Programme Review
Lower Carbon Meat & Dairy

Document purpose:	This document is the result of the programme reviews EECA and MBIE conducted across EECA's programme portfolio in 2016. The reviews were in response to a requirement to reprioritise the EECA's portfolio in the context of the new NZEECS, the new EV programme, and expanded levy. The framework for the review is available here. The reviews were based on existing documentation and workshops with MBIE, PwC and EECA staff.

About Lower Carbon Meat and Dairy

The Lower Carbon Meat and Dairy pilot programme focused on maximising energy efficiency and reducing carbon emissions in New Zealand's meat, dairy and seafood sectors[1] by reducing the energy used in processing (mainly fossil fuels in the form of coal and gas). Fuel switching opportunities were identified among other possible actions to reduce energy use, but these were rare and not the focus of the business cases.

Key components of the programme were:

- Developing and managing relationships with contracted service providers (after request for proposals).
- Contracting with energy consultants nationwide to conduct energy audits and develop good quality business cases, in non-technical language, for consideration by senior decision-makers in the meat and dairy businesses.
- Providing 75 per cent cost reimbursements (up to $15,000) to businesses who present an action plan based on consultants' recommendations.
- Advice from EECA's project and relationship managers.

Conclusions

There is a strong role for government to intervene in the meat, dairy, and seafood industries to overcome the lack of information and affordability barriers in the market and extract the significant public benefits identified. There is also strong alignment with the proposed New Zealand Energy Efficiency and Conservation Strategy (NZEECS) priorities.

The Lower Carbon Meat and Dairy programme has been an effective intervention which has generated a good return on public investment at relatively low scale. The programme has been successful by focusing on more easily achieved change; that is, encouraging businesses to optimise the facilities they have, rather than on activity requiring capital investment. This has generated both strong private and public benefit. The meat and dairy processing industries are low-margin so small achievements can make a large difference to profits.

The success of the Lower Carbon Meat and Dairy programme could be replicated across the meat, dairy, and seafood sectors and other sectors, and targeted at areas of highest potential. This could

[1] The scope of the programme was expanded to include the seafood sector, which shares many market characteristics with the meat and dairy sector. There are less potential sites in the seafood sector and only Sanford participated.

be achieved through, for example, the use of case studies or the “demonstration effect”, or increasing visibility throughout a business by making a board member responsible for energy efficiency. However, EECA’s experience with this and other programmes suggests that self-sustaining behavioural change is difficult to implement.

Recommendations

Analyse the effectiveness of each intervention activity within the programme (e.g. business plan, management capability support) to assess effectiveness of individual activities and any lessons. It is recommended that an evaluation plan be refreshed and actioned at an appropriate time.

Utilise the Ministry of Business, Innovation and Employment and EECA’s analysis of potential investment return on:

- efficiency opportunities (optimising existing facilities), versus
- fuel switching opportunities (requiring capital investment) in process heat.

In light of this analysis, consider replication of the Lower Carbon Meat and Dairy model in this and other sectors, targeting the potential public benefits in process heat with the highest energy users represented by the Top 200 Programme (as proposed within the refreshed NZEECS).

Contents

1 The problem

1.1 Problem description

Dairy, meat and seafood processors are not prioritising economic opportunities to improve the energy efficiency of their plants through improvements to heat recovery processes, boiler tuning or fuel switching (e.g. from coal to wood). EECA estimates there are 0.5PJ of energy savings that can be made through greater energy efficiency in the meat and dairy sector. These savings are not being made because businesses:

- do not know they could be saving energy
- do not value or prioritise energy efficiency
- are constrained financially and thus don't spend money obtaining information.

This leads to higher energy use and costs, and more greenhouse gas emissions than if they were making the most efficient use of their energy.

1.2 The programme

1.2.1 Origins

In 2013 the Minister of Energy and Resources commissioned EECA to investigate new opportunities for energy efficiency and carbon savings outside EECA's mainstream programmes. The Lower Carbon Meat and Dairy pilot programme is one of four small-scale programmes designed to meet this request.

The other three pilot programmes were the Fuel Efficient Tyres programme (2014 – 2016), Heavy Vehicle Fuel Efficiency programme (2014 – 2017), and Wood Energy South initiative (2014 – 2017). Each pilot programme was funded from a small amount of retained earnings rather than from baseline.

1.2.2 Purpose

The LCMD programme focused on maximising energy efficiency and reducing carbon emissions in New Zealand's meat, dairy and seafood sectors[2] by reducing the energy used in processing (mainly fossil fuels in the form of coal and gas). Fuel switching opportunities were identified among other possible actions to reduce energy use, but these were rare and not the focus of the business cases.

The programme ran for two years, from 2014 to June 2016, and targeted a carbon savings of 7,000 tonnes per year.

1.2.3 Key components

The LCMD programme cost $732,000 during its two-year duration. Key components of the programme were:

- Updating and utilising the Heat Plant Database to target meat and dairy heat plants.

[2] The scope of the programme was expanded to include the seafood sector, which shares many market characteristics with the meat and dairy sector. There are less potential sites in the seafood sector and only Sanford participated.

- Developing and managing relationships with contracted service providers (after request for proposals).
- Contracting with energy consultants nationwide to conduct energy audits and develop good quality business cases, in non-technical language, for consideration by senior decision-makers in the meat and dairy businesses.
- Providing 75 per cent cost reimbursement to businesses who present an action plan based on consultants' recommendations.
- Advice from EECA's project and relationship managers.

EECA estimates that around $2 million of investment in energy efficiency will be made by processors in 2017.

1.3 Market characteristics

The main market actors involved in the LCMD pilot project are meat and dairy processing sites, the majority of which are large energy users,[3] and energy management experts with established credentials in these sectors. While seafood processing was added to the project, only one site investigated energy efficiency opportunities.

1.3.1 Meat and dairy processing sites

- The meat and dairy processing industry is made up of approximately 200 sites owned by large farmer cooperatives and independent operators. Meat and dairy processors use boilers to produce heat, hot water, and steam to sanitise their plants, and to process raw product into other product for sale (such as to convert liquid milk into powder).
- The meat and dairy processing sectors consume approximately 12 PJ of coal and 8 PJ of gas for industrial heat. These sites use 1800MW of heat plant in the dairy sector and 460MW of heat plant in the meat sector, and have an average energy spend of $1m per site per annum.
- All participants in the lower carbon meat and dairy project are large energy users (i.e. businesses with an annual energy spend of greater than $2.5 million). Around 70% of the sites participating are meat processing, and the remainder are dairy processing with one seafood processing site. Around 60% of the sites are using coal with the remainder using natural gas. The parent company of the majority of these sites had existing relationships with EECA through the Top 200 programme (e.g. ANZCO, AFFCO, Fonterra, Alliance, Goodman Fielder, Lion, Oceania Dairy).

As participants in the Top 200 business programme, the majority of processing sites exhibit the following characterises:

- Many companies are large exporters and run very small profit margins, such as businesses within the meat processing sector. Most companies are large employers and as such play an important role in local communities and economies.
- Processing plants vary widely in age, level of energy efficiency and long-term likelihood of survival, which impacts the approach to investment in upgrades at individual plants.

[3] These large energy users in the meat and dairy sector are likely participating in the Top 200 business programme.

- Depending on their capability, the business approaches to energy management can be very different even within the same sector. For many companies energy can be a small proportion of total costs.
- The majority of businesses prioritise health and safety, production/through-put, growth, cost reduction and quality ahead of reducing their carbon footprint.
- A large number of these businesses are in overseas ownership which can have a large impact on supply chain management, the budget and approval cycle, site priorities and approach to sustainability (e.g. Chinese-owned versus European-owned as a stark comparison).
- Many of the leading companies are open to sharing information within their sectors and are willing to collaborate on energy efficiency and sustainability between sectors. More and more businesses are starting to regard the priority of energy efficiency as being similar to health and safety.
- Energy management within businesses is driven by engineering capability and an increasing sustainability focus (while growing, this is still a weaker driver in comparison to cost).

1.3.2 Energy management experts (service providers)

Sixteen energy management experts (consultants) are registered through the project. EECA had existing relationships with the majority of the consultants accredited. These consultants were already providing energy audits and/or business cases in the industrial and food processing sectors. Maintenance contractors also regularly work with meat and dairy processing sites.

Energy consultants include energy managers, engineers, energy auditors, and energy technology specialists. Consultants provide technical advice and deliver on energy efficiency projects. The market is dominated by technical specialists who are well-equipped to diagnose energy efficiency issues and to engage at an operational level. In many cases they engage with clients on an ad hoc basis rather than developing long-term relationships.

Maintenance contractors, including boiler tuners, have regular involvement with processing sites but are often reactive and focused on reliable operation of heat plant. They may lack the skills or incentives to proactively identify and evaluate opportunities to invest in more efficient heat production.

2 Strategic fit

The programme aims to increase the energy efficiency of process heat in the food processing sector which aligns with the following government priorities in Table 1.

***Table 1:** Programme alignment with government priorities*

NZEECS 2011-2016
"Enhanced business growth and competitiveness from energy intensity improvements." – *Business objective*
Business Growth Agenda
"Improve energy efficiency and use of renewable energy to raise productivity, reduce carbon emissions and promote consumer choice" – *Focus area 7 of the natural resources chapter*

3 Role for government

3.1 Market failures and barriers

The role for Government is based on the presence of market failures and barriers which prevent meat, dairy and seafood operators from being more efficient with their energy use. The market failures and barriers fall primarily into four categories:

- A lack of information and understanding.
- Affordability barriers, both real and perceived.
- Split incentives between operational staff and management.
- A culture of risk aversion amongst decision makers.

These prevent the market from operating most efficiently, and from taking up opportunities to use energy more effectively. The LCMD programme addresses these market failures and barriers.

Government action will help to overcome these market inefficiencies. While the benefits are largely private benefits through reduced energy costs, these savings will contribute towards economic growth and development at a national level, and contribute towards the Business Growth Agenda (e.g. through the reduction of carbon emissions).

EECA is also using these private benefits to motivate participants to generate public goods. There are public goods in the form of savings of carbon emissions that will be delivered through the programmes. There is a potential role for Government in cases such as this where the public benefits are not captured by private market agents.

3.1.1 Market failures

Operators lack the resources or technical expertise to understand potential reduced energy costs and productivity improvements that could be gained from understanding their energy use. It was also identified that there are split incentives within these businesses, between operational level staff and senior management that prevent energy efficiency from becoming a priority. These market failures are discussed further below.

Lack of information and understanding

Market theory assumes all participants have perfect information, but this is rarely the case. Where participants lack information and understanding, there is a role for government in ensuring that they have the information they need to make informed decisions, and to assist them more directly when they lack capacity to deal with that information.

The value of government action in providing information is demonstrated by people altering their decision-making and acting differently when provided with information. Since people have limited capacity to seek out information, in particular where they don't know they have information gaps (the "unknown unknowns"), government action is warranted to ensure people's choices are well-informed.

Here, at a business level, the information barrier can be of different types:

- Actual lack of knowledge – not knowing energy efficiency represents an opportunity.
- Actual lack of understanding – not knowing how to achieve energy efficiency.
- Lack of motivation – believing energy efficiency to be too hard and/or not a priority.

Part of the barrier to motivation is that energy costs, even among large energy users, do not constitute a high proportion of total costs. A business whose energy use is 20% of their costs, told they can save 10% of their energy use, will only be looking at a 2% reduction in costs.

The LCMD programme addresses these barriers directly by working with businesses to identify opportunities (including the scale of opportunities) and helping them to make action plans (lowering the barriers to action).

3.1.2 Market barriers

Affordability

Affordability barriers can be present when businesses would like to invest in a long-term saving but cannot afford the upfront cost. Within businesses there are constraints on resources (both people and capital) and so energy efficiency projects compete for resources with other strategic priorities within businesses. Meat and dairy businesses are under immense pressure to produce profit as businesses focus on surviving in a competitive market. This prioritisation is unlikely to be a market failure (businesses will often be prioritising appropriately for their needs), but the constrained resources remains a barrier to the market working efficiently, since it will result in higher than necessary energy costs. There is a role for government in helping businesses overcome these barriers to assist the market to work more efficiently and generate public benefits that would otherwise not be made.

There is a real affordability issue over information, as bringing in an expert to provide relevant, quality information comes with a cost hurdle. This puts businesses off seeking this information, even if the potential savings far exceed the expense. The Government is addressing this barrier by reimbursing much of the cost of seeking information if the businesses agree to act on it. In this way, an investment in information that is seen as risky will be seen as safer by businesses.

However, much of businesses' concerns with affordability are about perception of risk and payback, and prioritisation more than a lack of funding. Some businesses who say they cannot afford to be energy efficient will change their mind with sufficient information on the relative costs and benefits.

In these cases, the affordability barrier is a perceived barrier rather than a real barrier, and given sufficient certainty that the investment in energy efficiency was worthwhile, businesses will make the investment. Here, the Government is helping businesses to make more rational choices and overcome their inherent biases by providing information.

Culture among decision makers

Management capability in these businesses can be low. An aversion to external advisors is common in the industry, particularly amongst the people that typically make decisions in the meat and dairy sector. There is also a potential 'she'll be right' attitude to asset management.

Split incentives

Operational staff and management have different incentives which can prevent the prioritisation of energy efficiency. Operational staff can readily identify energy efficiency opportunities, but are not able to construct business cases in the language that influences management, who tend to have a broader view of an organisation when deciding on capital expenditure.

3.2 Potential benefits

Table 2: *Type of benefits expected from the programme*

PUBLIC BENEFITS	PRIVATE BENEFITS
• Avoided greenhouse gas emissions (primary) • Improved energy security • Improved air quality	• Reduced costs (primary) o Fuel o Other utilities (water and electricity) o Maintenance

Avoided greenhouse gas emissions – primary public benefit
Improvements to businesses' energy efficiency will reduce the burning of fuels, or the combustion of fuel to produce electricity. This directly reduces New Zealand's greenhouse gas emissions.

Improved energy security – public benefit
Reductions in fossil fuels used lower our reliance on imports of fuel and improve our security of supply, were outside events to interrupt our fuel imports.

Improved air quality – public benefit
Reductions in fossil fuel burned, particularly coal, will lower the amount of pollutants in the air, leading to lower rates of respiratory illness for those in the surrounding area where this is an issue.

Reduced costs – primary private benefit
The primary private benefit of the programme is a reduction in fuel, utility and maintenance costs to participating businesses. In addition to the direct benefits, these flow through to increases in productivity and competitiveness and contribute to national economic growth.

3.3 Potential costs

To date, the programme does not seem to have crowded out private sector initiatives or created any unintended side effects.

EECA has made a conscious effort to avoid crowding out private actors by collaborating with energy audit consultants nationwide. This included contracting with energy consultants nationwide to conduct energy audits and developing good quality business cases, and cost reimbursements to processors who present an action plan based on these business cases.

4 Intervention

4.1 Intervention logic

An intervention logic was put together during evaluation planning in 2014 (see Appendix One).

4.2 Options

There are other means to address the market barriers identified (such as training energy users, providing case studies, improving metering and monitoring systems). These are complementary options rather than alternatives to the chosen option.

EECA considered options on the shape of the specific offer (e.g. whether the subsidy was provided directly to heat users or indirectly through consultants; the level of financial contribution split between EECA and the heat users; and the choice between funding energy audits and business cases). Previous EECA business programmes provided businesses with audits to identify potential energy savings and encourage investment to achieve savings. However, the rates of conversion from audits to action have been as low as 10% for specific technologies[4].

No options analysis was conducted to determine how to best solve the problem identified. However, EECA did consider options for:

- the amount of retained earnings which should be spent on the LCMD pilot programme versus the other three pilot projects
- what level of funding should be given to each component of the LCMD programme; for example, the level of cost reimbursement that should be given to processors who produce an action plan.

4.3 Investment objectives

Inefficiencies in industrial heating for the meat and dairy sector result in excessive energy consumption. This pilot programme planned to reduce this by 0.1 PJ per annum by targeting around 50 fossil-fuelled meat and dairy plants. Based on market data and estimated participation, this would lead to 7,000 tonnes of CO_2 emissions avoided each year.

Expected outputs of the programme are:

[4] Compressed air analysis - Evaluation plan information.msg

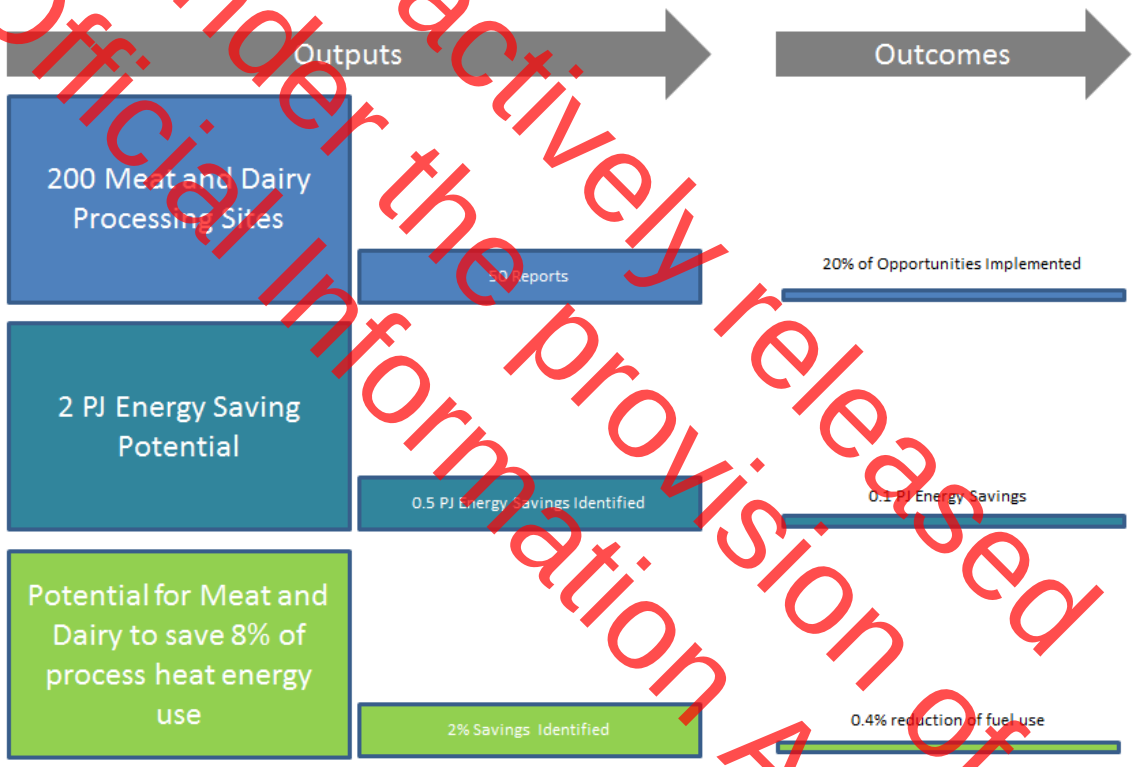
- National energy savings of 0.1 PJ per annum from a mix of coal and gas.
- 7,000 tonnes of avoided CO_2 emissions per annum.
- An improvement in the industrial sector energy intensity level.

In the longer-term, the programme aims to improve the energy productivity of the meat and dairy processing sector, and reduce the amount of carbon emissions per dollar of GDP created.

4.4 Potential impact

The meat and dairy processing industry is made up of approximately 200 sites owned by large farmer cooperatives and independent operators. The programme is expected to have reached 50 sites (25%) over two years (Figure 1).

***Figure 1**: Expected impact of the programme*



4.5 Market readiness

EECA had existing relationships with the majority of the consultants accredited. These consultants were already providing energy audits and/or business cases in the marketplace and so capability of market participants to deliver the programme has not been an issue.

4.6 Risks

Table 3: Identified risks to programme success

Risk	Likelihood (high, med, low)	Mitigation
May lock in coal use for longer	Low	Don't recommend anything that prolongs coal boiler life, only encourage combustion tuning and heat recovery as it will reduce fuel use and carbon emissions.
Business cases are not acted on	Medium	Have conservatively estimated 20% energy savings arising from action in response to the business cases. CEO-level commitment will be required under the contract, and $15,000 payment made only after the action plan is signed off by the CEO. EECA research shows that often the management level is disconnected from operational issues and this approach is required to get action.
Data for monitoring and evaluation is unavailable or of poor quality	Medium	For larger projects (with annual carbon savings of at least 500 tonnes), EECA will fund monitoring and verification to identify 'scope 1' savings consistent with international standard IPMVP or ISO 50015:2014 by a certified practitioner. For small projects or those where it is not possible or practical to verify savings using IPMVP, savings will be reported as 'scope 2' as per EECA's Measurement and Verification Guide.

4.7 Interdependencies

The Lower Carbon Meat and Dairy programme is delivered through partnerships with large energy users participating in the Top 200 business programme. These partnerships provide the relationship basis for promoting the Lower Carbon Meat and Dairy programme and also a vehicle for following up on opportunities that require further investigation and to ensure reporting on the projects.

4.8 Resource allocation

- 0.65 FTE
- $0.681 million over 2 years.

5 Performance

5.1 Effectiveness

In total, around 50 sites investigated opportunities such as improved heat recovery processes, boiler tuning or fuel switching to renewables. Sites were targeted nationwide, reaching major dairy and meat regions including Waikato, Whanganui, and Canterbury.

Around 70% of participating sites are meat processing. The remainder are dairy processing and there is one seafood processing site. Around 60% of the sites are using coal with the remainder using natural gas.

All participants in the programme are large energy users and the majority had a parent company with an existing relationship with EECA (e.g. ANZCO, AFFCO, Fonterra, Alliance, Goodman Fielder, Lion, and Oceania Dairy).

5.2 Achieved benefits

The programme is on track to meet its targets. The programme's performance against its targeted objectives is summarised in Table 4.

Table 4: Programme performance against targets

Target	Result
National energy savings of 0.1 PJ per annum from a mix of coal and gas	Annual energy savings by opportunity status: • 0.08 PJ is complete • 0.075PJ committed, and • 0.091 PJ is in the pipeline
7,000 tonnes of avoided CO_2 emissions per annum	CO_2 annual savings by opportunity status: • 5,141 tonnes are complete • 4,477 tonnes are committed, and • 12,546 tonnes are in the pipeline
An improvement in the industrial sector energy intensity level	There is no overall metric on industry-wide energy intensity. Energy savings have been realised through efficiency gains by 19 sites that have implemented energy-saving measures.

5.3 Value-for-money

A cost-benefit analysis was conducted to assess the quantifiable outcomes of EECA's expenditure from programme inception through to the end of the 2015/16 financial year. The results are summarised in Table 5 and details and assumptions are outlined in Appendix Two. Future benefits (e.g. energy savings) accruing from EECA expenditure to year end 2015/16 are included assuming a lifetime of 10 years.

At this early stage of project implementation there are no measured benefits. Estimates of benefits were taken from the consultants' business cases and costs were based on specific activities, providing a relatively high level of granularity.

Despite this and the lack of detailed records of client companies' costs of project implementation, the metrics determined are considered relatively robust in the context of the overall programme review process because:

- only committed and completed projects are included in the analysis
- it is probable the additionality of this programme is relatively high given the low profitability of the meat industry (especially) and its historically low uptake of energy efficiency measures
- there are potential projects in the pipeline awaiting decisions amounting to a further 12,000 tonnes CO_2-e per year. In that sense, the figures for completed and committed projects are a floor or a minimum of the benefits provided, which will increase as some of the projects in the pipeline are completed.

***Table 5:** Cost-benefit analysis results for Lower Carbon Meat and Dairy*

Metric	Description	Value	Comment
Net present value		$5.9m	Based on the projected fuel savings and costs anticipated in the consultants' business cases
Benefit-cost ratio	PV all benefits/PV all costs	2.6:1	
ROI-Government	PV public (government) benefits/PV public (government) costs	2.3:1	Public benefits from carbon dioxide reduction are significant given the type of fuels

5.4 Programme future

EECA account managers will continue to monitor implementation of action plans. An evaluation plan has been developed but budget has yet to be assigned. It is expected that programme management will continue after 30 June 2016 until contracts with consultants are completed (i.e. the point where clients adopt an action plan to reduce CO_2 emissions). Those in the pipeline will be tracked to observe their decision whether to act or not based on the business cases produced. At present, results are measured based on business cases and energy audit findings. Once actions have been implemented, EECA will spot test actual results to check the programme has delivered on its objectives.

The approach of providing assistance with business case production is being wrapped into the larger Top 200 business programme.

6 Lead organisation

Given EECA's statutory mandate to promote energy efficiency, its role in the NZEECS, and its existing relationships with energy specialists and businesses through the Top 200/Next 1000 programme, it is best placed to lead the LCMD programme.

7 Conclusions

There is a strong role for government to intervene in the meat, dairy, and seafood industries to overcome the lack of information and affordability barriers in the market and extract the significant public benefits identified. There is also strong alignment with the proposed NZEECS priorities.

The Lower Carbon Meat and Dairy programme has been an effective intervention which has generated a good return on public investment at relatively low scale. The programme has been successful by focusing on more easily achieved change; that is, encouraging businesses to optimise the facilities they have, rather than on activity requiring capital investment. This has generated both strong private and public benefit. The meat and dairy processing industries are low-margin so small achievements can make a large difference to profits.

The success of the Lower Carbon Meat and Dairy programme could be replicated across the meat, dairy, and seafood sectors and other sectors, and targeted at areas of highest potential. This could be achieved through, for example, the use of case studies or the "demonstration effect", or increasing visibility throughout a business by making a board member responsible for energy efficiency. However, EECA's experience with this and other programmes suggests that self-sustaining behavioural change is difficult to implement.

8 Recommendations

Analyse the effectiveness of each intervention activity within the programme (e.g. business plan, management capability support) to assess effectiveness of individual activities and any lessons. It is recommended that an evaluation plan be refreshed and actioned at an appropriate time.

Utilise the Ministry of Business, Innovation and Employment and EECA's analysis of potential investment return on:

- efficiency opportunities (optimising existing facilities), versus
- fuel switching opportunities (requiring capital investment) in process heat.

In light of this analysis, consider replication of the Lower Carbon Meat and Dairy model in this and other sectors, targeting the potential public benefits in process heat with the highest energy users represented by the Top 200 Programme (as proposed within the refreshed NZEECS).

9 Appendices

9.1 Appendix One – Intervention logic

WHAT PROBLEM ARE WE SOLVING (MARKET FAILURE)?

Imperfect information: Operators lack of resources or know how to understand potential reduced energy costs and productivity improvements that could be gained from understanding their energy use.

Split incentives issue: People in the organisation who can see energy inefficiencies and potential for improvement are often at an operations level and are not at the individuals making capital expenditure decisions.

Perceived affordability: A lack of information on the benefits of energy efficiency leads processors to believe there in issue with the perceived affordability of capital investment. The initial outlay fails to seem cost effective when the potential savings are understated.

9.2 Appendix Two – Cost Benefit Analysis

This cost-benefit analysis assesses the quantifiable outcomes of EECA's expenditure from programme inception through to the end of the 2015/16 financial year. General assumptions applied in the analytical framework used in this review:

- EECA costs include all direct internal costs and payments and grants to service providers and client companies. General EECA overheads have not been included.
- All third party capital and operating costs, whether actual or estimated, are included. Estimated/budget costs and benefits are used in the absence of actual measured benefits. Source, granularity and attributed confidence of this data are noted.
- Only expenditure to year end 2015/16 is included, anticipated subsequent payments are omitted.
- Future benefits (e.g. energy savings) accruing from EECA expenditure to year end 2015/16 are included. Benefits from future expenditure omitted.
- Comment is made on the likely additionality of the EECA programmes.
- Cash flows are expressed in NZ$2016 discounted at the default Treasury rate of 7%.

Specific inputs used in the review of the Lower Carbon Meat and Dairy programme:

- EECA direct costs of running the programme plus about 75% of payments to consultants developing the business cases. These are treated as public costs and are taken from EECA's internal records.
- Third party costs, including the residual costs of developing the business cases plus the costs of implementing the proposals contained therein. The latter have been drawn from the consultants' business cases for each project within the programme. These are designated private costs.
- The principal quantifiable benefit is the reduction in fuel consumption by the client companies. This is a private benefit. Estimated savings have been taken from the consultants' business cases which estimate energy savings by fuel type and quantity for specific project activities.
- Reduced carbon dioxide emissions can be directly associated with the fuel savings. This is a public benefit.
- Only projects with a completed or committed status are included in this review. Other prospective projects arising from the programme have been identified but have not received commitment from the client companies as yet.
- Fuel savings arising from the programme are assumed to continue for ten years. This is a generalised average as the programme activities cover a range of operational and capital projects with benefit lifespans likely to range from a few years to about 20 years in the case of capital investment. A ten year life was assumed in the original programme cost-benefit analysis.
- MBIE's price monitors have been used for deriving economic prices for fuels. Market prices have been used for fuels not included in the monitors and all future prices are maintained at

the 2016 level. Carbon dioxide prices are set at the average value of an NZU in each year of the programme and valued at $25 per tonne thereafter.

Costs and benefits are summarised in the table below.

	2015	*2016*	*2017*	*2018*	*2019*	*2020*
Expenditure $M						
Surveys						
EECA	-0.481					
Third Parties	-0.176					
Capex						
EECA		-0.100	-0.100			
Third Parties	0.00	-0.76	-1.94	0.00	0.00	0.00
Value of Energy Saved $ million	0.00	0.00	0.58	1.16	1.16	1.16
Value of Emissions Reduction $ million	0.00	0.00	0.15	0.26	0.26	0.26

Key conclusions to draw under these assumptions:

- The net present value of the programme to date is in the order of $5.9 million (see table below) based on the project fuels savings and costs anticipated in the consultants' business cases.

		2015	*2016*	*2017*	*2018*	*2019*	*2020*
Cash Flow: $2016 million	*PV 2016 $M*						
EECA Costs	*-0.766*	-0.481	-0.251	0.000	0.000	0.000	0.000
Third Party Costs	*-2.949*	-0.088	-0.946	-2.042	0.000	0.000	0.000
Energy Saved	*7.860*	0.000	0.000	0.579	1.157	1.157	1.157
CO2 Reduction	*1.753*	0.000	0.000	0.146	0.257	0.257	0.257
Net Present Value	*5.899*						
Ratios							
All Benefits/All Costs	*2.59*						
Public Benefits/Public Costs	*2.29*						
Public Benefits/Private Benefits	*0.22*						
Private Costs/Public Costs.	*3.85*						

- Benefits fall principally to the private sector through fuel cost savings. However, public benefits from carbon dioxide reduction are significant given that the fuels reduced, gas (63%) and coal (33%), have relatively low marginal economic values and coal has a high carbon dioxide emission factor.
- Funding business cases for client companies to invest in energy efficiency measures, results in a high leverage of private investment from public costs – the private cost to public cost ratio approaches 4:1.
- Consequently, the public benefit to public cost ratio for the programme to date is 2.3:1.
- Changing the assumed average life of the fuel savings accruing from the programme will significantly impact the public benefit to public cost ratio. At 5 years the ratio will fall to 1.5 but will increase to 3.0 if the life is extended to 15 years.

This analysis has quantified greenhouse gas emission reductions and reduced fuel consumption by client companies. There are expected to be benefits that have been unquantified and the scale is unknown. These include improved energy security, improved air quality, increased productivity and competitiveness.

Despite there being no measured energy savings from the programme or detailed records of client companies' costs of project implementation upon which to base this analysis, the resulting economic metrics determined are relatively robust in the context of the overall programme review process:

- The consultants' business cases estimating fuel savings and costs were based on specific activities, providing a relatively high level of granularity.
- Only committed and completed projects are included in the analysis.
- The Lower Carbon Meat and Dairy programme has been undertaken as a pilot programme and is effectively completed.
- It is probable the additionality of this programme is relatively high given the low profitability of the meat industry (especially) and its historically low uptake of energy efficiency measures.