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LBNL Report

User's Manual for BEST-Dairy:

Benchmarking and Energy/water-Saving Tool
(BEST) for the Dairy Processing Industry
(Version 1.2)

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**User’s Manual for BEST-Dairy (V1.2):
Benchmarking and Energy/water-Saving Tool (BEST)
for the Dairy Processing Industry**

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ABOUT THE USER'S MANUAL

This User's Manual summarizes the background information of the Benchmarking and Energy/water-Saving Tool (BEST) for the Dairy Processing Industry (Version 1.2, 2011), including "Read Me" portion of the tool, the sections of Introduction, and Instructions for the BEST-Dairy tool that is developed and distributed by Lawrence Berkeley National Laboratory (LBNL).

BEST-DAIRY BENCHMARKING TOOL - READ ME

This BEST-Dairy benchmarking tool (V1.2, 2011) is developed for industrial users to compile data on energy and water usage in their own dairy processing plants, and to compare the efficiency levels with those of best references.

The BEST-Dairy allows a user to calculate energy and water use intensity and obtain a benchmarking score(s) for the selected plant, as compared with the best available references that we have identified from literature search nationally and globally. With the best references as the baseline, a higher benchmark score normally means higher savings potential from future efficiency improvement in your plant. The BEST-Dairy is intended to serve as a quick assessment of relative energy and water efficiency, which may also help to identify potential savings opportunities in the plant and processes. Users of the BEST-Dairy are advised that additional information and evaluation of the technologies be needed when considering system upgrades. Sometimes a benchmarking score cannot be calculated because of unavailability of best reference data for certain processes or dairy products.

If you are first-time user of the BEST, it is recommended that you read the "Introduction" and "Instruction" sections before "Start BEST." When you are ready, simply click the button of your choice in the top box to go to the intended section.

INTRODUCTION

California's dairy processing industry is primarily comprised of four segments: fluid milk, butter, cheese, and powder milk products. According to the California Department of Food and Agriculture (CDFA 2006; 2009) and the California Milk Advisory Board (CMAD 2008), California has been the nation's largest milk producer since 1993, followed by Wisconsin, New York, Pennsylvania, and Idaho. With the increasing economic and environmental pressures and consequences of increased energy and water usage in California, making energy and water efficiency improvement will be an essential part of the business for dairy processing sectors.

Benchmarking is a useful tool for gathering data and understanding energy and water consumption patterns in dairy-processing plants and for designing potential programs and policies to improve energy and water efficiency. Energy and/or water benchmarking allows energy and/or water performance of an individual plant or an entire sector of similar plants to be compared against a common metric that represents "standard" or "optimal" performance. It may also allow comparisons of the energy and/or water performance of a number of plants with each other.

Benchmarking Energy/Water Savings Tool (BEST) for the Dairy Processing, or BEST-Dairy (version 1.2), is developed and distributed by Lawrence Berkeley National Laboratory.

In this BEST-Dairy tool, energy (or water) intensity is calculated to measure energy (or water) use per unit of output (e.g., fluid milk, cheese, butter, milk powder), or sometimes per raw milk input. While benchmarking provides insights into the relative energy and water performance of the plant, it is also a good starting point for analysis of additional improvement opportunities. With funding support from California Energy Commission, LBNL has developed this BEST-Dairy tool for the four dairy processing sectors. For each dairy product, the BEST-Dairy tool is designed to provide users with three options to accommodate their benchmarking needs and availability for actual data: 1) plant level; 2) process-block level (i.e., grouping certain process steps into one block); and 3) process-step level. The major advantage of including process-step and process-block level is that the key process steps can be identified and performance comparisons can be performed for each step or block.

This BEST-Dairy tool requires the user to compile and input a cumulative of 12-month energy and water use data gathered for a dairy processing plant (including individual processes or process blocks). An embedded software calculator is included in the BEST-Dairy tool for your use of energy and water unit conversion. The BEST-Dairy tool allows the user to evaluate savings potentials from possible energy and water efficiency improvements. In addition, BEST-Dairy also provides the capability of assessing cost-saving potential compared to reference cases. The information produced from the tool can help the user in developing an implementation plan to achieve savings in energy and water use in dairy plants.

After the required cumulative 12-month data is input into the BEST Dairies, the energy and water performance of your dairy plant or processes is then compared to a reference counterpart representing best references. The benchmarking scores of your dairy processing will be calculated and expressed as an Energy Intensity Indicator (EII). EII values are unitless relative

values based upon the reference benchmarks that represent best available references, which are identified through extensive literature reviews and analysis in our study. A benchmarking score is normally expected to exceed 100 points, with a higher benchmarking score representing bigger energy and water savings potential in your plant or processes. If you obtain a benchmarking score lower than 100 points, this means that your dairy plant/process is probably more efficient than the ones that we have identified as best available reference (globally or regionally). Pending the data availability of best references, benchmark scores for some process steps or process blocks may not be always computable and will be shown as "-" instead. In any case, the tool developer (LBNL) is appreciative if you can share your benchmark data for consideration for formulating a reference point for future inclusion in the tool. We expect such a reference point can evolve over time if more data is made available.

Note: If you would like to contribute your data for developing new best practice reference points, simply save the BEST-Dairy Excel workbook as an Excel file after you input all data, and email the file to TTXu@LBL.Gov. Your data will be kept confidential.

The BEST-Dairy (V1.2) tool has been developed by Lawrence Berkeley National Laboratory (LBNL), with research funding support of the California Energy Commission (CEC). LBNL is a research laboratory of the U.S. Department of Energy managed by the University of California. LBNL develops free tools and studies to reduce the environmental impact of energy and water use. The BEST-Dairy is free to public.

INSTRUCTIONS

The BEST-Dairy (V1.2) tool allows you to evaluate the energy and water efficiency of your dairy processes by benchmarking energy and water intensity against a known reference dairy processing. The reference dairy process is based on existing and proven practices and technologies identified either from open global literatures or proprietary information with anonymous identity (Xu et al. 2009a; 2009b, 2011). The reference dairy process is deemed to emulate the processing of the same or similar dairy products using the characteristics that you enter for your dairy process; however, with the highest efficiency identified so far. The comparisons of the energy intensity of your dairy process to that of the reference dairy processes will provide a benchmark score, called the Energy Intensity Index (EII).

The benchmark score values can be used to indicate relative performance of your dairy process compared to the most efficient process identified from LBNL studies based upon extensive literature research. For example, a score value of 100 means that the energy or water intensity level of your dairy process is in par with the most efficient process identified, and a score value over 100 means that the energy or water intensity level of your dairy process is higher than the most efficient ones identified so far, corresponding to a lower efficiency level. By the same token, if you achieve a benchmark score under 100, that means your plant or processes are less energy (or water) intensive than the one that has been identified to be the least energy (or water) water intensive.

The outcomes from comparisons may become a basis for you to evaluate savings potential and to consider future improvements.

Applicability

BEST-Dairy is designed for typical dairy processors that produce common cheese, fluid milk, butter, milk powder, and additional dairy products.

Computer Requirements

BEST-Dairy is designed for use in MS Excel using a PC with Windows 2000 or Windows XP. Compatibility with Mac computers is not known. BEST Dairy is an MS Excel file that uses macros to carry out many of the calculations and to make the program more user-friendly.

After opening the original BEST-Dairy file, you may save the BEST-Dairy file with a different file name on your computer.

Using BEST-Dairy (V1.2)

This BEST-Dairy tool is an Excel workbook consists of a number of worksheets. Users are expected to have knowledge of typical dairy processes, and provide production and energy (water) data for a 12-month period in the input spreadsheets. The data supplied by the user will then be used for calculations throughout the workbook.

Important Note to the User: BEST Dairy uses macros to carry out many of the calculations and to make the program more user-friendly. During the process of opening a file, some versions of

Excel ask whether the user wants to enable or disable macros, while others may automatically disable macros through a security setting. In order to use BEST Dairy, the user must enable macros. If no dialogue box appeared asking you to enable or disable macros, select Tools --> Macro --> Security and click on medium or low. If medium security is chosen, every time BEST Dairy is opened, a dialog box will appear asking the user if macros should be enabled or disabled.

After completing input into a worksheet, you will be automatically transferred to the next worksheet by pressing "Next" button on the worksheet. You can go back to the previous worksheet by pressing "Previous" button. In the following, we will walk through the worksheets of BEST-Dairy step-by-step.

It's recommended that you save the file after completing all the input.

Main Sheet

In "Main" worksheet, important "Read Me" information is provided for you to familiarize with the BEST-dairy tool. From the "Main" sheet, you can open the "Introduction" and "Instruction" sheets to obtain more useful information about the BEST-Dairy tool by clicking the selected buttons.

If you are familiar with BEST-Dairy tool, you can directly press "Start BEST" button to start the benchmarking input.

Introduction Sheet

The "Introduction" worksheet provides a brief introduction to the BEST tool. After you read the introduction, press the "Return to Main" button to go back to the "Main" worksheet.

Instructions Sheet

The "Instructions" worksheet provides more detailed instructions for how to use BEST-Dairy tool. After you read the instructions, you can press the "Return to Main button" to go back to the "Main" worksheet. You can access to the "Instructions" worksheet anytime during the benchmarking by returning to the "Main" worksheet first and then press the "Instructions" button.

References Sheet

The "References" worksheet provides all references used in BEST-Dairy. After you read the references, you can press the "Return to Main" button to go back to Main sheet.

Product Selection Sheet

BEST-Dairy tool allows independent benchmarking activities for four types of dairy processes, i.e., fluid milk, cheese, milk powder, and butter. User should choose one of the products from this worksheet by pressing one of the product buttons provided on this product selection sheet.

If you have completed benchmarking for one of the four product types, and wish to benchmark for another new product type, you can choose to open a new BEST-Dairy file, or choose to come

back to this worksheet and select the new product to continue. The BEST-Dairy file is designed to store and calculate all the data that you've input.

If you have more than one plant making the same dairy product, you should create a different BEST-Dairy file for each of the plants.

After pressing one of the product selection buttons, you will be entering a new dairy-processing benchmarking worksheet, named as "Selection-[product name]."

Benchmarking Level Selection Sheet

For each dairy product, BEST-Dairy provides three assessment options for you to choose, based on your benchmark need and your data availability. In the "Selection-[product name]" worksheet, you will be asked to select from one of the three options:

(1) Plant Level Assessment: This is the most common (and easiest) benchmark to perform, especially when you don't have energy and water data per process step or block.

(2) Process-block Level Assessment: This will be a more detailed benchmark (than plant-level benchmark) to perform. Data input is for block-level assessment, especially when you have access to more energy data details than plant level, but don't have individual process-step energy data.

(3) Process Level Assessment: This is the most detailed (but often most challenging) benchmark to perform, for individual process steps. Data input requires that you have access to detail energy data for each process step.

After pressing one of the three options provided, you will be entering a new worksheet for data input, named as "Input - [product name & level]."

Input Sheet

In the Input sheet, you are required to enter all essential information to enable effective energy and water benchmarking in your dairy plants and/or processes.

Important Note #1:

Only fill in the yellow cells! Cells with other colors are calculated values from input data.

Important Note #2:

This BEST-Dairy tool adopts metric units in input and all benchmark calculations. For your convenience, we have developed a "Unit Conversion Calculator" for your use to convert US customary units to metric units. The "Unit Conversion Calculator" is available for use on the "Input" worksheet. Simply click "Unit Conversion Calculator" on the top right of the "Input" worksheet, select the parameters (Energy, Mass, Volume) of your choice and convert your raw data into required unit for manual input to the yellow cells on the "Input" worksheet.

(1) You will need to enter the annual production in your dairy plant. Note that the input should be a cumulative value for a 12-month period. The input should be based on actual production, not the entire capacity of your dairy plant. For "Process Level Assessment" or "Process-block

Level Assessment," the annual product volumes in the plant should correspond to each individual process step or each process-block.

(2) You will need to fill in the annual energy end use categorized by electricity and fuel types, as well as water usage. The cumulative energy and water end use data should be for a 12-month period that is consistent with the production data. For "Process Level Assessment" or "Process-block Level Assessment," the annual energy and water end use input should correspond to each individual process step or each process-block.

(3) If you input energy and water price information, this BEST tool can help you to assess potential energy cost savings from improving your system efficiency, using best practice benchmarks as the reference. You may skip this portion (e.g., its yellow cells) if you don't have price data to enter.

(4) After you fill in all the yellow cells in this worksheet, save your file then press "Next" button located on the top of the "Input" Worksheet. You will be entering a new worksheet named as "Results-[product name] plant/block/process."

Results Sheet

The "Results" worksheet for plant level assessment:

The "Results-[[product name] plant" worksheet presents the overall benchmarking scores, i.e., Energy Intensity Index (EII), for your dairy plant.

In addition, this worksheet also includes the actual energy/water use intensity that is calculated automatically based upon your input data.

The worksheet has included a reference plant's energy/water use intensity obtained from literature research and analyses - When such data is available, it is categorized into three groups to represent best practices (international, USA, and California).

Both actual data from your dairy plant/process and the reference plant/process data have been used to calculate your plant's benchmarking scores (EII). The EII is a unitless value comparing the total production energy intensity of your dairy with that of the reference-plant's energy/water use intensity (the reference plant can be on international, USA, or California levels). In addition, BEST-Dairy tool generates estimation of technical energy/water saving potential and the associated cost savings in your dairy plant. In another word, BEST Dairy provides an estimate of the potential for annual energy savings, energy costs savings, water savings, and water cost savings if your dairy would perform at the same performance level as the "reference" dairy plant pre-defined by the tool.

Note that Although SI units were required for input, the output data in "Results-[product name] plant" worksheet is presented in both SI and IP units for easy understanding.

Normally the benchmarking scores should be expected to be over 100 points. A higher score indicates greater savings potential in your dairy plant. A score lower than 100 points indicates that your plant is less energy intensive compared with the least energy intensive dairy that we have found by the time this BEST-Dairy tool is completed. Sometimes, no score can be given because of unavailability of reference data by the time this BEST-Dairy tool is completed.

Plant level assessment ends at this worksheet. Make sure to save the Excel file for your own record.

The "Results" worksheet for process-block and process level assessment:

The "Results-[product name] block/process" worksheet for process-block or process level assessment will first generate a Result page, named "Results-[product name] block/process" that will show overall benchmarking scores, EII, and technical savings potential for energy and water use, similar to the outcomes for plant level assessment. For more detailed assessment, please press the "Detailed Benchmarking Scores" button on the top of worksheet to enter detailed benchmarking results worksheet, named "Detailed-[product name] block/process."

Detailed Benchmarking Score Sheet

The detailed benchmarking sheet, named "Detailed-[product name] block/process," will show the Energy Intensity Index (EII) for each process step (for process level benchmarking) or process-block (for process-block level benchmarking). Once the actual energy intensity and benchmark energy intensity of each process step or process block have been input and calculated, they are used to calculate the detail EII values corresponding to individual process or process-block. The EII is a measurement of the production energy intensity of your dairy process step or process block compared to reference energy intensity. The detailed benchmarking scores - EII can be used to gauge energy-savings potential of each process step or process block.

Process-block or process level assessment ends at this worksheet. Make sure to save the Excel file for your own record.

For questions, comments, and contributions, please contact

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