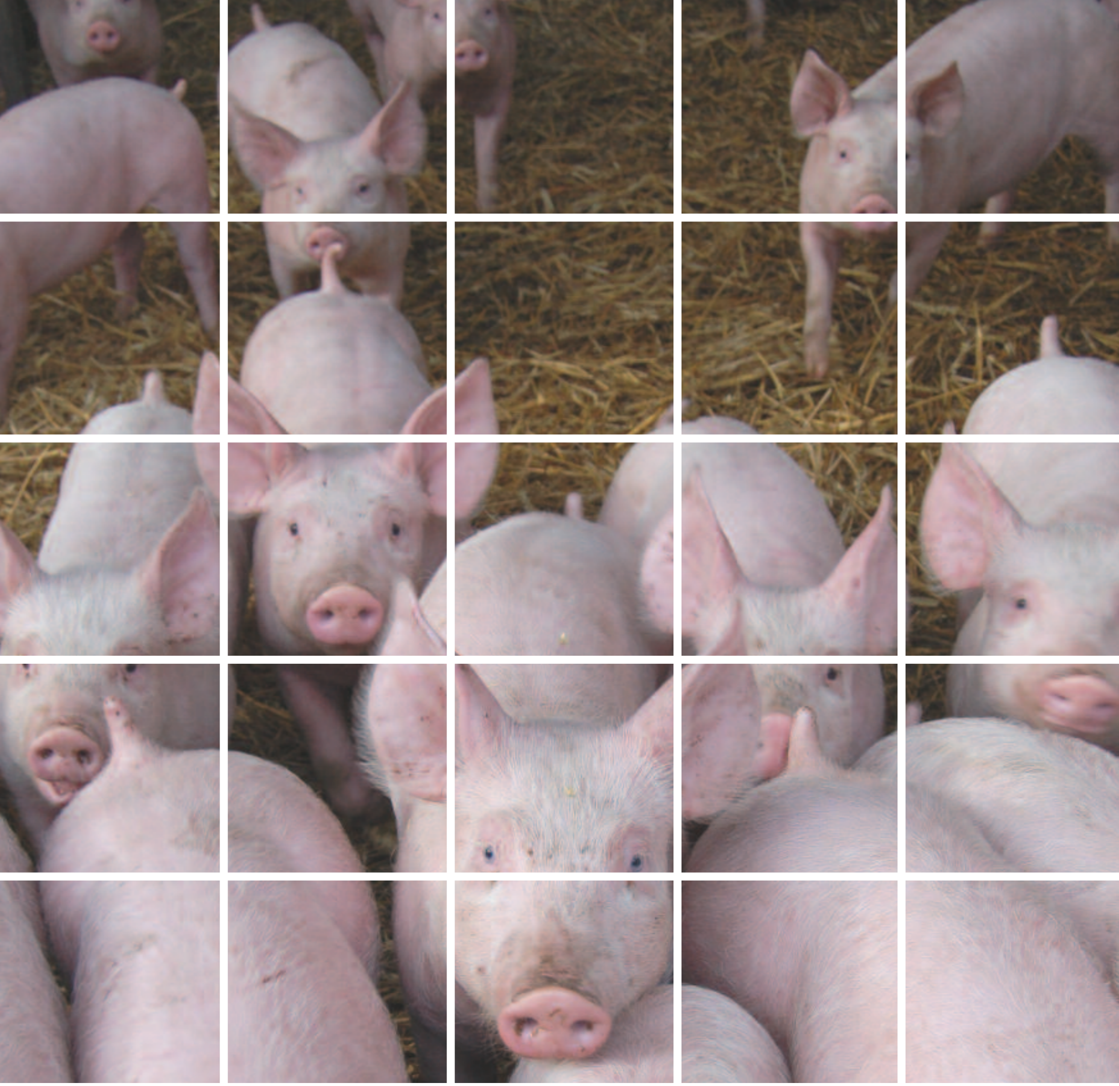


Life Cycle Assessment of British Pork

Environmental impacts of pig production 2008-2012 and forecast to 2020

Executive Summary

January 2014

BPEX

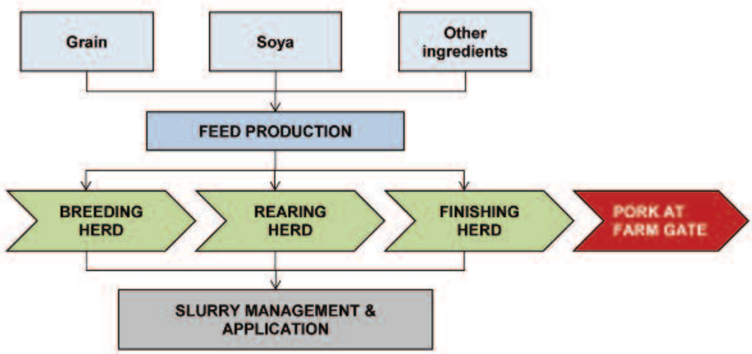
Environmental Impacts of Pork Production in the UK

This note highlights the key findings from a BPEX-funded report commissioned to estimate the sources and scale of environmental impacts of pork produced in the UK. 'Advancing Together, A Roadmap for the English Pig Industry' (April 2011) presented targets for reduced environmental impacts up to 2020. This report measures progress towards these targets up to 2013 and is issued as part of the periodic review process built into the Roadmap. This study succeeds previous work by the same authors for BPEX in 2008 and 2010, which assessed the entire life cycle of British pork. Forecast data for 2014 and 2020 have also been included, with the aim of estimating changes in the environmental profile of British produced pork. The results presented indicate significant improvement. Supporting data can be found in the full report.

Introduction

Life Cycle Assessment (LCA) is used to measure environmental impacts of a product from conception to a specified end point. This study is from serving a sow, through the following stages of production, to pigs leaving at the farm gate (Figure 1). The outputs are expressed as kilograms of pig meat not live pigs. This report will confirm, or otherwise, that improvements in practice and productivity at farm level since 2008 have reduced the environmental impacts of the industry. In addition, it contains the contribution of key aspects, whether the current focus areas are correct and if long term targets will be achieved. It is hoped that this will then inform subsequent policy.

Figure 1 Summary of pork production life cycle (cradle-to-gate)



Method

The LCA process takes into account feed production, rearing of pigs and the storage and management of slurry and farmyard manure, including its application to fields as fertiliser.

Environmental impacts also include pollution and transport issues. The following measures are then quantified and used to make comparisons of the impact of a process with the aim of identifying possible improvements or changes in production patterns or methods.

Climate change potential – is an increase in temperatures caused by the emission of carbon dioxide (CO_2) and other greenhouse gases (GHG) into the atmosphere. The results are expressed in kg CO_2 equivalents (eq) and represent a time horizon of 100 years.

Eutrophication potential – is a reflection of the amount of nutrients (eg nitrates and phosphates from manure/slurry) which is leached into the aquatic environment. These nutrients are essential for life but increased concentrations can cause excessive growth of algae, reducing the available oxygen in the water. The results are expressed in kg phosphates (PO_4) equivalents.

Acidification potential – relates to the release of acidic gases (eg ammonia from slurry/manure or sulphur dioxide (SO_2) from the combustion of fuels. These have the potential to cause acid rain. Reduced pH in natural habitats such as lakes can cause damage. The results are expressed in kg SO_2 equivalents.

Abiotic Resource depletion potential – estimates the extraction of scarce minerals and fossil fuels. An abiotic depletion factor is determined based on the remaining global reserves and their rates of de-accumulation. The results are expressed in kg antimony (Sb) equivalents.

Key Performance Targets remained as presented in the Roadmap (April 2011).

Many studies focus on climate change potential (carbon footprint) only. However, it is important that other impacts are included and 'pollution swapping' (the practice of improving one aspect to the detriment of another) does not occur and we strive for the best overall environmental and social outcomes.

Results

Based on the results of the 2010 LCA, it is known that the main contribution to environmental impacts associated with pork production is the production of animal feed consumed by pigs during growth. Changes in the composition of feed can have a marked effect on the environmental impact of the feed. During the period 2008–2020 the changes in components which made up the diet, driven by fluctuations of key feed ingredients, meant that the environmental impact of pig feed had decreased across all the measures above, with the greatest benefit to climate change.

.Other factors which affect the impact of pork production are:

- Performance efficiency
- Type of housing
- Slurry/manure management and storage
- Electricity and straw consumption.

Performance efficiencies achieved for 2008 to 2012 and forecasted for 2020

Breeding herd

Figure 2 shows year-on-year improvement for specific breeding herd parameters between 2008 and 2011 and forecasted to 2020.

Figure 2 Performance from the breeding herd between 2008 and 2011 and forecasted to 2020

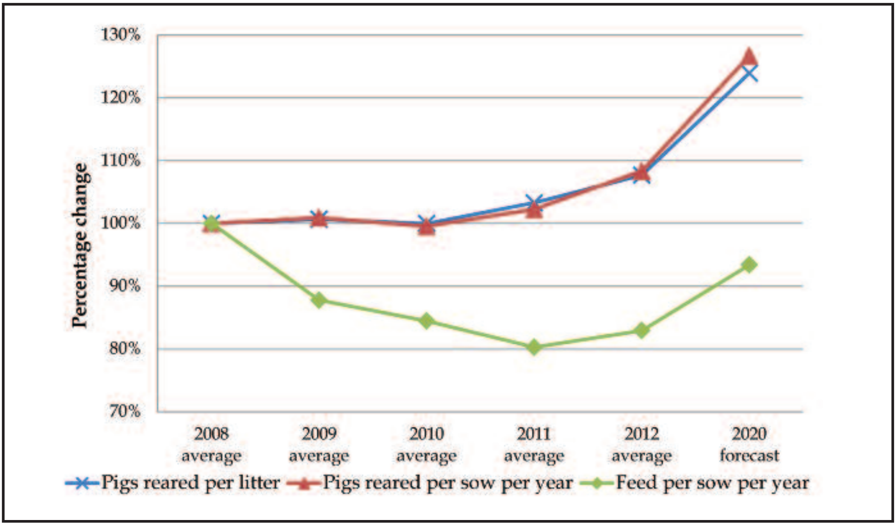


Figure 2 highlights the following:

- Between 2008 and 2012 the number of pigs reared per litter increased by 8%
- Between 2008 and 2012 the number of pigs reared per sow per year increased by 8%
- The increased pig production identified above is in the context of a reduction in the quantity of feed consumed per sow per year, which decreased by 17% between 2008 and 2012.

With regard to performance efficiencies of breeding herd parameters forecasted for 2020:

- The number of pigs reared per litter is forecast to increase by 16% between 2012 and 2020
- The number of pigs per sow per year is forecast to increase by 18% between 2012 and 2020 as the gap between lower and higher performing herds is closed

- The forecast data for 2020 suggests an increase in the quantity of feed per sow per year of 10% between 2012 and 2020. This is a consequence of larger litter sizes and the gap between lower and higher performing herds closing.

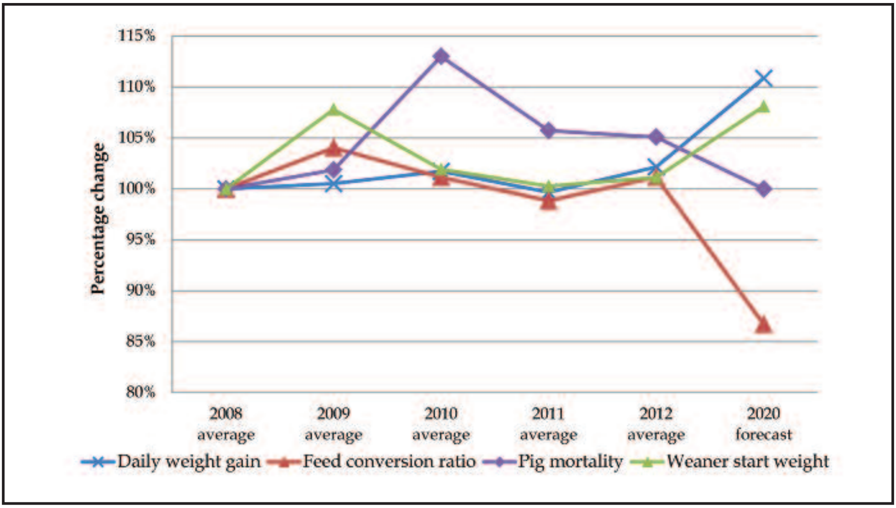
Rearing herd

Rearing herd parameters used were:

- Weaner start weight
- Daily weight gain
- Feed conversion ratio
- Pig mortality.

Figure 3 shows the average percentage change in the British rearing herd between 2008 and 2011 and forecasted for 2020.

Figure 3 Average percentage change in the British rearing herd



The following is evident from the performance efficiency of rearing herd parameters observed between 2008 and 2012:

- Daily weight gain remains relatively constant, between 2008 and 2012, showing a slight increase of 2% in 2012 compared with 2008
- Food Conversion Ratio (FCR) is seen to have **increased by 4% between 2008 and 2009 and then to have remained relatively constant resulting in a 1% increase** in 2012 compared to 2008. It is thought that this is a consequence of poor grain quality due to bad growing conditions during 2011-2012; anecdotal evidence is showing that the 2012 grain crop is showing improved performance
- Pig mortality, referring to the proportion of rearing herd pigs that die during this life cycle stage, is shown to increase up to a peak of 13% greater than 2008 levels in 2010, with a subsequent decline through to 2012 that results in a figure 5% greater than 2008 levels
- With the exception of one year (2009), weaner start weight remained relatively constant between 2008 and 2012, resulting in a 1% increase in 2012 compared with 2008. In 2009, weaner start weight increased by 8%. However, given that other years are relatively consistent, the value for this year is considered to be anomalous.

It should be noted that small percentage changes may be due to seasonal and annual variation in production and the situation at the end of each reporting year and therefore are indicative rather than defining.

Environmental Improvements between 2008 and 2012

Performance efficiency figures show that improvements have been achieved for all four of the environmental impact categories assessed.

Table 1 Comparison of 2008 to 2012 results (per kg of pork)

		2008	2009	2010	2011	2012	Change 2008-2012
Climate change	kg CO_2-eq	6.18	5.93	5.88	4.55	4.55	26.3%
	% change per year		4.0%	0.9%	22.6%	0.0%	
Eutrophication	kg PO_4-eq	0.072	0.069	0.068	0.063	0.059	13.2%
	% change per year		3.6%	1.8%	7.3%	1.0%	
Acidification	kg SO_2-eq	0.207	0.201	0.198	0.191	0.187	9.4%
	% change per year		2.7%	1.5%	3.7%	1.8%	
Resource depletion	kg Sb-eq	0.0090	0.0086	0.0085	0.0083	0.0083	8.3%
	% change per year		4.4%	1.5%	2.6%	0.0%	

The values of estimated environmental consequences of pig production presented in this report are different to those in the Roadmap, Advancing together. The farm productivity data and targets for numbers of pig reared etc., remain unchanged.

New calculations were necessary on account of a number of factors including changes to LCA methodologies, agreed emission factors, farm recording data points, the availability of new data from Defra providing a breakdown of the proportion of pigs housed in various systems, specific and detailed feed ration composition data as opposed to nutritional percentage. All environmental impacts were recalculated on the same basis. Consequently the historical emissions are higher than previously reported, however the results presented here are considered to be a truer representation of the system. It was not felt appropriate to continue with the existing methodology on account of this no longer being current.

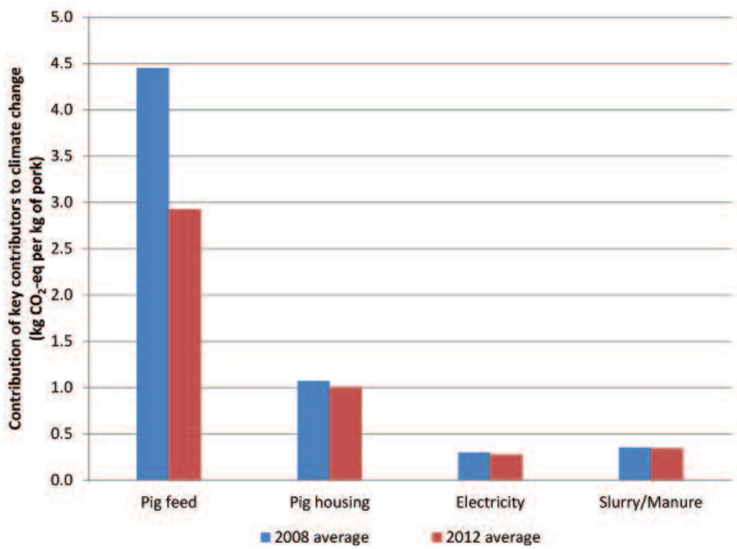
The science of LCA is continually developing, thus results from studies made at different times, even from the same author can only be compared if it is clear that the methodologies, assumptions and data are wholly compatible.

An analysis of inputs was conducted to investigate the contribution of key factors to these improvements in order to develop a greater understanding of the results.

This showed that improvements in productivity on farm have made a contribution; the changes to feed composition has been the most significant factor across all life cycle stages and impacts assessed. This is due to the fact that the feed industry provided much more detailed data for diet composition than had been available in the past. Changes in formulation since 2010, including the gradual increasing use of pure amino acids and food industry co-products, with a consequential reduction in soy bean meal inclusion, have made the greatest single contribution to the results.

Other contributions to climate change impacts have been made by improving pig housing, reducing electricity consumption and slurry/manure management, see Figure 4.

Figure 4 Change between 2008 and 2012 in the contribution to climate change impacts made by key inputs to the life cycle



Environmental impact improvement per life cycle stage

With regard to total environmental impacts from each life cycle stage, Table 2 shows the improvements from 2008 to 2012.

Table 2 Estimated percentage improvements for each stage of production

Impact category	Breeding herd	Rearing herd	Finishing herd	Sow replacements
Climate change	37%	12%	27%	24%
Eutrophication	13%	15%	12%	10%
Acidification	1%	14%	9%	6%
Resource depletion	24%	(8%)	8%	6%

Table 2 highlights that:

- The breeding herd has made considerable improvements in climate change and resource depletion impacts in particular (37% and 24% respectively)
- The rearing herd has achieved a considerable improvement in climate change impacts (27%)
- The sow replacement stage achieved a considerable improvement in climate change impacts (24%)
- The impact from resource depletion increased by 8% in 2012 compared with 2008; this is as a result of the change in feed consumption from 2011.

Figure 5 Climate change contributions to total environmental impacts from each life cycle stage – 2008 to 2012

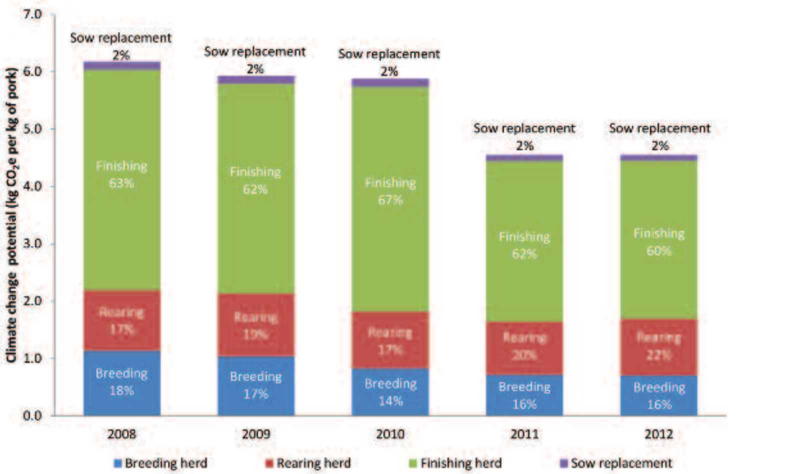


Figure 6 Eutrophication contribution from each life cycle stage – 2008 to 2012

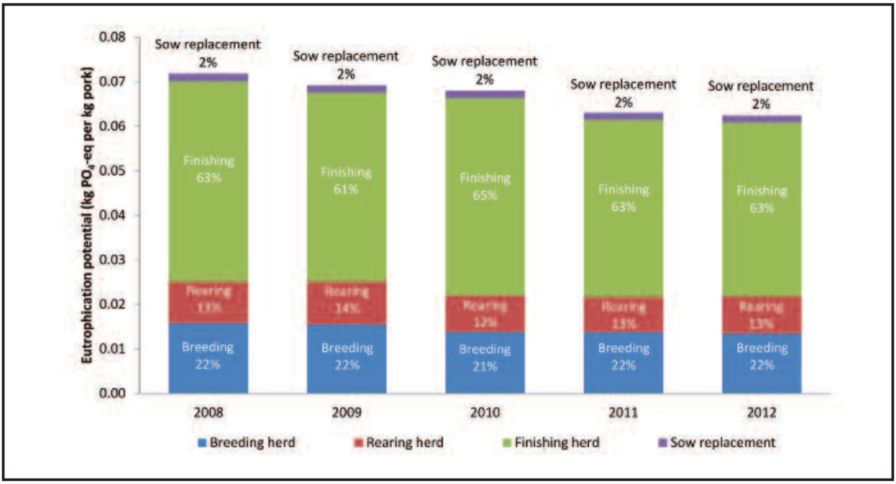


Figure 7 Acidification contribution from each life cycle stage – 2008 to 2012

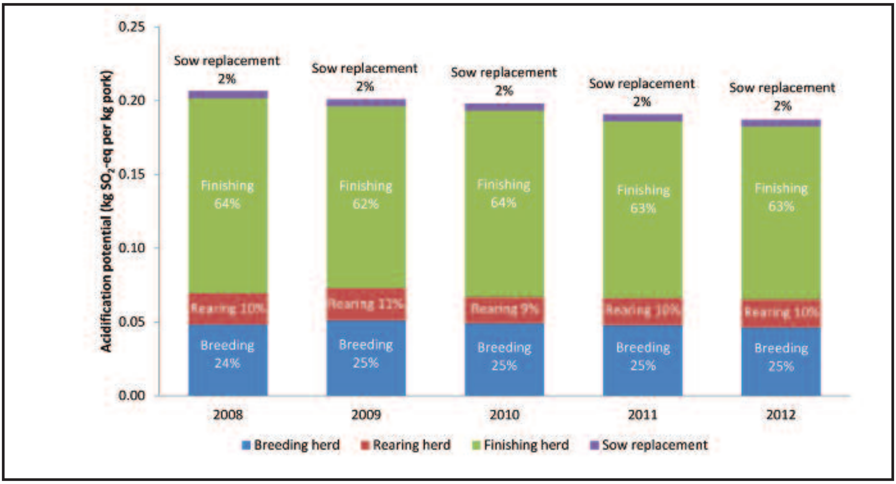


Figure 8 Resource depletion contribution from each life cycle stage – 2008 to 2012

The finishing life cycle stage makes the most significant contribution across all the environmental impact categories and across all the years assessed, ranging from 57% up to 67%. This is mainly due to the longer time that the pigs spend in the finishing herd, the proportion of total feed consumed and the weight gain achieved.

Based on the operational efficiencies forecasted across British pig producers, improvements in environmental impact are expected between 2012 and 2020 across all environmental impact categories and are shown in Table 3.

Table 3 Comparison of 2012 results and 2020 forecast – per kg of pork

Impact category	Unit	2012	2020 forecast	% improvement
Climate change	kg CO_2 -eq	4.551	4.116	10%
Eutrophication	kg PO_4 -eq	0.062	0.059	6%
Acidification	kg SO_2 -eq	0.187	0.180	4%
Resource depletion	kg Sb -eq	0.008	0.007	11%

Forecast environmental improvements per life cycle stage – 2012–2020

In terms of the improvements of environmental impacts at the different life cycle stages, the main point to note is the rearing life cycle stage is forecast to achieve the greatest environmental improvements across all the impact categories (38%).

This is because the quantity of pig feed is forecast to decrease for rearing, breeding and sow replacement stages. As feed is the main contributor to impacts across all categories, less feed consumed per pig results in lower impact. In turn, less feed consumed leads to less excreta produced per pig, leading to a reduced impact from the storage and management of excreta, as well as from agricultural emissions of ammonia, methane and nitrous oxide.

However, the finishing stage is forecast to increase its environmental impact by 20% for climate change, 4% for eutrophication, 8% for acidification and 1% for resource depletion. This is due to the higher quantity of feed per pig forecasted for 2020 compared to 2008, as quality may decrease as world competition for ingredients increases. In addition, the time period for the finishing stage and exit weight of the finishing pigs, is forecasted to increase between 2012 and 2020. This will increase the quantity of excreta produced, increasing the impact from storage and management, as well as higher emissions of ammonia, methane and nitrous oxide, based on manure handling and treatment practice remaining unchanged. Improved practice is an objective for the future.

Table 4 Comparison of 2008 and 2012 results and the forecast to 2020: environmental impact assessed (per kg of pork to farm gate)

Impact category	Unit	2008 average	2012 average	2020 forecast	% improvement 2008 to 2020
Climate change	kg CO_2 -eq	6.180	4.550	4.120	33%
Eutrophication	kg PO_4 -eq	0.072	0.062	0.059	18%
Acidification	kg SO_2 -eq	0.207	0.187	0.180	13%
Resource depletion	kg Sb -eq	0.0090	0.0083	0.0074	19%

Based on the assumption that the current feed composition by the British pig industry remains the same through to 2020, the main points to note from Table 4 are that climate change input is forecast to show the greatest improvement to 2020 at 33%, while acidification is forecast to show the least improvement at 13%.

Conclusions

This study builds on the findings from the 2010 LCA report which identified potential for improvement by improving performance efficiencies. Pig feed makes the most significant contribution across the life cycle.

Based on the assumption that there will no further significant changes in the main feed ingredients up to 2020, the following can be ascertained:

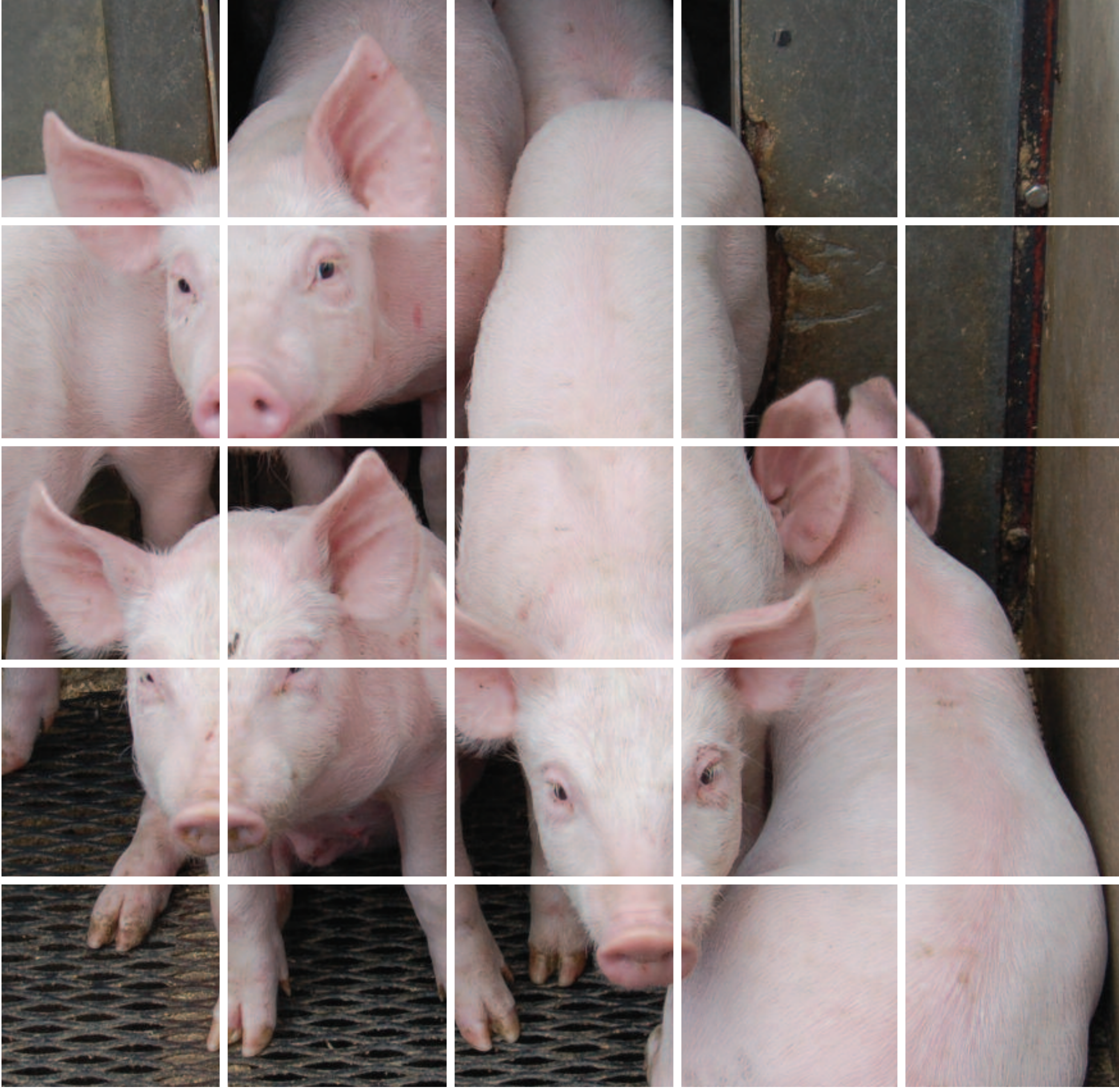
- Climate change impacts will decrease by 33% by 2020 compared to 2008 levels
- Eutrophication impacts will decrease by 18% by 2020 compared to 2008 levels
- Acidification impacts will decrease by 13% by 2020 compared to 2008 levels
- Resource depletion impacts will decrease by 19% by 2020 compared to 2008 levels.

These results confirm that the emphasis placed by the UK pig industry on improving productivity through better pig health and herd performance have delivered better than anticipated reductions in the environmental burdens to the farm gate. The influence of feed formulation has had the largest single influence but productivity gains are predicted to continue to progress towards better sustainability as the effects of improvements in one area can be seen against other areas, with no pollution swapping occurring.

These improvements have been and will continue to be of importance to the sector.

Further work

- It is proposed to repeat the assessment in four yearly cycles, monitoring progress towards the targets set in the English Pig industry Roadmap, 'Advancing Together'
- Development of a Farm Impacts Calculator by AHDB, to allow modelling of individual enterprises within the whole farm to see the effect of changes both at the micro and macro scale within a farm business.



BPEX
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL