Gas Use Regression: A Simplified Model

A Study of Gas Used for Supplementary Heating on US Weaner Producers

Introduction

In principle, heat loss from pig buildings is simple and predictable, depending on outside and inside temperatures and ventilation rate. Accordingly, it should be a simple matter to calculate the supplementary heating requirement over a range of outside temperatures and thereby gas use and heating cost. (Though the calculations might be little long winded on a typical farm because of the number of room and building elements.)

In practice, it is nowhere near so predictable as theory suggests, in much the same as way as motor cars rarely achieve their theoretical fuel efficiency, and for much the same reasons. In general, gas use is much higher than the theory suggests it should be, because different people use them in a variety of ways in different and changing conditions.

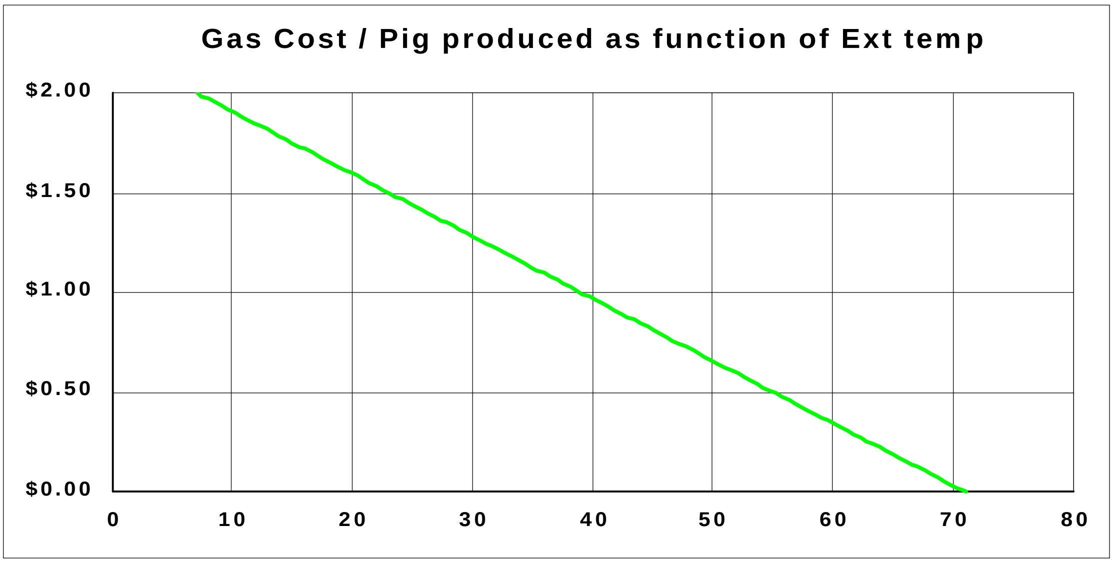
Theoretical calculations are, therefore, of very limited use in financial terms for assessing running costs, estimating the effectiveness of changes, predicting future costs or targeting improvements.

Monitoring of utility bills is, of course, an important step, but is crucially limited in that it cannot take account of external variables such as outside temperature.

What is needed, therefore, is a method which is both more accurate in terms of assessment and comparison, but simpler to use.

The Method

Heater use is logged using Dicam and Barn Report into summaries of daily use and gas use is calculated according to heater ratings. Using rolling averages to eliminate spurious variations, regression is calculated against outside temperature. Values are then converted to cost per pig produced for easier comparison between breeding units of different sizes.



The relationship follows the general form:

G = U (T - E)

Symbol	Description	Unit
G	Gas cost per pig produced	$
U	Usage factor	$/ºF, $/ºC etc.
T	Characteristic temperature	ºF, ºC
E	External temperature (mean)	ºF, ºC

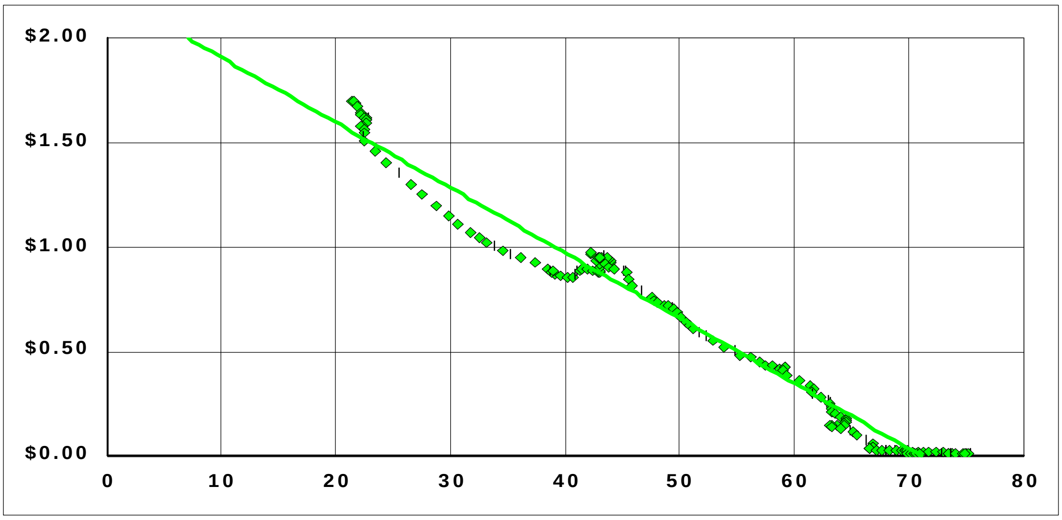
That is, for every degree of outside temperature drop below a certain trigger (characteristic) temperature, there is a certain increase in heating use, which is shown in value terms, per unit output.

When comparing production sites, or different periods on the same production site, therefore, the points of comparison are:
T - the characteristic temperature. This is the outside temperature point at which the site starts to use gas - when ambient temperature is above this value, no cost is incurred.
U - the increase in cost per fall in temperature.

Lower numbers represent higher usage efficiency.
In the example show above, T = 70.9ºF, U = $0.0313
In other words, there is no heating cost when average daily ambient temperature is at or above 70.9ºF. At mean temperatures below this, production costs increase by 3.13c per pig produced per degree F.
For example, if the average monthly temperature were 60F, then the gas cost would be 34c per pig produced.

Discussion

A perennial problem of comparisons is that of external influences beyond the control of the trial or study.
For example, the winter of 2000 in the US has been colder, and started earlier than the year before. A simple comparison of gas bills makes little sense, as you would expect them to be higher anyway.
Using this model means you can calculate how much bigger they should be, based on previous data even though the conditions haven't been experienced before.

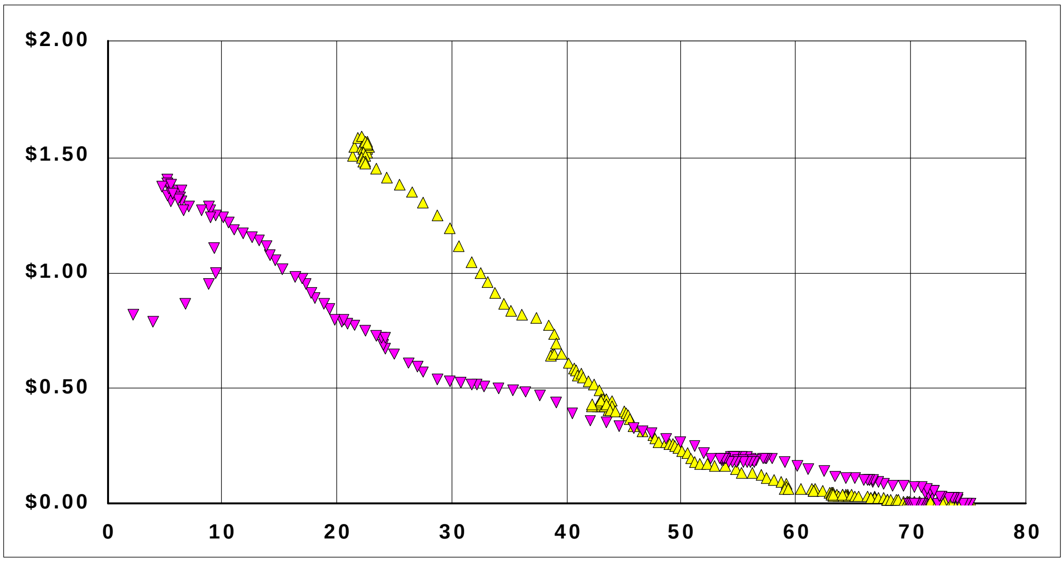


In practice there are other factors. In the above with individual data points, we can see a step change in the characteristic around 43ºF, summarised as follows:

	T	U
Overall	70.9ºF	$0.0313
Mode A (45 to 65ºF)	69.4ºF	$0.0353
Mode B (20 to 40ºF)	65.5ºF	$0.0328

Whatever the reasons for this change, the running cost differences are significant. For example, for a month when the mean outside temperature was 45ºF, the running cost in Mode A would be $400 more than Mode B for a 1250 sow unit.

In the following chart, the 1st half of the year 2000 (yellow) is compared with the 2nd half (purple) on a 2500 sow unit.



The average gas cost per pig produced was in fact higher in the second half ($0.82 instead of $0.43), but this is mainly because of the lower ambient temperature. You' can see that the regression is lower (response to temperature). The farm has become more efficient in use of gas. At 30ºF, this amounts to around $2,300 per month.
You can also see that gas is being used at higher ambient temperatures in the second half, indicating that some of the general improvement has been "left on the table".

Summary

Gas Use Regression is a quick and cost effective method of objective assessment.
Using this method, it is practical to summarise costs in a simple consistent format to allow direct comparison between farms, different times and to project costs under other circumstances.
It is accepted that the method gives limited information, but it has the great benefit of relative simplicity and relating directly to $ values, which is a present target.

The data for this study has been drawn from the Barn Report system. The figures shown are for illustration of the method only and should not be taken as bench marks or targets, although general consistency was found in the several farms studied. A wider based study would be required for further verification and target setting.

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2000-01-16