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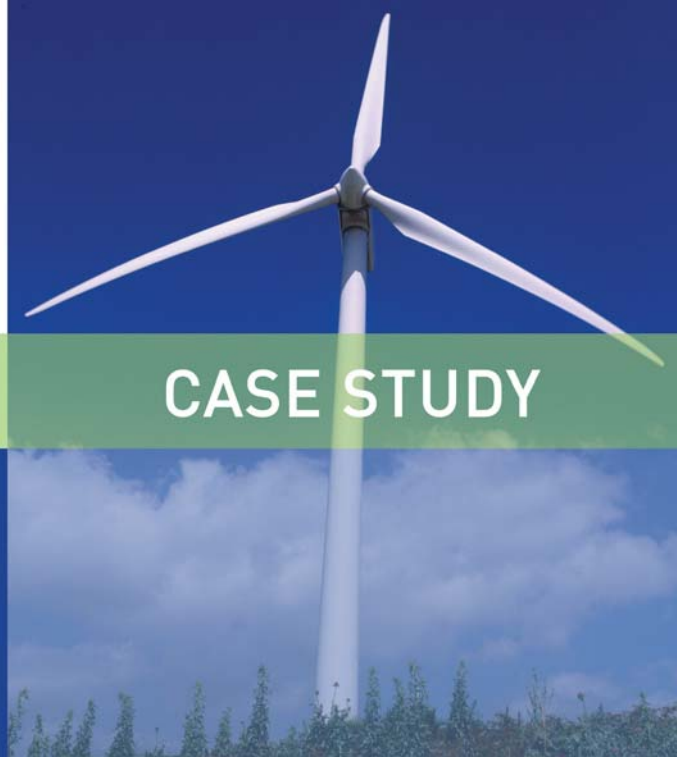


ENERGY CHALLENGE

CASE STUDY

Understanding Specific Energy Consumption; examples from within the Metal Forming Sector

As energy prices continue to increase and sectoral energy efficiency targets tighten significantly more attention is bound to be focused on Specific Energy Consumption (SEC) and the ways in which SEC targets can be met.

Within the metal forming sector targets are defined in kWh/tonne (expressed in terms of primary energy).

Sites that have joined the sectoral umbrella agreement have responsibility for monitoring energy usage that is deemed eligible in the site Climate Change Levy Agreement (CCLA) and similarly for accurately monitoring production. This is typically undertaken on a daily weekly or monthly basis for reporting quarterly to the CBM. Where the 90/10 rule has not been applied (i.e. when not all of the energy consumption on site is deemed to be eligible for a CCL rebate) these is a need to accurately monitor flow of energy into the eligible processes on site. Normally, this must be done by means of suitable sub-metering equipment.

The site operator needs to ensure that only eligible energy use and applicable production figures are used for the collection and analysis of data for the returns made to the trade association.

During the Energy Challenge Project a large amount of energy consumption and production data was collected. A number of analyses were carried out using sets of real sample data to determine the relationship between production figures and energy usage figures within the sector.

This simple study examines a number of sets of typical sample data with the aim of increasing awareness of the various types of relationship that may exist between energy consumption and production output.

Operators should aim to use data that gives the best possible correlation between primary energy usage and production, for example by using the most relevant tonnage figures (e.g., tonnes heated, tonnes forged, finished forging weights etc). Some within the sector have employed product mix corrections (algorithms) to their benefit, others have not. In some cases it is all but impossible to see any tangible correlation between energy usage and production output, whatever units are employed.

It is informative to examine a number of real examples form the sector. These are normalised to 100% in each case. Furthermore the data presented has been verified to ensure that the energy data relates to the correct production period and that production data is representative of eligible energy use for that production process (and directly associated processes).

Sample Data From The Metal Forming Sector

We have selected six samples sets of data. It is recognised that types of energy use vary; some processes use mainly electricity or gas, some utilise a significant proportion of each of these fuels.

The assumption made in the SEC monitoring process is straightforward. There should be a relationship between the energy consumption in (in primary kWhr) of a process and the production output from that process (in tonnes). No production should incur no energy usage.

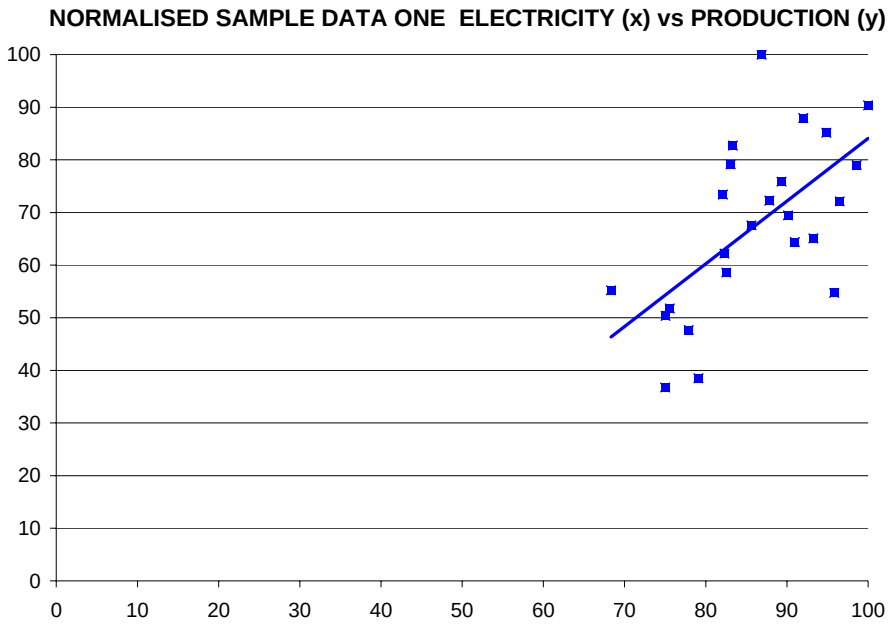
In reality we may expect some energy usage during low or no production periods for a variety of reasons. This non-productive energy consumption will be largely waste and can be targeted for significant reduction or elimination.

It is worth noting that regular monitoring of production and energy consumption, e.g. hourly will produce far more useful data for identify non-productive consumption. If energy and production are measured monthly then it is very unlikely that there is any month where either production or energy usage was zero so that any analysis gives an averaged result. This is used for CCLA reporting but has little value in identifying waste. Conversely, measuring energy usage and production on say an hourly basis will reveal the true relationship between energy consumption and production allowing non-production energy base loads and out of hours consumption to be clearly quantified.

We present six sets of sample data taken from UK metal forming companies. These include hot and cold forging and associated processes deemed eligible under CCLAs.

Example 1

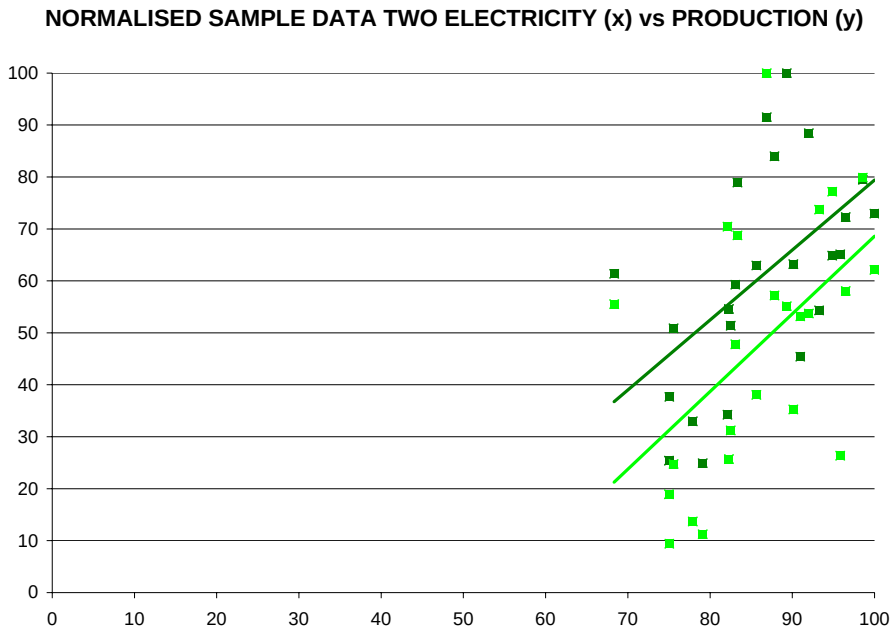
All examples show a simple analysis of energy consumption as a function of production output. This example shows electricity consumption verses production for a cold forging operation.



Using simple linear regression the implication is that electricity consumption is 30% of maximum when production output is zero. The data is highly scattered such that on a period to period basis the SEC will be highly variable.

Example 2

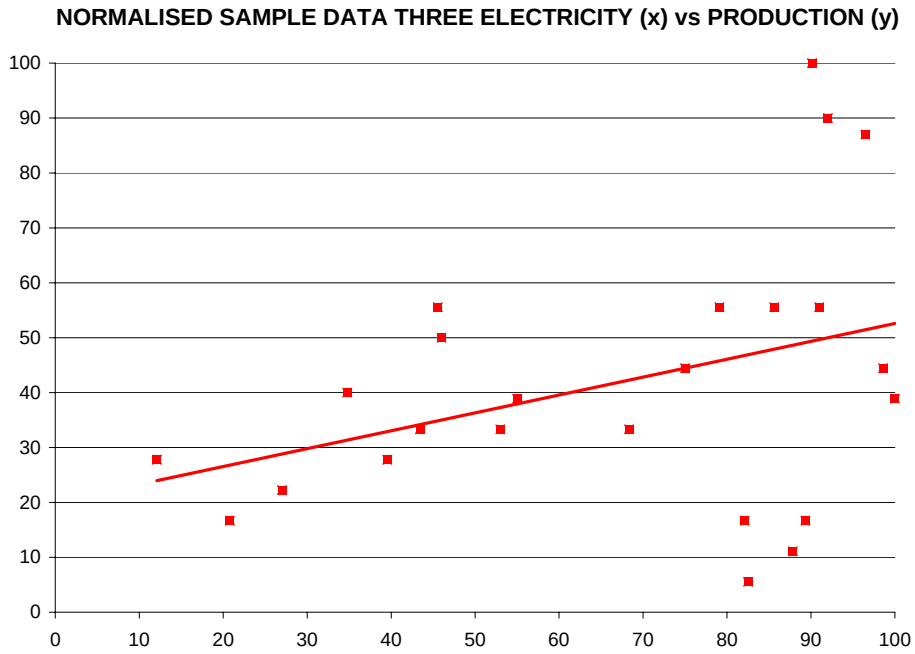
Electricity consumption is shown as a function of production output for a site carrying out cold forging operations using two similar production centres.



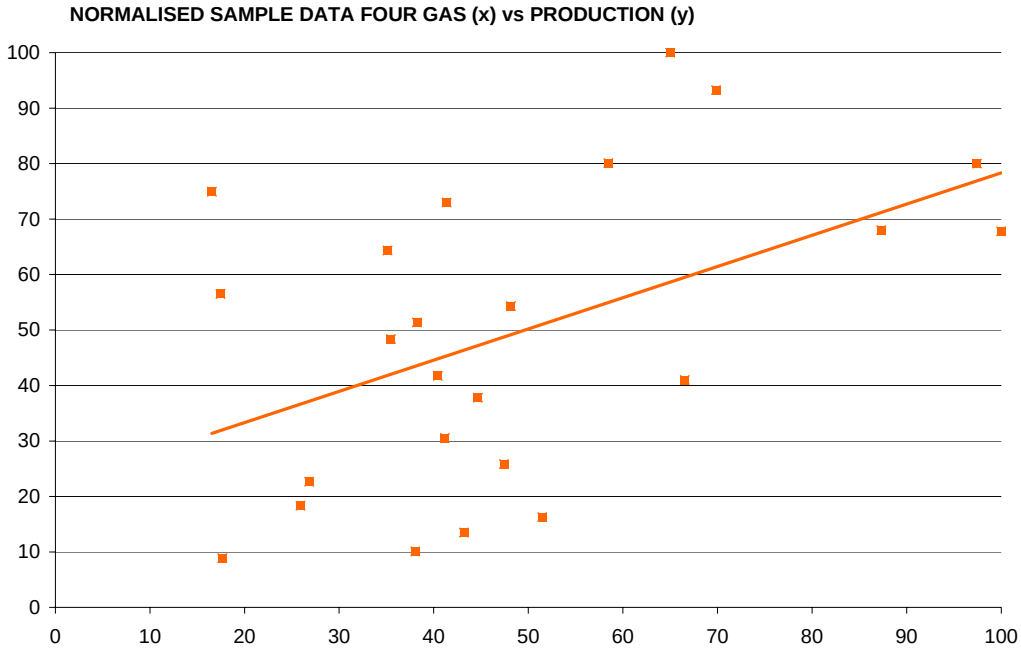
The implication is that depending on the production centre analysed between 41 and 54% of maximum electricity consumption occurs when production output is at zero. Again this is worthy of investigation since it could be read to represent a significant amount of waste occurring. Again the data is highly scattered giving a fluctuating SEC which makes meaningful reporting very difficult.

Examples 3 and 4

These examples show electricity and then gas consumption from a mixture of hot forging and ancillary processes.



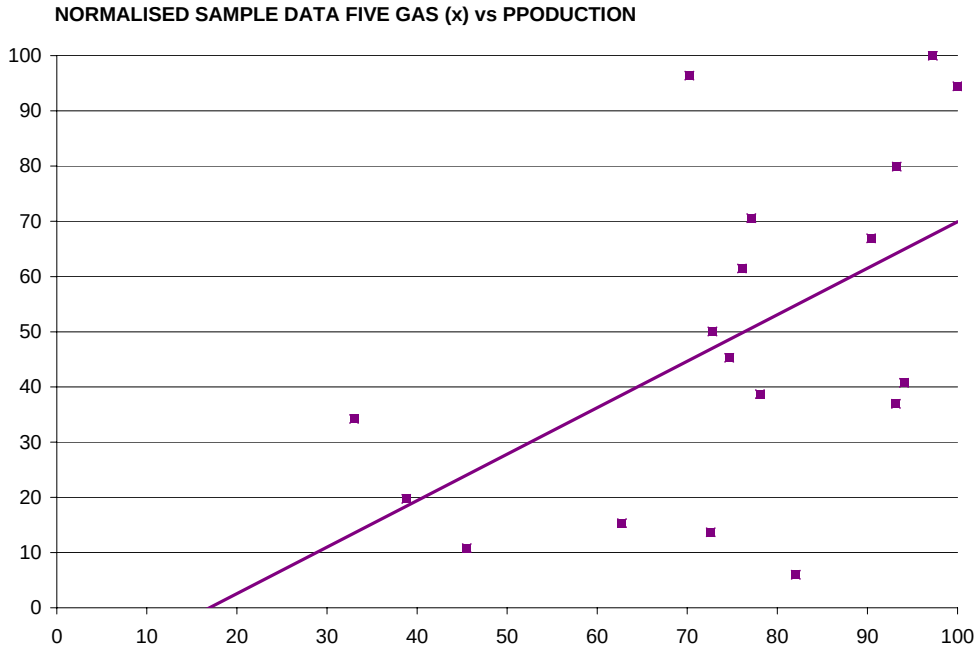
Simple linear regression shows that electricity consumption is approaches zero when production is at 20% of maximum.



The same principle is true for gas usage (example 4) within the processes. This is difficult to interpret in a meaningful way. The unusual form of the data and the large fluctuations seen make the monthly determination of SEC largely meaningless.

Example 5

This example shows gas usage by a hot forging operation. This is monthly data.

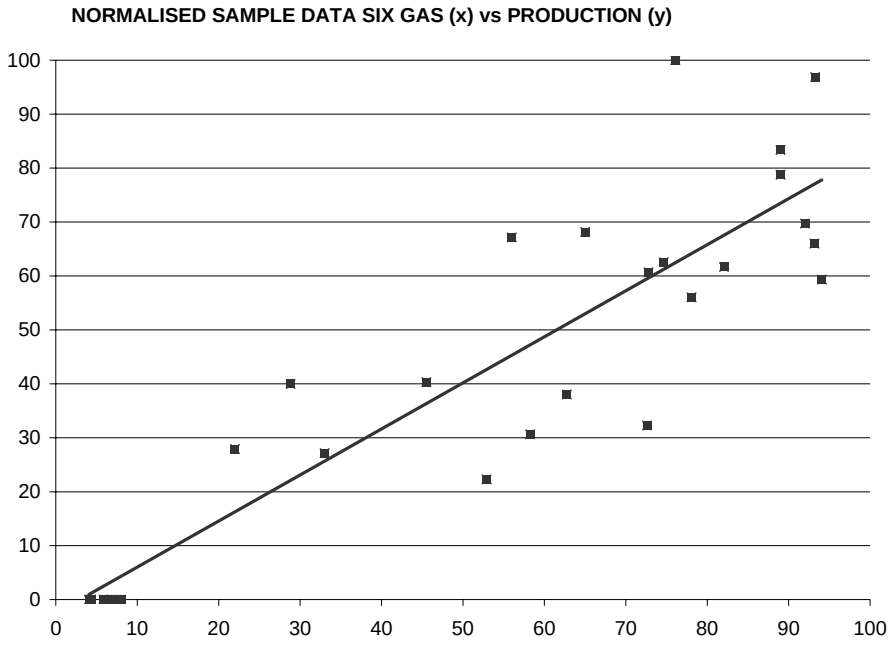


A gas usage of approximately 17% of the maximum usage is inferred when production is at zero. This level of "waste" may well be predicted given the heat losses associated with the operation of gas fired furnaces

and the long preheat and soak times required for larger ingots within the forging process. However, data is still highly scattered and month by month SEC calculation show significant variation.

Example 6

Again, this example relates to a hot forging operation. This is weekly data.



The data is less scattered and the non-productive gas usage is only about 4% of the maximum gas usage. Much of the improved correlation can be put down to the reduced timescale for data collection (i.e. weekly). The small amount of gas consumption observed when production is zero may be operation of furnaces for quality control purposes and test pieces (non-productive use). Monthly variations in the SEC are smaller making energy monitoring, reporting and the identification of waste much more straight forward.

Conclusions

The examples given above demonstrate a number of important principles.

- There are many cases where the calculation of monthly and quarterly Specific Energy Consumption values produces highly variable values. This is probably due to alterations in product type or mix or operation. In such cases there is significant benefit in reducing the data regarding period to either per day or per hour in order to properly relate energy usage to actual production at any one point in time. Using this more detailed data will allow SEC to be determined by product group and a sensible product mix correction to be made,

- A significant amount of the data collected revealed large non-productive use. Typically energy consumption during period of little or no production was between 10 and 40% of the maximum energy consumption. This represents a significant amount of energy waste. If following correlation of energy consumption to production using a simple linear regression this is found to be the case, it is worth considering analysis of hourly energy consumption in order to determine the period in which this energy consumption is occurring.

  The Energy Challenge web site www.energychallenge.co.uk gives examples of how detailed energy data can be analysed and made into a footprint to allow a better understanding of energy usage and the identification of waste,

- Where analysis of monthly data reveals little demonstrable relationship between energy usage and production and the site is working towards a relative target, it is likely that the site will need to review units of production employed and examine energy use on an hourly or half hourly basis. Only in this way can the relationship between energy usage and production be properly established and meaningful analysis and reporting carried out.

Information

www.energychallenge.co.uk

www.somersforge.com

www.proenviro.com