



Implementing Sustainable Practices in Dairy Manufacturing: A Guide for Small Companies Towards Carbon Neutrality by 2050

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Abstract:

This paper serves as a practical guide for small dairy manufacturing companies aiming to implement sustainable practices with the goal of achieving carbon neutrality by 2050. Focusing on the food and beverage industry, particularly dairy production, we outline the steps necessary to initiate sustainability initiatives, starting from data collection and assessment of scope 1, 2, and 3 emissions. We discuss partnering with industry stakeholders to establish baselines, aligning with the Science Based Targets initiative, and setting up Environmental Management Systems (EMS). By laying out small, actionable steps and emphasizing the importance of team building, the use of scorecards, and internal engagement, this guide empowers executives and teams to embark on their sustainability journey.

Keywords : Sustainable Manufacturing, Dairy Production, Carbon Neutrality, Scope 1 Emissions, Scope 2 Emissions, Scope 3 Emissions, Science Based Targets, Environmental Management System (EMS), Sustainability Initiatives

Introduction

The dairy industry plays a crucial role in the global food and beverage sector, providing essential nutrition to millions worldwide. However, dairy manufacturing is also associated with significant environmental impacts, including greenhouse gas emissions, energy consumption, water usage, and waste generation. As concerns about climate change intensify, there is a growing imperative for companies to adopt sustainable practices.

For small dairy companies, initiating sustainability initiatives may seem daunting due to limited resources and expertise. Yet, taking action is essential not only for environmental stewardship but also for meeting consumer demands and regulatory requirements. Setting a goal of carbon neutrality by 2050 aligns with global efforts, such as the Paris Agreement, to mitigate climate change [1]

This paper aims to guide small dairy manufacturing companies in starting their sustainability journey. We cover the foundational steps of data collection, understanding scope 1, 2, and 3 emissions, partnering with industry stakeholders to establish baselines, and aligning with the Science Based Targets initiative [1]. Additionally, we discuss forming dedicated teams, implementing Environmental Management

Systems (EMS) [1], utilizing scorecards, and adopting incremental approaches to achieve long-term sustainability goals [1]

Literature Review

a) **Sustainability in Dairy Manufacturing** The environmental footprint of dairy production is substantial. According to the Food and Agriculture Organization (FAO), the dairy sector contributes approximately 4% of global anthropogenic greenhouse gas emissions [1]. Emissions arise from various stages, including enteric fermentation in cattle, manure management, feed production, and energy use in processing plants. Sustainable practices in dairy manufacturing have been explored in recent studies. Strategies such as improving energy efficiency, adopting renewable energy sources, optimizing water usage, and reducing waste have shown promise in reducing environmental impacts [1].

b) **Scope 1, 2, and 3 Emissions**

Understanding emissions scopes is critical for effective sustainability planning:

- **Scope 1 Emissions:** Direct emissions from owned or controlled sources (e.g., on-site fuel combustion, company vehicles) [1]

- **Scope 2 Emissions:** Indirect emissions from the generation of purchased energy (e.g., electricity, heating)[1]
- **Scope 3 Emissions:** All other indirect emissions in the value chain (e.g., raw material extraction, transportation, waste disposal) [1]

Addressing all three scopes provides a comprehensive approach to emissions reduction.

c) **Science Based Targets Initiative (SBTi)** The SBTi is a collaboration between CDP, the United Nations Global Compact, World Resources Institute (WRI), and WWF. It helps companies set greenhouse gas reduction targets aligned with climate science [1]. Aligning with SBTi demonstrates a company's commitment to limiting global warming to well below 2°C above pre-industrial levels.

d) **Environmental Management Systems (EMS)** An EMS provides a structured framework for managing environmental responsibilities. ISO 14001 is the internationally recognized standard for EMS implementation [1]. An effective EMS helps organizations improve environmental performance, comply with regulations, and achieve sustainability goals.

Methodology

A) Initiating Sustainability Initiatives

1) Data Collection and Baseline Setting:

a) Conduct an Emissions Inventory:

- Partner with Consulting Firms
Engage with firms like Coho or Everag to assist in data collection and analysis.
- Follow CDP Guidelines
Utilize the Carbon Disclosure Project (CDP) framework for standardized reporting [1].
- Use Data Management Tools

Implement software solutions such as Sphera, Enablon, or custom dashboards for tracking energy use, emissions, and other environmental metrics.

b) Assess Emissions Scopes:

- **Scope 1:** Evaluate direct emissions from on-site fuel combustion and company vehicles [1].
- **Scope 2:** Analyze electricity and natural gas consumption to calculate indirect energy emissions [1].
- **Scope 3:** Gather data on emissions from purchased goods, transportation, waste, and other indirect sources[1] [?], [?], [?], [?].

Table 1 summarizes the emissions categories and their associated scopes.

- 2) Understanding Emissions Categories: To effectively reduce emissions, it's crucial to understand the sources and categorize them appropriately.

- **Transport Emissions** Internal Transport: Emissions from company-owned vehicles (Scope 1) [3]. 3rd Party Transport: Emissions from logistics providers (Scope 3) [3].
- **Energy Consumption** Electricity and Natural Gas: Indirect emissions from purchased energy (Scope 2) [3]. Mobile Combustion Propane: Direct emissions from equipment like forklifts (Scope 1) [3].
- **Other Categories** Water Usage, Waste Generation, Packaging, and Ingredients: Indirect emissions associated with operations (Scope 3) [3].

B) Partnering with Industry Stakeholders

1) Collaborate with Energy Providers:

- Explore options for **Renewable Energy Certificates (RECs)**.
- Consider long-term strategies like **Virtual Power Purchase Agreements (VPPAs)** through industry collaborations [2].

2) Engage with Local Universities: Partner with academic institutions for research support and access to sustainability expertise [2].

3) Join Industry Initiatives: Participate in dairy industry groups focused on sustainability to share best practices and resources [2].

C) Aligning with the Science Based Targets Initiative

1) Commit to SBTi: Officially commit by registering with the SBTi and publicly announcing intentions [4].

2) Set Science-Based Targets: Use SBTi tools and guidelines to set targets aligned with limiting global warming to 1.5°C [4].

3) Develop an Action Plan: Outline specific measures, timelines, and responsible parties to achieve targets [4].

D) Implementing Practical Steps

1) Focus on Easy Wins:

- **Electrify Equipment:** Replace fuel-powered forklifts with electric models to reduce scope 1 emissions [2].
- **Packaging Innovations:** Introduce biodegradable plastics and reduce packaging material usage [2].
- **Energy Efficiency Measures:** Upgrade to energy-efficient lighting and equipment [2]. Implement energy management systems for real-time monitoring [2].

2) Tracking and Reporting:

- **Integrate Sustainability KPIs** : Add emissions and waste metrics to daily production KPIs [5].
- **Use Scorecards**: Create visual dashboards to track progress and communicate results internally [5].
- **Regular Reporting**: Establish a schedule (e.g., monthly,

3) Establish Objectives: Set clear goals and expectations for the team, aligning with overall sustainability targets [5].

F) Implementing an Environmental Management System (EMS)

TABLE I
EMISSIONS CATEGORIES AND SCOPES

Category	Scope
Transport	
- Internal	Scope 1
- 3rd Party	Scope 3
Energy	
- Electricity	Scope 2
- Natural Gas	Scope 2
- Mobile Combustion Propane	Scope 1
Water	Scope 3
Waste	Scope 3
Packaging	Scope 3
Ingredients	Scope 3

TABLE II
EMS IMPLEMENTATION STEPS

Step	Description
1. Commitment	Obtain top management commitment to sustainability
2. Planning	Identify environmental aspects and legal requirements
3. Implementation	Develop procedures and provide training
4. Monitoring	Measure and monitor key operations
5. Review	Conduct periodic audits and management reviews
6. Continuous Improvement	Update policies and procedures based on findings

quarterly) for sustainability metrics [5].

3) Engaging Internal Teams:

- **Education and Training**: Provide sustainability training to employees at all levels [5].
- **Communication Channels**: Set up forums or meetings to discuss sustainability initiatives and gather feedback [5].
- **Employee Involvement**: Encourage staff to contribute ideas and participate in sustainability projects [5].

E) Setting Up a Sustainability Team

- 1) Form a Cross-Functional Team: Include representatives from operations, finance, procurement, HR, and other relevant departments [5].
- 2) Define Roles: Assign a Sustainability Coordinator or Manager to lead efforts [5].

Results

A. Case Study: F&B CPG Company Inc

• Background

As a dairy manufacturing company that has embarked on sustainability journey aiming for carbon neutrality by 2050.

- 1) Adopt ISO 14001 Framework: Utilize the ISO 14001 standard as a guideline for EMS development [5].
 - 2) Policy Development: Draft an environmental policy outlining the company's commitment and guiding principles [5].
 - 3) Procedure Documentation: Document processes related to environmental impacts, including waste management and energy use [5].
 - 4) Continuous Improvement: Regularly review EMS performance and make necessary adjustments [5].
- Table 2 outlines the steps for EMS implementation.

G) Pseudocode for Emissions Tracking Algorithm To automate emissions tracking, a simplified pseudocode is provided in appendix.

1. Initiatives Implemented: • Data Collection and Baseline Setting

Partnered with Coho, a sustainability consulting firm, to conduct a comprehensive emissions inventory [2].

• Emission Reduction Strategies

Replaced propane-powered forklifts with electric models, reducing scope 1 emissions by 10% [2]. Partnered with the

local energy provider to purchase **Renewable Energy Certificates (RECs)**, offsetting 50% of scope 2 emissions [2]. Initiated packaging innovations, introducing biodegradable plastics and reducing packaging weight by 15% [2].

• **Internal Engagement**

Integrated emissions tracking into daily production KPIs [5]. Established an internal sustainability forum for employees to discuss initiatives and share ideas

2. *Outcomes After Two Years:*

- **Emissions Reduction** Overall emissions reduced by **20%**, with significant decreases in scope 1 and scope 2 emissions.
- **Cost Savings** Achieved annual cost savings of **\$150,000** through energy efficiency and waste reduction.
- **Employee Engagement** Increased employee participation in sustainability initiatives by **75%**.

- Partnering with energy providers and universities can open up new opportunities for innovation and cost savings [2].

2) *Starting with Small Steps:*

- Focusing on easy wins builds momentum and demonstrates immediate benefits [2].
 - Simple actions like electrifying equipment or reducing packaging materials can have significant impacts [2].
- 3) *Internal Engagement:*

- Tracking emissions and waste as part of daily KPIs educates and involves employees [5].
- Creating avenues for discussion fosters a culture of sustainability and encourages idea sharing [5].

B) Challenges and Mitigation

- **Resource Constraints**

TABLE III
INITIATIVES AND IMPACT

Initiative	Scope	Emission Reduction	Cost Savings
Electrifying Forklifts	Scope 1	10%	\$50,000
Purchasing RECs	Scope 2	50%	\$70,000
Packaging Innovations	Scope 3	5%	\$30,000
Employee Engagement Programs		All Scopes	Indirect
			N/A

B) Summary of Initiatives and Impact Discussion

A) Practical Insights

1) *Importance of Partnerships:*

- Collaborations with consulting firms and industry partners provide expertise and resources that may not be available internally [2].

C) Tools and Resources

- **Data Collection Software**

Sphera, Enablon, and SimaPro for emissions tracking and life cycle assessments [3].

- **Reporting Frameworks**

CDP [3], **Global Reporting Initiative (GRI)**, and **Sustainability Accounting Standards Board (SASB)** standards.

- **Educational Resources**

Online courses and workshops on sustainability management and ISO 14001 implementation [5].

Conclusion

Implementing sustainable practices is a critical step for small dairy manufacturing companies aiming for carbon neutrality by 2050. By starting with data collection and under-

Prioritize initiatives based on cost-benefit analysis [2]. Seek grants or incentives for sustainability projects [2].

- **Data Accuracy**

Utilize reliable data management tools and conduct regular data verification [3].

- **Resistance to Change**

Communicate the benefits clearly and involve employees in decision-making processes [5].

standing emissions across all scopes, companies can develop targeted strategies for reduction. Partnering with industry stakeholders and aligning with initiatives like the Science Based Targets provides a framework for meaningful action. Forming dedicated teams, implementing an EMS, and utilizing scorecards are practical steps that facilitate progress tracking and continuous improvement. While challenges exist, taking small, incremental steps makes sustainability achievable and beneficial, leading to cost savings, enhanced reputation, and long-term viability.

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APPENDIX

```

BEGIN
  SET total_emissions = 0
  FOR each emission_source IN emission_sources
    emissions      =      calculate_emissions(
      emission_source)
    total_emissions += emissions      RECORD
    emissions in database
  END FOR
  DISPLAY total_emissions END

```

Code Snippet 1. Pseudocode for Emissions Tracking Algorithm

References

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