Accelerating Opportunities for U.S. Dairy Farmers to Meet 2050 Sustainability Goals

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Chief Science Officer

National Milk Producers Federation

U.S. dairy is an environmental solution

By 2050, U.S. dairy collectively commits to:

- **Achieve GHG neutrality**
- **Optimize water use** while maximizing recycling
- **Improve water quality** by optimizing utilization of manure and nutrients

KEY STRATEGIES TO ADVANCE 2050 GOALS

FOR FIELD AND FARM

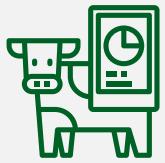
Net Zero Initiative

A collaboration of dairy organizations with the aim to knock down barriers and create incentives for farmers that will lead to economic viability and positive environmental impact, in the areas of feed production, enteric methane, energy efficiency and manure management.

Core Tracks

- GROUNDWORK

- DAIRY SCALE FOR GOOD (DS4G)



- COLLECTIVE IMPACT

FOR PROCESSORS

Processor Working Group

Led by the Innovation Center, a working group of more than 50 participants representing over 20 processing organizations convenes regularly and engages in facility-focused workstreams for waste, water, packaging, and GHG emissions to drive action and demonstrate progress towards the goals.

Sub-Teams

GHG

PACKAGING

WASTE

WATER

U.S. DAIRY
NET ZERO INITIATIVE

Led by six national dairy organizations:

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

DMI

IDFA
International Dairy Foods Association

NEWTRIENT

NMPF
NATIONAL MILK PRODUCERS FEDERATION

USA U.S. Dairy Export Council
Cheese | Ingredients | Global Markets

2050 Goals and NZI:
What it is and what it isn't

The goals are the **collective effort of all farms, cooperatives and processors-** Not every farm will reach GHG neutrality

NZI is a 5-year initiative to accelerate learning and increase options for a **30-year journey toward the 2050 goals**

The marketplace demands action on the environment; NZI advances science-based, economically-viable solutions that enable farms to meet these demands, and the goals demonstrate dairy's leadership and build trust

NZI opens opportunities for **farms of all sizes** to adopt technologies and practices

The roadmap that NZI develops considers a range of technologies and practices on **farms of varying sizes, designs and geographies.** This is not a one size fits all plan

Keys to Success

Affordability

Farmers need economically-viable technology and practice solutions, along with innovative product and market development, trading platforms, product sales & policy changes.

Data & Research Gaps

More research, applied knowledge and quantifiable outcomes needed.

Accessibility

To reach scale, farms of all sizes need technology and practice options and support to implement successfully.

Activities proposed to be funded by the dairy checkoff will be subject to the approval of USDA. No checkoff funds will be used for the purpose of influencing governmental policy or action.

Four Key Areas of Focus

These areas represent the total footprint on farm

(Percentage reflects portion of footprint addressed by each area.*)

Feed production & practice changes: (26.4%)

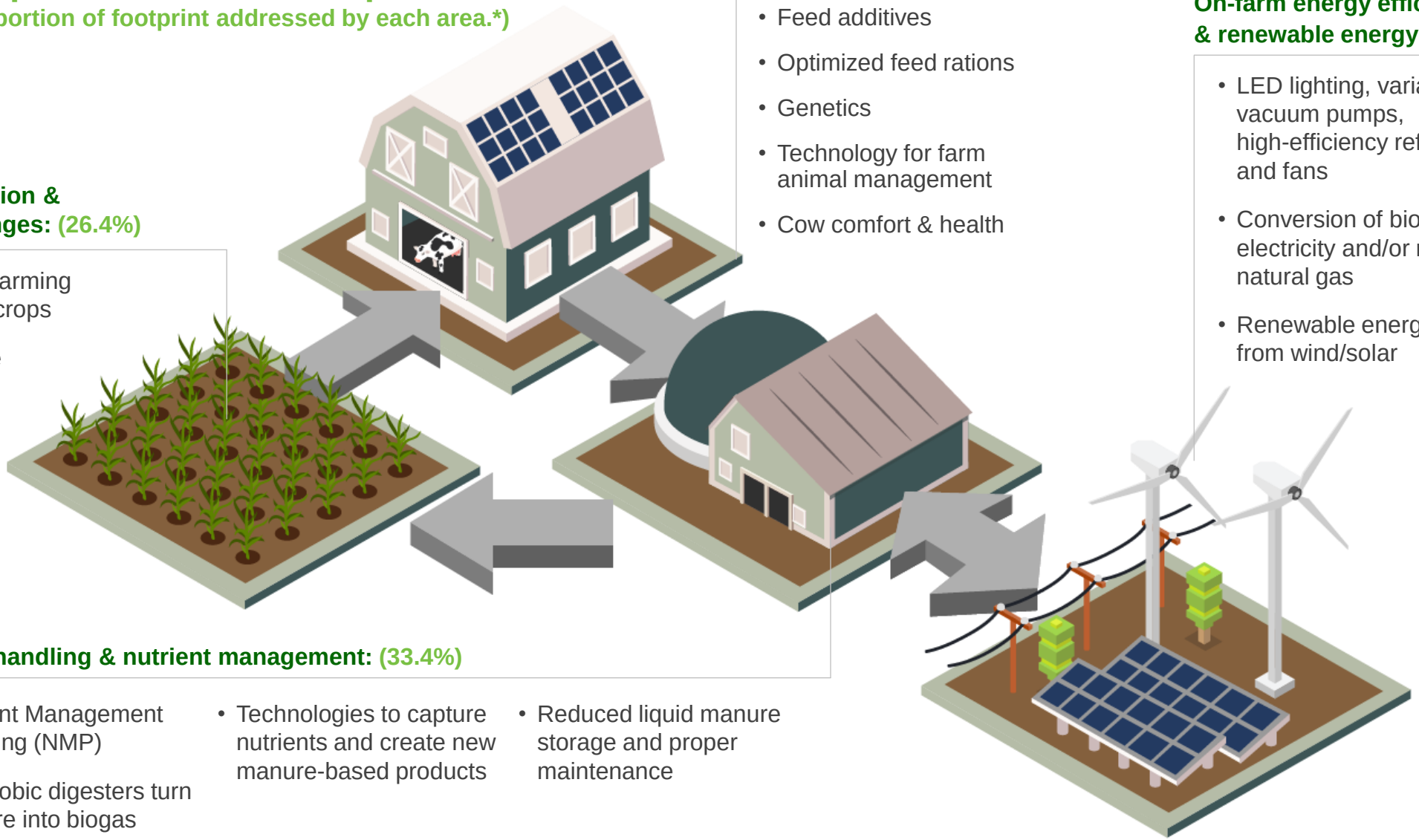
- No/low-till farming and cover crops
- Renewable fertilizers
- Precision agriculture

Enteric methane reduction: (34.8%)

- Feed additives
- Optimized feed rations
- Genetics
- Technology for farm animal management
- Cow comfort & health

On-farm energy efficiency & renewable energy usage: (5.4%)

- LED lighting, variable speed vacuum pumps, high-efficiency refrigeration, and fans
- Conversion of biogas into electricity and/or renewable natural gas
- Renewable energy sources from wind/solar



Manure handling & nutrient management: (33.4%)

- Nutrient Management Planning (NMP)
- Anaerobic digesters turn manure into biogas
- Technologies to capture nutrients and create new manure-based products
- Reduced liquid manure storage and proper maintenance

Visuals do not represent all possible practices, technologies or benefits. Each farm can voluntarily contribute to net zero efforts based on their individual operation.

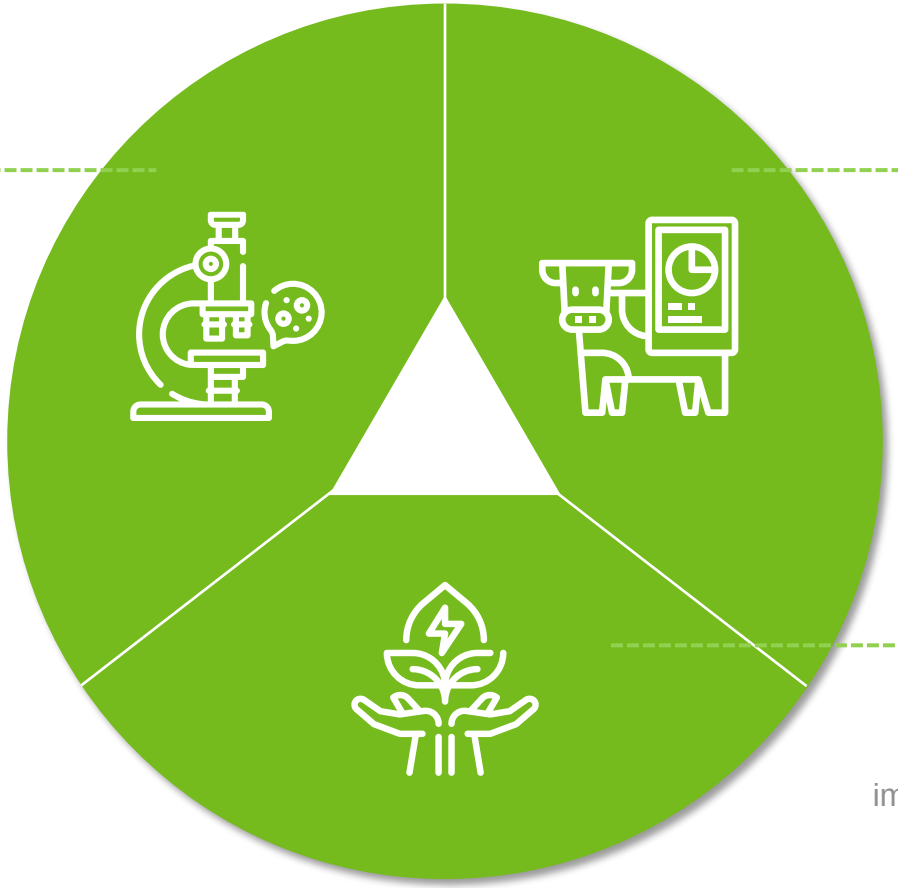
*Thoma 2013, Regional Analysis of greenhouse gas emissions from USA dairy farms. A cradle to farm-gate assessment of the American dairy industry, circa 2008

Core Tracks

Research, Analysis & Modeling: Groundwork

Fill key research gaps and improve measurement to help the dairy farming community use science-based models and scenario planning to analyze the environmental and economic impacts of various efforts, including:

- Cow care and efficiency
- Feed production
- Manure handling and nutrient use
- Energy efficiency & renewable energy generation



Viability Study: Dairy Scale For Good

Through partnership with 5 farms, prove the economic viability of a comprehensive suite of field and farm practices and technologies and establish market-based approaches for reaching net zero emissions, improved water quality and increased farmer livelihood.

Adoption: Collective Impact

Drive broad, voluntary farmer adoption of proven best practices, technologies and combinations of both and share the positive impact that farms of varying geographies, sizes and capabilities are making together on the environment.

NZI: Collaborating Partners

NZI is comprehensive and collaborative. Partners bring expertise, leadership and financial support to strengthen the plan and accelerate action leading to results

Between 2020 and 2021, **more than $31 million in external support** from corporate partners and granting agencies

DAIRY NATIONAL LEADERSHIP
and member constituents

CORPORATE AND FUNDING PARTNERS

NGO PARTNERS

RESEARCH PARTNERS

PROJECT PARTNERS

NET ZERO INITIATIVE

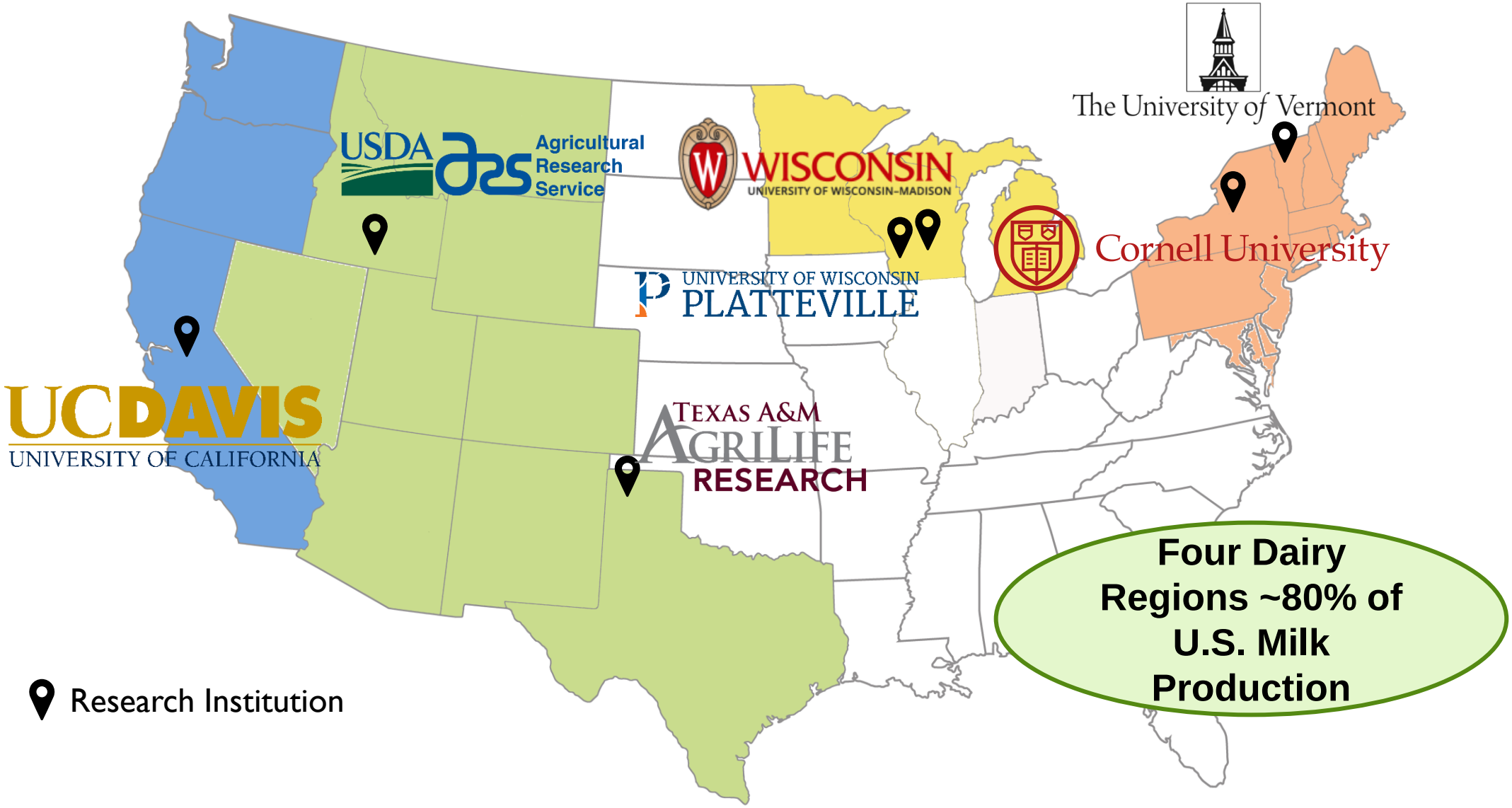
Update: Groundwork

GROUNDWORK

New and expanded research projects to improve data, knowledge in feed production, cow care and efficiency, manure and nutrient management and on-farm energy efficiency

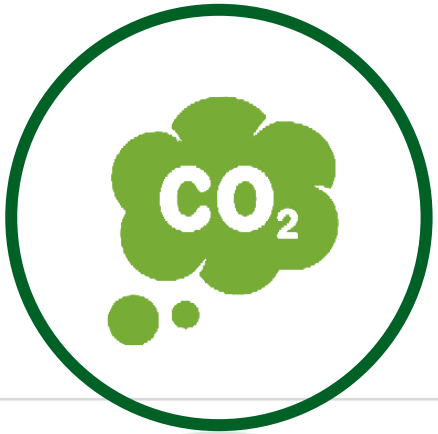
- Develop and co-fund a program to research efforts on feed production
- Develop and co-fund a program to research efforts to reduce enteric methane emissions
- Develop on-farm and sector-wide measurement strategies to track progress toward goals
- Improve existing NZI modeling and add Western Dairy and Small/Mid-Size Dairy Analyses
- Develop roadmap for how U.S. dairy, from field to processor gate, achieves collective goals

Spotlight on Groundwork: Research Institutions and Dairy Regions



NZI Dairy Feed, Soil and Water Outcomes

Addressing **research gaps:**



Soil carbon sequestration for regional dairy feed rotations

Environmental, agronomic and delivery outcomes of new manure-based fertilizer products

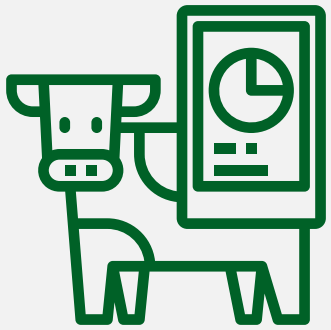
Soil health benefits

Greener Cattle Initiative

- An industry-oriented program that supports the development of **commercially-feasible solutions to reduce methane emissions from dairy and beef cattle**
- The program is a vehicle for collaboration and exposure to new ideas, while **leveraging resources and de-risking R&D**
- Focus on feed additives, feed reformulation, genetics and technology
- For every farmer dollar invested, minimum of 4X match on research investment

Update: Dairy Scale for Good

DAIRY SCALE FOR GOOD (DS4G)



Partner with commercially operating dairies to demonstrate the ability to:

- Environmental
  - Significantly reduce greenhouse gas emissions
  - Improve water quality and quantity
- Economic
  - Increase and diversify on-farm revenue

How do we get there:

- New technology and practice change due diligence
- Profit and loss modeling
- De-risking through demonstration
- Ecosystem services market building

First Farm in DS4G Pilot Announced

CARNATION® Farm Joins U.S. Dairy Net Zero Initiative as First Pilot Farm

Farm to chart path to carbon neutrality in partnership with Nestlé and the Innovation Center for U.S. Dairy as part of the industry's Dairy Scale for Good pilot

Nestlé
Good food, Good life

NEWS PROVIDED BY
Nestle USA →
Jun 24, 2021, 09:08 ET

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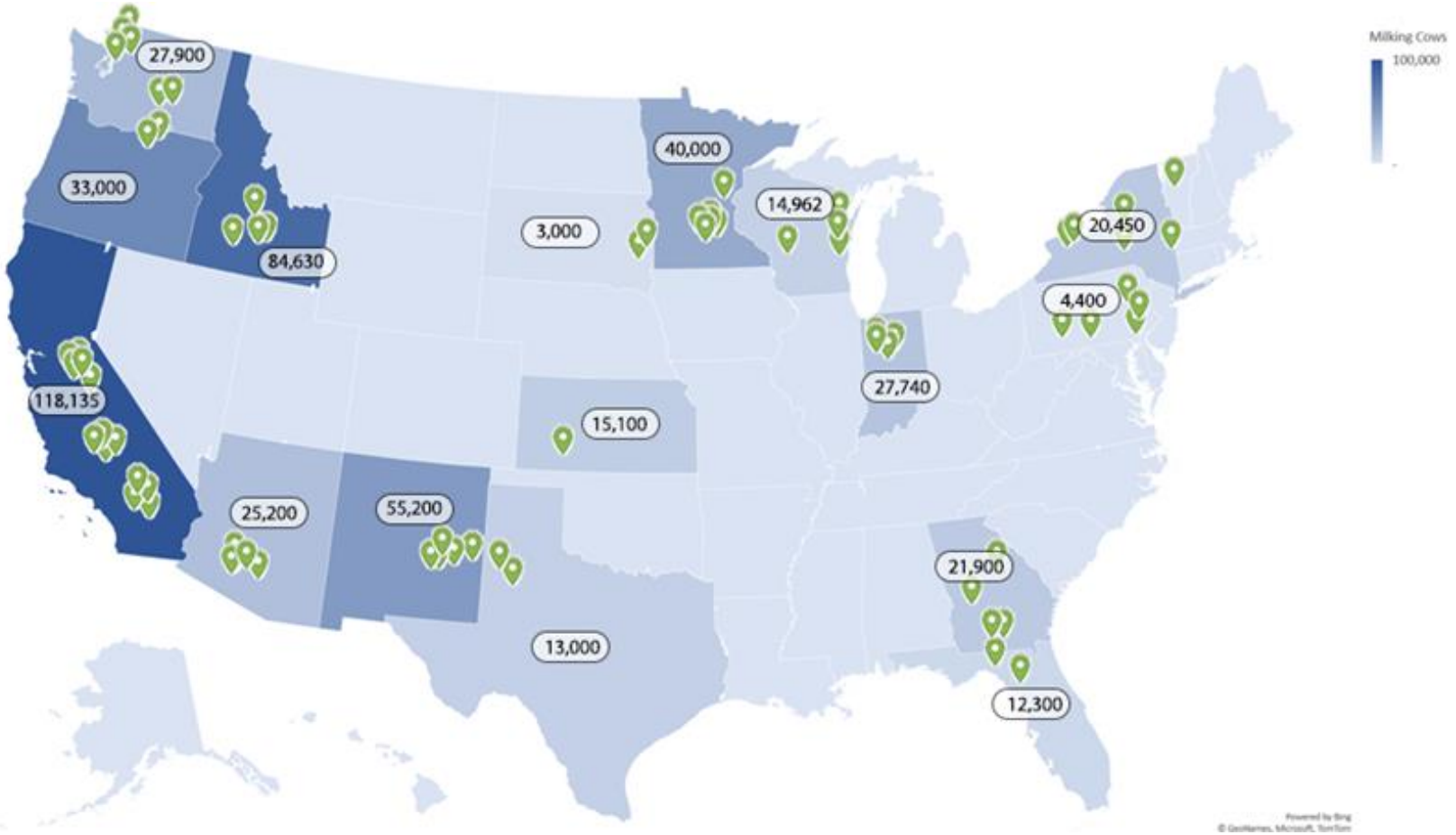
MODESTO, Calif., June 24, 2021 /PRNewswire/ -- Nestlé USA and the Innovation Center for U.S. Dairy today announced that Trinkler Dairy Farm, a Carnation supplier, is the first partner farm of the Dairy Scale for Good pilot within the Net Zero Initiative, a first-of-its-kind industry effort helping U.S. dairy farms of all sizes and geographies adopt new technologies and economically viable practices. As part of this industry effort, Trinkler Dairy Farm is the first U.S. dairy farm to pilot new technologies and implement sustainable farming practices to demonstrate the economic viability of achieving net zero emissions within the next five years.

Partnership development, technology and practice due diligence and field-testing ideas with farmers



Touring 6/28/20-4/30/21

Milking Cows Represented:
500K+ (5% of US HERD)

Dairies Represented:
90+

States Represented:
17
AZ, CA, GA, FL, ID, KS, MN, MA, NM, NY, OR, PA, SD, TX, VT, WA, WI

Manure Samples Processed: 500+

Data Points Gathered:
10K+

Update: Collective Impact

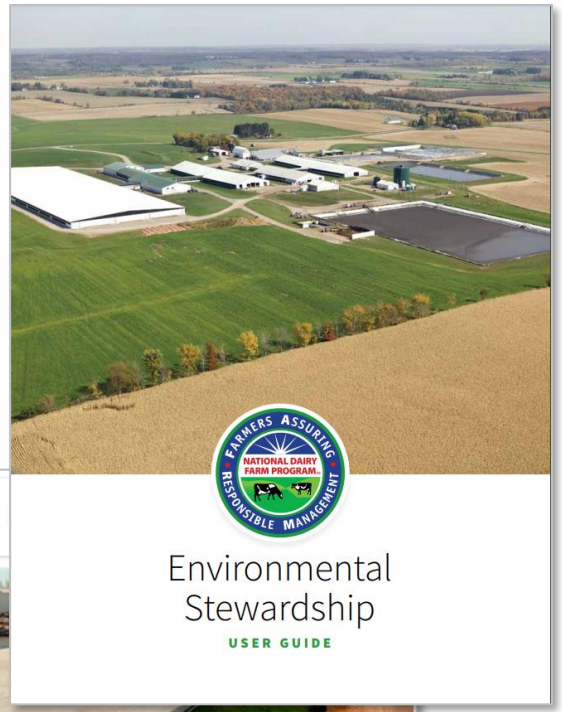
COLLECTIVE IMPACT

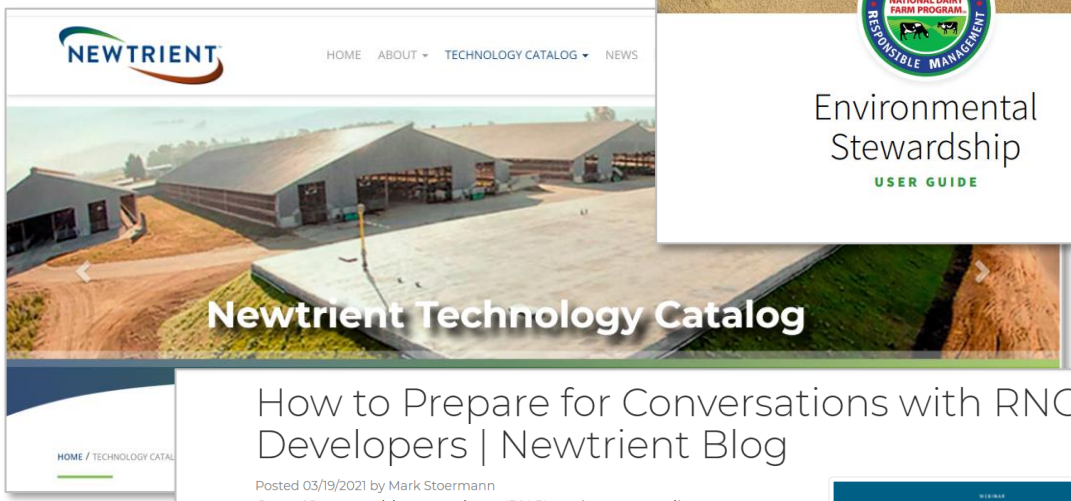
Drive broad, voluntary farmer adoption of proven best practices, technologies and combinations of both and share the positive impact that farms of varying geographies, sizes and capabilities are making together on the environment

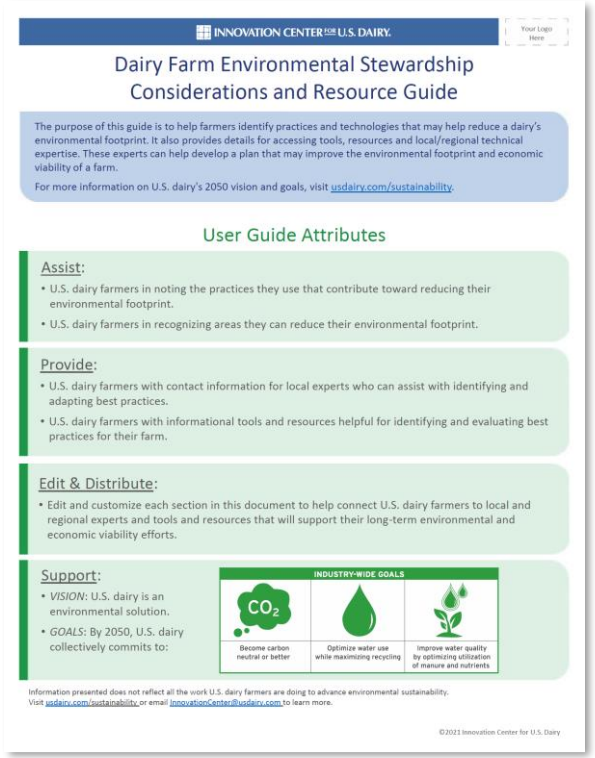
- Supply chain demonstration projects
- Inventory of current adoption
- Farmer environmental ambassador program
- Community of Practice

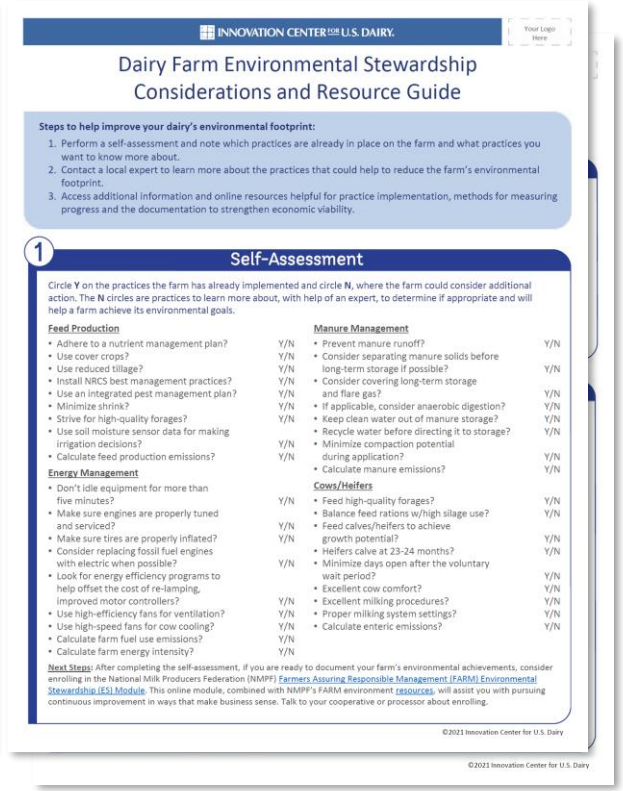
Resources for Farmers

Current resources

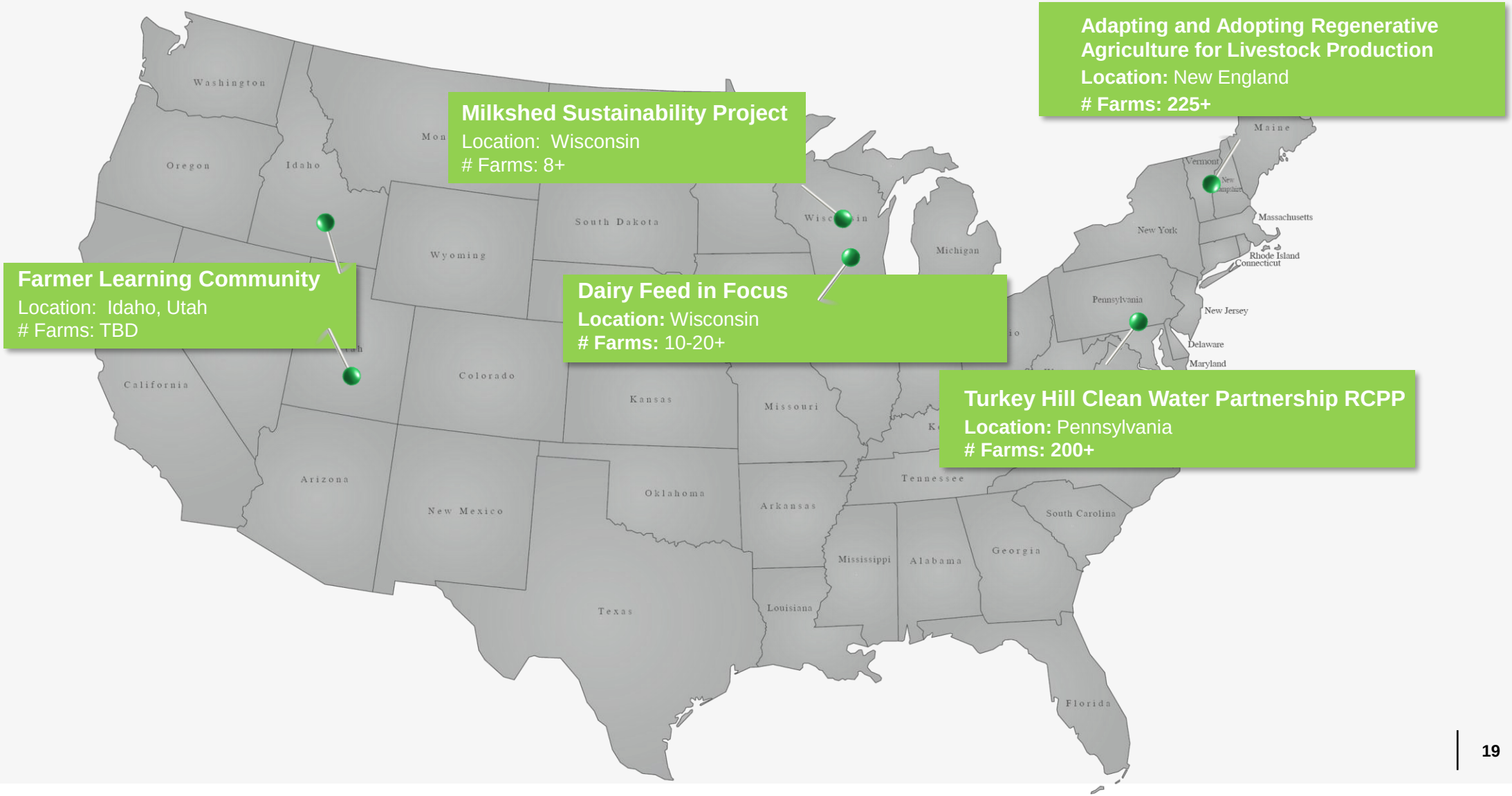








Scaling Up Across U.S. Dairy: Demonstration Projects



Milkshed Sustainability Project
Location: Wisconsin
Farms: 8+

Adapting and Adopting Regenerative Agriculture for Livestock Production
Location: New England
 # Farms: 225+

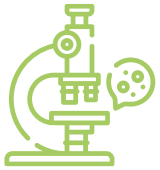
Farmer Learning Community
Location: Idaho, Utah
Farms: TBD

Dairy Feed in Focus
Location: Wisconsin
 # Farms: 10-20+

Turkey Hill Clean Water Partnership RCPP
Location: Pennsylvania
 # Farms: 200+

FAQ: How does NZI benefit farms of all sizes?

Groundwork



- Pathway for enteric emissions and water quality reductions
- Credible science to support development of new carbon market opportunities
- Clear insights to select on-farm technology
- Improved data on minimal disturbance tillage, cover cropping, innovative crop rotations in dairy forage production and the integration of new manure-based products
- Tools to help on-farm technology and practice selection based on measurable outcomes

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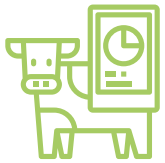
Dairy Scale For Good



FARMS WITH 3,000+ COWS

3-5 pilot operations on dairies:

- recover nutrients to use more efficiently on-farm or sell off the farm
- prove new revenue streams in ecosystem services markets through changes in management practices
- generate revenue in renewable energy markets (RNG and electricity)

FARMS OF ALL SIZES

- Identification, due diligence and pilot demonstration of new technologies and practices to test environmental and economic viability of net zero approach, reduce capital and operational costs and de-risk investment required for adoption across a broader coalition of dairy farms.
- Markets for farms to sell carbon and water quality credits and manure-based products

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Collective Impact

- Regional supply chain partner projects to evaluate and demonstrate best practices and technologies and provide replicable models to facilitate greater adoption
- Greater access to information that supports the adoption of best practices and technologies:
  - Educational materials (Case studies, webinars, etc.)
  - Technical assistance
  - Cost share and grant programs
  - New revenue opportunities

FAQ: What can farms do now?

1. Feed the optimum level of protein and phosphorus to reduce the amount of excreted nitrogen and phosphorus
2. Select diet ingredients that reduce enteric methane intensity from cattle, by using a nutrition model like the Cornell Net Carbohydrate and Protein System and look for the GHG emissions predictions
3. Optimize milk production to minimize GHG emission per gallon of milk
4. Talk to a nutritionist about adding monensin to cattle diets
5. Optimize the growth of replacement heifers and only to maintain herd size
6. Reduce nitrous oxide emission by capturing more manure nitrogen in crops
7. Improve nitrogen management by calculating the appropriate rate of manure for the crop being grown, improve application timing to increase crop uptake and ensure that maximum application rates do not exceed needs
8. Adopt strip till or no-till practices in crop production
9. Plant cover crops after corn silage
10. Combine manure injection and no-till practices by using low-disturbance shanks
11. Install an anaerobic digestor to capture biogas to produce renewable energy
12. Installing a gas-tight impermeable cover to capture biogas to collect and flare or produce renewable energy

Source: K. Czymmek, M. Van Amburgh and C. Gooch, Cornell University. “12 Ideas to Reduce Greenhouse Gas Emissions and Water Quality Impact from a Dairy Farm.” *Progressive Dairy*, October 1, 2021.

Measurement

Developing a strategy and approach to measuring the industry progress toward goals (“Goals Measurement”)

- Data collection is critical to success
- Working group has been formed under the IC Environmental Stewardship Committee, including farmer representation

Evaluating current on-farm measurement tools and investigating new metrics to bring meaningful data to farmers

Program Mission

To aid dairy farmers and cooperatives/processors in assuring consumers and customers that dairy farmers manage their animals, workforce and land in a responsible manner through science-driven methods and a commitment to continuous improvement.

FARM ES Overview

Quantifies a dairy farm's GHG + energy use footprints and asks about the use of nutrient management plans to enable supply chain transparency and support continuous improvement

Accomplishments

- **2,300+** FARM ES assessments completed
- **38** participating co-ops and processors representing **78%** of milk supply

Strengths

- Strong science w/ periodic updates
- Trained, 2nd party evaluators
- Resources for continuous improvement
- Enables supply chain reporting and collaboration

FARM ES Participants

Agri-Mark

ampi

California Dairies inc.

CM Cayuga Marketing

Cobblestone Milk Cooperative

DFA Dairy Farmers of America

Prairie Farms

Saputo Foodservice

SARTORI

DARIGOLD

Elba Cooperative Creamery

Ellsworth Cooperative Creamery

First District Association

Foremost Farms USA

glanbia

United Dairy

United Dairymen of Arizona

Upstate Niagara

Grande Cheese Company

Grassland

Great Lakes

Hilmar Cheese Company

Idaho Milk Products

White Eagle Cooperative

Walmart

Land O'Lakes, Inc.

Lone Star Milk Producers

Maryland & Virginia

MMPA

Mullins Cheese

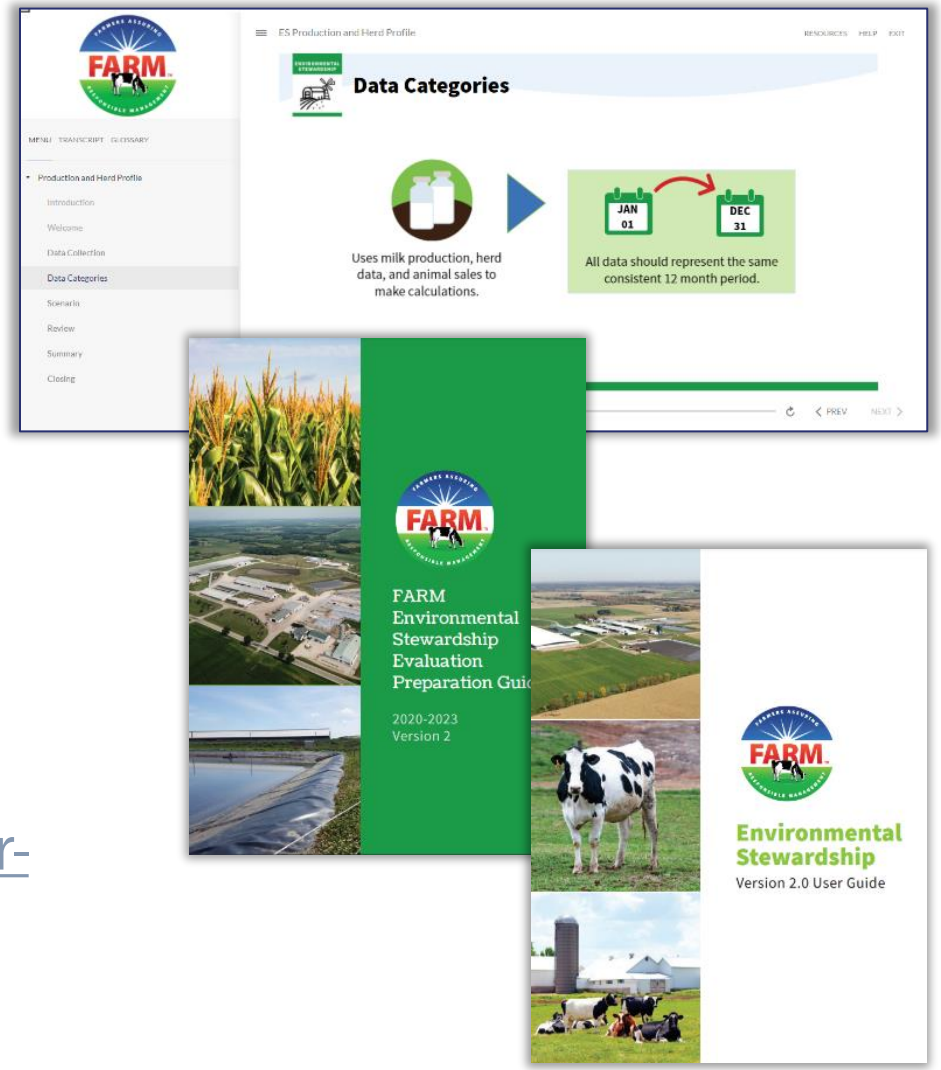
National All-Jersey Inc.

Valley Queen

Resources

- **Online Evaluator Training**
  - Certification required

- **Materials**
  - Evaluation Prep Guide
  - User Guide Version 2.0
  - Data Collection Sheets
  - Reference Manual

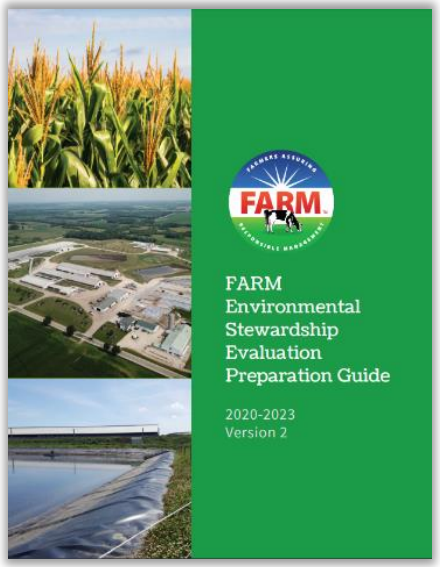


https://nationaldairyfarm.com/producer-resources/environment/

Evaluation Process

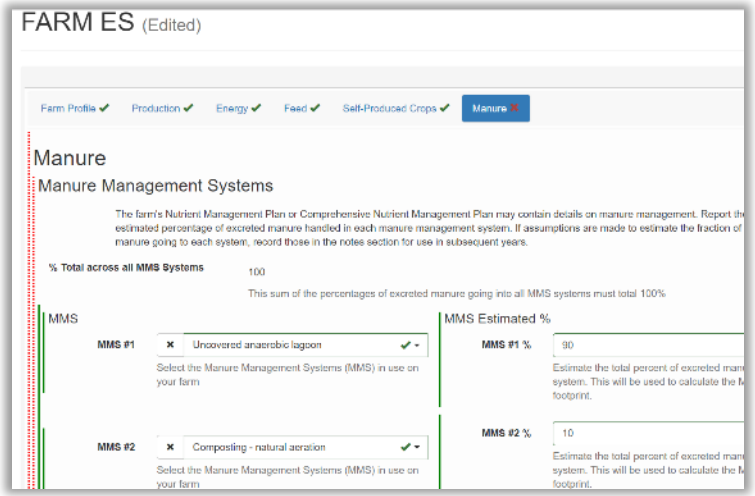
Pre-Visit

- Evaluator schedules farm visit
- Provides prep material



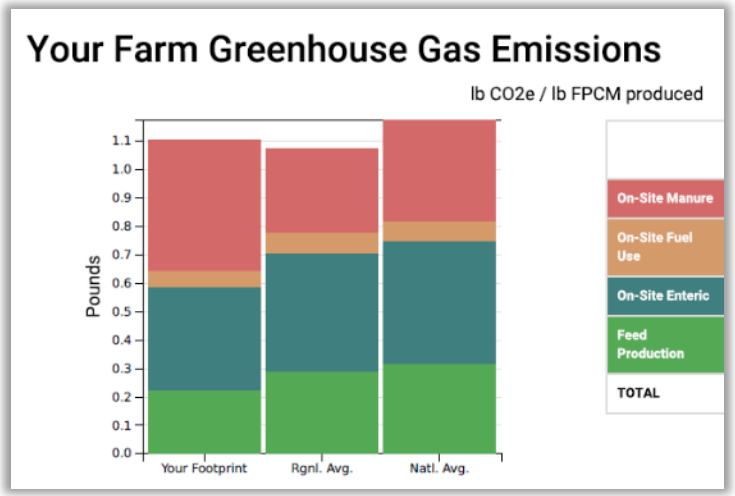
Evaluation

- Web or app-based entry



Results

- GHG and energy use intensity; use of NMPs
- Track changes over time



Model

- Model output is lifecycle-based – from cradle to farmgate
- Based on peer-reviewed, published research
- Model explains 98% of the variability in total GHG footprint across farms

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Dairy farm greenhouse gas impacts: A parsimonious model for a farmer's decision support tool

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ABSTRACT

This study presents an analysis of the cradle to farm gate greenhouse gas footprint of milk. Compared with the detailed model, we aim to accurately represent the variations in carbon footprint across farms, while being more parsimonious in terms of data needs. The simplified model strongly reduces the farm-specific data requirement from 162 animal-rations in the detailed survey to 12 feed rations for lactating cows, while explaining 91% of the variability in feed print and 98% of the variability in total footprint across 531 farms. The additional 95% confidence interval on an individual farm footprint is less than 10%. Feed efficiency and manure management are key determinants of the footprint per kg milk. A 15% reduction in the average footprint can be achieved by a 10% reduction for the 50th percentile of the best farms and by a higher and targeted reduction for the less efficient farms.

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1. Introduction

Consumers and retailers are becoming increasingly aware of their impact on the environment and especially of their impacts on climate change. They are changing their consumption to lead a more environmentally friendly lifestyle, and want to know that what they buy has been produced in an environmentally sustainable way. To proactively meet the needs of the marketplace, the U.S. dairy industry commissioned a detailed greenhouse gas (GHG) life cycle assessment (LCA), or carbon footprint study, for fluid milk (Thoma et al., 2013b,c) to identify where the industry can innovate to reduce GHG emissions across the supply chain to achieve the greatest gains. This article builds on that detailed study to develop a parsimonious, but still accurate and representative tool for farmers to determine and potentially reduce their cradle to farm gate carbon footprint.

In recent years, various tools have been developed to assess the GHG emissions in agriculture. Some tools, like Century (Parton, Schimel, Cole, & Ojima, 2006), DayCent (Parton, Ojima, Cole, & Schimel, 2008), US Department of Agriculture's Comet VR (USDA NRCS, 2011), US Cropland GHG Calculator (McSwiney, Bohm, Grace, & Robertson, 2010), or US Energy Information Administration's (EIA's) "N_2O from agricultural soils" (EIA, 2010), specifically aim at assessing crop production emissions or footprint per surface unit. Others, like EIA's "Livestock waste" and "Enteric Fermentation" (EIA, 2010), assess part of the emissions in the milk production chain, at the farm level, but do not cover the whole milk production process at the farm gate.

Tools like the Integrated Farm System Model (IFSM; Rotz et al., 2011), Denitrification–Decomposition (DNDC; Giltrap, Li, & Saggar, 2010), the "Cool Farm Tool" (Unilever, 2011), aim at assessing a given farm carbon footprint. They cover the different steps of milk production, assessing the overall farm emissions; similarly, The Dairy Greenhouse Gas Abatement Strategies (DGAS) tool (Eckard et al., 2009) enables Australian farmers to compute their footprint, which also enables them to test strategies of mitigation. But the farm may also carry out activities other than milk production, e.g., cash crop production; the assessment of the overall farm print does not enable fair comparisons per quantity of milk produced. The "Shades of Green" (SOG) dairy farm management calculator (Benbrook et al., 2010), encompasses the dairy production boundaries but only assesses the methane emissions, missing other compounds.

Other simplified tools such as the "Carbon Calculator" (CFG, 2009), compute simplified footprints per head or per farm that

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Data Inputs

The data needed to estimate GHG emissions and energy use intensity include:

Milk Production

Herd Data

Rations

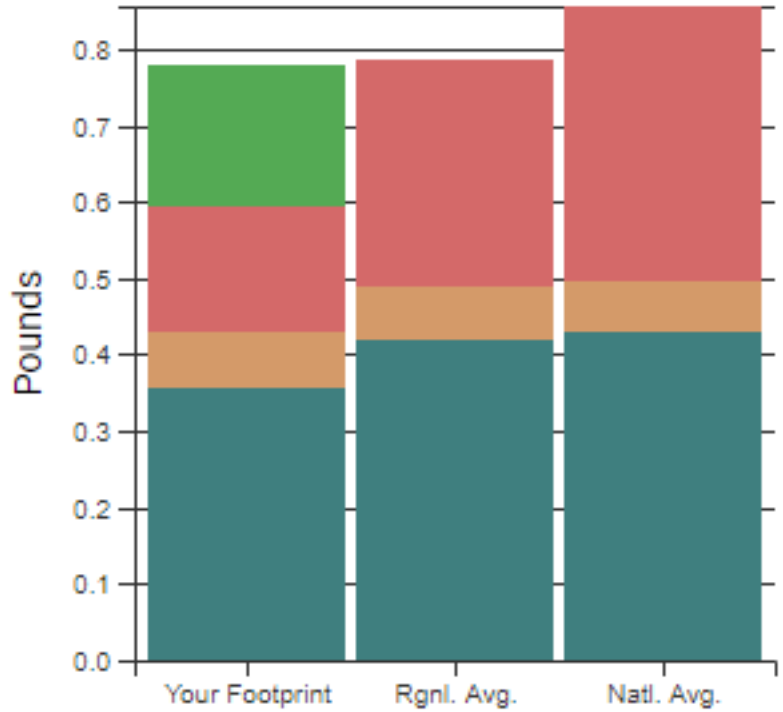
Manure Management

Energy Use

Data Outputs

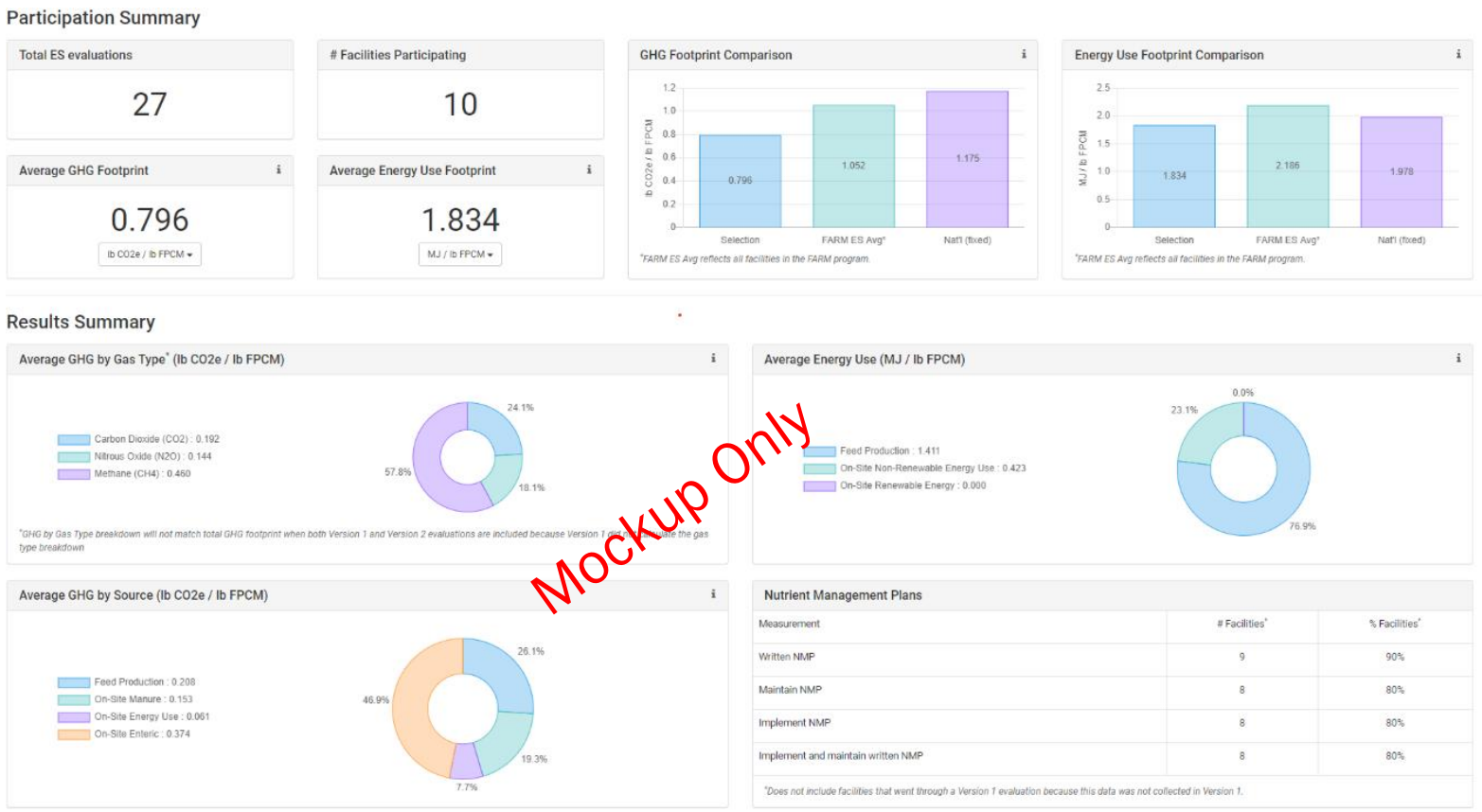
Your Farm Greenhouse Gas Emissions

lb CO2e / lb FPCM produced



	Your Footprint	Rgnl. Avg.	Rgnl. Diff.	Natl. Avg.	Natl. Diff.
Feed Production*	0.185				
On-Site Manure	0.165	0.296	0.131	0.358	0.193
On-Site Energy Use	0.072	0.072	0.000	0.067	-0.005
On-Site Enteric	0.357	0.418	0.061	0.431	0.074
Total (w/o Feed Production)	0.594	0.786	0.193	0.856	0.262
Total	0.778				

Aggregate Reporting



Net Zero (Policy) Initiative

NMPF

Net Zero (Policy) Initiative

- **Spending measure likely to include climate smart ag funding**
  - NMPF has led ag community in support of this effort to bolster NZI
  - Working with Senate Ag on language to prioritize enteric/feed management
  - Funding will increase conservation baseline for upcoming farm bill
- **NMPF-led ITC proposal also in running for spending package**
  - Senate Finance Committee incorporated into energy tax vehicle
  - House Ways and Means Committee has begun to advance measure as well
- **Feed additive language in House and Senate Appropriations bills**
  - Directs FDA to seek solutions on approving additives as foods, not drugs
  - NMPF secured new funding in both chambers' bills to fulfill this directive
- **USDA implementing new climate smart partnership initiative**
  - Will fund pilot projects to test innovative practices and quantify benefits
  - NMPF submitted comments advocating for dairy projects

Bringing it All Together

Fill research gaps to activate more options and solutions for farms of all sizes and geographies; feed production and enteric methane are highest priority in short term

Enhance the Dairy LCA to assess the environmental benefits of advanced soil health management practices and new manure-based products and the connection to new carbon and water quality market opportunities for dairy farmers

Demonstrate that through technology and innovation – while enteric methane emissions cannot be eliminated – it can be significantly reduced while offering new carbon market opportunities

Enable accurate and transparent measurement methodology that will empower farmers to make informed and strategic decisions and accelerate progress toward goals

Develop a roadmap that brings together everything we know today and offer an informed and scientifically supportable analysis detailing how U.S. Dairy collectively will achieve our 2050 Environmental Stewardship Goals

On-farm Benefits

Cow care & efficiency:

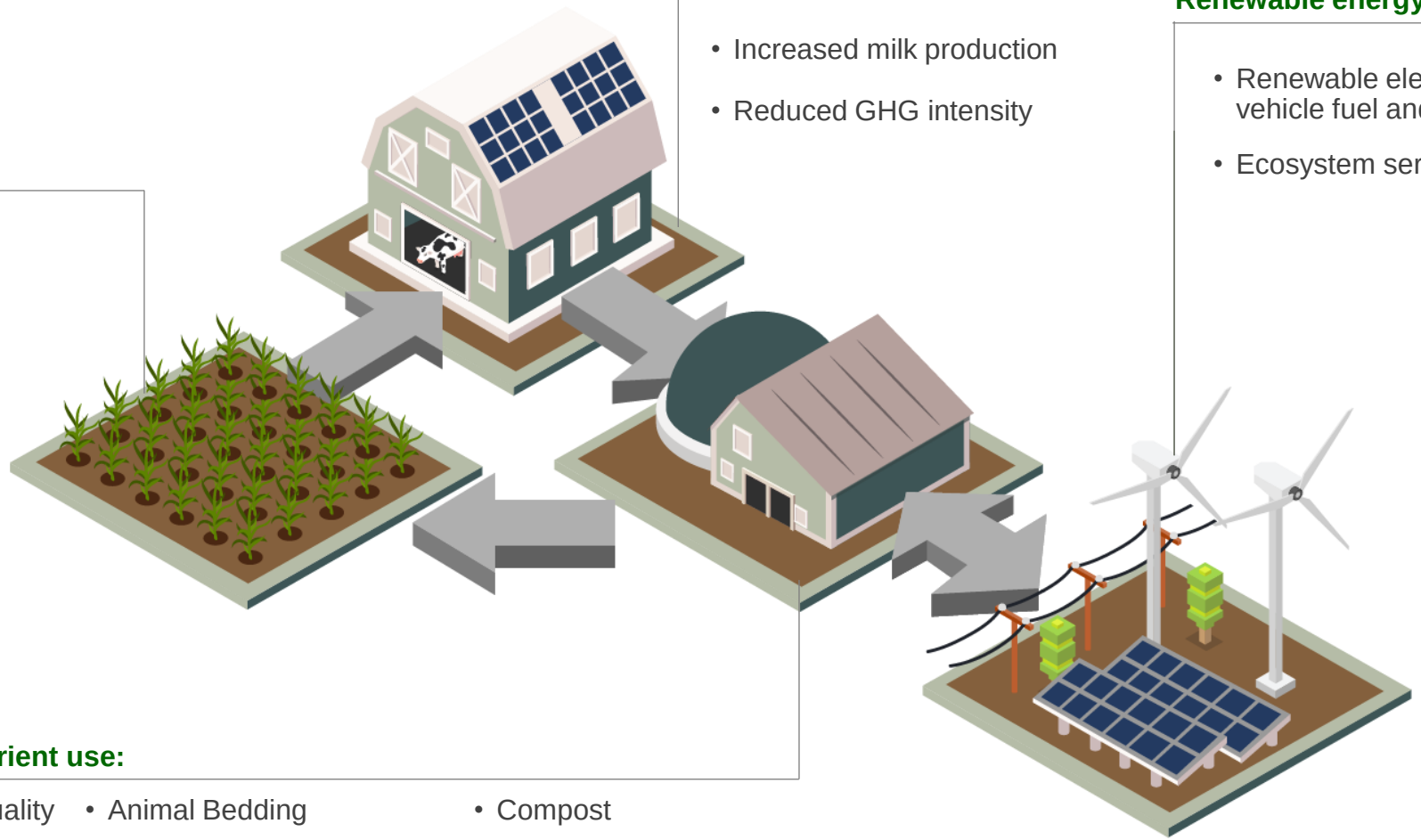
- Healthier cows
- Increased milk production
- Reduced GHG intensity

Renewable energy:

- Renewable electricity, heat, vehicle fuel and natural gas
- Ecosystem services

Feed production & practice changes:

- Healthy soils
- Water resistant soils
- Improved nutrient and carbon cycling
- Enhanced air and water quality
- Ecosystem services

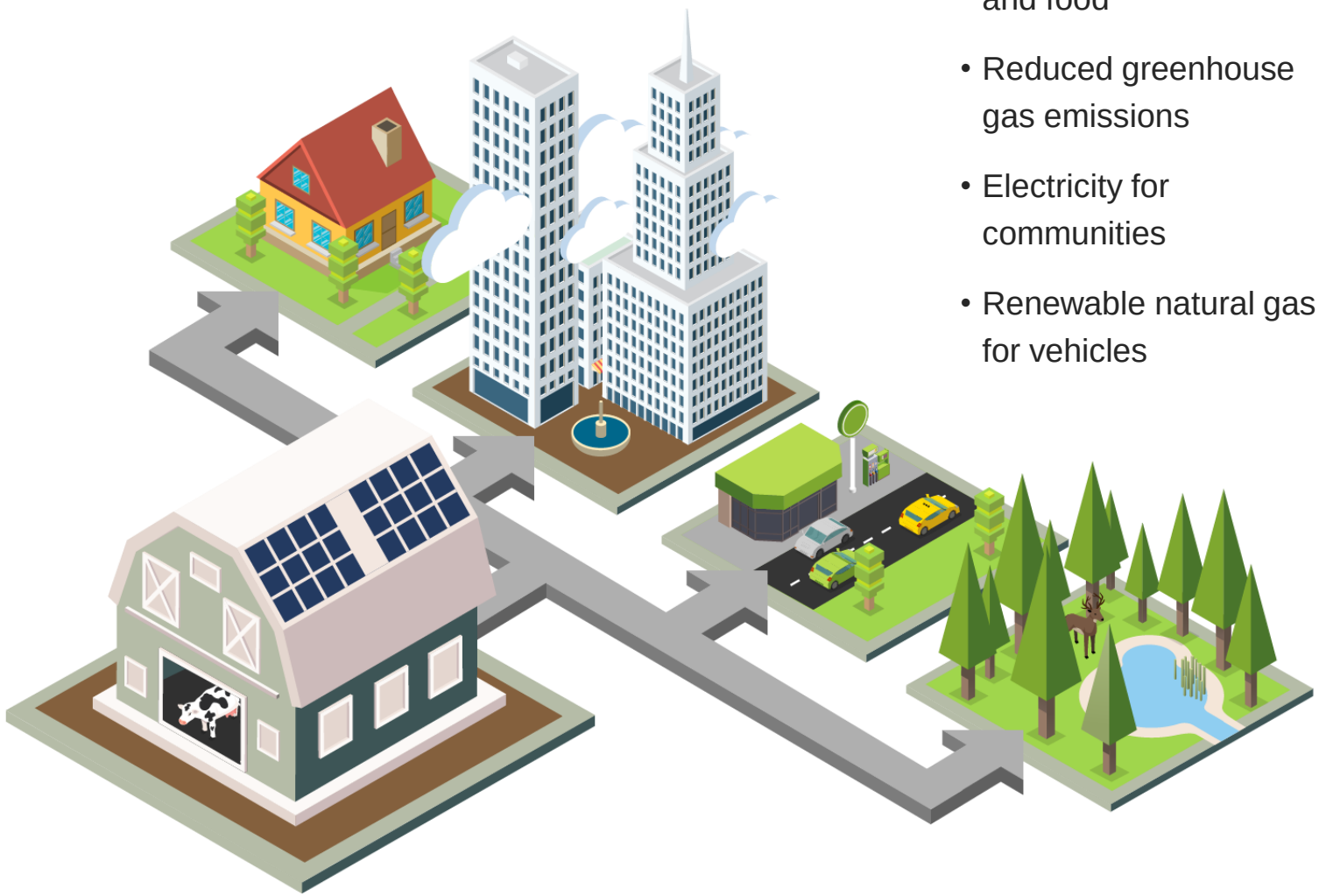


Manure handling & nutrient use:

- Transportable, high-quality fertilizers
- Animal Bedding
- Clean, recycled water
- Compost
- Ecosystem Services

Visuals do not represent all possible practices, technologies, or benefits. Each farm can voluntarily contribute to net zero efforts based on their individual operation.

Off-farm Benefits



- Nutritious milk and food
- Reduced greenhouse gas emissions
- Electricity for communities
- Renewable natural gas for vehicles

- Improved air quality
- Improved water quality
- Soil health and water resistance
- Biodiversity
- Renewable fertilizers
- Carbon sequestration and greenhouse gas reduction
- Alternative to landfill for food waste

Visuals do not represent all possible practices, technologies, or benefits. Each farm can voluntarily contribute to net zero efforts based on their individual operation.

How we demonstrate dairy's leadership as essential and sustainable food source

Advance science & action with farmers and industry

PROOF

+

Engage with & through dairy community & partners

PARTNER

+

Inform & engage with thought leaders & media

INFORM

=

More demand, increased trust & support

Accelerating Opportunities for U.S. Dairy Farmers to Meet 2050 Sustainability Goals

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