
Pigs UK
Mass Balance of the UK Pig Industry
kg
£/kg
0.302
0.00
Use by
TODAY!
Serves
PRICE
£0.00
Suitable for Home Freezing
Keep Refrigerated
Once opened use immediately
Biffaward
Programme on
Sustainable
Resource
Use

Biffaward Programme on Sustainable Resource Use

Objectives

This report forms part of the Biffaward Programme on Sustainable Resource Use. The aim of this programme is to provide accessible, well researched information about the flows of different resources through the UK economy, based either singly, or on a combination of regions, material streams or industry sectors.

Background

Information about material resource flows through the UK economy is of fundamental importance to the cost-effective management of resource flows, especially at the stage when the resources become 'waste'.

In order to maximise the Programme's full potential, data will be generated and classified in ways that are both consistent with each other, and with the methodologies of the other generators of resource flow/waste management data. In addition to the projects having their own means of dissemination to their own constituencies, their data and information will be gathered together in a common format to facilitate policy making at corporate, regional and national levels.

Further information on the Programme is available at www.biffaward.org/studies.

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This Report was prepared for Biffaward by
RACEnvironment Ltd
Races Farm
Aston Tirrold
DIDCOT
Oxon
OX11 9DJ
race@racesfarm.demon.co.uk

Project Steering Group

Mr Mick Sloyan, MLC

Mr Pinder Gill, MLC

Mr Nigel Penlington, MLC

Mr Mark Heighton, Geo Adams and Sons Ltd

Mr Rob Nicholls, JSR Genetics Ltd

Mr Simon Carlton, ABNA Ltd

Mr Stuart Bridge, Wheyfeed Ltd

Mr John Godfrey, RJ & AE Godfrey

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All care has been taken to ensure the accuracy of the information presented in this report. All of the calculations, information and recommendations in this report have been compiled for the Biffaward Programme on Sustainable Resource Use using data provided by independent contributors, and should not be regarded as definitive.

A. Introduction

This report forms part of Biffaward's Sustainable Resource Use Programme, the aim of which is to quantify the flows of primary resources through the UK environmental economy.

The programme will aid the effective management of primary resources by identifying the flows of those resources at material, regional or sectoral levels. The principal goal of this project is to identify opportunities to reduce waste by reduced use, recycling, re-use or recovery.

Within the Programme, data are generated in ways that are consistent between projects and are compatible with other sets of resource flow data. This will enable the information gathered to be made available in a common format to inform policy-makers at corporate, regional and national levels.

In return for providing data for the Programme, the UK Pig Industry has been provided with an opportunity to establish benchmarks for environmental performance at a variety of levels throughout the supply chain.

The report is divided into four sections. Following this introduction, part B of the report follows the developing UK Pig industry from its early stages to the present day, looking at scale, structure and ownership of today's industry and the drivers affecting the sector; key legislation is referred to in section B.5.

Section C covers the mass balance, which aims to quantify resources and energy flows within the sector in 2004. This section covers feed production, all aspects of farming, processing and rendering, together with the linking transport requirements. The section goes on to use the data gathered for the mass balance to produce an ecological footprint, which provides an indication of natural resource consumption by the sector, and a set of benchmarks to help the industry learn lessons from the data gathered. Section C finishes with a summary of environmental, economic and social issues affecting the sector and anticipates change in these drivers.

The conclusions and recommendations look at ways in which the sector might improve its resource use and so increase competitiveness in the global marketplace.

The information gathered for this report encompasses all of the major aspects of mainstream pig production, from the production of feed through the breeding and growing of the stock, to the production of jointed meat products and rendered products such as lard.

The report will be disseminated throughout the pig industry and will be made generally available for use in education and policy-making. The report is downloadable from www.racenvironment.co.uk.

It is intended that the project will:

- provide a sound basis for understanding the nature and scale of materials and resource flows through part of the UK agricultural sector; and

- enable the industry to identify any scope for changes in practice that facilitate more sustainable use of resources within the sector.

The study has been funded by Biffaward using landfill tax credits and contributions from members of the Pig Industry that are acknowledged elsewhere in this report.

B The UK Pig Industry

B.1 History

Pigs have been domesticated for at least five thousand years, and pig meat generally has been Britain's favourite meat for the entire period. Records from Roman times show that at that time pigs were the population's main source of animal protein.

Today pig meat is the most popular source of meat protein in the world, with a global average per capita intake of 14.3kg/year. The European consumption per capita is 2.3 times greater than the global average. However, in terms of total volume, Asia as a whole consumes more than twice the amount of pork as Europe, nearly 53.75 billion tonnes.

The early pioneers of animal breeding selected from types common within local populations, as a result specialist breeds were established in different regions. Some of these breeds went on to be crossed with imported pigs, whilst other breeds were developed purely from native stock. In all cases the regional breeds seen today were well established before the end of Queen Victoria's reign.

During and immediately after the Second World War pigs were especially popular because they could be fed on kitchen scraps and fattened-up to provide pork and bacon. Pig keeping became a craze and a large number

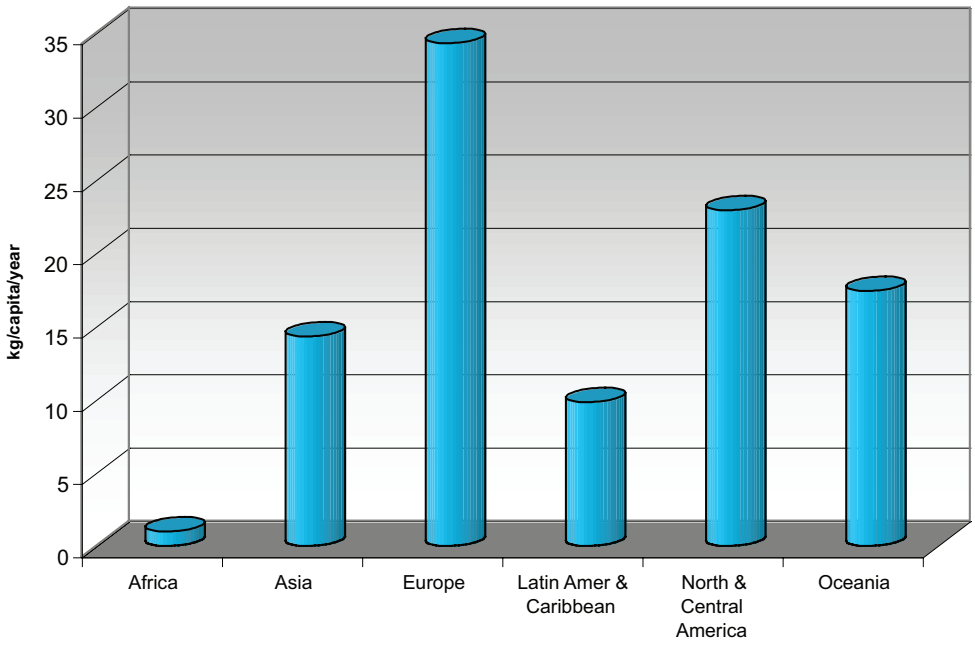


Figure B.1.1: Average per capita intake by continent (Source: FAOSTAT data 2006)

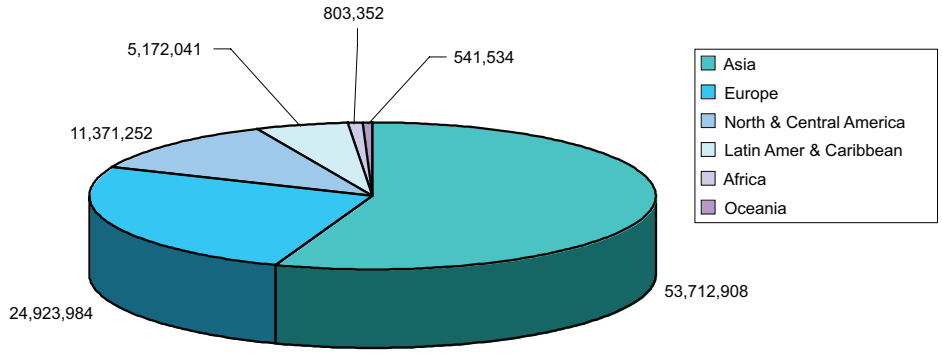


Figure B.1.2: Global Consumption million tonnes per year (Source: FAOSTAT data 2006)

of Pig Clubs were formed with hundreds of thousands of members; each club raised money to buy pigs, and the final products were distributed amongst its members. This was the start of swill feeding, which was widely practised on a farm scale until the Foot and Mouth Disease outbreak of 2001.

Traditional breeds were found across the UK, animals with regional names such as Gloucester Old Spot, Tamworth, Berkshire and Oxford Sandy, together with the Middle White, Large Black, British Lop, Black and Saddlebacks were the most common breeds used up to the 1960s.

Most of the pedigree and rare breeds that we still have today had a significant role in mainstream commercial production until the beginning of the 1930s. Each breed was developed with particular characteristics to suit a regional market or production system. During the 1930s the popularity of the Middle White and the Berkshire breeds declined considerably; until then both had been popular in crosses producing both bacon and pork, and were commonly kept as house pigs because of their versatility.

In 1955 with the end of rationing and a return to free markets, the government became concerned about the international competitiveness of UK pig producers compared with potential imported sources of pork and bacon. A committee under Sir Harold Howitt was established to “advise in what ways pig production would best be developed particularly in regard to general breeding policy…”

The committee published its report in October 1955, with far reaching consequences for the future of British pig breeds. The committee reported that it had “formed the view that one of the main handicaps facing the British pig industry today is the diversity of the type of pig which is found throughout the country. The pig industry will in our view only make real progress when it concentrates on a few main types and – if it were at any time found possible – on a single type of pig for commercial production.”

The committee went on to identify three breeds, the Large White, Landrace and Welsh as the potential foundations of a modern pig industry. “It is from these three breeds that we would hope to see developed through intensive progeny testing in the coming years the improved bacon pig which would provide boars for use by nearly all commercial breeders for bacon and pork. The importance and urgency of this task cannot be overstated.” So it was that the UK’s systems of progeny testing, nucleus herds and AI stations, which became envied around the world, were established.

The British pig revolution really started in the 1960s. The benefits of controlled environment buildings had been discovered, as were the increased yields that could be achieved with genetic improvement, and many of today’s international pig breeding companies were formed in the UK at that time.

The increase in pig production brought with it a need for new buildings; up to this time purpose-built pig buildings were of traditional brick and concrete construction, or pigs were housed in general-purpose structures. The idea of specially designed pre-fabricated wood and fibre cement panel buildings that were robust, flexible to use and easy to erect was developed. Buildings had to be cost effective and provide the correct environment for pigs, thus a new generation of structures were developed and constructed around the country.

Large-scale outdoor pig production, which is common today, wasn’t seen in the UK until the 1950s when the Roadnight System was developed in South Oxfordshire; in this system, pigs were considered to be a replacement for a break crop in the farm’s arable rotation. Outdoor pig keeping increased in popularity through the 1960s, when about 5% of the UK breeding herd was in outdoor systems. It didn’t see any further expansion until the 1980s when there was a rapid expansion in areas where there were light free-draining soils and low rainfall; areas such as East Anglia, southern England, and the east coast of Scotland. Today it is estimated that 30% of the UK breeding herd is kept outdoors.

The animal feed industry has been developed since the beginning of the 20th century; initially supplying feedstuffs for ruminants and later, as demand developed, for pigs and poultry. Historically, since many of the raw materials were imported, feed mills were commonly established at major ports, or close to inland waterways. Diets have developed to incorporate more less-costly ingredients and protein content is now closely targeted to pig growth stages. The basic raw materials of pig feed are wheat, barley, oilseed rape, Soya bean and a range of by-products, mixed together to provide a complete diet for the pig.

By the late 1970s there were over 400 feed businesses, some were national, some were co-operatives, but many were still long-established local mills. Latterly, the picture started to change, mainly driven by a reduction in pig population, which has precipitated a series of acquisitions where companies have purchased others to maintain tonnage sold, whilst other mills have been mothballed.

There have also been changes in slaughtering and processing. In the late 1950s there were still many multi-species slaughterhouses located close to markets, and a lot of butchers had their own slaughter facilities, buying stock from local farmers or markets. In the early 1980s, EU Regulation and the cost of updating to meet modern standards started a decline in the number of multi-species slaughtering facilities. Today, most of the large slaughterhouses for pigs are species specific.

B.2 The UK Pig Industry - The last 10 years

This section presents a summary overview of how the UK industry has arrived where it is today. It identifies the key drivers that have positioned the industry to date in order that motivation for change and future direction can be understood.

The last decade has seen major changes in the UK pig industry, there has been a substantial decline in the number of pig keepers and in the total number of breeding sows. The whole of the pig sector supply chain has changed, there are fewer feed compounders, a much reduced slaughter and processing industry, specialist pig veterinarians and farm staff are hard to find, and pig courses at Agricultural Colleges are all but none existent. But how has this come about?

The UK pig herd peaked in 1997-98 at just over 8.1 million head, and in the past five years the national herd has contracted significantly. The Agricultural Census of June 2002 recorded 5.6 million pigs in the UK, a 31% fall from 1997-98 levels. But this apparent trend is underlain by cyclical market trends, which vary both annually and from year-to-year. This phenomenon is known as the Pig Cycle, which reflects the lag between signals from the market and the response of producers.

When pig prices are high and returns are good we see expansion in the pig herd; conversely, when returns are poor industry contracts.

Economists advise that production should be increased in a falling market, but farmers taking this advice run the risk of achieved prices being below the cost of production. Equally, at the top of the cycle, farmers should reduce pig numbers. One thing is certain; the Pig Cycle will continue to roll.

The Pig Cycle is seen superimposed on a general rising trend in variations in monthly average pig prices over a five-year period, as shown in Figure B.1.3 below. Historically the price of pig meat has increased immediately after Christmas and farmers have placed weaners in September in anticipation. However, when demand fails to materialise the price of pigmeat falls and farmers lose money; the following year pigs aren't produced and the price hardens as a result.

Similar trends are also evident in the numbers of animals in the national herd. Pig population statistics since the 1930s, displayed on a decade-by-decade basis, show a post-war fall in pig numbers superimposed on a rising trend that lasted until 1980.

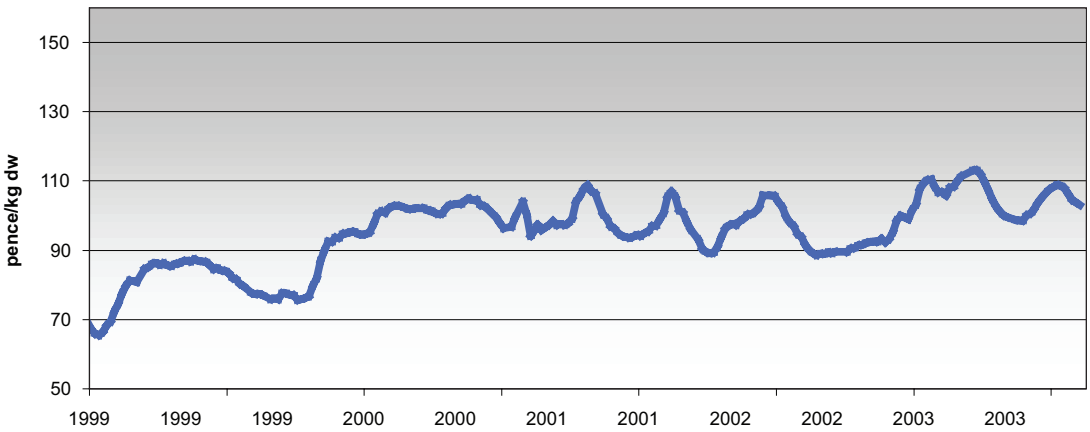


Figure B.1.3: Average Weekly Market Price All Pigs (Source: Defra statistics)

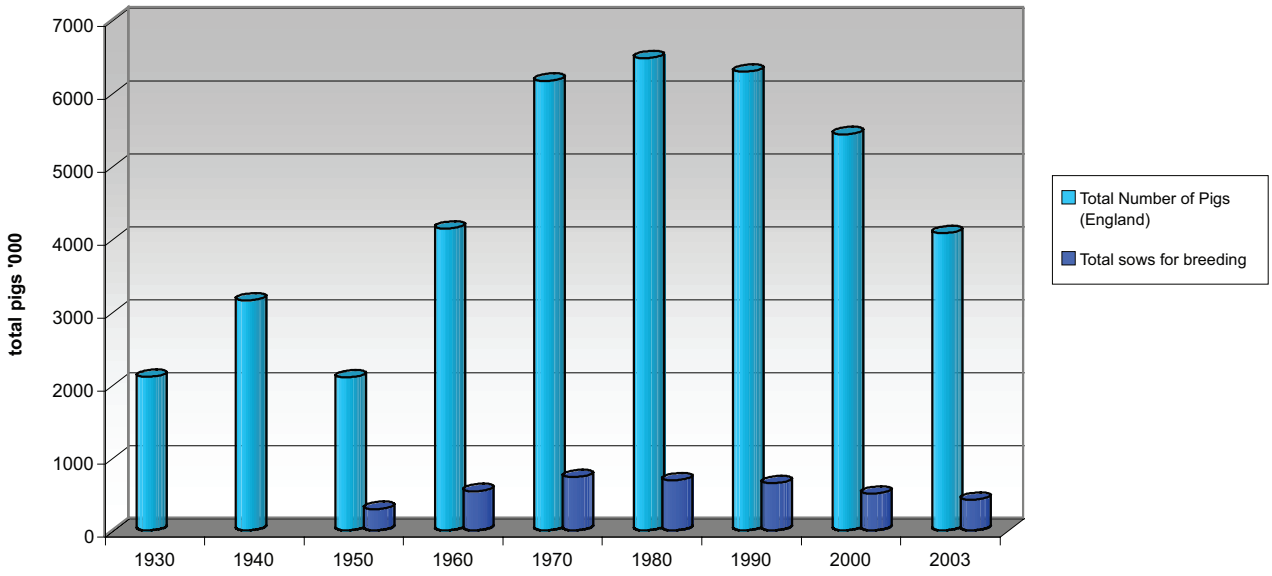


Figure B.1.4: Total Pig Numbers (England) (Source: Defra statistics)

Given past experience, the trend of the past decade may only be short-term, preceding decades saw steady increases in numbers and whilst the current pig population is now well below anything seen in the UK in recent decades, in the right climate recovery is possible.

Following a long period of expansion and relative stability, much of the recent decline in pig numbers visible in Figures B.1.4 & B.1.5 can directly be attributed to:

- low returns for pig meat and lack of monies for reinvestment;
- a lowering of the pig herd health status, Porcine Reproductive and Respiratory Syndrome (PRRS) and new wasting diseases Post Weaning Multisystemic Wasting Syndrome (PMWS) & Porcine Dermatitis Nephropathy Syndrome (PDNS);
- legislation - a ban on stall and tethers as accommodation for dry sows;
- outbreaks of Classical Swine Fever in 2000, & Foot and Mouth Disease in 2001;
- the Pig Industry Restructuring Scheme (PIRS), the objectives of which were:
  - a reduction in the size of the national herd and
  - accelerated restructuring; and
- future environmental legislation.

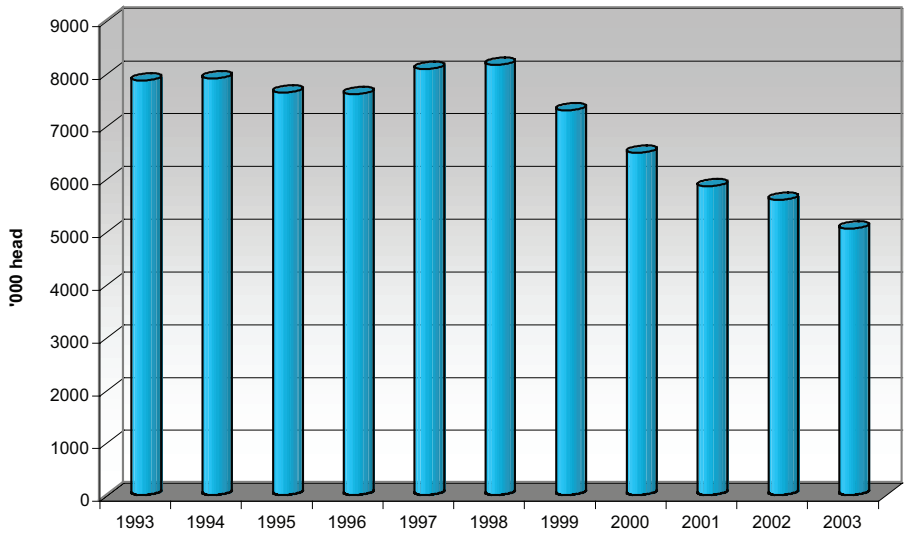


Figure B.1.5: UK Pig Population (Source: Defra statistics)

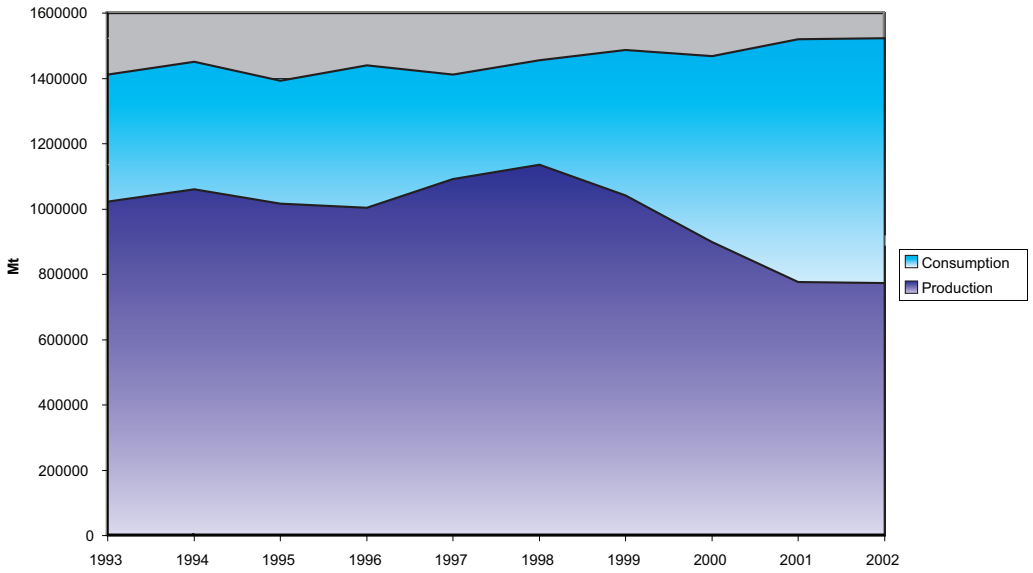


Figure B.1.6: UK Consumption v Production (Source: Defra statistics)

The recent reduction in the UK pig population has been accompanied by greatly improved production efficiency and greater average carcase weights. However, the overall trend in volumes of home produced pig meat is in decline from the levels achieved over the past decade; this is reflected in the levels of imports into the UK:

1990-02 - UK was 82% self sufficient in pig meat
2001 - UK was 64% self sufficient in pig meat
See figure B.2.7.

Pig herd performance is measured using a series of parameters: feed conversion ratio; numbers of pigs produced per sow; daily weight gain; and mortality. Figures B.1.7 - B.1.8 clearly show that, with the exception of the recent impact of disease, performance of the UK national herd has improved significantly over the past decade. Feed conversion ratios have recovered to levels last seen in the mid-1980s; the number of litters per sow per year increased slightly until 2000; the number of piglets born alive per litter increased, whilst mortality in piglets born alive dropped; and daily weight gains improved in both rearing and growing sub sectors. However, much of the improvement, gained by genetic improvement and improved feeding, have been wiped out by disease in the national herd.

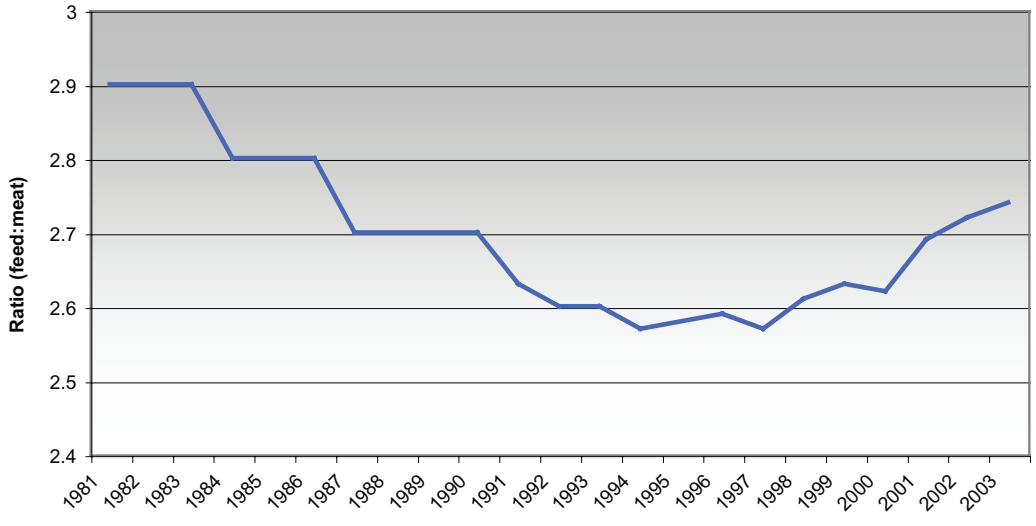


Figure B.1.7: Feed Conversion Ratio (feeding herd) (Source: MLC Pig Yearbook)

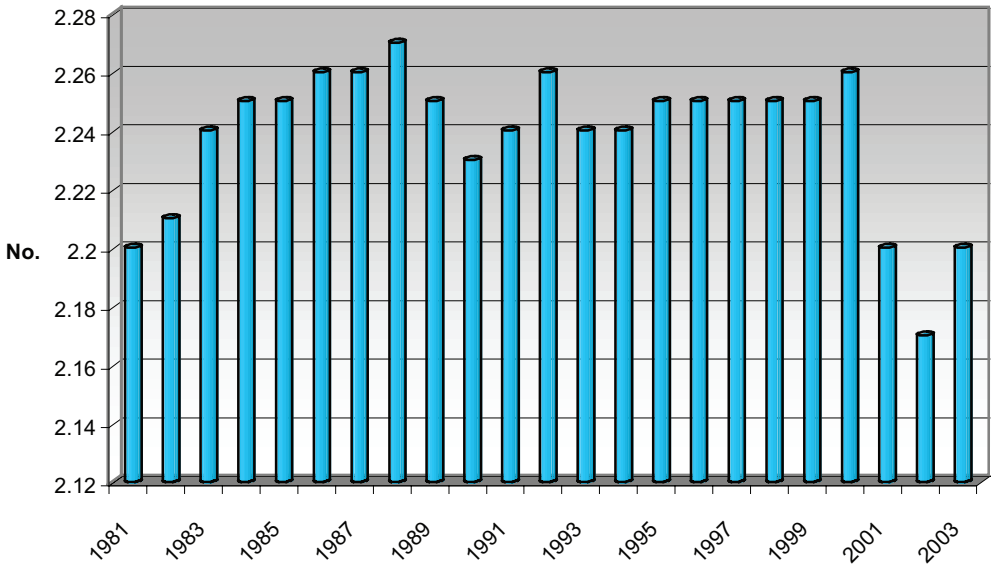


Figure B.1.8: Number of Litters (Sow/Year) (Source: MLC Pig Yearbook)

In a consumer-driven, highly price-sensitive marketplace, processors of pig meat have become more specific about the types of carcase required from producers. Generally, the requirement is for uniform carcases with an increasing lean content and a reduced level of fat in order to produce relatively standard cuts and joints for sale in supermarkets. In cases where pigs are produced with what is considered to be too much fat, fat is removed at the processing stage, and joints may be soaked in brine to give meat better cooking characteristics.

Pressure to produce uniform carcases has caused pig producers to change their production systems over the past ten years. Gone are the days when mixed livestock farms had between 50 and 100 breeding sows, and reared all the progeny to slaughter. The size and scale of operations on pig farms has had to change in order to produce large batches of uniform pigs.

At the beginning of the 21st Century, the majority of pig production in the UK is concentrated in large herds, with around 80% of pigs kept in herd sizes of 1,000 head or more.

Pig numbers maybe declining overall, but underlying trends are more complex, for instance, there are fewer producers, but with larger numbers of sows. Many of

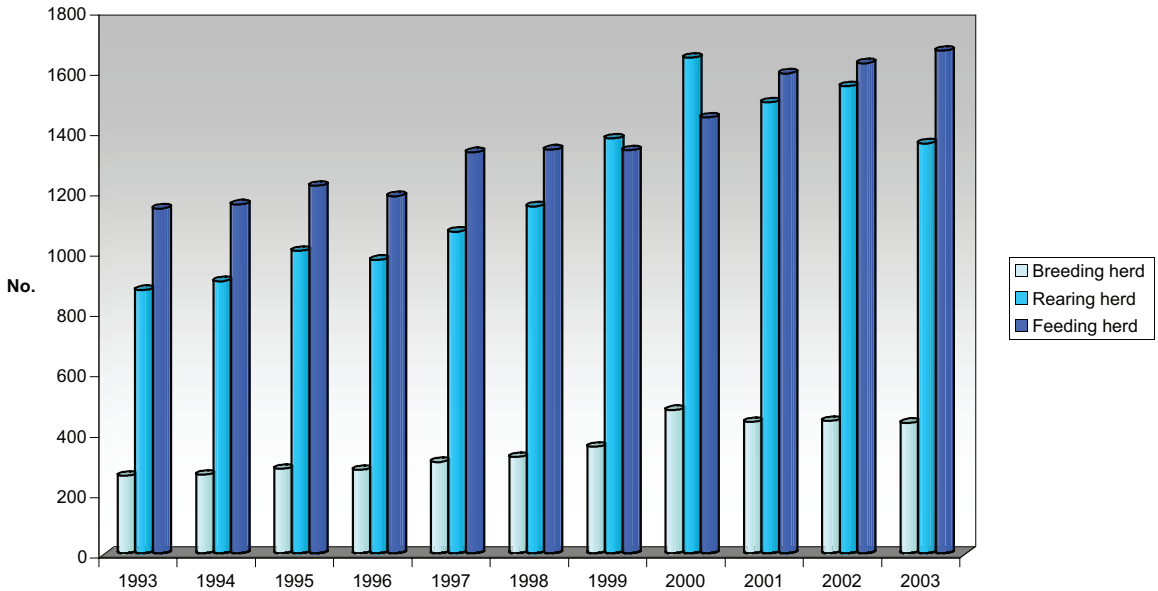


Figure B.1.9: Change in Average British Herd Size (Source: MLC Pig Yearbook)

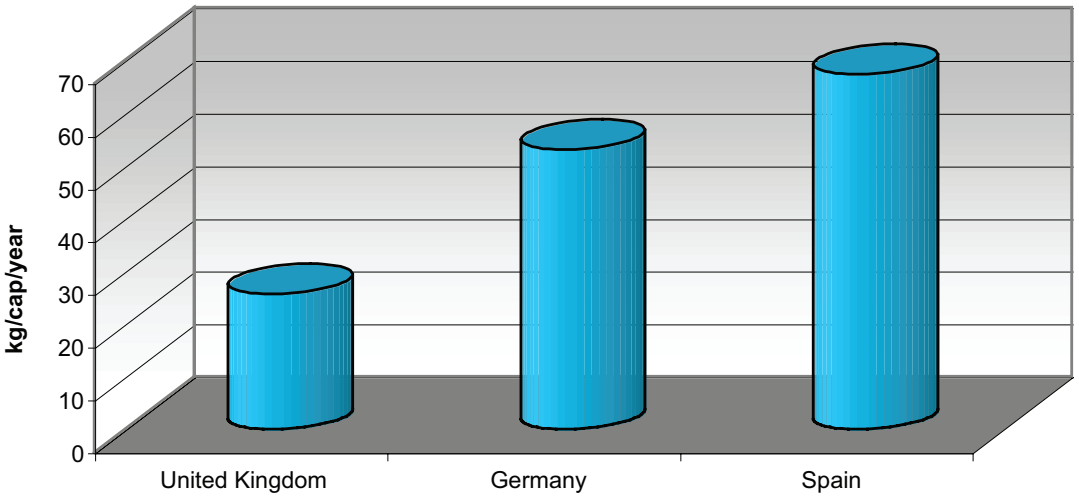


Figure B.1.10: Comparison of per Capita Consumption of Pigmeat Between Selected European Countries
(Source: FAOSTAT data 2006)

these large producers have more than one site and then feed into pyramid systems. Pyramid systems are designed with disease management in mind, with specialist breeding units, rearing units and feeding units under one management umbrella, but on multiple sites sometimes many miles apart.

Breeding companies have used improvements in their breeding programmes to maximise prolificacy, develop good mothering traits, and produce progeny that are efficient converters of feed and are lean.

The breeding industry has moved rapidly forward in the use of Artificial Insemination (AI) with diluents that provide a longer shelf life longer shelf life for straws of semen, improved delivery systems to producers and in-house training programmes on semen collection and insemination techniques.

Consumption of pig meat per head in the UK has remained fairly constant over the past decade, although as a nation we consume little relative to Germany and Spain, see Figure B.1.10; on a global scale the Chinese consume more pigmeat per capita, than any other nation.

The differences observed are probably due to the greater levels of consumption of processed pork

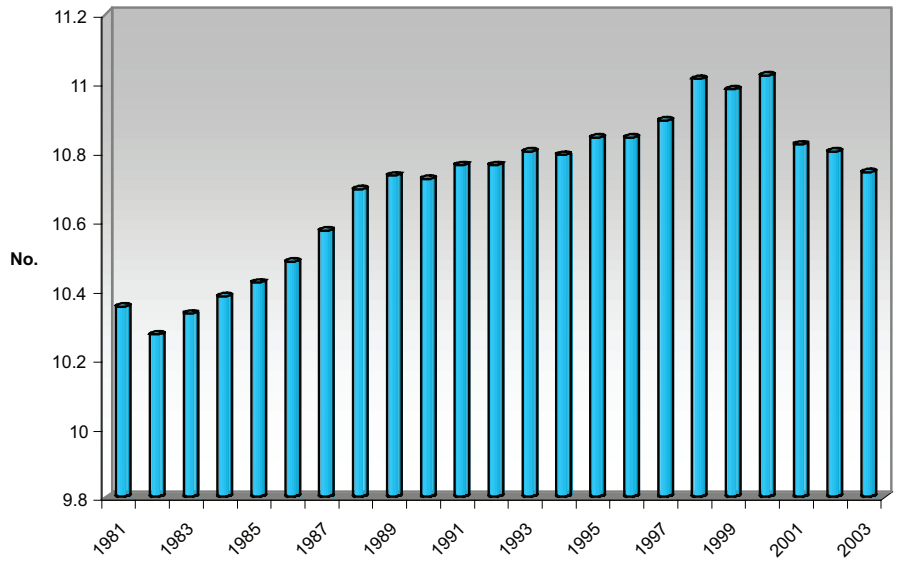


Figure B.1.11: Pigs Born Alive per Litter (Source: MLC Pig Yearbook)

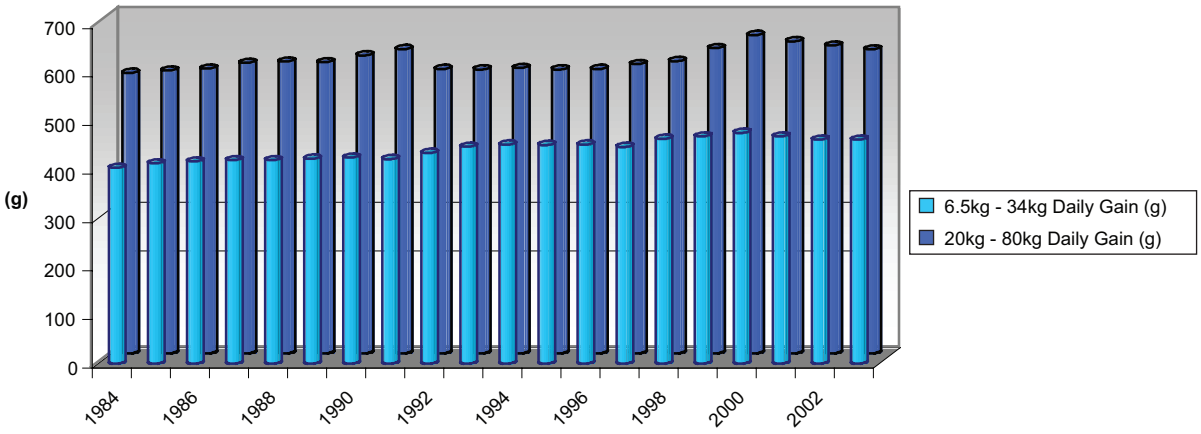


Figure B.1.12: Daily Liveweight Gain of Pigs in the Weaning and Rearing Sectors (Source: MLC Pig Yearbook)

products such as ham, salami and other sausage type products, as well as pork, in the rest of Europe, and consumption of offal in China.

In terms of consumption, the UK market has been helped by the public's perception of pig meat as a white meat, with pork being put on a par with poultry meat; nutritious and with a low fat content.

The retail value equivalent of the UK pigmeat market in 2001 was an estimated £5 billion, slightly more than the equivalent poultrymeat market. A substantial amount of advertising over recent years, funded by the MLC from levy payments, has targeted consumers with the aim of positioning pork, bacon, ham and sausages as quick, convenient, modern meals.

Despite all of the apparently good news, consumption is relatively static, and the UK pig industry has in fact suffered more than most sectors of agriculture during the past decade, Figure B.1.6 shows how the UK market has grown but the source of supply has shifted from domestic production to imported product from other EU countries.

In addition to the specific factors mentioned above, the following factors have all played a role in the current decline of the UK pig industry:

- continued pressure on producer prices;
- the strength of the pound making imports cheaper;
- higher input costs, increasing the costs of production;
- investment in high welfare systems and BSE controls; and
- the consequences of disease, notably classical swine fever, foot and mouth disease and the impact of pig wasting disease.

All of these factors have helped undermine producers' profitability, reduced the competitiveness of the homegrown product in the international marketplace, and knocked industry confidence.

On the positive side, the UK pig industry retains a number of fundamental strengths. These include:

- a robust, varied and valuable home market for pork and pork products;
- abattoirs and meat processors with logistical skills able to service the needs of supermarkets; and
- a strong structure at farm level.

To halt the decline, the British Pig Executive (BPEX) has put forward a strategy document, 'Road to Recovery', a vision for the future of the UK pig industry.

BPEX have identified opportunities for the industry: improved competitiveness; increased consumer demand through promotion and marketing; a growing market for more convenience products; an ability to improve pork eating quality; greater collaboration within the supply chain; and expansion of the Quality Assured British product.

The industry vision is clear. It should be more competitive and more cohesive, and must produce a range of modern, convenient, healthy and safe quality pork products to inspire consumers. This can be achieved by creating an industry that is information-driven to respond to the changing needs of consumers; an industry that focuses on those parts of the market that place sufficient value on UK-produced pork and pork products.

The 13-point BPEX action plan to help the industry deliver this vision has three specific objectives:

- improve competitiveness throughout the supply chain;
- defend and add value to markets for pork and pork products; and
- build alliances to develop the home market.

The cost of implementing this plan is estimated to be at least £13 million a year, of which UK levy payers will contribute £10 million.

In January 2002 the Curry Report was published. The author's remit was to 'advise Government on how a sustainable, competitive and diverse farming and food sector can be created, which contributes to a thriving and sustainable rural economy, advances environmental, economic, health and animal welfare goals and is consistent with the Governments aims for Common Agricultural Policy (CAP) reform, enlargement of the EU and increased trade liberalisation'.

The National Pig Association's (NPA) response to the Curry Report made the following points:

- pigmeat takes the largest part of the retailing and catering meat sectors;
- pig production accounts for 5% of UK farm output and consumes over 1.5 million tonnes of UK grain;
- pigmeat is a major part of the throughput of the abattoir and meat processing sector, which employs 85,000 people in Great Britain – the majority in small towns and rural areas;
- pork, bacon and ham, and pork-based processed products account for about 30% of the £16 million spent on meat and meat products in the UK annually;
- the pig industry offers a sustainable, connected supply chain delivering quality assured, traceable, safe, wholesome and healthy meat, and meat products at a reasonable price; and
- the sector has adopted welfare measures that are among the strictest in the world.

In 1999, a ban on stalls and tethers on pig farms was introduced in the UK, in advance of any other EU country and in response to demands from consumers insisting on higher levels of animal welfare. The UK industry response to this was simple and effective, to develop breeding stock and low input/cost technology for systems that allow for loose housing of groups of sows in straw yards.

Through all of the industry changes over the past decade and longer, the pig itself has changed little; in 1997 the European Scientific Veterinary Committee noted: "although domestication and selection has altered basic aspects of the anatomy and physiology of the pig, comparisons reveal that no major changes in basic behavioural systems have occurred during domestication".

B.2 The Pig Industry Today

This section presents a summary overview of the UK industry as it is today. It builds on past development of the industry and examines those drivers that will impact on the industry in the future.

Pork is currently the world's most popular meat and it is projected to maintain its lead over poultry beyond 2010. It follows, therefore that there will be substantial investment opportunities in pig and poultry to meet this demand.

According to the International Meat Secretariat, China accounts for more than half the world's pork production and consumption, and is the fourth-largest beef producer. The group links 65% of the recent growth in global pork consumption to China.

In the UK, pigs are produced as cutters for the fresh meat market, a lighter pig usually around the 80kg liveweight, and as bacon pigs for gammons and bacon; these are a heavier pig around 95 to 105kg liveweight.

The most popular choice of pork cuts in the UK are pork chops and steaks from the lighter pigs, but a large proportion of pork is consumed in processed form, for example as sausages, bacon or ham. The versatility of pork lends itself to both meal and snack formats and is popular among all ages of consumer.

Rashers are the most popular bacon product consumed in the UK, accounting for 72% of household consumption (bacon joints 19% & bacon steaks 9%). However, nearly 60% of the bacon eaten in the UK is imported, the most important suppliers being Denmark and the Netherlands.

Consumers now purchase 76% of pork and 86% of bacon from multiple retailers - the supermarkets. This is a very different story from that of the 1960s, when the high street butcher was the dominant force in the supply of fresh meat products. Some would say that this is confirmation of the retail sector's power over the pig supply chain.

In order to ensure that the sector responds well to social pressures, the pig industry, through BPEX, is in the process of creating a centre of excellence, which will offer training in animal husbandry and demonstrate the highest standards of welfare and environmental compliance. It is intended that this centre at Stotfold will be a model for similar centres for the cattle and sheep sectors.

The major problem facing the industry is one of creating a market for home produced pork whilst persuading consumers to first recognise and then choose home produced products. Recent trends in consumption and imports demonstrate that this job will not be easy.

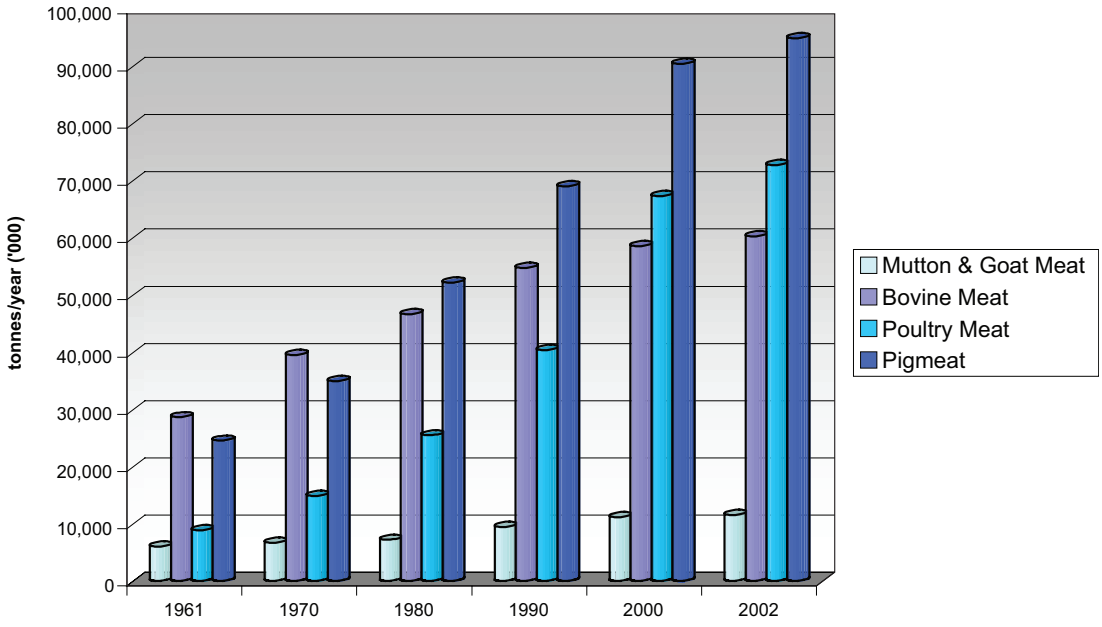


Figure B.2.1: Global Meat Consumption (Source: FAOSTAT data 2006)

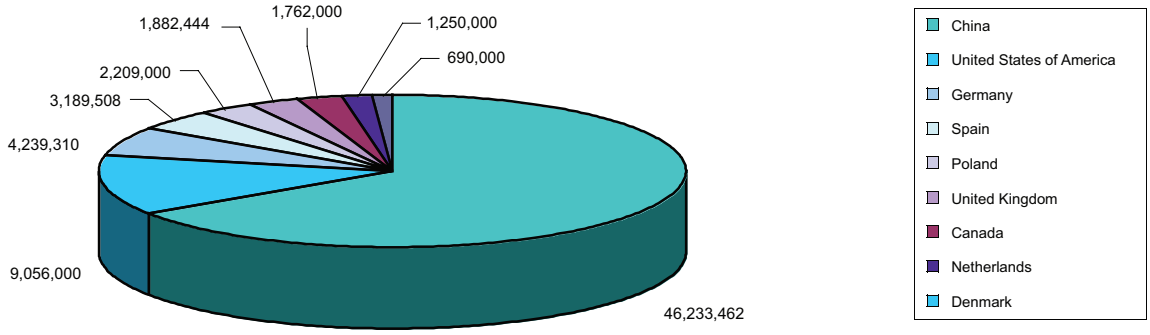


Figure B.2.2: Pigmeat Production by Country (Mt/year) (Source: FAOSTAT data 2006)

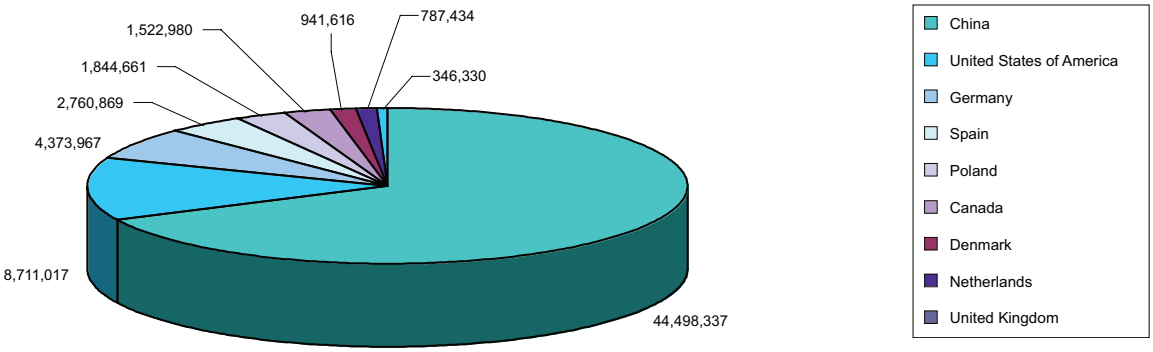


Figure B.2.3: Pigmeat Consumption by Country (Mt/year) (Source: FAOSTAT data 2006)

B.2.1 Structure and Scale

The structure of the UK pig industry is complex, involving multiple diverse activities working together to deliver further value. The industry currently consists of a core of 7,320 farm businesses served by 21 feed mills and 226 slaughterhouses.

The location of feed mills and processing plants relative to areas of production are shown in Figure B.2.4. This also shows how pig production is generally located in the arable areas of the UK, which is consistent with the historical role of an industry integrated within agriculture generally, for the use of products from other agricultural sub sectors. It is also apparent that feed mills are located close to cereals growing areas/ports/pig growing areas and slaughterhouses close to consumer/pig production.

B.2.2 Segmentation & Integration

Unlike the poultry sector, a similarly unsupported agricultural sector, the pig industry is not highly integrated vertically. Vertical integration in the poultry sector has brought benefits of control over the supply chain for a product that has a 'production time' of about 50 days from fertilised egg to wrapped product on the supermarket shelf. The 'production time' for the pig, on the other hand is between 250 and 300 days, depending on the weight of the finished animal. The longer 'production time' increases the potential for uncertainty, particularly regarding demand, which may fluctuate unpredictably throughout the year and even between years; the Pig Cycle.

Many of the benefits normally arising from integration are already found in the pig-farming sector, where, often informal, cooperation between feed suppliers, breeding companies and farmers has brought about significant improvement in performance, to the benefit of all.

Attempts to integrate the feed and farming sub-sectors of the UK industry are described later, and despite earlier efforts, the major feed suppliers have chosen not to make further attempts to integrate the lower end of the supply chain. However, several larger farmers, who also have interests in cereal and or milk production,

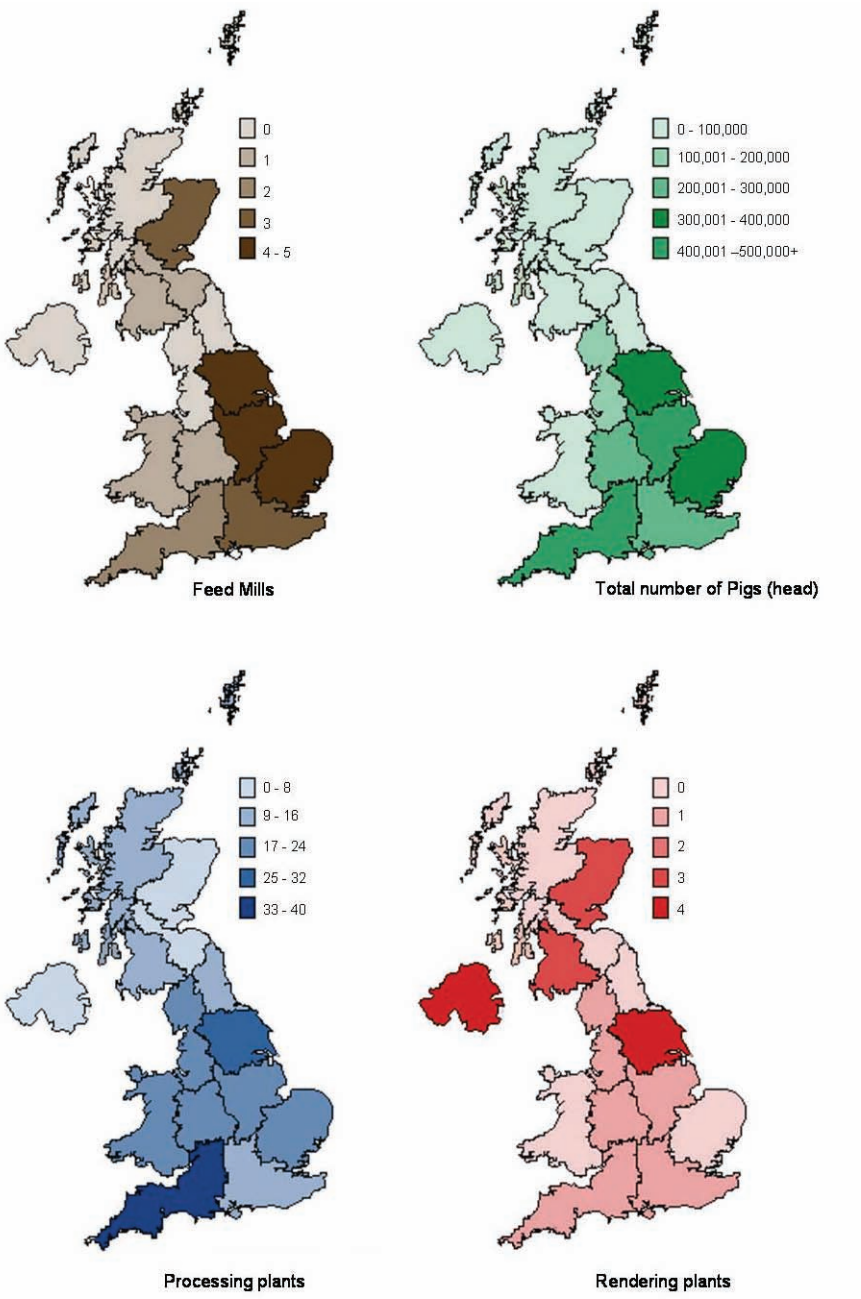


Figure B.2.4: Regional Distribution of Pigmeat Industry

have successful histories of producing feed for pig herds. The feeding of whey from milk used in cheese production is common in the south west of England, where pig and dairy herds often exist in the same business. Where such an enterprise exists, manure from both herds is often applied to grass and arable land to reduce fertiliser inputs to land producing forage for cattle and cereals for compound or home-milled feeds.

Some farm businesses have extended their own marketing activities by coordinating pig-marketing groups, such as Thames Valley Pigs Cambac (TVP), MW & J Easey, Porcofram, Beadle Price Livestock, Linc Pork, Anglia Quality Meat and Meadow Quality.

This form of integration puts the groups into strong positions to develop alliances with a broad range of customers, and gives them the ability to seal long-term contracts with processors. This means they do not have to rely heavily on single outlets, which history has

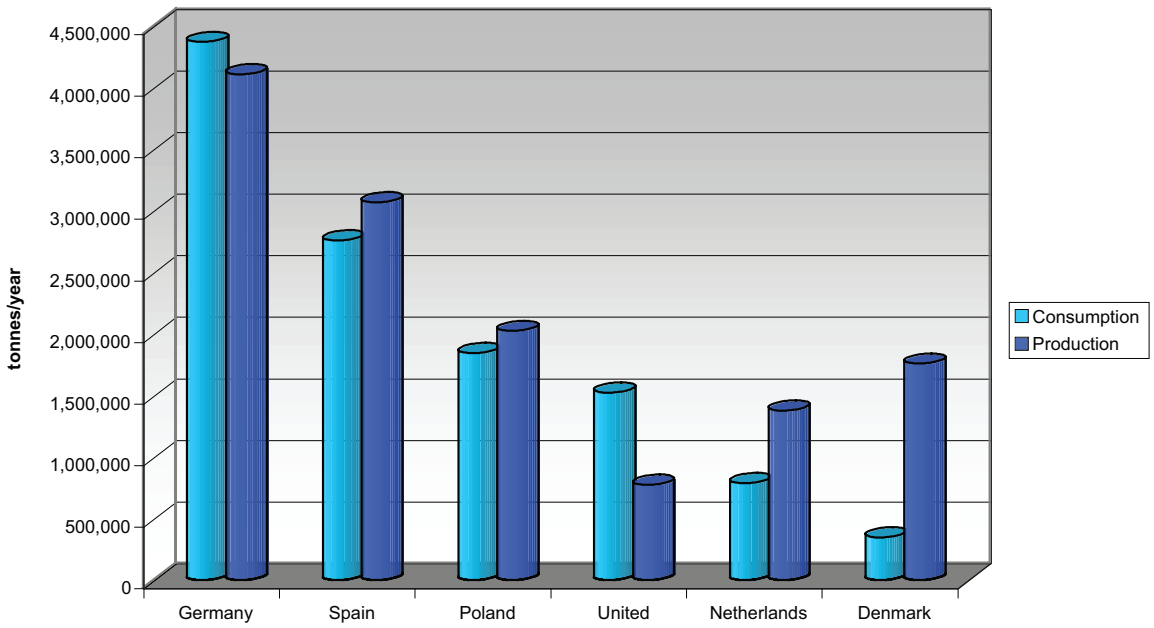


Figure B.2.5: European Consumption v Production (Source: FAOSTAT data 2006)

shown to be unstable. Similarly, processors don't need to rely heavily on single suppliers, although TVP do provide in the region of 75% of the pigs sent to Dalehead's Bristol plant and 70% of Grampian's Wiveliscombe intake.

Transport of livestock is a specialist sub-sector in its own right, and whilst a large majority of pig haulage is done using farm haulage, and so might be termed 'integrated', a relatively small number of specialist contractors haul a significant proportion of pigs being taken to slaughter. The use of specialist hauliers has the benefit of drivers being accustomed to biosecurity measures at abattoirs and facilitating the use of relatively high cost, high welfare trailers, which avoid stress in animals and with it damage to meat quality.

The integration of slaughterhouses and processing plants into the supply chain is not common. The single largest integrated pork producer is the Grampian Country Food Group, with 10 pig abattoirs across the UK. Grampian, established in 1980, also has interests in the chicken, turkey, beef and sheep sectors.

Bowes of Norfolk is a farming business that has diversified successfully into large-scale pig production, slaughtering and processing, and now supplies retail customers across the UK and throughout the world from its Watton factory.

Some growers produce pigs on contract to processors, although they are commonly part of larger producer groups, such as those listed above, and so might be considered to be more integrated than some stand-alone producers. Such producer groups produce specific numbers of pigs within narrow weight bands, according to the projected requirements of processors.

B.2.3 The Production Chain

Only about 5% of breeding pigs and 28% of rearing and finishing pigs are grown on farms under the direct control of processors; the majority of production comes from independent farms, many of whom are contracted to a processor, some directly but the majority through producer groups. There is a small market for locally produced pork sold through high street butchers.

Many characteristics of the production chain are common across the sector, particularly in the farming sub sector, although some specialist producers may only operate in restricted parts of the chain, for instance the breeding and rearing of pigs up to 20kg for subsequent fattening to 120kg on by-products.

In the region of 90% of UK genetic stock comes from five breeding companies, all of which are major players in the world market. On breeding units, sows are served by boars or using Artificial Insemination (AI), the progeny being weaned at about four weeks of age; at a weight of about 7kg.

Within the farming sub sector of the chain, there are two distinctly different production systems, indoor and outdoor. In addition to wholly indoor and outdoor herds, the two systems are often combined, although at the

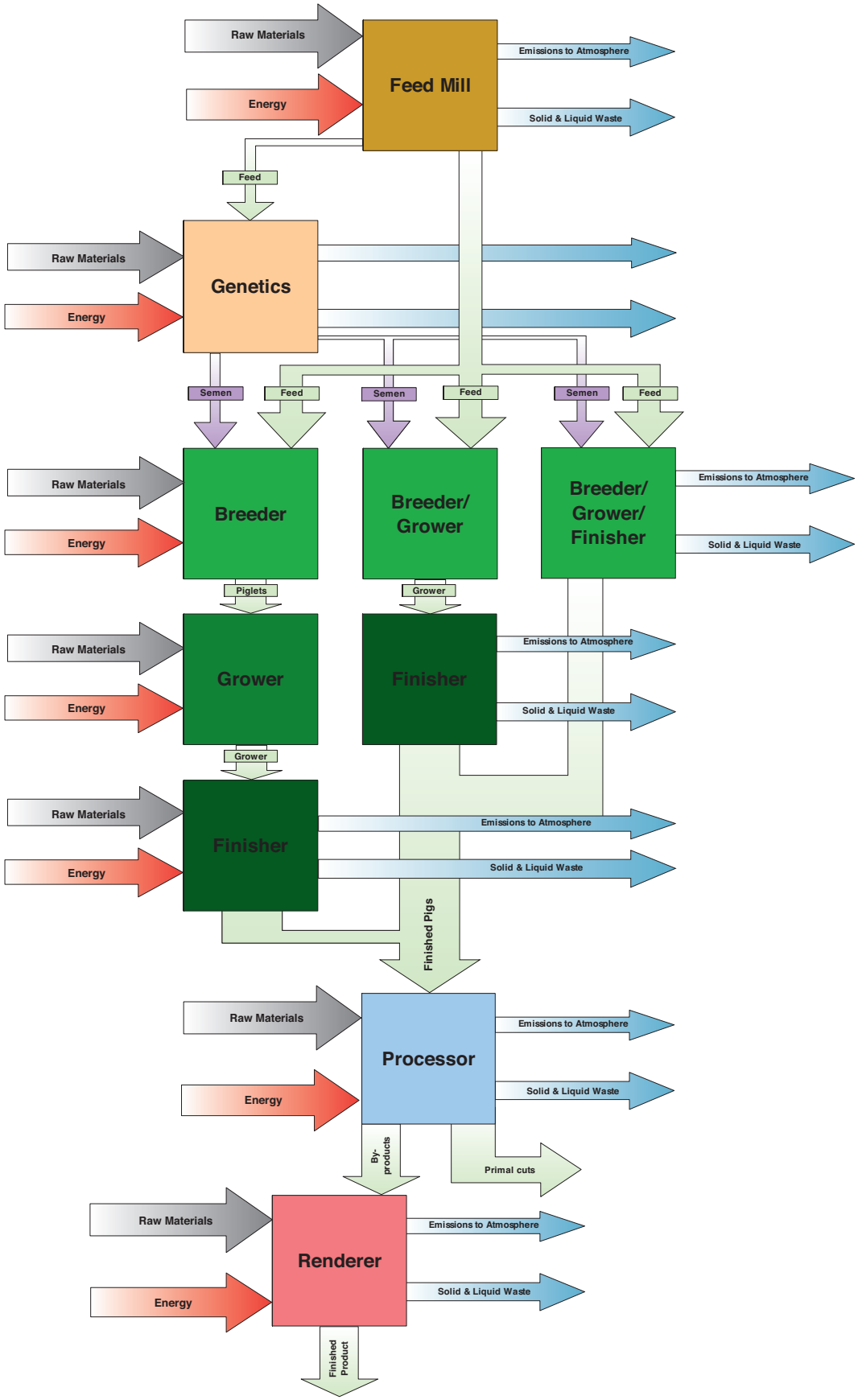


Figure B.2.6: The Production Chain

end of 2005 the main driver to outdoor pig keeping was not increased efficiency but avoidance of regulation under IPPC. The highly diverse nature of the farming sub sector makes it extremely difficult to examine resource flows; for instance, a pig born on a unit may be reared and fattened on units in the same ownership, alternatively, it might be moved between units in different ownerships on up to two occasions before being taken for slaughter – and not every farm is the same, variation between farms can be enormous.

B.2.3.1 Feed Manufacture

In recent years, the manufacture of pig feeds has developed in line with the requirements of improved genetics on commercial farms. It is commonly required that diets be tailored to meet the pig's dietary requirements at each stage of the production cycle; this is primarily in order to target proteins, so optimising growth rates and reducing waste; special sow diets have also been introduced, specifically for lactation and pregnancy.

Pig feed is normally produced in a pelletised or meal form known as compound feed, which flows easily in mechanical feeding systems. The development of the outdoor sector has brought about a need to produce a diet in the form of a roll or a cob, which retains its shape when fed in the field using a mechanical feed spreader.

Liquid feeds, which have similar nutritional characteristics to compound feed, are made up of normally liquid co-products, such as whey and potato starch, combined with dry ingredients, such as cereals Soya meal and rape meal, with vitamin and mineral balancers to compensate for variations in quality and consistency of the co-product.

The production of specialist baby pig diets and the use of very high quality raw materials are designed to provide piglets with very palatable feed at an early age, so encouraging the early uptake of solid feeds. The use of sweeteners and flavours are increasingly used to ensure trouble-free changeover between diets and so maintaining high growth rates.

Over the past decade much rationalisation has taken place in the feed industry, with mergers and acquisitions of feed companies. Many small country mills have disappeared, leaving only two major national feed compounders in the UK and a number of smaller feed companies, servicing regional, rather than local markets. The majority of pig feed is now manufactured in pig- and poultry-specific mills, with ruminant diets manufactured in separate mills.

The main reasons for the establishment of species-specific mills are to avoid cross contamination of products, reduce cleaning down time between different product lines, and enhance speed of operation. To some extent the pig sector works against the second reason because of the number of diets required by farmers.

The pig feed manufacturing industry is by far the largest supplier of materials into the production sector and so has control over the highest cost element in producing pig meat. MLC costings show that feed accounts for between 60% and 70% of the total cost of producing a kilogram of pig meat. The producer and the feed manufacturer have to work together to maximise feed intake, and subsequent conversion of feed into kilograms of pig meat in order to maintain profitability.

This is reflected in the more integrated supply chain partnerships that are currently being established, brought about through closer collaboration between raw material suppliers, feed manufacturers, pig producers vets and breeding companies. This collaborative approach is providing the UK industry with opportunities to reduce cost and improve efficiency.

Pig feed formulation is complex, and factors such as type of pig, live weight and the stage of growth will influence the composition of feed. Apart from formulating the diet to closely match the requirements of the pig, different types of feed are required for each stage of the production cycle.

This leads to feed manufacturers producing a great variety of similar pig products, specified by producers to meet dietary requirements or simply as a personal preference. The variation is on top of requirements for the basic phased feeding diets to suit dry or lactating sows, growers and finishing pigs. The results of the survey show that a single mill might produce over 300 separate lines giving rise to significant inefficiencies in production and wastage between batches.

On the other hand, with veterinary support, a reduction in the use of in-feed drugs used to control diseases within the pig herd is leading to fewer product lines being manufactured incorporating drugs. This reduces cleaning time at mills and allows longer run times of

standard products, so reducing costs and waste. The reduction in the amount of waste product from less cleaning is significant in economic and environmental terms.

Approximately 30% of pig producers currently use liquid feeds as opposed to feeding a dry compound feed or home mixed ration. Liquid feeding is not new to the industry, but UK producers have been slow to take advantage of it, mainly because of the high capital cost of conversion. Liquid feeds can also be problematic because they can ferment in storage, and this can cause digestive problems if they are not fed fresh; but fermentation, when controlled can be used to the benefit of the farmer and the pig. Furthermore, the level of hygiene required to achieve good results has to be high and effluent output is higher in liquid fed systems because of the extra volume of water consumed by the pigs.

Liquid feeding is more common in the growing and fattening stages of the pig cycle although some producers are introducing liquid feed from as early as 12kg (six weeks of age), primarily to take advantage of lower overall feed costs. There are a variety of liquid feeds, which can be mixed to individual specifications on farm to meet the pig's dietary requirements.

Any pig producer setting up a liquid feeding system will be classified as an "on farm mixer of animal feed stuffs" and accordingly have to register with the Local Trading Standards office under the Statutory Instrument No 1872 "Feeding Stuffs (Establishments and Intermediaries) Regulations 1999"; the keeping of animal feeds also brings units into the scope of the Food Hygiene (England) Regulations 2005. Inevitably registration brings with it the associated burdens of recording and reporting.

Until recently swill feeding, the feeding of catering waste (food from restaurants schools, hospitals etc.), was considered an acceptable way of recycling waste material; the practice was not perceived as posing a threat through the spread of diseases such as Foot and Mouth Disease (FMD) or Swine Fever. Such viruses can be found in meat and pose a potential threat if fed back to pigs unless feed is heat treated at 100°C for an hour. The treatment of swill does not pose a problem when treated according to requirements of the Animal By-Products Order 1999.

However, policing the processing of swill is problematic, as demonstrated by the 2001 outbreak of FMD in the UK; as a consequence of which the feeding of swill has been banned in the UK.

There are many by-products of the human food processing industry that represent no risk of spreading disease to pigs, because they do not contain meat of mammalian origin. These products are variously known within the industry as co-products or by-products, and include residues of vegetable processing and by-products of the food and brewing industries such as: biscuit fragments; whey; yoghurt tank washings and by-products from the cereal processing industry.

Because they were originally intended to enter the human food chain, the quality of these products is high, and if they were not recycled into animal feed, they would be disposed of to landfill, composting or by incineration.

The main benefits of co-products are that they can be fed through liquid feeding systems, and some experienced users can save as much as 30% on the cost of equivalent compound feed.

The total amount of feed used in the pig industry is difficult to establish as only about 55% of producers appear to use manufactured compound feeds, and the quantities of by- and co-products is not fully accounted for in readily available statistics.

Due to the size of areas served by mills, distances travelled by feed lorries are much greater today than in the recent past and the size of lorries has increased as a consequence. Feed is now moved in bulk lorries with only a very small percentage of food moved in bags. In order to reduce the cost of transport, the feed industry already operates a 24-hour delivery pattern to allow more effective scheduling of deliveries and vehicle usage. There are significant opportunities to reduce transport costs and environmental impacts still further by the use of more efficient delivery systems.

B.2.3.2 Pig Farming

Since the Second World War, the trend in farming was first towards larger, pig-specialist units, producing pigs from farrow-to-finish; farms where pigs are reared from birth to market. Over the past twenty years the trend has shifted to age-specialist units. Sometimes a 'pyramid' of

	UK	NL	DK
Pigs reared/sow/year	20.4	21.9	21.9
Average daily gain (g)	657	768	789
Food conversion rate	2.6	2.6	2.7
Av. Liveweight (kg)	94	112	101
Cost/ kg (Pence)	0.92	0.82	0.86

Table B.2.1: Herd Performance Comparisons (Source: MLC 2002)

such units is in a single ownership, the first unit dealing with breeding, gestation and farrowing. At the end of this stage, weaned piglets, weighing about 7kg, are moved on to a nursery, where they are fed targeted diets in controlled environments. At about eight to twelve weeks of age, weighing between 20kg and 35kg, they are transported to a finishing facility where they are fed to finished weight, which will be between 85kg and 120kg. This structure reduces the risk and impact of disease outbreak, whilst increasing the efficiency of use of labour and facilities.

Despite the apparently simple structure outlined above, the underlying extensive and diverse nature of the pig-farming sub sector gives rise to a plethora of different housing and husbandry systems, all of which can combine in various ways to produce a finished pig.

Housing systems are designed to optimise physical performance, in well insulated, easily maintained buildings with effective ventilations systems. Housing has to provide a clean healthy environment for both stock and stockperson.

Each stage of production has its own range of building systems, sow housing has seen the majority of development in recent years.

The 1999 ban on keeping pregnant sows in stalls and tethers forced the industry to have a complete rethink on sow housing. Dry sows are now housed in groups in yards or pens with access to feed via electronic sow feeding systems or, where they are fed as a group, using dump feeders or spinners. The yards, or pens, can be partially slatted or straw boxed; in the UK, there are few systems that are fully slatted.

In order to maintain high levels of herd performance in these new sow housing systems, a different level of stockmanship is required to the stall and tether system.

Farrowing houses have separate forward or side creep areas for feeding of suckling piglets.

Housing systems for growing and finishing pigs range from buildings that are either fully or partially slatted with automatically controlled powered ventilation systems, through natural ventilation systems to yarded systems where pigs are bedded on straw and kept in larger group sizes.

Production systems also vary from the intensive all in/all out batch system to units that make regular sales of stock.

The environmental conditions of housing systems can vary according to weather, building construction and the stage of production of the stock, but it is imperative to try and minimise variation to ensure growing and finishing pigs are able to convert feed as efficiently as possible into lean meat.

Heating and cooling systems in buildings range from local heating using under-floor systems to volume heating for individual or groups of rooms and from hand-controlled or fully-automated fan-based systems to open-sided buildings. The common factor between systems is that there should be no draughts, which are likely to have an adverse effect on pig health.

Comparison between UK producers and their major competitors

Conventionally comparisons are made between physical and financial performance of national sectors, as outlined in Tables B.2.1 and B.2.2.

Costs per kilogram deadweight adjusted to a constant 70kg dw pig.

	UK	NL	DK
Feed costs	49.69	38.32	40.18
Labour	10.49	10.89	11.51
Building, machinery & equipment	21.48	25.76	21.75

Table B.2.2: Cost Comparisons (pence per kg deadweight) (Source: MLC 2002)

Trends in Pig Production

Pig production in the UK is now generally geared to supplying the fresh pork market with only limited supplies going into the bacon sector. The average carcase weight has been traditionally around 69kg but this increased to 72kg in 2001 and to 72.7kg in 2002.

The increase in carcase weights has coincided with the reduction in the national herd and the numbers of live pigs available for processing on a weekly basis. It is generally thought that average weights will continue to rise. UK pig slaughterings reached a peak of 16.2 million head in 1998; the annual total of pigs slaughtered has since fallen to a low of 10.26 million in 2002.

This developing shortage of home produced pig meat has led to a substantial increase in the volumes of pork imports. The UK in 2002 has moved to a net importer of pork, a stark contrast to the late 1990s where we were a net exporter of pork, see figure B.2.7.

The cut back in bacon production has lead to an increase in imports of whole carcases for further processing from member states particularly Holland, Denmark, Eire, and France.

In 2002 UK pig producers' share of the home bacon market fell to 40% from 43% in 2001.

The demand for pig meat products within the UK has shown some decline since 1998, this has been part of an overall trend that has seen a reduction in the volume of meat products consumed by the public. Several reasons are given for this reduction:

- food scares in the agricultural sector;
- concern over fat intake;
- animal welfare; and
- a move to convenience foods that generally contain less meat than traditional meals.

The drop in pig numbers associated with the reduction in consumption has been accompanied by the production of pigs with heavier carcass weights. But this has raised concern over boar taint in pork and pig meat products and the associated potential for damage to consumer sales. It is essential in the UK that these heavier carcasses from boar pigs (entire males) do not result in a loss of meat quality, either in terms of appearance or eating quality; tenderness, juiciness and flavour.

Boar taint is caused by androstenone and skatole, which are found in pork and pig meat products derived from entire males. Unlike our European neighbours, boars in the UK are not castrated, the problem does not occur in sows, gilts or castrates, only in active males.

In addition to concerns over products, increasing slaughter weight is accompanied by increased production of effluent and manure. In order to mitigate this increase and limit its environmental impact, it will be necessary to implement a feeding strategy and production system tailored to the genetic potential of stock.

Increased average weights are also a concern to hauliers, heavier pigs will impact on stocking densities in transit and thus may lead to more journeys with increased fuel use and tyre wear.

In the recent past there has been a trend towards an increase in the average size of pig units, this has been associated with a reduction in the number of pig farms, reflecting the industry's desire to control production costs using economies of scale.

The reduction in numbers of pig units has also been accompanied by a decline in the total number of people employed on holdings with pigs. In the three years to 2003, there was a 13% fall in employment on pig farms; this is greater than the trend in the livestock sector generally.

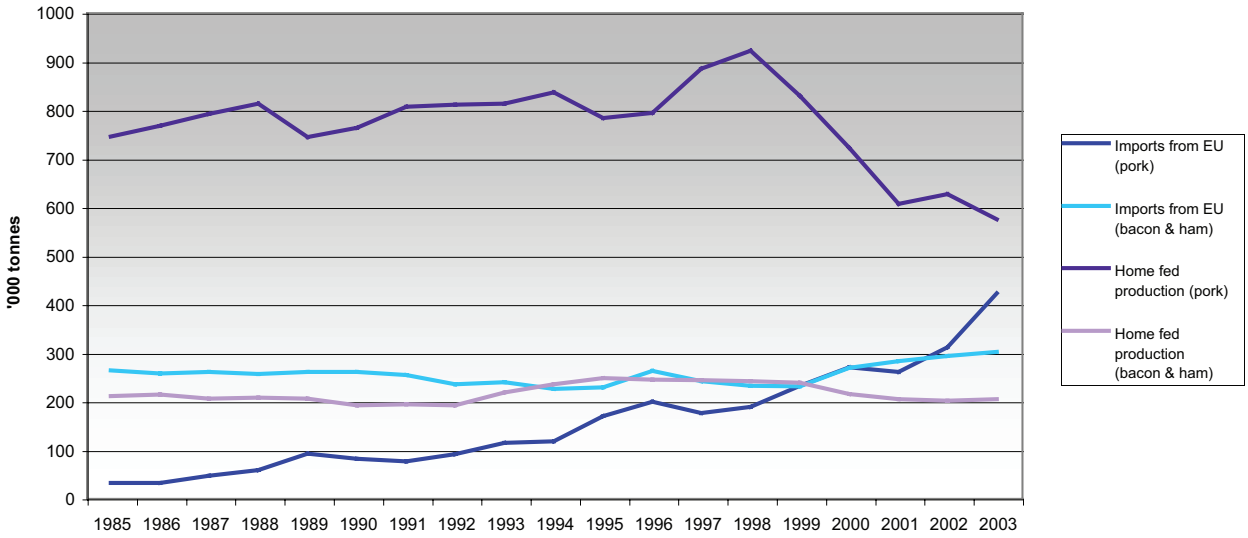


Figure B.2.7: UK Supply and Use of Pork and Bacon in UK and Comparison with Imports from EU
(Source: Defra statistics)

Despite being in relative decline, the UK pig industry has made scientific and technological advances that will have benefits at both national and global levels. Improvements in semen diluents have led to an increase in the use of AI in the UK and the development of genetic marker selection and the use of BLUP (Best Linear Unbiased Prediction) have increased the efficacy of breeding programs designed to serve both home and global pork chains.

The European pig industry has been long regarded as an effective and often-hostile competitor in the UK market, but the reduction in national herd size and increasing global competition has made it beneficial to view it as a partner. UK genetics are being developed for international use and European farmers are now looking to buy land and pig businesses in the UK; particularly the Dutch and the Danes.

The type of pig production unit is also different. Today's pig units may still include large intensive breeder finisher sites but there are increasing numbers of large outdoor producers who only breed, the progeny being moved on at 7kg and/or 30kg. This multi-site operation is intended to improve the pig health and growth rates.

These changes also have the potential to have adverse effects on the environment. Large intensive units produce waste in confined areas with a need to store and then apply slurry to land within an ever-reducing window of opportunity. Outdoor units with multi-site operations are likely to involve many more vehicle movements and increased fuel consumption with the land possibly subject to poaching and soil erosion.

Pig producers obtain breeding herd replacements from specialist breeding companies, which are engaged in genetic programmes to improve their stock lines. Replacements have historically been brought on to farms at regular intervals throughout the year. Over the last five to seven years, with new diseases and the Foot and Mouth outbreak of 2001, the industry has implemented a series of changes in order to maintain disease control:

- reduction of the number of deliveries of replacement stock;
- the purchase of grandparent stock to produce replacement breeding stock independently; and
- improvement and increased use of Artificial Insemination.

There are three main types of manure handling system, which are present throughout the industry, often with more than one on a farm:

Deep litter systems use absorbent bedding material to keep the stocked area in a clean and dry state. It is common for two areas to be provided, a warm and comfortable lying area and a cold dunging area. Straw is the most common source of material used.

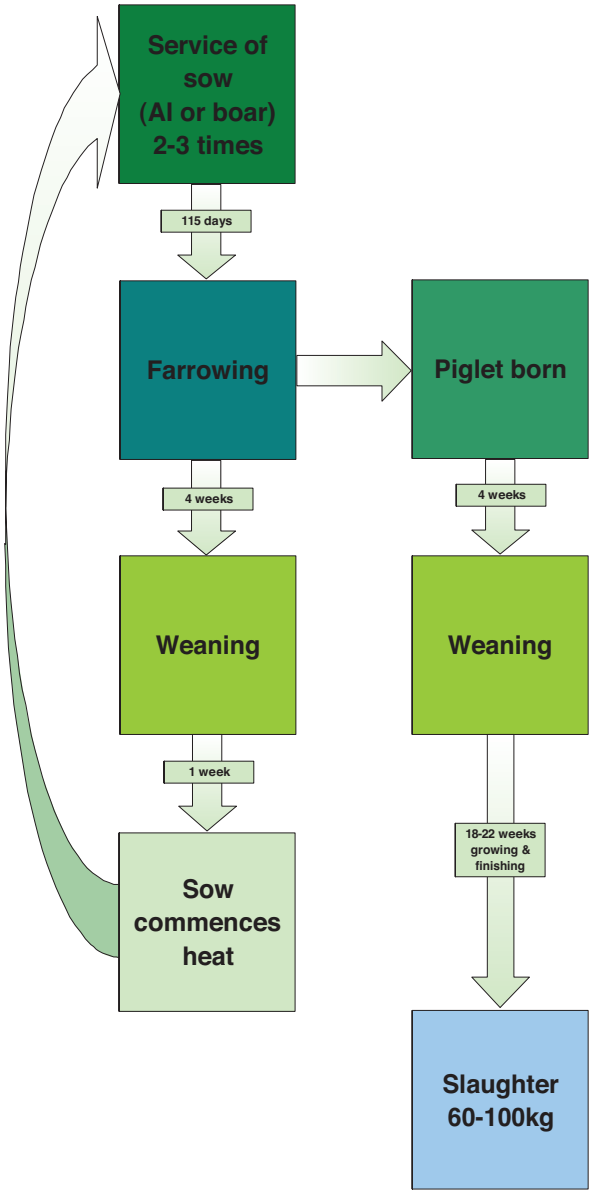


Figure B.2.9 The Pig Production Cycle

Scraped systems have discrete areas for lying and dunging, and a tractor-mounted or automatic scraper removes manure. A limited amount of bedding such as sand, shredded paper or wood shavings is used.

Slatted systems use no bedding and hygiene is maintained by use of a slatted floor, through which dung and urine fall into storage away from the animals. Slats may either cover the whole stocked area, or only be located over a slurry channel, with a solid floor in the rest of the pen area.

On top of the manure handling systems may be any combination of housing and feeding system, as already described.

Indoor housing for breeding sows is split into two stages: farrowing/lactating, and service/dry.

Farrowing and lactating sows are housed in pens that limit the movement of the sow, so she doesn't crush the piglets, and yet allows the piglets to suckle and have a nest area away from their mother. Welfare requires that piglets be weaned at 28 days. Farrowing sows are generally fed twice per day but may have access to ad lib feed.

In order to balance the heat requirements of sows and piglets, farrowing houses normally have a controlled environment with additional heating sources for the piglets. Air is drawn in through side vents and over the stocked area, and is exhausted by extractor fans on the roof of the building.

Temperature control in housing is critical for efficient pig production. If the temperature of a pig's immediate surrounding falls below its Lower Critical Temperature (LCT), the animal must use some of its food to maintain body heat. Older pigs can stand lower temperatures for short periods without apparent ill health, but food conversion efficiency will suffer; provided that draughts are not present. Even ideal ambient temperatures can be unsatisfactory if conditions are draughty.

The optimum temperature for newborn piglets is between 27°C and 29°C; the newborn piglet's ability to withstand cold is very limited. Piglet losses can occur very quickly where the temperature remains much below 16°C for any time. At ambient temperatures below 2°C, fatal chilling will occur within minutes unless a source of warmth is available.

The danger areas in pig housing are wall cracks at or near floor level, open-ended slurry channels which can cause up draughts through slats and uncovered heat lamps in otherwise cold buildings. The latter can create a draught at floor level when warm air rises and is displaced by cool air.

Newly weaned sows move on from the farrowing house into the service house. The service house will also hold gilts prior to service. Boars are individually penned in close proximity to sows and gilts to help stimulate oestrus.

The number of boars kept on farms has fallen dramatically with the increasing use of AI in the UK pig herd.

Weaning is an abrupt process where piglets are removed from farrowing accommodation and put into either a kennelled system, which has an indoor covered lying area and slatted outdoor dunging area, or a flat deck system on slatted floors, which consists of a series of rooms within a building; each room having its own controlled environment.

The high capital cost of specialist buildings has encouraged some producers to adapt covered yards, which are filled with straw on which the pigs are reared. This practice often makes use of redundant cattle buildings and can provide a healthy environment for pigs right up to finishing weight, although finished animals have been found to carry more fat than those finished in other conventional systems.

The majority of pigs are kept in this accommodation up to 30kgs or ten to twelve weeks of age, and generally always have feed available.

Accommodation for fattening pigs may be fully slatted or partly slatted, with limited amounts of bedding. Pens may have designated lying and scraped dunging areas. Fattening pigs are normally ad lib fed, with wet or dry feed.

On indoor pig units, the large volumes of manure produced, as either slurry or solid manure or a combination of both, are stored in silos, lagoons or manure clamps; all structures for manure containment have to meet the requirements of the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991 (as amended).

Outdoor systems, where breeding sows live 'free range' were originally developed to be low input, low output systems, as part of an integrated arable rotation. They came into their own in the late 1980s, when they occupied the less productive land on arable farms. The popularity of outdoor pig production has continued to increase to the present time where it is estimated that up to 30% of the national breeding herd is now kept outdoors.

The first factors to take into account when considering outdoor pig production are: climate; soil type; topography; and location. Free draining soils and areas of low rainfall are essential, thus outdoors production tends to be concentrated in the southern and eastern areas of the UK.

Breeding sows are usually grouped in fenced paddocks with large communal shelters, arks or tents for dry sows and boars. Farrowing sows have individual shelters or arks, which are normally insulated and the piglets contained within the confines of the ark by a fender. All sows are free to exercise within a paddock.

Piglets born outdoors are weaned at 28 days and are moved into outdoor kennels, sited away from the breeding herd. These kennels have a covered lying area and an outside dunging area, which is fenced. They remain in this accommodation up to approximately ten weeks of age, when they are moved to indoor finishing accommodation.

Outdoor production does not produce the large volumes of manure to be applied to land, or washings and rainwater from large roof areas, as is often the case with indoor units. Dung is deposited over the paddock and the only waste that needs to be disposed of is bedding straw, which is normally burned in the field.

B.2.3.3 Slaughter and Primary Processing

The UK's pork processing sub-sector is part of a larger meat-processing sector, which in 2003 was undergoing a rapid change as major players consumed smaller businesses. UK meat consumption is at a twenty year high, but the sector is highly competitive and vertical integration and acquisitions are being used to achieve the economies of scale necessary to remain competitive.

Consolidation in the sector is common and acquisitive companies such as Tulip UK and Grampian Country Food Group are taking greater market shares at the expense of smaller firms. In 2004-2005, the five biggest processors, the above plus: Cranswick Country Foods; Geo Adams & Sons Ltd; and Bowes of Norfolk Ltd, accounted for 64% of pig slaughtering; ten years earlier, the equivalent figure was only 37%.

Primary processing has been particularly hard hit by legislative change in recent years and it is expected that many small abattoirs will have potentially terminal problems with incoming hygiene legislation. Grampian has carried out a £16million expansion of its pork

processing business at Broxburn, near Edinburgh, creating a centre of excellence for pork and sausage production employing about 1,100 people; at the same time Grampian shut down its Buckie site, which employed 330 people.

In early 2005, Grampian completed a £23million investment in Winsford, Cheshire, constructing a highly automated plant for the production and packaging of primary cuts of pork and lamb.

In Humberside, Cranswick Country Foods opened new facilities as part of a planned £20million expansion; local opposition has subsequently halted further expansion at the site.

But, despite the number of businesses in the sub sector using economy of scale as a survival tool, the problems caused by cheap imports are unlikely to go away and the trend towards the larger players is likely to continue.

B.2.3.4 The Rendering Sub-Sector

Approximately 75% of the pig is directly consumed in one form or other, the remainder is recycled, the vast majority ending up at a rendering plant. In 2003 nearly 897,000 tonnes of pigs were slaughtered at processing plants in the UK, this generated in the region of 214,000 tonnes of by-products.

Renderers process the majority of animal by-products from the meat production chain, which do not end up on the consumer's plate. A small proportion of by-products are used by other sectors such as the pet food industry.

The rendering process involves the crushing and grinding of by-products, followed by heat treatment to reduce moisture content and kill microorganisms. Melted fat (tallow) and solids (protein) fractions are separated using centrifuges and presses.

By-products are segregated according to quality and veterinary classification at processing plants. They are transferred to storage in dedicated containers, which are normally collected by the renderer the same day.

Meat and bone meal, a major product of the rendering industry, has traditionally been used as a source of dietary protein in farm livestock; in particular the pig and poultry sectors. The incorporation of meat and bone meal in any farm livestock rations has been prohibited in the UK since 29 March 1996; this followed the ban on its use in ruminant rations in 1988. The EU prohibited the use of all animal proteins used in livestock rations in January 2001.

Following these bans, almost all meat and bone meal has been landfilled or incinerated; a major problem for the industry. In the rest of the world, meat and bone meal is still used in animal feeds; primarily for pig and poultry rations, a somewhat unfair playing field for the European industry.

The impact of the 1996 ban on UK pig producers, when an alternative source of protein had to be found, has been an estimated cost of an additional £3.00 per pig. In addition, the extra disposal charges, of about £1.00 per pig, have been added to slaughterhouse charges.

The other main product of rendering is tallow, much of which is used to produce chemical derivatives, which are in turn used in industries as diverse as soap and paint manufacture or tyre production. Currently, as a consequence of BSE, all UK tallow, not only that from beef production, is discounted in comparison with international market values.

Other potential markets for by-product residues are fuels, such as bio-diesel or in cement production, and, in the case of meat and bone meal, as a soil enhancer.

The Animal By-Products Regulations of May 2003 banned the burial of fallen stock on farms, leaving incineration and rendering as the only means of disposal. A recent DEFRA survey indicated that only 500 pig units were equipped with low grade incinerators, conventionally fired with fuel oil. The effective implementation of these Regulations will inevitably increase the amount of material going to the rendering industry.

New blood regulations were introduced in May 2003, which prohibit the spreading of blood to land and require complete containment and treatment of the blood. Filtration techniques have been developed which enable abattoirs to treat blood waste, separating out protein to be sent for rendering, leaving the liquid fraction to be disposed of to more conventional treatment.

In order to maintain low costs and a viable business, renderers generate a value of between £50 and £60 per tonne for the material they produce. In terms of costs,

the majority are incurred for transport to the rendering plant, and so depend on volumes of material produced; it is in the economic interest of processors to minimise waste volumes.

B.2.4 The Integrated Industry

The analysis at B.2.2 above clearly shows the vertical integration of the UK pig sector to be limited, with the majority of integration being limited to horizontal integration, producer groups, or within farm businesses.

Integration is normally associated with growth of businesses, improved efficiency, a geographical shift in production or implementation of new technology. All of these involve some degree of investment, and it is likely that reluctance to invest in the sector generally reflects the low level of confidence in a sector that has shown poor returns and pressure from cheap imports.

B.2.5 Ownership of the Pigmeat Industry

Grampian Country Foods is the only fully integrated company with feed- and pig-producing and processing interests to be a quoted UK Company. The majority of businesses in the farming sector are still in family hands, as is a significant, but rapidly declining number of processing businesses; companies that are part of larger, quoted companies, carry out the bulk of feed production.

Some pig producers have expanded their operations through acquisition, amongst others, BQP, TVP, MJ & JA Easey and DC & RJ Allen have all acquired units from the breakdown of producer groups or other farming businesses. It is estimated that 33 pig farming businesses produced more than half of the pigs finished in 2004 in England and Wales. This obviously provides considerable benefits of scale to these businesses.

In the breeding sub sector, PIC acquired Northern Pig Development in 1995, together with its pig management software packages, which were sold on to Agrosoft in 2001.

In 2003, the merger of three internationally renowned breeding companies, JSR Healthbred, Newsham and Cotswold formed JSR Genetics Ltd. The merger has allowed JSR Genetics to have the power and ability to develop a world-class range of products and services.

Two companies, BOCM Pauls and ABNA Ltd, dominate the pig feed manufacturing sub sector with an overall market share of over 50%, and there are only five other major companies involved in the UK: Lloyds Animal Feeds Ltd; Harbro Ltd; Cranswick Mill Plc; Favor Parker Ltd (owned by Grampian) and Carrs Agriculture Ltd.

Grampian is the business most like a poultry integrator in that it owns feed mills, has its own production sites, rearing and fattening sites and its own processing plants. Grampian has developed the use of large rearing and fattening sheds, along the same line as broiler units where the environment requirements are changed as the pig grows, although this is understood to have had limited success.

In early 2004, the farmer co-op Danish Crown (the largest pigmeat processor in the world) acquired Flagship Foods Limited to merge it with its own UK subsidiary, Thetford-based Tulip Limited. This takeover created the world's largest integrated pigmeat group. Both companies had a significant presence in the UK market. The Flagship group comprised Roach Foods Ltd, Dalehead Foods Ltd (Cambs/Suffolk), Flagship Fresh Meats Ltd (the business acquired from Glanbia PLC in 2003) and BQP Pig Farming Enterprise (Cambs/Norfolk/Suffolk)). Tulip Ltd (Norfolk) has several processing factories in the UK and now throughout Europe.

Elsewhere in the processing sector competitive pressure has also been severe. The reduction in pig numbers has resulted in excess slaughter capacity. The resulting pressure on efficiency combined with the relentless price pressure from major customers, such as retailers and food service companies, and the loss of many export markets in the wake of Classical Swine Fever and Foot and Mouth Disease resulted in abattoir closures and the amalgamation of a number of companies.

B.3 Industry Drivers

A range of driving forces affects the pig industry. For convenience, these have been classified as Economic and Market, Social, Environmental, Political, and Legislative drivers.

B.3.1 Economic and Market Drivers

The primary economic and market drivers affecting the UK pig industry are related to the steady globalisation of the sector.

Starting with pig genetics, globalisation has made available to UK farmers world-class genotypes, which improve performance on farm and provide better quality carcases to processing plants, creating all round better economic performance. But these benefits are also available to all other countries' pig industries competing on the global stage, and so do not provide any advantage to the home industry.

In trade generally, the European position at the recent Beijing WTO round suggests a desire to see greater free trade in meat products. Any increase in free trade is likely to be achieved through a reduction in import tariffs, which will lead to greater imports of pork and pork products to Europe, generating greater price competition in the domestic market.

Whilst free trade is desirable, and necessary, domestic producers currently face significant restrictions that are not faced by non-EU producers, such as: the removal of antibiotic growth promoters from feed; a ban on the use of sow stalls and tethers; a ban on meat and bonemeal in feedstuffs; substantial environmental protection measures; and employment protection legislation. These restrictions add substantially to costs and have been said to undermine fair trade.

It is important that any WTO agreement must recognise differences in environmental and welfare standards in order not to export production to non-EU countries, with lower standards than demanded by the home market.

Nor is the UK industry well placed to maintain "low cost production"; the UK's major international competitors all have considerably lower feed costs. With feed accounting for about 60% - 70% of the cost of producing a slaughter-weight pig, the UK's inability to produce certain feed ingredients (proteins especially) and the relatively high costs of producing cereals in the EU will always allow the potential for successful non-EU competition.

The general lack of investment in the UK pig sector means that in recent years the industry has failed to innovate, particularly in terms of production systems and information exchange. Some European competitors have systems that produce 50% more piglets per sow per year, a significant advantage in simple competition terms, but a possible disadvantage in terms of welfare and sow health.

Lack of uptake of new techniques has also led to a 30% variance in on farm production costs between UK and other EU producers, and many poorly performing units risk going out of business. Many units with high costs are also likely to have poor environmental performance, which not only incurs an unnecessary economic burden, but also puts businesses at risk of non-compliance with existing and incoming environmental regulations.

In the past decade the health advantages previously enjoyed by the UK pig herd have diminished. The increasing importation of meat and meat products, and a casual attitude to animal health precautions have exposed the UK to global pig diseases such as Swine Fever and Foot and Mouth Disease.

Few economies of scale have recently been made in terms of farm size, with little or no investment in additional buildings on existing units. Whilst a ready market for pigmeat is available, there is pressure to increase production. However, limitations imposed by availability of land for the application of manure and slurry may be perceived as an obstacle; where expansion happens it is normally by the acquisition of existing farms or farming businesses.

There has also been relatively little investment in new processing plants, with the majority of capacity provided by long-established plants, which are upgraded as necessary to meet increasing demand or welfare and environmental standards.

The UK pig sector in isolation cannot truly "match production to demand" in the world market, where price is the over-riding factor and demand is selective.

In order to compensate, UK producers are looking at ways to add value to production and thus increase returns. The main way in which this has been achieved is through the production of ready prepared meals. However, such innovation is unlikely to be able to support a sustained recovery of the UK pig sector given the experience of the poultry sector, which faces strong competition from neighbouring European producers.

B.3.2 Social drivers

Social drivers should work for the industry as well as against it. It is well known that the UK consumer demands high quality, healthy, safe, welfare-friendly, environmentally sustainable meat. Equally, it is also known that many consumers are rarely prepared to pay the cost of quality products. Nonetheless, the pressures on the EU and UK industries are to encourage ever-higher standards.

Household incomes will influence the market for pigmeat products. Any increase in disposable income is likely to increase demand for value added products, such as ready meals and more meals will be eaten outside the home.

Polarisation of incomes will also create a split market; the less affluent will concentrate demand for lower cost cuts, whilst the more affluent will demand high quality products.

Changing working patterns and a decline in basic cooking skills mean that people have less time and inclination to shop and cook, increasing society's reliance on ready meals.

The trend towards single person households means that portion sizes will change and is also likely to increase demand for ready meals.

Demographic changes will influence production, particularly where an aging population will drive the market for leaner and more convenience cuts.

Pork as a product is well placed to meet future demands as it is recognised as lean meat, supplying the health conscious. It is relatively easy to prepare and has a variety of uses. It is attractive for use in ready meals and is available all the year round.

Welfare

Concerns have been expressed by the industry that a proportion of the pig meat imported into the UK does not conform to the UK minimum legal standards, regarding pig welfare. The UK has an independently audited Quality Assurance scheme marketed under the British Quality Standard Mark, which covers the whole supply chain.

Assurance schemes operate in other member states but with varying degrees of independence and market coverage. The major difference between pig production systems in the UK and other EU countries (except Sweden) is that the use of stalls and tethers for pregnant sows has been banned in the UK since the beginning of 1999. A ban on the use of tethers in the rest of the EU is not effective until 2006 and a partial ban on sow stalls will not be introduced until 2013.

There is a perception that the UK market is not concerned with imports of pork and pork products produced from pigs outside of the UK that only meet the UK legal minimum standard. Consumer research, however clearly shows that consumers are overwhelmingly concerned about imports not meeting UK minimum legal standards and they believe that the independent quality assurance schemes are important. They recognise the Quality Standard Mark or the Red Tractor as meeting these standards and are confident of purchasing food displaying them.

The EU - as a legislative whole - has higher standards of animal welfare than anywhere else in the world, the approved regime balances the needs of animals with the commercial interests of farming. A raft of welfare regulations covers pig production.

Despite the detailed regulations and voluntary standards covering welfare policed by DEFRA and the supermarket retailers, some sectors of the UK public have an increasing interest and a perception of the pig industry which is less than favourable. This perception is founded largely on ignorance, and can only be overcome by successful lobbying of animals rights organisations concerned over industry developments.

In the absence of a well-orchestrated campaign to make the public more aware of the high welfare standards applied in the UK, the industry must expect welfare pressures to continue despite the fact that European and national welfare measures should provide an effective response to the ethical lobby.

Future welfare and environmental performance within the industry is likely to be affected by social pressure, and the increasing demand for higher welfare products may favour organic production over any others.

Food Safety and Health

Food Safety issues closely parallel those concerning animal welfare.

Pigmeat is considered a white meat and therefore like poultry meat a good source of protein with a relatively low fat content. Consumers are much more aware of welfare, environment (outdoors perceived to be healthy) and country of origin. Health issues associated with eating meat, such as salmonella or enteritis, are being addressed by the industry through the promotion of correct cooking temperatures and length of cooking for pigmeat products.

Consumers and retail customers have an increasing desire for traceability of products and assurances that products are 'safe'.

In the long term, health concerns and an increased demand for healthy products are likely to favour pork in the overall red meat sector

In the UK, competent implementation of food safety legislation and public pressure have tended to push the home industry ahead of other EU members. Growth promoters, including prophylactic use of antibiotics, have been banned voluntarily in the UK as a result of public pressure.

From 1 January 2006, the Food Hygiene (England) Regulations 2005 in England (and similar legislation in Scotland and Wales) will revoke and replace most of the existing food hygiene national legislation, see Section B.4 below.

B.3.3 Environmental Drivers

Integrated Pollution Prevention and Control (IPPC) and the Climate Change Levy (CCL) have, or will have, a considerable impact on the pig industry, particularly in the breeding and fattening sub-sectors.

All new or substantially changed farms with more than 2,000 pig fattening places or 750 sows must have a Pollution Prevention and Control (PPC) permit before starting up, and all existing pig farms will have to be permitted by January 2007. In order to obtain a permit, units will have to demonstrate that they are using Best Available Techniques (BAT) to limit their effect on the environment. The imminent implementation of IPPC has already caused a shift in farming practice, with many marginal units moving animals out-of-doors and onto another unit to avoid reaching the threshold.

Although many pig units practice BAT - and thus costs for compliance activities should be modest - the fees and charges associated with IPPC represent a significant financial burden; permit applications are expected to cost £3,240 with an annual large farm subsistence fee of about £2,718.

The first milestones of the CCL Rebate Agreement have been met by almost all of the farms covered by the Agreement with an overall saving of over 67,0000 carbon tonnes. However, subsequent milestones will be much harder to meet. It is almost certain that considerable redesign/rebuilding of some existing pig accommodation will be needed to comply, and it is doubtful that, in many cases, this will be an economic option.

B.3.4 Political drivers

Although government regulation operates on industry via economic and social mechanisms, political considerations often tend to distort 'normal' systems.
A true free market in global pig meat is constrained in many ways by both global and national politics. The pig industry is unsupported by the EU Common Agricultural Policy (CAP), being under the 'light regime' where the only support mechanisms are Trade Tariffs. However, as with welfare and food safety, different EU countries 'interpret the rules' according to their own internal political agenda.

B.4 Legislation Affecting Pig Enterprises

There is an increasing amount of European, UK, British and regional environmental legislation relevant to the pig industry, with the prospect of more on the agenda. The following is not an exhaustive list and equivalent legislation exists in Scotland, Wales and Northern Ireland.

Current Legislation

Integrated Pollution Prevention and Control

Pollution Prevention and Control Act gives effect to the Pollution Prevention and Control (PPC) Regulations, which came into effect in August 2000. IPPC Affects installations with a capacity for 2000 and above producer pig places (greater than 30 kg) or 750 and above sow places.

Existing units do not have to be permitted until 2007, but new or 'substantially changed' units are affected as soon as they are operated.

The scope of the Regulations covers farm management including use of feed, housing design, manure management (storage and spreading), emergency planning, noise and odour management and resource use (such as water and energy use).

Climate Change Levy (CCL)

The CCL was introduced in April 2001 as part of the package of measures designed so the UK will meet its legally binding target from Kyoto to cut greenhouse gas emissions by 12.5% below 1990 levels by 2008-2012 and to cut carbon emissions by 20% below 1990 levels by 2010.

The levy takes the form of a tax on energy. It is revenue neutral; all money raised is recycled back via a 0.3% reduction in employers National Insurance Contributions (NICs) and subsidy of energy efficient measures.

The government recognised the position of energy-intensive industries such as intensive pig production and processing, the requirements of Integrated Pollution Prevention and Control (IPPC) and their exposure to international competition. Consequently the pig industry has been able to register for an 80% discount on the levy in return for agreed improvements in energy-efficiency over a 10-year period.

The pig industry agreed a target energy reduction of 16% over a ten-year period, including five two-year milestones. This was based on how much potential was thought to exist within the sector for realistic energy savings.

Pig Welfare

From 1 January 2003 EU legislation came into effect that laid down minimum standards for the welfare of pigs came into force; not all aspects of the legislation will come into force on existing units in other EU countries until 2013.

The key provisions of the Regulations are:

- that all pigs must have permanent access to manipulable materials.
- minimum space allowances for sows and gilts.

An increase in the minimum weaning age from 21 to 28 days.

The Pig Welfare Directives are due to be reviewed in 2008.

Pig Identification

Pig identification legislation requires that all premises in England and Wales containing pigs must be registered with the local Animal Health Divisional Office (AHDO) which issues units with a unique DEFRA Herdmark.

The herdmark comprises one or two letters followed by four numbers e.g. AD1256 or D1026 and all pigs moving from a holding to an abattoir must be marked with the herdmark using either an eartag, tattoo or slapmark prior to leaving a holding. Pigs moving from one holding to another have to carry an identifying temporary paint mark.

The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulation 1999

The development projects that are required to undergo an Environmental Impact Assessment are set out in the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1990 and the Environmental Assessment (Scotland)

Regulations 1988 (as amended by the Environmental Impact Assessment (Scotland) Regulation 1999.

Schedule 1 s17 'Installations for the intensive rearing of poultry or pigs with more than

(a) 3,000 places for production pigs (over 30kg) or

(b) 900 places for sows

or under Schedule 2 Intensive livestock installations, if the area of new floor space exceeds 500 square metres.

Control of Substances Hazardous to Health (COSHH) Regulation 2002

The COSHH Regulations apply to all potentially harmful or hazardous substances, including waste. The health risks to employees from exposure to substances considered hazardous must undergo a risk by employers and the exposure of employees to such substances prevented or controlled. Suitable and sufficient information and training must be provided plus routine exposure monitoring and health surveillance.

Environmental Protection Act 1990 (EPA1990)

The EPA (1990) regulates the collection and disposal of waste and defines statutory nuisance. In relation to pig production, the statutory nuisance sections are particularly relevant. A statutory nuisance is defined as "any dust, steam, smell or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance.

"Noise emitted from premises so as to be prejudicial to health or a nuisance."

The local Authority has powers to investigate such complaints and can issue an Abatement Notice if a statutory nuisance exists.

The EPA (1990) Part I introduced a system of Integrated Pollution Control (IPC) in order to make provision for the improved control of pollution arising from certain industrial and other processes. The IPC system provides a framework for pollution control by controlling the emissions to air, water and land from certain specified processes in a single authorisation.

Integrated Pollution Prevention and Control (IPPC) is a major new piece of legislation that will have an important impact on the pig industry. IPPC aims to control the environmental impacts from certain industrial activities, including the pig industry, by preventing or where this is not practicable, reducing emissions to air, water and land. This is done by determining and enforcing conditions that represent the best available techniques (BAT). It also promotes careful use of resources such a water and electricity.

Installations which fall within the scope of IPPC will have to manage and control their activities in order to protect the environment and will have to apply for a permit to operate. Authorisation will come from the Environment Agency.

For pigs, installations that have places for more than 750 breeding sows or places for more than 2,000 production pigs (over 30kg) will be subject to the regulations.

IPPC has been incorporated within the Pollution Prevention and Control (England and Wales) Regulations 2000.

New pig installations have to seek a permit immediately but existing installations have until January 2007 to obtain a permit. Pig producers will have to demonstrate to the Environment Agency the following environmental issues have been satisfied.

- satisfactory environmental management of the installation;
- causing no significant levels of pollution and demonstration of BAT;
- adequate compliance monitoring;
- using energy efficiently;
- taking effective measures to prevent environmental accidents;
- minimising and ensuring the suitable disposal of waste.

Food Hygiene (England) Regulations 2005 in England (and similar legislation in Scotland and Wales)

From 1 January 2006, the Food Hygiene (England) Regulations 2005 in England (and similar legislation in Scotland and Wales) will revoke and replace most of the existing food hygiene national legislation. In England, the full range of food hygiene national legislation

revoked or amended is set out in Schedule 7 of the regulations.

Feed (Hygiene and Enforcement) (England) Regulations 2005

The Feed (Hygiene and Enforcement) (England) Regulations came into force on 1 January 2006. Their purpose is to bring the main provisions on animal feed law enforcement into one set of Regulations. They consolidate the enforcement of EC Regulation 178/2002, (currently set out in the Feeding Stuffs (Safety Requirements for Feed for Food-Producing Animals) Regulations 2004), as well as the provisions on fees for the approval of establishments, as currently set out in the Feeding Stuffs (Establishments and Intermediaries) (Amendment) (England) Regulations 2005.

Regulation (EC) No 183/2005 (the Feed Hygiene Regulation) was adopted by the Council of Agriculture Ministers of the European Union on 22 December 2004. The objective of this Regulation fulfils a commitment in the Commission's White Paper on Food Safety of January 2000, which is to strengthen feed safety, in particular in relation to feed traceability and the operational standards of feed businesses.

It replaces Council Directive 95/69/EC, which provided for the approval and registration of feed businesses involved in the manufacture, use or marketing of certain feed additives. Regulation (EC) No 183/2005 extends the approval or registration requirement to nearly all feed businesses.

This means, for example, that importers of feed, agricultural merchants, food businesses selling co-products for feed use and the majority of farms (arable and livestock) had to have the required approval or registration since 1 January 2006.

Food Labelling

The Food Safety Act 1990 prohibits misleading advertising, labelling and presentation of food. Food labelling is closely related to composition, and local authorities' trading standards or consumer protection departments enforce both.

The definition of 'meat' when used generically in food labelling has affected declaration of the meat content of meat products and lists of ingredients.

The definition of 'meat' is restricted to skeletal muscle meat with limited proportions of associated fat and connective tissue. Excesses of these components must be declared separately. Offal and some other parts of the carcase are not considered as 'meat'.

The compositional standards as defined require smaller amounts of 'EU meat' to be present than was the case under the former British definition (e.g. 'pork sausages' will require 42% of EU pork, whereas 65% of meat was required under the old rules).

The Water Resources Act 1991 (WRA 1991)

The WRA is the principal legislation for regulating water quality and quantity in England and Wales and its aim is to prevent water pollution from occurring and allows people to be prosecuted if they pollute under the Act.

It prohibits causing or knowingly permitting the discharge or other entry of poisonous, noxious or polluting matters to controlled waters. Controlled waters include ground water, lakes, ponds, rivers, streams, and ditches. Businesses intending to discharge such substances, or trade, or sewage effluent directly to controlled waters, must obtain consent from the Environment Agency or risk prosecution. The licence details the conditions on the concentration limits, characteristics and volume of effluent permitted.

The Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991 as amended

The control of Pollution Regulations specify the performance levels for installations used for the storage of silage, slurry and agricultural fuel oil to minimise the risk of water pollution for keeping and handling these substances. Dirty water and foul run-off is described as slurry in the Regulations. Facilities that were in existence before 1st September 1991 are usually exempt from the rules but the Environment Agency can require them to be improved under a notice if there is significant risk of pollution. New units or substantially enlarged or reconstructed facilities must meet the standards set out in the Regulations. The Agency must be informed at least 14 days before and of the exact site on which new facilities are to be used.

The Protection of Water against Agricultural Nitrate Pollution (England and Wales) Regulations 1996 and the Action Programme for Nitrate Vulnerable Zones (NVZ) (England and Wales) Regulations 1998

The regulations arose from the EC Nitrates Directive (91/676/EEC) which was introduced amid environmental and health concerns over high levels of nitrate found in certain waters. The Directive aims to

reduce nitrate pollution from agricultural sources such as manure and fertiliser applications and will include pig units. A total of 55% was designated as an NVZ in October 2002. Farmers located in NVZs have been required to apply 'Action programmes measure' to reduce nitrate leading since 19 December 2002. The Nitrates Directive requires identification of nitrate polluted waters where the nitrate concentration exceeds or expected to exceed the limit of 50mg/l. For pig enterprises most of the rules within the NVZ Action Programme are contained within the Code of Good Agricultural Practice for the Protection of Water (The Water Code) and in many respects are consistent with good economic practice and whilst some additional costs are likely, these maybe recovered over time as a result of better utilisation of manures and reduced fertiliser inputs. They relate to the timing of manure applications, controlling the rate, having enough land to apply manures and appropriate storage of slurry.

The Animal By-Products Regulations 2003

These came into force on 1st July 2003 (England) and replaces the Annual By-Products Order 1999. The aims of the Regulations are to protect animal and public health by ensuring safe processing, disposal or use of animal by-products.

A ban on the feeding of catering waste to pigs came into force on 24th May 2001, Animal By-Products (Amendment) (England) Order 2001.

The latest regulations cover animal by-products, animal carcases and products of animal origin, which are not intended for human consumption. The disposal routes for these must be rendering or incineration through a suitable installation.

The EU Animal By-Products Regulation banning the routine on-farm burial and burning of animal carcasses came into effect in England on 1st July 2003, certain low capacity incinerators can be used on farms for the disposal of fallen stock. In situations where an incinerator is not available, a UK fallen stock scheme has been effective since January 2004; this scheme is jointly financed by subscriptions from farmers and Government.

Waste Management Licensing Regulations 2006

The Waste Management (England and Wales) Regulations 2006 (S.I. 2006 No. 937), The Environment Act 1995 (Commencement No. 23) (England and Wales) Order 2006 (2006 No. (C. 934)) and a final regulatory impact assessment, were laid before Parliament in March 2006. The effect of the Act is to exclude waste from premises used for agriculture from the waste management controls that apply to "controlled waste". The main purpose of the regulations is to repeal that exclusion and to apply to agricultural waste the controls that are already in place to comply with the Waste Framework Directive (75/442/EEC as amended) and the Landfill Directive (1999/31/EC).

Until May 2006 most agricultural waste was disposed of on farm in "farm dumps" or by open burning. The regulations ensure that agricultural waste is recovered or disposed of in ways that protect the environment and human health.

From October 2006 farmers will have to register with the Environment Agency to transport agricultural waste on a professional basis or as a dealer or broker; and will have to apply to the Agency for waste management licences, to dispose of or recover agricultural waste on-farm, or to register licensing exemptions.

A wide range of licensing exemptions is available to farmers. Licensing exemptions for agricultural waste cover, inter alia, the use of drum incinerators, and ash from the incineration of non-SRM pig and poultry carcasses. More exemptions will be brought forward in the twelve months to May 2007.

The regulations also contain amendments to existing regulations, for instance to ensure continuing compliance with the Waste Framework Directive following the introduction of the EU Animal By-Products Regulation, which lays down health rules concerning animal by-products not intended for human consumption. The proposed amendments apply to animal by-products which are waste within the meaning of Article 1(a) of the Waste Framework Directive and are not excluded from the Directive's scope under Article 2.

B.5 The future of the UK Pig Industry

In the face of intense competition from overseas, the future of the UK Pig industry is far from certain.

The UK pig industry clearly believes that it almost certainly has the best product in the world. “Best” meaning consistency across the board, not only in quality of product - paramount though this may be - but also in food safety, animal welfare and environmental awareness. Nonetheless, the UK industry sees itself in apparently inexorable decline in supplying its own home markets.

The industry is quite prepared to compete in the global market. It accepts that this will always be tough - cost differentials, particularly on feedstuffs and labour costs - will always militate against the UK product. But most respondents reckon that their sub-sectors - their companies - can handle this. Being tough is something that the pig industry has had to be; unlike the majority of agri-businesses in the UK, it receives no income from the CAP.

Despite this, the industry competes with third-country imports that have cost advantages and, at least sometimes, don’t match the “social specifications” of hygiene, welfare etc, that are imposed upon home production.

Additionally, other EU countries have their own range of problems. For example, in 2005 mortality in Danish pigs destined for slaughter has increased by 25% in the past 10 years from 16.9% in 1996 to 21.2% in the past year. The Danes regard this as an unethical paradox as millions of Euros have been invested to improve pig living conditions, yet more animals are dying. It has been suggested that the reason for this may be that the optimum litter size for the species has been exceeded in the breeding herd.

C. The Mass Balance Model

C.1 Industry Sectors and the Supply Chain

This mass balance model aims to quantify the material resource and energy inputs to, and major waste outputs and emissions from the UK Pig Industry in 2003.

The boundaries of the model, arrived at with the guidance of industry members, extend from the manufacture of pig feed, using cereals, oilseeds and amino acids, through the supply chain to primal cuts and portions, to output from rendering plants.

Further processing to add value to pork products, by curing, smoking, the production of sausages, pork pies and prepared portions for ready meals and the catering trade has not been included in this part of the study.

Whilst the majority of inputs and outputs in the relevant sectors of the pig meat supply chain are included in the study, the primary subjects of the study are energy and water usage; the two major resources flowing through the pig supply chain.

The boundaries of the sectors making up the pig meat supply chain are laid out below and in Figure B.2.6.

Feed Production

Of the raw material input to the feed milling sector, about 60% is cereals, and 29% Soya and oilseeds or pulses. The remaining inputs provide oils and additional proteins, including vitamins, minerals and amino acids, to balance the feed and optimise rations at each stage of pig development, plus packaging necessary for delivery of small-scale production.

Feed compounding is a process based on blending and mixing to produce a meal, and the further application of heat and pressure to produce a pelleted end product. Both meal and pellets are readily eaten by pigs and are easily handled and transported. The heat-based parts of the process normally use steam as the heat source; the means of raising steam vary between sites. The majority of output from the sector is compound feed, which is delivered to the point of consumption in bulk, using road vehicles, which are accounted for elsewhere in the mass balance.

In addition to compound feed, pig farmers also use co- and by-products, which are often waste food products from other sectors of the agricultural food industry. No account for the transport of these materials from the point of production to the farm is made in this study. The amount of energy used in the feeding of co- and by-products is limited to the on-farm mixing of products, which is included in the analysis of the farming sub sector.

The secondary outputs from feed production consist mainly of atmospheric emissions of steam and gases, foul water and waste packaging.

Farming

The outputs from the farming sub sector are primarily animals for processing, and slurry or manure, which is normally applied to agricultural land, and the carcases of pigs that have died during the production cycle. In addition, wastes arise from cleaning and disinfecting the housing at the end of each production cycle, plus other emissions to atmosphere.

Within the farming sub sector production is carried on in a variety of systems, using a common range of components, which can be summarised as follows:

'Breeding and Finishing Herds' contain breeding animals producing piglets that are taken through to finishing weights of between 75kg and 110kg liveweight;

'Breeder Herds' contain breeding animals producing piglets that are moved on at 7kg; this sub sector includes elite and some other breeding animals, which are generally kept in nucleus and multiplication herds in similar conditions to other stages of the production cycle, but with more health precautions;

'Breeder Grower Herds' contain breeding animals producing piglets that are moved on at 30kg;

'Grower Herds' take 7kg piglets in from Breeder Herds and rear them on to about 30kg, when they are moved on to Finishing Herds; and

'Finishing Herds' take in animals at 30kg and grow them on to finishing weights of between 75kg and 110kg liveweight.

Breeding

The breeding herd is based on groups of sows serviced by a number of boars to produce the stock that will go on through rearing and fattening to processing.

Maiden sows, known as gilts, enter the breeding herd when they reach sexual maturity at about 20 weeks. Sows produce around 50 piglets in a lifetime, which are subsequently successfully reared, in a total of five parities (pregnancies) over a life span of about two and a half years. After the fifth parity, the number of piglets born tends to drop and sows are replaced. Pig producers normally replace about 40% of their herd each year. However, the current UK average is just over 2.5 parities per sow, which reflects increased early culling of sows because of fertility and health problems in the national herd.

In the year up to June 2003, 514,000 sows in the UK produced a total of 10,200,000 successfully reared piglets, an average of 19.85 piglets per sow.

Gilts are brought into herds as full weights (100kg) or as growers (30kg) or weaner gilts (7kg). Gilts go through a period of quarantine before entering a herd, after which they are fully integrated with the herd, mixing with older animals at all stages from service to dry sow.

Gilts are normally first mated when they achieve a liveweight of 120kg.

Piglets stay with their mother for 4 weeks after birth, although this period can be a lot shorter in some competitor countries. Whilst they are with their mothers, piglets suckle their mothers although natural feeding can be supplemented with small amounts of creep feed. At weaning, piglets weighing about 7kg are abruptly removed from their mothers and moved on to a rearing unit.

The dry sow is then moved to a service area where within 5 to 7 days she will come onto heat and be served again. The aim for most pig businesses is for sows to have at least two pregnancies per year.

Growing

Weaned piglets are moved into a growing unit, which on many indoor units is a specialised building with additional heat inputs for the first two to three weeks. On wholly outdoor units the weaned piglets move away from the breeding herd, into kennels with a covered lying area with straw bedding and a fenced outdoor dunging area. The weaned piglets are given specialised feed, the specifications of which may be changed two or three times during the six to ten-week growing period.

The growing accommodation on a conventional, indoor unit may range from fully climate-controlled housing with insulation, through adapted agricultural buildings, which may or may not have originally been designed for livestock, to simple umbrella buildings designed to protect housed stock from the worst of the weather.

Pigs are moved on from growing units at between 20kg and 40kg liveweight, depending on the type of accommodation available on the farm.

Fattening

The majority of pigs in the UK are moved into the fattening accommodation at 35kg.

Housing for the fattening herd is usually in kennels or separate pens under a single span ‘Suffolk’ house. Specialist accommodation can either be all or part slatted or at least be designed with separate dung and lying areas.

At this stage pigs are fed a fattening ration, which may be split into two diets according to growth stage, provided that the unit has sufficient bulk bins. Diets are tailored to meet the requirements of the pig. Where too few diets are fed; it is inevitable that at some stage the animals will be overfed with protein, which increases the amount of waste nitrogen excreted.

Pigs leave fattening units at weights that meet the requirements of a processor contract or marketing outlet, normally about 80 – 90kg liveweight for pork and cutters, and 100 – 110kg liveweight for bacon.

Many producers now operate systems where whole pens are emptied at the same time. This ‘all in – all out’ system increases the importance of feeding regimes and controlled environments, and with proper management individual batches of pigs can be produced within a 10kg weight range.

After destocking, accommodation is thoroughly washed out and disinfected before the next batch of animals is brought in.

To minimise risk of disease, a range of precautions are normally implemented: access to units is limited to

personnel working on the unit; and no lorries are allowed to enter the unit. Feed lorries usually load bins situated inside the unit from outside the perimeter, and pigs are loaded onto lorries using a loading ramp on the perimeter of the unit, and staff are not allowed to bring any pork products onto the unit for their own consumption.

Transport

Transport is required between all stages of the supply chain, feed from mill to farm, semen from breeding companies to farms, gilts and boars from breeding companies to farms, piglets from breeding to growing and finishing units, finished pigs to processing, and waste from processing to rendering plant.

When pigs reach their target weight, which is normally between 90kg and 110kg, they are removed from the production site and are transported in specialised livestock transporters to a processing plant. The conditions on transporters are critical to avoid stress in the animals, which has meat quality as well as welfare implications.

Specialist livestock transporters move animals from breeding to growing farms

Processing

Processing is technically the most complex sector of the pig meat supply chain, the main input of which is live pigs and outputs are primal cuts or jointed meat. The remaining inputs to the system are: energy, to light and power the plant; water for washing; disinfectants and other chemicals; and packaging. The secondary outputs are animal by-products, dirty washing water, packaging and emissions to atmosphere.

Pigs are received at the processing plant and directly placed into lairage where they are allowed to recover from transport stress, the increased levels of adrenaline that occur in transit can have an adverse effect on meat quality. The lairage may be equipped with spray cooling systems to assist in reducing stress in the animals. Pigs are normally allowed to rest for at least an hour and usually longer, depending on travel time between farm and plant, before being guided into the stunning area. From time-to-time pigs are kept in the lairage overnight, during which period they are given feed and water, and may be provided with bedding material.

There are two types of stunning system in use at processing plants; electrical and gas. The electrical system is further split into manual, on-floor stunning, and manual or automatic, restrainer-conveyor systems. The number of pigs handled in these systems ranges from 180 to 440 pigs per hour.

Once stunned, the pigs are hung on shackles and immediately stuck in the throat to kill and allow the carcase to bleed.

After a short bleeding period, the carcase is dipped into a scald tank to loosen hair after which the carcase is cut off the shackle and dropped into a tumbler, in which the majority of hair is removed.

After being de-haired, the carcase is hamstrung on a second line, which first leads into a rubber-fingered flail and on to gas burner to remove residual hair. Carcases are then polished and manually finished to remove charred hair.

Clean carcases move on to evisceration, the ‘plug’ is removed and the carcase split from the throat up to reveal the digestive tract and internal organs, which are removed and split into red and green offal. At this stage all red offal is carried on the same line, and green offal on a parallel line so that the Meat Hygiene Service can inspect it, together with the carcase for any disease or abscesses.

At this stage, the carcase is split down the spine to the base of the skull.

Red offal, together with the tongue, are separated and cooled prior to cutting into component parts for human or animal consumption.

Gut contents are emptied and sent for disposal and body material is taken for rendering and subsequent destruction.

Split carcases are then further inspected by the Meat Hygiene Service for cleanliness and for conditions such as jaundice and broken limbs, which may or may not cause the carcase to be rejected. Rejected carcases are sprayed blue and sent for rendering, destruction and subsequent disposal. Other carcases are suitably treated and returned to the line for further processing.

At this stage, carcases are cleaned out and graded for the amount of backfat, producers are currently paid according to the level of backfat- commonly know as P2 measurements, the front trotters are removed and placed in chillers for around 24 hours.

Chillers reduce the carcase temperature to around 2°C to ease cutting and jointing; it is an EU requirement that pig carcases leave the chilling room at no more than 4°C.

After the sides have been separated by the removal of the head, the carcases are cut into shoulder, leg, loin and belly, the primal cuts.

Depending on the processing plant, the primal cuts may then be sent elsewhere for further jointing, or are jointed on a subsequent section of line.

Rendering and Pet Food

Waste animal material from processing plants is collected and sent for rendering and used in pet food manufacture; rendering may be used as a means to reduce the volume or moisture content prior to final disposal or to produce ingredients for pet food.

Such waste materials fall into one of two categories, either Category 2 or Category 3 as defined in the EC Common Position Document No12/2002, dealing with animal by-products not intended for human consumption.

Category 3 materials consist of parts of slaughtered animals that are fit for human consumption, but are not intended for human consumption, parts of slaughtered animals which are rejected as unfit for human consumption, but are not affected by any signs of diseases transmissible to humans or animals and derive from carcases that are fit for human consumption.

Following appropriate processing, Category 3 materials are used in the manufacture of wet or dried pet foods, as well other animal feeds or some other, industrial use; or it can be applied to agricultural land. The Balance takes into account that proportion of the material flow that goes on to be rendered or processed into wet or dried pet food.

Category 2 materials consist of manure and digestive tract contents; solid waste separated from wastewater, pigs that were dead on arrival at the plant, and veterinary condemnations.

These latter materials are not fit for consumption and are processed prior to use as a fuel or subject to restrictions, in compost, which may be applied to agricultural land as fertiliser or soil-improver. These materials are either included in the waste stream from

The study deals with the following areas as defined by the Standard Industry Classifications (SIC):

A01.23	Farming of swine
D15.11/1	Production and preserving of meat, slaughtering of animals other than poultry and rabbits
D15.11/2	Animal by-product processing
D15.71	Manufacture of prepared feed for farm animals

Waste production is not classified within the SIC system, and in order to provide input to Mass Balance UK waste produced within the pig industry has been classified within the following categories of the UK Waste Classification System:

22.07.00 Animal matter

22.07.01 Waste food – animal or mixed including – waste food that contains animal matter, canteen waste

22.07.02 Whole and/or part animals including – blood, skins, bones, dead animals

22.07.03 Excreta including – washing or processing liquors contaminated with blood or excrement

22.08.00 Animal or vegetable fat, wax, grease

22.08.01 Animal fats oils, waxes and/or grease including tallow

25.02.00 Waste from biological processes other than sewage treatment or composting

25.02.01 Wastes from biological treatment of effluents or wastes including – biological sludge from the treatment of effluents from the food industry, slaughtering excluding – sludge from physico-chemical treatment, untreated settled solids.

Table C.1.1: Standard industry classifications codes and UK waste industry classification codes

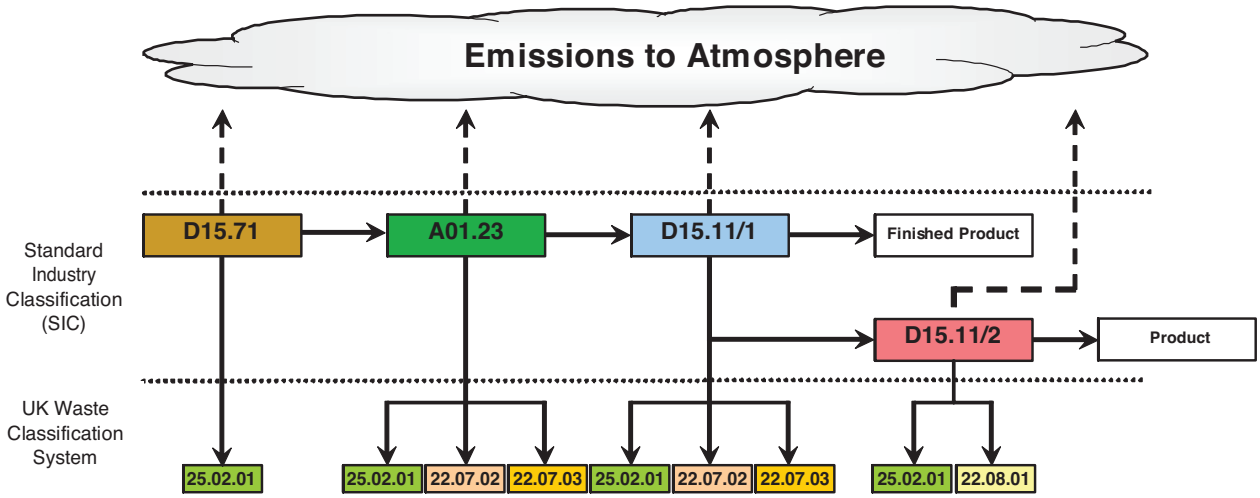


Figure C.1.1: Pig industry SIC and UK Waste Classification System flow chart

the processing sub sector, or are accounted for as wastes from the rendering sector. Category 1 material is unlikely to arise from pigmeat processing.

C.1.2 Inputs, Outputs - the Balance

Whilst the primary aim of the study is to quantify the flows of carbon (in the form of energy and emissions) and water through the sector, in the course of gathering data, all significant materials flows have been quantified to enable the data to be used within the framework of Mass Balance UK.

The accounting period for the mass balance of the UK pig industry is taken as January to December 2003, and the flows quantified by the project are as follows:

Initial Stock - for mass balance purposes, this report assumes that no finished product or raw materials existed within the sector at the beginning of the study period, or remains at its end. However, account is made of the number of pigs existing on farms at the beginning and end of the period, the difference being the change in population during the year.

Imports - the quantities of materials brought into the pig sector from other sectors. The primary imports into the sector are the ingredients of feedstuffs, bedding, energy, water, packaging, process chemicals and medicines. No account is taken of the inputs required to produce or transport materials such as cereals, oils and packaging to production sites, the environmental costs of which are assumed to be associated with other sectors such as arable farming and packaging production.

Produced/extracted - no raw materials are extracted, or produced in the sector.

Exports - the primary exports from the sector are primal cuts and joints that are either sent for retail sales or use in the catering sector. The bulk of exports are fresh chilled, but some account is made for the supply of frozen product for sale in either the home or export market. Environmental exports from the sector can be directly set against imports of feed, water and energy.

Embodied - the only materials embodied in the sector are the packaging used to protect products in transit, on the supermarket shelf and in storage awaiting consumption, and some water which is taken up by meat during processing.

Transformed - no materials are transformed by any of the processes in the sector.

Recycled/recovered - some of the materials arising from the sector have been identified as being transferred for use in another sector. Some waste arisings in parts of the sector are taken for recycling, for instance paper and metals, are recovered for other uses, and slurry from farms can be used in methanogenesis, with the gas arising being used for power generation, or applied to land as a fertiliser.

Recycled and recovered material can be set directly against imports such as feed, bedding and packaging.

	Study	UK figures	%
Compound feed (tonnes)	1,286,754	1,560,000	82.5%
Breeding herd (total numbers)	951,534	9,177,000	10.4%
Growing herd (total numbers)	508,530	9,002,000	5.6%
Finishing herd (total numbers)	409,700	8,740,000	4.7%
Processed pigs (total numbers)	850,183	8,987,000	9.46%
Processed meat (tonnes) UK production	62,239	687,000	9.05%
Rending (tonnes)	242,190	220,000	110%

Table C.1.2: Proportion of the pigmeat industry surveyed

Disposal - the volume of material going for final disposal from the sector is relatively small, mainly comprising animal by-products that are unfit for human consumption, liquid effluents and some waste packaging materials.

Emissions - emissions from the sector are primarily to atmosphere and water, and include gaseous emissions from pig housing, dirty washing water discharged to sewer from several sub sectors and steam, comprising waste heat and water, from feed production and final processing. Emissions can be set directly against imports of protein, water and energy. However, no quantitative data exist for many of the emissions from the sector, and estimates have been made using information from research in the UK and elsewhere in the EU.

C.1.3 Data Gathering

The sample for study was identified with the aid of the National Pig Association, members of the project Steering Group and using existing trade contacts. Contributors included a representative number of small- and large-scale, indoor and outdoor producers, together with some organic producers. Of the companies and individuals approached, few outside the processing sector refused to participate in the project. It is estimated that the following proportions of the sub sectors making up the industry responded by providing information for one or more of the sub sector studies. It was originally anticipated that the response would be in excess of 25% for all sectors.

A series of five questionnaires was mailed to relevant potential respondents in the sub sectors and responses were made over a period of fourteen months. The sub sectors were as follows: feed mills; farms (identified by stages of production); processing; and rendering. A separate questionnaire was used to assess the impact of transport. The excessive time taken for responses to be made was primarily due to the complexity/unavailability of the data requested and change of personnel within companies.

The data gathered were input into a series of interactive MS Excel spreadsheets that allowed data to be verified as reasonable as it was recorded. Data quality queries where addressed as they arose and, where required, corrections made. The data were then manipulated to produce a range of benchmarks and information required for Mass Balance UK.

The regional distribution of sub sector activity within the pig industry is shown in Figure C.1.2. The response to the request to complete the questionnaires was good, although the processing division of a single large company failed to make any returns as promised at the outset of the project; this was due to matters unrelated to the project and outside the control of the contributor.

Overall, the responses account for 850,183 pigs produced in the study year, that is 9.46% of the UK's annual pig production; and 62,239 tonnes of finished product, that is 9.05% of UK production. Given the diverse nature of the sector and the sample, it is considered that this level of response makes the conclusions of the project relevant to the whole UK pig industry.

In addition to 687,000 tonnes of home-produced meat processed in the UK, a further 424,000 tonnes were imported for further processing and 74,000 tonnes exported during the study period, a net supply of 1,037,000 tonnes. Imports of pig meat have historically been derived mainly from Denmark and Holland, but other countries, outside the European Community,

where energy and labour costs are lower than in the UK, are likely to provide an increasing proportion of UK meat imports in the foreseeable future.

The distribution of farm units throughout the UK cannot be inferred from the responses received because individual units were not identified by location. The distribution of pig farms in the UK shown in the maps on Figure* is inferred from Defra data.

C.1.4 Data Validation

Data input into the spreadsheets for analysis were validated initially by comparison with industry standard performance data and subsequently with a rolling average of data input. Where significant differences were detected, the relevant respondent was contacted by telephone and the return discussed.

Many inconsistencies were identified in the course of data inputting, the main reasons for the differences were:

- misunderstanding of the questionnaire;
- use of the incorrect units;
- the production site being destocked during the study year; and
- the use of multiple husbandry systems on single sites.

Where possible, inconsistencies were corrected using revised information submitted by respondents; a significant amount of information was discarded as unusable. Much of the requested quantitative data was not readily available to all respondents and in some cases returns simply identified source and/or disposal route. For the purposes of the mass balance, quantitative data from the returns has been extrapolated to represent national consumption/production using national statistics.

C.2 Mass Balance Outputs

The acquisition of data for this mass balance was intended to make it possible to address all aspects of the sector and enable comparisons to be made between husbandry systems in the farming sub sector. However, the disparate nature of pig farms returning data has made it impossible to produce a comprehensive and valid set of comparisons as intended. Where possible, the analysis of the mass balance in the sub sectors laid out below includes comparisons between husbandry systems, primarily indoor and outdoor production. Where comparisons are not made, it is because there were insufficient data available of adequate quality to make a valid assessment.

C.2.1 SIC D15.71 Manufacture of Prepared Feed for Farm Animals

This part of the sectoral mass balance consists only of data relating to the manufacture of compound pig feed by the animal feed industry; it does not include home-produced feeds used on some pig farms; By- and co-products are not included in the Mass Balance because of lack of information regarding the total volumes fed to the UK pig herd.

The nutrient specification and meal equivalent formulations of liquid feeds are broadly equivalent to those of compound feed as shown in Figure C.2.1 below, although liquid feed formulations need to be adjusted for the individual analyses of co-product ingredients. Given the broad similarity between the two formulations, for the purposes of this balance the UK herd's consumption of pig feed is expressed in terms of compound feed; no account is taken of the use of co-products, which are likely to have significantly lower overall inputs in terms of energy inputs. The allocation of energy use in the original process from which co-products are derived is unclear, but it might be assumed that all energy use is allocated to the primary product, rather than to what is often perceived as a waste product.

Mills producing compound pig feed often specialise in the production of pig and poultry feeds, which are similar in constitution, both animals being monogastric. A small number of mills produce pig feed alone. Estimates of inputs for pig feed production were made where two species feeds were produced at a single mill, and this is allowed for in the Mass Balance calculation.

The total quantity of compound pig feed produced in the United Kingdom in the study period was 1,560,000

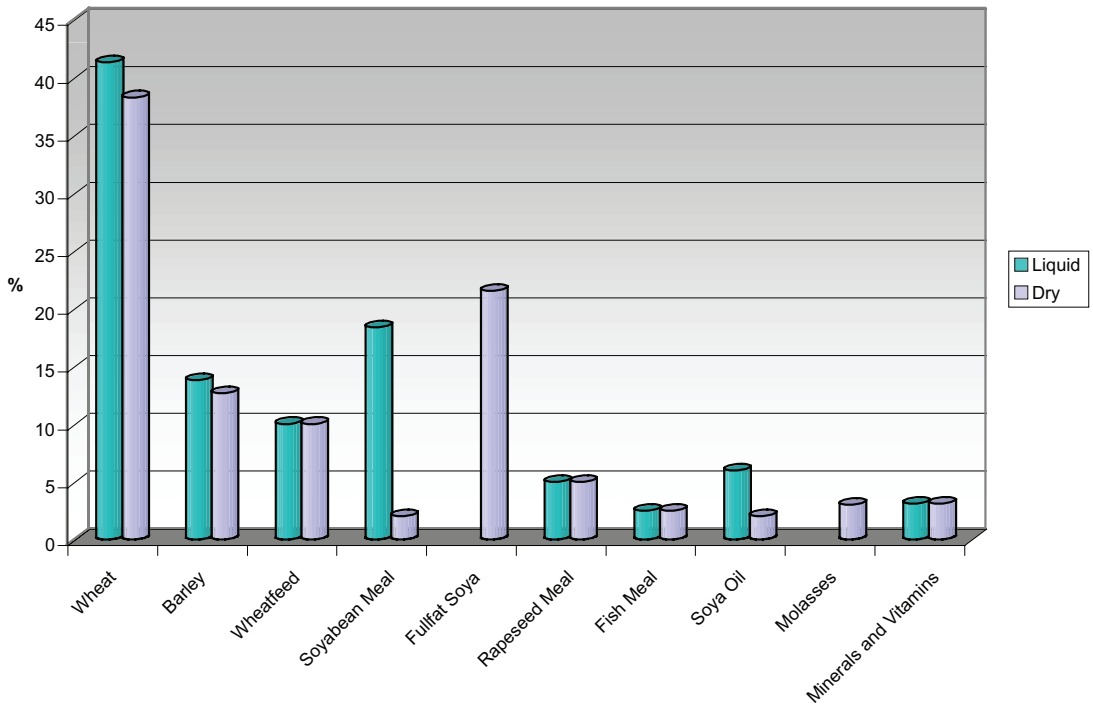


Figure C.2.1: Ingredients of Liquid and Dry Diets – Finishing Pigs (Source: p32 of Stotfold finishing pigs systems research)

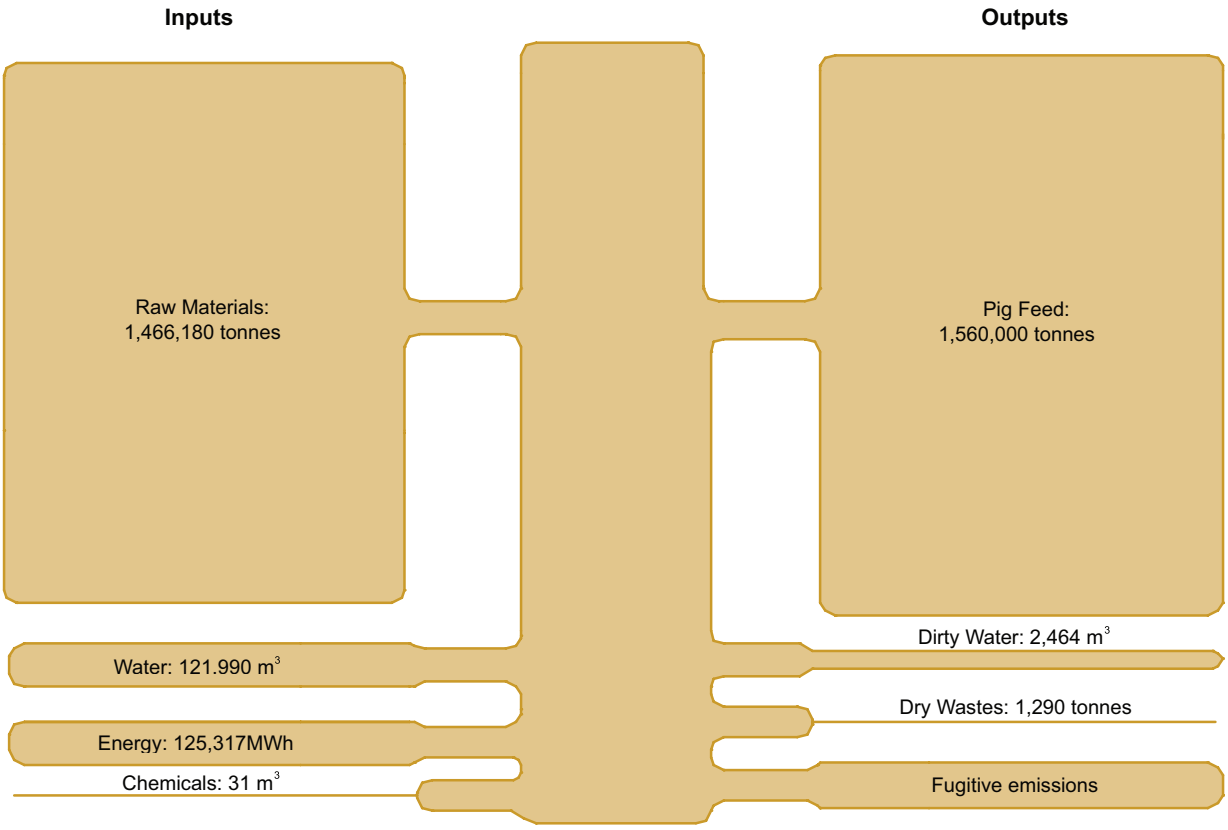


Figure C.2.2: Mass Balance of the Pig Feed Sector

tonnes. The quantity of compounded pig feed accounted for by the survey was 1,286,754 tonnes, that is 82.5% of all compounded pig feed produced in the UK; this reflects the size of the two main suppliers of compounded feed in the UK.

The balance of mass in the above table, excluding energy, shows an imbalance of 26,551 tonnes (1.7% of total inputs). This small increase can be probably be accounted for by an unidentified reduction in stock over the year and failure to account for hidden inputs to the process.

Of the total water input to the sub sector, only 44% is accounted for as dirty water arising from production; this mainly arises from lorry washing, the balance being lost to atmosphere as steam or embedded in the compound feed. Of the wastewater identified by respondents, less than 1% was applied directly to land, the remainder being either treated on site, or discharged to the public sewer.

The energy consumption per tonne of feed produced by the respondents was 80.33kWh, that is 125.32GWh for all feed produced. The breakdown of energy sources used in the production of pig feed is shown in Figure C.2.3.

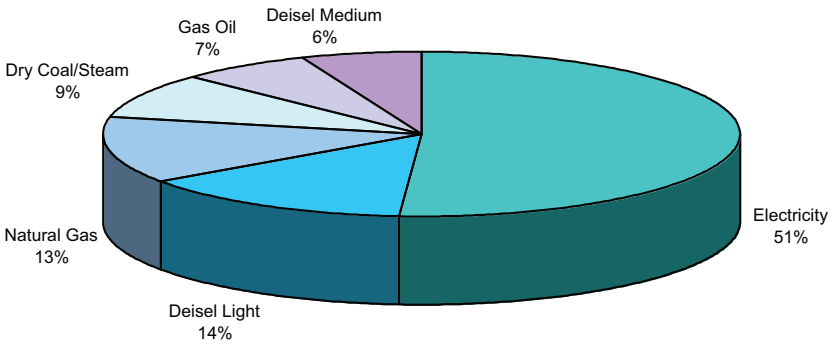


Figure C.2.3: Breakdown of energy sources used in the production of pig feed

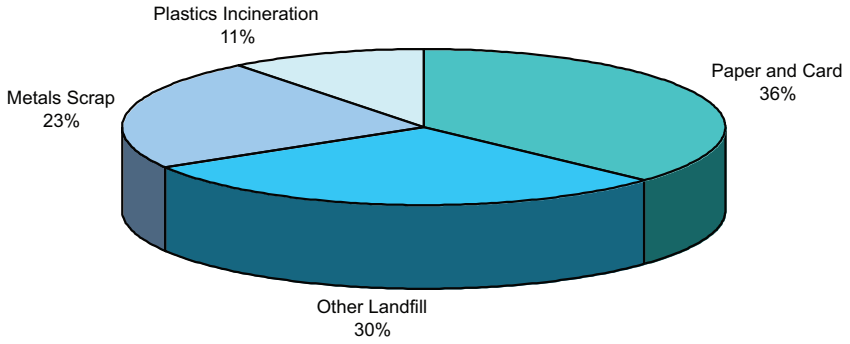


Figure C.2.4: Breakdown of the waste types arising from the feed sector

The sub sector used about 0.02 litres of chemicals per tonne of feed produced, mainly disinfectants, detergents and odour control agents; a total of 31.2m^3 for all UK production.

The volume of solid waste produced per tonne of pig feed was 0.82kg per tonne of feed produced. The majority of solid wastes produced arose from consumption associated with production; such as packaging and consumables. The inferred quantity of solid waste produced in the course of pig feed manufacture was 0.851kg/tonne, a total of 1,327 tonnes. The chart below shows the breakdown of waste types produced and their fate in terms of disposal to landfill or recycling.

C.2.2 SIC A01.23 Farming of Swine

This section of the report uses data derived from about 9.5% of UK production described under this SIC code.

For the purposes of this project, the farming of pigs is taken to include the breeding, rearing and growing of all pigs, including elite and grandparent stock, in the United Kingdom.

The number of pigs surveyed was related to the total number for the period taken from Defra statistics and overall consumption and outputs for the UK sector inferred from that relationship.

The number of pigs slaughtered in the UK during the study period, as identified by Defra was 8,987,000, including cull boars and sows.

The output from this sub sector identified by the survey was net of mortality on the farm, but included Dead on Arrivals and slaughterhouse rejects, which are accounted for in the transport and processing sections of the Mass Balance respectively. In the absence of a direct comparison between Defra data and gathered data, calculations for this section of the Mass Balance are based on the number of weaners produced on UK farms taken from Defra statistics.

The Breeding Herd

For the purposes of this report, the 'breeding' herd has been limited to units carrying sows, gilts, boars and weaners up to 7kg. Where separate data could be derived from returns from combined units that included a breeding component, the relevant information has been included in the balance. A comparison between indoor and outdoor units has been undertaken.

The total number of weaners produced in the study year by the farms making returns was 951,534. The total number of weaners produced by the UK sector in the survey period was about 9,177,000 animals; that is 10.4% of UK production.

The majority of the imbalance between inputs and outputs in this sub sector are likely to be accountable as fugitive emissions of gases, heat and water vapour from pig accommodation, which account for 12.13% of emissions. A very small number of pigs in the breeding herd are fed on co-products, which are not accounted for in this balance.

Energy use in the sub sector is divided between sources as shown in the pork pie chart C.2.6.

The Growing Herd

For the purposes of this report, the 'growing' herd has been limited to units carrying pigs between 7kg and 35kg. Where separate data could be derived from returns from combined units that included a growing

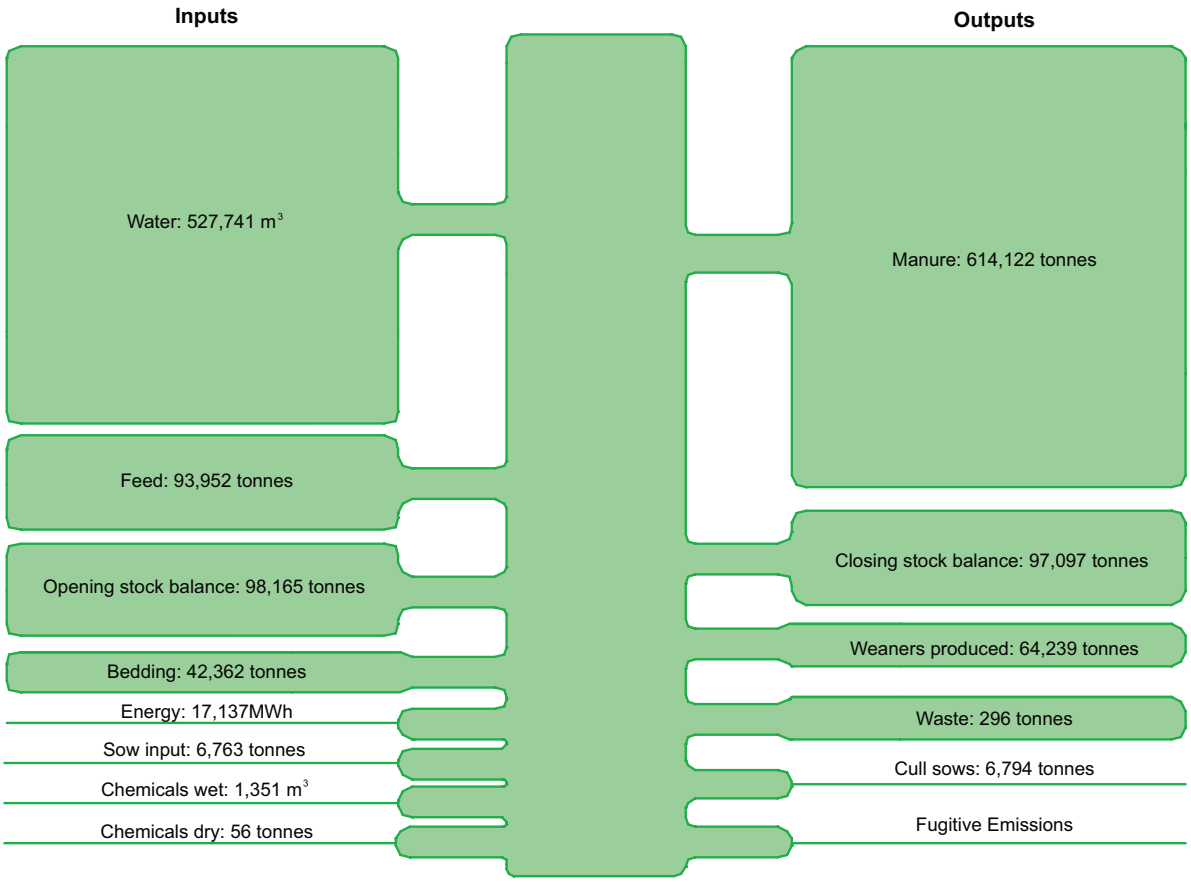


Figure C.2.5 Mass Balance of the Breeding Herd

component, the relevant information has been included in the balance. A comparison between indoor and outdoor units has been carried out.

The total number of identifiable growing pigs produced by the farms making returns was 508,530 animals. The total number of growers produced by the UK sector in the survey period was in the region of 9,002,000 animals; that is 5.6% of UK production.

The unknown influence of feeding co-products to an unknown proportion of this part of the UK herd makes it impossible to make any accurate assumptions from these data.

The Finishing Herd

For the purposes of this report, the 'finishing' herd has been limited to units carrying pigs from 35 - 110kg liveweight. Where separate data could be derived from returns from combined units that included a finishing

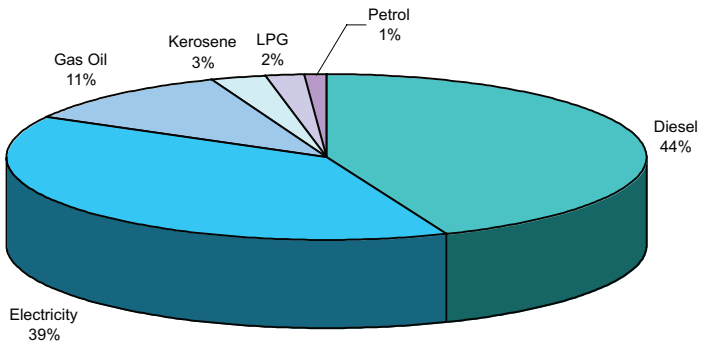


Figure C.2.6: Energy Use in the Breeding Sector by Source

component, the relevant information has been included in the balance. A comparison between indoor and outdoor units has been carried out.

The total number of finishing pigs produced by the farms making returns was 409,700. The total number of pigs finished in the UK sector during the survey period was about 8,740,000 animals; that is 4.7% of UK production.

A significant proportion of the UK finishing herd are fed on diets containing up to 100% co-products. In order to overcome this, in the finishing herd the quantity of co-products used has been estimated assuming a feed conversion ratio of 2.6:1.

All Pig Growing

The diverse nature of the UK pig herd has made it difficult to obtain representative samples of the individual components of the farming sub sectors; similarly, it is reasonable to question the typicality of the overall sample used in this study.

However, it is impossible to state even approximately what mix of indoor and outdoor, ACNV and controlled environment housing, starting and finishing weights, and environmental/production performance etcetera makes up the UK pig-farming sector. Therefore, given the diverse nature of responses received, it may be reasonable to assume that the data obtained as part of this study are as, if not more, representative as any model using 'standard' data.

'All Pig Growing' takes into account the inputs and outputs of the entire pig farming sector, from elite breeding units to finishing units, based on Defra statistics for 2003, using environmental performance data derived from responses made as part of this study.

Figure C.2.9 shows the Mass Balance of the UK pig herd.

The proportion of the UK pig herd represented in this balance varies with each of the development stages being considered; therefore the statistical validity of data obtained during the study also varies. The balance shown should only be taken as an impression of the general relationships between inputs and outputs,

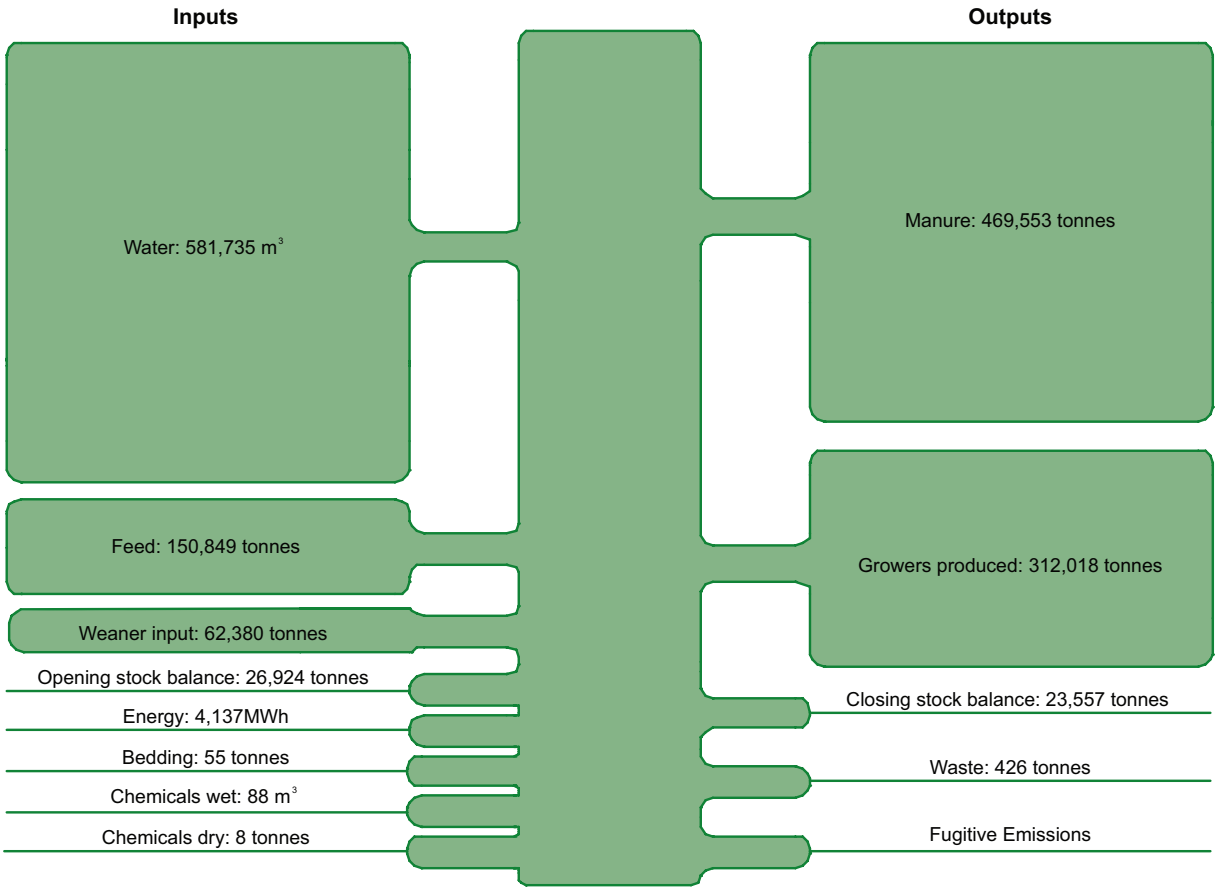


Figure C.2.7: Mass Balance of the Growing Herd

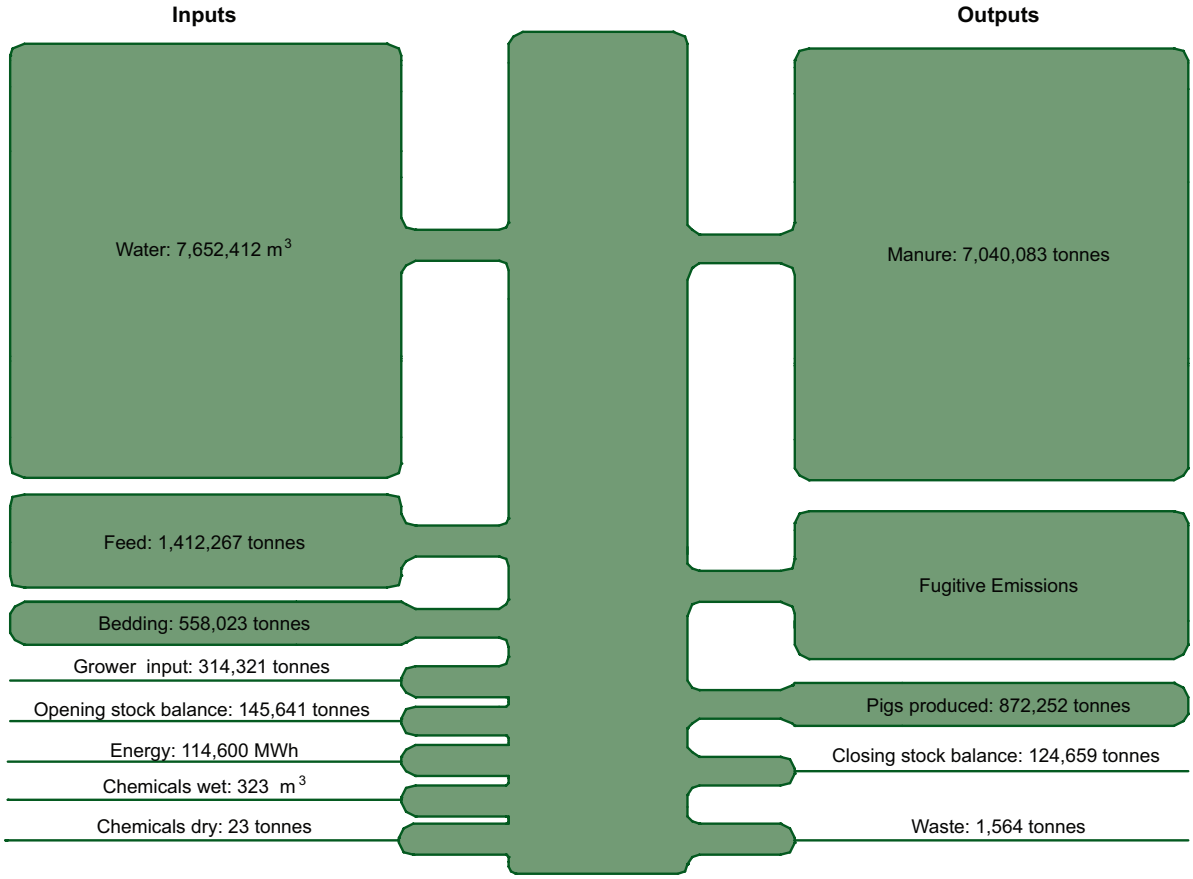


Figure C.2.8: Mass Balance of the Finishing Herd

rather than an accurate representation. A number of influences on inputs and outputs are discussed below.

When co-products are included in the balance, 28.56% by weight, some 3,470,000 tonnes of the materials input are not accounted for in the outputs. These fugitive emissions include gaseous emissions, carbon dioxide and other, nitrogenous, gases, moisture and heat from stock. No attempt has been made to model heat losses at any stage of the pig farming sub sector.

The inputs and outputs do not reflect precisely the aggregate inputs and outputs of the components of the herd as expressed in the breeding, growing and finishing sections above, because of the inclusion of the elite and grandparent stock in this section, and also because of the use of a larger sample in the baseline calculation of resource use and waste generation per unit of production.

Energy use in the farming sub sector is principally related to heating and ventilation of buildings. A range of means of heating and ventilation exist. Generally, heating in houses can be either direct or indirect; heating can also be applied locally or to a whole room, local heating is advantageous because it is aimed at where it is needed.

Direct heating can be by either heating elements built into the floor or radiant elements above the pig lying area. Room-scale heating can use preheated air brought into the building through a heated passage, to reduce fluctuations, or heating of air in the room.

Direct heating uses:

Gas
– infrared; air heaters; or radiation convectors; and hot air blowers, or

Electricity
– radiators such as light bulbs or ceramics; and
– electric floor heating on matting or in floor; and
– hot air blowers

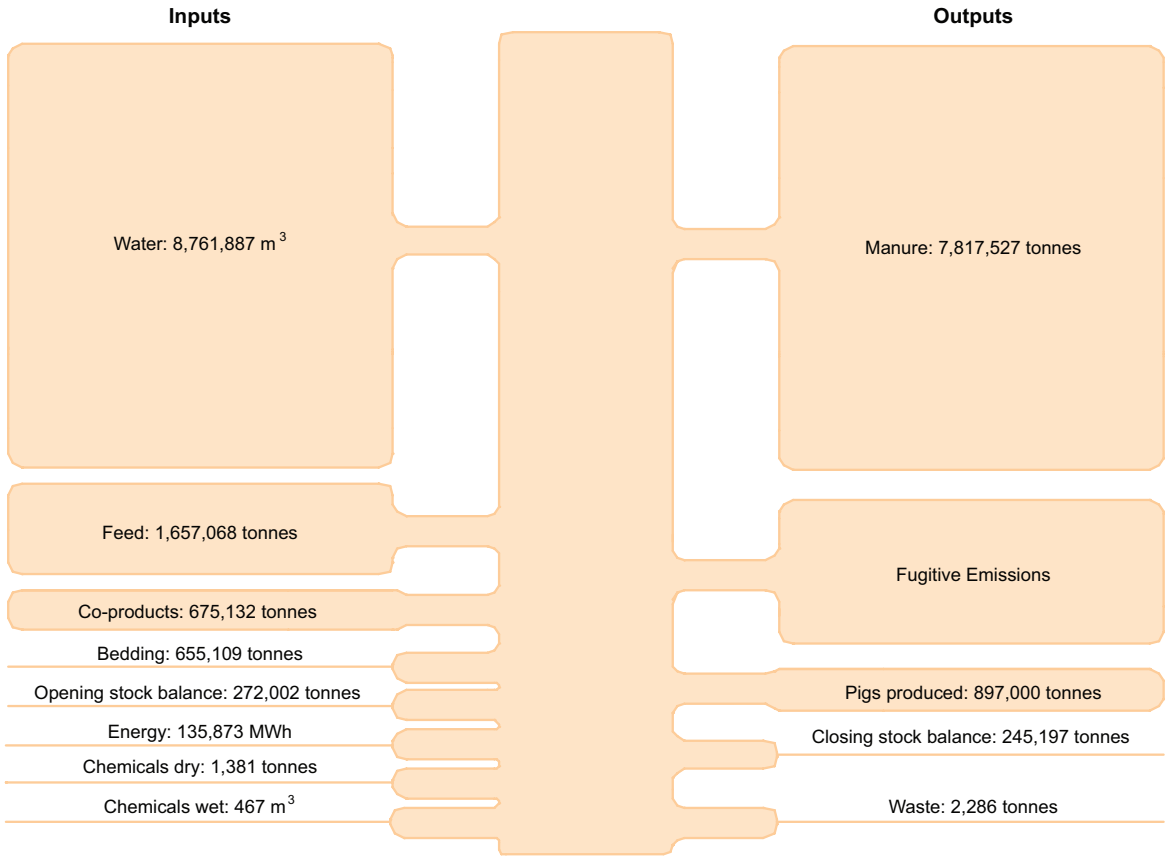


Figure C.2.9: Mass Balance of the UK Pig Herd

Indirect heating is directly comparable with domestic central heating, using boilers of a wide range of efficiencies to produce hot water or air, which is delivered to the area of need by pipe or duct.

Energy is also used to drive fans in accommodation where forced ventilation is used. Of the respondents that provided information about the types of ventilation used in pi g accommodation, 73% of the floor area was naturally ventilated, 2.5% had automatically controlled natural ventilation and 24.5% fully controlled ventilation.

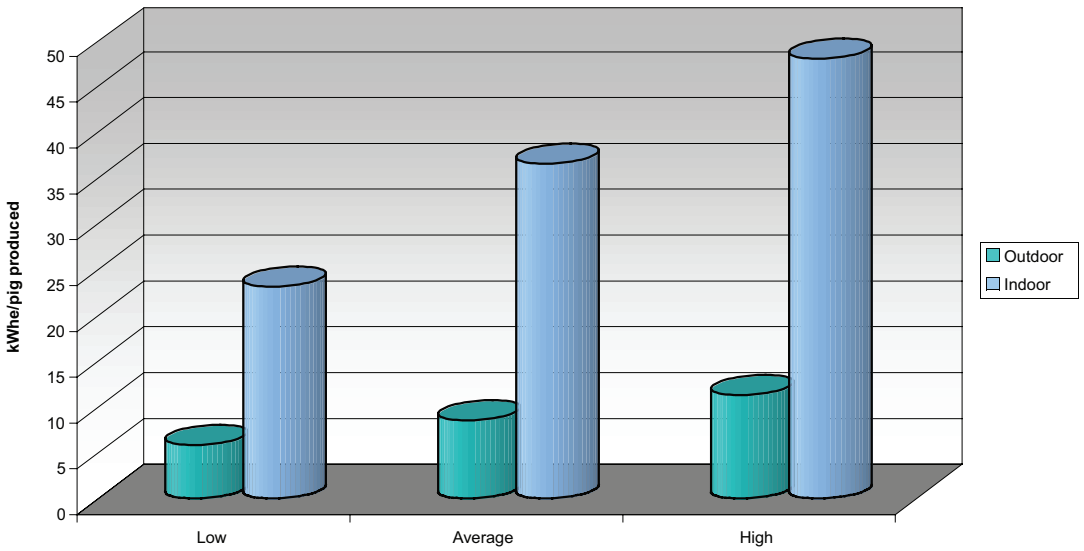


Figure C.2.10: Energy Consumed - Indoor & Outdoor Herds

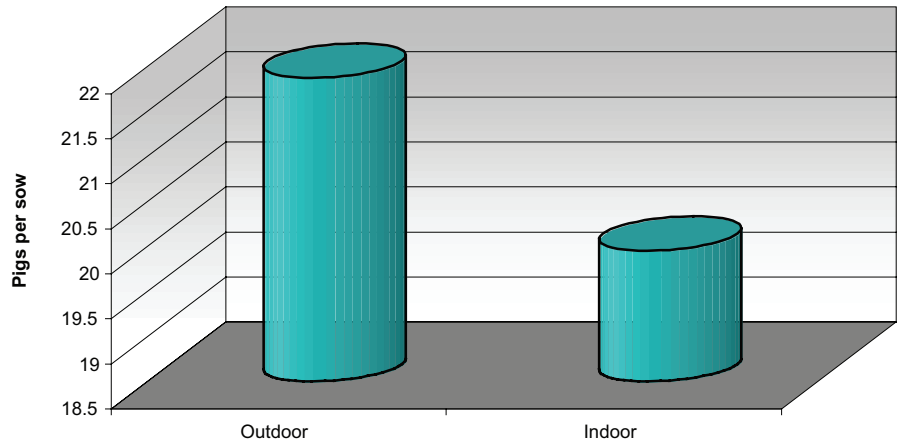


Figure C.2.11: Pigs per Sow - Indoor & Outdoor Herds

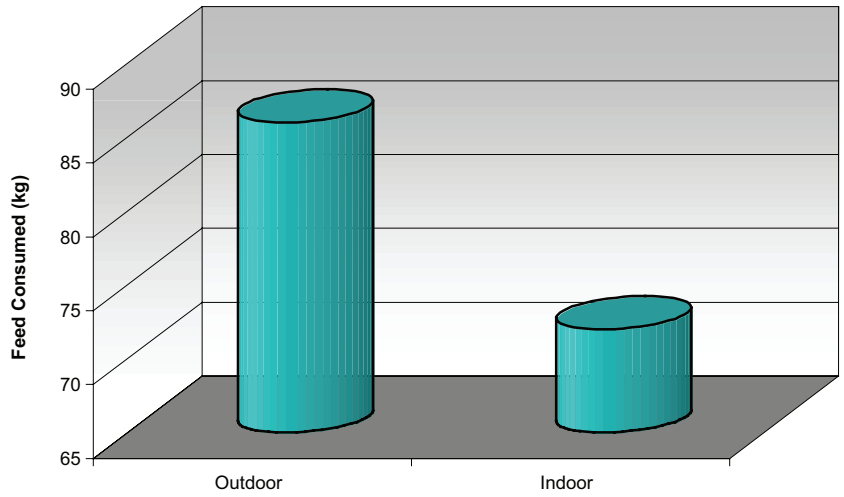


Figure C.2.12: Annual Feed Consumption - Indoor & Outdoor Herds

The sample floor area was heavily biased towards finishing pigs, the distribution being 12.7% sow accommodation; 18.1% weaner; 11.3% grower; and 57.9% finisher.

Artificial ventilation is always driven by electric fans placing the building under either positive or negative pressure.

Positive pressure systems draw air from atmosphere and allow air to exhaust through outlets. Incoming air can be heated before being distributed but this adds to costs and can result in cool draughts close to inlets.

Negative pressure systems, which draw air in through the sides of the building and exhaust it through roof-mounted fans, are little used in the UK.

The structure of this study allows a comparison between the performance of outdoor and indoor herds on a variety of levels. Figure C.2.10 shows the amount of energy consumed (including fuel for vehicles) to produce a weaner on indoor and outdoor units. It is quite clear from the chart that the energy burden of a pig produced indoors can be up to four times that of an outdoor-produced pig; the chart also shows the wide variation between indoor units.

Figure C.2.11 compares the number of weaners produced per sow on indoor and outdoor units. The major feature of the chart is that outdoor sows produce on average about 9% more piglets per year than an indoor sow. Whilst some of this additional performance is the product of breeding, the outdoor environment undoubtedly has health benefits not found in indoor units. For instance, the incidence of scouring in young piglets is much lower on outdoor units than indoors.

Farm Type	Average	Indoor	Outdoor	Combined
Breeder/Weaner	0.91	-	0.91	-
Breeder/Grower	1.29	0.48	1.67	-
Breeder/Finisher	5.33	6.57	-	1.35
Finishing only	0.86	0.86	-	-

Table C.2.1 Average Distance travelled per pig produced (km)

The negative aspect of outdoor pig production is shown in Figure C.2.12, which compares feed consumption of indoor and outdoor herds.

C.2.3 Transport of within the Pigmeat Sector

For the purposes of this report, transport within the sector includes all vehicle movements concerned with the movement of finished animal feed to farms, inter and intra farm vehicle movements and transport of finished and cull stock from farm to the processing plant. Vehicle movements associated with the administration of activities has not been included, although the data were collected.

The questionnaire sent to businesses related the distance travelled by vehicle types to sub sectors, and this information has been extrapolated to arrive at the overall distances travelled within the sector. The data provided by respondents was accurate, but it is not known how representative the data are in relation to either individual sub sectors or the whole industry.

Feed

In the feed sub sector as identified in the returns, the total distance travelled by vehicles was just less than 17.25 million kilometres, and 6.7 million litres of diesel used. Given averages of 6.84km travelled, and 2.65

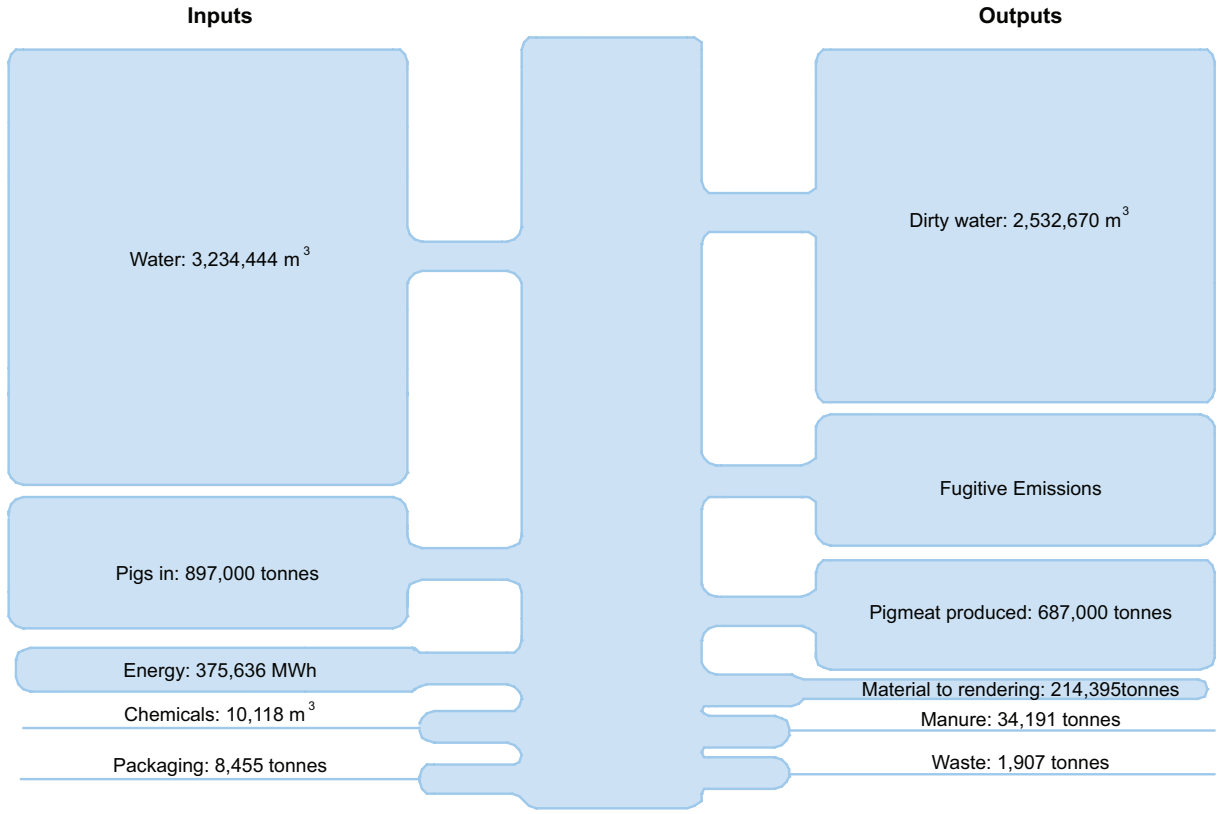


Figure C.2.1.3: Mass Balance of the Pigmeat Processing Sector

litres consumed per tonne of feed produced, this equates to national totals of almost 10.7 million kilometres travelled and 4.14 million litres of fuel consumed.

Farming

The number of usable responses received limits the value of the figures for the farming sub sector. Given the assumption that all of the returns received were accurate, Table C.2.1 shows the average distance travelled per pig produced using farm transport (including travel to abattoirs).

The major waste product attributable to the transport sub sector, other than lorry washing water, which is accounted for in the processing section of the balance, is mortality en route between farm and factory. Generally, this figure is taken to be in the region of 0.07%, and so is minimal.

C.2.4 SIC D15.12 Production and preserving of pig meat

DA 15.11 Production and Preserving of Meat

DA 15.11/1 Slaughtering of Animals other than Poultry or Rabbits: This subclass includes:

- production of fresh, chilled or frozen meat, in carcasses

- production of fresh, chilled or frozen meat, in cuts

This section covers the production and preserving of pig meat as described in the SIC Code. That is, as the production of fresh, chilled or frozen meat in carcasses and cuts.

This sector does not include the further processing of meat, or any of the below-mentioned products, which are classified under SIC Code D15.11; the production of ham, bacon, sausages and pies, prepared meals, and preparations of meat, meat offal or blood. It does, however, include the meat and offal used in these products.

Meat that is subsequently used in the production of added value products is kept in cool storage until it is required for further processing.

The calculation of water usage and wastewater arising during the production and processing of pig meat was not straightforward. It was impossible to make any general conclusion regarding the volume of water used – or waste water arising – per tonne of meat produced.

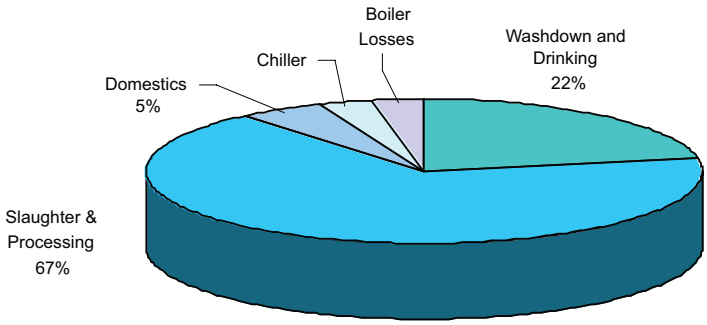


Figure C.2.14: Breakdown of Water Use in a Meat Processing Plant

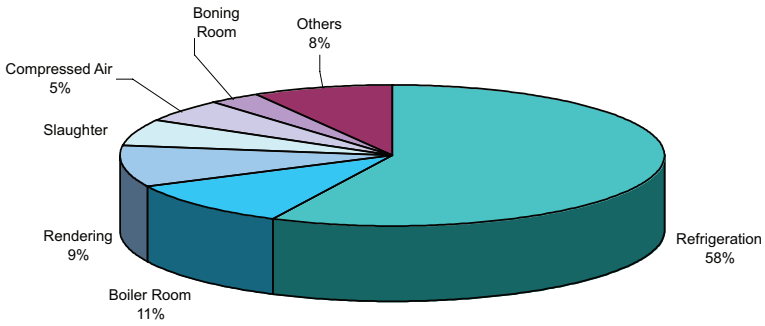


Figure C.2.15: Breakdown of Energy Use in a Meat Processing Plant

The reason for this was the wide range of input and output volumes per tonne of meat produced given in returns and the apparent lack of any relationship between production volumes and water in or waste out. The variation in flows may also be the result of differences in practices adopted in processing plants, for instance a plant that has undergone a thorough water audit is likely to have a water consumption significantly lower than one where hoses are left running by default.

The survey of pig processing captured data from 9.05% of UK production. The Defra data for pig slaughterings in 2002 shows a total of 9.4 million animals, producing a dressed carcase weight of 687,000 tonnes; an average dead weight of 73kg. This statistic does not include offal or pigs that were rejected as unsuitable for human consumption post-slaughter; for the purposes of this project such animals are classed as 'Meat Wastes'.

For the purposes of this study, 'dry wastes' include: paper and card; plastics; glass and metal. 'Dry wastes' are solely derived from discarded packaging such as wrapping from deliveries of food containers and consumables' containers.

The materials influx of any food processing plant is dominated by water for washing and cleaning, energy for cooling meat and heating water, and chemicals for disinfection and for use in cooling plant. Figure C.2.14 shows the approximate breakdown of water use in a meat processing plant.

Cooling is necessary initially to reduce carcase temperature to ease cutting and subsequently for conservation, as chilled or frozen primal or retail cuts.

Hot water is used for cleaning down and at various stages of production, such as for scalding.

The staged development of many pigmeat-processing plants is common. As advances in technology and changes in environmental and welfare regulation have progressed, plants have been improved and adapted. Furthermore, many plants have been adapted for single species production from formerly multi-species sites. This has resulted in very few truly integrated slaughter/cutting plants, capable of exploiting fully technology that might bring about savings in energy and other resource use.

The values underlying the above statistics have been input to Mass Balance UK.

The principal opportunities for significant reductions in the volumes of wastes arising from the sector lie in two areas. The recovery of low -grade waste heat from refrigeration plant for use in the pre-heating of water destined for steam raising and the use of water in washing-down food production areas. Whilst water reduction can usually be achieved through management measures, the integration of refrigeration and steam raising plant may require a significant amount of capital investment as well as redesign of plant layout.

Figure C.2.15 shows a typical of typical energy consumption according to activity in a pork processing facility.

C.2.5 SIC Code D15.11/2 Animal By Product Processing

There are 25 dedicated rendering plants across the UK, processing around 1.75 million tonnes of material per annum, about 15% of which is derived from the pigmeat sector.

The survey returns account for 242,190 tonnes of waste from the pigmeat sector. Based on the total number animals processed in the sector, it is assumed that the total volume of pig-derived material processed in 2003 was about 220,000 tonnes, made up of waste from slaughter, blood, and mortalities; the study accounts for about 110% of the UK throughput of pig waste.

This excess might be accounted for by mortalities, animals that were dead on arrival at the processing plant, and carcases that were condemned as being unsuitable for human consumption at the processing plant. This material is normally rendered separately from material from carcases fit for human consumption, and the resulting high dry matter material incinerated. It is also very likely that a significant proportion of the additional volume is water.

The remaining material is waste from pigs fit for human consumption, and therefore suitable for inclusion in pet food or other animal feedstuff.

In addition to rendered 'waste' meat and bone, blood arising from pigmeat production has uses other than for the manufacture of black pudding. Pig blood is used in the manufacture of spray-dried and other porcine blood products, which are used as therapeutic products in the treatment of diabetes, haemophilia and other

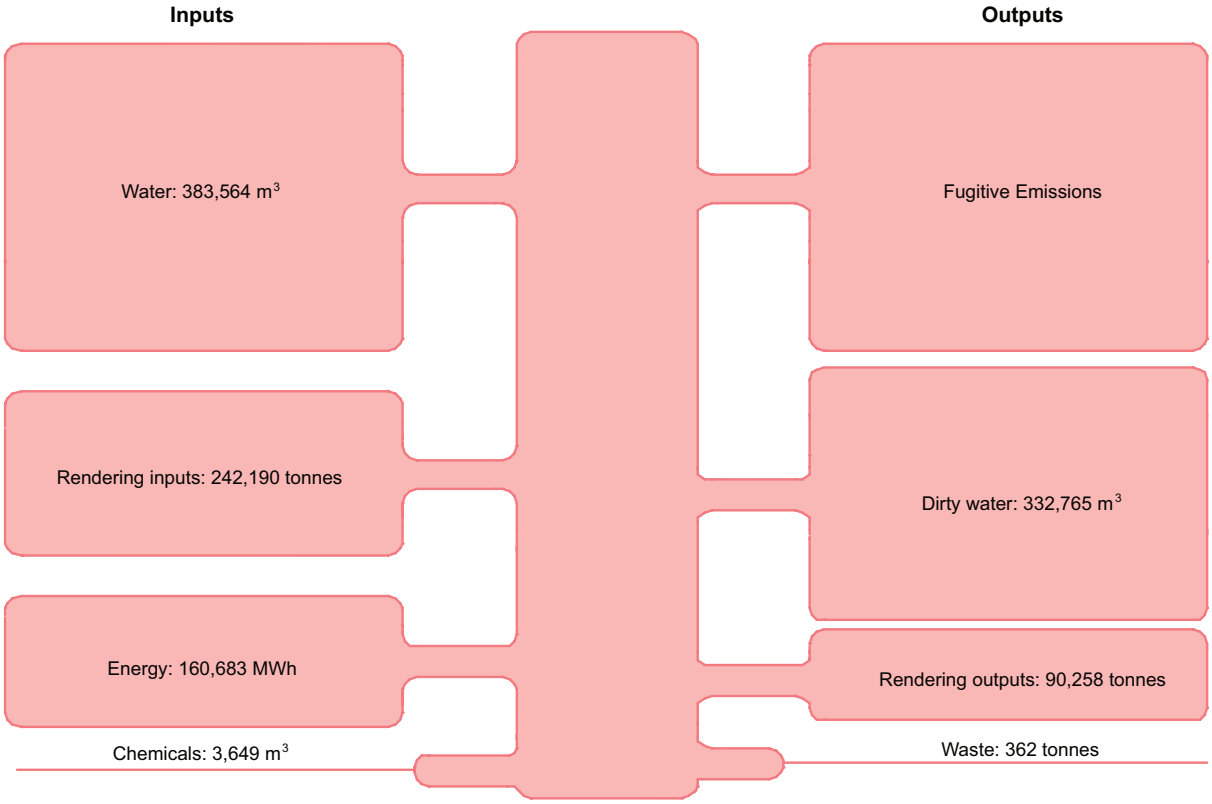


Figure C.2.16: Mass balance of the Pigmeat rendering sector

coagulation disorders, and HIV Aids. Porcine tissue is also used in replacement heart valves for human patients.

Some material, such as heads feet and viscera, taken from carcases deemed fit for human consumption is ground and cooked or rendered prior to inclusion in pet food; raw pork cannot be fed to animals. Other material, waste fat, some hair, heads and viscera, is ground and cooked to destroy pathogens and reduce moisture. The component products (pig fat and meal) are then separated and taken for further treatment based on end use. Depending on the source of the waste from which the fat and meal are derived, tallow and pig fat are used in animal foodstuffs and as an oil replacement in combustion. Meal is used in pet food manufacture and as a solid fuel replacement in power generation and cement manufacture.

The total amount of raw materials from the pig sector rendered in the UK in 2002 was about 630,000 tonnes.

The outputs from the sector generally relate directly to the volume input in the following approximate proportions: 11% pig fat or tallow; 21% meal and 68% water vapour; see Figure C.2.17.

The bulk of water vapour arising from the rendering operation is condensed out and discharged to sewer or applied to land with any non-condensable vapour discharged to atmosphere via an odour control system. Condensate from rendering contains a significant

Everything But The Oink

It is often said that that every bit of the pig, bar the oink, has its use. Here are some uses of pig by products – other than as food:

- High Quality Hair and paint brushes
- Glue (blood, bones and skin)
- Buttons (bone)
- Gloves and Shoes (Skin)
- Porcelain Enamel (Bonemeal)
- Blood Plasma and Haemoglobin
- Replacement Body Parts
- Cosmetics (Fat)
- Skin Grafts (Skin)
- Fabric softener (Fat)
- Nitroglycerine (Fat)
- Matches (Fat)

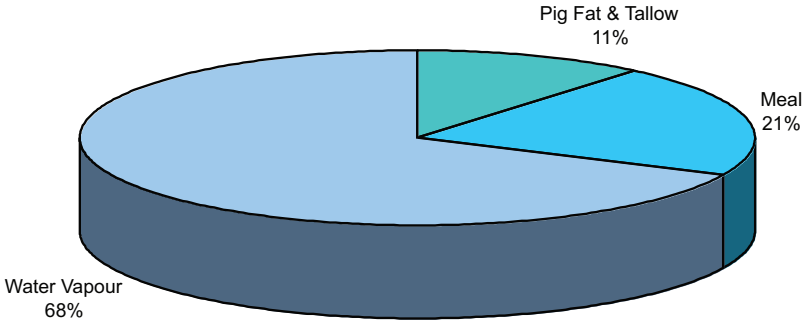


Figure C.2.17: Breakdown of Rendered Products

quantity of nitrogen, the major source of which is protein in blood and meat particles. Historically, this has been applied to agricultural land untreated, but since 2001 it has to be treated to discharge standards set out in the Rendering (Fluid Treatment) (England) Order 2001, before being applied to land or disposed of via sewer or watercourses.

The sludge fraction of the waste arising from rendering plants may also be applied to land.

C.3 Ecological Footprint

C.3.1 Background

The ecological footprint of the UK pig industry provides an indicator of the aggregated natural resource consumption of the sector in the same way as established indicators may represent various aspects of the financial sector.

The footprint accounts for use of renewable resources only, and the consequential demands placed on the environment. Non-renewable resources are only accounted for by their impact on, or use of renewable, productive biological capacity.

The footprint of the pigmeat industry is defined as “the area of land and sea that would be required to maintain current levels of consumption, using existing technology.”

Since many of the environmental impacts of production in the UK are outside the country, footprinting effectively reallocates environmental pressures, first on the industry and subsequently down the supply chain to the consumer.

The footprint is measured in global hectares (gha), a standardised unit equivalent to a world-average productive hectare. Whilst no account is made for variation in productivity of land, such standardisation does permit global comparisons, between nations, regions, industries and companies.

The footprint includes land necessary to sequestrate carbon dioxide emissions from power generation and onsite fuel usage.

In 1999 the global average personal ecological footprint was 2.3gha, compared with a global capacity of 1.9gha. This value suggests that the human race is using more natural resources than can be sustained. The average personal ecological footprint in the UK in 2000 was 4.9gha, and in the south east of England 6.8gha; the

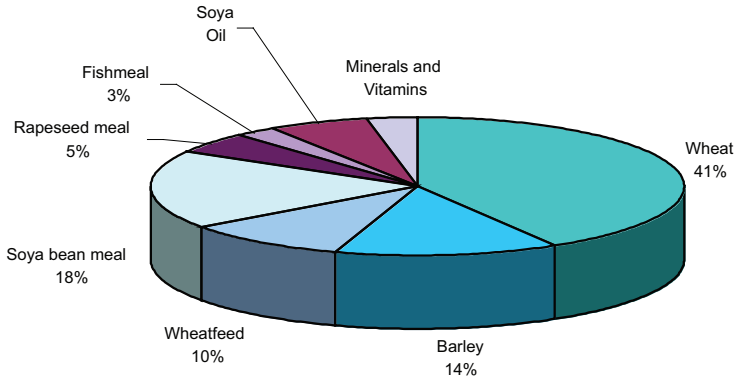


Figure C.3.1: Composition of Liquid Feed - Finishing Pigs (Source: Stotfold finishing pigs systems research)

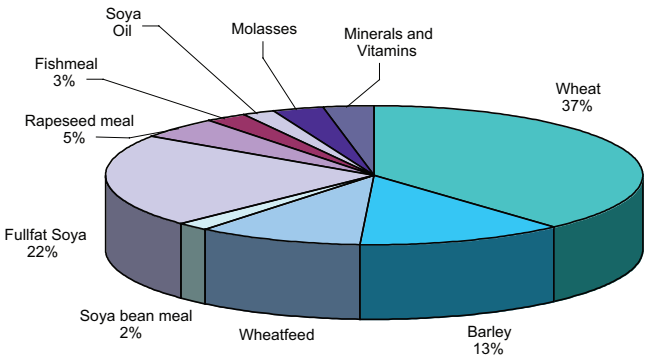


Figure C.3.2: Composition of Compound Feed - Finishing Pigs (Source: Stotfold finishing pigs systems research)

average citizen of the United States has a footprint of 9.6gha.

C.3.2 Energy Use

Energy use by the sector is accounted for in the ecological footprint by direct land use plus the land required to reabsorb associated carbon emissions; referred to as 'energy land'. Potential for significant reductions in energy use in the sector have been identified and, if implemented, the relevant measures would result in a reduction in the sector's footprint.

The ecological footprint of energy use in the UK pig industry is 1.17ha per tonne of pig meat produced that is a total of 804,186gha of energy land.

The use of energy in the sector is weighted towards the feed and farming sections of the supply chain, with electricity being the most common energy source in the feed sub sector and hydrocarbon-based fuel in the farming sub sector.

Significant savings could be made by reducing the amount of compound feed used on farms and by the recovery of waste heat from cooling of produce, that is the integration of feed and final processing.

C.3.3 Water Use

A range of sources are used for water supply throughout the sector, and the level of treatment varies significantly between water used for drinking and washing down on farms to that used for washing down in food processing plants. The different sources of supply are accounted for in the main footprint, and on-site treatment is accounted for in the chemicals input to the footprint.

Water use in the pig industry is dominated by the farming sub sector, which accounts for 89.27% of consumption; the feed, processing and rendering sub sectors account for 0.89%, 9.18% and 0.66% respectively. The volume of water used to wash down accommodation probably accounts for the relatively high proportion of water use in the farming sector. This suggests that it is possible that improvements in the design of pig housing might reduce the volume of water used in the sub sector.

The use of water in the processing sector is accounted for by the need for frequent cleaning of machinery and production space.

The water footprint for the UK pig industry is 0.0016gha of energy land per tonne of meat produced, or a total of 1,112gha. This takes no account of any mains leakage that may exist, but does account for energy consumption in purification and transmission of raw water.

Any significant reduction in water usage in the sector is likely to compromise either animal or human health, the greatest part of the consumption being used for the cleaning of pig accommodation and processing plants.

C.3.4 Feed Raw Materials

Nearly 698,522 tonnes of homegrown grain are used in pig rations. Conventional pig finishing rations will consist of between 50 and 60% cereals.

The principal ingredients of compound pig feed used in the UK are shown in Figure C.3.1.2 The majority of inputs are from UK sources, other than Soya, which is mainly imported from the Americas. The 'growing' footprint of the feed ingredients is 2.15gha/tonne of pigmeat, that is, the actual global area required to grow the crops; 31.5% of that area is outside the UK and a further 17.3% (0.37gha/tonne) is sea.

Sector	SEI REAP gha/tone	Pig UK gha/ tonne	Poultry UK gha/tonne	Proportion of SEI	Pig Adjusted gha/tonne	Poultry Adjusted gha/tonne
Beef and Veal	5.18				5.13	8.49
Mutton and Lamb	3.51				3.47	5.76
Pork	3.73	3.71		99%		6.11
Poultry	2.85		4.68	164%	2.82	

Table C.3.1: Comparison of the global footprint for meat industry sectors including adjusted SEI figures

The feed raw material part of the footprint can only be reduced by increased efficiency in production. Any such improvements are likely to be accompanied by increased consumption elsewhere, and may ultimately prove to be neutral or possibly negative in terms of global impact.

C.3.5 The Nitrogen Balance

Nitrogen is a significant component of the pig production system, the key process being the conversion of vegetable protein to meat protein. Any industry footprint based on the use of imported and home-produced ingredients that have been grown using artificial fertilisers will include a significant impact from that area alone. The pig industry produces a significant quantity of nitrogenous waste in manure throughout the farming sub sector, and emits nitrogenous gases during production, subsequent storage and spreading of manure; none of these issues arise in traditional footprinting, because there is no direct use or reduction in use of land.

The efficiency of nitrogen use in the disposal section of the material flow is also disregarded by footprinting, with the majority of slurry and manure being applied directly to agricultural land as fertiliser, and some being processed in anaerobic digesters to produce methane, which can be used for power generation, before being applied to land as a fertiliser.

In footprinting terms therefore, little account is made of the recycling of nutrients within UK agriculture or the potential to displace some energy consumption. The recycling of nutrients to land, would serve to significantly reduce the industry's footprint by removing petroleum-based inputs and imports of phosphate.

Furthermore, the UK is a net importer of nitrogen mainly driven by imports of fertiliser and protein in the form of food or ingredients for animal feeds. In order to restore balance in the nitrogen cycle, it is imperative that imports are reduced, by both increased consumption of home produced foods and increased recycling of nutrients land to reduce fertiliser imports.

C.3.6 The Footprint

The sum of the component parts detailed above, plus those items such as chemicals and internal transport, which are not included, gives an overall total ecological footprint of 3.71gha for each tonne of pig meat produced in the UK.

This value may include some double counting, for instance, where energy is recovered from manure is used as a source of nutrients for growing crops.

The bulk of the direct land usage of the UK pig sector, which amounts to some 2.54gha/tonne of pig meat produced, arises mainly from the growing of food crops, but includes land required to grow straw for bedding and timber for paper products used in the course of production. That part of the feed that is produced inside the United Kingdom, occupies in the region of 760,000gha, and overseas Soya production occupies 265,000gha. These values include fertiliser inputs and the sequestration of emissions arising from cultivation activities.

Shipping from overseas and goods vehicle transport within UK account for a small proportion of the energy land-take, as does the production of chemicals, such as disinfectants and refrigerants, used in the sector.

C.3.7 Footprint Comparisons

Historically, the only other agricultural/food sector that has been surveyed for Resource Flows to the extent that this project has examined the pig sector is the poultry sector. Comparable footprints have been produced by SEI for the Beef and Veal, Mutton and Lamb, and Poultry sectors.

The results of these footprints, which are taken from the SEI Resources and Energy Programme, are laid out Table C.3.1. This shows a small variation from the footprint derived from data from the current analysis and a significant difference in the case of the sister analysis of the UK poultry sector.

The sector footprint derived from current data is 1% less than that calculated by SEI. This variation is despite the diverse nature of the pig industry, particularly in the farming sub sector, and the small size of the sample. For the purposes of comparison Table C.3.1 also shows comparisons with the adjusted footprints of the other sectors. This comparison should be viewed with caution because of the inherent differences between the sectors; for instance, a large proportion of UK-produced beef is reared on grass, thus removing the need for compound feed that is currently a basic requirement of pig production.

C.4 Benchmarking the Sector

C.4.1 Why Benchmark?

"Benchmarking is a performance measurement tool used in conjunction with improvement initiatives to measure comparative operating performance and identify Best Practice" The Benchmarking Network.

Put simply, benchmarking involves an outward look at how others achieve their performance levels, together with an understanding of the processes that they use to achieve their performance level. Lessons learnt from benchmarking exercises, when used properly, lead to improved performance.

C.4.2 Using Benchmarking

To be effective, benchmarking should be an ongoing process, using regular comparisons to identify areas for improvement. The technique can be used at all levels of industry; in this exercise the relevant levels are enterprise and sector.

At the enterprise level, benchmarking can support management strategies to improve performance and competitiveness. The data arising from this project can be used to compare the performance of individual companies with industry performance, enabling the identification of areas of relative strength and weakness.

Companies may then work with one or more benchmarking partners to seek to identify how specific processes can be improved through understanding of how superior performance is achieved. This can help companies find innovative solutions in a culture where knowledge is shared and greater understanding of processes is achieved.

At the sector level, the techniques used in enterprise benchmarking are applied to the whole industry in which similar types of best practice are essential for compliance or competitiveness in a wider marketplace. The techniques provide a means of monitoring key performance indicators that impact on the ability of the sector to respond to changes in standards, and to identify best practice in relation to those factors.

Effective benchmarking exercises are never one-offs; they should be part of an ongoing strategy for improvement, at whichever level they are carried out. It is also imperative that individual enterprises commit to benchmarking at all levels of the business, and are prepared to accept criticism of performance and to provide the means to bring about improvement.

	Energy (kWh)	Water (litres)
Feed Manufacture (per tonne)	80.332	78.200
Farming (growing) (per kg)	0.042	6.33
Farming (fattening) (per kg)	0.289	20.86
Processing (per tonne produced)	553.2189945	3666.961
Rendering (per tonne produced)	663.458	1583.734

Table C.4.1: Resource consumption of the various pigmeat sectors

C.4.3 The Outputs

The data gathered could be used to establish a wide range of benchmarks, however, this report lays out only a few of the key indicators identified in the course of the project. The benchmark indicators extracted from the data can be found in Table C.4.1 opposite.

Data providers have been provided with the above information directly related to their individual performance as given on the relevant return.

In addition to the benchmarking information shown above, the data gathered provide a useful picture of the range of practices employed in the industry; this information, when used with the benchmarking data may be used to identify best practice, particularly in the farming sector.

It is clear from the data that the majority of indoor breeding and growing units use LPG as the primary heat source, whilst there is no alternative to electricity available for lighting and assisted ventilation.

Energy recovery in the farming sector could be used in the later stages of production to provide heat for young piglets immediately post weaning. However, this could only be achieved by the replacement of all floors in the existing building stock or, more likely given the age of much of the UK industry's building stock, it being replaced. This is unlikely to happen given the levels of profit currently being achieved in the farming sub sector.

The observed variations in electricity consumption between comparable units also suggests that some savings could be made by use of energy-saving techniques, for instance changing from tungsten filament bulbs to fluorescent lighting.

In the feed production sector, savings could be achieved by the use of combined heat and power plants (CHP), but only at significant capital cost.
On an industry scale, further significant savings could be made at relatively low cost by reducing the degree of compounding employed in feed production. The meal products could be used in liquid feed systems with or without co-products; the use of co-products may vary greatly according to availability and price, which may increase significantly with increased demand, part of which might come from other agricultural sectors, such as dairying.

In processing plants, the use of CHP would also result in savings, possibly with a payback period of as little as five years. Heat recovery would also provide savings, but these techniques are likely to be primarily employed in new-build plants, where such techniques can be designed-in before construction.

The use of localised chilling techniques has the potential to reduce the amount of energy used compared with chilling whole overnight storage and workrooms.

It is clear that, in most of the pigmeat sector, upgrading of existing equipment would result in some savings, but the industry's unwillingness or inability to invest will not be overcome by existing government action schemes or incentives.

Whilst environmental benchmarking would be a valuable tool to facilitate continuous improvement in the sector, this study has found that performance within specialist sub sectors can be highly variable, due to substantial differences between farms, types of operation, the age of capital, and age of pigs grown or slaughtered. Ideally, benchmarking should compare like-with-like, but this may not always be possible in the UK pig sector.

The best outcome of an industry-wide environmental benchmarking exercise would be recognition that outdated, energy-hungry techniques should be abandoned in favour of energy-efficient techniques on both existing and new units.

C.5 Environmental Issues - Current and Future

The principal environmental issue of concern to the industry is the full implementation of the IPPC Directive, which was in mid-2004 for processing and is due in January 2007 for farms, by which time all qualifying sites will need a permit to operate. However, in addition to this legislative burden, the industry is faced with a raft of other issues that are likely to have an effect on its environmental performance. The economic and trading status of the sector, that has already been described, often make it difficult to invest significant capital sums in techniques and technologies that may show an immediate environmental benefit, but have a long-term financial payback. Therefore, the response of the industry to non-legislative environmental pressures is likely to be minimal, if it exists at all. Any policy changes likely to impose a financial burden on the sector will have to bear in mind the limiting factors so that UK production is not replaced by potentially less resource-efficient imports, that would satisfy demand at a lower cost but transfer environmental burdens away from the UK.

C.5.1 Raw Materials

The range of raw materials used in the pig sector is relatively small; feed, bedding, water and energy are the most significant inputs, and of these little is of direct environmental concern.

Feed suppliers already face opposition to the use of GM ingredients in their products and have to contend with fluctuating world commodity prices where non-GM ingredients are likely to carry an ever-increasing premium.

Whilst the pig industry uses about 20% of UK wheat production, which is currently non-GM, depending on growth stage of the animal between 10% and 25% of the pig diet fed in the UK is imported Soya. The pressure on global producers to grow GM varieties of Soya is significant, and continuing insistence on the use of non-GM ingredients in the supply chain is likely to increase the cost of feed and consequently the UK-produced end product.

Consumption of feed can only be reduced through increased efficiency of pigs, either by improved breeding or fecundity, which may have social or welfare implications, or by more accurate targeting of protein in diets, through better-phased feeding or diet manipulation. Phased feeding is the managed change of diet through the life of a pig herd, by changing the balance of ingredients to suit each growth stage.

Practically, the volume of feed used and availability of storage capacity restrict changes of diet; improvements in phased feeding can only be made on well-equipped home-mixing units or at large sites with versatile and plentiful storage. The other main raw materials used in the sub sector are bedding for pigs and water.

C.5.2 Products

The past ten years have seen a significant shift in the volume of pigmeat production from the fresh ‘raw’ product, to ready-prepared meals and convenience foods, the UK is becoming the primary European producer of ready meals, with increasing export markets in France, Germany and the Low Countries. The UK government is seeking to reduce energy use in the food chain and in particular the amount of energy used to prepare and store fresh ingredients and frozen products in households. The energy use associated with the use of fresh and frozen ingredients is significantly greater than that associated with part-cooked, chilled further processed food, such as ready meals.

Social changes over the next decade are likely to result in an increase in the proportion of pig meat sold as ready meals and an increasing demand for smaller portions as the number of single-person households increases, by up to 40% by 2011. The increased use of cook/chilled products is likely to have caused a slight reduction in the per capita consumption of energy in the UK, as less food is prepared from joints and fresh cuts of meat. Whilst in overall terms this will to some extent be offset by the increasing number of single-person households, the net benefit is likely to be significant. If some reduction is possible in this area, it is likely that government will ensure that pressure is exerted to make savings.

C.5.3 Energy Sources and Consumption

The majority of the sector is tied into the climate change levy, and so is under pressure to reduce energy consumption in all sub sectors.

Feed Manufacture

Pelleted feeds, such as those in widespread use throughout the industry, require considerable amounts of energy to provide a carefully formulated, consistent product that optimises growth. The feeding of whole grains may also enable locally produced grain to be used in diets, so reducing the amount of emissions from transport.

The energy use per tonne of feed produced, as identified by this study is 80.33kWh, compared with 50kWh/tonne of non-pelleted feed. Given a level of production of 1.56 million tonnes per annum, a change from pelleted to non-pelleted feed would result in a saving of 47.31GWh per year.

Farming

A significant amount of energy is used in the indoor farming sub sector of the industry, first to keep housed animals warm and subsequently to cool them. No add-in technology is currently available to transfer heat produced in one housing area into areas with heat demands, despite the fact that it would be practicable. The amount of heat produced by a single pig weighing 45kg varies between 125W and 257W; in a building containing 500 pigs, this is equivalent to 62.5kW; on a site of 5,000 fattening pigs this equates to 0.625MW.

The necessary heat to sustain young pigs is currently supplied using infrared heat lamps, electric heat pads, and LPG heaters. In later stages of the production cycle excess heat is extracted using electrically powered ventilation fans. Full-scale trials in the poultry sector using heat pumps installed in building floors and heat storage using underground water suggest that a 50% reduction in energy consumption would be possible using this technology.

Such an energy recovery system would serve to significantly reduce cost to the pig industry and the need to sequestrate carbon arising from power generation to satisfy demand to drive ventilation and combustion of gases to heat buildings. However, the capital costs associated with such changes, however small, may not be justifiable in the uncertain climate prevailing over the UK pig sector.

The study has identified that the use of fluorescent lighting in place of the existing incandescent bulbs, and more effective insulation, for heat loss in the early stages, and reduction of solar gain in the later stages of production would lead to savings in energy consumption.

It is accepted that the replacement of incandescent light bulbs with fluorescent lighting can give rise to significant savings in energy consumption, by up to 75%.

Given the assumption that a 10% reduction in electricity consumption could be achieved through the use of fluorescent lighting on pig farms, an annual saving of about 28GWh could easily be achieved.

Processing

The pig industry is currently not faced with pressure to ‘green’ its energy use, that is to use wind or hydro-power sources, but if relatively low cost alternative energy sources could be found, such as a heat recovery system as described above or sustainable energy from a waste incineration plant with CHP, producers and processors would undoubtedly be interested; provided costs suited companies’ capital expenditure programmes.

Such energy sources may be incineration of rural wastes in plants located near processing sites, or simple on-site gas or oil-fuelled power plants with heat recovery.

Processing plants have high demands for both refrigeration and heating but the two systems are conventionally kept separate. Heating and cooling by process integration is an accepted technique, but is not widely adopted in industry. The technique can involve the recovery of waste heat from a centralised cooling system, and connecting production processes to make both heat and cold available for use in factory operations. For instance, process water might be pre-warmed using heat recovered either directly or via a heat pump from both refrigerator and flue gas condensers. An additional saving might be made using waste heat from the gas burners used to remove hair from carcases to preheat feed water to for the scald tanks, which are normally located within a short distance of each other.

Similarly, such low-level heat might be used for office heating using an under floor system. Given a sufficiently high energy usage, it has been shown that the capital cost of this type of installation can be recovered within three years.

In the poultry sector, Banham Poultry is in the process of setting up a pyrolysis and gasification plant to treat by products from processing lines. The gases released during the process will be used for energy generation. This system could be readily adapted for use in the pig processing sub sector.

Both water and energy consumption can be reduced by the use of steam and condensation scalding rather than the commonly used scald tanks. Savings of between 75% and 90% can be made using these techniques, but the high capital costs involved could not be justified on the basis of savings on water and energy; it would only be worthwhile considering change in new-build or upgrading large plants.

The majority of UK pork processors use 24-hour chillers to reduce carcases to cutting temperature, during which time carcases can shrink by up to 1.5% through water loss. This loss can be reduced to less than 1% by use of blast chilling, at lower temperatures for shorter periods. Whilst blast chilling would have a slightly higher energy cost, it would increase the shelf life of the product and reduce weight loss, these advantages would offset the operating costs of the system.

It can be concluded that energy savings can be made at all stages of the pigmeat supply chain, but only if sufficient capital investment is available or the burden of regulation is overbearing. Given the current state of the UK pig sector, it is unlikely that any significant capital investment will be made in existing installations, or that many new installations will be started. Government might be able to encourage an increase in investment by offering suitable tax incentives rather than by providing direct financial assistance for the carrying out of works.

C.5.4 Waste Generation

The environmental impacts due to waste arising from the majority of sites associated with pig production and processing are controlled by the incoming IPPC Regulations. IPPC requires that the operators of installations seek to use Best Available Techniques (BAT), which balance the costs to the operator against the benefit to the environment. Where there is a choice, the technique that results in the lowest overall emissions will be BAT, unless it is not an 'available technique'.

The key to effective BAT implementation is, however, the balancing of costs to the operator and advantages for the environment. Any technique may be rejected as BAT if the cost of its implementation outweighs its environmental benefits. This consideration of environmental economics is not an easy concept for the majority IPPC applicants to grasp.

Effective BAT implementation balances the operator costs with advantages for the environment

Of great relevance to the sector is the fact that the cost to the operator of implementing BAT should not take into account its potential impact on the profitability of the business, or any other aspect of its financial position; the balance is simply between the cost of the installation and its environmental benefits.

If the improvement in performance likely to arise from the implementation of BAT is small and its cost is significant, then the appropriate standard should be applied to take account of this fact. Correspondingly, if any significant improvement in benefits as a result of the implementation of BAT has a high financial worth and is likely to justify greater costs.

The correct interpretation of IPPC may well cause businesses to become unviable, and therefore fail, but in some cases the initial expenditure may well be recouped by improvements in performance or waste reduction.

C.5.5 Re-use and Recycling

The nature of any food supply chain is such that opportunities for the re-use of items used in the food preparation sectors are minimal. Similarly, in the farming sector, the nature of consumption is such that no significant items of consumption are re-useable.

In the feed manufacturing sector, the main areas of wastage that have the potential for recovery and recycling are dust from manufactured feed, which, if suitable, can be and often is recycled into contemporary production, and steam condensate, much of which is embodied in the product, which can be returned to the system.

The farming sector has a single significant opportunity for recycling, that is the application of manure to land for use as a fertiliser. In the region of 7,817527 tonnes of

slurry and manure are excreted annually by the UK national pig herd. By recycling this valuable resource to land effectively, much of the nitrogen content can be taken up by growing crops and the carbon content can be sequestrated in the national soil resource.

C.5.6 Atmospheric Emissions

Atmospheric emissions from the pig industry are dominated by emissions from the farming sector, which are mainly nitrogen-based gases, predominantly ammonia.

Ammonia arises directly from wastes excreted by pig, and its emission from pig housing is closely related to the rate of house ventilation. The amount of waste nitrogen in pig excreta is directly related to the efficiency of digestion of the feed, which can be related to protein targeting in the feed, the pig gut microflora, and feed dry matter levels.

Once excreted, the nitrogen in excreted urea is incorporated into other compounds: ammonia through mineralisation, nitrite and subsequently nitrate through nitrification; and organic nitrogen, fixed with carbon. The reduction of atmospheric emissions of nitrogen can only be achieved by immobilisation in organic nitrogen, or nitrification. The products of these two processes are locked into the pig manure and can be taken up by growing plants, including crops.

C.5.7 Water

Water as a resource is coming under increasing pressure, particularly in southeast England. The scope for reduction in water consumption in the pig sector, whether by recycling/reuse or change in practice, is limited given the economic state of the sector. Any future ban on the use of chlorine for the additional treatment of water in the sector may bring about a change in treatment to include ozone, which, together with additional filtration, might enable wastewater from some processing operations to be reused.

In the processing sub sector, water is often used in the conveyance of green offal, particularly paunch contents. Installing a dry system can make significant savings, although the current low cost of water makes this option only worth considering for new plants or plants undergoing refurbishment.

The use of high-pressure hose systems for end-of-day cleaning down has been shown to reduce water use by approximately one third. Water can be delivered to point of use in a high-pressure ring main or via existing low-pressure distribution mains serving portable pressure washers.

In new-build plants it may be possible to design in opportunities for the limited reuse of water; for example, in the conveyance of some solid materials.

In the absence of opportunities for recycling, the most significant saving that might be achieved in all parts of the sector would be by repairing broken distribution systems and turning off unnecessary taps.

The farming sector consumes a significant volume of water, much of which is used in cleaning. Water use in cleaning operations can be minimised through good housing design, making use of washable surfaces and limiting the surface area that needs to be cleaned. Many pig units are simply adaptations of pre-existing buildings, that may or may not have been intended for use as livestock buildings. The use of specifically designed buildings and structures would go some way to not only reducing water consumption, but also to improving conditions for the pig with consequential benefits in terms of performance.

C.5.8 The Future

The thorough implementation of IPPC has the potential to significantly improve the overall environmental performance of the sector. Experience to date suggests that the licensing process is adequately establishing the baseline performance and encouraging the phased implementation of BAT. However, there is some doubt that the process allows a significantly holistic view of environmental performance within sub sectors. This appears to be due to the splitting of sub sectors into individual processes, each with its own set of impacts and BAT. Several participants in the project felt that this approach, which is relatively narrow when compared with techniques employed in Environmental Impact Assessment within the planning process, is likely to stand in the way of significant improvements in the overall environmental performance within the sector, particularly in terms of emissions to atmosphere arising from transport.

C.6 Economic, Market and Social Issues - Current and Future

C.6.1 Sustainability

External pressures toward the economic and social sustainability of the UK Pig Industry are minimal, the economic sustainability of any industry being of little apparent consequence to the majority of outsiders. Socially, the industry recognises responsibilities in terms of providing employment in rural areas, in both production and processing sectors, and its duty to produce pig meat to the highest standards of welfare and food safety. However, the impact of any closures of installations involved with the sector is unlikely to make national headlines.

C.6.2 Economic Pressures

The primary economic pressure facing the UK pig industry is survival in the face of an increasingly aged capital base and disease in the national herd. The unsubsidised nature of the UK industry, together with pig meat being a globally traded, but regionally protected commodity, leads to a reluctance to make investments that are either perceived as risky, or have a relatively long payback period. Any industry that feels that it is unable, for whatever reason, to make significant investment in its core business is unlikely to improve its environmental performance without external legislative or social pressure.

This situation has led the majority of UK businesses to become reactive and unwilling to commit to strategic plans that might lead to improvements in environmental performance. The greatest economic savings that can be made in a mature sector such as this are through economies of scale resulting from the acquisition of other, similar businesses.

The sector faces continuing, sustained pressure to produce cheaper meat, which ultimately can only be satisfied by reduced costs of growing, feeding or processing, or by matching production exactly to demand.

The potential for savings that might arise from improved environmental performance and the constraints on the implementation of measures are outlined in the body of the report, but the ability of the sector to match production to demand is limited by the extended lead times between the serving of a sow that gives birth to a piglet and the point of supply of the finished pig, which is at least 280 days later.

Inevitably, unforeseen fluctuations in demand have to be either satisfied by the importation of meat from abroad to satisfy demand, or by the freezing or placing on the export market at commodity prices of surplus production; all at some economic or environmental cost.

C.6.3 Social Pressures

The principal social pressures on the sector concern food safety and animal welfare. The animal welfare lobby, whilst strong, is faced with effectively needing to increase the standards set by the European Community. Those standards have been the subject of legal challenge and the ruling is that existing standards adequately balance the welfare needs of animals with the commercial interests of farming. Despite this ruling, the lack of uniformity between welfare standards achieved in the UK, the rest of the EU and the rest of the world remains a significant, largely unrecognised obstacle to the establishment of a level playing field for pig production.

The industry also recognises its retailer customers as a significant driver of product specification. Retailer customers are also the principal specifiers of packaging and packaging systems that may require gas flushing of containers or new methods of presentation. Changes in packaging are significant consumers of materials and energy; and changes seldom lead to savings in either.

Product assurance schemes may be a useful way to encourage overall improvement in standards, and as retailers become engaged with the requirements of ISO14001, further pressure may come to bear on the sector.

C.6.4 Legislative Pressures

The pig sector bears the burden of a wide range of legislative pressures, driven by environmental, social and health concerns, much of which is already in force and is discussed earlier in the report. Other than IPPC, the full implementation of which is due in early 2007, the

only pending legislation that is likely to impact the UK pig sector is the Environmental Liability Directive, which came into force in April 2004, but member states have until 30th April 2007 to incorporate the Directive's provisions into national law.

The Directive is aimed at preventing environmental damage by forcing industrial polluters to pay prevention and remediation costs. The Directive aims to establish a framework that would prevent "significant environmental damage" or rectify damage after it has occurred.

The damage covered by the Directive is to:

- biodiversity, whether protected at EU or national levels;
- waters covered by the Water Framework Directive; and
- human health (including land contamination when it is a threat to human health).

Operators of IPPC permitted operations, including pig farms, will be held strictly liable (i.e. no need to show fault or negligence) for preventing or restoring any damage caused to land, water and protected habitats and species.

Operators of other, less harmful, activities will be held liable when damage to protected habitats and species has been caused by their fault or negligence.

D. Conclusions and Recommendations

The UK Pig industry has to survive in a highly competitive international marketplace. In order to succeed it is necessary that the sector takes advantage of every opportunity to reduce costs, improve product or gain a competitive edge in some other way, whether through high standards of welfare or environmental performance. The UK sector is at the forefront of world welfare standards, but there remains scope for improvement in environmental performance.

The environmental challenges faced by the sector are not simply fashion and their importance will increase as the population grows and demand for resources increases. In the long term, environmental issues should be regarded as opportunities, not challenges, and by adopting a proactive rather than a reactive approach the industry might become more stable and find itself once more in the vanguard of global pig production.

Feed

There is some potential for reduction in energy use during feed manufacture, and by production of a ration that would allow zero or minimal use of compounded feedstuffs on farms.

In production plants, environmental performance could be improved through the use of energy recovery and CHP, particularly on sites where energy and steam use is relatively high.

It is, however, unlikely that changes will be made to production systems unless integrated into a new plant or the substantial refurbishment of an existing site.

Breeding, Growing, and Finishing

There are many similarities between all of the farming sub sectors. In indoor units, it would be possible to make substantial energy savings through the improvements in building stocks, although this may involve high capital costs which may not be available within the industry.

Immediate savings could be realised through the use of low energy fluorescent light in housing.

The use of better insulation in older building stock would help to reduce the current need for both heating and cooling during the winter and summer months on pig farms.

Processing

The use of CHP in the processing sub sector is relatively uncommon, considering the relatively great on-site requirements for energy, steam and cooling. The fuel source for CHP could come from agricultural by-products such as straw, bio-fuels grown on agricultural land or from waste products produced within the sector.

None of the opportunities for improvement in environmental performance identified above are likely to happen without involvement of third parties. Processors of all sizes consider themselves to be in the business of producing pig meat, not waste management or power generation. If changes are to be made, the most successful application is likely to be in new-build projects, not through the retrospective installation of technology in existing plants.

Rendering and Pet Food

The scope for reduction of environmental impact in the rendering and pet food sectors is limited by the relative simplicity of the process, but opportunities are most likely to arise from energy recovery in rendering plants and the use of relatively low value, dry products for combustion in on-site CHP plants, rather than such material being sent to landfill.

Overall

In summary, few improvements can be made in the environmental performance of the sector without significant capital investment. In the current world pig market, it is unlikely that any such investment will be made in UK operations, in the absence of some form of encouragement. The UK pig sector will continue to have a major role as a supplier of high quality food to the nation, but it is very likely that companies will increasingly move production and primary processing to sites overseas, particularly for production of commodity meat for the inclusion in pre-prepared foods, if the differential costs of infrastructure development remain so heavily weighted against the UK.

The pig/pork supply chain is complex. The UK pig sector faces significant competition from imports in terms of price and quality, but it is important to UK agriculture

that UK-based pig production, and subsequent slaughter and processing continue.

Consumption of pig meat is static, imports to the UK are increasing, if the UK pig industry is to have a future within the market place it must have an impact on consumer demands for pig products, encouraging consumption of home-produced foods.

There are two ways in which the UK sector can gain the competitive edge, superior product value and improved process efficiency; improved environmental performance can be a key contributor to the latter. By achieving long term, sustainable economic benefits through planned investment in environmental improvement, the industry can place itself in a position to fully exploit the strong background in nutrition and breeding and become more competitive in both the home and export markets.

The varied nature of the farming and processing sub sectors makes it difficult to set useable environmental benchmarks, and this may prove an insurmountable obstacle on the road to environmental and economic improvement.

In the absence of integration and the organisational efficiencies that come with it, it is highly unlikely that the UK pig industry will make any worthwhile, sustainable savings in environmental terms; furthermore it is therefore unlikely that the industry will be able to make the overall changes necessary to make it competitive in the global market.

Notes

See insert for benchmarking figures.

Notes

Completed Mass Balance Reports

Geographical

Isle of Wight

City Limits Report (London)

Mass Balance UK book

Mass Balance UK book 2

South East Report

Northern Ireland Report

Scotland Report

Wales Report

Sector

Agricultural Report (Marcus Hodges)

Agricultural Waste Report (C-Tech)

Construction Report (Viridis)

BedZed Construction Report pt1

4sight – Rocks to Rubble – eco-region

Public Sector Report (Waste Watch

Solvent Waste in UK Furniture Manufacturing Industry

Exhibition Industry

Greening Britain's Schools

Publishing

Electricity Report

Foundry Report

UK Status Report on Waste from Electrical & Electronic Equipment (ICER)UK Status Report on Waste from Electrical & Electronic Equipment (ICER)

Mass Balance Study into Waste Arisings from the Food & Drink Processing Industries

National Health Service

Financial Sector

Newspaper Report

UK Paper & Board Industry

Ceramics Industry

Magazines Sector

Automotive

Poultry

Material

Carbon UK Report

UK Tyres Report (Viridis)

European Tyres Report (Viridis)

Chemical Report

Thermal Methods Report

PIRA Packaging Report

Benchmarking Wood Combustion

Large Scale Glass Manufacture

Sustainable Timber Waste

Furniture Packaging Optimisation

Plastic Report

Sustainable Markets for Waste Glass from Fluorescent Tubes and Lamps

Paper

Material Flows of Iron, Steel and Aluminium

Civil Engineering Application of Tyres (Viridis)

Packaging Report

Glass

Transport Options for Waste in Scotland

Farm Packaging Waste

Mass Balance Reports To be completed

Geographical

Ecological Budget UK (WWF), regional series

South West

Sector

Pigs

Material

Embodied Wood: The UK Mass Balance and Efficiency of Use

Mass Balance & Scenario Analysis for UK Clothing & Textiles

Nitrogen

Methane

See www.massbalance.org for downloadable copies completed reports, if available.



Ingredients:

A Introduction

B The UK Pig Industry
History, The Pig Industry Today, Industry Drivers, Legislation Affecting Pig Enterprises, The Future of the UK Pig industry

C The Mass Balance
Mass Balance Outputs, Ecological Footprint, Benchmarking the Sector, Environmental Issues - Current and Future, Economic, Market and Social Issues - Current and Future

D Conclusions and Recommendations

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