Cut Waste, GROW PROFIT™

Reducing Food Waste by Addressing the Disconnect between the Attitude and Behaviour of Producers and Managers of Businesses Situated along the Value Chain

May 30, 2013

www.cutwastegrowprofit.com

Investment in this project was provided by Agriculture and Agri-Food Canada's Adaptation Programming and administered by the Agricultural Adaptation Council.
Acknowledgements

We gratefully acknowledge the support and advice provided by Professor Ralph Martin, Loblaw's Chair of Sustainability, University of Guelph, and the George Morris Centre, Guelph, Ontario.

We appreciate the advice provided by Canadian and UK experts in the field of beef and process improvement, including David Evans, Dr. Phil Hadley, Sean Firth, and several others. We also thank Dr. Keivan Zokaei and Professor Peter Hines of S A Partners, UK, for contributing their expertise to the Cut Waste, GROW PROFIT™ initiative.

Report Authors

Martin Gooch (Canada)
Nicole Marenick (Canada)
Dan Laplain (Canada)
Benjamin Dent (UK)

2013 Cut Waste, GROW PROFIT™ Forum

The second annual forum will take place on Tuesday, November 12, 2013. Maple Leaf Foods Inc. is once again a lead sponsor, providing its ThinkFOOD! Centre for the venue, which is located in Mississauga, Ontario.

The keynote speaker is Dr. Peter Whitehead, former Director of the UK’s Food Chain Centre and now a coordinator of WRAP’s (Waste Reduction Action Plan) business-level waste reduction programs.

Forum information, including registration details, will be available via the following website: www.cutwastegrowprofit.com.

Forum Contact:

S. Caroline Glasbey
Director, Corporate Communications
Value Chain Management International Inc.
Tel: +1 289-291-3991
Email: caroline@vcm-international.com

While the Value Chain Management Centre and VCM International have verified the secondary data presented in this report wherever possible, we cannot guarantee that the information provided by Statistics Canada, peer reviewed papers, and other sources are accurate.
Table of Contents

Acknowledgements .......................................................................................................................... 1
2013 Cut Waste, GROW PROFIT™ Forum .................................................................................... 1
Executive Summary .......................................................................................................................... 3
1 Introduction ................................................................................................................................... 5
2 The Extent of Food Waste and Its Environmental Impact .............................................................. 8
   2.1 Quantifying the Extent of Food Waste .................................................................................. 8
   2.2 Environmental Implications of Food Waste ....................................................................... 10
   2.3 Initiatives Designed to Combat Food Waste ....................................................................... 11
3 Demonstrating the Opportunities in a Specific Industry (Beef) .................................................. 16
   3.1 Beef Chain ............................................................................................................................. 18
4 Practical Model for Improving Performance .............................................................................. 22
5 Conclusion .................................................................................................................................. 32
Endnotes and References ................................................................................................................ 34

List of Figures

Figure 1-1: How active are you in trying to reduce food waste? .................................................... 5
Figure 1-2: What priority does (vs. should) food waste reduction have in your work environment? 6
Figure 2-1: Estimates of Where Food Waste Occurs along the Value Chain ............................... 8
Figure 2-2: How important is it for Canada to implement a program such as WRAP? ................. 13
Figure 2-3: Who should take the lead on establishing food waste reduction programs? ............. 14
Figure 4-1: Steps used to define and improve the effectiveness of operations ................................ 23
Figure 4-2: Pareto chart of waste types ......................................................................................... 24
Figure 4-3: Process A – Capability ............................................................................................... 27
Figure 4-4: Process A – Control Chart ......................................................................................... 28
Figure 4-5: Process A – Improvement Target .............................................................................. 30

List of Tables

Table 2-1: Environmental Implications of Food Waste ................................................................. 10
Table 2-2: Ranking of resources required to encourage necessary changes in business management 14
Executive Summary

Food waste and its implications for society is an enormous challenge facing us today. The impact that a combination of lifestyle and a dysfunctional food system have on the environment is extraordinary. If everyone lived as opulently as North Americans, our planet would sustain just 1.5 billion people. With natural resources already under immense strain, and the air that we breathe containing unprecedented levels of carbon dioxide, feeding a burgeoning population will not solely rely on increasing production. Neither does it lie in managing organic waste more effectively, which is akin to closing the door after the horse has bolted. It lies in using our natural resources more effectively, to reduce as much waste as possible from occurring in the first place.

Numerous reports have focused on identifying and addressing food waste that can be observed. This kind of waste can often be identified and addressed relatively easily. What is more difficult to quantify are the associated wastes (incl. energy, water, labour, etc.) and their economic and environmental impact. This report goes beyond current discussions, by identifying the types of food and associated wastes that cannot be readily observed, though can have enormous economic, social, and environmental impacts. The final section of the report presents a framework that the Value Chain Management Centre and the VCM International team have used on numerous occasions to improve businesses’ profitability and reduce their environmental impact, through reducing food and associated wastes.

The identification and eradication of waste that may not be observable without objectively analyzing performance and the relationships that exist between the three factors that ultimately determine profitability and sustainability (inputs, processes, and outputs) reflect the lean six sigma (LSS) approach. LSS defines waste as any inputs that are used unnecessarily (whether fertilizer, chemical, feed, labour, energy, water, etc.), because the processes used to produce an outcome are not sufficiently rigorous or managed correctly.

As described in Section 3, many of these wastes are not immediately obvious, though their negative impact on business performance and the environment can be immense. For example, it has been estimated that improving the feed conversion rate of UK beef cattle by a single unit (i.e., 9:1 vs. 10:1) could save the equivalent of ten percent of the UK’s annual wheat crop. The same volume of beef would be produced using fewer resources, which would in turn reduce the environmental impact of the UK beef industry. In Canada, where feed conversion rates are already better than in the UK, a 0.5 unit improvement could save the equivalent of 1 million tonnes of grain annually. The wheat and other grains/crops freed up by improved processes could lessen the need for imports, be exported, or allow more valuable crops to be grown in their place. As proven in the US, UK, and other jurisdictions, this level of improvement is well within the realms of possibility. Extend the improvements along the entire value chain, and across all sectors of the food industry, and the potential economic and environmental ramifications of establishing more effective and efficient food value chains are huge.

---

a Stated in simply terms, food waste is the loss of food along the value chain that is suitable for human consumption, or will be fit for human consumption after processing – such as wheat.
The primary purpose of this report is to help address the disconnect between the attitude and behaviour of producers and managers of businesses situated along the food value chain. We do this by highlighting the opportunities that exist for agri-food businesses to benefit financially through reducing waste and providing guidance on how any size of business can incrementally improve its performance. Our experience is that businesses’ ability to benefit financially from reducing waste relies more on individuals’ determination to learn and their ability to communicate effectively than any other factor.
1 Introduction

Since last year’s “Cut Waste, GROW PROFIT™” report and inaugural forum, increasing evidence points to the implications that food and associated wastes are having upon the global environment, through depleting the availability and quality of natural resources including water, energy, land, and air. In short, food waste and associated wastes are a symptom of a larger problem that is affecting our economy and our environment. While the greatest loss of food that is (or was) fit to eat has been thought to occur at the consumer level, studies suggest that the true impact that the ineffective management of natural resources throughout the value chain is having on our economy and environment exceeds previous estimates. This is largely because previous studies have estimated terminal waste. They have not included the lean six sigma (LSS) definition of waste: any inputs that are used unnecessarily (whether fertilizer, chemical, feed, labour, energy, water, etc.), because the processes used to produce an outcome are not sufficiently rigorous or managed correctly. As described in Section 3, many of these wastes are not immediately obvious, though they negatively impact business performance and the environment.

That these wastes and their causes are often not immediately obvious or quantifiable from a business perspective could explain why the majority of respondents who attended the “Cut Waste, GROW PROFIT™” forum stated that they are more active in trying to reduce food waste at home than they are in their business. The good news is that 41 percent of respondents said that they are “active” or “very active” in trying to reduce food waste at work. Only 11 percent said that they were not doing anything at all.

Figure 1-1: How active are you in trying to reduce food waste?

---

b Terminal Waste is food waste that is primarily disposed of in landfills, composting, or bio-digestion.

c The sample size varied by 77-83 respondents. Due to the small sample size, findings are directional only.
The responses presented below explain why many individuals are more diligently attempting to reduce food waste at home versus in their place of work. A disconnect exists between the actual and ideal priority that businesses place upon the issue of reducing food waste. Seventy-five percent of respondents indicated that food waste reduction should be a very important or extremely important priority; however, only 45 percent indicated that it actually is.

**Figure 1-2: What priority does (vs. should) food waste reduction have in your work environment?**

When asked what if anything was inhibiting their ability or desire to adopt food waste reduction strategies at work, the responses in order were: Business culture/lack of senior support (28%), Priorities set by senior management (22%), Lack of personal knowledge and capabilities (training) (9%) and Financial constraints (8%). In our experience, due to many wastes and related opportunities not being easily identifiable, the same holds true of many businesses’ focus on reducing waste *per se*. Managers instead continue to focus on using traditional measures such as price, volume, and market share to evaluate performance. Helping to address the disconnect between attitude, behavior, and the opportunities that exist for agri-food businesses to benefit financially through reducing waste is the primary purpose of this report.
This report is about practical steps that can be replicated across thousands of businesses, resulting in improvements in their profitability, the overall economy and the global environment.

While many commentaries and reports have been produced on reducing waste through encouraging changes in behaviour among consumers or diverting food from landfill, very little has been published on how businesses can profit from proactively reducing the food and other wastes occurring in their own operations. This report is about practical steps that can be replicated across thousands of businesses, resulting in improvements in their profitability, the overall economy, and the global environment.

The remainder of this paper comprises three sections. Section 2 identifies the impact that food and associated wastes have upon the agri-food industry and the enormous untapped opportunities that exist to more effectively produce food. It also positions the topic of food waste within the broader context of sustainability. Section 3 provides insights into the opportunities relating to a specific industry – beef. Section 4 then presents tools and techniques that businesses can use to identify and subsequently profit from eradicating waste from their operations.
2 The Extent of Food Waste and Its Environmental Impact

2.1 Quantifying the Extent of Food Waste

The world generates 1.2 to 2 billion tonnes of food waste annually. Between 30 and 50 percent of all food produced is wasted along the value chain. In 2010, the Value Chain Management Centre estimated that $27 billion of food is wasted annually in Canada. The breakdown of these losses from a value chain perspective are presented below in Figure 2-1. In 2012 we reported that Statistics Canada (2010) estimated that Canadian food waste at the retail and consumer level amounted to approximately 122 kg per person for total fresh and processed fruits and vegetables, 6 kg for dairy products, 10 kg of poultry (boneless), 16 kg red meats (boneless), and 18 kg of oils, fats, sugar, and syrup.

Figure 2-1: Estimates of Where Food Waste Occurs along the Value Chain

![Figure 2-1: Estimates of Where Food Waste Occurs along the Value Chain](image)

Note: HRI = Hotel/Restaurant/Institutional food outlets
Source: Statistics Canada, 2010; Macdonald, 2009; VCMC, 2010

According to the United Nations Food and Agriculture Organization (FAO), 95 percent of food waste in developing countries is unintentional losses at early stages of the food supply chain. It is estimated that 60 percent of the opportunity to reduce food waste in developing countries could be captured by installing

---

These numbers were calculated from Statistics Canada’s Food Statistics (2010) by deducting the total food available adjusted for losses for each food group from food available for each food group. The adjustment factors that Statistics Canada uses to estimate food losses accounts for “losses at the retail and consumer levels, including institutions, restaurants and households. The factors attempt to account for losses or waste from storage, in the preparation of food and from the plate. The factors were provided, with appreciation, from the United States Department of Agriculture.” (Statistics Canada, 2010, p.40)
modern cold-storage and improved distribution. In Africa, for example, societal factors lead many farmers to resist using metal silos. Instead, they store grain in their home to avoid theft. This exacerbates losses due to vermin, etc., which would be prevented if the grain was stored in modern silos. A similar scenario exists in India, where inadequate storage facilities lead to a greater volume of grain being lost annually than is produced by Australia.

A number of analyses identified that in developed countries more food waste has been identified as occurring at the consumer level than at any other step along the value chain. The average American consumer wastes 10 times as much food as someone in Southeast Asia, a five-fold increase since the 1970s. A UK study found that the primary cause of food waste in the home is “not using (perishable) food in time.” It accounts for up to 60 percent of food waste. This increase is partly explained through a direct correlation being found to exist between increased consumption of fruits and vegetables and household food waste.

A 2013 report commissioned by WRAP (Waste Resource Action Plan) identified the top 50 product groups where many of the biggest environmental savings could be made. Categorized by product type, the list included perishable foods, ranging from pork and lamb through to margarine and butter; beverages, such as cider and fruit juice; and general household goods (toilet cleaners, laundry detergents, and shampoo). Additional research is being conducted to understand the environmental impacts for non-food and drink products and further supply chain waste issues. Once this work is complete, it is expected that a further 20 products will be identified in the summer of 2013. It is estimated that the combined list of approximately 70 items will account for more than 90 percent of the greenhouse gas emissions associated with producing, transporting, and retailing the grocery products consumed in the UK. They will also account for the majority of water unnecessarily used and/or degradation in the production of food, which is itself an enormous global challenge.

Recently released studies suggest that, like developing nations, businesses operating in developed countries are often responsible for the majority of waste that occurs both along the food chain and in the home. A direct relationship having been identified between retailers’ business practices and the occurrence of food waste prior and post its purchase by consumers in developed and developing nations has led the international retailer Tesco to announce a new social strategy. The strategy includes using data from Tesco’s loyalty card to change how the retailer works with suppliers and retailers, leading to reductions in food waste from farm to consumer.
2.2 Environmental Implications of Food Waste

The efforts being undertaken by WRAP and other programs reflect a growing recognition that current attitudes and behaviours present a far greater issue than food going in the trash bin. As summarized below in Table 2-1, the resources (including land, water, and energy) used to produce, process, and distribute products, and the availability of resources required to feed a burgeoning population are acutely affected. In fact the very sustainability of our agri-food system is placed in doubt.

Table 2-1: Environmental Implications of Food Waste

| Land             | Over the last five decades, improved farming techniques and technologies have helped to significantly increase crop yields and expand the acreage of farmland by 12%. The demand this places on associated natural resources differs by production types and region. For example, feeding a population on animal-based products can place greater demands on the available land mass than feeding a similar sized population on crop-based (grains, fruit, vegetables, etc.) products. As well, significant differences exist between the amounts of land required to produce a calorie of beef versus a calorie of chicken. Competition for land will also increase as demand for food competes with demands for renewable energy. |
| Water           | It takes substantial quantities of water to produce food. Even more water is required if the food is processed before consumption — an example being the estimated 2,400 litres of water required to produce one hamburger. Assuming that the food supply for an average person is 3,000 kcal per day by 2050 and is derived 80% from plants and 20% from animals, the water needed to produce that quantity of food would be triple what is currently extracted. In many regions of the world, the volume of water extracted for (or degraded by) food production already exceeds that which is naturally sustainable. |
| Energy          | The food sector consumes approximately 30% of total global energy consumption. It is estimated that an average of 7–10 calories of input is required to produce one calorie of food. This varies dramatically: from 3 calories for crops, to as much as 35 calories for beef. Since much of this energy comes from the utilization of fossil fuels, food waste represents the release of unnecessary high levels of carbon dioxide into the environment. |
| Air             | The decomposition of organic waste in landfills produces methane: a greenhouse gas with a global warming potential that is 20–25 times higher than carbon dioxide. An unnecessarily large carbon footprint results from transported grains and oilseeds that are processed into feedstuffs, then used unnecessarily in the production of livestock. This is due to producers not having effective management systems and/or using genetics that are not adequately “fit for use.” |
Population growth and dietary trends, which are seeing a shift away from grain-based foods and towards consumption of animal products, will exacerbate the issues described above.\textsuperscript{25} As a global society, establishing more effective agri-food systems than presently exist is critical to managing the food-energy-water nexus in a sustainable fashion.\textsuperscript{26}

2.3 Initiatives Designed to Combat Food Waste

Since the first paper in this series was released in 2010,\textsuperscript{27} international attention about the need to reduce food and associated wastes throughout the value chain has markedly increased. An example is the European parliament adopting a resolution to reduce food waste by 50 percent by 2020 and designating 2014 as the “European year against food waste.”\textsuperscript{28} Great recognition has also occurred concerning the amount of food and other wastes occurring along the entire value chain.\textsuperscript{29}

Since November 2012 a number of jurisdictions have introduced initiatives designed to reduce food waste through influencing the attitudes and behaviour of consumers and commercial businesses. Examples of North American small- and medium-sized enterprises (SMEs) that have profited from understanding their processes to more effectively manage food waste include the US retailer “Stop and Shop.”\textsuperscript{30} The business was able to save an estimated $100 million annually after identifying relationships between freshness, shrink, and customer satisfaction in their perishables department.\textsuperscript{30} Another example of profiting by understanding the extent and opportunity of waste streams and adopting best practices is a dining hall at a US college that reduced its kitchen waste by 40 percent, resulting in savings of over US$1,600 per week.\textsuperscript{31}

The most proactive and far-reaching initiative is arguably the UK WRAP (Waste Reduction Action Plan) program. An example of one of WRAP’s consumer education programs is “Fresher for Longer.”\textsuperscript{32} It is managed by WRAP and supported by the British Retail Consortium, the Food and Drink Federation, the Packaging Federation, the packaging trade group INCPEN, the Kent Waste Partnership, and Marks & Spencer. The program’s objective is to educate consumers about the role of packaging in extending food’s lifespan. The program, the purpose of which is to reduce food waste through influencing behavioural change among consumers, evolved from a survey which found that 61 percent of consumers mistakenly believe that removing food from packaging will extend its lifespan, despite the opposite being true. The net result of this and other factors is that significant numbers
of people were found to be discarding food packaging in the home and storing staples like apples and bread in a manner that accelerates spoiling.\textsuperscript{33} Value Chain Management Centre research has identified that many Canadian consumers also do not know how to handle and store food at home.\textsuperscript{34}

The program also stemmed from WRAP estimating that up to 20 percent of household food waste is linked to date-labelling confusion (“Best by” vs. “Use by” vs. “Best before”).\textsuperscript{35} In short, many consumers mistake “best before” to mean “dangerous after.”\textsuperscript{36} The same issue exists in Canada. In an effort to address consumer confusion, the Canadian Food Inspection Agency states on its website that a best-before date (unlike an expiration date) signifies the point at which the product is at its peak, rather than when something is dangerous to eat. “You can buy and eat food after the best-before date has passed. However, the food may lose some of its freshness and flavour, or its texture may have changed.” (CFIA, 2013)

WRAP’s business-focused initiatives include assisting processors and retailers to develop more effective packaging. An example of these efforts include the recently announced third phase of the Courtauld Agreement. The agreement involves 45 retailers (Sainbury’s, Marks & Spencer, Tesco, etc.) and food manufacturers (Coca-Cola Enterprises, Unilever, AB InBev, Nestlé, etc.) committing to a goal of reducing food and drink waste by 1.1 million metric tons by 2015. If met, the program will reduce carbon dioxide emissions by 2.9 metric tons and bring £1.6 billion (C$2.42 billion\textsuperscript{e}) cost benefits to consumers and business. Given the expected increase in the volume of food and drink produced in the UK, meeting these targets will amount to nine percent real reduction in food and drink waste.\textsuperscript{37} The two previous Courtauld Agreements are estimated to have prevented around £3.5 billion (C$5.28 billion) in food waste. Examples of businesses that have benefited from reducing food and associated wastes and how, through WRAP and other funding programs, are included in the recently published “Creating a Lean and Green Business System.”\textsuperscript{38}

In partnership with WRAP and Feeding the 5k,\textsuperscript{39} United Nations Environment Programme (UNEP) and FAO established “Think.Eat.Save.” The global program reflects what Dobbs \textit{et al.} describe as how the fragmented nature of governments and the vested interests of individual ministries impact their ability to address complex issues such as food waste. The Think.Eat.Save campaign is seeking to encourage the collaboration and information sharing between businesses, governments, and consumers that are required to achieve social change,\textsuperscript{40} by providing a global vision and information-sharing portal for the many and diverse initiatives currently underway around the world.\textsuperscript{41}

WRAP is also participating in a Welsh initiative targeted at SMEs. Welsh SMEs are eligible to apply for grants of up to £50,000 (C$75,500) to invest in the “installation and maintenance of recycling and waste-prevention equipment, as well as sustainable waste management plans.” Up to £10,000 (C$15,100) worth of resources will also be available to businesses, including advice and business support from a “WRAP-appointed business

---

\textsuperscript{e} Exchange rate of 1.51
Reducing food waste by addressing attitudinal and behavioural disconnects along the value chain

consultant” with specific industry experience. The scheme, launched by WRAP Cymru in association with the British Hospitality Association, is backed by £920,000 (C$1,389,200) of Welsh government funding, with support from the Wales Tourism Alliance and the Institute of Hospitality Cymru. The new scheme hopes to assist food service establishments in Wales save £5 million pounds (C$7.6 million) per year through recycling more and reducing their waste.\(^{42}\)

The new scheme hopes to assist food service establishments in Wales save £5 million pounds (C$7.6 million) per year through recycling more and reducing their waste.

In response to hearing about projects and initiatives undertaken in the UK and Canada, the majority of delegates (88%) who attended the “Cut Waste, GROW PROFIT™” forum indicated that the Canadian industry would benefit from establishing an initiative similar to the UK’s WRAP program. (See Figure 2-2 below.)

**Figure 2-2:** How important is it for Canada to implement a program such as WRAP?

![How important is it for Canada to implement a program such as WRAP?](image)

Shown below in Figure 2-3 are delegates’ responses to the question, “Who should take the lead on establishing food waste reduction programs?” The majority felt that *commercial industry* should take the lead (44% of first round votes and 41% of second round votes).
The need for governments’ involvement is reflected in Table 2-2, which shows the weight that respondents place on demonstration projects and training for influencing changes in the attitudes and behaviour of managers and consumers. The responses show that increasing managers’ motivation to invest resources in reducing food waste, as with any new initiative, relies on providing them with easily digestible information on how it will benefit them financially. They need a business case. As shown below in Table 2-2, respondents stated that providing this service and means is best achieved through a publicly funded program. The second most important resource cited by respondents is training and awareness, to instil in managers the ability and confidence to implement the types of waste-reduction initiatives discussed at the “Cut Waste, GROW PROFIT™” forum.

Table 2-2: Ranking of resources required to encourage necessary changes in business management

<table>
<thead>
<tr>
<th>Rank</th>
<th>Resources required to encourage businesses to adopt food waste reduction strategies</th>
<th>% of Vote</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Publicly funding programs - for pilot projects and advisory services</td>
<td>40%</td>
</tr>
<tr>
<td>2</td>
<td>Training/awareness (workshops and courses)</td>
<td>27%</td>
</tr>
<tr>
<td>3</td>
<td>Third party consultants/advisors</td>
<td>19%</td>
</tr>
<tr>
<td>4</td>
<td>Other (not specified)</td>
<td>10%</td>
</tr>
<tr>
<td>5</td>
<td>Written manuals and case studies</td>
<td>4%</td>
</tr>
</tbody>
</table>
The remainder of this report has been designed to guide producers, managers of agri-food business, and wider industry stakeholders through the process of identifying how their business, and the sector(s) in which they operate, could benefit from reducing food and associated wastes, and how to implement the necessary processes. While beef is used as an example of where waste occurs along an agri-food value chain and why, our experience shows that every sector exhibits what can be immense opportunities to improve. The approaches described in section 3 are equally applicable to any sector of the agri-food industry.
3 Demonstrating the Opportunities in a Specific Industry (Beef)

Considerable attention has been focused on quantifying and addressing the food waste created by consumer behaviour and consumers’ interaction with retailers and foodservice operators. Relatively little attention has been given to quantifying food and other wastes that regularly occur along the value chain. The beef industry is used as a means to contextualize the opportunities that exist for businesses and the environment to benefit by addressing the fragmented operations that regularly exist along agri-food value chains. While many of the factors that impact the effectiveness and efficiency of beef value chains are unique to the beef industry, our research shows that the scale of opportunities are not unique when compared to other sectors of the food industry.

As with most foods, the journey that beef takes from a farm to consumers’ dinner plates comprises many steps. If even a few of those steps are improperly managed, the cumulative effect on businesses’ profitability and the environment can be significant. This is particularly true in beef, where a whole product (a live animal) results from one series of inputs and processes. Another series of processes are then used to steadily deconstruct the carcass into products eaten by a final consumer. The complex series of intertwined relationships means that it can cost ten times the amount to address an issue at one step of the chain, compared to if the same issue had been addressed sooner at a previous step along the value chain. The information presented below was developed from reviewing academic and industry papers, prior studies by the Value Chain Management Centre, and speaking with individuals recognized as possessing unique expertise in the management of beef value chains.

The Canadian beef industry contributes over $33 billion to the Canadian economy. However, its profitability and competiveness, along with its impact on the environment, is negatively affected by the lack of co-ordination and integration that exists between the involved businesses. The same holds true for other nations’ beef industries. The unfortunate news is that this leads to inefficiencies that result in significant levels of waste and higher costs of production. The positive news is that there is considerable scope for improvement, particularly at the production level. This would enable considerably more to be produced with the same resources. It would also significantly reduce our food system’s impact on the environment.

It is impossible to eradicate every cent of waste from a system. Estimates on the amount of waste that occurs along a beef value chain, and that can be addressed through managing the input variables which ultimately determine profitability, range from 10–25+ percent of final retail price. A specific example is Beef
Improvement Group (UK), which states that it has reduced the cost of producing a finished beef animal by £250 (C$380). This has been achieved through implementing methods already used in the pig industry, such as building a nucleus herd to contractually produce and resell genetics whose performance is monitored constantly. In the US, Ranchers Renaissance is said to have reduced production costs by US$500 per head, through establishing birth-to-slaughter performance measures. Add to this downstream efficiencies that can be achieved by processors, and retailers, etc., and the magnitude of opportunities comes into focus.

Another example is Blade Farming. Owned by one of Europe’s largest meat processors ABP, Blade has greatly improved the efficiency of beef production by measuring performance against key performance indicators (KPIs), issuing extensive forward contracts, implementing a conception to consumption continual improvement program, and establishing a “Keiretsu” (the Japanese word for interlocking strategically aligned businesses that possess complementary skills and capabilities). Blade also offers financial programs to assist producers manage cash flow. These management arrangements are more akin to the Japanese automotive industry than red meat.48

To aid in conveying opportunities to improve performance in the best means possible, the conceptual value chain comprises four steps. In reality, many beef value chains are considerably longer and more complex, with opportunities to improve performance extending beyond those presented below. Of the factors described below, genetics and management are the most critical. Genetics influence reproduction rates, feed conversion rates (FCRs), mortality rates, volume of feed consumed by breeding stock and progeny to produce 1 kg of meat, eating quality, processing costs, and more. Management is critical due to there being greater variation in cattle genetics and less coordination in how genetics are used to produce a final product when compared to other major forms of livestock. As well, the rate at which cattle genetics have been improved from a “fit for use” perspective has trailed other sectors of the livestock industry.
### 3.1 Beef Chain

<table>
<thead>
<tr>
<th>Factor</th>
<th>Management: The most critical factor from a cost and environment perspective, and the fastest way to improve efficiencies along the entire value chain.</th>
</tr>
</thead>
</table>
| **Cow-calf**      | • Cost of production (COP) commonly not known, due to lack of continuous measurable data  
                     • COP information that is known, is often not used to make more effective management decisions  
                     • Many breeding decisions are not based on market demand  
                     • Few producers have defined feed or health protocols, or regularly evaluate their effectiveness  
                     • Lack of value chain connectivity leads to unnecessary re-vaccinations on arrival, because the producer does not trust whether the cattle he is receiving were treated or not |
| **Feeding/Finishing** | • Few producers have defined feed or health protocols that are evaluated objectively and/or regularly  
                       • Lack of value chain connectivity leads to unnecessary re-vaccinations on arrival, because the producer does not trust whether the cattle he is receiving were treated or not  
                       • Decisions primarily subjective, focused on cost reduction vs. profit maximization  
                       • Few producers objectively track and measure animal performance |
| **Processing**    | • Most focus is on reducing overhead costs by sourcing large volumes of well-fed cattle  
                     • Tendency to sell on price and volume vs. market  
                     • Tend not to work collaboratively |
| **Retail**        | • Waste results from disconnects between buying, operations, and marketing  
                     • Tendency to focus on price, volume, and margin, vs. value chain strategy |
| **Impact**        | Increasing the effectiveness of management decisions along the entire chain can reduce production costs by 40-50%+.
## Factor

<table>
<thead>
<tr>
<th>Genetics: The second most critical factor from a cost and environment perspective.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cow-calf</strong></td>
</tr>
<tr>
<td>• Impacts pregnancy, calving ease and mortality, growth rates, meat quality</td>
</tr>
<tr>
<td>• At average of 0.8 per year, cattle have the lowest reproduction rates of any livestock</td>
</tr>
<tr>
<td><strong>Feeding/Finishing</strong></td>
</tr>
<tr>
<td>• Animal genetics have significant impact on financial viability of any beef operation</td>
</tr>
<tr>
<td>• Relative amount of meat produced per mother lower than other livestock</td>
</tr>
<tr>
<td><strong>Processing</strong></td>
</tr>
<tr>
<td>• Variation in carcass composition impacts yield, costs, revenue</td>
</tr>
<tr>
<td>• Share information requirement to make more informed decisions</td>
</tr>
<tr>
<td><strong>Retail</strong></td>
</tr>
<tr>
<td>• Variation in eating quality and appearance impacts sales</td>
</tr>
</tbody>
</table>

### Impact

Choosing genetics against “fit for use” criteria can reduce costs by 10–40%.

---

## Factor

<table>
<thead>
<tr>
<th>Feed: FCR = the amount of dry matter required to produce 1 kg of beef. The Canadian average is 7-9:1. In 2012, Canada produced 982 million kg of beef. This equates to ~1.8 million tonnes of live animals, and a total dry matter intake of 12.6-16.2 million tonnes.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cow-calf</strong></td>
</tr>
<tr>
<td>• 70% of production costs (mainly feed) attributed to the cow</td>
</tr>
<tr>
<td>• Less than 80% of cows produce a calf annually</td>
</tr>
<tr>
<td>• Feeding barren cows is a significant cost for zero revenue and has an unnecessary impact on the environment</td>
</tr>
<tr>
<td><strong>Feeding/Finishing</strong></td>
</tr>
<tr>
<td>• FCR reduces as cattle age and gain fat</td>
</tr>
<tr>
<td>• Less feed efficient to produce AAA versus A-grade beef</td>
</tr>
<tr>
<td>• 2 out of every 100 animals placed on feed dies, with subsequent feed loss</td>
</tr>
<tr>
<td><strong>Processing</strong></td>
</tr>
<tr>
<td>• Excess fat removed by processor equates to unnecessary feed costs and environmental impact associated with feed production</td>
</tr>
<tr>
<td><strong>Retail</strong></td>
</tr>
<tr>
<td>• Excess fat removed by retailer equates to wasted feed and associated environmental impacts</td>
</tr>
<tr>
<td>• Retail shrink equates to feed waste and unnecessary environmental impact</td>
</tr>
</tbody>
</table>

### Impact

Improving FCR by 0.5 (e.g. 6.5-8.5:1 vs. 7-9:1) could save 0.9 million tonnes of dry matter annually. At 13.5% moisture, this equates to ~1 million tonnes of wheat and ~3.7% of Canada’s 2012 crop. In UK, a 1.0 change in FCR is estimated to be the equivalent of 10% of the country’s annual wheat crop.
<table>
<thead>
<tr>
<th>Factor</th>
<th>Water: volume of water used to produce 1 calorie from beef averages 20 times more than that used to produce 1 calorie from cereals and starchy foods.</th>
</tr>
</thead>
</table>
| Cow-calf     | • Majority of water footprint created by live animal drinking and water is used in the feed production  
• Cold climate and resulting heat loss can reduce animals’ FCRs |
| Feeding/Finishing | • Inefficient use of feed significantly increases the water footprint of beef production  
• Concentration and location of cattle production can impact water quality and availability |
| Processing   | • More water than necessary is used due to incorrectly managed processes  
• Amount of water used further impacted by federal, provincial, and municipal regulations |
| Retail       | • Comparatively little of the water directly and indirectly used to produce beef is consumed at the retail level |
| Impact       | Compared to other livestock, cattle use water inefficiently – results in significant opportunities to reduce usage and environmental impacts. |

<table>
<thead>
<tr>
<th>Factor</th>
<th>Energy: includes electricity, gas, fuel, oil, coal</th>
</tr>
</thead>
</table>
| Cow-calf   | • While grassland and crop management critical to efficient use of energy, farm management practices are often ineffective.  
• Raising beef on grassland can equate to less energy usage, if pasture and the herd are managed effectively. This is often not the case. |
| Feeding/Finishing | • Cattle tend to be trucked considerably further than other livestock.  
• In Alberta, each beef animal is trucked an average of 1,081 km. |
| Processing | • Approximately 2% of beef lost due to ineffective process.  
• Estimated that 50% of associated costs are energy related: killing, cutting, hot water, packing process, packaging materials, chillers, heating, etc. |
| Retail     | • Average meat losses in retail system estimated at 4-8%. Wasted energy includes that used to chill, display, and truck.  
• Further energy costs incurred in disposal of meat lost through shrink. |
| Impact     | Unnecessary energy costs that stem from current beef production are estimated to average 5-15% of price paid by consumers.  
Production and consumption of this energy has significant environmental impacts. |
<table>
<thead>
<tr>
<th>Factor</th>
<th>Miscellaneous additional wastes and their cause(s)</th>
</tr>
</thead>
</table>
| Cow-calf      | • Higher transport costs due to not arranging full loads of cattle  
• Cost of carrying bulls for 12 months, vs. using artificial insemination (AI) to acquire more superior genetics than possible if purchasing live bulls  
• Medication used unnecessarily, due to producers having to combat health issues created by ineffective processes |
| Feeding/Finishing | • Medication used unnecessarily, due to producers having to combat health issues created by ineffective processes  
• Use of inappropriate feedstuffs impacts meat quality and value  
• Financial penalties from having produced out-of-spec cattle |
| Processing    | • Rejection and disposal of part or entire carcasses due to disease, parasites, ineffective processes, or variations in carcass quality  
• Discounting below COP to reduce inventory |
| Retail        | • Rejection and disposal of 2-4% of products at distribution centres, due to physical issues, e.g., discolouration  
• Promotions leading to bulk buying and more at-home waste |
| Impact        | **Beyond the waste created by these factors through the ineffective use of resources, they also impact businesses’ profitability through reducing revenues.** |
4 Practical Model for Improving Performance

That we have observed similar levels of food and associated wastes to those described above in other sectors of the agri-food industry conveys the magnitude of the opportunities. The next section describes a methodology that the Value Chain Management Centre and VCM International have applied on numerous occasions to develop solutions that lead to measurable improvements in clients’ financial and operational performance, through reducing food and other types of waste. This lessens businesses’ environmental footprint too. Further information on these management techniques and their application is available in the following workbook (http://vcm-international.com/wp-content/uploads/2013/04/VCM-FIRST-WORKBOOK.pdf). A more comprehensive workbook, based on lean process improvement principles, can be ordered via email (info@vcm-international.com).

The methodology described below reflects an approach called DMAIC (Define, Measure, Analyze, Improve, Control). Tools and techniques applied during a DMAIC project include SIPOC diagram (suppliers, inputs, process, outputs and customers); critical to satisfaction (CTS); analysis; association matrix; value chain mapping, capability analysis and control plans; failure mode and effects [FMEA]; lean tools; design of experiment (DOE); and conjoint analysis (CA). These and other techniques enable a rigorous analysis into the root causes of issues affecting businesses’ performance, followed by the development and implementation of processes that enable continual improvements in the performance of the value chains and the individual businesses concerned. DMAIC projects comprise five phases, each of which are briefly described below. Also presented are the types of information and insights produced by each of the five phases.

A word of encouragement: do not be intimidated by the thought of having to analyze reams of statistics. Our experience is that success relies more on individuals’ determination to learn and the ability to communicate effectively than on statistical prowess. The individuals at Blade Farming, for example, are not statisticians. Their primary focus is on forging constructive business partnerships and using relationships that extend along the entire value chain to achieve outcomes that would not otherwise be possible.

Phase 1 – Define
The primary purpose of the define phase is to quantify the nature of the overall value chain and the individual businesses it comprises. This includes the relationships that exist between and within the involved businesses and the nature of problems and opportunities within the chain. What results is a detailed picture of information and material flows, and the relative impact that specific factors have on performance. For example, where is the most waste seen or perceived to be occurring, and why?
Mapping the value chain produces insights that quantify the extent to which revenues are being wasted on non-value adding activities, the nature and extent of undesired effects, where improvement opportunities lie, and what strategies could be employed to identify root causes and develop long-term solutions.

where improvement opportunities lie, and what strategies could be employed to identify root causes and develop long-term solutions. It also produces a structured framework that enables opportunities to be prioritized objectively in relation to ROI, guides subsequent phases of the DMAIC process, and enables results to be measured quantifiably.

To map the value chain you need to physically walk the route that the product in question follows as it progressively moves towards the point at which it is consumed, and to speak to the people involved in managing each of the processes that you have witnessed. Mapping the value chain will provide you with a crystalized understanding of the processes that together form the value chain under study. It will in all likelihood also dispel previous assumptions about what happens where, why, and the resulting outcomes, and provide insights into where immediate opportunities lie to improve performance.

Rather than begin by attempting to improve the overall value chain’s performance, we recommend that you seek to improve the performance of one business in relation to the value chain in which it operates. This will lessen the complexity of the challenge before you. It will also enable improvements to be attained faster, which creates enthusiasm for undertaking larger more complex projects.

**Figure 4-1: Steps used to define and improve the effectiveness of operations**
Shown above in the bottom half of Figure 4-2 are the series of subsequent steps that will enable you to improve the effectiveness of operations performed within a specific business within the context of the overall value chain. They are shown in the order in which they will be discussed. The first action is to prepare a Pareto chart of the types of waste found to occur within the business, and the process at which they were found to occur.

The Pareto chart (see below) enables you to prioritize opportunities, through weighing their potential impact on the business’s (and potentially the overall value chain’s) performance. It enables you to identify the vital few opportunities as opposed to the trivial many. It also guides you where the likely best place(s) is to measure performance, and where to invest resources to achieve the required ROI. What inputs or processes require the greatest attention, and are our primary financial opportunities?

**Figure 4-2: Pareto chart of waste types**

<table>
<thead>
<tr>
<th>Waste types</th>
<th>Occurences</th>
<th>Percent</th>
<th>Cum %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>120</td>
<td>30.5</td>
<td>30.5</td>
</tr>
<tr>
<td>B</td>
<td>100</td>
<td>25.4</td>
<td>55.8</td>
</tr>
<tr>
<td>C</td>
<td>75</td>
<td>19.0</td>
<td>74.9</td>
</tr>
<tr>
<td>D</td>
<td>38</td>
<td>9.6</td>
<td>84.5</td>
</tr>
<tr>
<td>E</td>
<td>29</td>
<td>7.4</td>
<td>91.9</td>
</tr>
<tr>
<td>F</td>
<td>23</td>
<td>5.6</td>
<td>97.7</td>
</tr>
<tr>
<td>G</td>
<td>9</td>
<td>2.3</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Once you have identified where the greatest opportunities lie, you need to establish the business case and ensure that everyone who works on the initiative is marching to the same drum. In this case, from walking the chain and getting the supporting data, we observe that A and B account for 56 percent of the waste. Producers might find distinct differences in the growth rates for similar amounts of feed and/or differences in the health status of their cattle. Processors might find that variations in yield or extraneous fat appear to have greatest impact on their cost structure or profitability. While the nature of issues might have been correctly identified, their cause is often more difficult to quantify.
Developing a project charter (see list below) forces the author(s) to identify what resources (dollar amounts, personnel, skills, etc.) are required to achieve the end of desired outcomes, the individual roles that they must perform, along with when, why, and how individuals’ and the overall team’s performance will be evaluated.

**Project Charter**
- Process A waste
- Problem
- Objective
- Scope
- Target savings
- Sponsor
- Leader
- Team

**Phase 2 – Measure**
The objective of the measure phase is to map and measure the performance of a business in a manner that enables you to identify input variables which may be the potential cause of problems or opportunities to exploit. Examples include the following: What, when, and why are health issues occurring in the cattle herd? What is the relationship between growth rates and feed intake? What is the root cause(s) of variations in yield or extraneous fat? These questions can only be answered by objectively measuring the performance of process(es) in relation to specific inputs and outputs.

The measurement phase also enables an assessment to be made of the integrity of data currently used to measure performance, determines whether the correct metrics are being used to measure performance, and evaluates the effectiveness of current process controls.

The outcomes will include an assured way of monitoring the current and improved performance of the process(es) going forward. It will also enable future relationships between activities occurring at multiple points along the value chain to be quantified by monitoring for trends and patterns.

A data collection plan is critical to deciding what to measure, by first deciding what information is required to make effective decisions. What measurements will produce results that you can act upon to improve profitability? Remembering that improving performance relies on identifying the root causes of issues, not
just symptoms, questions to ask people associated with the process(es) being evaluated and relevant experts when developing a data collection plan include

- What do we want to measure, and why?
- Where, when, how often, and for how long will we measure it?
- Who will measure it?
- How will they measure it?
- Where will data be recorded?

An initial analysis of performance will provide you with a bell-shaped curve that illustrates the variability which is inherent to your current process(es). This high-level snapshot will enable you to quantify current overall performance versus expectations. Is your process out of control and, if so, to what degree?

This information (an example is shown below in Figure 4-3) will also enable you to determine targets that, if met, will result in improved performance, and what options exist to reduce variability. Do you need to narrow the variance in performance through raising the lower end of the spectrum or by reducing the upper end? Or is another change required to increase overall performance? As can be seen in the chart below, the process being scrutinized was underperforming by a considerable margin of error. Ways must be found to reduce the percentage of production falling below acceptable levels (in this case, 14) without increasing the percentage of production that exceeds the upper level of expectations (in this case, 18). Only more granular, time-oriented data will enable you to identify how to achieve these improvements.
You are now armed with an overall snapshot showing on which end of the spectrum the greatest variability appears to lie. Improving performance relies on establishing relationships between inputs, process, and outputs. Achieving this will enable you to control performance more effectively than otherwise possible; though getting there requires more granulated and time-orientated data. This leads us to the analyze phase.

**Phase 3 – Analyze**

The more inconsistent the process, the more waste it will produce.

The objective of the analyze phase is to determine to what extent the potential inputs (measure phase) actually have an effect on the output of the value chain. While no process is ever 100 percent perfect, the more inconsistent the process, the more waste it will produce. Inconsistency is itself, however, a symptom, created by potentially numerous root causes. Are the root causes that you identify associated with a specific producer, source of feed, or type of genetics?

One of our analyses identified that inconsistency in the size of duck breasts and seemingly erratic fluctuations in health issues (which resulted in lost revenue and unnecessary costs) was caused by the producer’s having purchased cheap bedding that had been stored outside for long periods of time. This might have led to a build-up of organisms that were then ingested by the ducks, resulting in health issues. It
was found that the amount of money saved by purchasing cheap bedding was significantly less than the costs and unrealized revenues that were being incurred from having used such bedding.

To produce insights that can be acted upon, you next need to analyze the data collected during the measurement phase to identify what is causing any variability in the effectiveness of the process(es) under scrutiny. This is achieved by methodically analyzing the data to identify patterns, trends, differences, and causal relationships between inputs, processes, and outputs.

Run charts (shown below in Figure 4-4) are the voice of the process. They provide you with information on when to regard variation as normal (do nothing), versus when something has shifted and therefore action is required to bring your process back into acceptable levels of normality. They achieve this by providing you with the ability to identify patterns (correlations) between specific inputs, processes, and outputs. You might find that what you believe is saving you money (e.g., cheaper inputs) is, in fact, creating hidden costs that outweigh the benefits that you had assumed to exist.

Figure 4-4: Process A – Control Chart
Phase 4 – Improve

The information and data acquired from phases 1 to 3 will enable you to design solutions to reduce costs and/or increase revenues. In many cases this will include developing a procurement policy that motivates changes to how cattle (for example) are produced and sold, through more directly reflecting a quality-based pricing formula then previously existed. Improving performance will almost invariably reduce the value chain’s environmental impact. The same information also provides the opportunity to implement a communications plan that supports the implementation of changes by providing proof on how they will benefit from the changes being proposed.

Improvements that rely on changes occurring at multiple points along the value chain provides the opportunity for the involved businesses to benefit in ways that would not otherwise be possible. Examples include a producer-owned cooperative that improved its annual financial performance by $50 million while simultaneously increasing its payment to farmers. This came from having identified the impact that sourcing policies were having on pineapple producers’ behaviour and the enormous costs that were subsequently being incurred by the processor. Paying producers more to produce pineapples more suited to end-market requirements than previously produced significantly reduced the processor’s operating costs. It also lessened the environmental impact of producing and processing pineapples.

As can be seen below in Figure 4-5, a proportion of production currently falls below the acceptable threshold of performance. Of potentially greater importance, an even higher percentage of production might easily fall below the acceptable threshold. Once the improvement targets have been established, the next action is to establish a plan to attain and maintain the desired outcomes.
From having analyzed the data to identify which process input variables affect outputs and to what extent, and from having established improvement targets, you will be able to develop a formal improvement plan. The same reasons mentioned about the need and benefits of establishing a project charter (incl. coordination, accountability, and ROI) apply to the improvement plan. The plan establishes how you are going to improve and monitor performance by identifying and communicating:

- What is the action?
- Who is responsible for implementation?
- When is implementation to be completed by?
- How will we validate implementation?

**Phase 5 – Control**

The final stage of the DMAIC process is to establish the controls necessary for ensuring that the improvements achieved to date are maintained, and can be continually improved upon, through monitoring performance. This comes from incentivizing people to support the business practices being proposed, because they can see how it will benefit them, either financially or otherwise — such as increasing their quality of life.
This is achieved through establishing standard operating procedures (SOPs) and key performance indicators (KPIs), ensuring visibility and the reaction to swiftly respond to issues, through implementing daily management systems, and setting in place the processes that people should follow if performance falters. Communication, training, and post-implementation follow-up audits are also key elements of the control phase.

For many of the same reasons as described for the project charter and improvement plan, the control plan will identify:

- What is the new process?
- Who has to do what, when and how?
- What features about the inputs, process, outputs will we measure?
- Where, when, and how often will we measure?
- Who will measure?
- How will they measure?
- Where will data be recorded?
- How do we respond if the data indicates the process is not performing properly?
5 Conclusion

The primary purpose of this report is to help address the disconnect between the attitude and behaviour of producers and managers of any sized business situated along the food value chain. We do this by presenting a proven means of improving financial performance through reducing food and associated wastes. We define food waste as the loss of food along the value chain that is suitable for human consumption, or would be fit for human consumption after processing — such as wheat.

The report began by identifying that in both developed and developing nations the amount of food wasted along the value chain, prior to its purchase by consumers, is greater than previously thought. From a lean six sigma (LSS) perspective — which defines waste as any inputs (incl. water, fertilizer, chemical, feed, labour, energy, water, etc.) that are used unnecessarily, because the processes used to produce an outcome are not sufficiently rigorous or managed correctly — we believe the true extent of food and associated wastes exceeds previous estimates. Internationally, the economic and environmental implications of food and associated wastes are also greater than initially calculated. An example comes from the UK, where it has been estimated that improving the feed conversion rate of beef by a single unit would save the equivalent of ten percent of the annual UK wheat harvest. In Canada, where feed conversion rates are generally better than the UK, a 0.5 unit improvement could save the equivalent of one million tonnes of wheat. This improvement is well within the realms of possibility.

That similar opportunities have been identified in other sectors of the agri-food industry illustrates the magnitude of the economic and environmental opportunities that lie before us. Feeding a burgeoning population, while sustaining the environment, relies on businesses collaborating more effectively then is presently the case. Governments must foster more effective long-term collaboration between their own ministries and each other. While change is steadily occurring, such as those recently announced by Tesco in the UK and Stop and Shop in the US, and through industry level initiatives such as the UK’s Waste Resource Action Plan (WRAP) and the international “Think.Eat.Save” program, relatively little is occurring in Canada. What is occurring primarily revolves around the improved management of organic waste, which, from a sustainability perspective, is not unlike shutting the gate after the horse has bolted. We need to prevent as much food and associated wastes as possible from occurring in the first place, not just seek to manage it after the fact.

The preventative measures proposed in Section 4 are based on our and others’ experiences assisting businesses of all sizes to improve their profitability by reducing waste. They work. The influence that initiatives such as WRAP have had on changing businesses’ behavior has come from demonstrating the application of such measures. This has led to senior managers’ acknowledging that a business case exists for implementing similar programs in their own businesses.
Maintaining a sustainable and vibrant agri-food industry is critical to Canada’s economic well-being. We have the opportunity to benefit from becoming a world leader in the responsible use of natural resources, while simultaneously becoming an economic agri-food powerhouse. We do not need to reinvent the wheel. As recognized by the delegates who attended the 2012 “Cut Waste, GROW PROFIT™ forum, we need to foster widespread changes in the attitude and behaviour of business managers and consumers, by applying lessons learned from programs and initiatives that already exist.
Endnotes and References

1 Attenborough, 2012
2 Farm Credit Canada, 2013; Mekonnen and Hoekstra, 2012; The Council of Canadian Academies, 2013; FAO, 2011b
3 Maclean’s, 2013 http://www2.macleans.ca/2013/05/11/world-passes-carbon-dioxide-level-milestone/
4 Institute of Mechanical Engineers, 2013
5 Gooch, Felfel & Marenick, 2010
6 Plummer, 2013; Ryaboi, 2013
7 Dobbs, Oppenheim, Thompson, 2012
8 Hedley, 2012
9 FAO, 2013a; FAO, 2011b
10 Hall et al., 2009
11 WRAP, 2013A
12 Abdulla, Martín, Gooch, Jovel, 2013
13 WRAP, 2013 C
14 Farm Credit Canada, 2013; Mekonnen and Hoekstra, 2012; Council of Canadian Academies, 2013
15 This Is Rubbish, 2013; Institute of Mechanical Engineers, 2013
16 Clarke, 2013; Smithers, 2013
17 Mekonnen and Hoekstra, 2012;
18 Institute of Mechanical Engineers, 2013
19 Evans, 2013; Mekonnen and Hoekstra, 2012; PWC, 2012
20 Farm Credit Canada, 2013
21 Institute of Mechanical Engineers, 2013
22 Farm Credit Canada, 2013; Boccaletti, Grobbel, Stuchtey, 2009; Attenborough, 2012
23 Institute of Mechanical Engineers, 2013; FAO, 2011b
24 Environment Canada, 2010
25 Institute of Mechanical Engineers, 2013
26 Cooper, 2013
27 Gooch, Felfel & Marenick, 2010
28 Eur-Active, 2012
30 Gunders, 2012
31 Living Sustainably, 2013
32 WRAP, 2013 B
33 Murray, 2013
34 Gooch, Marenick, Laplain, 2011
35 WRAP, 2013 A
36 Ryaboi, 2013
37 Environmental Leader, 2013
39 www.feeding5k.org
40 Gunders, 2012
41 Living Sustainably, 2013
42 Derrick, 2013
43 Examples include: FCC / RMIF, 2003; Food Chain Centre, 2008; Gooch et al., 2009; Gooch, Felfel, & LaPlain, 2009; Gooch, Marenick, Laplain, 2011
44 FCC / RMIF, 2003; The Meating Place, 2013
Reducing food waste by addressing attitudinal and behavioural disconnects along the value chain

References


CAPI, 2012

Evans, 2013; Hadley, 2013; FCC / RMIF, 2002

Gooch, 2011; VCMC / OCA, 2012

Reducing food waste by addressing attitudinal and behavioural disconnects along the value chain

https://www.mckinseyquarterly.com/Energy_Resources_Materials/Strategy_Analysis/Mobilizing_for_a_resource_revolution_2908


Evans, D. (2013). Personal Communications; Beef Production Systems Ltd.; United Kingdom

http://www.fcc-fac.ca/en/LearningCentre/Knowledge/doc/KI_water13_e.PDF


FCC and RMIF (2002); Cutting Costs – Adding Value to Red Meat; Food Chain Centre in Partnership with the Red Meat Industry Forum; United Kingdom

Food Chain Centre (2008). Improving Right First Time in Soft Fruit: A Case Study of Angus Fresh Fruits Ltd.; Food Chain Centre; Institute of Grocery Distribution; United Kingdom

Gooch, M. (2006). Quality Based Pricing – Paying More Can Actually Lower Your Costs; Agri-Food For Thought; George Morris Centre; Fall 2006 Edition


Hadley. P. (2013). Personal Communication; EBLEX; United Kingdom


Hedley, D. (2012). Presentation to the House of Commons’ Standing Committee on Agriculture and Agri-Food


Ireland’s Food Waste Regulations for business http://www.foodwaste.ie/


Makepovertyhistory.ca website viewed April 2013 http://makepovertyhistory.ca/learn/issues/end-poverty-in-canada

Mekonnen, M.M., Hoekstra, A.Y., (2012). A Global Assessment of the Water Footprint of Farm Animal Products; Ecosystems; v15, pp401-415; Published online: January 24, 2012


PWC (2012). Water: challenges, drivers and solutions; PriceWaterhouseCoopers


This is Rubbish (2013). Counting What Matters: The Report of The Industry Food Waste Audit Proposal; This Is Rubbish; www.thisisrubbish.org.uk


Reducing food waste by addressing attitudinal and behavioural disconnects along the value chain


