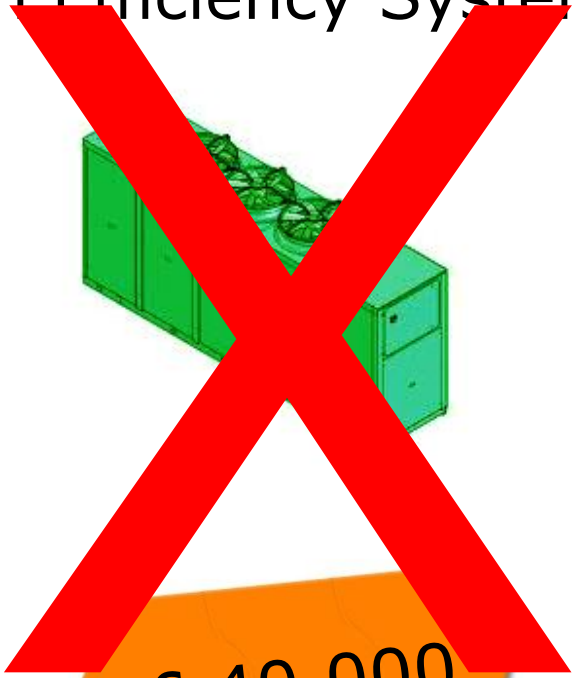
Purchase Price Trap

Standard System



£ 20,000

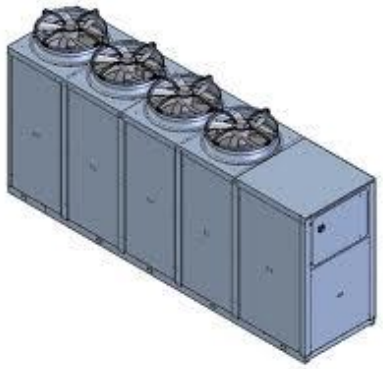
High Efficiency System



£ 40,000

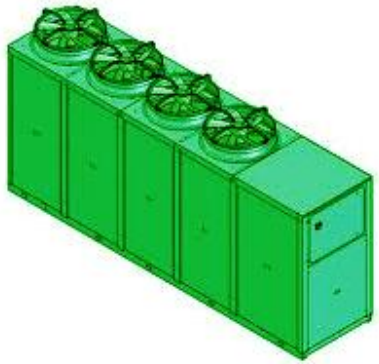
Lifetime Cost Analysis

Standard System



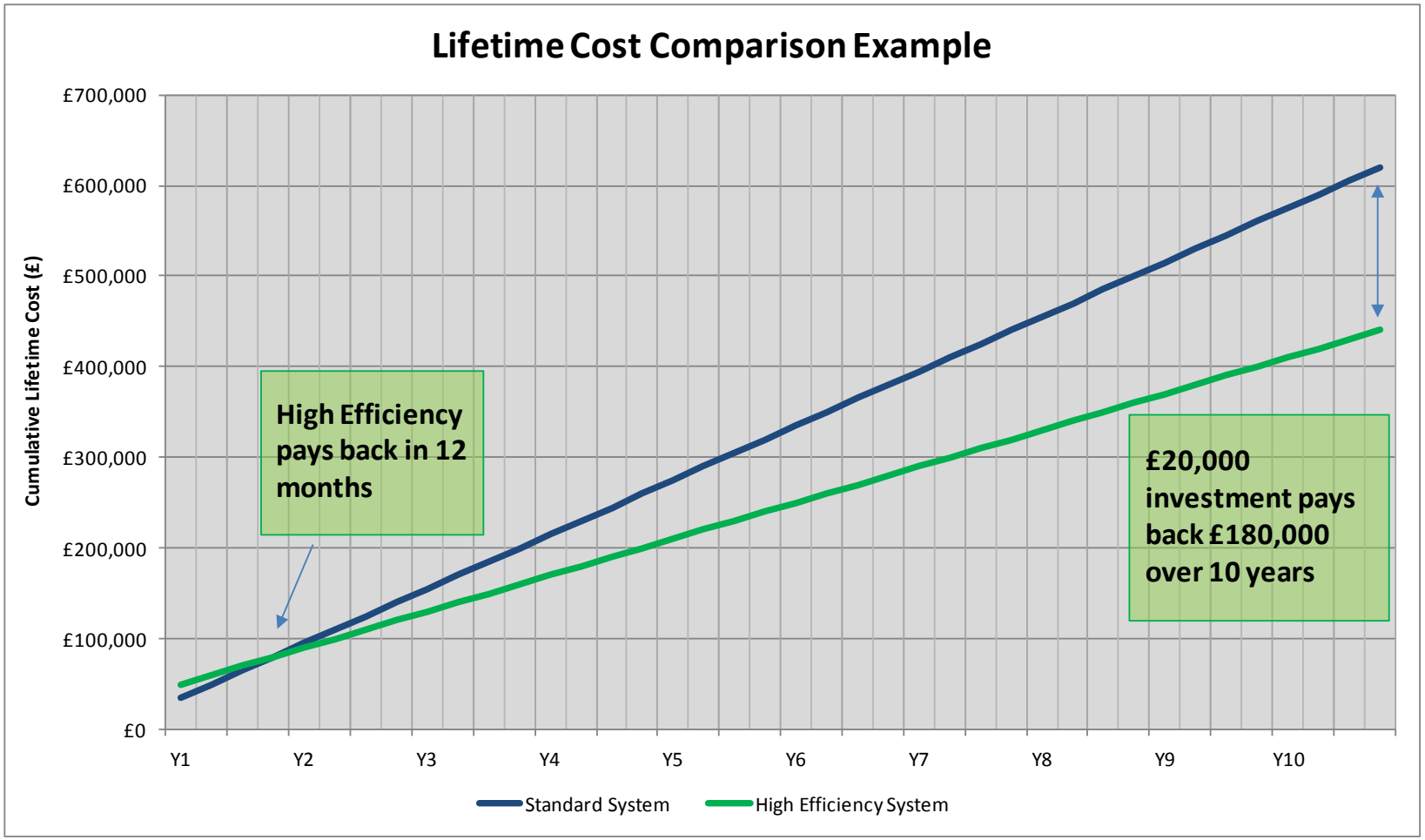
Purchase	- £20k
Energy 1 yr	- £60k
First yr	- £80k
10 years	**- £620k**

High Efficiency System



Purchase	- £40k
Energy 1 yr	- £40k
First yr	- £80k
10 years	**- £440k**

Beyond the short term



A Sound Investment

Comparison with other investments

Investment	Annual return rate	10 year return	Source
Energy Efficient Motor System	24.6%	£180,000	*GAMBICA*
FTSE 250 shares	9.6%	£50,019	*FTSE Group*
UK Housing Market	8.4%	£44,805	*Halifax House Price Index*
Cash ISA	3.0%	£26,878	*Guardian Money*

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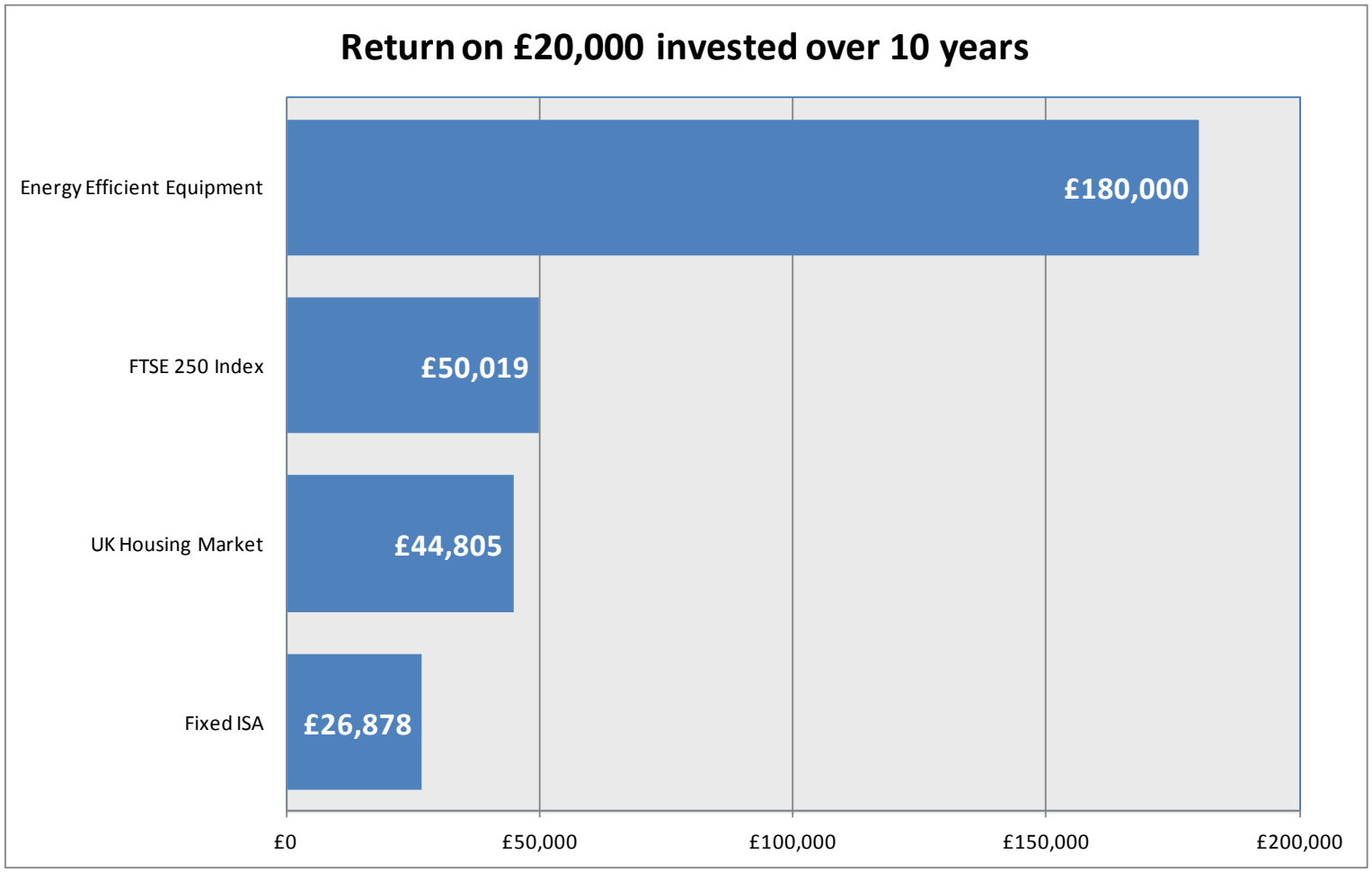
A Sound Investment



What's stopping people?

3 reasons why people don't invest in energy efficient systems

1. **Not aware of the potential savings**

2. **Focus on purchase price**

3. **Lack of systematic approach**

1. Lack of awareness

A thought experiment...

Imagine that your car;

- Has no accelerator pedal
- Has a 300 bhp engine set at constant 5500 rpm
- Can only be slowed down by gears and brakes

- Very inefficient
- Burning fuel all the time
- Wasting energy
- Costing money

Yet many electric motors are used this way. Oversized, always on, no speed control, with a damped load to control output

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Control is key

Switch it off, turn it down

Control Type	Description	Energy Benefit
Fixed Speed Control (Contactor, DOL, Soft Start)	Automated logic control, motor runs at constant speed but is automatically turned off when not required	Energy is not consumed when the motor is off
Variable Speed Control (VSD)	Motor speed can be variable to match the output requirements	Energy is reduced when the speed is reduced (see load types)

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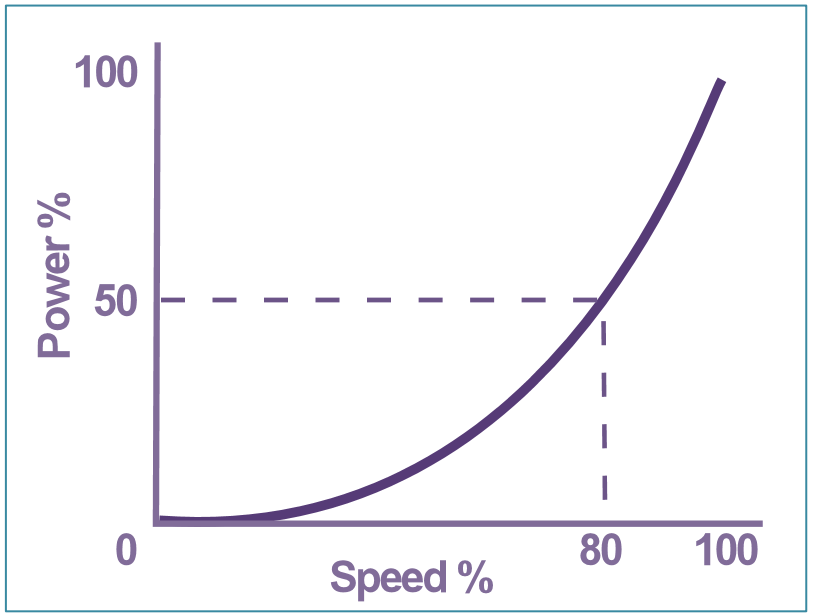
Load Types

Variable Torque

Typical applications

- Pumps
- Fans
- Centrifugal Compressors



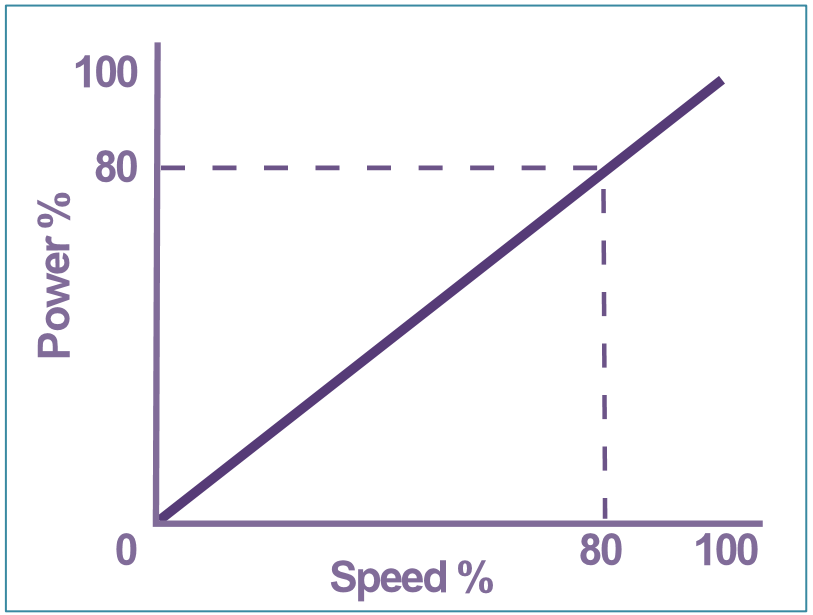
20% speed reduction = 50% energy reduction

Load Types

Constant Torque

Typical applications

- Conveyors
- Reciprocating Compressors
- Roots Blowers
- Crushers

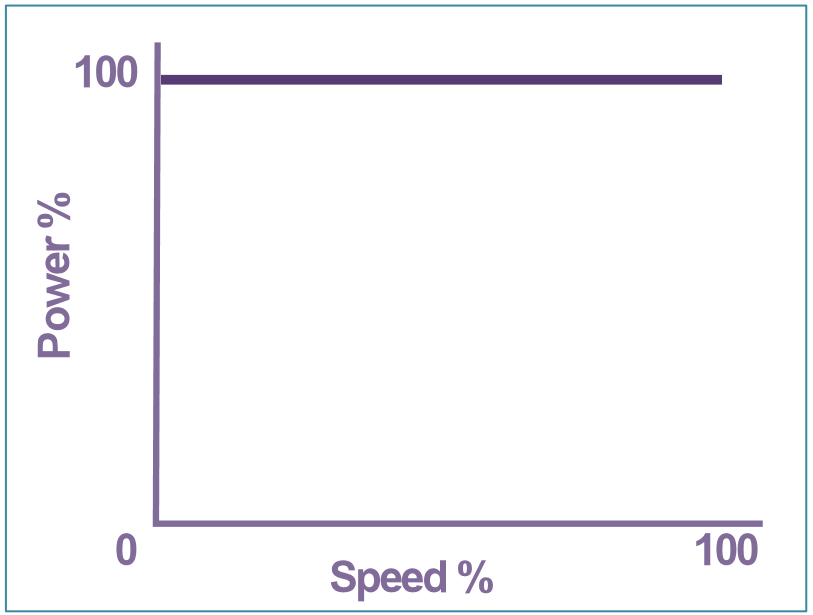


20% speed reduction = 20% energy reduction

Load Types

Constant Power

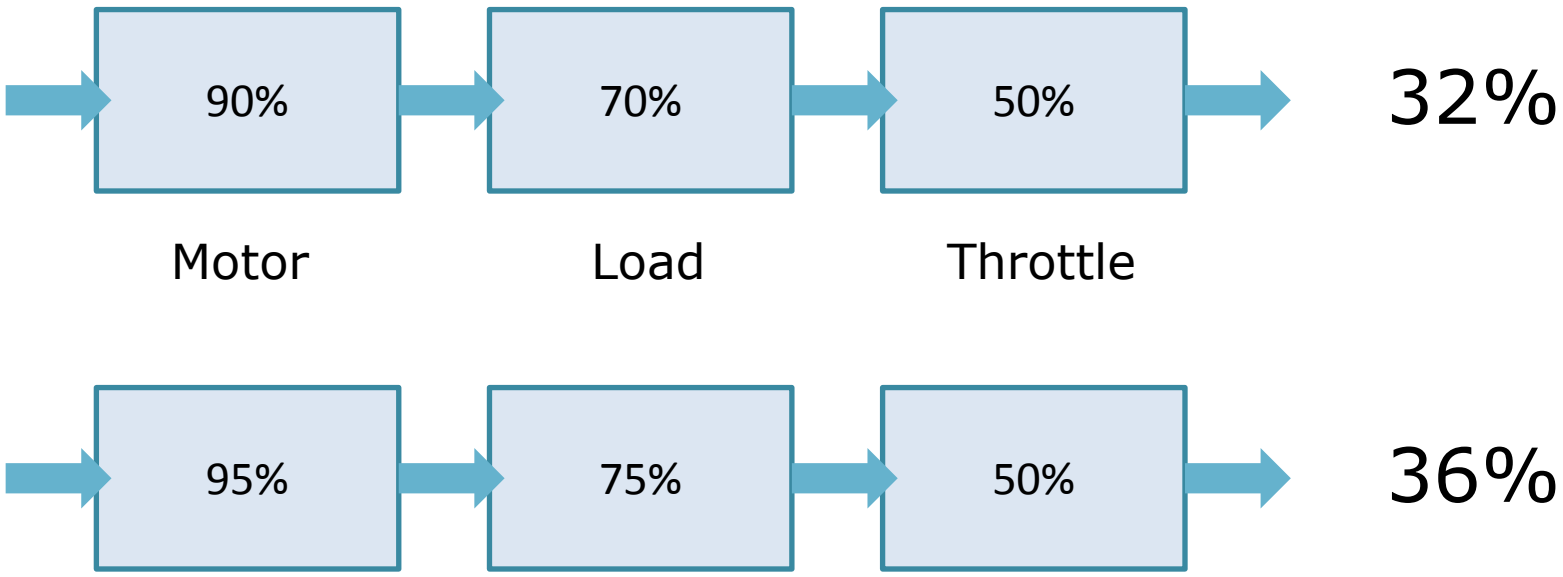
Typical applications
- Machine Tools
- Centre Winders



20% speed reduction = No energy reduction

System Efficiency

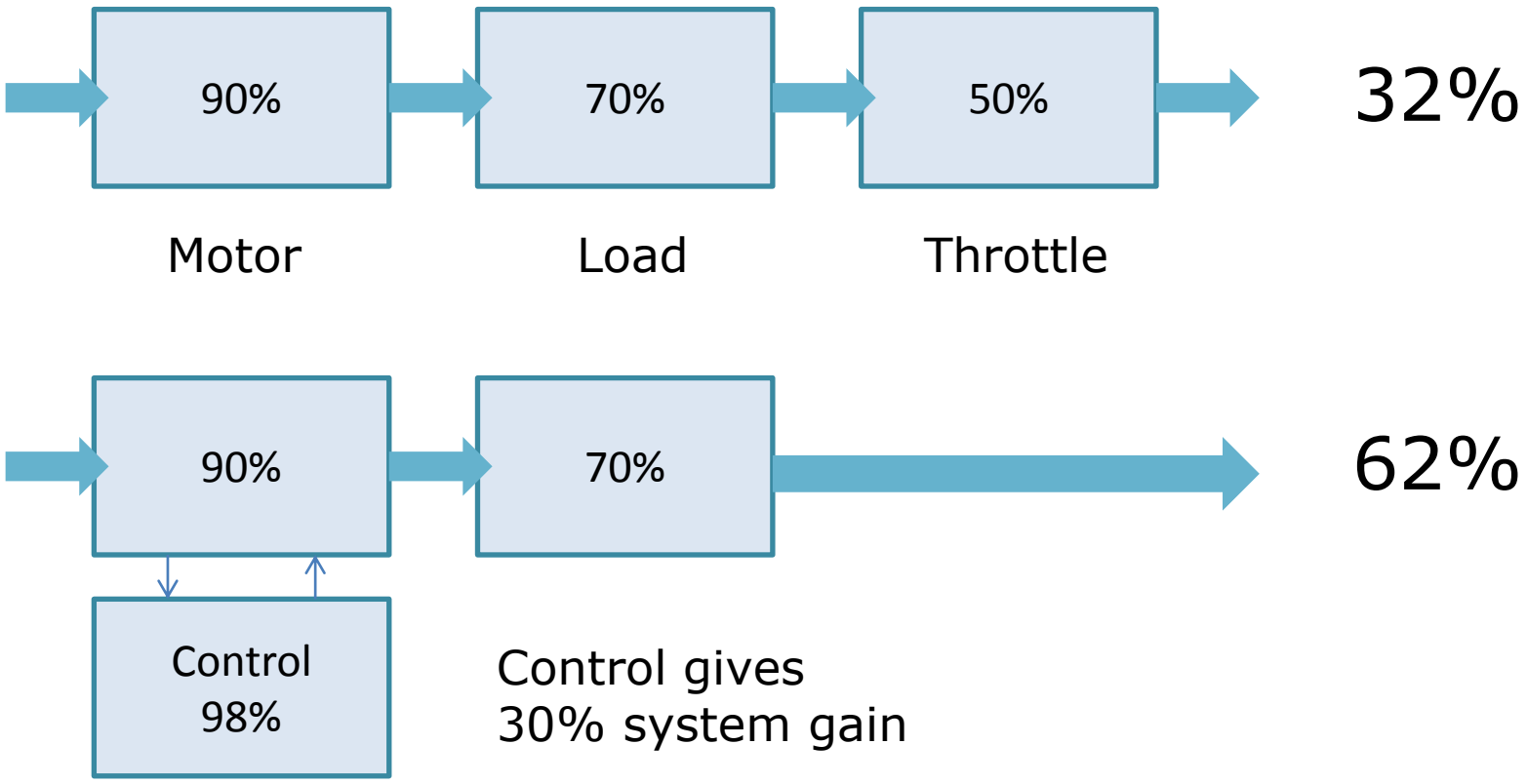
More than just the sum of the parts



High efficiency components give 4% system gain

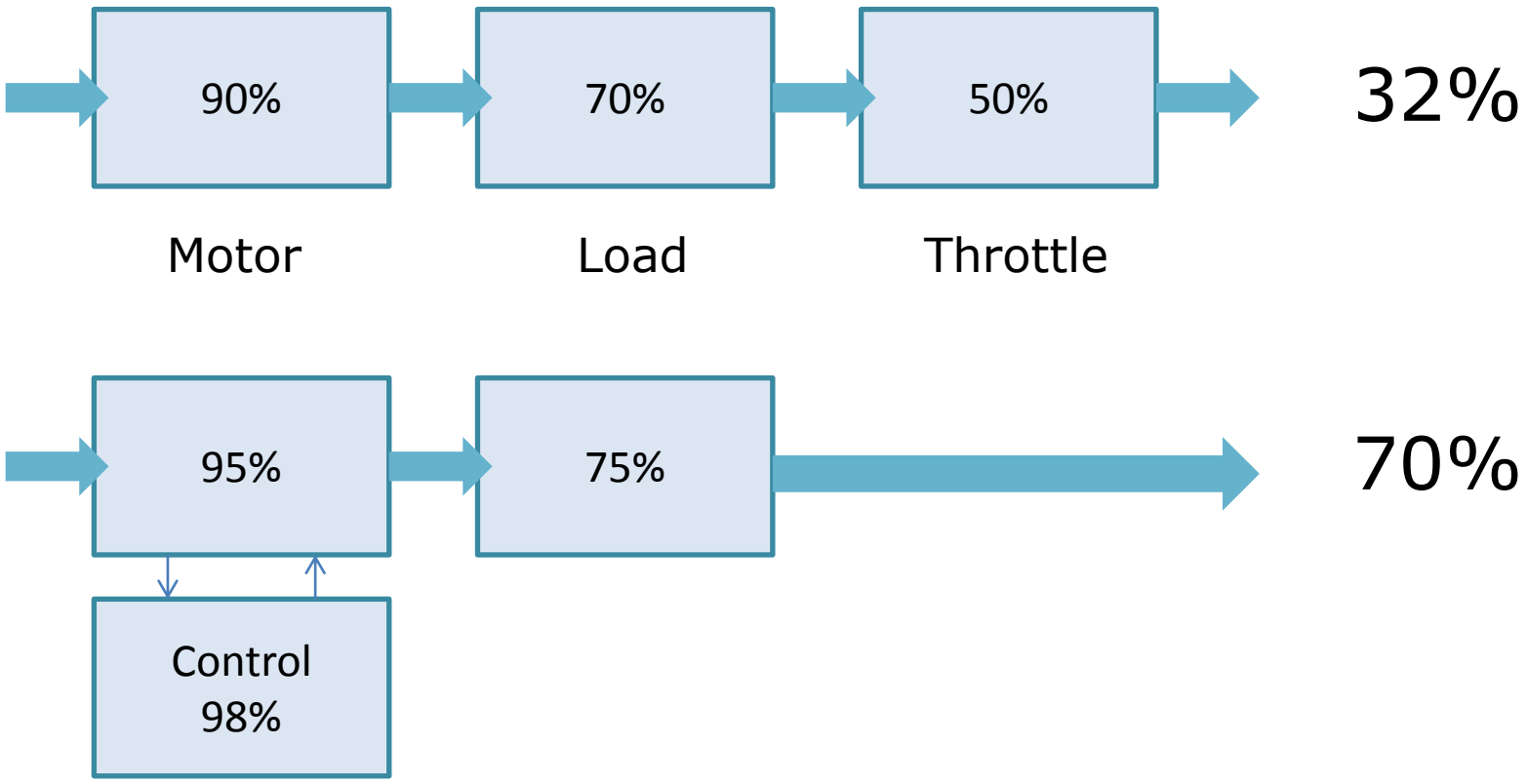
System Efficiency

Control can add significant system benefits



System Efficiency

The combination can yield even greater gains



2. Focus on selling price

Problem – Lifetime cost is not part of the purchasing decision

Buyer

- Purchaser is measured on purchase price
- User is measured on output and uptime
- Energy bill paid by financial admin

Vendor

- Competes on selling price

2. Focus on selling price

Solution – Lifetime cost built into specification, quotation, selection, validation and performance measurement

Specification	Energy consumption targets are set
Quotation	Vendor estimates annual energy cost
Selection	Lifetime cost is one of the selection criteria
Validation	Equipment signed off if meets the agreed target
Performance Measurement	Production and Maintenance are measured

3. Systematic approach

Energy management system

- Use of standards such as ISO 50001
- Appoint responsibilities to drive change
- A nominated energy manager
- A board member champion
- Energy as a company KPI
- Energy consumption as a KPI for key staff in relevant areas.

3. Systematic approach

Common pitfalls

• Seeing energy as a technical project for engineering departments without a budget

• Sweating assets in the belief it saves money, but in reality consumes more energy

• Purchasing energy efficient products, but not making big gains that system control brings

• Viewing energy cost reduction as a tariff negotiation exercise with the energy supplier

Case Study 1

Airport Air Handling System
- Variable Speed Motor Control

	Before	After
Control method	All fans on continuous running	All fans controlled by Variable Speed Drives
Output control	Motors run at full speed.	Fan speed controlled by VSD, linked to air monitors
Saving (£pa)	-	£100,000
Payback period (months)	-	12 months

Case Study 2

Industrial Process Cooling System
- Variable Speed Motor Control

	Before	After
Control Method	Direct on line started	Variable Speed Drives
Output Control	Variable dampers	Output controlled by VSD
Absorbed Power (kW)	320 kW	50 kW
Operating Cost (£ p.a.)	£128,656	£38,348
Capital Investment (£)	-	£47,440
Payback Period (months)	-	6 months

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Case Study 3

Airport baggage conveyors

- Automated Direct On Line start/stops

	Before	After
Control Method	Always On	DOL, Automated
Absorbed Power (kW)	2.2 kW	1.2 kW
Operating Cost (£ p.a.)	£8,126	£4,131
Saving (£ p.a.)	-	£3,995 (49%)

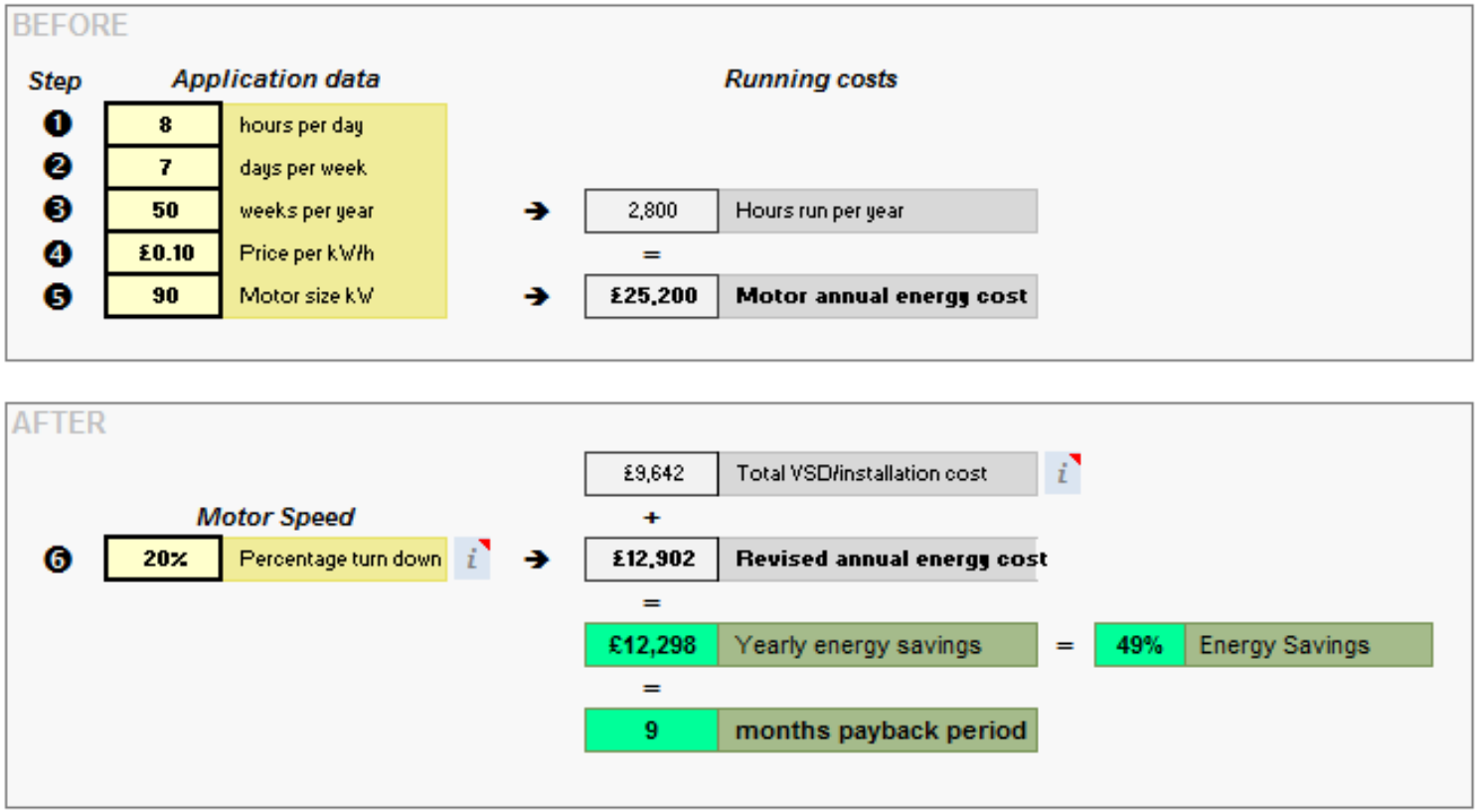
Where are motors used?

Hidden in basements and behind panels
Not just in heavy industry
Also in offices, retail, assembly, etc

- Ventilation, Air conditioning, Heating
- Refrigeration and Chilling
- Lifts, Hoists, Cranes
- Conveyors, Storage, Handling
- Water, Oil, Gas, Fluid handling
- Machinery, Packaging, Automation

GAMBICA VSD Calculator

For pump and fan loads
http://www.gambica.org.uk/vsdcalculator



Capital Allowances

Enhanced Capital Allowance scheme (ECA)

- Run by The Carbon Trust
- Valid for products on the Energy Technology List (ETL) – VSD and Motors - https://etl.decc.gov.uk/etl/site/etl/browse-etl/motors-drives.html
- Customer can claim 100% value in the first year on tax return

Capital Allowance changes

- From Jan 2013 for 2 years
- Investment allowance changed from £25k to £250k per year

Capital Allowances

Type	Value
Enhanced Capital Allowance (ECA)	Qualifying products: 10 x 90kW Variable Speed Drives Claim Value: £100,000 Corporation Tax rate: 24% **ECA saving: £24,000**
Capital Allowance	Claim Value: £200,000 Corporation Tax rate: 24% **Capital Allowance Tax Saving: £48,000**
Energy Saving	10 x 90kW drives, 4000 hours per year saving 33% of energy **Energy saving per year: £120,000**

Total Savings	**First year: £192,000** **Following years: £120,000** **Payback: less than 2 years**

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Ecodesign Directive

Commission Regulation (EC) No 640/2009 sets minimum standards for electric motors, defined by IEC standard 60034-30:2008

Date	Motor Range	Minimum Efficiency Standard
June 2011	0.75 kW to 375 kW	IE2 (with fixed or variable speed control)
January 2015	7.5 kW to 375 kW	IE3 (with fixed or variable speed control) *or* IE2 with Variable Speed Drive
January 2017	0.75 kW to 375 kW	IE3 (with fixed or variable speed control) *or* IE2 with Variable Speed Drive

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Further Information

GAMBICA Technical Publications
www.gambica.org.uk/technicalpublications

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Thank you