

1. Executive Summary

The Pork CRC was established in July 2005.

During almost six years of operation the Pork CRC has revitalised pig and pork research in Australia and enhanced the global competitiveness of the Australian pork industry through the development of an unprecedented range of new technologies and information. With the possible exception of weight sold/sow/year which is limited by retail demand for smaller carcasses in Australia, the major business KPIs for the Australian industry are now equal and in some cases better than our major competitors. The new technologies made available to industry and in the final stages of development by the Pork CRC currently exceed those available anywhere else in the world and will provide industry with means of further enhancing the efficiency and reducing the cost of production for some time to come. The three commercial participants (production based) of the Pork CRC have determined and reported (see annual report for 2010) that implementation of technologies developed by the Pork CRC to date has improved their bottom line by some \$14 million annually.

The advances made in the areas of grain technology, herd feed efficiency and in establishing the human health attributes of Australian pork by the Pork CRC are the results of excellence in science, the close involvement of industry in the R&D programs and effective communication/demonstration of outcomes to participant's and the industry in general.

The Pork CRC R&D program has been inclusive and has attracted researchers not previously engaged in pork research but who have brought some excellent science and innovation to the program and industry.

The Pork CRC has been instrumental in the training of new generation scientists and has helped support R&D facilities across Australia through base funding arrangements in conjunction with Australian Pork Limited (APL). The base funding strategy provided some certainty to R&D providers, has reduced the cost of research and facilitated even greater cooperation between research organisations and industry and the training of students within commercial facilities/organisations.

The outcomes have exceeded participant and industry expectations and demonstrate the value of the CRC model for aligning industry needs with Australia's research capabilities to develop collaborative R&D programs to enhance industry productivity and at the same time achieve excellence in science.

2. General report

2.1 Performance against the Commonwealth Agreement

The Pork CRC conducted research and commercialisation activities in the three programs. These were:

- a) **Program 1: Securing more reliable and consistent supplies of protein and energy for pig diets.**
The targets were 1) reduce diet costs by 10% by 2012 and 2) improve the Digestible energy (DE) content of grains by 1.0 MJ/kg by 2012.
- b) **Program 2: Improving Whole Herd Feed Efficiency.**
The target was to reduce HFC from 4.3 to 3.6 over the life of the Pork CRC.
- c) **Program 3: Enhancing capacity to deliver nutrients promoting health and well being through pork.**

The targets were 1) increase export and domestic sales volumes by 10% by 2012 and 2) to achieve a \$1.00/kg increase in returns for 10% of the product sold into the higher value markets by 2012

Research and commercialisation activities in Program 1 has enabled the Pork CRC to meet all Commonwealth objectives and milestones. To date the Pork CRC has released two new grain varieties (Barley and Triticale) and three new pea varieties to industry. NIRS calibrations for rapidly determining the available energy and other nutrient values of grains for pigs, poultry and cattle have been developed and commercialised through AusScan. The calibrations are licensed to 17 Australian organisations and are being investigated by international organisations. The Pork CRC also established new grain processing technologies that improved the efficiency of feed utilisation by 12% to 23% in pigs between 20 and 50 kg and between 7 and 20 kg respectively. Smaller effects have been identified through changes to feed manufacturing processes and the results have markedly enhanced the attention paid by feed mills and home feed mixers to grain processing and the assessment of grain particle size and distribution. Combined, the outcomes of Program 1 met all Commonwealth outputs and milestones and reduced feed costs by more than the 10% target. The effects of the new grains on feed costs will increase over time as the amount of each grain available to growers and producers increases.

In Program 2 (Improving Herd Feed Efficiency (HFC)) the Pork CRC has developed new technologies and new information that, if fully implemented, would reduce HFC well below the target set out in the Commonwealth agreement. To date the Pork CRC benchmarking project shows that HFC has on average been reduced to 3.7 with individual enterprises achieving HFC values of 3.4. The latter is world class and at 2004 feed costs the improvement achieved by these individual producers would reduce average feed cost by 20 cents/kg carcass weight (\$15/pig). Given the marked increase in feed costs that the Australian and global industries have experienced over the last 3-4 years (46% to 100%) the improvement in HFC achieved through Pork CRC research would reduce feed costs by between 19 and 26 cents/kg carcass weight (\$13.68 -\$18.72/pig). Based on 2004 figures the average cost reduction would be 14.4 cents/kg carcass weight (some \$51 million annually across the industry).

The program has enabled the Pork CRC to achieve Commonwealth objectives and to meet most of the outputs and milestones within the Commonwealth agreement.

In Program 3 the Pork CRC has established the natural human health benefits of Australian pork in respect to cardiometabolic health, weight loss in overweight subjects, iron deficiency in young women and weight loss and thiamine status in Type 2 diabetics. The outcomes enabled the Pork CRC to achieve all Commonwealth outputs and milestones in respect to identifying and promoting the natural health attributes of Australian pork.

Commonwealth milestones and outputs on means of manipulating the cholesterol content of pork and enhancing /understanding the availability of minerals and vitamins in Australian pork were also achieved.

Overall the outcomes from Program 3 have markedly enhanced consumer and human health experts knowledge on the health attributes of pork. The outcomes have been surprisingly and unexpectedly positive which largely reflects the general negative perceptions of pork and the lack of good science and research on the subject. The findings have been widely communicated to human nutritionists, wholesale and retail participants and organisations and now form part of the pork promotion campaigns for the Australian and NZ pork industries.

In Program 4 (Education and Communications) the Pork CRC targets in the Commonwealth agreement were to successfully complete 3 postdoctoral programs, 12 postgraduate projects and 21 undergraduate projects. To date the Pork CRC has successfully completed 5 postdoctoral programs, seven postgraduate projects and 46 undergraduate (Honours awards) projects.

Within Program 4 the Pork CRC has met all other milestones relating to the development and running of refresher courses (the third of three will be held in June 2011) for the industry and effectively reinvigorated and made relevant industry meetings such as that organised by the Australasian Pig Science Association and Pan Pacific Pork Expo.

Governance and Finance

The Pork CRC has met all the financial reporting requirements and all cash and in kind contributions described and agreed to in the Commonwealth agreement. Two non essential participants exited the Pork CRC during its period of operation and three new non essential participants joined the Pork CRC during the same period.

All core participants remained active during the tenure of the current Pork CRC and have agreed to become essential participants of the new Pork CRC.

In addition to the cash contributions by the Commonwealth and participants the Pork CRC was able to obtain additional cash funds that exceeded \$ 3.2 million during the operation of the Pork CRC to date.

There have been no problems with the operation of the Pork CRC board or board appointed committees during the course of Pork CRC operations and no concerns regarding governance. The management of the Pork CRC has operated in line with board expectations and experienced few difficulties or complaints though two business managers resigned during the operation of the Pork CRC to date. In each case a competent replacement was recruited without any major difficulties or delays.

2.3 Pork CRC Outcomes and Impacts

The major outcomes and Impacts from the Pork CRC to date within each program include:

Program 1

New grains and NIRS Technology

Research and commercialisation activities in program 1 have resulted in the release of two new grain varieties and three new pea varieties developed specifically for pigs and to be grown in pork producing areas of Australia. Plant breeder's rights are owned by the Pork CRC for one grain (Berkshire) and two pulse varieties (Maki and Walana). The grains are being commercialised through a SME seed company - Waratah Seeds. Berkshire has proven particularly successful date in terms of yield and its suitability for both pigs and poultry and would seem to have excellent commercial potential as more of the grain becomes available for commercial planting and access by pork and poultry producers. The grain is being grown under contract and closed loop arrangements by pork producers in NSW, Victoria and Western Australia.

A number of other barley and wheat varieties are in the final stages of evaluation and commercialisation within a Pork CRC project with Intergrain (WA). The project will be completed in the new Pork CRC which will also continue to develop and release high yielding high nutrient content grains to the industry.

Research in Program 1 has also established and commercialised (through AusScan) NIRS calibrations for the rapid assessment of the energy and other nutrient values of grains. The latter is a world first and benefits grain growers, feed mills and intensive animal industries (pork, poultry, and dairy and feed lot cattle). The technology is licensed to 17 Australian organisations. The latter include grain testing laboratories, feed milling organisations and plant breeding and research laboratories. The importance of these outcomes to the Australian pork industry is illustrated by the response of one of the industry's leading nutritionists/consultants (Mr Tony Edwards-ACE Consultancy) in response to a Pork CRC board review of non-core participants on the impact of the Pork CRC.

Mr Edward's response regarding the grain and NIRS technologies was "The Australian pig industry has long been at the mercy of droughts, competition for feedstuffs from other livestock species, human food requirements as well as export markets, currency exchange fluctuation and hazardous purchasing options due to extended delays in feedstuff analysis etc."

"Having dedicated feed grains, contractual supply arrangements, currency fluctuation hedging, and a service providing rapid assessment of the feeding value of specific materials, have all helped to contain the volatility of feed costs."

"Given the numerous extraneous factors involved and the changes of circumstance from year to year, it is difficult to quantitate the contribution of each of the components above but a reduction in feed cost by \$10/tonne reduces the cost of production by about 4c/kg and their combined influence has probably been far greater than this. In particular the AusScan analytical service has been able to detect variation in energy and protein content of grains with an accuracy and speed previously not available. Since each MJ DE/kg in grain is worth approximately \$20/tonne and each percent of protein worth \$4/tonne, knowledge of the composition of feedstuffs on offer can allow for more selective purchasing, or in the case of home grown feedstuffs, more effective incorporation of materials into diets, resulting in lower feed costs and improved herd feed efficiency. Identifying a 0.5 MJ DE/kg and one percentage unit advantage in a grain source could raise its value by \$15/tonne and reduce feed costs by \$10/tonne."

"The AusScan service is now being widely utilised and is resulting in more predictable and consistent performance from the diets employed". Mr Edwards advises the majority of Australia's independent producers on nutrition and production management and is a major influencer in the industry.

In a survey of industry nutritionists the NIRS technology was rated the number 1 output of the Pork CRC to date. The Pork CRC currently receives approximately \$100,000 annually from licence fees and it is hoped that this will increase once agreements are signed with the major poultry integrators and the technology is extended globally.

Grain Processing

A new grain processing technology was investigated and established in the Pork CRC to remove the larger particles in both barley and sorghum. The technology and new information developed by scientists at the University of Queensland showed that it is the larger particles (>1.0 mm) in ground grain that affects the availability of starch in the small intestine. In animal experiments removing and/or reducing the percentage of large particles in ground barley and sorghum improved overall feed efficiency in growing pigs by 8%-12% and in weaner pigs by 15%-20%. The effects are extraordinarily large and the research identified an area of grain utilisation that was previously largely overlooked by the industry. For a standard grower diet the findings have the potential to reduce feed cost by \$24 to \$36 per tonne. The outcomes have been widely adopted by industry which has responded by changing the screens used in hammer mills, the instalment (in new mills and some existing mills) of disc mills which enable more precision over grain processing and the assessment (measurement) of particle size and distribution of grains after milling.

Other

Other outcomes from Program 1 include the development of NIRS calibrations for the available lysine content of imported soy bean meal and the evaluation of a number of different alternative ingredients for pigs. The most important of the latter is Juncea meal (mustard oil seed) which is the by product of the extraction of oil from the crop Juncea which is being grown more widely in Australia for the biofuel industry. The meal has been fully evaluated for pigs by the Pork CRC and the report distributed to grain growers, the oil seed industry and nutritionists and producers.

The Pork CRC is currently in the process of protecting the discovery of a gene in sorghum which is an indicator of starch availability.

Program 2

The outcomes from Program 2 are too numerous to describe in any detail. All have been detailed in the Pork CRC annual reports. The outcomes from Program 2 have had a marked effect on changing processes involved in commercial production and in the use of new technologies to enhance the efficiency of production, to reduce overhead costs and increase revenue. The changes and improvement has been achieved through

- A) The identification of Australian genetics with the same and potentially better performance capabilities than those available anywhere in the world. The discovery removed industry concerns that Australian genetics were a constraint on the global competitiveness of the industry.
- B) The establishment of the nutritional requirements of modern Australian genetics. These differed and were higher than current/previous commercial recommendations.
- C) The establishment and refinement of metabolism modifiers (Ractopamine and Porcine Somatotropin) that improve feed efficiency and carcass gain in the last 4-5 weeks of growth by 10% to 24%.
- D) Development of new weaner nutritional and management programs that reduced overall costs and enhanced survival and performance.
- E) Discovery of nutraceuticals that enhance the feed intake of pigs immediately after weaning by 20%-80% but more importantly enhance gut development and immune competence and reduce pre and post weaning mortality particularly in gilt progeny. The outcomes arose out of a PhD project conducted in commercial facilities. The technologies have been adopted widely by industry and are the only effective interventions developed for enhancing the health and survival of light birth weight piglets and gilt progeny.
- F) The development of a novel and effective vaccine against *Actinobacillus pleuropneumonia* (APP). The vaccine technology is protected by an innovation patent. The Pork CRC won an Excellence in Innovation Award from the CRCA for the technology which continues to be used by Australia's two largest commercial producers. The Pork CRC has issued two manufacturing licences for the vaccine and income to date has exceeded \$100,000. The vaccine will be further refined in the new Pork CRC.
- G) The development of a range of diagnostic tests for common diseases of pigs in Australia and globally. Specifically the Pork CRC developed a quantitative PCR test for ileitis and is in the final stages of refining a pen side strip test for the same disease organism. An Elisa kit has been developed (and patented) for swine dysentery and PCR and other tests have been developed for Glasser's disease. Alternatives to antibiotics to control E coli infections particularly in young pigs have also been developed. These include Bacteriophages and probiotic strategies based in the genotype of the pathogenic E coli strains. Both the latter technologies will form part of Program 2 of the new Pork CRC.
- H) The discovery and development of a range of new science and technologies for enhancing the reproductive performance of sows. These include world first science on the effects of

nutrition in early pregnancy on the peripheral and ovarian supply of progesterone to the developing embryo. The research challenges current concepts and the findings provide producers with flexibility (reduce costs and/or manipulate sow condition) are likely to lead to techniques for successfully combating seasonal infertility. Associated research is also investigating some novel IP to exogenously enhance progesterone levels and embryo survival and increase litter size. These projects which have far reaching global and commercial implications will be completed in the new Pork CRC. Other research has identified that methyl groups are limiting the reproductive performance of older sows and the findings were adopted immediately and widely across the industry. In late gestation researchers at SARDI have shown that high feeding levels have little effect of the birth weight or vitality of piglets born but can depress sow feed intake and increase sow weight loss in lactation. The findings question current feeding practices and have opened up a new area for research that has cost and productivity implications - world class science. Earlier Pork CRC projects established that lactating gilts (first litter sows) require higher specification (energy and amino acids) to prevent subsequent reproductive failure (a common problem in the Australian industry) and the new information and has been widely adopted across the industry. Researchers at the University of Adelaide have discovered that a metabolism modifier can be used in lactation to reduce body protein loss by the sow and results in significant improvements in subsequent fertility and litter size. The findings are covered by two patents and the project will be completed and the outcomes commercialised in the first 12 months of the new Pork CRC. Another major breakthrough by the Pork CRC has been the development of a system/method for successfully inducing oestrus and mating sows during lactation. The findings are potentially system changing and they form the basis of Program 1 of the new Pork CRC.

- l) Other outcomes from Program 2 include the establishment of the requirements and economics surrounding the Improvac technology for the immunocastration of intact male pigs. The technology is being adopted globally and the Pork CRC research provides Australian producers with a competitive advantage over their global competitors. We have also recently established the effects of dietary energy on the responses of pigs to Ractopamine. The results demonstrate that the magnitude of the improvement in carcass gain elicited by ractopamine increases with increasing energy and at the highest level of energy tested profitability was increased by some \$6.00 per pig (8.8 cents/kg). Even larger improvements in profitability have been suggested by recent research designed to investigate the effects of using a single diet between 20 and 100 kg compared to the usual phase feeding practices used by industry. The results suggest that depending on the cost and nutrient specifications of the single diet savings of as much as \$7/pig is possible. The research will be followed up by Australian Pork Limited.

The implementation of the new technologies by the Pork CRC three commercial participants has improved net margins over the three organisations by \$14 million annually.

The value of the technologies and new information developed by the Pork CRC within Program 2 is conservatively worth 35 cents/kg carcass weight or \$116 million across the Australian industry.

The impact of the Pork CRC research outcomes in Program 2 on the industry in general is illustrated by the response of Mr Geoff Handley (Hi Spec Rural services) to the Board survey of Pork CRC impacts across the industry. Mr Handley consults to producers in Queensland and runs a management group comprising some 10 production businesses. His response to the question reading the impact of the Pork CRC was: "The Australian Pork CRC has been a driver for improved productivity through science for many years. I can attest to many improved outcomes for my clients that have been directly driven by the results from or extended ideas that have lead from the research work funded and directed by the CRC."

“The emphasis on Herd Food Conversion, and the various work that has directed practical responses on my farms, has helped drive Herd DW FCR down from over 4.0:1 to under 3.6:1 for heavy bacon production. The emphasis on Gilt and Lac Sow nutrition in recent years has seen improvements in feed management to these groups, resulting in at least 0.5 extra piglets weaned per litter. The recent work on Creep Feed Management; Nupro nucleotides and Porcine Blood Plasma has seen many of my farms increase their 22 day weaning weight targets from 6.2kg to 7.2kg, with significant concurrent increases in final sale weight. One producer credits these creep and post weaning feeding technologies to shaving 8 days off his time to market.”

“The recent push by the CRC to fund a national Performance Benchmarking program has already motivated 5 of my farms to higher production levels. By comparing, on a standardized basis, their performance to others, they have been able to quantify in real world terms where they can still move forward. Sharing information within the group, from the better producers to those that can still improve, will make significant impacts across all participating farms. The project, and in particular the correlation between performance parameters (e.g. Weaning Age to Pigs Weaned per Sow per year), will allow the whole industry to adjust its management accordingly”.

Within Program 2 the Pork CRC has patented two new feeding devices and licensed one to a commercial company, patented an image analysis system for estimating pig weight, patented two new reproductive technologies for increasing fertility and litter size in sows, one new diagnostic tool for swine dysentery and is in the process of protecting recent discoveries on an exogenous means of increasing embryo survival and fertility in sows.

Program 3

The major outcomes from Program 3 have been the discovery that Se enhanced pork reduces the incidence of colon cancer in a rat model and the establishment of the human health attributes of Australian pork. The latter have included:

- a) The role of pork in the control of Type -2 diabetes. The research showed that when combined with exercise inclusion of fresh pork in the diet resulted in greater weight loss than subjects on a starch based diet and that pork prevented the marked decline in Thiamine status exhibited by subjects on the starch based diet.
- b) The effect of including pork in the diet of overweight and obese subjects on cardiometabolic health and weight control. The results showed that increasing pork consumption some 10 fold over a six month period had no adverse effect of cardiometabolic health but actually significantly reduced body weight and body fat loss compared to subjects who remained on their normal diet. The weight loss was reflected in a significant reduction in waist circumference of some 2.5 cm in male subjects. The results of this and other studies suggest there is something about pork and human health and weight loss. The findings are being explored in more detail in a project that will be completed in the new Pork CRC and the impact of pork on human health is a component of Program 3 in the new Pork CRC.
- c) Established that including pork in the diets of young women improved their haemoglobin status and enhanced plasma Vitamin B and folate levels.
- d) Established that including pork in the breakfast meal had the same effects on satiety and subsequent energy intake as poultry and beef.
- e) More recently the Pork CRC has investigated the genetics of muscle iron levels in pork and nutritional and other means of increasing muscle iron levels. The research outcomes have identified a potential (and very positive) unexpected effect of iron supplementation on the development of internal organs and the gastrointestinal tract. The research is ongoing and the findings will be fully evaluated and if warranted followed up in the near future. The Pork CRC has also investigated the effects of Lecithin on the cholesterol and fatty acid composition of pork. The results to date are intriguing in that they are showing marked

changes in the fatty acid composition of pork a reduction in cholesterol and an unexpected effect on carcass weight gain. The studies will be completed by June 30 2011.

Overall the outcomes from Program 3 have markedly enhanced consumer and human health experts knowledge on the health attributes of pork. The outcomes have been surprisingly and unexpectedly positive which largely reflects the general negative perceptions of pork and the lack of good science and research on the subject. The findings have been widely communicated to human nutritionists, wholesale and retail participants and organisations and now form part of the pork promotion campaigns for the Australian and NZ pork industries.

Program 4 Education and Communications

Postdocs

Four of those who successfully completed postdoctoral programs are now employed full time with Universities in Australia where they fill previously large gaps in undergraduate teaching of pig science and pork production in Australia. All four are also actively involved in pork research and one in particular (Dr William van Wettere) who is employed by the School of Veterinary Science at the University of Adelaide has proven a great mentor of students and in attracting students to undergraduate and postgraduate positions for the Australian industry.

The fifth postdoctoral candidate has been employed by the world's largest pig genetic company (Pig Improvement Company) and will be based in the USA.

Postgraduates

Of the seven postgraduates who have been awarded their PhD's and/or Master's degrees, three are employed by commercial companies involved directly with pork production or with groups who provide advice to the production industry. One is a research scientist with Australia's largest production company (Rivalea), one is employed by a veterinary group (Portec in WA) but also has a lecturing role at the University of WA and the other provides nutritional advice to a range of feed mills and production enterprises.

Two postgraduates have taken up postdoctoral positions. One is based in France and will continue to contribute to our understanding of the basic science underlying reproduction. The other has a position in the Poultry Foundation at the University of Sydney and will be involved in a number of grain based projects as part of the new Pork CRC.

Of the other two postgraduates who have been awarded their higher degrees one has returned to Morocco but is seeking employment in Australia and the other is raising a young family but is looking for further opportunities within the Australian industry.

By June 30 2011 we expect to have other 6-7 postgraduates complete their higher degrees. Three of these are already employed within the Australian pork supply chain.

The postgraduate program within the Pork CRC has successfully developed next generation scientists and filled gaps in the areas of nutrition, reproduction and grain science. Those expected to complete their higher degrees over the next 6-12 months will fill gaps in the areas of animal health, engineering and growth physiology.

Undergraduates

The Pork CRC undergraduate program (Honours awards) proved extremely successful and has resulted in the identification and development of some extremely competent and bright young people who will contribute to the Australian pork industry in the longer term.

Six of our Honours students have gone on to postgraduate studies and a number (at least 5) have been employed directly by Pork CRC participants in research roles and /or as part of graduate training programs. Others have been employed by other primary industry based organisations and/or have gone onto postgraduate studies at other Universities.

New course in pork production and science

In 2009 the Pork CRC developed a residential course “Pig Science into Practice” designed for producers, postgraduates and technically based industry people.

The course is held at the University of Adelaide’s Roseworthy campus in January and covers all technical and commercial aspects of pork production including visits to research, production, milling and processing facilities.

The course has proved extremely successful /popular with producers, students (undergraduate and postgraduate) and industry specialists and has been oversubscribed in its first two years of operation. The course developed by Professor Paul Hughes at SARDI is run through the University of Adelaide. It provides attendees the latest information on pork production most of which has arisen from Pork CRC research and how science and commercial production interact to affect profitability and the efficiency of production. The course will be made available to all other Australian Universities and is currently being prepared to be launched on line.

As part of its lifelong learning programs, the Pork CRC Refresher Courses for industry consultants / advisers have proven very successful. In 2010 the pork CRC held a refresher course on reproduction which was attended by 120 delegates. Based on the feedback from attendees the course was exceptionally successful and resulted in many producers adopting new technologies developed by the Pork CRC and/or presented and discussed by international participants and by some more successful Australian producers who were asked to contribute to the program. The refresher courses provide an excellent forum for researchers, consultants/advisers and producers to discuss and debate new technologies and how they might or should be implemented and would appear to enhance the uptake of new information and technologies. A third refresher course based on Pork CRC outcomes in the area of progeny performance and progeny based technologies for enhancing profit will be held in Melbourne in June 2011.

The Pork CRC postgraduate and undergraduate programs have also brought about change across the industry.

The work conducted by one of our postgraduates (Dr Megan Edwards) on the impact of nutrition in early life on the life time performance and survival of pigs resulted in the discovery of two ingredients that increased the health and survival of pigs and particularly of light birth weight piglets and gilt progeny. Previous Pork CRC research had established that both categories of animals were at high risk of poor overall performance and high mortality. The outcomes represent genuine breakthroughs and have been widely communicated to and adopted by industry. The findings are credited with significantly improving the overall performance and survival of pigs through to sale.

One of the Pork CRC honour’s students (Amy Lealiifano) established the time frame following the second vaccination against boar taint using the Improvac vaccine, over which plasma testosterone is reduced and the levels of androsternone and skatole (the two major compounds contributing to boar taint) decline to non detectable levels in carcass fat. The results showed that after only two weeks following the second vaccination testosterone was reduced to the level found in surgically castrated males and both androsternone and skatole had fallen to levels below those associated with the detection of “boar taint” in the carcass. The results were a world first and provided users of the technology in Australia and globally with information that enabled better and more cost

effective utilisation of the technology. Amy won the APSA medal for the best first time presentation at the meeting in 2009 and the Pork CRC Award for the best presentation at the same meeting. Amy is currently employed by Rivalea the largest pork producer in Australia.

The impact of the Pork CRC's education program on the industry is illustrated by the response of Dr Brian Luxford from Rivalea to the Board directed survey of non-core participants on the impact of the Pork CRC on the Australian industry.

" Apart from the obvious bottom line value of the research results, the Pork CRC has provided a number of additional benefits for Rivalea. The CRC has provided advanced training opportunities for a number of our existing staff including one PhD program which is near completion. Also we have employed additional research staffs who have come out of CRC programs. Employment of trained staff is becoming increasingly difficult".

Changes in the operating and business environments since the time the Pork CRC was funded (2005) and implications on the impact of the Pork CRC outcomes

The business environment has changed quite markedly since the Pork CRC began operations. Over the six year period the Australian pork industry experienced, along with the rest of the world's pork producing countries, an extended period of negative margins associated largely with large increases in grain and feed costs in 2007 and increased imports of pork from Canada, Denmark and the USA. The cost-price pressures resulting from these events brought about further rationalisation of the industry. During the last 2.5 years however, the Australian industry has enjoyed good margins and recovered from the 2007 "crisis" quicker than most other major pork producing countries. Nevertheless the continuing and increasing use of grain for fuel production and low reserve stocks of grain globally has recently pushed grain prices beyond the highs reached in the 2007 crisis. The trend is likely to continue and prices and supply may reach near unmanageable levels in 2012 depending on global grain harvest in 2011. Regardless of the supply situation in 2012 grain prices will remain volatile over the next 2-4 years.

The Pork CRC's concentration on reducing feed costs and enhancing feed conversion efficiency have resulted in new information and technologies that have benefited Australian producers. The outcomes will have even greater financial benefits in the high grain and fuel cost scenario facing the world at the moment and that is likely to continue for the next 2-3 years (at least). Food costs and food security will be at the forefront of politicians and world leaders agendas over the same time frame and technologies developed by the Pork CRC will contribute positively to both areas. For example the recent finding that combining the metabolism modifier Ractopamine with higher energy diets improved the carcass weight output per unit feed input by 22%. Ractopamine alone reduced the feed energy required per kg carcass weight produced by 11%.

The Pork CRC's research on Improvac showed that the use of the technology (developed in Australia) globally would enable producers to remove the inefficiency imposed by surgical castration across the pork supply chain and potentially reduce feed usage per male pig by 35-40 kg. Projected globally this would reduce feed usage across the major pork producing countries by 15 billion kg.

At the same time the world faces grain shortages retail pressures on the use of technologies such as Ractopamine especially in Australia and Europe is increasing and fails to realise the extreme pressures that currently exist on global food production and the impacts of such decisions on food costs and local and global food security but this is the contradictory environment in which we are living at the moment. It is likely that such decisions may be revisited and /or similar improvements in the efficiency of food production will need to be achieved by alternative means as the grain crisis becomes more obvious over the next 12 months. The new pork CRC for high integrity will address the more social aspects of pork production but the technologies developed by the current

pork CRC will play a major role in maintaining the margins and sustainability of Australian pork producers in what will be very challenging times ahead.

Impact of Collaboration

The outcomes from the Pork CRC would not have been possible without collaboration across research organisations and between researchers and end users.

Some 72% of all projects conducted by the Pork CRC have involved two or more organisations and the benefit to end users by collaborating with researchers is illustrated by the response of Dr Brian Luxford from Rivalea (Australia's largest pork production company) to a Board directed survey on the impacts of the Pork CRC. Dr Luxford's response was:

"The CRC with its emphasis on collaboration has also provided significant opportunities for interaction with both other producers and scientific groups. The benchmarking program established by the CRC is one example. This program provides a forum where producers can jointly seek solutions to improve productivity. The development of the base funding model has brought additional researchers utilizing Rivalea's facilities. This has provided additional opportunities for exchange of ideas".

Pork CRC and APL base funded facilities have been established in three commercial (end user) organisations, with two State governments and one University. The facilities in commercial facilities encourage researchers to conduct at least part of their projects in these facilities and to interact with end users. In general the more basic research is conducted within the facilities of research organisations (State government and Universities) and the more applied research and/or verification of the outcomes from basic R&D is conducted within commercial/end user facilities. In all cases the research projects are collaborative and include research and end user organisations as project participants. The latter often include SME and non Pork CRC participant organisations.

Over the course of the Pork CRC researchers from the University Of Adelaide, SARDI, DAWFA and The University of SA have conducted major collaborative research projects in the sow and grower R&D and commercial facilities provided by Australian Pork Farms Group in SA. Researchers from the University of Adelaide, SARDI, Charles Sturt University, University of SA, Cameron Hall and McLean (CHM - an end user), Sydney University and Melbourne University have conducted collaborative research projects in the facilities of Rivalea in NSW. Rivalea researchers have also collaborated in PhD and other programs using the laboratories and discovery facilities within Adelaide University.

Researchers from SARDI, University of Adelaide and other research organisations have been involved in conducting R&D projects in the commercial facilities provided by CHM.

Of the seven Pork CRC postgraduate students who have received their higher degrees all conducted the majority of or a component of their studies in commercial facilities and were closely involved in communicating their findings and their commercial implications to the production staff in all cases. A number of honours students have also conducted their research projects within commercial facilities.

Two of the better examples of collaborations delivering important outcomes to the industry involve the development of the vaccine against APP and the provision of new information and technologies to improve sow longevity.

The APP project involved collaboration between the Victorian Department of Primary Industries who conducted the basic challenge studies to establish the effectiveness of the vaccine, Australian pork Farms Group and Rivalea who tested the vaccine under commercial situations and ACE Laboratories in Bendigo Victoria a SME who perfected the development, storage and distribution of

the vaccine to end users and commercial researchers. ACE Laboratories also developed the quality control testing procedures (with Queensland State government researchers) that are applied to every batch of the vaccine before it is released. No single organisation could have developed and delivered the vaccine to the industry working in isolation.

The sow longevity project involved collaboration between researchers at SARDI and the University of Adelaide with three end users (APFG, CHM and Rivalea) the animal health company Elanco and geneticists including a pork CRC Postdoc from AGBU. The research program involved both basic and more practical studies aimed at establishing the causes of high sow turnover in Australia and investigations on various interventions. The project has resulted in two patented technologies for minimising sow body protein loss in lactation, the development of nutritional strategies for improving the retention of gilts in the herd after their first lactation and subsequent reproduction, unique information on the effects of nutrition and lactation demand on the life time performance of sows and new information on the genetics of sow longevity. Without the management (think tank) group comprising members from all collaborating organisations and a coordinated research approach across the organisations based on new ideas and the outcomes from the more basic R&D the outcomes would not have been delivered or would have been much more limited in scale.

Relationship to the new Commonwealth agreement

Projects that have not been completed in the current Pork CRC will be transferred as residual projects to the new pork CRC and completed within the first 12 months operation of the extension Pork CRC. Research outcomes from the current pork CRC that have direct impacts on the objectives and milestones with the new Pork CRC will be pursued within the new pork CRC.

The commercialisation of outcomes from the current pork CRC will be conducted under a separate company and independent companies and/or through licences with the new pork CRC.

Additional research on discoveries from the current Pork that warrant follow up/development but do not fit the objectives of the new Pork CRC will be perused through APL and in particular APL Specialist Groups 2 and 3. Specialist Group 3 is chaired by the CEO of the Pork CRC will help ensure R&D outcomes from the current Pork CRC are followed up where warranted and that the transfer of technology and responsibilities across organisations occurs in a coordinated manner.

There are a number of projects that will be completed within the new Pork CRC and other outcomes pursued by APL that are expected to have further impacts on the cost competitiveness and efficiency of the Australian pork industry. These include nutritional and other means of increasing reproduction and reducing the impact of seasonal infertility on reproduction, alternative nutritional strategies to reduce feed costs between 20 and 100 kg (potentially by \$7.00/pig) , explore the impact of Chromium Picolinate on the feed efficiency and carcass characteristics and further investigations on discoveries from Pork CRC initiated research on the effects of materials for improving carcass dressing percentage and the fatty acid composition of carcass fat.

The impacts will have economic and social benefits through further cost reduction or enhanced cost effectiveness and through maintaining and or increasing employment across the pork supply chain.