Environmental Stewardship

USER GUIDE

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NMPF
NATIONAL MILK PRODUCERS FEDERATION

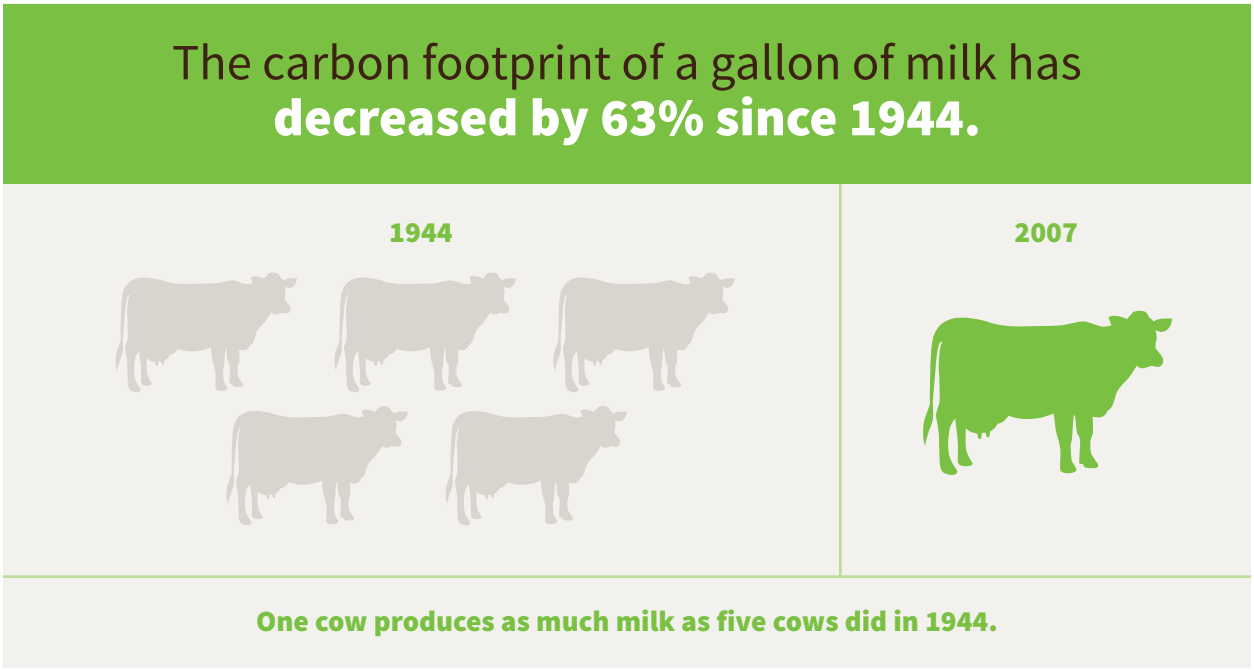
INNOVATION CENTER FOR U.S. DAIRY
HEALTHY PEOPLE • HEALTHY PRODUCTS • HEALTHY PLANET

Chapter 1: Introduction

Customers and retailers are increasingly looking to tell a positive story about their commitment to the environment. To develop that story, customers are exerting pressure up the supply chain – asking farmers to provide information about the impacts of food production. While their demand certainly presents a challenge, it is also an opportunity for the dairy industry to highlight its current and future accomplishments.

U.S. dairy farmers have a longstanding history of environmental stewardship. As dairy production has become more efficient, it requires fewer resources to produce the same amount of milk. Compared to 70 years ago, producing a gallon of milk uses 65 percent less water, requires 90 percent less land and has a 63 percent smaller carbon footprint.[1] In fact, the U.S. dairy industry may be the world's most efficient. According to a study by the United Nations Food and Agriculture Organization, dairy farming in North America has the lowest greenhouse gas emissions intensity of any region in the world.[2]

Our industry's challenge today is to track and communicate dairy's continued path of efficiency and environmental achievements. The FARM Environmental Stewardship (ES) module is designed to capture those improvements and ensure consumer confidence. Dairy farmers can assure food companies and consumers of our commitment to continuous improvement by using the FARM ES module to measure greenhouse gas emissions and energy intensity. At the same time, dairy farmers can use the results to identify opportunities for improvement that benefit both the planet and the farm's bottom line.



[1] *Capper, J. L., Cady, R. A., & Bauman, D. E. (2009). The environmental impact of dairy production: 1944 compared with 2007. Journal of Animal Science, 87(6), 2160-2167. doi:10.2527/jas.2009-1781*

[2] *Gerber, P., et al. (2010). Greenhouse Gas Emissions from the Dairy Sector, a Life Cycle Assessment. FAO Food and Agriculture Organization of the United Nations. Animal Production and Health Division. http://www.fao.org/docrep/012/k7930e/k7930e00.pdf*

The Environmental Stewardship Module

The FARM Environmental Stewardship module provides a comprehensive estimate of the greenhouse gas (GHG) emissions and energy use associated with dairy farming. The tool is based on a life cycle assessment (LCA) of fluid milk conducted by the Applied Sustainability Center at the University of Arkansas, incorporating data from more than 500 dairy farms across the United States. The FARM ES module asks a limited set of questions to assess a farm's carbon and energy footprint – reducing the burden on farmers while still providing reliable, statistically robust estimates.

The purpose of this User Guide is to enable co-op field staff, FARM evaluators and individual farmers to input their data into the FARM ES module – explaining which resources may contain the data on their farm, as well as answering common questions about how to interpret each measure. The User Guide also explains how to understand the results. Users already familiar with the FARM ES module may find value in referring to the Appendix for a summary table of required data.

Accompanying this User Guide is a supplemental FARM ES Project Guide detailing the science used to develop the FARM ES module and best management practices that can improve performance. The FARM ES Project Guide should be consulted to understand the specifics of how the user's data is reflected in the FARM ES module results.

Getting Ready

The FARM ES module uses data from a consistent year – a 12-month period that does not necessarily reflect a calendar year. The same 12-month period (for example, March 1 to February 28) should be used each time the farm enters data into the FARM ES module. Before entering information, operations should gather the following:

- Obtain milk production records, including total production as well as average protein and fat percentages. Operations can find production information in the DHIA report or other dairy record management systems. The farm's cooperative would also be able to provide milk production data.
- Assess the average herd size, including the average number of lactating cows, dry cows, replacement heifers under 2 months (both on- and off-farm) and replacement heifers over 2 months (both on- and off-farm). This information may be available in the DHIA report or other dairy record management systems.
- Collect records on mature cows culled for beef and calves sold for beef production.
- Contact the nutritionist to obtain average feed ration for lactating cows, including concentrate and forage, preferably on a dry matter basis.
- If it applies to the operation, consult grazing records or pasture management spreadsheets. A Nutrient Management Plan may also contain pasture information.
- Collect documents on electricity and fuel consumption. Utility bills may be useful for determining electricity and natural gas usage. Information on other fuels may be found in purchase records or usage logs.
- Obtain information on manure management systems. The farm's Nutrient Management Plan or Comprehensive Nutrient Management Plan may contain details on manure management.
- For operations with anaerobic digesters, contact the company that installed or operates the digester for information on conversion efficiency and the percentage of electricity or heat utilized.

Documentation

Document FARM ES module data on the National Dairy FARM Program data entry application, available on the FARM website and via mobile app. It is the same application used for FARM Animal Care Program evaluation.

Documenting the approach for entering data into the FARM ES module is essential for consistent reporting. The notes section under each question within the data entry application should be used to specify what records or software were referenced and any assumptions that were made to calculate values. These notes will be available the next time the operation is assessed using the FARM ES module. Being consistent ensures that the operation's performance can be compared over time. There is also a notes section at the end of this guide for additional documentation of methods and tips to help access and enter data more easily.

Thank you for your participation. U.S. dairy farmers have a longstanding commitment to positive environmental stewardship and outcomes. Your decision to be a part of the FARM ES program is an important step in communicating that dedication to customers and consumers.

If you have questions about the FARM Environmental Stewardship module, please call NMPF at (703) 243-6111 or log on to www.nationaldairyfarm.com.

Glossary

Consistent Year: Data in the FARM Environmental Stewardship module should be entered for a 12-month period. The same 12-month period should be used each time the farm enters data in the FARM ES module. This may or may not align with the calendar year. For some farms, this will mean March 1 to February 28; others may have a financial year of July 1 to June 30.

DHIA: Dairy Herd Improvement Association.

Enteric Methane: Methane livestock produce via the digestive process.

FPCM: Fat and Protein Corrected Milk. A measure of milk production that normalizes milk output to an average content of 4 percent fat and 3.3 percent protein.

GHG: Greenhouse Gas. A gas that absorbs and re-emits heat in the Earth's atmosphere.

LCA: Life Cycle Assessment. A life cycle assessment is a type of analysis that assesses the environmental impacts associated with a product across all stages of production.

Milk Marketer: The entity that sells or markets the operation's milk. This may include a cooperative, processor or other entity.

Chapter 2: Production

The total number of animals present on a farm impacts an operation's carbon footprint. Cows emit greenhouse gases (GHGs) directly during digestion as well as indirectly via manure decomposition. This section records milk output, herd averages and beef production data used in emissions calculations. Milk production is used to normalize results in order to compare performance year to year and across farms that differ in milk output. Improved efficiency, animal health, herd management and nutrition continue to generate positive returns for dairy producers across the country. Managing production efficiencies also translates into better GHG and energy use performance for U.S. dairy producers.

What's Included This section covers milk production, herd size and animals culled/sold for beef production. Exclude crop production totals as well as any other non-dairy enterprises.

Values Reported Milk production and herd data are reported as totals or averages over the course of a consistent year, depending on the specific data requested.

What's Needed Data on milk production, including fat and protein content, herd data and animal sales are required. Operations can find production, herd and animal sales information in the DHIA report or other dairy record management systems. The farm's milk marketer would also be able to provide milk production data. Additional sales records may be consulted as needed.

Reporting Guidance

Milk Production

Total annual milk production *Pounds of milk shipped, used ON-farm, or other*	_____ **lbs.**
Average milk protein content	_____ **%**
Average milk fat content	_____ **%**

Report total milk production for a consistent year, including pounds sold, used on-farm or other, as well as the average milk protein content and milk fat content.

Herd Size

Annual average herd size *Lactating and dry cows*	_____ **cows**
Annual average dry cows *% of total cows*	_____**%**
Annual average number of heifer calves:	
Less than 2 months raised ON-farm	_____ **calves**
Less than 2 months raised OFF-farm	_____ **calves**
Annual average number of heifers:	
2 months to first calf raised ON-farm	_____ **cows**
2 months to first calf raised OFF-farm	_____ **cows**

The average herd size includes both lactating and dry cows. For heifers and heifer calves, record the running herd average of the replacement animals, not the annual total.

What if the herd is seasonal and typically dry at the same time?

For seasonal herds, report the average fraction of a consistent year that the herd is dry. For example, if the herd is dry for 45 days per year, enter 45/365 or 12.3 percent.

Beef Production

Total annual number of mature cows culled for beef	_____ **cows**
Average weight per culled cow (value between 700 lbs. and 2,000 lbs).	_____ **lbs.**
Total annual number of calves sold for beef	_____ **calves**
Average calf weight at time of sale (value between 50 lbs. and 350 lbs.)	_____ **lbs.**

In addition to milk production, most dairy farms market animals for beef. As such, a portion of the environmental footprint associated with raising the animals should be allocated to beef production instead of milk production. This section asks for information on culled mature cows and calves sold for beef in order to determine how best to allocate the environmental footprint between beef and dairy.

For mature cows culled for beef, exclude cows sold to other farms for additional production as well as cows that die of natural causes or are otherwise euthanized. For calves sold for beef, do not include calves sold as replacement animals to other dairies.

Chapter 3: Energy

From powering tractors to lighting barns and cooling milk, energy is a critical piece of dairy farm activities. Managing energy use and pursuing energy efficiency can help farmers reduce costs and lessen exposure to price volatility. At the same time, energy reductions can lower a farm's carbon footprint. Addressing energy consumption presents a win-win for both the farm's profitability and GHG emission reductions. Options for reducing energy use will vary by farm, but opportunities include servicing and maintaining equipment, installing efficient lighting and equipment upgrades. Knowing the operation's current energy use can help determine the best strategy.

What's Included The focus is on energy used for dairy activities only. This includes uses such as heating water, milking, cleaning, scraping, ventilating, grinding and mixing.

As much as possible, exclude crop production activities like planting, irrigation and harvest as well as any other non-dairy enterprises on the farm. Impacts from these activities are already estimated in the FARM ES module using information from the dairy LCA. Crop production should be excluded even if the crop is used as feed for the operation's cows. However, activities that occur starting with the removal of feed from storage, such as feed mixing and conveyance, should be included.

Values Reported Figures for energy consumption are reported as total use over the course of a consistent year.

What's Needed Utility bills may be useful for determining electricity and natural gas usage. Information on other fuels may be found in purchase records or usage logs.

Reporting Guidance

In general, any energy use associated with the dairy operation should be included. The following table can be used to determine which activities to include and exclude. However, this table may not represent an exhaustive list of practices and equipment that use energy on every dairy farm. Please consider how each unique operation uses energy for dairy activities.

What if equipment is also used for crop production or other non-dairy activities? Similarly, what if the utility bill includes the home or other non-dairy buildings? It is common for equipment and utility bills to be shared across farm activities and buildings not associated with the dairy operation. Recognizing this constraint, the module allows users to enter in the total use and then estimate the percentage used on dairy activities. Another option is to look at energy use during months where the operation is not conducting any crop production activities. An annual estimate can be derived based on those months. Any assumptions or estimates used to report energy should be logged in the notes section.

What if the only known information is the total amount spent on electricity or fuel, not the total use? Use the average price per kWh of electricity or price per gallon of fuel to estimate the total usage. For example, if the average price of electricity is $0.12 per kWh and the farm's expenditure for a consistent year was $48,000, then the total annual usage was approximately 48,000 / 0.12= 400,000 kWh.

Category	Unit	Include	Exclude	Farm's Annual Usage
Electricity	kWh	• dairy parlor use (compressors, pumps, etc.) • lighting • ventilation • feed conveyance • manure management • other	• crop production activities (e.g. irrigation, drying) • non-dairy enterprises on your farm • home electricity use	_____ kWh _____ % used on dairy activities
Diesel	Gallons	• machinery for feeding • manure management, except for spreading • transporting heifers or cows	• crop production activities (e.g. tillage, planting, harvest) • non-dairy enterprises on your farm	_____ gal. _____ % used on dairy activities
Biodiesel	Gallons	• machinery for feeding • manure management, except for spreading • transporting heifers or cows • for blended fuels, report only the biodiesel portion: gallons x % biodiesel	• crop production activities (e.g. tillage, planting, harvest) • non-dairy enterprises on your farm	_____ gal. _____ % used on dairy activities
Fuel Oil	Gallons	• heating/water heating when used for dairy activities	• home heating • non-dairy enterprises on your farm	_____ gal. _____ % used on dairy activities
Propane	Gallons	• heating/water heating when used for dairy activities	• home heating • non-dairy enterprises on your farm • crop production activities, such as grain drying	_____ gal. _____ % used on dairy activities
Natural Gas	Therms	• heating/water heating when used for dairy activities • 1 Therm=1 CCF = 100 cubic feet	• home heating • non-dairy enterprises on your farm • crop production activities, such as grain drying	_____ therms _____ % used on dairy activities
Gasoline	Gallons	• machinery for feeding • manure management • transporting heifers or cows • vehicles used in other dairy management activities	• crop production activities (e.g. tillage, planting, harvest) • non-dairy enterprises on your farm	_____ gal. _____ % used on dairy activities

Chapter 4: Feed

Ruminant livestock have a four-compartment stomach within their digestive tract that promotes microbial fermentation. The process of fermentation helps cows break down roughage, but it also results in the production of methane, a potent greenhouse gas. The total amount fed significantly contributes to how much methane is released. So improvements in feed efficiency – more milk production per unit of dry matter intake – can address both profitability and the farm's environmental footprint. Ongoing research continues to deepen our understanding of how to manage enteric methane. Additionally, this section includes questions about ration composition. Crop production and feed processing both require energy, which varies by feed ingredient. Therefore, understanding ration formulations is important for estimating the farm's carbon and energy impacts.

Pasture

What's Included Pasture questions refer to lactating cows, dry cows and young stock. This section is only applicable to farms that utilize pasture as one of their feedstuffs.

Values Reported Time in pasture is recorded in weeks/year and average hours/day for a consistent year.

What's Needed Grazing records or pasture management spreadsheets may be consulted. A Nutrient Management Plan may also contain information on pasture utilization.

Reporting Guidance

Animal Type	Time in Pasture	
	Weeks per Year (0 to 52)	*Average Hours per Day (0 to 24)*
Lactating cows		
Dry cows		
Young stock		

Enter the weeks per year and average hours per day spent in pasture for lactating cows, dry cows and young stock.

Rations

What's Included Ration questions refer to lactating cows only. The FARM ES module estimates dry cow and heifer rations based on survey data from the dairy LCA. Details on these estimates can be found in the accompanying FARM ES Project Guide.

Values Reported Ration and feed figures are reported as the average daily intake per head of lactating cow during a consistent year.

What's Needed The farm's nutritionist may be able to provide a printout or electronic copy of feed rations for lactating cows. Ration data may also be available in the operation's dairy management software system or in written records.

Reporting Guidance

Users may need to average values across varying rations to come up with a single average for the entire lactating herd as well as convert from an as-fed basis to a dry matter basis.

Average Dry Matter Intake

Report the average dry matter intake (DMI) per head for lactating cows only in pounds per day (lbs./day). This figure should be available from the farm's nutritionist. If multiple rations are fed throughout the lactating phase and the overall average ration is not known, the following worksheet can be used to determine a time-weighted, overall average of the rations:

Ration	**DMI** *lbs./day*		**Average Days in Ration**		**Total Lactating Days**		**Time-Weighted DMI** *lbs./day (Total this column to find the overall average)*
E.g. High	50	X	150	/	300	=	25
E.g. Low	30	X	150	/	300	=	15
		X		/		=	
		X		/		=	
		X		/		=	
		X		/		=	
						Total:	_____

Percent Make-Up of Average Lactating Cow Ration

Report the percent make-up, on a dry matter basis, of ingredients in the average lactating cow ration. The following table can be used to convert from an as-fed basis to a dry matter basis.

What if the ration includes ingredients that are not listed in the table? If the operation's rations contain ingredients that are not listed below, such as high-moisture corn, they can be entered into the "All Other Feed" category.

Feed Ingredient	**As-Fed** *lbs./day*	**Average % Dry Matter Content**	**Dry Matter Intake** *lbs./day*	**Feed Ingredient % of Total DMI** *(dry matter basis)*
Corn grain (including cracked, ground and steam-flaked)	X	85%	=	
Corn silage	X	35%	=	
Wet DGS	X	40%	=	
Dry DGS	X	91%	=	
Soybean (raw or roasted)	X	91%	=	
Soybean meal	X	89%	=	
Alfalfa hay	X	84%	=	
Alfalfa silage	X	39%	=	
Grass hay	X	84%	=	
Grass silage	X	35%	=	
Pasture	X	20%	=	
All other feed	X	85%	=	

Chapter 5: Crop

The FARM ES module estimates the greenhouse gas impacts associated with producing crops for dairy feed. As part of this estimate, the module differentiates between the impacts from purchased feed versus feed produced on-farm. Purchased feed, for example, must be transported and delivered to the farm, which entails using fuel for transit. In general, crop production activities like tillage, planting and harvest all use fossil fuels that emit greenhouse gases. The decision to purchase feed or produce it on-farm depends on the operation's unique circumstance. For operations engaged in feed production, best practices like ensuring equipment is in good working shape and limiting idling time to less than 10 minutes can help reduce fuel use and the operation's carbon footprint.

What's Included This section refers to the crops produced on the farm that are used as feed for the dairy operation. It does not encompass crops grown for other purposes (i.e. sold or used for the production of other animals).

Values Reported Crop production data is reported as annual average percentages for a consistent year.

What's Needed The operation's feed purchase records or written records may be consulted for crop production information.

Reporting Guidance

Crop Type	% That is Self-Produced
Soybean	_____%
Corn grain	_____%
Alfalfa hay	_____%
Alfalfa silage	_____%
Corn silage	_____%
Grass hay	_____%
Grass silage	_____%

For each of the crops listed that are used as dairy feed on the operation, specify the portion that is self-produced.

Chapter 6: Manure Management

Over time, manure decomposes and releases greenhouse gases – methane and nitrous oxide – during the process. The amount and rate of emissions depends on how much manure is present and how the manure is stored. Nitrous oxide emissions will also vary with the carbon and nitrogen content. However, greenhouse gas emissions are not the only important factor in choosing a manure management system – one must also balance the issues of cost, regional constraints, nutrient management and more.

What's Included This section covers all manure management for the entire dairy operation, including the lactating cows, dry cows, heifers and calves. Manure deposited onto pasture should be excluded from reporting because the model uses the time spent on pasture, as inputted in Chapter 4, to estimate the associated emissions.

Values Reported Manure management data is reported as the average over the course of a consistent year.

What's Needed The farm's Nutrient Management Plan or Comprehensive Nutrient Management Plan may contain details on manure management.

Reporting Guidance

Manure Management Systems

Report the estimated percentage of excreted manure handled in each manure management system.

What if the fraction of manure handled by each system is not known? One option is to use the time spent in various farm areas as a proxy for manure distribution. For example, consider a case where manure from the milking parlor is sent into an anaerobic lagoon and manure in the freestall barn is scraped into solid storage. If each lactating cow spends about 3 hours per day in the milking parlor and 21 hours per day in the freestalls, then about 3/24 or 13 percent of manure goes to the anaerobic lagoon and 21/24 or 87 percent goes to solid storage.

If assumptions are made to estimate the fraction of manure going to each system, record those in the notes section for use in subsequent years.

System	Description	% of Manure
Daily spread	Manure is collected and land applied within 24 hours.	%
Solid storage	Storage of manure, often for several months, in unconfined piles or stacks.	%
Dry lot	A paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically.	%
Liquid/slurry with natural crust	Manure is stored alone or with limited additional water in tanks or earthen ponds, usually for less than one year. A natural crust is allowed to form.	%
Liquid/slurry without natural crust	Manure is stored alone or with limited additional water in tanks or earthen ponds, usually for less than one year. A natural crust is NOT allowed to form.	%
Uncovered anaerobic lagoon	Liquid storage system designed and operated to combine waste stabilization and storage, with varying lengths of storage (up to a year or greater). Uncovered lagoons are open to the ambient air.	%
Covered anaerobic lagoon	Liquid storage system designed and operated to combine waste stabilization and storage, with varying lengths of storage (up to a year or greater). Covered lagoons have a physical covering.	%
Pit storage less than 1 month	Usually with little or no added water, collected below a slatted floor, with storage LESS THAN one month.	%
Pit storage greater than 1 month	Usually with little or no added water, collected below a slatted floor, with storage GREATER THAN one month.	%
Deep bedding less than 1 month	Bedding is continually added to absorb moisture over a production cycle LESS THAN one month (a.k.a. bedded pack).	%
Deep bedding greater than 1 month	Bedding is continually added to absorb moisture over a production cycle GREATER THAN one month (a.k.a. bedded pack).	%
Composting in-vessel or static	In-vessel: typically in an enclosed channel, with forced aeration and continuous mixing. Static pile: in piles with forced aeration but no mixing.	%
Composting intensive with forced aeration	Composting in windrows with regular (daily, 2 to 3 times per week, or weekly depending on stage) turning for mixing and aeration.	%
Composting natural aeration	Composting in windrows with infrequent turning for mixing and aeration, often with installed pipes for passive aeration (no blower or other forced air).	%
Aerobic treatment with forced aeration	Liquid handling with the addition of oxygen through forced aeration.	%
Aerobic treatment with natural aeration	Liquid handling with the addition of oxygen through natural aeration, such as facultative ponds and wetland systems that rely on photosynthesis.	%
Anaerobic digester	Encourages the bacterial decomposition of manure in the absence of oxygen, producing biogas, which is collected and utilized or flared.	%

Source: Manure management system descriptions are derived from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.[3]

[3] *IPCC. (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme. Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). IGES, Japan.*

Anaerobic Digester Details

For operations with anaerobic digesters, the FARM ES module contains additional questions to estimate the carbon footprint reduction associated with the digester.

Item	Description	Value
Conversion efficiency	Solids-to-gas conversion efficiency of the digester. Values range from 20% to 55%, though 30% is typical.	_____%
Manure management system for effluent *(after digester)*	Select the manure management system (MMS) from the previous table that best describes how the effluent is treated after exiting the digester.	Choose one MMS from the options in the previous table: _____ _____
Percent of electricity generation potential utilized	Fraction of electricity generated potential that is actually converted to electricity. Ranges from 0% to 40%.	_____%
Percent of heating potential utilized	Fraction of heating potential utilized. Ranges from 0% to 40%.	_____%

Chapter 7: Results

Increasingly, customers demand proof of sustainability and stewardship from their supply chain. From farm to retail, the U.S. dairy industry has become vastly more efficient over the years, enabling overall reductions in resource use per gallon of milk. However, tracking and communicating that efficiency story has not always been easy or straightforward for farmers or cooperatives. The FARM ES module results help prove a piece of dairy's sustainability story – continued efficiencies enabling industry-wide reductions in greenhouse gas emissions and energy use.

Interpreting Results

Overview The module uses the information entered in the previous steps to estimate the farm's greenhouse gas emissions and energy use. The results are scaled by pounds of milk produced in order to compare performance year-to-year and across farms that differ in milk output. Specifically, milk output is converted to fat and protein corrected milk, FPCM, which is a measure of milk production that normalizes milk output to the same scale (to an average content of 4 percent fat and 3.3 percent protein).

Users can record their first set of footprint results as the farm's baseline. Recording results annually creates a history of the farm's performance over time. Because farming relies on natural systems and external markets – both of which can be unpredictable – there may no observable improvements year-to-year. The goal is to capture long-term trends, regardless of annual ups and downs.

Greenhouse Gas Emissions

Background

A greenhouse gas (GHG) is a gas that absorbs and re-emits heat in the Earth's atmosphere. GHGs differ in their ability to trap and emit heat. For example, carbon dioxide has a Global Warming Potential of 1, whereas methane is rated a 25. In other words, methane has 25 times the potential impact as carbon dioxide.[4] To compare across these gases, they are all converted into carbon dioxide equivalents (CO_2e).

Results

The graph and table in Figure 1 (Page 16) show the pounds of CO_2e per pound of FPCM.

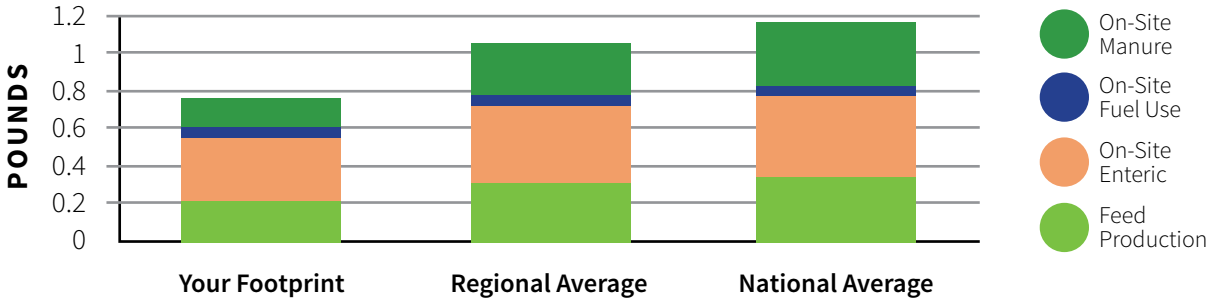
The results are divided into areas of production: feed production, on-site enteric, on-site manure and on-site fuel use. "On-site" refers to dairy activities on the farm. If the operation purchases feed and does not engage in crop production activities, the output will still generate an estimate for the impacts of the purchased feed.

The table provides greater insight into how the operation's results compare to similarly-sized farms, by showing regional and national averages. Regions are shown in Figure 2 (Page 16).

[4] *IPCC. (2007). Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.*

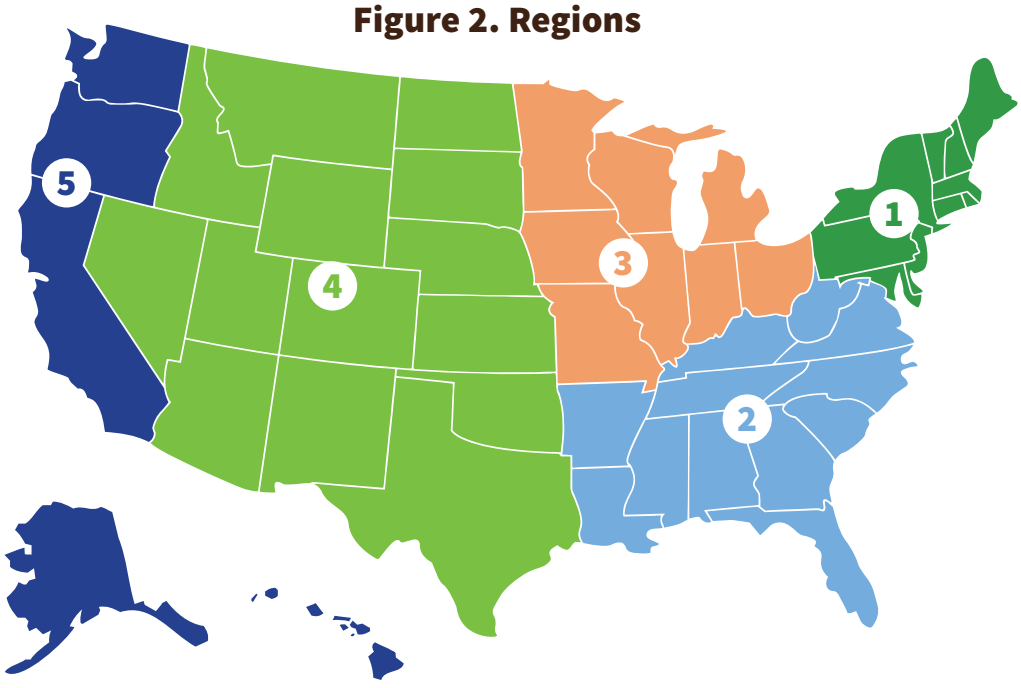
Figure 1. Your Farm Greenhouse Gas Emissions

lb CO_2e / lb FPCM produced



	Your Footprint	Regional Average	Regional Difference	National Average	National Difference
Feed Production	0.20	0.29	*(0.09)*	0.32	*(0.12)*
On-Site Enteric	0.34	0.42	*(0.08)*	0.43	*(0.09)*
On-Site Fuel Use	0.06	0.07	*(0.01)*	0.07	*(0.01)*
On-Site Manure	0.17	0.30	*(0.13)*	0.36	*(0.19)*
TOTAL	**0.77**	**1.08**	***(0.31)***	**1.18**	***(0.41)***

Figure 2. Regions



Energy Intensity

Background

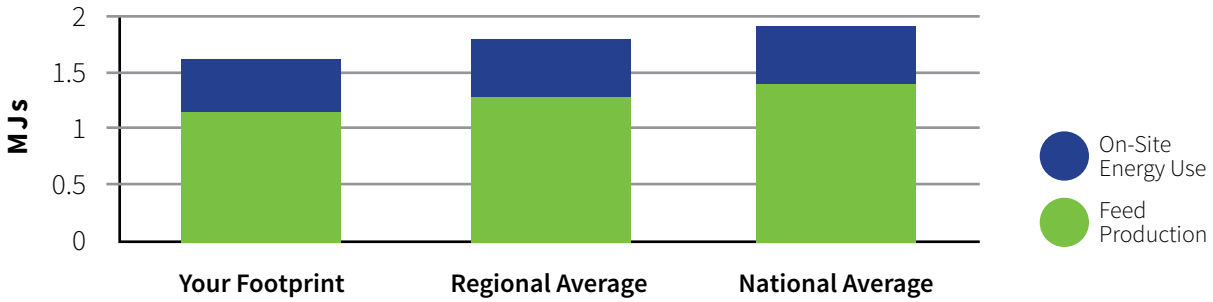
The energy used to produce milk – in the form of gasoline, electricity, propane or other – is converted into megajoule (MJ) and divided by the pounds of FPCM.

Results

The graph and table in Figure 3 show the MJs of energy per pound of FPCM. The results are divided into areas of production: feed production and on-site energy. "On-site" refers to dairy activities on the farm. If the operation purchases feed and does not engage in crop production activities, the output will still generate an estimate for the impacts of the purchased feed categories under "feed production." The table provides greater insight into how the operation's results compare to similarly-sized farms by providing regional and national averages. Regions are shown in Figure 2.

Figure 3. Your Farm Energy Use

MJs / lb FPCM produced



	Your Footprint	Regional Average	Regional Difference	National Average	National Difference
Feed Production	1.12	1.29	*(0.17)*	1.47	*(0.35)*
On-Site Energy Usage	0.42	0.44	*(0.02)*	0.41	0.01
TOTAL	**1.54**	**1.73**	***(0.19)***	**1.88**	***(0.34)***

Limitations The FARM ES module relies on regional and national statistics compiled by the U.S. dairy industry's Life Cycle Assessment (LCA) for Fluid Milk. As such, the module does not directly measure a farm's actual environmental footprint; instead, it provides reliable, statistical estimates. It focuses on the 20 variables that explain almost 90 percent of the industry's carbon footprint.[5] While these estimates are useful for tracking the direction of continuous improvement, they do not capture the absolute value of environmental impacts. The tool does not take into account the details of every on-farm management practice or technology. For example, your farm may implement energy efficient lighting, use solar panels or optimize feed concentrates to reduce methane emissions. These particulars are not reflected in the FARM ES module.

Additional Resources The FARM ES module also does not provide farm-specific recommendations for reducing GHG emissions or energy use. Interested users should consult the FARM ES Project Guide for suggested practices that farmers can implement on their farms to improve both economic and environmental performance.

[5] *Innovation Center for U.S. Dairy. (2013). U.S. Dairy's Environmental Footprint: A summary of findings, 2008-2012. http://www.usdairy.com/~/media/USD/Public/DairysEnvironmentalFootprint4_2013.pdf*

Appendix

The following summary table may be used to enter data for the FARM Environmental Stewardship module. Please reference the User Guide for definitions and scope.

Production

Milk Production	Farm Data
Total annual milk production | Pounds of milk shipped, used ON-farm or other	lbs.
Average milk protein content | from 1% to 5%	%
Average milk fat content | from 1.8% to 5.5%	%

Herd Size	Farm Data
Annual average herd size | lactating and dry cows	cows
Annual average of dry cows in herd | % of total cows	% cows
Annual average number of heifer calves | less than 2 months raised ON-farm	cows
Annual average number of heifer calves | less than 2 months raised OFF-farm	cows
Annual average number of heifers | 2 months to first calf raised ON-farm	cows
Annual average number of heifers | 2 months to first calf raised OFF-farm	cows

Beef Production	Farm Data
Total annual number of mature cows culled for beef	**cows**
Average weight per cow | choose range between 700 lbs. to 2,000 lbs.	lbs.
Total annual number of calves sold for beef	**cows**
Average weight at time of sale | choose range between 50 lbs. to 350 lbs.	lbs.

Energy *(for heating water, milking, cleaning, scraping, fans, grinding and mixing; NOT for irrigation, hauling, crops, etc.)*

Energy Source	Farm Data
Electricity | TOTAL annual ON-farm use Estimate the % used for dairy activities	**kWh.** %
Diesel | TOTAL annual ON-farm use Estimate the % used for dairy activities	**gal.** %
Biodiesel | TOTAL annual ON-farm use Estimate the % used for dairy activities	**gal.** %
Fuel Oil | TOTAL annual ON-farm use Estimate the % used for dairy activities	**gal.** %
Propane | TOTAL annual ON-farm use Estimate the % used for dairy activities	**gal.** %
Natural Gas | TOTAL annual ON-farm use Estimate the % used for dairy activities	**therm.** %
Gasoline | TOTAL annual ON-farm use Estimate the % used for dairy activities	**gal.** %

Crop

Crop Type	% That is Self-Produced
Soybean	%
Corn grain	%
Alfalfa hay	%
Alfalfa silage	%
Corn silage	%
Grass hay	%
Grass silage	%

Feed

Do you pasture any animals? ❑ Yes ❑ No

Pasture Detail (Number of Weeks and Hours Per Day)	No. weeks/yr.	Hrs./day
Lactating cows | ranges: 0 to 52 wks./yr. and 0 to 24 hrs./day		
Dry cows | ranges: 0 to 52 wks./yr. and 0 to 24 hrs./day		
Young stock | ranges: 0 to 52 wks./yr. and 0 to 24 hrs./day		

Average Dry Matter Intake (DMI)	Lbs./day (Enter to the 10th of lb.)
Average DMI per head per day for lactating animals (Excluding dry cows and young stock) | Average ration for production period | ranges: 25 to 70 lbs/day	Lbs./day

Percent Make-Up (in Dry Matter) for Average Lactating Cow Ration	Farm Data	
Corn grain | ranges: 0 to 40%	%	The sum of these categories must total 100%.
Corn silage | ranges: 0 to 60%	%	
Wet DGS | ranges: 0 to 40%	%	
Dry DGS | ranges: 0 to 30%	%	
Soybean (raw or roasted) | ranges: 0 to 15%	%	
Soybean meal | ranges: 0 to 30%	%	
Alfalfa hay | ranges: 0 to 80%	%	
Alfalfa silage | ranges: 0 to 70%	%	
Grass hay | ranges: 0 to 40%	%	
Grass silage | ranges: 0 to 40%	%	
Pasture | ranges: 0 to 100%	%	
All other feed | ranges: 0 to 90%	%	

Manure

Estimate the percentage of excreted manure going to each manure management system (MMS). The combined percentages of your systems must total 100 percent. This will be used to calculate the manure footprint. All farm data inputs are 12-month averages.

Manure Management Systems	Farm Data	
Daily spread	%	The sum of these categories must total 100%.
Solid storage	%	
Dry lot	%	
Liquid/slurry | with natural crust	%	
Liquid/slurry | without natural crust	%	
Uncovered anaerobic lagoon	%	
Covered anaerobic lagoon	%	
Pit storage below animals | less than 1 month	%	
Pit storage below animals | greater than 1 month	%	
Deep bedding | less than 1 month	%	
Deep bedding | greater than 1 month	%	
Composting | static in vessel	%	
Composting | intensive with forced aeration	%	
Composting | natural aeration	%	
Aerobic treatment | with forced aeration	%	
Aerobic treatment | with natural aeration	%	
Anaerobic digester	%	

Are anaerobic digester(s) installed on the farm? ❑ Yes ❑ No (If YES, please answer the following):

What is the volatile solids conversion efficiency? | between 20% and 30%	%
Manure management system for effluent (after digester). Select the manure management system (MMS) from the list above that best describes how the effluent is treated after exiting the digester. (List only ONE)	
Percent of electricity generation potential utilized | between 0 and 40%	%
Percent of heating potential utilized | between 0 and 40%	%

Notes:

To learn more about the National Dairy FARM Program, visit

NATIONALDAIRYFARM.COM

or contact the National Milk Producers Federation at

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