

COW OF THE FUTURE: THE ENTERIC METHANE REDUCTION PROJECT SUPPORTING THE U.S. DAIRY INDUSTRY SUSTAINABILITY COMMITMENT

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INTRODUCTION

Cow of the Future is one of ten projects the Innovation Center for U.S. Dairy launched to support the industry-wide initiative to reduce greenhouse gas emissions (GHG) for fluid milk across the entire dairy supply chain by 25% by 2020. The milk production segment of the U.S. dairy supply chain is the single largest source of GHG emissions contributing 51.5% to the fluid milk carbon footprint (Thoma et al., 2012). In addition, enteric methane constitutes 25.1% of the entire dairy value chain carbon footprint (Figure 1; Innovation Center for U.S. Dairy, 2012). Given the large size of its contribution to the overall carbon footprint, the Innovation Center for U.S. Dairy identified enteric methane mitigation as a priority area and launched the Cow of the Future project to address it.

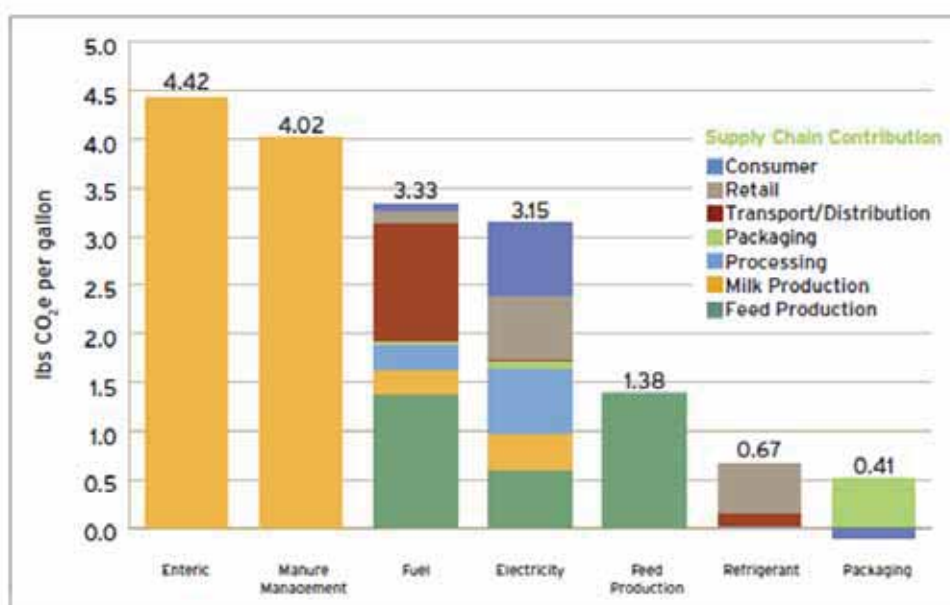


Figure 1. Supply chain contribution to the carbon footprint of regional-production-weighted (raw milk input) and purchase-volume-weighted (milk fat content) average milk consumed in the U.S. during 2007.

As feed costs continue to rise, even small improvements in feed efficiency, if economically viable, could both reduce the dairy's fluid milk carbon footprint and potentially lower operating costs for the dairy producer. Today, many producers already reduce enteric methane emissions by maximizing feed efficiency and increasing production per cow. However, there is an opportunity to develop solutions that significantly reduce enteric methane emissions per hundredweight of milk.

It is useful to examine the history and development of the U.S. Dairy Sustainability Commitment in order to fully understand the Cow of the Future project within the context of this industry-wide initiative.

THE U.S. DAIRY SUSTAINABILITY COMMITMENT AND THE INNOVATION CENTER FOR U.S. DAIRY

Early Stages and the Sustainability Summit

The U.S. dairy sustainability initiative began in 2007 when leaders from across the dairy industry convened to define the meaning of sustainability for the industry¹ and its role for the industry's future. These efforts eventually led to a Sustainability Summit held on June 17-19th, 2008 in Rogers, Arkansas. The Sustainability Summit was attended by 250 participants including representatives of the full spectrum of the dairy value chain, as well as academia, government and non-governmental organizations. This summit was an action-focused dialogue among dairy industry stakeholders. The participants focused on identifying breakthrough approaches to reduce GHG emissions by designing business strategies for the fluid milk value chain with potential to build economic, social and environmental value. Emphasis was placed on developing solutions with the potential to generate business value through innovation.

This summit offered an unprecedented opportunity for representatives across the entire dairy value chain to build a vision, generate ideas, and design plans to position the industry on a more competitive and sustainable path. It also represented a forum to affirm the dairy industry's shared commitment to consumers, the environment and all industry value chain participants. Committing to and drafting a vision and set of guiding principles to build on dairy's heritage and establish a new way for the industry to collaborate pre-competitively was one of the important outcomes of the summit. In addition, 27 potential projects for the dairy industry to reduce GHG emissions were identified in the summit.

The Innovation Center for U.S. Dairy

The Innovation Center for U.S. Dairy was created in 2008 as a result of recognizing the need for industry collaboration by Dairy Management Inc. (DMI), the National Milk Producers Federation (NMPF) and the International Dairy Foods Association (IDFA) to support sales of milk and milk products (Innovation Center for U.S. Dairy, 2011). The Innovation Center board of directors includes 31 leaders from 30 key U.S. producer organizations, dairy cooperatives, processors, manufacturers and brands. The Innovation Center is supported and staffed by DMI — the nonprofit domestic and international planning and management organization responsible for increasing sales of

¹ U.S. Dairy Industry definition of sustainability: *To provide consumers with the nutritious dairy products they want in a way that makes our industry, the earth and its people economically, environmentally and socially better — now and for future generations.*

and demand for U.S.-produced dairy products and ingredients on behalf of America's dairy producers². Today, the Innovation Center for U.S. Dairy provides a forum for the dairy industry to collaborate pre-competitively by aligning its collective resources to address barriers and opportunities to foster innovation and increase sales, offer consumers nutritious dairy products and ingredients, and promote the health of people, communities, the planet and the industry. The Innovation Center board's leadership and commitment to sustainability shows a way to continue building on the dairy industry's heritage of stewardship to promote and protect dairy in the changing social, environmental and economic landscape of our planet.

The U.S. Dairy Sustainability Commitment Roadmap

The "U.S. Dairy Sustainability Initiative — A Roadmap to Reduce Greenhouse Gas Emissions and Increase Business Value" (Innovation Center for U.S. Dairy, 2008) is the document that encapsulates the culmination of the first phase of the initiative and defined the industry-wide sustainability commitment (from now on referred to as the Roadmap). In this document, the Innovation Center identifies sustainability as a major area of focus and GHG reduction as the initial priority. In addition, the document declares an industry-wide commitment to unified industry leadership in sustainability in general and GHG reduction in particular. The commitment calls for the dairy industry to support an overall GHG reduction goal of 25% by 2020 for the entire value chain from farm to retail. This reduction goal is currently expressed in terms of emission intensity, or GHG emissions per unit of milk produced or consumed.

Two additional requests in the Roadmap that are worthy of mention in this paper are industry-wide commitments for: 1) support strategies to pursue funding for projects contributing to the U.S. Sustainability Initiative, and 2) support the launch of a second phase of the initiative, which expands the LCA efforts beyond fluid milk and address opportunities beyond GHG emissions.

The Roadmap also describes a variety of actions to support the overall GHG reduction goal while creating business value. These actions included coordinated industry collaboration to: conduct a peer-reviewed life cycle assessment (LCA) based on data gathered from industry participants across the value chain to quantify the GHG footprint for fluid milk in the U.S., form a council of industry leaders and stakeholders representing the entire dairy value chain to serve as an advisory group (currently referred to as the Sustainability Council), and refine and prioritize the initial 27 projects into a portfolio of 12 projects under the guidance of the Sustainability Council. Cow of the Future is one of those 12 projects initially developed in the Roadmap and one of 10 active projects currently managed by the Innovation Center for U.S. Dairy in support of the U.S. Dairy Sustainability Commitment.

² DMI manages the American Dairy Association, National Dairy Council, U.S. Dairy Export Council and the U.S. dairy check-off program, which supports milk producers in marketing their products.

THE COW OF THE FUTURE PROJECT

Cow of the Future Vision, Goals, and Project Stages

The Cow of the Future project addresses enteric methane produced by cows during the process of feed digestion. Its main objective is to identify opportunities to reduce enteric methane, the single largest component of the dairy industry's GHG footprint, through improvements in animal nutrition, health, and genetics. The vision for the project, as stated in the Roadmap, is "to clarify for producers which products reduce carbon and are economically viable". In this way, the project's primary audience (the dairy producers), overall objective (to understand and clarify carbon reduction products, technologies, and practices), and commercial conditions (economic viability) were established. The current specific goals for the Cow of the Future project are to 1) understand and disseminate currently available enteric methane mitigation practices for adoption by U.S. dairy producers, and 2) coordinate future enteric methane mitigation research to advance science and increase international collaboration.

The Roadmap also identified two project stages that are aligned with the above vision and goals. Stage one focuses on identification of mitigation opportunities through comprehensive reviews of technologies. These reviews consider various research topic areas, such as nutrition, metabolic processes, immunology, and genetics to highlight current and potential technologies and products. The focus for the second stage is on dissemination of mitigation opportunities through a multi-stakeholder engagement process to support producer adoption and consumer acceptance of enteric methane-reducing technologies. The importance of this stakeholder process must not be underestimated. Its objective is to develop both industry and consumer understanding of new opportunities to provide stakeholder alignment, reduce the risk of industry or consumer technology rejection, and facilitate technology adoption.

The rest of this paper will focus on describing Cow of the Future major milestones, next steps and future plans.

Cow of the Future Research Priorities White Paper

The "Cow of the Future Research Priorities for Mitigating Enteric Methane Emissions from Dairy" is a white paper published on the Innovation Center for U.S. Dairy website in July 2011 (Knapp et al. 2011). This document summarized the evaluation of research opportunities conducted by an Advisory Group and identified eight major research areas for the development of new strategies and technologies. The research priorities white paper was developed to support the goal of coordination of future enteric methane mitigation research to advance science. The document is intended to stimulate conversation within the academic and business community to advance our collaborative efforts to reach the dairy industry's voluntary GHG reduction goal.

The Advisory Group that authored the white paper included key leaders in rumen microbiology, dairy cattle nutrition, animal genetics, and dairy herd management who are associated with land-grant universities and livestock industries in the U.S. These individuals willingly contributed their time and expertise to provide advice and, over the course of five months, solicit and review expressions of interests from more than 50 investigators from over 20 institutions in the U.S. In addition, the document was reviewed by additional experts outside of Innovation Center for U.S. Dairy, the Advisory Group, and those who submitted expressions of interests.

Content from the Cow of the Future Research Priorities document was first shared with the scientific community, along with presentations by various highly recognized scientists, in a day-long symposium at the 2011 Joint Annual Meeting of the American Dairy Science Association and American Society of Animal Science. The Innovation Center for U.S. Dairy sponsored the “Production, Management and the Environment & Forages and Pastures Joint Symposium: Environmental Impact of Beef and Dairy Systems” as part of the Cow of the Future agenda to foster dialogue among the science community on how existing livestock production systems affect air, land and water resources.

Eight major areas of research were identified for the development of new products, technologies, and practices (Figure 2). Three major areas provide the foundation and integration of knowledge to strengthen research efforts in areas with direct impact on methane emissions. Those three foundational areas are: 1) rumen microbial genomics and ecology, 2) development and refinement of methane measurement techniques, and 3) mathematical modeling efforts to quantitatively integrate knowledge. The five areas with the potential to directly impact on methane emissions include: 1) rumen function and modifiers, 2) enhancing feed quality and ingredient usage to improve feed efficiency, 3) genetic approaches to increase individual cow productivity, 4) management practices to increase individual cow productivity, and 5) management of herd structure to reduce number of cow-days of non-productivity. In addition to reductions in methane emissions, the advisory group believes that research in all of the priority areas has the potential to lead to even greater improvements in dairy productivity, environmental sustainability, consumer reception of dairy production practices and products, and animal health and welfare.

It is also worthwhile to point out that several research areas identified above have not been recognized or generally associated with enteric methane mitigation opportunities in the past, but clearly present a significant potential for GHG mitigation, especially when emissions are considered per unit of milk produced or consumed. The areas of research outlined in the research priorities white paper are aligned with the statement by EPA that “Improving livestock productivity so that less methane is emitted per unit of product is the most promising and cost effective technique for reducing emissions in the U.S.” (EPA, 2005). This approach is also clearly exemplified by the historical improvements in milk yield per cow in the U.S. leading to 90% less land, 65% less water, 75% less manure, and 63% smaller carbon footprint per gallon of milk from 1944 to 2007 (Capper et al., 2009).

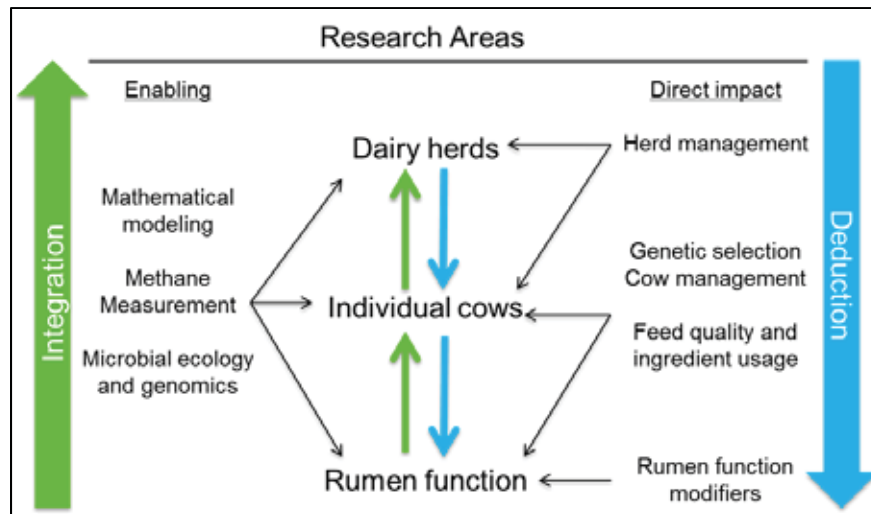


Figure 2. Major research areas for development of mitigation strategies identified in the document “Cow of the Future Research Priorities for Mitigating Enteric Emissions from Dairy” (Knapp et al., 2011).

Cow of the Future Project Team

The Advisory Group that drafted the research priorities white paper represents only a small fraction of stakeholders actively participating in the Cow of the Future project team. Currently the team includes more than 130 participants from academia, industry (including individual dairy producers), government, and non-governmental organizations. Team members have an opportunity to interact with the project director, Innovation Center for U.S. Dairy staff, and each other via conference calls, webinars, surveys, quarterly updates, and in-person meetings throughout the year.

Cow of the Future 2012 Refined Project Plan

Although the Roadmap described business and action plans for the Cow of the Future’s contributions to the industry’s sustainability goals, the project work plan was refined when the current project director joined the Innovation Center for U.S. Dairy in 2011. The Cow of the Future current working plan is focused on developing mitigation opportunities into business cases for the latent opportunities in technology, products, and practices that will drive innovation in enteric methane mitigation to achieve the industry goal of 25% GHG emissions reduction by 2020. The plan includes 3 different phases or steps: 1) comprehensive scientific review, 2) feasibility evaluation, and 3) business case development (Figure 3).

These working plan phases are not necessarily sequential for every mitigation opportunity that is selected for evaluation and development. However, the scientific review phase is a necessary first step because the dairy industry values science as the foundation of its commitment to sustainability. This commitment to science-based improvement is demonstrated in the decades-long approach to human nutrition

research by the dairy industry. Peer-reviewed scientific research grounds dairy industry's decisions, informs the development of best management practices and helps establish goals and measure accomplishments for every segment of the dairy value chain.

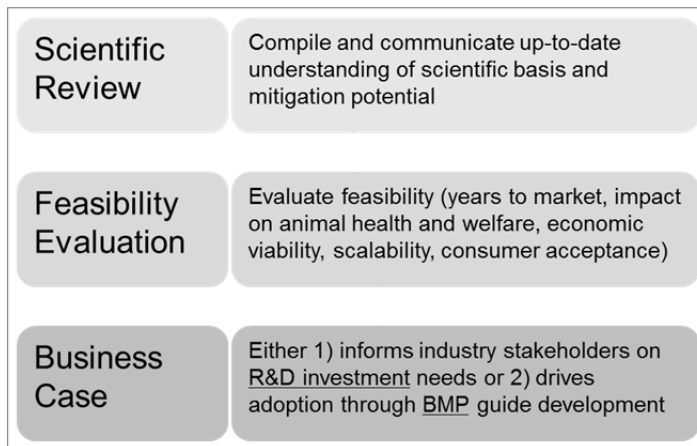


Figure 3. The Cow of the Future current working plan includes scientific reviews, feasibility evaluations, and business case development for all enteric methane mitigation opportunities considered.

The feasibility evaluation is intended to apply economic and social criteria to review the science-based solutions that show undisputed mitigation potential. Some mitigation opportunities will show promising mitigation potential but lack sufficient data to pursue a feasibility evaluation. Similarly, foundational or enabling research areas may not present direct mitigation opportunities at all. The business case for those opportunities and research areas will focus on informing the dairy industry stakeholders on research and development investment needs for further developing the knowledge base and the potential opportunities.

Thoroughly studied mitigation opportunities that successfully complete scientific review and feasibility evaluations may be developed into business cases that focus on driving adoption through management practice guides.

Cow of the Future Progress Update and Next Steps

During the first quarter of 2012, the Cow of the Future project team prioritized four opportunity categories for scientific review. Those categories are 1) methods for measuring methane emissions, 2) cow health and herd productive efficiency, 3) forage quality and feed management, and 4) metagenomic approaches to mitigation. In addition, Cow of the Future held a workshop in Rosemont, IL on Dec 14, 2011 where practice categories were identified that many dairy producers currently employ but lack the connection to enteric methane mitigation potential.

The Cow of the Future project team is currently working on a scientific review on the effects of cow health and herd productive efficiency on enteric methane emissions, an interpretive summary that can be used to develop a business case to inform stakeholders on research and development needs for methodologies to measure methane, and a Best Management Practices (BMP) guide that makes the connections between currently available and used practices that make economic sense and at the same time reduce enteric methane emissions.

The Cow of the Future team will continue to foster research opportunities through public dialogue, peer-reviewed publications, cross-industry collaboration and communications on better management practices for reducing enteric emissions (Innovation Center for U.S. Dairy, 2012).

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