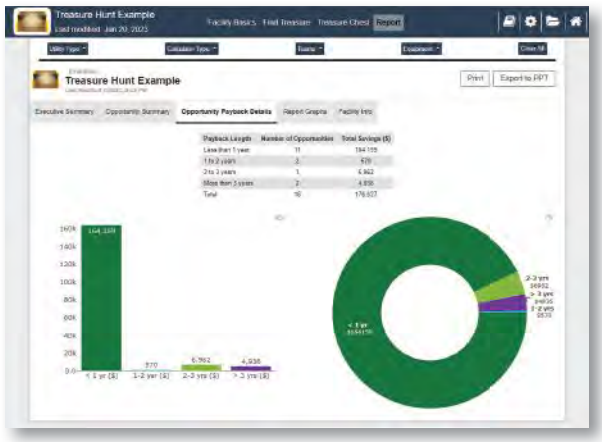
MEASUR UP

IDENTIFYING OPPORTUNITIES IN A FACILITY

BY KRISTINA ARMSTRONG, ALEX BOTTS & THOMAS WENNING

The commercial and industrial sectors account for nearly half of the total U.S. energy consumption. To help these sectors reduce their energy intensity, the U.S. Department of Energy (DOE) designed the Better Buildings, Better Plants Initiative. Through this initiative, more than 900 industrial, commercial, public and residential organizations commit to long-term sustainability goals and share their proven energy efficiency strategies, which inspire others to tap into the continued potential for energy efficiency. Collectively, these organizations have saved 2.5 quadrillion BTUs of energy, equivalent to US$15.3 billion, and 155 million metric tons of carbon dioxide. Within the initiative, the Better Plants side of the program focuses specifically on the industrial sector. More than 270 industrial partners have taken advantage of the unique selection of resources offered including workforce development programs, information sharing, peer-to-peer networking, diagnostic tool loans and software tools. One of the most powerful tools offered is a revitalization of the legacy DOE software tools used by industry for decades. These have been transformed into a new, free, open-source software tool suite: MEASUR (Manufacturing Energy Assessment Software for Utility Reduction).

MEASUR helps facility and energy management teams identify, assess, and quantify energy and decarbonization opportunities in their energy intensive systems including motors, pumps, fans, process heating, steam and compressed air. MEASUR also includes a module for energy treasure hunts — organized events to find low-to-no cost savings opportunities. The software is separated into two main categories: calculators and assessment modules. There are more than 70 standalone calculators, most requiring only a few inputs. While quick and simple, these calculators are based on engineering principles and used as a great place to start to find savings or used as reference calculations.



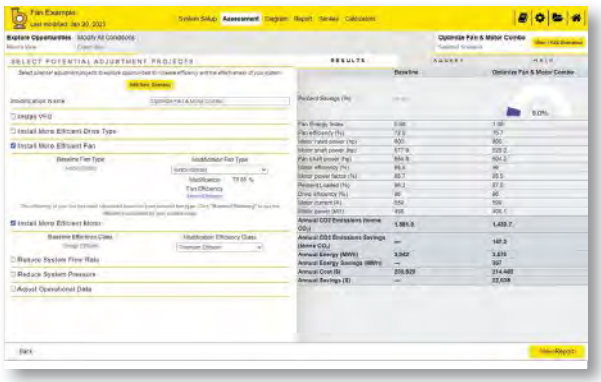
Alternatively, the assessment modules are much more in-depth than the calculators and produce a more thorough analysis but require much more data and measurements on the front end. There are two additional modules: the motor inventory module and the data explorer. Motor inventory allows users to catalog all the motors in a facility, provides aid in creating visualizations of the inventory, and helps with rewind/replace analysis. The data explorer allows users to manipulate large scale data sets (usually sensor data) and manipulate them to create day type averages and data visualizations.

MEASUR is used by the Better Plants Program in its workforce development programs: In-Plant Trainings (INPLT) and Virtual In-Plant Trainings (VINPLT). Attendees are trained in conducting energy assessments and using MEASUR to help estimate their savings. The VINPLTS can be viewed online and cover energy support systems, wastewater, drinking water and ammonia refrigeration. While MEASUR was originally intended for industrial facilities, there is plenty of overlap with the commercial sector, especially in larger buildings. Most industrial and commercial facilities do not have a full-time dedicated energy manager to conduct energy assessments and often do not have the in-house expertise to estimate savings from energy efficiency projects. MEASUR can help users (like energy, facility and maintenance managers) become more self-reliant in these tasks before seeking outside consultants for more in-depth engineering analysis.

SYSTEM LEVEL ASSESSMENTS

The assessment modules are the heart of the tool, but they are also the most data-driven and user-involved portions of the software. The assessments allow users to model their equipment and systems from their facilities by using the foundational energy assessment process. Each assessment module starts by asking users to enter basic facility

information (such as utility cost or system operating hours), followed by relevant operational and measured data about the systems or equipment's operation. MEASUR takes this data and provides the estimated annual baseline consumption results.



Next, in the assessment portion of the module, users create what-if scenarios by modifying the baseline system. Users can create and compare multiple scenarios to determine which projects will have the biggest impact on their facility. Within most of the assessments, there are two scenario modes: expert and novice. The expert view shows the baseline and what-if scenario side by side, allowing users to directly change and compare the new scenario. Here, the tool has visual cues to help quickly see what has been changed in each scenario, such as color-changing badges and field highlighting. In the novice view, MEASUR provides a list of common potential energy reduction opportunities and shows only the fields relating to those opportunities. As inputs change, MEASUR immediately displays the effect on the total energy use and cost in the results panel. Each assessment concludes with a report summarizing the possible estimated savings the user has explored, in terms of energy, cost and carbon emissions. In the report tab, users can select the specific report sections that they care about most for printing or copying to other platforms, shifting the focus to what is most important to their management. Additionally, the results provide multiple graphs and tables that can be copied into proposals or presentations.

Among the assessment modules, Treasure Hunt is unique: it focuses on identifying and quantifying low-to-no cost savings opportunities in a facility regardless of system. An Energy Treasure Hunt (sometimes referred to as a Kaizen) is often performed as an on-site, multi-day event engaging cross-functional teams of employees to find low-to-no cost operational and maintenance energy opportunities. The Treasure Hunt module was designed to support these events using small calculators to estimate savings from these proposed projects, such as improving insulation, turning off equipment (the Reduction calculators) and lighting system overhauls.

One key difference in the Treasure Hunt is the Opportunity Sheet. During the event, these Opportunity Sheets are used to enter data relating to the implementation of the project (costs, individuals responsible, difficulty of implementation). This allows MEASUR to estimate important information for project approval, like total cost and payback period. Projects are stored in the "Treasure Chest" and the outcomes can be reviewed in the Results tab. Finally, the module can produce a report and a PowerPoint that can be used at the management debrief segment of the event. In addition to being utilized by the Better Plants program, Energy Treasure Hunts are also part of the Federal Energy Management Program (FEMP) toolbox for reducing energy use in government facilities.

QUICK AND EASY CALCULATORS

For quick calculations, MEASUR offers more than 70 calculators for various energy systems, plus decarbonization and general engineering reference. The calculators require fewer inputs than the assessments but are a great alternative for users who need quick estimates and do not need the full details in the assessments. Several of these calculators use industry-accepted rules of thumb and others are based on first-principles engineering calculations. Each of these calculators features a Generate Example button that allows the user to see the calculators in action without entering data.

While geared toward industrial energy management, there are many calculators that are applicable to commercial facilities, depending on the building size and use.

- **FANS** | Calculators for performing fan traverse analysis (using a pitot tube) and creating a modified fan curve
- **LIGHTING** | Calculator to estimate the savings from installing more efficient lighting systems
- **MOTORS** | Several calculators including estimating part-load current, efficiency and power factor, and estimating savings from improving motor drive
- **PUMPS** | Calculators for estimating developed pump head and creating a modified pump curve
- **COMPRESSED AIR** | Many calculators including estimating the impacts of pressure reduction, pipe sizing, system capacity and more
- **WEATHER BINNING** | Uses typical meteorological year data to build weather profiles for use in chiller calculators or externally
- **PROCESS COOLING** | Several calculators for understanding the impact of chiller staging or chiller operating parameters on energy use, estimate basin heater or cooling tower fan energy consumption, and cooling tower water consumption
- **ELECTRICITY AND NATURAL GAS REDUCTION** | Calculators from the Treasure Hunt Toolkit to help estimate annual savings from minor changes to electrical or natural gas equipment

DATA AND FILE MANAGEMENT

MEASUR offers easy and secure data management. For both the downloaded and online versions, data from MEASUR assessments are stored on your computer, not on someone else's server, so data privacy concerns are minimal. Data relating to your page views are shared with the MEASUR team to improve the user experience; but none of the data entered into the tool is shared or sent.

Within the tool, the files are stored in the dashboard, where users create folders and move, copy and delete assessments. Additionally, the dashboard is where users can export assessments (to send to other MEASUR users) and import MEASUR files from others. The dashboard also provides a place to specify general facility information (such as name, location) and to specify folder-wide settings that set certain defaults for any assessments made from within that folder, so they do not have to have changed every time a new assessment is created.

TOOL GUIDANCE

MEASUR is designed to be easy to navigate, with quick navigation links and a standardized flow within the assessment modules. Every page and data field has specific help text to assist users. The help text can feature common ranges for entry values, links to further references or diagrams explaining how to find the data. Some data fields that are not directly measurable, or that may not be easily determined, have additional mini calculators that can automatically perform a calculation with already provided data or provide a pop-up window for the calculation.

To reduce the chances of entering incorrect information, most fields have input validation, providing messages notifying if the input data is too far off the expected or allowable range. These could be yellow (where MEASUR still calculates results) or red (where the value is too far off and will stop any calculations). MEASUR also integrates visual cues in the navigation bar when errors in the form exist or to indicate that a value is different from the baseline.

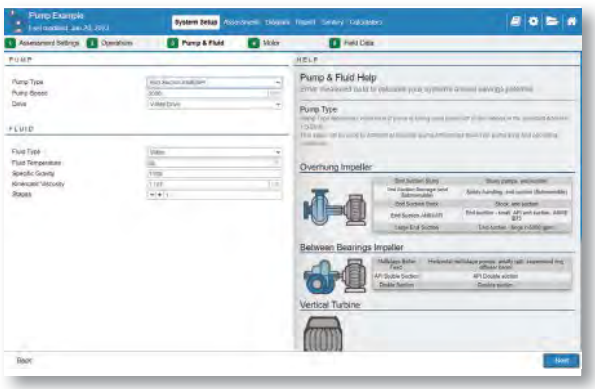
AVAILABLE INTERNATIONALLY

MEASUR is not limited to use in the United States. Additional features include the ability to switch units before and after data has been entered (with the option to automatically convert any fields that have been filled in). Google Translate is also integrated into MEASUR to help international users navigate the tool. This allows MEASUR to positively impact energy efficiency and carbon emission reduction efforts globally.

MANAGE WITH MEASUR

MEASUR helps energy and facility managers understand their energy use, quantify potential savings and improve their system efficiency. MEASUR walks users through understanding what data they need, performing energy efficiency calculations and setting up what-if scenarios to explore savings opportunities. This allows facilities without in-house energy experts to quickly estimate the savings from possible projects and know if the projects are viable before hiring outside consultants.

MEASUR is free, open-source and operates on all major operating systems and online. MEASUR can even be used on mobile devices, allowing users to start entering data while visiting the equipment. FMJ



ADDITIONAL RESOURCES

measur.ornl.gov

betterbuildingssolutioncenter.energy.gov

betterbuildingssolutioncenter.energy.gov/better-plants/energy-treasure-hunts

bptraining.ornl.gov

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