Cost of Processing in Cheese, Whey, Butter and Nonfat Dry Milk Plants

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Project Justification

Benchmarking the cost of processing is a helpful exercise which can lead to improvement in business performance. Firms often engage in internal benchmarking to understand their own costs and to gauge progress in reduction of those costs over time. While this is internally useful, it is more difficult to assess whether a plant is performing *well* against competitors. Benchmarking across competitor dairy plants can be difficult because a standard of cost determination does not exist, and without that, plants may be comparing "apples to oranges."

Modern dairy plants are large and complex in product mix, processing technologies and business arrangements. Multi-plant firms may procure inputs at lower costs due to volume purchases helping to create a low cost operation. But they may also assess their individual operations a headquarter expense that independent plants will not have. Determining a uniform procedure for calculating the cost of processing across a multitude plant experiences must adapt to a changing processing landscape.

With Federal Milk Marketing Order (FMMO) reform back in the late 1990s, replacement of the Minnesota-Wisconsin (M-W) price as the Basic Formula Price (BFP) was deemed essential. As Grade B milk supplies had dwindled, it was felt that the survey of unregulated transactions between dairy plants and farmers was insufficient to provide an adequate representation of national markets for milk. A university study committee was assembled to evaluate the performance of 32 options[2] including Product Price Formulas (PPFs).

Product Price Formulas were ultimately selected by the U.S. Department of Agriculture as the new method of determining a BFP. PPFs work by moving up the marketing chain one step to survey unregulated buying and selling of wholesale dairy products and then using those dairy product prices as the means of back-calculating the value of milk used to make those products (Figure 1). Milk is the primary cost of producing dairy products like cheese or butter, but it isn't the only cost. Dairy plants also purchase labor, utilities, packaging, etc. to transform milk into finished products, and

[1] Mark Stephenson is the retired Director of Dairy Policy Analysis from the University of Wisconsin.

[2] Knutson, Ronald D., et al., "An Economic Evaluation of Basic Formula Price (BFP) Alternatives.", AFPC Working Paper 96-5. October 1996.

those costs must be taken into account in a PPF. These parameters are informally referred to as the "make allowances". Determining realistic benchmarks of the cost of processing are important to update PPFs for FMMOs.

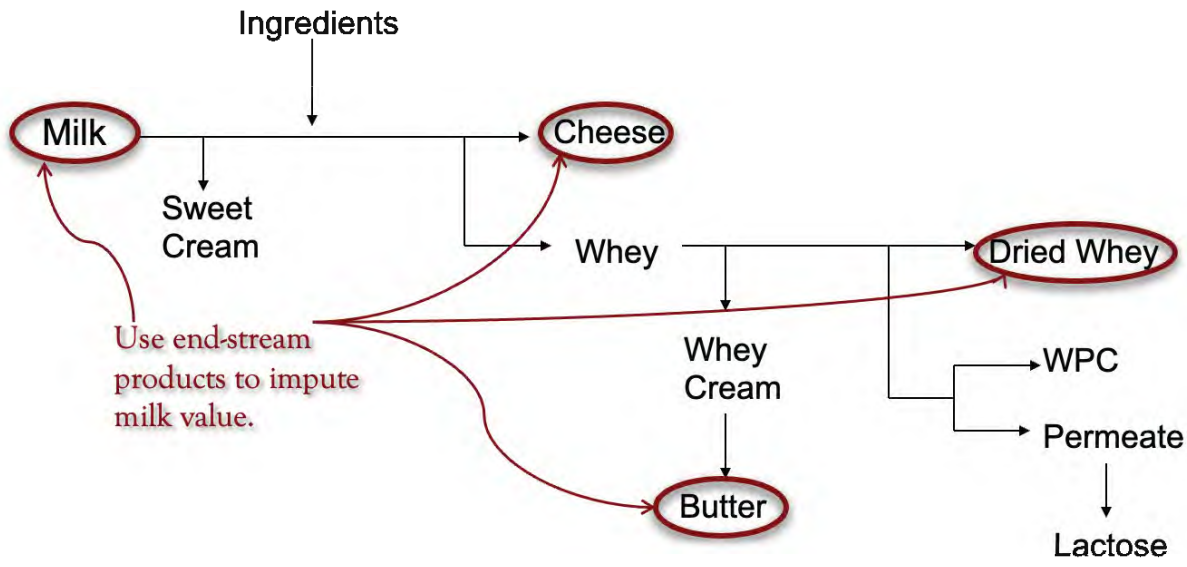

Figure 1. End Product Streams in Cheese Plant.

In most FMMOs, farms are paid for the pounds of components (butterfat, protein, other solids) that they sell in their milk. One of the PPFs used to determine the monthly value of butterfat is: *Butterfat Price = (Butter Price – 0.1715) x 1.211* where the Butter Price is determined from a weekly survey of product sales[3]; the value of 0.1715 is the make allowance which literally can be interpreted as "It costs 17.15¢ to transform milk into one pound of butter; and the 1.211 parameter is known as the *yield factor* which can be thought of as one pound of butterfat will make 1.211 pounds of butter.[4]

Research Qualification

The author has been involved in cost of processing studies for more than 30 years. Early work at Cornell University dated back in the 1970s and 80s included the Dairy Information Management System, or DMIS, which was a project to collect and summarize monthly fluid milk plant processing costs. Later work by the Cornell Program on Dairy Markets and Policy (CPDMP) included studies on the cost of

[3] The National Dairy Products Sales Report is published weekly by the Agricultural Marketing Service of the U.S. Department of Agriculture. https://usda.library.cornell.edu/concern/publications/zs25x847n

[4] Domestic butter is about 80 percent butterfat.

processing cheese[5],[6], whey[7], butter, nonfat dry milk powder[8],[9], again fluid milk[10] and then ultra-filtered milk. Cost of processing projects were again conducted in 2006[11] and 2007[12] when the results were offered as testimony in Federal Milk Marketing Order hearings for changes to the make allowances at the time. In 2021, USDA funded a study to benchmark the cost of processing[13].

It was felt that the most recent 2021 study, which assessed costs in dairy plants pre-Covid, had not captured the significant increase in costs which resulted from interrupted supply chains and recent inflation.

This current assessment of the cost of processing is supported by the International Dairy Foods Association (IDFA) and the Wisconsin Cheese Makers Association (WCMA) to update the manufacturing costs in cheddar cheese, dry whey, butter and nonfat dry milk plants and builds on knowledge and background of earlier efforts.

This paper documents plant selection, data collection, methodology and processing cost summaries.

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[5] Mesa-Dishington, Jens K., Richard D. Aplin, and David M. Barbano., "Economic Performance of 11 Cheddar Cheese Manufacturing Plants in Northeast and North Central Regions, Part 1 of a Research Effort on Cheddar Cheese Manufacturing.", A.E. Res. 87-2, Dept. of Agr. Econ., Cornell Univ., January 1987.

[6] Mesa-Dishington, Jens K., David M. Barbano, and Richard D. Aplin., "Cheddar Cheese Manufacturing Costs, Economies of Size and Effects of Different Current Technologies, Part 2 of a Research Effort on Cheddar Cheese Manufacturing.", A.E.Res. 87-3, Dept. of Agr. Econ., Cornell Univ., January 1987.

[7] Hurst, Susan, Richard Aplin, and David Barbano., "Whey Powder and Whey Protein Concentrate Production Technology, Costs and Profitability, Part 4 of a Research Effort on Cheddar Cheese Manufacturing.", A.E.Res. 90-4, Dept. of Agr. Econ., Cornell Univ., April 1990.

[8] Stephenson, Mark W. and Andrew M. Novakovic., "Manufacturing Costs in Ten Butter/Powder Processing Plants.", A.E.Res. 89-19, Dept. of Agr. Econ., Cornell Univ., September 1989.

[9] Stephenson, Mark W. and Andrew M. Novakovic., "Determination of Butter/Powder Plant Manufacturing Costs Utilizing an Economic Engineering Approach.", A.E.Res. 90-6, Dept. of Agr. Econ., Cornell Univ., June 1990.

[10] Erba, Eric M., Richard D. Aplin, and Mark W. Stephenson., "Labor Productivities and Costs in 35 of the Best Fluid Milk Plants in the U.S.", E.B. 97-03, Dept. of Agr., Res., and Mgrl. Econ., Cornell Univ., March 1997.

[11] Stephenson, Mark W., “Cost of Processing in Cheese, Whey, Butter and Nonfat Dry Milk Plants”. Working Paper, Cornell Program on Dairy Markets and Policy. September 2006.

[12] Stephenson, Mark W., “Testimony on Cost of Processing in Cheese, Whey, Butter and Nonfat Dry Milk Plants”. Federal Milk Marketing Order Hearing, Pittsburgh, PA. July 9, 2007.

[13]Stephenson, Mark W., “Cost of Processing in Cheese, Whey, Butter and Nonfat Dry Milk Plants”. https://dairymarkets.org/cop/Report/2021_COP_Report.pdf

Plant Selection

In earlier studies, participating plants had been carefully selected to be "best practice" plants and plants with a fairly narrow product mix. These projects have always included plants of various sizes but selection of plants were made that were considered by industry observers to be efficient, low-cost processors at any given size. One of the objectives of those studies was to determine the cost "frontier", or the lowest possible costs over a range of plant capacities. The narrow product mix also meant that it was easier to allocate costs to the primary products of interest produced at the plant.

In more recent studies (Stephenson, 2006), plants were chosen on the basis of a random draw stratified by plant size and region of the country. This was an attempt to select representative plants whose market and experience could vary by geography and more completely explore the economies of scale.

In the 2021 study, plant selection was more targeted. It was felt important to assure that plants producing product that may be included in the National Dairy Products Sales Report (NDPSR), which determines the product prices used in the PPFs, should be solicited. The author maintains a proprietary list which currently contains about 687 dairy plants in the U.S. This database contains information on location, ownership type, company, location, primary products produced, estimated plant volume, etc. The National Agricultural Statistics Service report on Dairy Products 2019 Summary reports that there were 1,266 dairy plants in the U.S. in 2019. However, many of these plants are very small and produce products that would not be included in the National Dairy Products Sales Report.

Participation in this study is voluntary. Plants cannot be compelled and are not compensated for the time spent organizing and submitting their data. Individual plant data is considered highly confidential and only summary data are provided in this report. The 2021 study captured a good portion of the butter and nonfat dry milk sales reported in the NDPSR, but the proportion of cheddar cheese and dry whey was not as complete.

With urging from IDFA and WCMA to their members, participation of cheese and dry whey plants was higher and the average plant size was considerably larger than the 2021 study. It must be noted that a different sample of plants makes it more difficult to compare results from different studies. However, a "same plant" comparison is also made which reports on the subset of plants who participated in both the 2021 study and the current project.

In this round of cost calculation, there were 15 participating firms with ownership of 45 different plants. Eight of the firms were cooperative ownership with the remaining seven being proprietary. Thirteen of the plants processed butter, fifteen processed nonfat dry milk, eighteen processed cheddar cheese, and nine processed dry whey for a total of 55 plant-product observations.

Plant locations were geographically dispersed across all regions of the country except the Southeast where few manufacturing plants exist with reportable products.

Data Collection

Earlier survey work was conducted with a printed survey form. Utilizing fixed formats, such as a printed survey, requires that you have enough pages to cover all possible products, package sizes, labor, utilities, etc. for all possible plant configurations. Although filling out such a survey might be a relatively "sparse matrix" for any given plant, the document would be daunting in the number of possible pages and might diminish participation.

A stand-alone computer program was developed that would build a questionnaire based on responses to previous questions. For example, first identifying products produced at the plant generated subsequent questions about package sizes and monthly volume of production of the individual products. And, identifying package sizes then generated questions about the packaging costs for those particular containers. Every survey was unique to the plant responding to the questions. Versions of that program were available for 32 and 64 bit Windows operating systems and 32 and 64 bit Apple OS and Unix platforms. But, over time, compatibility with hardware and operating systems became problematic.

For the current survey, a highly secure web application was developed to collect data. The advantage of this approach is that all participants can use a variety of hardware and operating system of their choice. The application runs in any modern web browser window. This approach also means that participants are all working off of the same version of the software and that software can be updated as needed without the need to download a new and compatible version.

The electronic data collection process streamlined data entry and reduced possible re-entry errors from keying data into a computer from paper forms. Anecdotal evidence from participants indicate that completing the survey required between 4 and 8 hours of work depending on the complexity of the plant and the sophistication of the information retrieval systems of the company. Appendix A includes example screen shots for the Cost of Processing (COP) program for a cheese plant. This gives an idea of the questions that were asked and the data that were collected.

Methods

Key questions regarding methods involve: 1) What is included in the cost of processing and 2) How are costs allocated across products produced?

The cost of processing is intended to capture the costs of transforming milk and other dairy ingredients into the dairy products of interest. There is no need to consider the cost of the milk or dairy ingredients purchased nor is there a need to know dollar value of the sales of the finished product. We are not trying to determine profitability of plants, just the cost of processing.

While it might seem as though this strict definition of product transformation would create a bright line of demarkation between included and excluded costs, there are grey areas. One of those areas includes sales and general administrative costs. An attempt is made to separate the overhead costs required to own and operate a processing plant from the marketing expense. Product must be sold for plants to be viable, however, marketing costs can vary tremendously depending on your target channel (e.g., are plants selling consumer packages to higher end retailers or delivering bulk products to firms specializing in final product marketing). For this reason, all sales expenses are excluded from the cost of processing figures. But, some plants are charged a "headquarters" expense. This expense often covers centralized services such as legal, accounting, etc. that would otherwise be line items in a plant's general ledger.

Anywhere plant expenses can be directly allocated to particular products, plants are asked to do so. A good example is utility expense where individual electric or gas meter can be recorded and assigned to a product line such as cheese or powdered products. Some expenses must be indirectly allocated to various products produced at the plant.

Labor costs are identified by job function. Functional areas depend on the product mix but include such centers as receiving and tanker washing, cheese processing, cheese packaging, dryer labor, powder bagging, cold room, etc. Cheese processing or packaging labor are clearly assigned to cheese labor costs, although they may need to be allocated between different cheeses produced at the plant. However, job functions such as receiving and tanker washing should have labor apportioned to both cheese production, whey processing, etc.

Until recently, the California Department of Food and Agriculture's (CDFA) Division of Marketing Services had compiled and published manufacturing cost data for many years. For CDFA, any cost that cannot be clearly assigned to a single product line was apportioned according to the percent of milk solids processed in the various product lines. For example, a plant that brought in 100 pounds of raw milk and processed it into cheese, dry whey and whey cream might have sold 5.85 lbs of solids (fat and solids-not-fat) in the cheese, 6.12 lbs of solids in the dry whey and 0.20 lbs of solids in the whey cream. This would mean that $10,000 of labor in the receiving and tanker washing center would be apportioned as $4,807 to cheese, $5,029 to dry whey and $164 to whey cream. Any other costs which are unallocated to specific product lines are apportioned indirectly in the same way as the labor cost example.

In more complex plants, there can be a problem with the CDFA methodology. Suppose that a plant brings in farm milk and makes nonfat dry milk powder and sells the cream. But, the plant also sells some skim milk and also quite a bit of condensed skim milk. If a majority of the total solids are in the skim milk and the condensed skim milk and cream,

a large amount of the total costs would be allocated to these minimally processed products and the nonfat dry milk powder would appear to have a very low cost of processing.

In the 2021 study, we further assigned a degree of processing transformation to each product sold from the plant. The scale is from 1 to 10 where 1 represents minimal processing and 10 represents a high degree of transformation. If a plant produces cheese and sells wet whey, the cheese is assigned a transformation value of 8 whereas the liquid whey is assigned a value of 1. Although choosing these transformation values is somewhat subjective, the values were discussed with processing folks with the University of Wisconsin's Center for Dairy Research. Table 3 shows the value judgements used for various products. These transformation values provide an additional weighting methodology for product costs.

Table 1. Product Transformation Values.

Product Sold from Plant	Transformation Value
Milk (reload from plant)	1
Skim Milk	2
Cream	2
Skim Condensed	4
Butter	6
Nonfat Dry or Skim Milk Powder	9
Whole Milk Powder	9
Cheese	8
Whey (wet)	1
Condensed Whey	4
Dry Whey	9
Whey Protein Concentrate (wet)	6
Whey Protein Concentrate (powder)	10
Dry Lactose	10

An example of the allocation factor is shown in Table 4. Suppose that a plant used milk to produce and sell butter, nonfat dry milk and cream. The pounds of the finished product are given in the second column and the pounds of solids contained in the

finished product are shown in the third column. The degree of transformation is also assigned in the fourth column and these factors produce the allocation factor in the right-hand column.

Table 2. Example Allocation Factor.

Products Produced	Pounds of Product	Pounds of Solids	Degree of Transformation	Percent Allocation
Butter	28,000	24,000	6	16%
NFDM	75,000	74,000	9	75%
Cream	85,000	40,000	2	9%

If the plant has a single electric meter and bill for $3,000 then the nonfat dry milk is assigned 75% of the cost or $2,250 which is 3¢ per pound. If you allocated only by the percent solids then the cost per pound would be just a little over 2¢ per pound and probably an understatement of the electric cost for drying powder.

This was a new approach in the 2021 study and one which was somewhat controversial. It should be emphasized that total costs of a plant are maintained, but the weighting may be different. For example, in a butter-powder plant, the transformation values would tend to lower the cost of butter and increase the cost of powder. A similar observation (but to a lesser degree) is seen in a cheese and dry whey processing plant.

In the present round of cost evaluation, industry participants had asked for a return to the previous methodology without the degree of transformation applied. **For the costs presented in this document, unallocated costs were partitioned solely on the basis of the milk solids in the products produced and did not include the degree of product transformation**.

The data collection application has many places where it can be up to the plant to allocate costs to a product center. This is always preferred as they plant is in a better position to make that judgement. For example, the payroll screen would provide places for labor costs specifically for the butter churn, the cold room, the evaporator, dryer, powder bagging, as well as more general plant payroll such as laboratory personnel or maintenance workers. If costs are given for specific products, those are assigned to the specific products. If they are not, they are allocated as described above.

Every plant's data is scrutinized for completeness and accuracy relative to internal and external benchmarks. All data reported here have satisfied the researcher as to reasonable measures of accuracy and integrity. There are some data which are clear outliers as far as costs go, but plants have been asked to explain these and verify that they were charged to the manufacture of the product.

Another exception to CDFA's procedures is in the calculation of return on investment (ROI). Normally, ROI is a calculation based on the profit of the firm relative to the value of the assets needed to generate the profit (the investment). We are not collecting information on the sale of products nor on the cost of the major ingredients (milk) in this project. As such, we cannot calculate a firm's profit nor the ROI. However, an allowance for a ROI is viewed as an opportunity cost for the firm. If the firm invested the value of the capital assets in another venture or in financial instruments, they would expect a return.

CDFA calculates a ROI allowance based on the book value of individual assets depreciated by each asset's expected life. This is an attempt to determine a true economic depreciation and not a tax value depreciation (which tends to undervalue older plant and equipment). Determining the original purchase price and setting up a depreciation schedule for every building and piece of equipment for each plant is beyond the scope of this project. Plant's were asked to provide "market value of assets" for the plant and this is the value that is used to calculate a ROI allowance. Some plants were not able to estimate the plant's market value and left these fields blank. Those plants did not have a ROI allowance included in their cost of production.

Valuation of assets is half of the information needed to calculate a ROI allowance—a suitable rate of return is the other. CDFA had used the Moody's Baa corporate bond index as their rate and this project does also. This index is considered to be a medium-grade investment vehicle. It is comprised of bonds better than "junk" status but not as solid as "gilt edged" bonds—In other words, a middle of the road rate of return. Virtually all participants used calendar year 2022 for their data year but a few used their most recent fiscal year. Appendix B shows the monthly Moody's Baa Corporate Bond Index values since January, 2020. The Moody's Baa Corporate Bond Index value for the 12 months of 2022 was used to calculate a return on the value of assets which was equal to 5.07%.

Processing Cost Results

Plants were asked to supply one year's worth of data. Many of the values are requested as an annual summary but some are requested on a monthly basis. It is suggested that a plant select the most recent twelve-month period which corresponds to their fiscal year. Because the plants have some latitude for time period, the results do not always correspond to a calendar year or even to the same twelve-month period. However, the great majority of plants supplied data for the 2022 calendar year.

Plants may have processed several products but only cheddar cheese, dry whey, butter and nonfat dry milk powder results are presented here. The other products have had processing costs allocated to them in just the same way and those costs are not born by the products of interest.

The reporting format and the cost categories shown here are the same as CDFA's. "Processing Labor" includes all direct and indirectly allocated labor except for plant management and clerical labor. "Utilities" include all electric, natural gas, coal, steam or other energy costs. "Packaging" includes boxes, liners, totes, tape, labels, glue, pallets, pallet sheets, stretch wrap, etc. "Non-Labor or Utilities Processing" includes all non-dairy ingredients, such as salt, starter, etc., depreciation, taxes, cleaning, laboratory and general supplies, etc. "General & Administrative" includes management and clerical labor (but not sales or marketing), dues, postage, legal & accounting, headquarters expense and short-term interest. The "Return on Investment" is calculated as the applicable Moody's Baa rate times the market value of the plant and equipment. A few firms did not include a market value estimate so an ROI was not calculated as a cost for the firm.

As in previous cost of processing studies, there is a great range in the total cost of processing. The tables below show the weighted average of all participating plants and these plants are also rank separated by the approximate 50% lowest and 50% highest total cost of processing.

Observations

In the 2021 study, there were 27 nonfat dry milk plants who had participated while in the current 2023 study there were only 15. However, the average pounds of product per plant was much larger and total pounds of product reported for 2023 was slightly more than the previous study. Reported costs per pound declined by a little more than 6% but comparing the non-transformed weighted average in the 2023 study (27.50¢) with the non-transformed weighted average values for the 2021 study (24.54¢), the nonfat dry milk processing costs were increased by 12%.

There were 13 participating butter plants in the current study versus 12 plants in the 2021 study. There were nearly identical total amounts of butter processed by the plants in both the 2021 and 2023 studies. Comparing the non-transformed weighted average in the 2023 study (31.76¢) with the non-transformed weighted average values for the 2021 study (13.38¢), the butter processing costs were increased substantially.

Eighteen cheddar cheese plants participated in the 2023 round versus the 10 plants who were in the 2021 study. And, the average volume processed in the current plant set were about double in processing volume. The new plant sample represented more than 3.5 times the total volume of cheese than in the 2021 report. The 2023 study showed a weighted average cost of processing (26.43¢) almost 12% higher than the non-transformed 2021 study (23.65¢).

Finally, there were 9 dry whey plants in the 2023 study compared to the 8 plants in the 2021 project. The average 2023 plants processed slightly more than the 2021 plants which together amounted to somewhat more than 50% increase in total volume represented. The current whey processing costs (33.61¢) were about 37% greater than the non transformed 2021 study (24.57¢).

A few observations are worth noting—first, the sample matters. These studies rely on voluntary participation and the addition or loss of a handful of plants can make a notable difference to the outcome.

A second observation is that the notable difference in outcome suggests that there can be largely different experiences in costs of processing within a sample of plants. All of the studies have shown variation across the sample, but both the 2021 and the 2023 projects provide evidence that the variation has become larger than in earlier work like the 2006 and 2007 studies. New automation technology has become available which can reduce labor costs. And, there is considerable variation in per unit utility costs across plants. Further, larger multi-plant firms may have input purchasing cost advantages that smaller single-plant firms do not.

The third observation is that this researcher favors the weighting of unallocated processing costs by the degree of transformation of the products as well as the pounds of milk solids processed. In plants where there a significant portion of sales from the plant as cream or skim milk, the costs that are apportioned to the more highly processed products can be under accounted.

Finally, although the author has never had reason to doubt the integrity of data submissions, the voluntary process does not carry audit authority to verify unusual cost observations in plants. There are several built-in cross-checks with the data collection which can highlight unusual data. Often a follow-up call to the participating plant will fix an entry mistake, but verification is not possible.

As plants have become much larger and much more complex, attribution of costs to products has become more difficult. The industry must insist that care and thought be applied to cost collection and summary if these values are to be used in product price formulas. Accurate representation of costs is important to both milk producers and plant owners. Cost reporting should also be conducted on a regular and not ad hoc basis.

Table 3. Plant Costs for Nonfat Dry Milk Processing.

	Plant Costs for Nonfat Dry Milk Processing, 2022.							
	Product Pounds	**Processing Labor**	**Utilities**	**Packaging**	**Non-Labor or Utilities Processing**	**General and Administrative**	**Return on Investment**	**Total Cost**
Low Cost Plants	146,751,907	$0.0383	$0.0405	$0.0218	$0.0839	$0.0304	$0.0152	$0.2302
High Cost Plants	99,263,237	$0.0708	$0.0406	$0.0177	$0.1104	$0.0283	$0.0569	$0.3247
All Plants	119,615,524	$0.0537	$0.0405	$0.0199	$0.0965	$0.0294	$0.0350	$0.2750
N =	15							

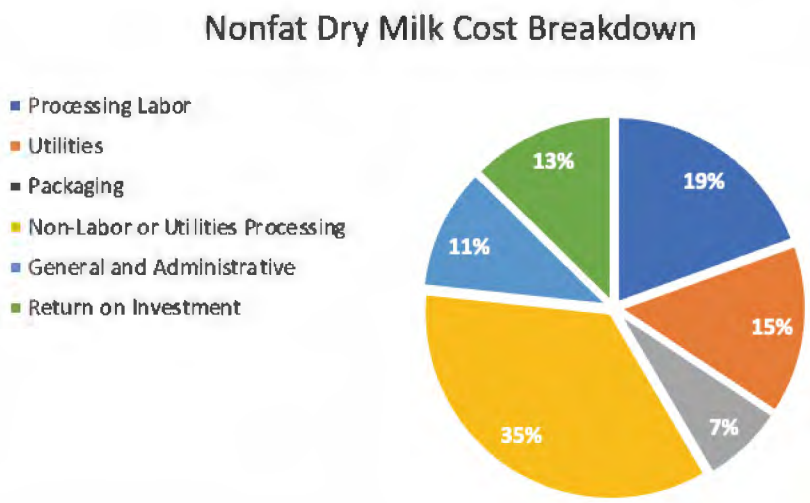


Figure 2. Proportional Breakdown of Costs in Nonfat Dry Milk Plants.

Table 4. Plant Costs for Butter Processing.

	Plant Costs for Butter Processing, 2022.							
	Product Pounds	**Processing Labor**	**Utilities**	**Packaging**	**Non-Labor or Utilities Processing**	**General and Administrative**	**Return on Investment**	**Total Cost**
Low Cost Plants	123,464,841	$0.0545	$0.0221	$0.0237	$0.1027	$0.0317	$0.0269	$0.2616
High Cost Plants	133,788,345	$0.1059	$0.0250	$0.0362	$0.1496	$0.0424	$0.0618	$0.4210
All Plants	126,906,009	$0.0726	$0.0231	$0.0281	$0.1192	$0.0355	$0.0392	$0.3176
N =	13							

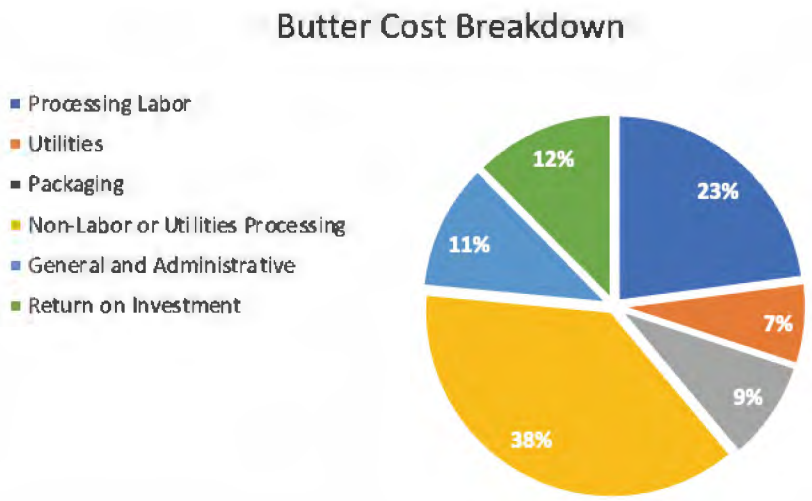


Figure 3. Proportional Breakdown of Costs in Butter Plants.

Table 5. Plant Costs for Cheddar Cheese Processing.

	Plant Costs for Cheddar Cheese Processing, 2022.							
	Product Pounds	**Processing Labor**	**Utilities**	**Packaging**	**Non-Labor or Utilities Processing**	**General and Administrative**	**Return on Investment**	**Total Cost**
Low Cost Plants	163,204,236	$0.0369	$0.0128	$0.0313	$0.0825	$0.0247	$0.0320	$0.2201
High Cost Plants	93,844,559	$0.0646	$0.0206	$0.0407	$0.1134	$0.0381	$0.0408	$0.3181
All Plants	122,404,426	$0.0494	$0.0163	$0.0355	$0.0964	$0.0307	$0.0360	$0.2643
N =	18							

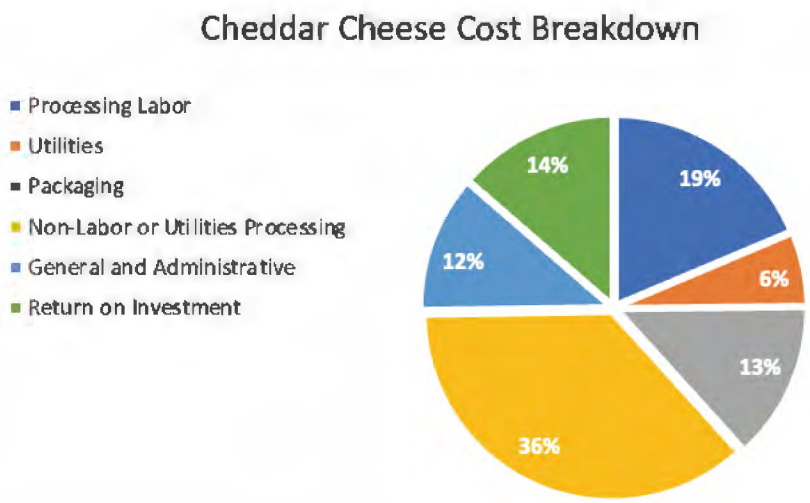


Figure 4. Proportional Breakdown of Costs in Cheddar Cheese Plants.

Cost of Processing Program

Table 6. Plant Costs for Dry Whey Processing.

	Plant Costs for Dry Whey Processing, 2022.							
	Product Pounds	**Processing Labor**	**Utilities**	**Packaging**	**Non-Labor or Utilities Processing**	**General and Administrative**	**Return on Investment**	**Total Cost**
Low Cost Plants	58,933,105	$0.0724	$0.0243	$0.0189	$0.0986	$0.0254	$0.0452	$0.2848
High Cost Plants	41,028,833	$0.0890	$0.0435	$0.0192	$0.1461	$0.0489	$0.0485	$0.3952
All Plants	48,986,287	$0.0801	$0.0332	$0.0190	$0.1207	$0.0363	$0.0467	$0.3361
N =	9							

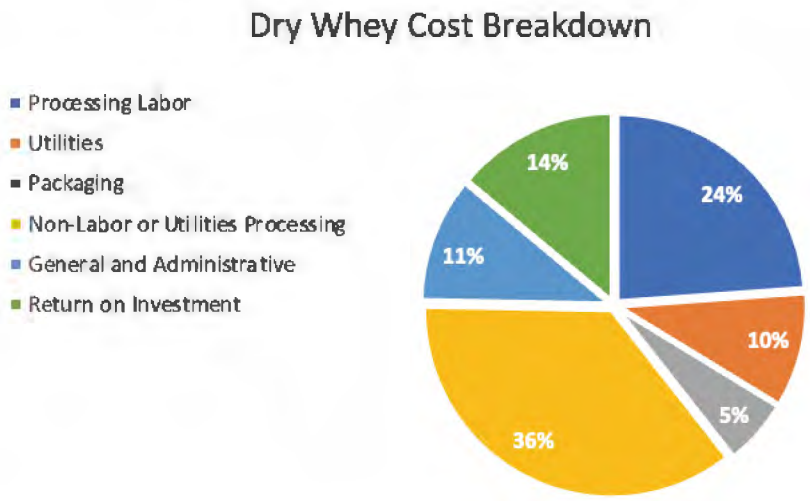
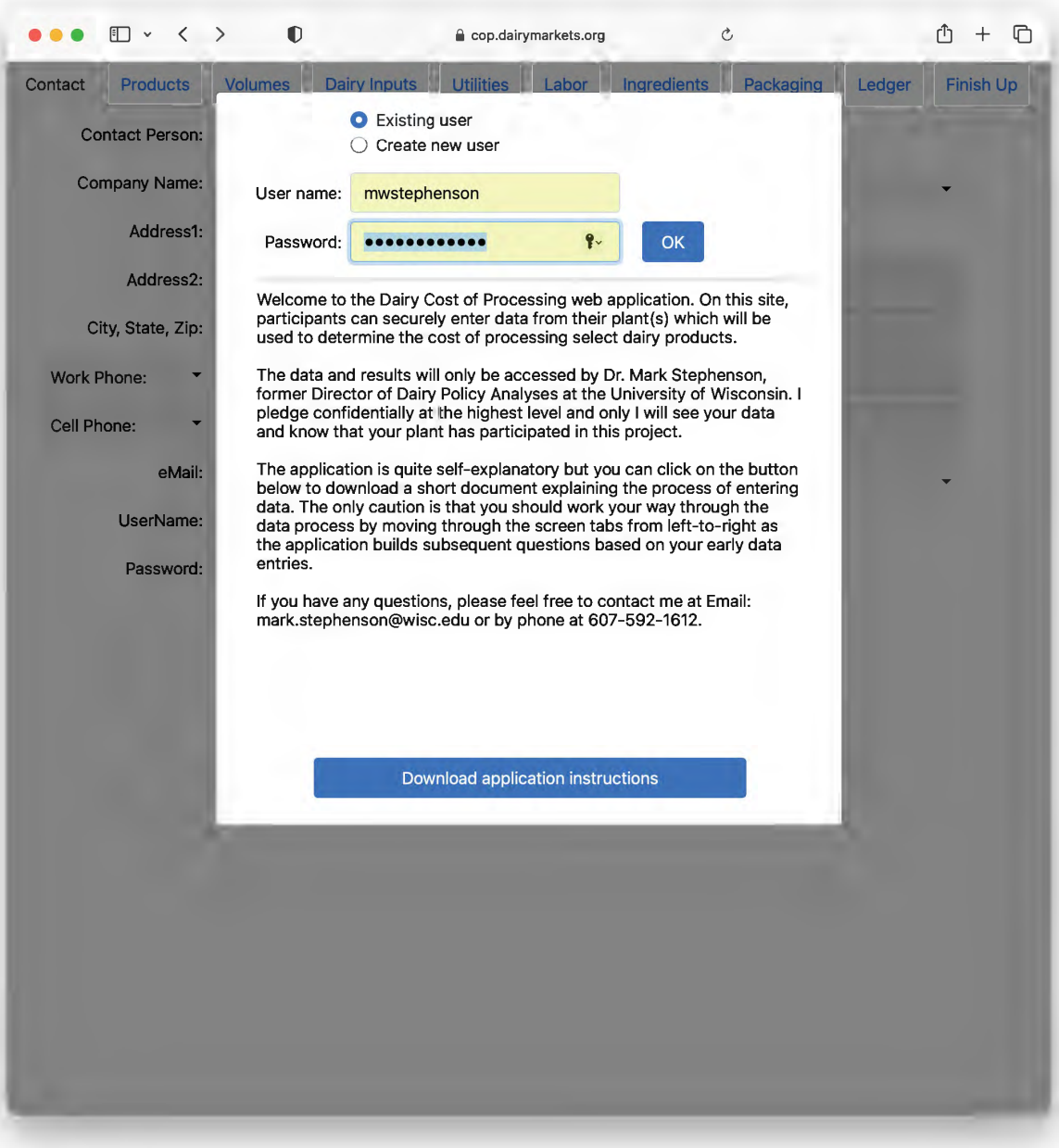
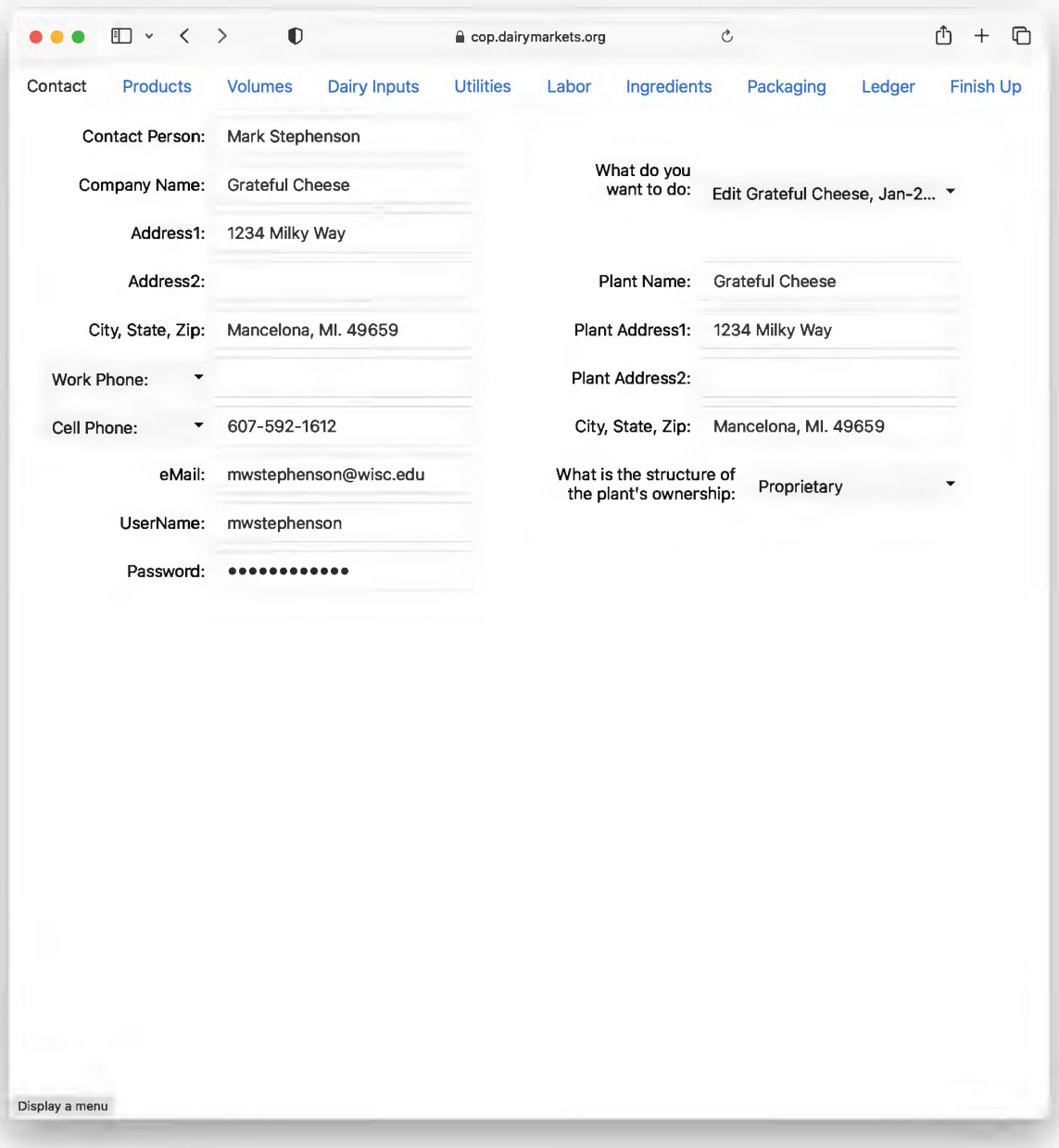
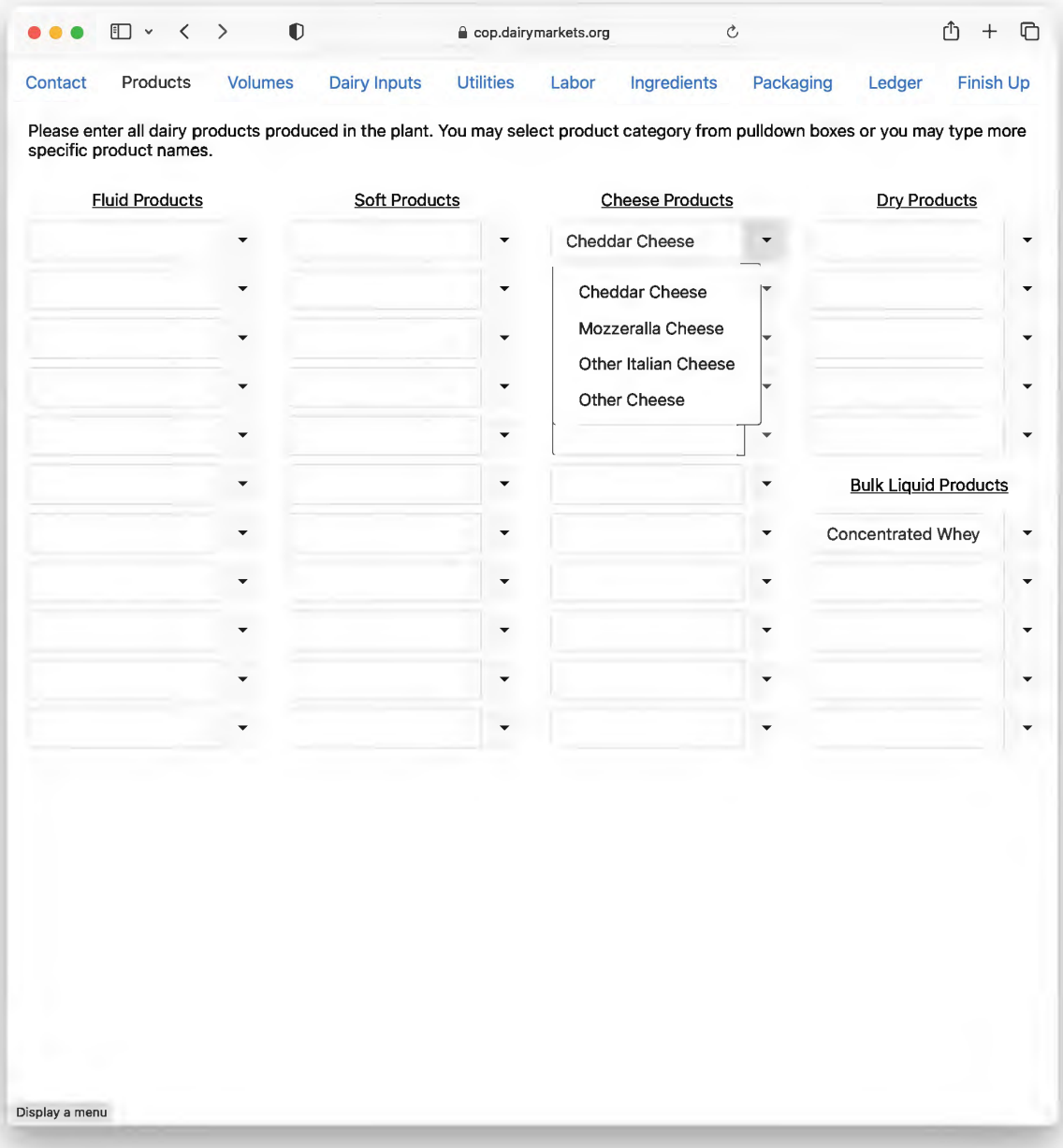


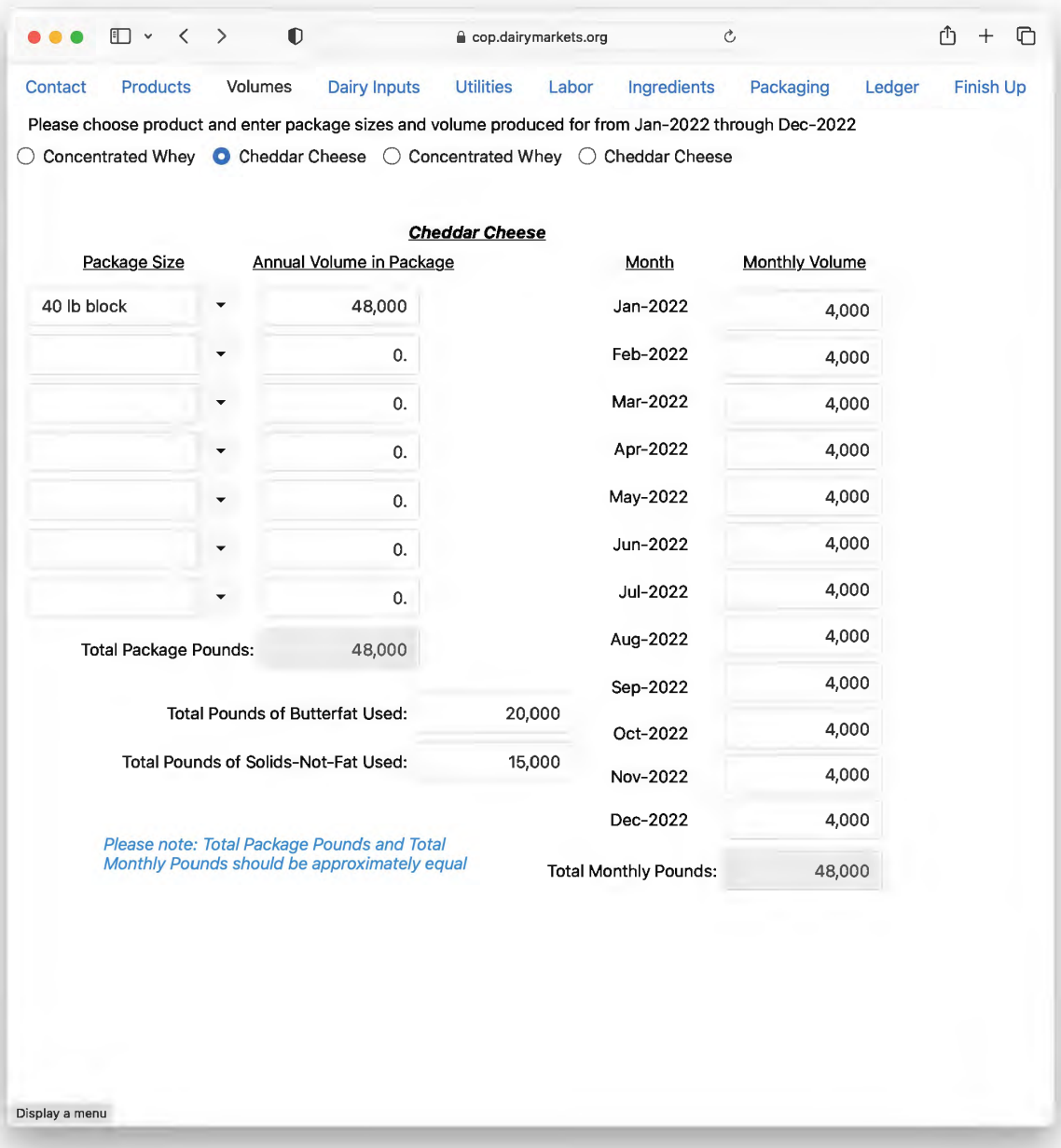
Figure 5. Proportional Breakdown of Costs in Dry Whey Plants.

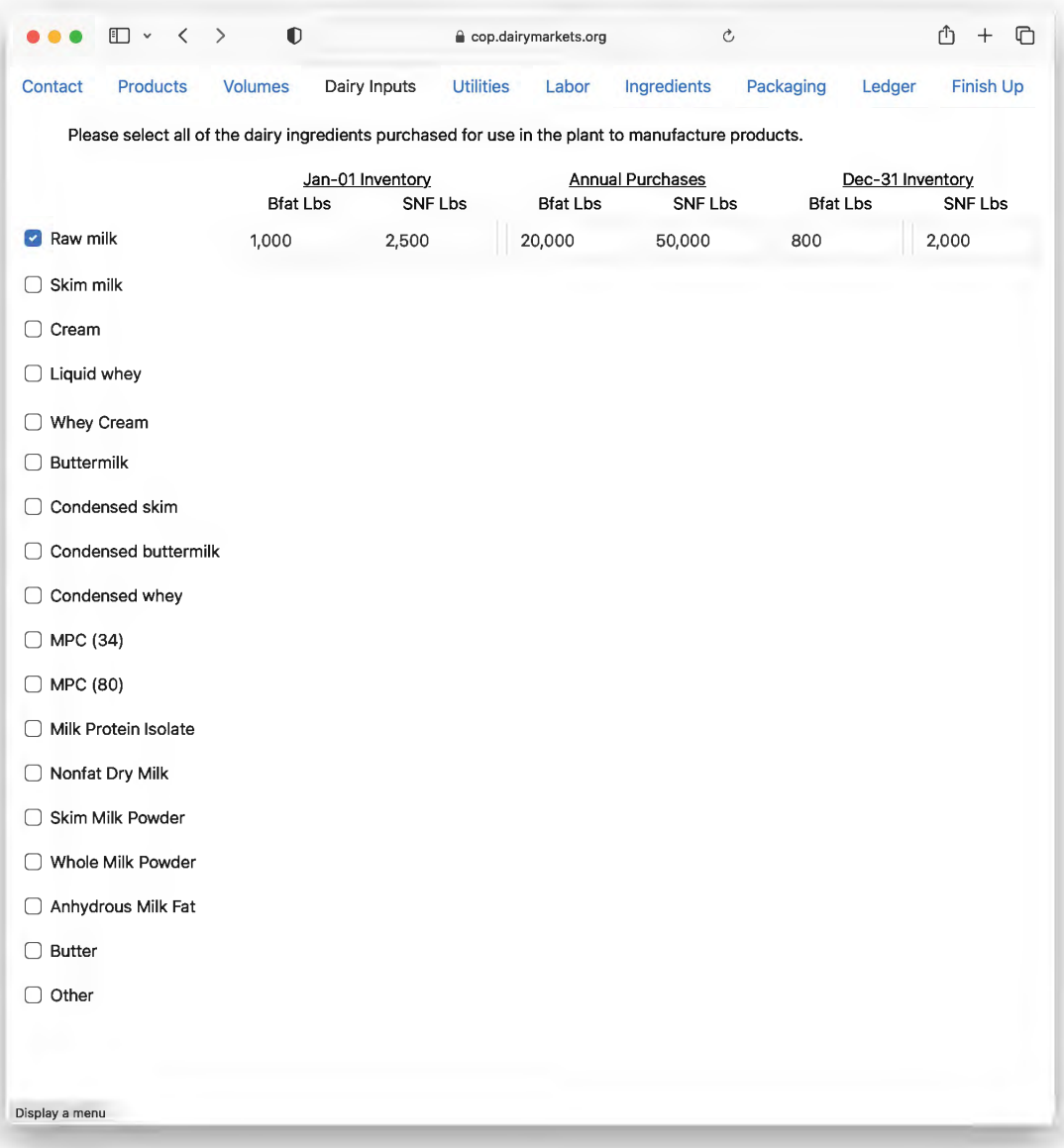
Appendix A—Screen Captures of the Cost of Processing Program

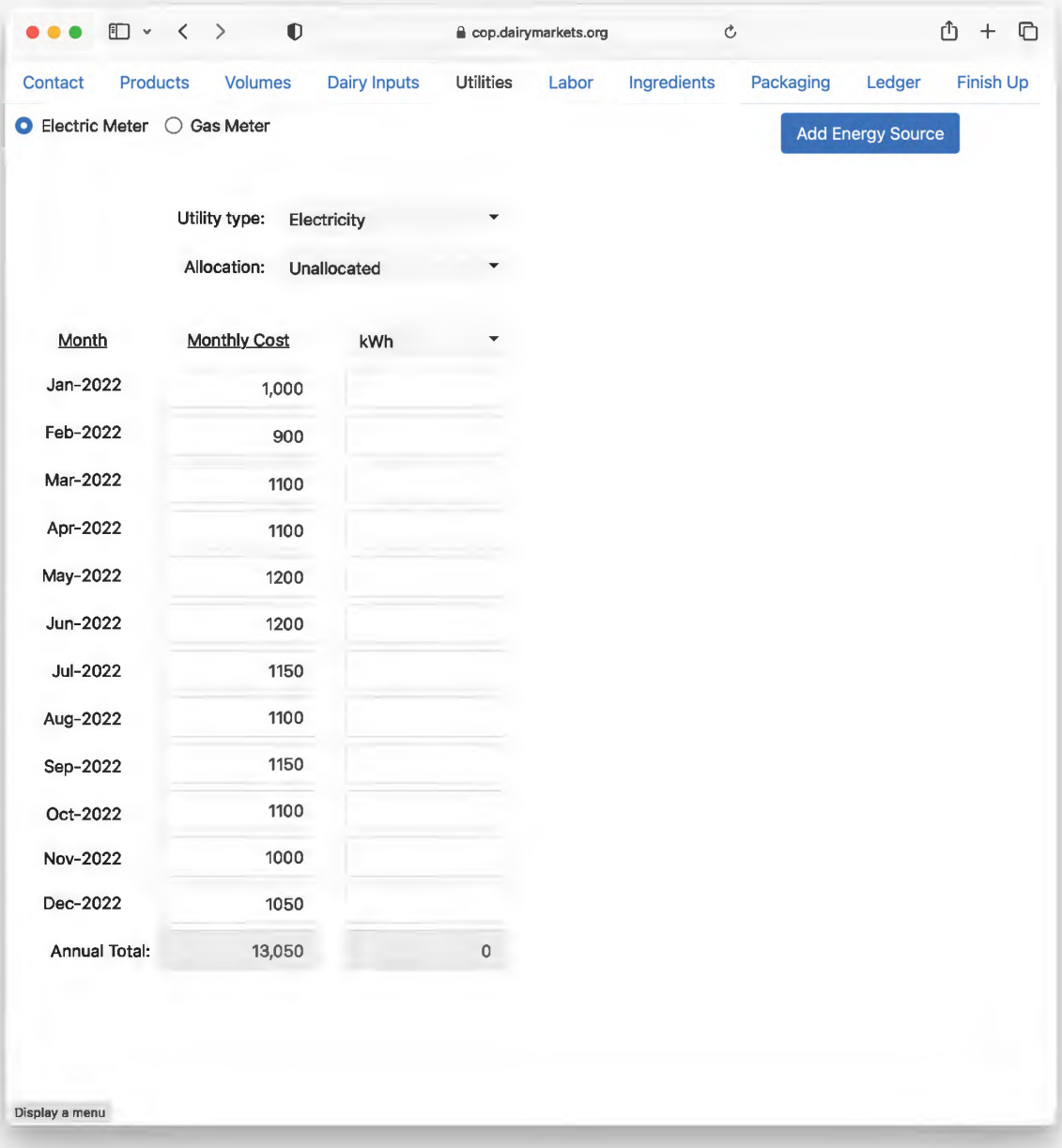

cop.dairymarkets.org
Contact
Products
Volumes
Dairy Inputs
Utilities
Labor
Ingredients
Packaging
Ledger
Finish Up
Contact Person:
Company Name:
Address1:
Address2:
City, State, Zip:
Work Phone:
Cell Phone:
eMail:
UserName:
Password:
Existing user
Create new user
User name:
mwstephenson
Password:
OK
Welcome to the Dairy Cost of Processing web application. On this site, participants can securely enter data from their plant(s) which will be used to determine the cost of processing select dairy products.
The data and results will only be accessed by Dr. Mark Stephenson, former Director of Dairy Policy Analyses at the University of Wisconsin. I pledge confidentially at the highest level and only I will see your data and know that your plant has participated in this project.
The application is quite self-explanatory but you can click on the button below to download a short document explaining the process of entering data. The only caution is that you should work your way through the data process by moving through the screen tabs from left-to-right as the application builds subsequent questions based on your early data entries.
If you have any questions, please feel free to contact me at Email: mark.stephenson@wisc.edu or by phone at 607-592-1612.
Download application instructions

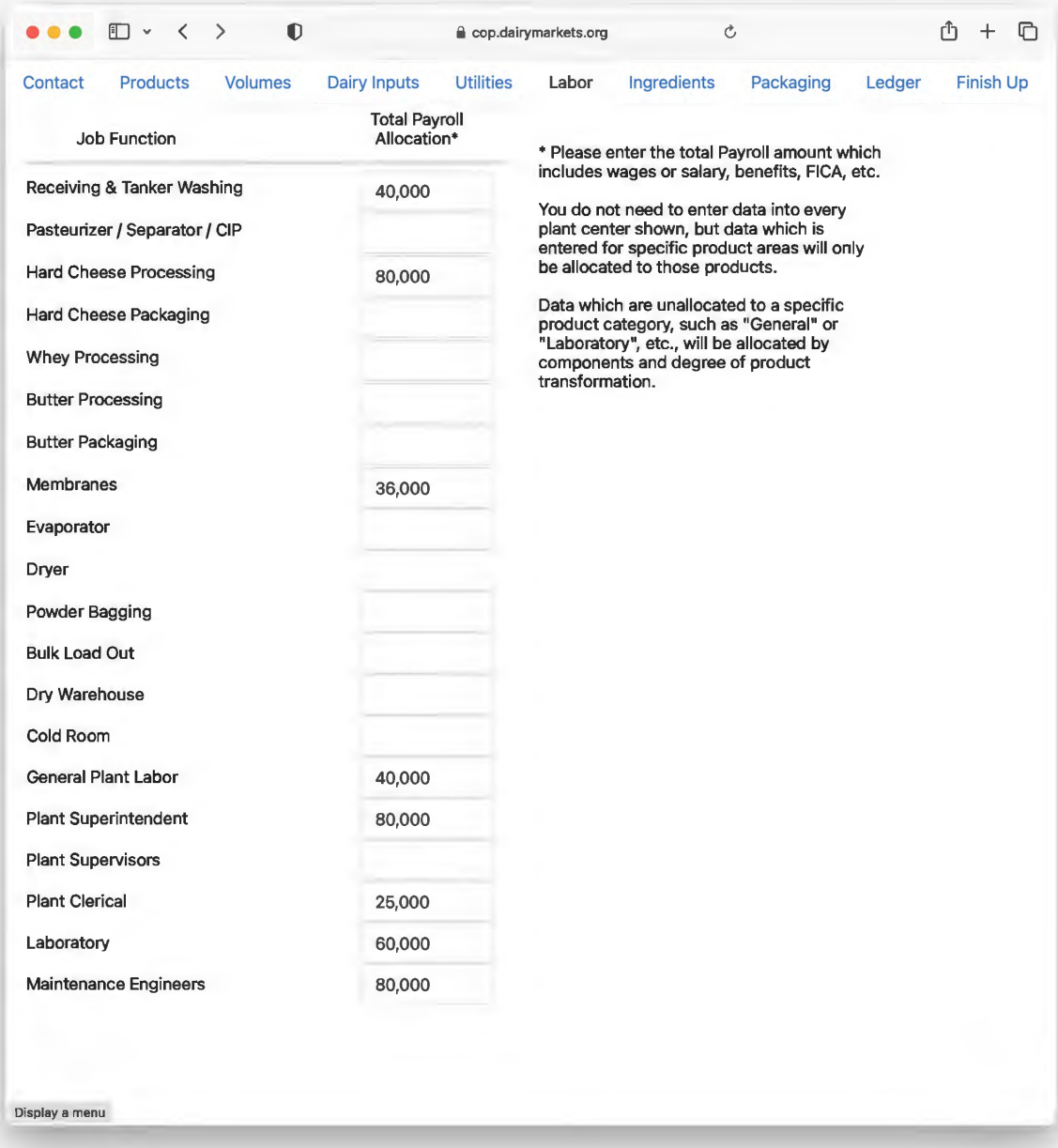

cop.dairymarkets.org
Contact
Products
Volumes
Dairy Inputs
Utilities
Labor
Ingredients
Packaging
Ledger
Finish Up
Contact Person: Mark Stephenson
Company Name: Grateful Cheese
Address1: 1234 Milky Way
Address2:
City, State, Zip: Mancelona, MI. 49659
Work Phone:
Cell Phone: 607-592-1612
eMail: mwstephenson@wisc.edu
UserName: mwstephenson
Password: ••••••••••••
What do you want to do: Edit Grateful Cheese, Jan-2...
Plant Name: Grateful Cheese
Plant Address1: 1234 Milky Way
Plant Address2:
City, State, Zip: Mancelona, MI. 49659
What is the structure of the plant's ownership: Proprietary
Display a menu

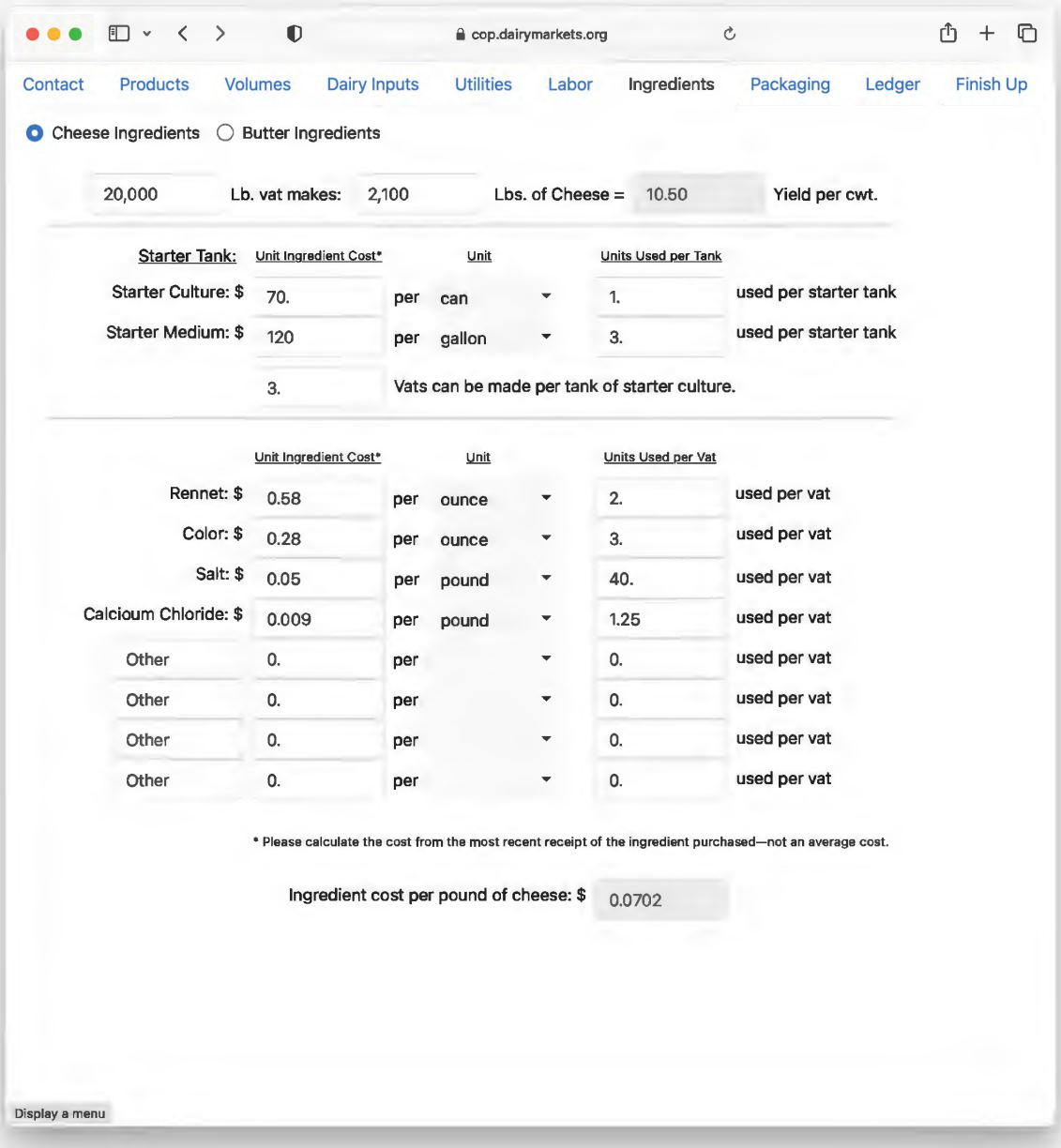

cop.dairymarkets.org
Contact
Products
Volumes
Dairy Inputs
Utilities
Labor
Ingredients
Packaging
Ledger
Finish Up
Please enter all dairy products produced in the plant. You may select product category from pulldown boxes or you may type more specific product names.
Fluid Products
Soft Products
Cheese Products
Dry Products
Cheddar Cheese
Cheddar Cheese
Mozzeralla Cheese
Other Italian Cheese
Other Cheese
Bulk Liquid Products
Concentrated Whey
Display a menu


cop.dairymarkets.org
Contact
Products
Volumes
Dairy Inputs
Utilities
Labor
Ingredients
Packaging
Ledger
Finish Up
Please choose product and enter package sizes and volume produced for from Jan-2022 through Dec-2022
Concentrated Whey
Cheddar Cheese
Concentrated Whey
Cheddar Cheese
Cheddar Cheese
Package Size
Annual Volume in Package
Month
Monthly Volume
40 lb block
48,000
0.
0.
0.
0.
0.
0.
Total Package Pounds:
48,000
Total Pounds of Butterfat Used:
20,000
Total Pounds of Solids-Not-Fat Used:
15,000
Please note: Total Package Pounds and Total Monthly Pounds should be approximately equal
Jan-2022
Feb-2022
Mar-2022
Apr-2022
May-2022
Jun-2022
Jul-2022
Aug-2022
Sep-2022
Oct-2022
Nov-2022
Dec-2022
4,000
Total Monthly Pounds:
48,000
Display a menu


cop.dairymarkets.org
Contact
Products
Volumes
Dairy Inputs
Utilities
Labor
Ingredients
Packaging
Ledger
Finish Up
Please select all of the dairy ingredients purchased for use in the plant to manufacture products.
Jan-01 Inventory
Annual Purchases
Dec-31 Inventory
Bfat Lbs
SNF Lbs
Bfat Lbs
SNF Lbs
Bfat Lbs
SNF Lbs
Raw milk
1,000
2,500
20,000
50,000
800
2,000
Skim milk
Cream
Liquid whey
Whey Cream
Buttermilk
Condensed skim
Condensed buttermilk
Condensed whey
MPC (34)
MPC (80)
Milk Protein Isolate
Nonfat Dry Milk
Skim Milk Powder
Whole Milk Powder
Anhydrous Milk Fat
Butter
Other
Display a menu


cop.dairymarkets.org
Contact
Products
Volumes
Dairy Inputs
Utilities
Labor
Ingredients
Packaging
Ledger
Finish Up
Electric Meter
Gas Meter
Add Energy Source
Utility type: Electricity
Allocation: Unallocated
Month
Monthly Cost
kWh
Jan-2022 1,000
Feb-2022 900
Mar-2022 1100
Apr-2022 1100
May-2022 1200
Jun-2022 1200
Jul-2022 1150
Aug-2022 1100
Sep-2022 1150
Oct-2022 1100
Nov-2022 1000
Dec-2022 1050
Annual Total: 13,050 0
Display a menu


cop.dairymarkets.org
Contact
Products
Volumes
Dairy Inputs
Utilities
Labor
Ingredients
Packaging
Ledger
Finish Up
Job Function
Total Payroll Allocation*
Receiving & Tanker Washing
40,000
Pasteurizer / Separator / CIP
Hard Cheese Processing
80,000
Hard Cheese Packaging
Whey Processing
Butter Processing
Butter Packaging
Membranes
36,000
Evaporator
Dryer
Powder Bagging
Bulk Load Out
Dry Warehouse
Cold Room
General Plant Labor
40,000
Plant Superintendent
80,000
Plant Supervisors
Plant Clerical
25,000
Laboratory
60,000
Maintenance Engineers
80,000
* Please enter the total Payroll amount which includes wages or salary, benefits, FICA, etc.
You do not need to enter data into every plant center shown, but data which is entered for specific product areas will only be allocated to those products.
Data which are unallocated to a specific product category, such as "General" or "Laboratory", etc., will be allocated by components and degree of product transformation.
Display a menu



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Contact | Products | Volumes | Dairy Inputs | Utilities | Labor | Ingredients | Packaging | Ledger | Finish Up

(●) Cheese Ingredients ( ) Butter Ingredients

20,000 Lb. vat makes: 2,100 Lbs. of Cheese = 10.50 Yield per cwt.

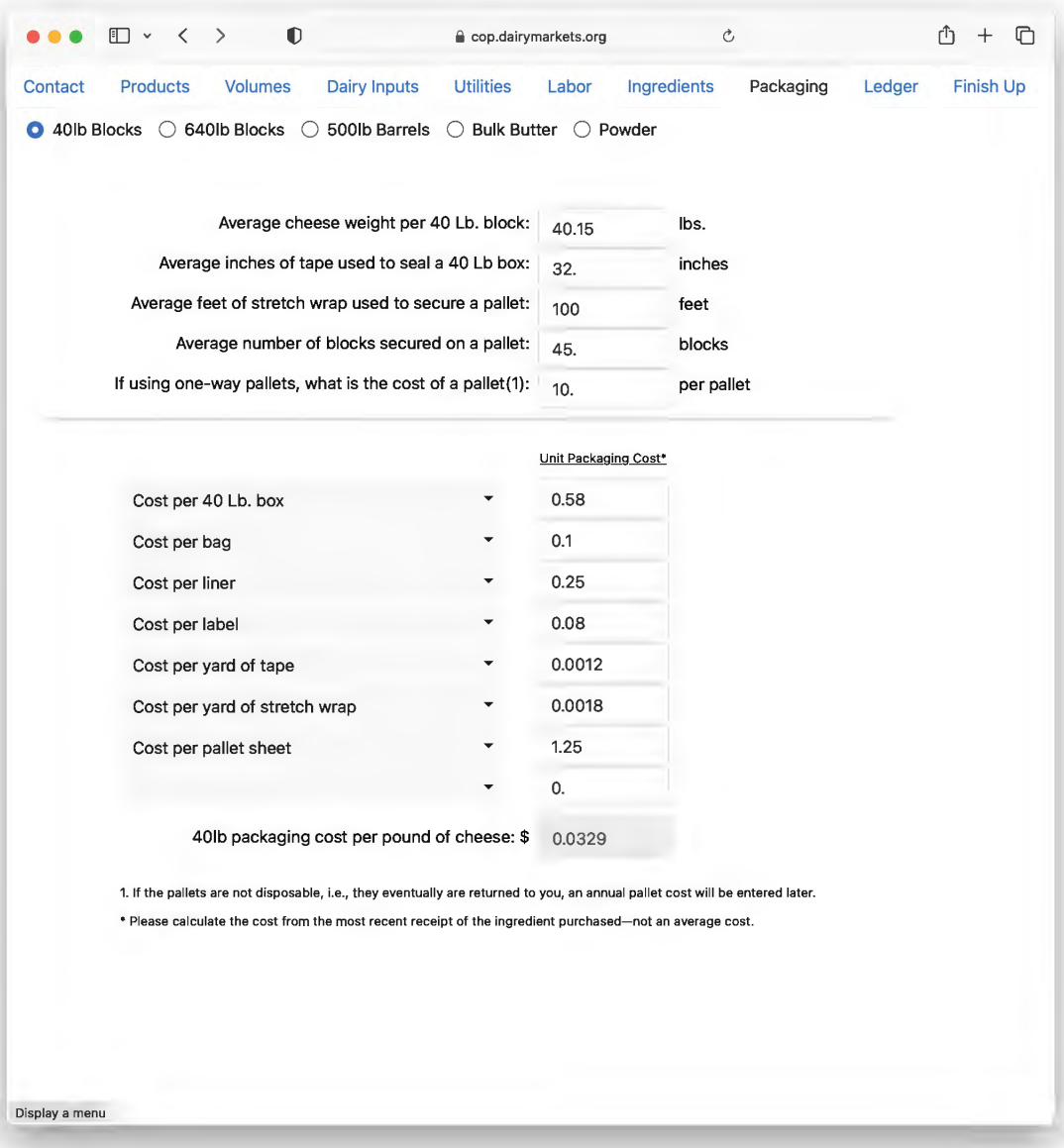
Starter Tank:	Unit Ingredient Cost*		Unit	Units Used per Tank	
Starter Culture: $	70.	per	can	1.	used per starter tank
Starter Medium: $	120	per	gallon	3.	used per starter tank
	3.	Vats can be made per tank of starter culture.			

	Unit Ingredient Cost*		Unit	Units Used per Vat	
Rennet: $	0.58	per	ounce	2.	used per vat
Color: $	0.28	per	ounce	3.	used per vat
Salt: $	0.05	per	pound	40.	used per vat
Calcioum Chloride: $	0.009	per	pound	1.25	used per vat
Other	0.	per		0.	used per vat
Other	0.	per		0.	used per vat
Other	0.	per		0.	used per vat
Other	0.	per		0.	used per vat

* Please calculate the cost from the most recent receipt of the ingredient purchased—not an average cost.

Ingredient cost per pound of cheese: $ 0.0702

Display a menu

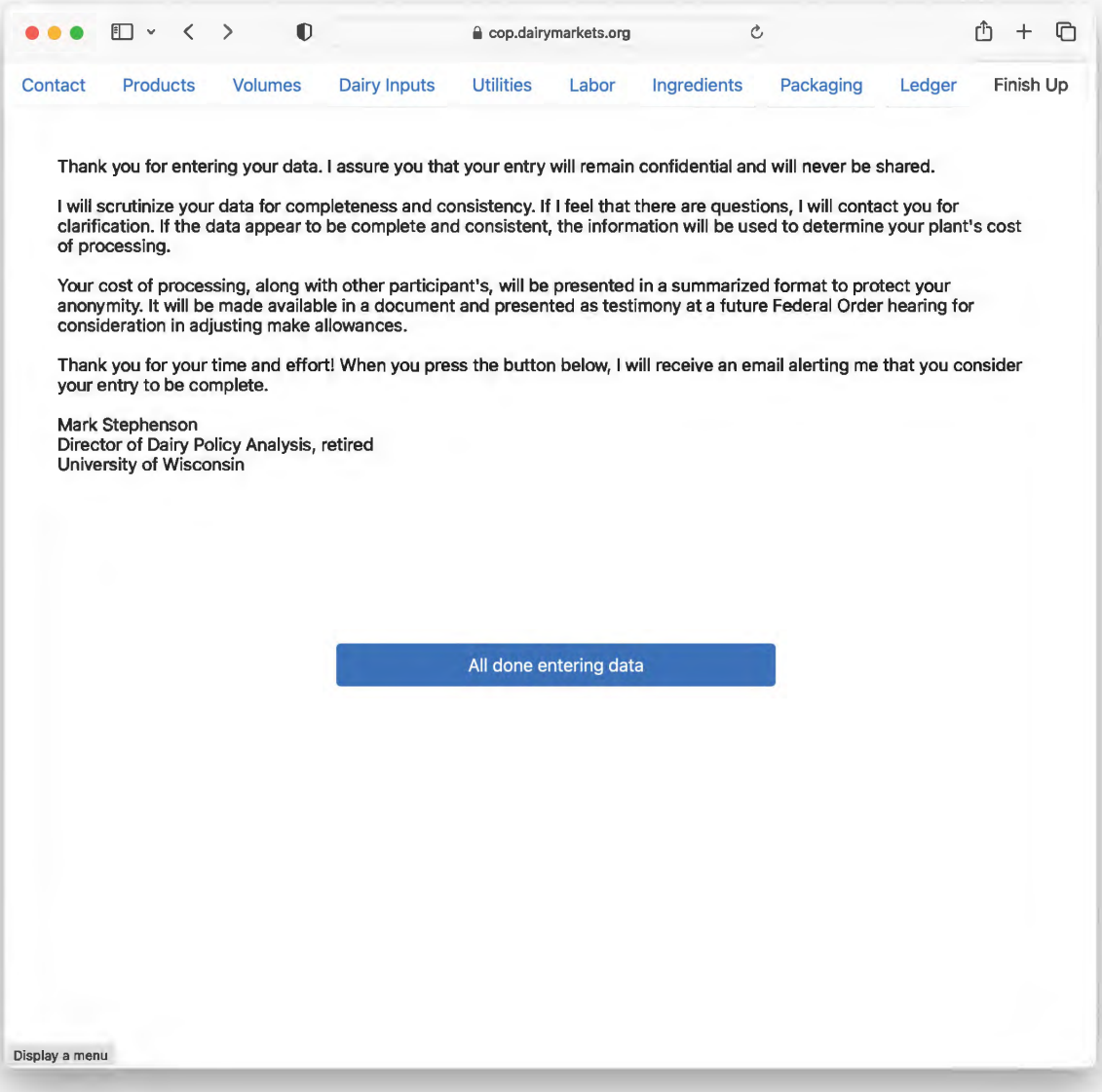

cop.dairymarkets.org
Contact
Products
Volumes
Dairy Inputs
Utilities
Labor
Ingredients
Packaging
Ledger
Finish Up
40lb Blocks
640lb Blocks
500lb Barrels
Bulk Butter
Powder
Average cheese weight per 40 Lb. block: 40.15 lbs.
Average inches of tape used to seal a 40 Lb box: 32. inches
Average feet of stretch wrap used to secure a pallet: 100 feet
Average number of blocks secured on a pallet: 45. blocks
If using one-way pallets, what is the cost of a pallet(1): 10. per pallet
Unit Packaging Cost*
Cost per 40 Lb. box 0.58
Cost per bag 0.1
Cost per liner 0.25
Cost per label 0.08
Cost per yard of tape 0.0012
Cost per yard of stretch wrap 0.0018
Cost per pallet sheet 1.25
0.
40lb packaging cost per pound of cheese: $ 0.0329
1. If the pallets are not disposable, i.e., they eventually are returned to you, an annual pallet cost will be entered later.
* Please calculate the cost from the most recent receipt of the ingredient purchased—not an average cost.
Display a menu

cop.dairymarkets.org

Contact | Products | Volumes | Dairy Inputs | Utilities | Labor | Ingredients | Packaging | Ledger | Finish Up

General Ledger Account	General Plant (Unallocated)	Cheese Products	Butter Products	Powder Products	Bulk Products
Market Value of Assets	1,500,000	0	0	0	0
Depreciation	80,000	0	0	0	0
Property Taxes	4,000	0	0	0	0
Water, Garbage & Sewage	2,500	0	0	0	0
Whey Disposal	60,000	0	0	0	0
Outside Storage	0	0	0	0	0
Grading	0	0	0	0	0
Inspection	0	0	0	0	0
Pallet Expense (if owned)	0	0	0	0	0
Travel & Entertainment	0	0	0	0	0
Telephone	0	0	0	0	0
IT Expense	0	0	0	0	0
Insurance	0	0	0	0	0
Laundry	0	0	0	0	0
Taxes & Licenses	0	0	0	0	0
Equipment Rental	0	0	0	0	0
Cleaning Supplies	0	0	0	0	0
Laboratory Supplies	0	0	0	0	0
General Supplies	0	0	0	0	0
Repair & Maintenance	0	0	0	0	0
Third Party Testing	0	0	0	0	0
Dues & Subscriptions	0	0	0	0	0
Postage	0	0	0	0	0
Miscellanous	0	0	0	0	0
Advertising & Promotion	0	0	0	0	0
Fees & Assessments	0	0	0	0	0
Professional Services	0	0	0	0	0
Legal & Accounting	0	0	0	0	0
Headquarters Expense	0	0	0	0	0
Short-term Interest Expense	0	0	0	0	0

Display a menu


cop.dairymarkets.org
Contact
Products
Volumes
Dairy Inputs
Utilities
Labor
Ingredients
Packaging
Ledger
Finish Up
Thank you for entering your data. I assure you that your entry will remain confidential and will never be shared.
I will scrutinize your data for completeness and consistency. If I feel that there are questions, I will contact you for clarification. If the data appear to be complete and consistent, the information will be used to determine your plant's cost of processing.
Your cost of processing, along with other participant's, will be presented in a summarized format to protect your anonymity. It will be made available in a document and presented as testimony at a future Federal Order hearing for consideration in adjusting make allowances.
Thank you for your time and effort! When you press the button below, I will receive an email alerting me that you consider your entry to be complete.
Mark Stephenson
Director of Dairy Policy Analysis, retired
University of Wisconsin
All done entering data
Display a menu

Appendix B—Recent Monthly Values for Moody's Baa Corporate Bond Index

Table 8. Interest Rate on Moody's Baa Corporate Bond Index.

Date	Percent Annual Rate
Jan-2020	3.77
Feb-2020	3.61
Mar-2020	4.29
Apr-2020	4.13
May-2020	3.95
Jun-2020	3.64
Jul-2020	3.31
Aug-2020	3.27
Sep-2020	3.36
Oct-2020	3.44
Nov-2020	3.30
Dec-2020	3.16
Jan-2021	3.24
Feb-2021	3.42
Mar-2021	3.74
Apr-2021	3.60
May-2021	3.62
Jun-2021	3.44
Jul-2021	3.24
Aug-2021	3.24
Sep-2021	3.23
Oct-2021	3.35
Nov-2021	3.28
Dec-2021	3.30
Jan-2022	3.58
Feb-2022	3.97

Date	Percent Annual Rate
Mar-2022	4.29
Apr-2022	4.66
May-2022	5.12
Jun-2022	5.27
Jul-2022	5.21
Aug-2022	5.15
Sep-2022	5.69
Oct-2022	6.26
Nov-2022	6.07
Dec-2022	5.59
Jan-2023	5.50
Feb-2023	5.59
Mar-2023	5.71
Apr-2023	5.53