RESTRICTED – COMMERCIAL

Aggregate Energy Consumption Guide
Summary Report

Prepared for:	**Jerry McLaughlin** Director Mineral Products Association Gillingham House 38-44 Gillingham Street London SW1V 1HU	**Prepared by:**	**Rob Banes & John Fifer** SKM Enviros Victoria House, Southampton Row, London. WC1B 4EA
Tel: E-mail:	0207 963 8000 Jerry.McLaughlin@mineralproducts.org	Tel: E-mail:	0207 759 2596 rbanes@globalskm.com
Carbon Trust Account Manager:	Richard Rugg	Tel: E-mail:	0207 832 4614 Richard.Rugg@carbontrust.co.uk

Date **June 2011**

Version Final

CONTENTS

ENERGY CONSUMPTION GUIDE TO THE AGGREGATE SECTOR 2009

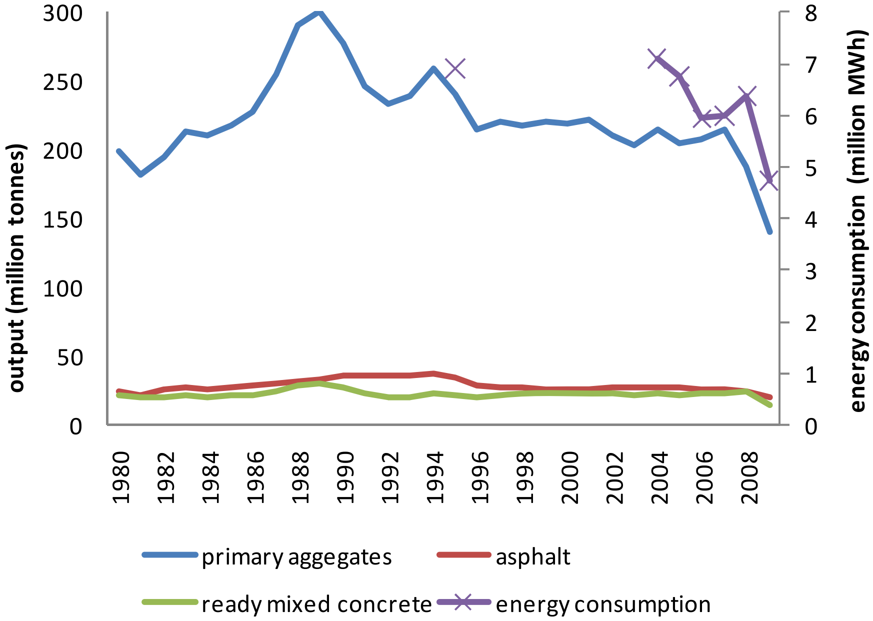
Message from the MPA

Aggregates are an essential part of our economic life in providing the infrastructure in which we live and work. As a natural resource industry the Aggregates Sector strives to protect and enhance the environment wherever possible and this includes actively managing energy consumption and carbon dioxide (CO_2) emissions from its operations. Over the past 3 years the sector, through the Mineral Products Association, the industry has been working with the Carbon Trust to reduce CO_2 emissions by increasing awareness of energy efficient practices, identifying innovation that will deliver future CO_2 savings and training staff to implement solutions. This guide gives an overview of the energy consumption of the sector in 2009; benchmarks have been calculated for different products and reduction targets suggested for sites to aim for and attain **sector leader** status. The MPA intends to repeat this survey as part of data collection for our sustainability report and over time it will represent an accurate measure of the sector's commitment to reducing its impact on climate change. Please use it to assess how your own site compares with others and use the resources available through the MPA web site (www.mineralproducts.org) to attain the good practice benchmark or, if you are already better than benchmark, to remain at the top by becoming a **sector leader**.

Sector Overview

Our survey uses data from 2009 which provides a snapshot of the industry. Output of primary aggregate in 2009 was at its lowest since 1980 as a result of the economic downturn.

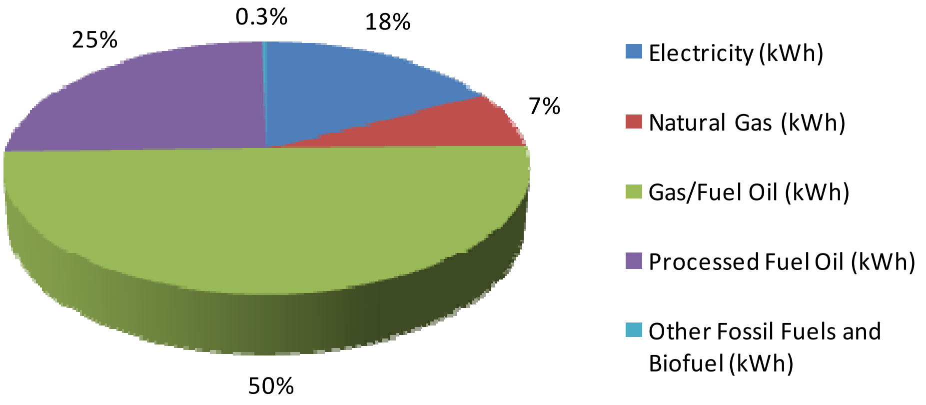
Figure 1 **Aggregate Production 1980-2009**



Our data boundary for this assessment includes CO_2 emitted from all fuel and power consumption from all operational activities taking place on site including mobile plant. This follows the methodology within the Greenhouse Gas Protocol (GHG)[1] for reporting operational carbon emissions. We are excluding energy and CO_2 emissions not related to site based activities such as diesel and petrol fuel consumption used for the delivery of material and transfer of product to customers or other sites.

In 2009 the aggregate sector consumed 705,000 MWh of electricity and 4,300,000 MWh of fuel emitting 1.2 million tonnes of CO_2. The proportion of the main energy sources is shown in the pie chart below.

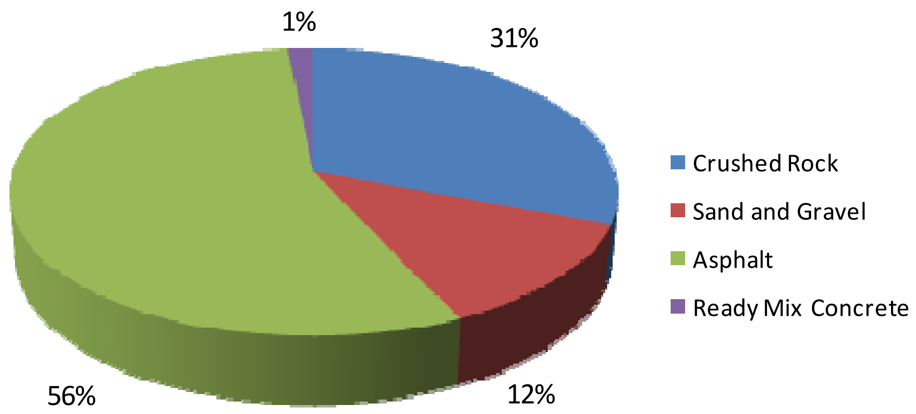
Figure 2 Energy Sources in the Aggregate Sector



We have divided the results of the report into the four main aggregate products. The proportion of energy used by each product is shown in the chart below.

[1] WRI, WBDSD (2004). Greenhouse Gas Protocol – A Corporate Accounting and Report Standard http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf

Figure 3 Energy Consumption by Product



The energy performances – measured as Specific Energy Consumption (SEC) - from the various products within the sector for 2009 are shown below along with the CO_2 emissions per tonne (Specific Carbon Emissions) (SCE) of product.

Table 1 Sector Overview

Sector	Total Production (million tonnes)[1]	Average SEC (kWh/t)	Average SCE ($kgCO_2$/t)
Crushed Rock	105.5	14.2	4.6
Igneous	*38.8*	*14.2*	*4.7*
Limestone	*58*	*14.2*	*4.5*
Sandstone	*8.5*	*20.5*	*6.7*
Sand and Gravel	46	11.7	4.0
Asphalt	20.5	117.6	34.9
Ready Mix Concrete	34.2	1.9	0.95

One of the objectives of this guide is to determine a benchmark against which sites can compare themselves and assess how they perform against industry norms.

We have determined a **good practice benchmark** based on the upper quartile of the results for each product, which is the SEC for which only 25% of the sites have a better performance. **A sector leader benchmark** has also been developed based on 25% improvement on the good practice.

[1] Office for National Statistics (2009). Mineral Extraction in Great Britain

Table 2 Good practice and sector leader benchmarks

Sector	Good Practice Benchmark (kWh/tonne)	Energy Saving if Achieved (%)	Carbon Saving if Achieved (tonnes)	Sector Leader Benchmark (kWh/tonne)
Crushed Rock	10.6	17	50,000	8.0
Sand and Gravel	8.4	27	24,000	6.3
Asphalt	102.6	10	40,500	80
Ready Mix Concrete	1.1	46%	8,800	0.8

The UK Climate Change Act (2008) requires the Government to reduce greenhouse gas emissions by at least 34% by 2020 and 80% by 2050 from a 1990 baseline. All sectors of the economy will need to contribute to help meet these targets. Benchmarks in this document highlight what is potentially achievable from the industry and could be used to help set targets for the aggregate sectors in the future.

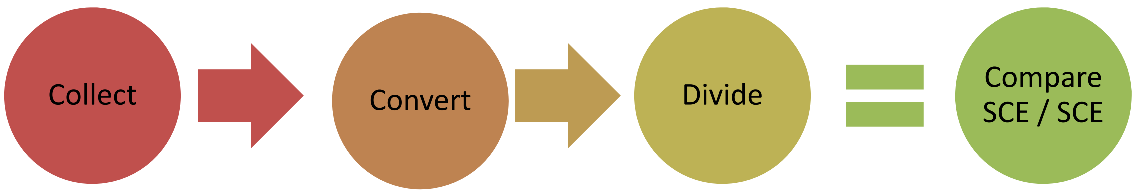
What should you do with this Guide?

Information presented in this guide will assist you to benchmark your operation against others in the industry.

Assessing your performance will help to identify sites where energy and carbon dioxide emissions can be reduced and sites that are performing well against industry benchmarks.

A simple four step process is presented below to calculate and compare your operation's Specific Energy Consumption (SEC) and Specific Carbon Emissions (SCE) with sector benchmarks. Tables and conversion factors to help carry out this process are outlined in Appendix A.

- **Step 1: Collect** 1 year's energy (electricity & fuel) and production data
- **Step 2: Convert** data to suitable units for assessment i.e. kWh and tonnes
- **Step 3: Divide** total energy consumption by production
- **Step 4: Compare the** SEC against the benchmarks in this guide



Your results should stimulate discussion and may lead to further analysis to see which activities on a site are not working efficiently and where opportunities may lie to make energy and carbon savings.

A wealth of further information, especially relating to practical energy saving ideas is available to help you on the MPA carbon reduction portal at http://www.aggregatescarbonreduction.com/.

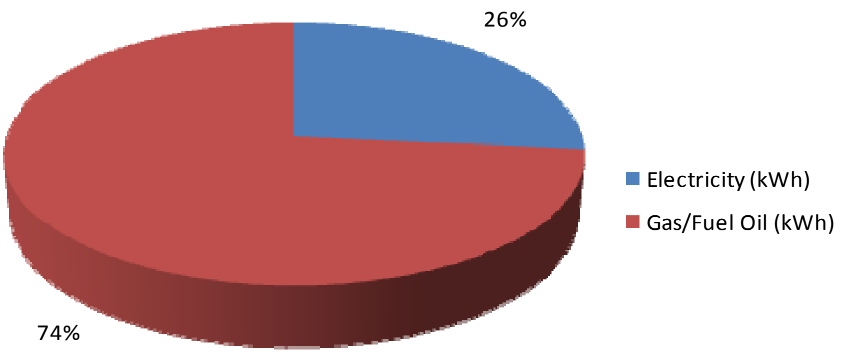
ENERGY BENCHMARKS

Although annual data for the sector as a whole is a good overall measure of the total energy consumption and CO_2 emissions; these aggregated figures do not give us information on the performance of individual sites nor on setting performance benchmarks against which sites can compare themselves. For this purpose we need to examine the performance in detail at product level.

Crushed Rock

The crushed rock sector in the UK produced 105 million tonnes of primary aggregate in 2009. We have chosen to display the data for all crushed rock quarries together as results have shown that there is little difference between the energy consumption of a limestone and a igneous (e.g. granite) quarry (sandstone data has been excluded due to lack of data from the sector). In the figure and table below we summarise the main findings. Our results are based on energy consumption and production data from 86 separate crushed rock operations.

Figure 4 Energy Split for Crushed Rock



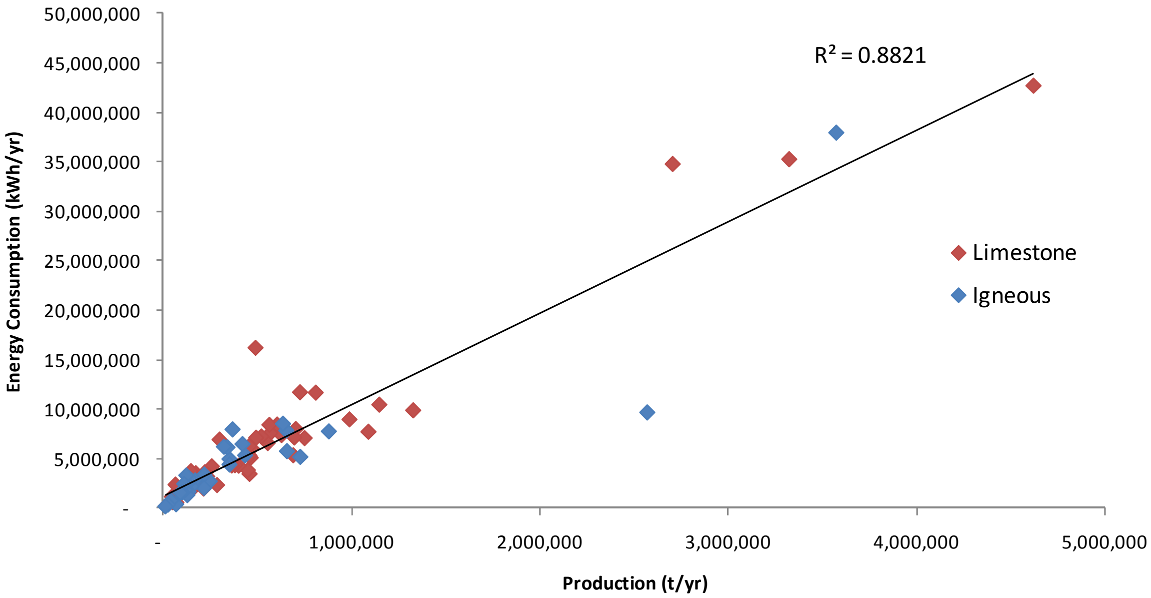
Gas/fuel oil makes up the majority of energy consumption from crushed rock sites with the remainder from grid electricity. This energy consumption relates to 430,000 tonnes of CO_2 emissions.

Table 3 Crushed Rock Summary

	2009
Total Production (million tonnes)	105.5
Total Energy Consumption (MWh)	1,235,500
Crushed Rock average SEC (kWh/tonne)	14.2
Total CO_2 Emissions (tonnes)	430,000
Crushed Rock average SCE ($kgCO_2$/tonne)	4.6

In figure 5 we show the energy consumption of crushed rock against production, different colours show the main product types of igneous and limestone. A line of best fit is displayed and most of the points lie close to the line showing a very strong relationship between production and energy consumption. The high R^2 value of 0.88 (88%) is a measure of how close that relationship is.

Figure 5 Energy Consumption vs Production for Crushed Rock

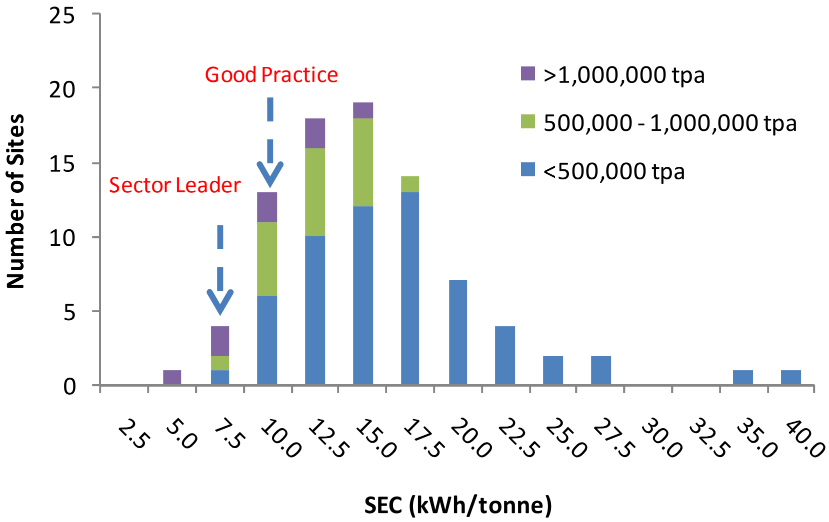


Dividing the annual energy consumption at each site by its production gives the energy performance or Specific Energy Consumption (SEC) in kWh/tonne; in the graph below we show the number of sites at each SEC range from 2.5 to 40 kWh/tonne. In addition we have indicated on the graph the relative size of the operation; for example at an SEC between 10 and 12.5 kWh/tonne there are:

- 10 sites with a production of less than 500,000 tonnes/year
- 6 sites with a production of between 500,000 and 1,000,000 tonnes/year
- 2 sites with a production of over 1,000,000 tonnes/year

It is clear from the histogram that the larger quarries tend to have a better SEC than the smaller ones however many small quarries do have energy performance to match that of the larger ones suggesting that small quarries can also become very energy efficient.

Figure 6 SEC for Crushed Rock Sites



We have used the individual SECs of the 86 sites to calculate a **good practice benchmark** for the sector. We have chosen the upper quartile of performance for the benchmark, in other words the SEC which only 25% of the sites are better than. In the case of crushed rock in 2009 this benchmark is 10.6 kWh/tonne. If every site met this benchmark the sector would save 17% of its energy consumption and of course of its CO_2 emissions.

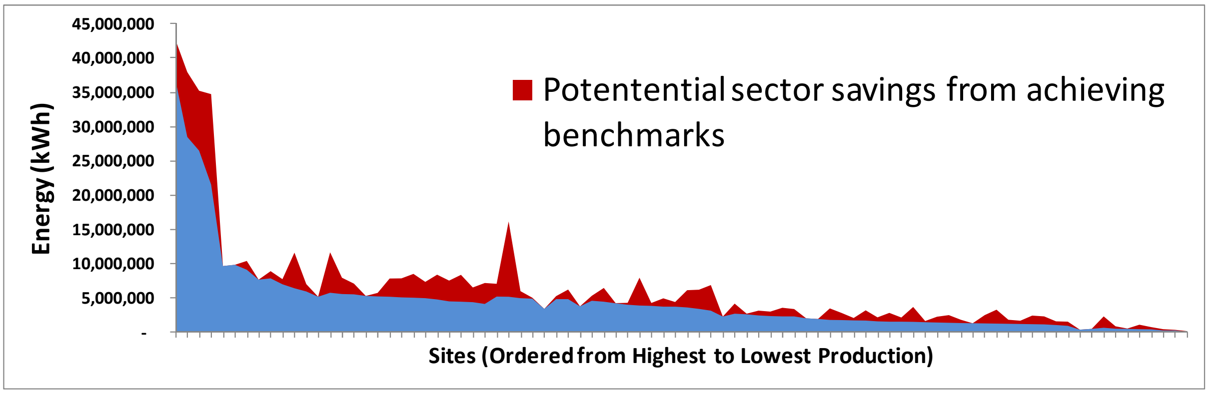
We hope that every hard rock site in the sector will compare itself to the benchmark of 10.6 kWh/tonne and put plans together to achieve or better it. Some sites of course are already better than benchmark and for those we recommend trying to achieve a **sector leader target** of 8.0 kWh/tonne which is a 25% improvement on the benchmark. If all those sites with production of over 500,000 tonnes achieved the sector leader target the saving would be an additional 10%.

Table 4 Crushed Rock Benchmarks

Good Practice Benchmark	Energy Saving if Achieved (%)	Carbon Saving if Achieved (t CO_2)	Sector Leader Target
10.6 kWh/tonne	17%	27,000	8.0 kWh/tonne

The chart below shows the potential energy savings from crushed rock operations if good practice benchmarks and sector leader targets for the largest sites are met. The area in red highlights this potential opportunity for energy reduction in the sector.

Figure 7 Potential Energy Savings from Good Practice and Sector Leaders

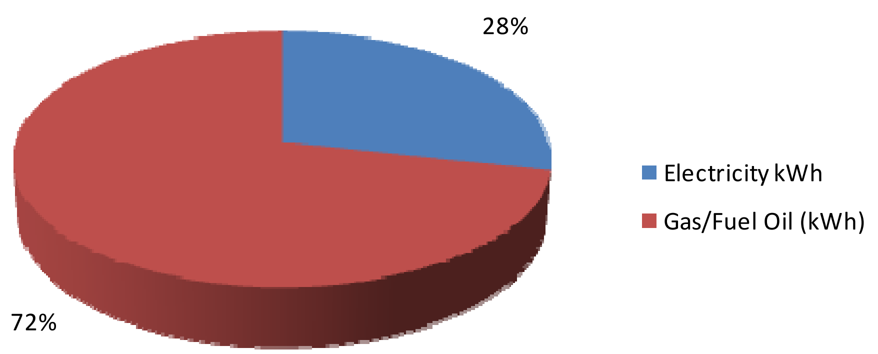


Sand and Gravel

This section provides information on sand and gravel extraction operations from land based activities.

Results are based on fuel consumption and aggregate production data from 138 separate land based sand and gravel operations.

Figure 8 Energy Split for Land Based Sand and Gravel



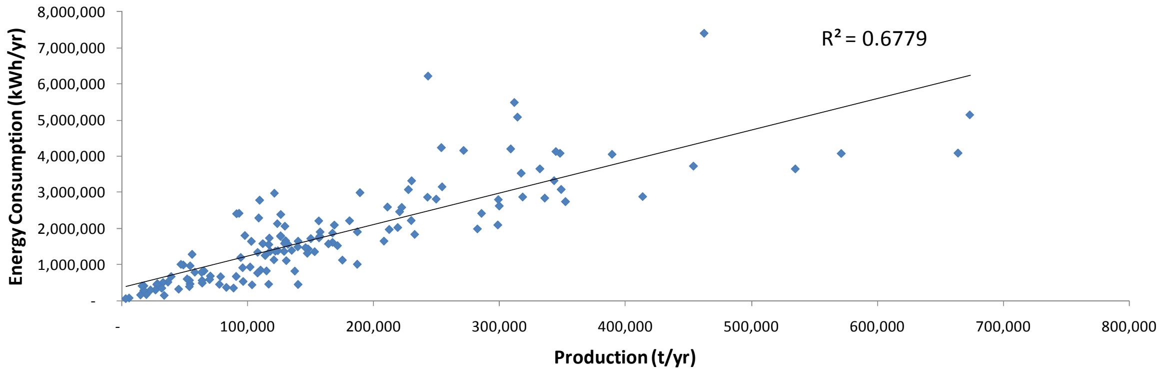
The table below provides an overview of the key results from the sector which produced 46.1 million tonnes of aggregate in 2009.

Table 5 Sand and Gravel Summary

	2009
Total Production (million tonnes)	46.1
Total Energy Consumption (MWh)	501,000
Sand and Gravel average SEC (kWh/tonne)	11.7
Total CO_2 Emissions (tonnes)	176,000
Sand and Gravel average SCE ($kgCO_2$/tonne)	4.0

In figure 9 we show the energy consumption of sand and gravel plants against production. A line of best fit is displayed and most of the points lie relatively close to the line showing some relationship between production and energy consumption. The R^2 percentage is a measure of this relationship (67%) demonstrating that although a relationship between production and energy is clear there are other factors strongly influencing energy consumption such as degree of processing.

Figure 9 Energy Consumption vs Production for Sand and Gravel



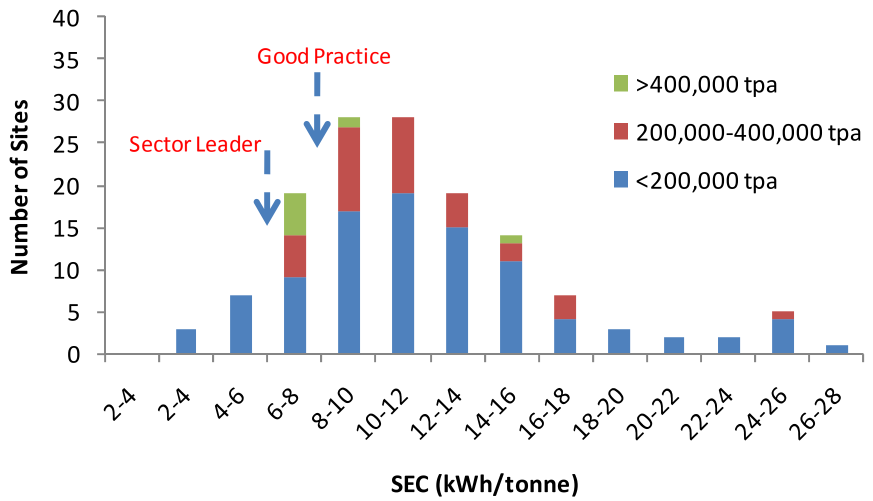
The graph below shows individual sand and gravel operations at different SEC (kWh/t) ranges for 2009. This value for each operation is calculated by dividing the annual energy consumption by production. The SECs within the sand and gravel sector range from 3-28 kWh/tonne. We have banded operations by size of production to demonstrate how output of an operation can affect the SEC.

As an example in the 14-16 SEC range there are:

- 11 operations with an annual production below 200,000 tonnes
- 2 operations with an annual production between 200,000 and 400,000 tonnes
- 1 operation with an annual production over 400,000 tonnes

The histogram below shows that larger operations generally have better energy performance than smaller ones, this is not to say that small sites cannot be efficient as a number of smaller sites with lower production levels also achieve high levels of energy efficiency.

Figure 10 SEC for Sand and Gravel Sites



A **good practice benchmark** has been calculated for the sand and gravel sector based on the better performing sites. Based on the individual site data from 2009 this benchmark is 8.4kWh/t. If every site in the survey achieved this level of efficiency, energy savings of 27% could be seen across the sector.

If operations with an annual production over 200,000 tonnes achieve the **sector leader target,** which we have developed to provide a goal for the best performing sites to pursue, a further 10% energy savings could be realised.

Table 6 Sand and Gravel Benchmarks

Good Practice Benchmark	Energy Saving if Achieved (%)	Carbon Saving if Achieved (t CO_2)	Sector Leader Target
8.4 (kWh/tonne)	27%	24,000	6.3 (kWh/tonne)

The chart below shows the potential energy savings from sand and gravel operations if good practice benchmarks and sector leader targets are met. With operations plotted by size of production the area in red highlights the potential opportunity for each site and the sector as whole.

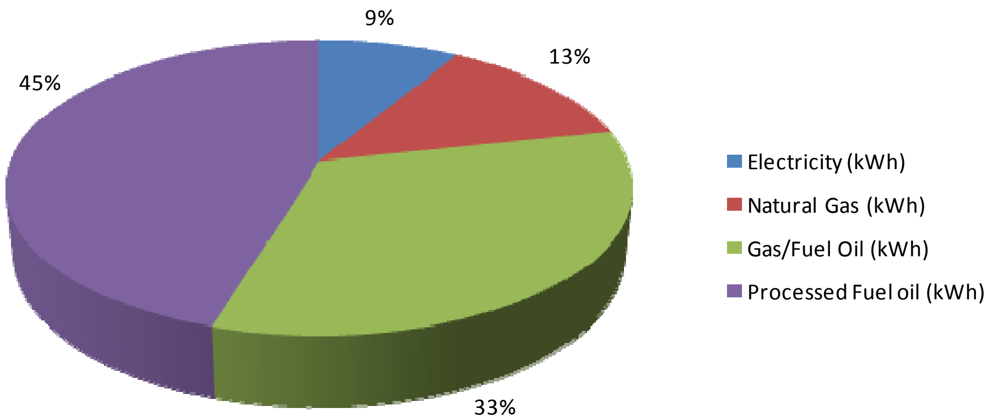
Figure 11 **Potential Energy Savings from Good Practice and Sector Leaders**

Asphalt

The production of surface coated materials – Asphalt – is one of the most energy intensive processes in the Aggregates sector. A large amount of heat is required to remove moisture from the crushed material and elevate it to a temperature where it can be mixed with the bitumen binder.

In the figure and table below we summarise the main findings from the survey for Asphalt. The results are based on fuel consumption and production data from 148 separate asphalt operations.

Figure 12 Energy Split for Asphalt



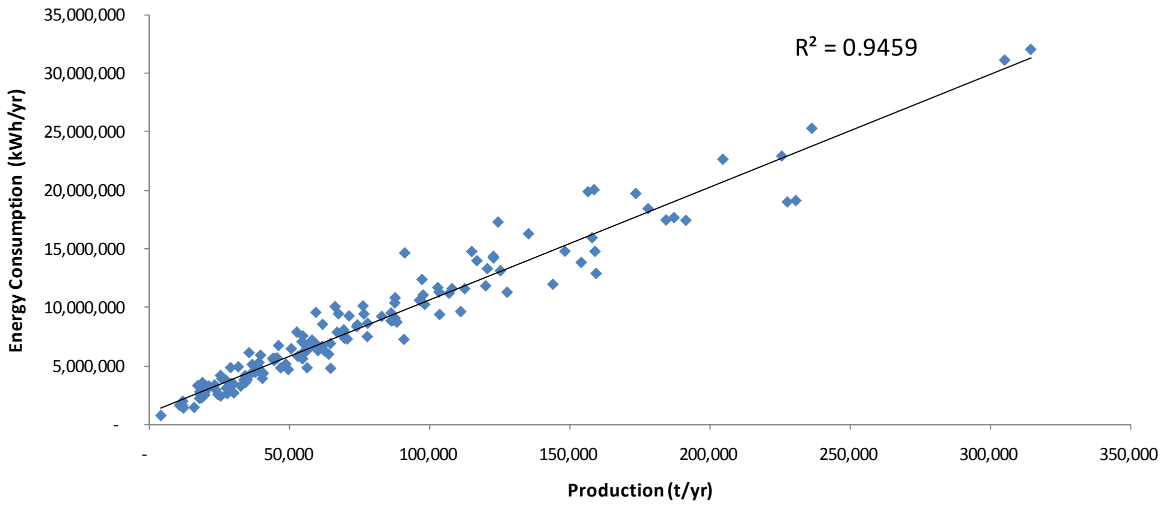
The asphalt sector in the UK produced 20.5 million tonnes of material in 2009, emitting 655,300 tonnes of CO_2 emissions.

Table 7 Asphalt Summary

	2009
Total Production (million tonnes)	20.5
Total Energy Consumption (MWh)	2,250,000
Asphalt average SEC (kWh/tonne)	117.6
Total CO_2 Emissions (tonnes)	655,300
Asphalt average SCE (kgCO_2/tonne)	34.9

In figure 13 we show the energy consumption of asphalt plants against production. A line of best fit is displayed and most of the points lie close to the line showing a very strong relationship between production and energy consumption. The high R^2 value of 0.95 (95%) is a measure of how close that relationship is.

Figure 13 Energy Consumption vs Production for Asphalt



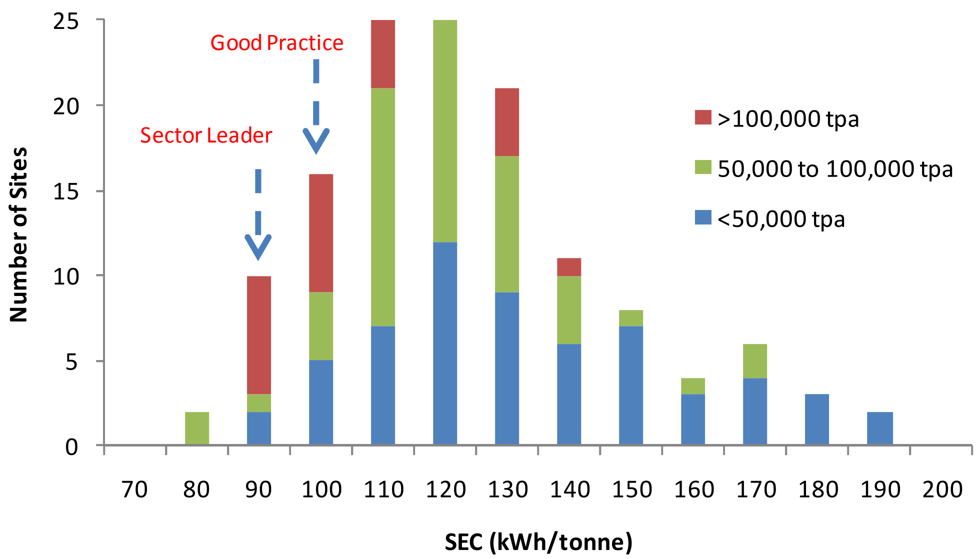
Dividing the energy consumption at each site by its production gives the sites energy performance or Specific Energy Consumption (SEC) in kWh/tonne; in the chart below we show the number of sites at each SEC range from 70 to 200 kWh/tonne. In addition we have indicated on the graph the relative size of the operation.

For example at an SEC between 130 and 140 kWh/tonne there are:

- 9 sites with a production of less than 50,000 tonnes/year
- 8 sites with a production of between 50,000 and 100,000 tonnes/year
- 4 sites with a production of over 100,000 tonnes/year

With generally low SECs, the chart shows that larger asphalt sites tend to have a better SEC than the smaller ones. As in other sectors some small plants do have energy performance to match that of the best larger ones suggesting that small asphalt plants can also become very energy efficient.

Figure 14 SEC for Asphalt Sites



We have used the individual SECs of the 148 sites in the survey to calculate a **good practice benchmark** for the sector. We have chosen the upper quartile of performance, in other words the SEC which only 25% of the sites are better than; for asphalt in 2009 this benchmark is 102.6 kWh/tonne. If every site met this benchmark the sector would save 10% of its energy costs and of course of its CO_2 emissions.

We hope that every asphalt plant will compare itself to the benchmark of 102.6 kWh/tonne and put plans together to achieve or better it. Some sites of course are already better than benchmark and for those we recommend trying to achieve a **sector leader target** of 80.0 kWh/tonne which is a 22% improvement on the benchmark. If all those sites the sites with production of over 50,000 tonnes achieved the sector leader target the saving would be an additional 15%.

Table 8 Asphalt Benchmarks

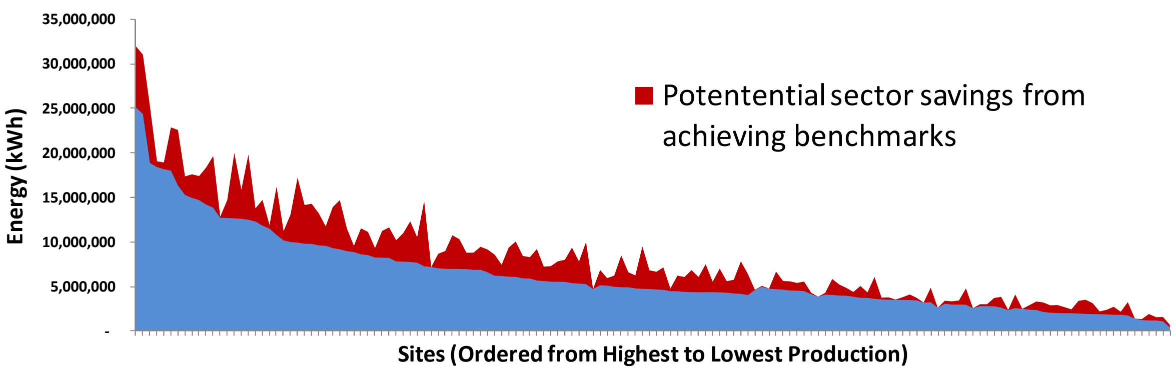
Good Practice Benchmark	Energy Saving if Achieved (%)	Carbon Saving if Achieved (t CO_2)	Sector Leader Target
102.6 kWh/tonne	10%	40,500	80 kWh/tonne

Benchmark for Very Small Plants

As there are so many small asphalt plants, many serving a local demand for short production runs we have also determined a benchmark for asphalt plants with production of below 50,000 tonnes per year. In the case the best practice benchmark is 110.5 kWh/tonnes as an alternative for small urban plants to compare themselves with.

Ranked by size of production, the chart below shows the potential energy savings asphalt operations if good practice benchmarks and sector leader targets are met. The area in red highlights the challenge and potential opportunity for the sector.

Figure 15 Potential Energy Savings from Good Practice and Sector Leaders

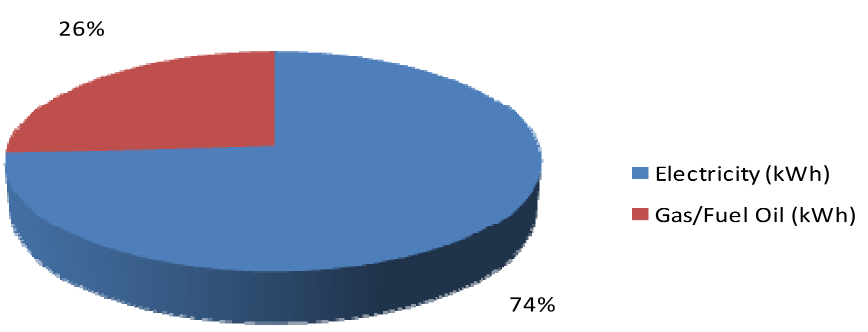


Ready Mix Concrete

Ready Mix Concrete is a type of concrete made off the construction site mixing concrete, aggregates, water and additives. Our results are based on fuel consumption and production data from 638 separate ready mix concrete operations.

Although ready mix concrete only contributes around 2% of energy consumption of the aggregates industry as a whole, a significant opportunity still exists to reduce energy alongside cost and carbon savings in this sector due to the wide variation in current performance.

Figure 16 Energy Split for Ready Mix Concrete



Production of ready mix concrete is also measured in volume using m^3 as units. For ease of comparison with other sectors ready mix concrete results are presented here in tonnes per year[1].

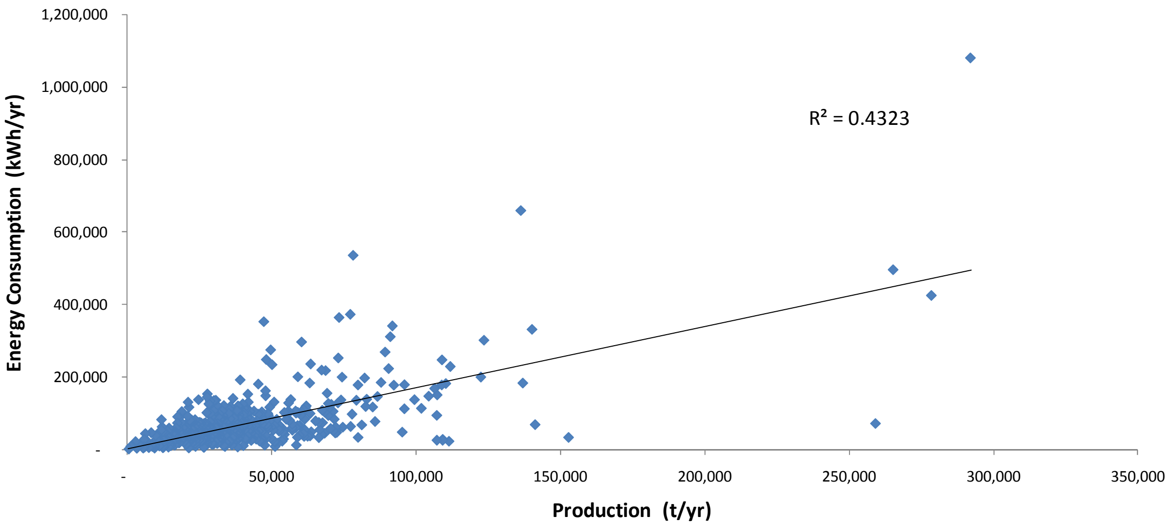
Table 9 Ready Mix Concrete Summary

	2009
Total Production (million tonnes)	34.2
Total Energy Consumption (MWh)	59,600
Ready Mix Concrete average SEC (kWh/tonne)	1.9
Total CO2 Emissions (tonnes)	29,400
Ready Mix Concrete average SCE ($kgCO_2$/tonne)	0.95

[1] Ready mix conversion 2.38 t/m^3 based on Concrete Guidance Document on Sustainability Performance Indicators – Issue 5 (2010)

In figure 17 we show the energy consumption of ready mix concrete operations against production. A line of best fit is displayed shows the relationship between energy consumption and production. A high R^2 value (close to 100%) shows a strong relationship, so a value of 43% demonstrates a relatively weak relationship between energy use and production in the ready mix concrete sector. Other factors in this sector aside from level of production will also have a strong impact on energy consumption.

Figure 17 Energy Consumption vs Production for Ready Mix Concrete



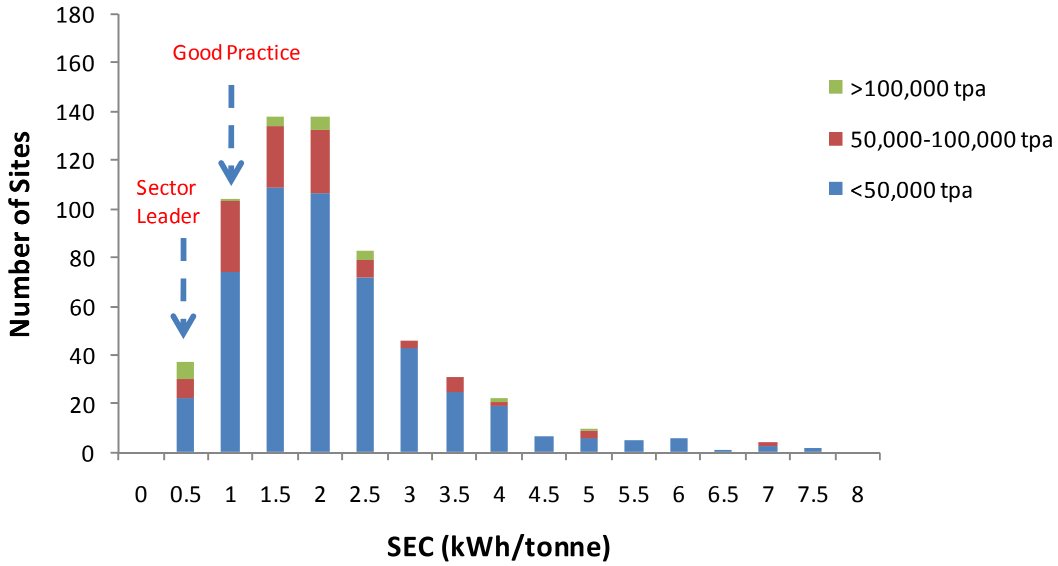
Output from ready mix concrete operations in 2009 ranged from a few hundred tonnes to around three hundred thousand tonnes. Energy intensity shown by the SEC is generally lower than the other sectors in the industry. The individual SEC for each of the 638 site surveyed ranges from about 1-8kWh/t with the majority of sites clustered between 1-4 kWh/t.

For example in the graph below:

- 215 operations with production below 50,000 t have an SEC of 1-2 kWh/t/yr
- 54 operations with production between 50,000 t and 100,000 t have an SEC of 1-2 kWh/t/yr
- 10 operations with production over 100,000 t have an SEC of 1-2 kWh/t/yr

A fairly weak relationship exists between production and energy efficiency in the ready mix concrete section. This can be seen in the histogram below with each production group fairly proportionally represented at different levels of efficiency. The ready mix concrete sector has probably had the lowest level of assistance throughout the industry to reduce emissions and these results suggest that significant energy, carbon and cost savings could be realised in this sector.

Figure 18 SEC for Ready Mix Concrete Sites



A **good practice benchmark** for this sector has been calculated on the upper quartile of SECs, based on the level where only 25% of sites are performing better. A number of operations have a higher SEC than the 2009 average (the 'long tail' seen on the histogram). If operations with production above 50,000 tonnes met the good practice benchmark in the sector this would lead to a 46% energy savings across the sector.

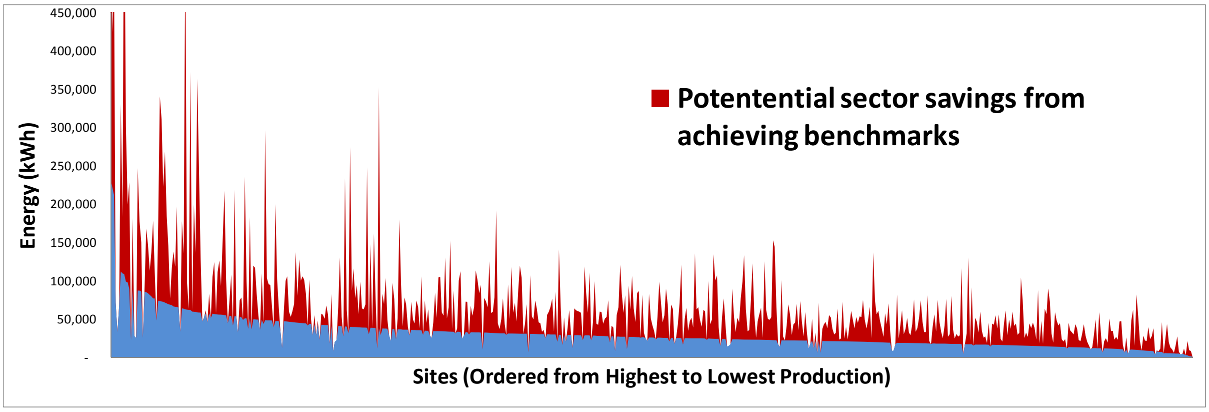
Some sites are already performing better than the best practice benchmark and should look to meet and exceed the **sector leader target.** If this benchmark, based on a 25% improvement on best practice is achieved, a further 25% energy savings would be seen across the sector.

Table 10 Ready Mix Concrete Benchmarks

Good Practice Benchmark	Energy Saving if Achieved (%)	Carbon Saving if Achieved (t CO_2)	Sector Leader Target
1.1 (kWh/tonne)	46%	8,800	0.8 (kWh/tonne)

The chart below shows the potential energy savings from ready mix operations if good practice benchmarks and sector leader targets are met. With operations plotted by size of production the area in red highlights the potential opportunity for energy reduction from each site and the sector as whole.

Figure 19 **Potential Energy Savings from Good Practice and Sector Leaders**



APPENDIX 1 - CALCULATING AND COMPARING SEC AND SCE

A step by step process is provided in the boxes below to assist in calculating the Specific Energy Consumption (SEC) and Specific Carbon Emissions (SCE) for your site. Both calculations follow an easy four step process.

- **Step 1: Collect** 1 year's fuel and production data
- **Step 2: Convert** data to suitable units for assessment
- **Step 3: Divide** total energy or carbon emissions by production
- **Step 4: Compare** SEC or SCE against benchmarks in this guide

Box 1: Calculate Specific Energy Consumption (SEC)

Step 1: Collect 1 year's electricity, fuel and renewable energy consumption and production (sales) data. Add more fuels as necessary.

(1) Production		T or (m^3)
(2) Electricity		kWh
(3) Fuel (1)		litres
(4) Fuel (2)		litres

Step 2: Convert fuel consumption (e.g. litres) into energy for all fuels using Government approved conversion factors (See Box 3)

(5) Fuel (1)		litres x	*Conversion factor*	=		kWh
(6) Fuel (1)		litres x	*Conversion factor*	=		kWh

Step 3: Divide total energy by total production

(7) Sum of electricity and fuels - add (2)+(5)+(6)		kWh
(8) Divide by production (covert m^3 to tonnes) (1)		tonnes
(9) SEC - Specfic Enregy Consumption		kWh/t

Step 4: Compare the SEC with the specfic good and sector leader benchmarks in this guide

Box 2 To calcualte the Specific Carbon Emissions (SCE)

Step 1: Collect 1 year's electricity, fuel and renewable energy consumption and production (sales) data. Add more fuels as necessary.

(1) Production		T or (m^3)
(2) Electricity		kWh
(3) Fuel (1)		litres
(4) Fuel (2)		litres

Step 2: Convert fuels (kWh, litres etc) into carbon emission using DEFRA carbon conversion factors (see Box 4) for each fuel. Fuels can be converted to kWh as above or converted from volume- make sure the correct carbon factor is used.

(5) Electricity (kWh)		x	*Conversion factor*	=		kg CO_2
(6) Fuel (1) (units)		x	*Conversion factor*	=		kgCO_2
(7) Fuel (2) (units)		x	*Conversion factor*	=		kgCO_2

Step 3: Divide total carbon emissions by total production

(8) Sum of electricity and fuels - add (5)+(6)+(7)		kgCo_2
(9) Divide by production (covert m^3 to tonnes) (1)		tonnes
(10) SCE – Specfic Carbon Emissions		kgCO_2/t

Step 4: Compare the SEC with the specfic good and sector leader benchmarks in this guide

Box 3: Fuel Unit Conversion Factors

In order to calculated the Specific Energy Consumption (SEC) all energy units need to be converted into kWh to enable like for like comparison. To help calculate your total site energy consumption the key unit conversion factors used in this report are provided below.

Fuel	Units	Conversion Factor	Reference
Natural gas	kWh/m3	11.02	Carbon Trust Conversion Factors (2009)
Fuel Oil	kWh/litre	11.84	Defra (2009)
LPG	kWh/litre	6.96	Defra (2009)
Gas/Diesel Oil	kWh/litre	10.97	Defra (2009)
Burning Oil	kWh/litre	10.30	Defra (2009)
Processed Fuel Oil (PFO)	kWh/litre	10.56	Defra (2009) (lubricants)
Biofuel	kWh/litre	10.15	Defra (2009)
Petrol	kWh/litre	9.60	Defra (2009)
Biofuel	kWh/litre	10.15	Defra (2009)
Diesel	kWh/litre	10.56	Defra (2009)
Ready mix concrete	t/m^3	2.38	MPA Sustainability Performance Indicators – Issue 5 (2010)

Box 4: Carbon Conversion Factors

Once the energy consumption is known this data needs to be converted in order to determine the total carbon dioxide emissions.

Carbon emission factors have been taken where possible from the Government 2009 published factors[1]. The main conversion factors used in this report are provided below with a reference to the source.

Fuel	Units	Conversion Factor kgCO_2e	Reference
Electricity	kWh	0.545	Defra (2009)
Natural Gas	kWh	0.206	Defra (2009)
Fuel Oil	kWh	0.283	Defra (2009)
Gas Oil	kWh	0.293	Defra (2009)
Processed Fuel Oil	kWh	0.280	Defra (2009) (lubricants)
Natural Gas	m^3	2.03	Defra (2009)
Diesel	litres	2.67	Defra (2009)
Gas Oil	litres	3.02	Defra (2009)
Processed Fuel Oil	litres	2.95	Defra (2009) (lubricants)
Biofuel	litres	1.59	Defra (2009)
Petrol	litres	2.32	Defra (2009)

[1] Defra (2009). Guidelines to Defra / DECC's Greenhouse Gas Conversion Factors for Company Reporting

APPENDIX 2 - GLOSSARY

Average: There are three main statistical methods to calculate the average SEC or SCE for a sector– mean, mode and median. To ease replication for future Guides, the mean average is used in this guide calculated by dividing the total of the SECs or SCEs in a sector by the number of operations.

Average Specific Carbon Emissions (SCE): The average SCE is calculated across a sector to avoid the disproportional impact that large sites will affect total consumption divided by total production. This is determined by taking the average of the SCE across the sector.

Average Specific Energy Consumption (SEC): The average SEC is calculated across a sector to avoid the disproportional impact that large sites will affect total consumption divided by total production. This is determined by taking the average of the SEC across the sector.

Specific Carbon Emissions (SCE): Total carbon emissions (kgCO_2) divided by total production (t).SCE is measured in units of kgCO_2/t/yr

Specific Energy Consumption (SEC): Total energy consumption (kWh) divided by total production (t). SEC is measured in units of KWh/t.