Executive Summary

The U.S. Department of Energy's (DOE) Better Buildings, Better Plants Program and Challenge helps secure American innovation and manufacturing competitiveness. Across the country, Better Plants partners are reducing energy costs to strengthen their productivity, create jobs, and increase their resiliency. Partners now represent roughly 12 percent of the U.S. manufacturing energy footprint and have reported estimated cumulative energy cost savings of $4.2 billion over the last seven years (see Figure 1).[1]

Better Plants partnerships can help drive greater benefits and a stronger, more secure U.S. industrial base. A recent study shows industrial energy efficiency savings potential on the order of 7,500 TBtu between 2016 and 2035, or the rough equivalent of $35 billion at current energy prices.[2] Through Better Plants, partners voluntarily set a specific goal, typically to reduce energy intensity by 25 percent over a 10-year period across all their U.S. operations. Organizations may also take the higher-level Better Plants Challenge and demonstrate their leadership by publicly sharing energy performance data and solutions—in addition to setting an energy-saving goal—so that many more companies can see a pathway to improved competitiveness.

Last year, four Challenge partners and four program partners achieved their energy savings goals (see page 6). This brings the total of goal achievers to 43 over the past four years, meaning more than 20 percent of all partners have met their ambitious energy saving goals. Moreover, 15 goal-achieving partners have doubled-down on success, re-pledging in the program with a new, ambitious goal (see Figure 2). One of these Challenge partners, Celanese Corporation, a Fortune 500 chemicals and advanced materials manufacturer from Irving, Texas, actually met its second goal after meeting its first goal in 2014.

Over the past year, DOE welcomed twelve program partners and five Challenge partners, bringing the total number of partners committing to improving energy performance to 190. The program has also added new resources and advanced new ways to share partner successes:

- New Better Practice and Better Project awards were introduced in 2017 for exceptional energy-efficiency solutions (see page 7).
- The Field Validation and Diagnostic Equipment Program was created to facilitate data analysis and measurement among partners (see page 8).
- Better Plants supported DOE's mission to translate early-stage innovation at the National Laboratories to the private sector through a Technology Day at Oak Ridge National Laboratory (see page 9).
- Two new In-Plant Training topics – water/wastewater treatment and energy treasure hunt exchanges – are helping to train America's manufacturing workforce for the future (see page 10).

Figure 1: Better Plants Snapshot, September 2017

Partnership Size	Total
Number of Partner Companies	190
Approximate Number of Facilities	2,900
Percent of U.S. Manufacturing Energy Footprint	11.7%
Reported Savings through 2016	
Cumulative Energy Savings (TBtu)	830
Cumulative Cost Savings (Billions)	$4.2
Average Annual Energy-Intensity Improvement Rate	3.1%

Figure 2: Goal Achievers Committing to a New Pledge

Saving Energy, Driving Competitiveness

Combined, Better Plants partners represent workers at roughly 2,900 facilities located in all 50 states, Puerto Rico, and Washington, D.C. Better Plants partners are also representative of the breadth and dynamism of the U.S. industrial sector, with water and wastewater treatment agencies and recognizable brands like **Bridgestone Americas, Campbell Soup Company**, **General Mills**, **General Motors, Harley-Davidson**, and **Johnson & Johnson**. Fourteen partners are members of the Fortune 100, the largest U.S. corporations by gross revenue.

Better Plants partners' energy efficiency leadership is paying off with real results. The estimated cumulative energy cost savings of $4.2 billion by partners to date translates into the average annual salaries of approximately 52,000 manufacturing workers, 6.2 million tons of steel, or 38 million tons of cement (see Figure 3). The savings from these kinds of improvements can reduce operating expenses, making the U.S. industrial sector even more vibrant and competitive, which will lead to increased operations and new jobs. In one notable recent example of how energy efficiency can grow jobs, Challenge partner **Ingersoll Rand** hired an alumnus of a complementary DOE Advanced Manufacturing Office program to improve its compressed air system-assessment capabilities (see below).

Figure 3: Estimated Cumulative Energy Cost Savings Are Roughly Equivalent to:[3]

52 thousand annual average salaries

Manufacturing workers

6.2 million tons

Steel

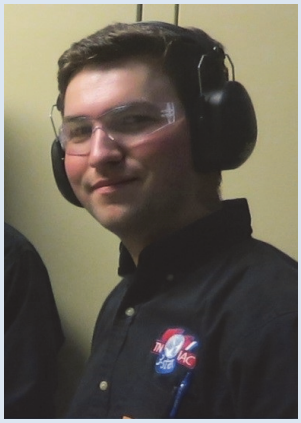
38 million tons

Cement

Industrial Assessment Center Alumnus Hired by Challenge Partner Ingersoll Rand

As a Master of Science in Mechanical Engineering Student at Tennessee Tech University, Anthony Taylor was an active participant in its U.S. Department of Energy Industrial Assessment Center (IAC; see page 13). Over a three-and-a-half year period, he participated in 38 energy assessments of small and medium-sized manufacturers throughout Tennessee and the surrounding region and was the lead student on 18 of them. His leadership won him the 2017 Industrial Assessment Center Outstanding Student Award.

In a further testament to the hands-on, technical experience provided by the IAC program, he was hired as a compressed air auditor by **Ingersoll Rand** upon his graduation. In fact, he was hired on the spot after an in-person interview and waived through the standard one-year training for the role; a first for the company. "I was welcomed with arms wide open since I had done so much work previously with compressed air systems, including plenty of **Ingersoll Rand** products," Taylor said."My experience with the IAC really gave me a competitive edge."



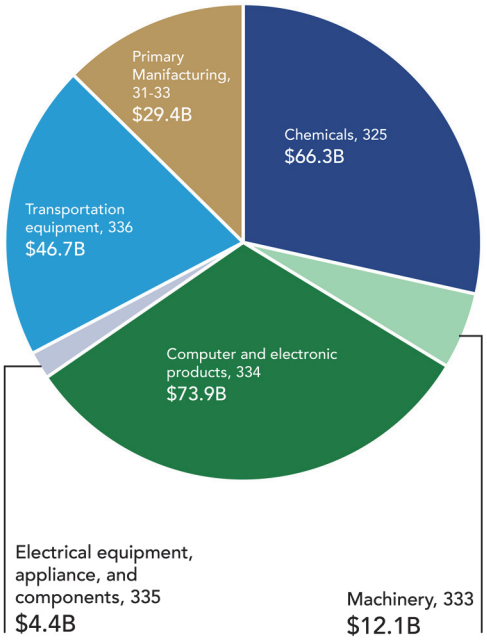
Anthony Taylor, Air System Assessment Engineer at ***Ingersoll Rand***

Better Plants partners are also increasingly seeking advanced technology to optimize their processes. As a 2016 study co-authored by Deloitte and the Council on Competitiveness observed of manufacturers as a whole, "As the digital and physical worlds converge within manufacturing, executives indicate the path to manufacturing competitiveness is through advanced technologies, ranking predictive analytics, Internet-of-Things (IoT), both smart products and smart factories via Industry 4.0, as well as advanced materials as critical to future competitiveness."[4] Better Plants partners are among those leading the U.S. industrial sector in adopting cutting-edge energy-savings technologies and processes to improve energy intensity, save money, and gain a competitive edge. For example, **General Electric** (GE) detailed in an online showcase project last year how the installation of enthalpy controls cut a facility's HVAC energy use and costs by more than half. In other showcase projects published last year as part of their commitment to the Better Plants Challenge, **Ford Motor Company** and **Volvo North America** shared how adopting an advanced paint booth application and infrared heating technology, respectively, can lead to similarly impressive savings.

On the process improvement side, **Celanese Corporation** shared an implementation model (see page 7) on creating "Energy Dashboards" to provide facility operators with access to real-time energy consumption and dynamic energy target information, giving them knowledge and tools to reduce energy consumption. $300,000 in energy cost savings and the identification of $1.5 million in additional low to no-cost energy-saving opportunities at one facility is now leading to a greater rollout across the enterprise.

Ford Motor Company's new paint shop at their Kentucky Truck Plant located in Louisville, Kentucky.

Figure 4: R&D Investment by Manufacturing Sector[12]



A Look at the State of American Manufacturing

An estimated 12 million Americans worked in manufacturing in June 2017, an increase of almost a million jobs compared to early 2010.[5] Last year, more manufacturing jobs came back to the country than left it for the first time in decades – a net gain of more than 25,000 jobs.[6] Confidence is high as well; in March 2017, the Manufacturers' Outlook Survey from the National Association of Manufacturers hit an all-time high in the survey's 20-year history, with more than 93 percent of respondents positive about their own company's outlook.[7]

In 2016, manufacturing accounted for about 12 percent of the U.S.' gross domestic product (GDP).[8] But that figure belies the sector's greater economic impact; for every $1.00 spent in manufacturing, as much as $3.60 is added to the economy.[9] The manufacturing sector is also a major driver of innovation as the nation's leading buyer of technology and the source of an estimated 90 percent of all new patents.[10] In 2014, roughly $233 billion was dedicated to research & development (R&D) in the sector, about 70 percent of all private-sector R&D;[11] a breakdown by individual manufacturing sector can be seen in Figure 4, above.

New Challenge Partners

Five Better Plants partners stepped up to the Challenge this year, bringing the total number of Challenge partners to 41. In addition to setting energy-efficiency goals, Better Plants Challenge partners commit to publicly sharing their solutions and successes, including energy-efficiency best practices in the form of "showcase projects," which are near-term demonstrations of significant energy savings at an individual facility, and "implementation models," which document corporate-level best practices that overcome specific barriers to energy efficiency (see TE Connectivity's, below). Showcase projects and implementation models from Better Plants Challenge partners and other economic sectors can be found at the online Better Buildings Solution Center.

Largest water utility in Iowa, providing drinking water to approximately 500,000 people in the greater Des Moines area.

Diversified company with products that enhance the quality and comfort of air in homes and buildings, help transport and protect food and perishables, and increase industrial productivity and efficiency.

Utility that reclaims water, engages in watershed management, and promotes pollution prevention and water conservation in Northeast Wisconsin.

Manufacturer of vitamins, minerals, and herbal supplements through the brands Nature Made and FoodState.

Manufacturer of air filtration, separation, and silencing products that are designed to protect machinery and the surrounding environment, including compressors, turbines, vacuum pumps, and reciprocating engines.

TE Connectivity's "Centers of Excellence" Proliferate Energy-Efficiency Best Practices

TE Connectivity found it difficult to share and promote energy best practices at a company of its size. To address this issue, the Challenge partner created "Centers of Excellence" – "COEs" – for its core manufacturing processes and for energy efficiency. The COEs are multidisciplinary teams of people with specific expertise and/or interest in a particular COE topic, such as energy. The purpose of the COEs is to foster collaboration and the sharing of expertise and best practices throughout all operations. Ready-to-deploy project details and associated adoption rate, progress, and savings data are stored online. As a result of the COEs, TE Connectivity has greatly improved the implementation rates of impactful energy efficiency projects.

Learn more at the Better Buildings Solution Center: https://betterbuildingssolutioncenter.energy.gov/implementation-models/energy-center-excellence.

New Program Partners

Better Plants continued to grow in 2016, with a diverse group of industrial organizations joining the program and voluntarily pledging to reduce energy intensity by 25 percent within 10 years. Better Plants now encompasses partners in almost every single manufacturing sector. New program partners include water and wastewater utilities, automotive and transportation parts suppliers, and a biopharmaceutical company.

Manufacturer and designer of direct current-electric motors, actuators, and other electrical components.

Global supplier of systems and components for the automotive industry.

Asama Coldwater Manufacturing makes automotive components.

Manufacturer of ride control products for a variety of aircraft and vehicles.

Global biopharmaceutical company and medicine manufacturer.

Manufacturer of piston rings for automobiles, heavy equipment, small engines, and aircraft applications.

Cardington, Ohio-based automotive parts supplier.

Automotive exhaust system, frame, and trim products manufacturer.

Public water and wastewater utility serving the Greater Charleston, South Carolina, area.

Maker of ball and roller bearings for automotive and other industrial applications.

Provider of water, wastewater, and solid waste utility services for the Roseville, California, community.

Serves the Philadelphia region with potable water, wastewater, and stormwater services.

Celebrating Success: Goal Achievers

Four Challenge partners and four program partners met their energy reduction goals last year, and one Challenge partner met its water reduction goal.

Better Plants Challenge Goal Achievers

21%

energy intensity improvement in three years

Manufacturer of differentiated chemistry solutions and specialty materials.

26%

in seven years

Diversified producer of automotive parts and HVAC equipment for buildings.

30%

in three years

Provider of wastewater treatment service for more than 400,000 residents in San Diego County.

26%

in eight years

Energy management and automation solutions provider.

28%

reduction in water intensity in six years

Detroit-based vehicles and vehicle parts manufacturer.

Better Plants Program Goal Achievers

33%

in eight years

Manufacturer of metal castings and mining consumables for industrial market sectors.

30%

in ten years

Manufacturer of fluid power, electrical, automotive, and truck products.

27%

in five years

Industrial automation products specialist.

29%

in six years

Producer of deli and specialty meats headquartered in Cudahy, Wisconsin.

Celebrating Success: New Awards

Better Plants partners are at the forefront of implementing innovative energy efficiency solutions. This year, Better Plants provided two new ways to highlight and honor partners' industry-leading work. The **Better Practice Award** recognizes outstanding accomplishments in implementing and promoting the practices, principles, and procedures of energy management in industry. The **Better Project Award** is presented to partners for outstanding accomplishments in implementing energy efficiency projects at individual facilities.

*The **Martin Guitar** energy team receives a Better Project award for a comprehensive HVAC upgrade.*

2017 Better Practice Award Winners

For utilizing the energy treasure hunt exchange process to train employees, identify cost savings, and improve ISO 50001 implementation.

For developing a multi-disciplinary Sustainability Team that helped achieve a 30 percent decrease in facility energy consumption.

For establishing a company-wide Energy Hunt program that resulted in a threefold increase in identified energy savings projects and helped the company meet its Better Plants Challenge goal two years early.

For implementing an enterprise-wide Energy Management System certified to ISO 50001 that includes all U.S. manufacturing facilities.

For creating WWE (Waste, Water, Energy) Awards to inspire competition among 120+ manufacturing sites to reduce their environmental impact.

For creating a multifaceted energy efficiency improvement program that has saved millions in cumulative energy costs.

2017 Better Project Award Winners

For installing an industrial HVAC upgrade that led to a 40 percent reduction in system energy consumption, better product quality, and reduced maintenance needs.

For installing a combustion turbine burner that has improved steam production reliability and saved 156,000 MMBTU in annual energy consumption.

For implementing lighting and HVAC upgrades across several facilities, with site energy consumption decreases of as much as 2 percent.

For installing three 1.5 MW wind turbines that offset $600,000 in annual electricity costs and yield hundreds of thousands more in renewable energy credit sales.

For installing a 1.6 MW CHP system fueled by on-site produced biogas that has achieved $473,000 in annual energy cost savings.

The 2018 award application period will open at the start of next year.

New Resources: Diagnostic Equipment Program

The Field Validation and Diagnostic Equipment Program (DEP) provides Better Plants partners with access to 19 different instruments to measure their energy consumption. Accurate and reliable measurement of operating data is essential to evaluate equipment efficacy and quantify energy performance improvements at both the equipment and system level. However, plant operation personnel do not always have access to the necessary tools. They also may not know the right tool to use, or cannot yet justify the cost of purchasing one. The DEP helps address these issues; partners can borrow equipment on a short-term basis for measurement and verification, to conduct energy assessments/treasure hunts, or simply to test them out before committing to a purchase. Tools are available free of charge, including shipping, for up to four weeks on a first come, first serve basis. Better Plants also provides technical assistance to help with the selection and use of the tools.

*Workers at **Charter Steel**'s Saukville, Wisconsin, plant use an infrared camera to identify energy savings.*

Available Equipment

DEP tools serve a wide variety of functions. Strobe tachometers, for example, are a non-contact method to determine the rotating speed of a shaft in motors, pumps, and fans. Infrared cameras are very useful for evaluating structures, door seals, insulation, oven hot spots, and the like. And ultrasonic leak detectors can easily identify leaks in compressed air or steam systems. Other available tools are: anemometer; combustion analyzer; conductivity meter; current transformer; digital manometer; digital multimeter; HOBO data logger; infrared thermometer; manometer–hydronic; pitot tube; power logger; pressure transducer; thermocouple; time-of-use logger; and ultrasonic flow meter.

Saint-Gobain Uncovers $20,000 in Potential Annual Energy Savings Through DEP

Saint-Gobain Corporation, a Better Plants Challenge partner, was one of the first to leverage the DEP's resources by borrowing a flow meter. The production process utilized at one of its subsidiary's plants involves an exothermic reaction, making a reliable cooling water supply critical to its safe operation. Over the years, changes in the production process, accumulation of scale in the piping mains and heat exchangers, and normal wear and tear degraded the ability of the cooling system to remove heat. There was clearly an opportunity for energy performance improvement, but staff lacked information on system energy performance and lacked the equipment to acquire that information.

Using a DEP-provided flow meter, plant staff were able to determine the actual flow rate of the cooling water pumping system. Prior to this, pressure measurements were used to simply estimate pump performance. Additional measurements may be required, but the DEP opened the door to understanding that significant savings are possible - preliminary results revealed as much as $20,000 in potential annual energy cost reductions.

Learn more at the Better Buildings Beat Blog: betterbuildingssolutioncenter.energy.gov/beat-blog/saint-gobain-takes-advantage-new-better-plants-diagnostic-equipment-program.

New Resources: National Laboratory Collaboration

U.S. Energy Secretary Rick Perry describes the National Labs as the "crown jewels of America's R&D efforts."[13] This is why Better Plants is helping industry boost productivity by facilitating research and development collaboration with the 17 U.S. National Labs, up to and including the adoption of new energy technology. As part of this effort, Better Plants began hosting Technology Days, which aim to demonstrate the various early-stage technologies best positioned to enable American industrial competitiveness and innovation.

Partners at Tech Deployment Day 2017 learn about wireless charging research and development at ORNL.

At the inaugural Technology Day this past spring, partners gathered at Oak Ridge National Laboratory (ORNL) to hear from industrial research and development experts about the cutting-edge technologies being worked on at the Lab such as additive manufacturing, advanced sensors, and software platforms. Additionally, partners were able to tour several innovative facilities in the Lab such as the:

- Manufacturing Demonstration Facility
- National Transportation Research Center
- Building Technologies Research and Integration Center
- Bio-derived Materials and Advanced Materials and Coatings
- Advanced Sensor and Drone Laboratory
- Visualization Laboratory
- High-Performing Super-computing

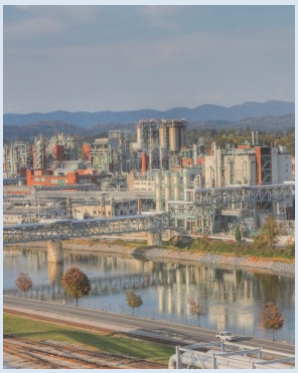
In addition to the hands-on technology demonstrations, representatives from two Better Plants partners, **United Technologies** and **Cummins**, led a panel discussion offering their perspectives on Lab-industry partnerships based on their successful experiences with several of the National Labs and how these partnerships enabled them to leverage research and technologies that benefited their companies.

"Working directly with our National Labs has sparked innovation that allows us to compete with companies around the globe. There are a lot of really smart people at [Oak Ridge], and when you hang around smart people you only get smarter."

-Roger England, Director of Materials Engineering and Technology, Cummins, Inc.

Eastman Chemical Explores Industrial Applications for Drones and Ultrasonic Drying

For representatives of **Eastman**, a visit to Oak Ridge National Laboratory on the inaugural Better Plants Technology Day spurred a lot of thinking. For example, partner engineers were intrigued by the Lab's ultrasonic dryer prototype, which uses vibration to remove water from materials – potentially much faster and more efficiently than conventional clothes dryers. The partner is now exploring the feasibility of applying ultrasonic drying technology to industrial plant processes. The company has also initiated talks with the Lab about possibly using drones for asset management; they could potentially inspect columns at its facilities like the one in Kingsport, Tennessee, at right, or look for heat loss with an attached thermal camera. This could improve safety by reducing the need for work at elevated heights.



New Resources: Additional In-Plant Training Topics

In-Plant Trainings (INPLTs) are workshops led by technical experts that train manufacturing employees on how to identify, implement, and replicate energy performance improvement. Better Plants partners agree to host an on-site, two to four-day training at one of their facilities, and invite participants from their other facilities and even nearby partners to attend. Technical expertise gained through the INPLTs help partners overcome critical barriers to implementing energy management practices and technologies. Since 2011, Better Plants has conducted more than 80 INPLTs with almost 1,500 participants. Cumulatively, the INPLTs have identified more than $33.6 million in potential energy savings. In the past year, one INPLT on pumping systems identified more than $2 million in actionable annual energy savings opportunities for the Los Angeles Bureau of Sanitation and the Los Angeles Department of Water & Power, while a separate INPLT on fan systems at Ingevity uncovered almost $1 million in potential savings.

INPLTs typically focus on energy consuming-industrial systems, such as steam, process heating, or compressed air. Last year, Better Plants began offering energy treasure hunt exchanges, which enable partners to exchange each other's energy team to explore energy saving opportunities. This year, water/wastewater and energy treasure hunt exchanges became available topics.

Participants at the Orange Water and Sewer Authority In-Plant Training on water and wastewater at the partner's North Carolina facility in May 2017.

"The INPLT was extremely valuable in raising the energy intelligence of our organization. It brought together operators, maintenance staff, managers, and engineers around a common language of energy management."

-Mary Tiger, Sustainability Manager, Orange Water and Sewer Authority

AbbVie held an energy treasure hunt exchange INPLT in January 2017, mixing together teams of employees with various functions from multiple facilities to identify energy and co-saving opportunities at its North Chicago plant. The INPLT identified approximately 8 percent potential reduction in annual energy spending for the partner's R&D and fermentation buildings. As a result of the training, AbbVie plans to conduct additional energy treasure hunts at other facilities, fulfilling a key goal of the exchanges—to train company staff so they can conduct more energy treasure hunts elsewhere within the company.

Orange Water and Sewer Authority Hosts One of the First Water/Wastewater INPLTs

Orange Water and Sewer Authority (OWASA), a Better Plants Challenge partner that provides water and wastewater services for southeastern Orange County in North Carolina, hosted one of the first water/wastewater treatment-focused In-Plant Trainings in May 2017. The four-day session attracted 26 attendees, including participants from two other water utilities. The first three days focused on wastewater treatment, covering topics ranging from plant energy basics and pumping systems, to more process-specific optimization opportunities that enable reduced aeration loads or more efficient control of the primary clarifier sludge blanket levels. The fourth day shifted to opportunities specific to the water treatment plant.

Overall, more than 30 energy opportunities were identified during the INPLT, and OWASA is now working to incorporate these into its energy management plan. OWASA is also taking advantage of the new Diagnostic Equipment Program (see page 8) to borrow sub-meters that will allow them to measure the savings achieved by operating with an increased wet well level, which was one of the opportunities uncovered through the INPLT.

Expanded Opportunities to Save Energy: Supply Chain Initiative

According to a University of Minnesota estimate, over 85 percent of the energy used in the entire manufacturing process can be consumed before the facility making the final product even receives the supplies it uses in production.[14] That's why more and more manufacturers are looking to extend their energy efficiency efforts beyond their own operations and into their supply chains. Better Plants is helping partners facilitate this effort with the Supply Chain Initiative. Through the Initiative, partners are sponsoring cohorts of their own suppliers to join Better Plants. In addition to setting energy saving goals and developing energy management plans, suppliers receive customized technical assistance in the form of training webinars and tools. In some cases, commitments to sustainability initiatives can help suppliers achieve and/or maintain tier 1 status with their Original Equipment Manufacturer (OEM) customers, which places them first in line for orders.

*Acura MDXs on the assembly line at **Honda North America**'s East Liberty, Ohio, manufacturing facility.*

Last year, **Honda North America** joined **Legrand**, **UTC**, and **Lockheed Martin** in the Supply Chain Initiative, sponsoring a cohort of eight suppliers that are now taking advantage of Better Plants resources and technical assistance. "[The Initiative] has encouraged our suppliers to map out a plan for their energy management while offering them access to resources such as free industrial assessments to jump start their energy savings," said **UTC** Corporate Energy Manager Sean West. "The DOE provides an annual report summarizing the aggregate progress made by the cohort. We would recommend that other partners consider initiating a supply chain program for their company!"

Expanded Opportunities to Save Energy: Water Savings Initiative

Better Plants Challenge partners are able to receive engineering support and recognition for saving water in addition to energy, as awareness has grown that saving water saves energy. Water efficiency also has ancillary benefits like lower operating costs, a more reliable water supply, and improved water quality. Through the Water Savings Initiative, participating partners receive engineering support with water data tracking and share water management solutions.

Last year, **BD** joined **Cummins**, **Ford Motor Company**, **General Motors**, **HARBEC, Inc.**, **Nissan**, **Saint-Gobain Corporation**, **Toyota**, and **UTC** in the Initiative, bringing the total number of participants to nine. Better Plants also hosted a webinar for the suppliers of several Supply Chain Initiative sponsor-partners on tracking water use at the facility and process level.

General Motors also joined **Cummins** and **UTC** as a water savings goal achiever. The partner pledged to reduce water intensity, or the average amount of water used per vehicle produced, at its 31 U.S. facilities by 20 percent by 2020. They exceeded the goal four years early, reducing water intensity by 28.3 percent against a 2010 baseline.

Plant Water Profiler Tool Helps Manufacturers Track Water Use

DOE and Oak Ridge National Laboratory are drawing on the experiences and best practices of Better Plants partners to develop a Plant Water Profiler (PWP) tool. The PWP tool is designed to help industrial facility managers:

- Identify how water is being procured and consumed at their plants;
- Quantify the true cost of water used in different systems and potential water and cost savings;
- Identify next steps that could be followed to save water;
- Prioritize implementation of water efficiency measures.

Tool developers are consulting industry for feedback and beginning to organize training sessions to demonstrate how to use it, with an eye on a late 2017 public release.

Expanded Opportunities to Save Energy: Complementary Programs

Better Plants helps partners access other valuable DOE complementary technical partnerships that can expand and enhance their energy efficiency efforts.

50001 Ready

DOE's 50001 Ready program is a self-guided approach for facilities to establish an energy management system based on the structure of ISO 50001 using an easy online navigator. Organizations can then self-attest to having completed the process; Charter Steel is the first partner to achieve 50001 Ready designation (see callout box below).

Learn more at energy.gov/50001Ready.

Superior Energy Performance and ISO 50001

Superior Energy Performance (SEP) provides guidance, tools, and protocols to quantify and verify energy savings from the ISO 50001 standard. SEP-certified facilities have improved their energy performance up to 30 percent over three years. The program has added 10 certified Better Plants partner-facilities since September 2016.

Learn more at energy.gov/ISOSEP.

Combined Heat and Power

DOE provides combined heat and power (CHP) deployment resources and direct project-specific technical assistance to transform the U.S. market for CHP, waste heat to power, microgrids, and district energy throughout the United States. Since September 2016, 32 qualification screenings were conducted for Better Plants partners.

Learn more at energy.gov/CHP.

Industrial Assessment Centers

The Industrial Assessment Centers (IACs) are university-based teams around the country that provide no-cost energy assessments for small- and medium-sized manufacturers. Better Plants partners receive priority access to IAC assessments. To date, IACs have provided more than 17,600 manufacturers with over 134,000 actionable recommendations.

Learn more at energy.gov/IAC.

Charter Steel Uses the Navigator to Become 50001 Ready

Charter Steel became the first industrial company and Better Plants partner to achieve the 50001 Ready designation in August 2017. While the company had already started implementing the ISO 50001 standard and is on track to get certified to it, using the 50001 Navigator was very helpful in providing more context to the Energy Management System (EnMS) and translating some of the requirements of ISO 50001 into actionable items. The company was also able to identify ways to improve its safety materials by reviewing the documentation. "A key to our success is the great relationships among our energy team members, and strong support from upper management," Charter Steel energy manager Tari Emerson observes. "The Navigator tool was really easy to use, and we had lots of support from the DOE Better Plants program team as well."

Looking Ahead

Better Plants partners are demonstrating that industrial energy efficiency can be an important cost-saver and competitiveness driver. By setting and working to achieve long-term energy intensity reduction goals, partners are boosting their bottom lines, growing jobs, and being responsible corporate citizens. The past year was a banner year for the Better Plants program in terms of new partners joining and new initiatives created to serve their needs. Here's how Better Plants plans to carry the momentum forward in the upcoming year:

- Technology Days: Energy Secretary Rick Perry has said that "the technology that comes often out of a DOE National Lab changes the world."[15] Building on last year's successful Technology Day at Oak Ridge National Lab, Better Plants will expand to host regional Technology Days at additional National Labs across the country. These events serve to connect partners to innovative new technology they might be able to leverage in their plants, and just as importantly, break down barriers to make it easier for industry to partner with lab scientists on some of their most complex technical challenges.

- In-Plant Trainings: Better Plants' In-Plant Trainings have prepared over 1,000 partner employees to analyze energy data and identify, implement, and replicate energy-saving projects. In addition to traditional industrial systems like compressed air, other motor-driven systems, and steam and process heating, the program rolled out energy treasure hunt exchanges. This fall, Better Plants partners will have the opportunity to try out newer training topics: industrial refrigeration and energy management.

- Tools: The DOE Advanced Manufacturing Office's energy system and energy management software tools help manufacturers increase energy efficiency at the plant-level and in specific systems. In FY18, DOE will have fully updated several of its most popular tools. These include: pumping and process heating, fans, steam, and compressed air.

- Integration with Federal Resources: Better Plants will continue to debut opportunities to better navigate DOE programs and resources, starting with Advanced Manufacturing R&D funding opportunities and consortia, but also including additional DOE technology offices.

- Engineer Exchange/Internship Center: Better Plants will build on its debut of the IAC internship and jobs portal by expanding the resource and making it even easier to navigate. In addition, Better Plants will work with partners to explore creating an "Engineer Exchange," facilitating partners who wish to "swap" a staff member to learn from each other's facilities.

- Enhanced Communications and Networking: Better Plants will continue to build on its communications and networking offerings, making it easier for partners looking for recognition for their leadership to leverage the program. This will include revamping the Better Buildings, Better Plants Solution Center. The online Solution Center currently houses more than 1,000 energy efficiency solutions tested and proven by partners, searchable by topic, barrier, sector, technology, and more. Better Plants will overhaul the website to make it easier for partners to leverage the resources being offered. This will include, but not be limited to: recorded pre-INPLT training webinars, developing direct points of contact based on technological expertise, and case studies.

Endnotes

1. Energy performance data cited in this report is based on DOE-reviewed individual annual reports submitted by Better Plants Partners. DOE will sometimes exclude from its final metrics data reports that raise technical or other issues that cannot be resolved in consultation with partners. These include, but are not limited to, reports that use inappropriate or inconsistent methodologies to calculate energy intensity, contain missing or incomplete data, or show changes in energy intensity that do not accurately reflect energy-efficiency actions undertaken by the partner. As new information comes in, DOE will sometimes revise or delete erroneous data reports that were previously submitted by partners. This can result in changes to previously published program-wide metrics.

2. U.S. Department of Energy, *2016 Industrial Energy Efficiency Potential Analysis,* https://energy.gov/sites/prod/files/2017/04/f34/energy-savings-by-state-industrial-methodology.pdf

3. Better Plants cumulative energy cost savings values are calculated using EPA unit price values and MECS 2010 manufacturing energy distribution summary statistics. Savings equivalency for: manufacturing workers' annual average salaries ($81,289 in 2015) is derived from the National Association of Manufacturers, http://www.nam.org/Newsroom/Facts-About-Manufacturing, steel data ($681 per metric ton as of July 24, 2017) is derived from SteelBenchmarker, http://steelbenchmarker.com/files/history.pdf, and cement data ($111 per ton in 2016) is derived from the U.S. Geological Survey, https://minerals.usgs.gov/minerals/pubs/commodity/cement/mcs-2017-cemen.pdf.

4. Council on Competitiveness and Deloitte, *2016 Global Manufacturing Competitiveness Index*, https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Manufacturing/gx-global-mfg-competitiveness-index-2016.pdf.

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Partners as of September 2017

3M*
AbbVie Inc.
Alcoa Inc.
Alexandria Renew Enterprises
Amcor Rigid Plastics
American Mitsuba Corp.
ArcelorMittal USA
Armstrong Flooring
Asama Cold Manufacturing
AT&T*
Ball Corporation
Bath Electric Gas and Water System
BD
Bentley Mills*
Bosch Rexroth
BPM, Inc.*
Bradken*
Bridgestone Americas, Inc.
Briggs & Stratton Corporation
Bristol-Meyers Squibb
Buck Company
Bucks County Water and Sewer Authority (BCWSA)
C. F. Martin & Company
CalPortland Company
Campbell Soup Company
Cardington Yutaka Technologies
Carlton Forge Works
Cascade Engineering Technologies, Inc.
Celanese Corporation*
Chapco Inc.
Charleston Water System
Charter Steel
Chippewa Valley Ethanol Company
Citrus World, Inc.
City of Grand Rapids Water Resource Recovery Facility
City of Phoenix Water Services Department
City of Roseville, Environmental Utilities Department
Clearwater Engineering, Inc.
Co-Operative Industries Aerospace and Defense
Coilplus Inc.
Comau LLC*
Commercial Metals Company
Complete Design and Packaging
Cooper Standard
Cummins, Inc.*~
Daikin Applied Americas*
Darigold
Davisco Foods
Delta Diablo
Denison Industries
Des Moines Water Works
Didion Milling
Dow Chemical Company
DSM North America
Durex Inc.
EARTH$_2$O
Eastman Chemical Corporation
Eaton Corporation*
Eck Industries
Electrolux
Encina Wastewater Authority*
Expera Specialty Solutions*
Flambeau River Papers
FMC Corporation
Ford Motor Company
General Aluminum Manufacturing Company
General Dynamics Ordnance and Tactical Systems Scranton Operation*
General Electric
General Mills
General Motors~
General Sheet Metal Works, Inc.
GKN Aerospace
Golden Renewable Energy, LLC
Goodyear Tire and Rubber Company, U.S. Tire Plants
Graphic Packaging*
HARBEC, Inc.*
Harley-Davidson
Harrison Steel Castings Co.
Harva Company
Haynes International
HNI Corporation
Holcim (US) Inc.*
Honda North America
Huntsman Corporation
Ingersoll Rand*
Ingevity*
Intel
International Paper
Intertape Polymer Group
Ithaca Area Wastewater Treatment Facility
J.R. Simplot
JBT Corporation
Jedco, Inc.
Johnson & Johnson*
Johnson Controls*
Johnson Matthey Emission Control Technologies Division
Kent County Department of Public Works
Kenworth Truck Company
Kingspan Insulated Panels, Inc.*
KYB Americas Corporation
L'Oréal USA
Land O' Lakes
Legrand North America*
Lennox International*
Lineage Logistics
Lockheed Martin
Los Angeles Bureau of Sanitation
Los Angeles Department of Water & Power
Lynam Industries Inc.
Magnetic Metals Corp.
MAHLE Engine Components USA, Inc.
Manitowoc Grey Iron Foundry
Mannington Mills
Marquis Energy
Marquis Energy Wisconsin
Massachusetts Water Resources Authority
MB Aerospace East Granby
McCain Foods USA, Inc.
MedImmune
Metal Industries, Inc.*
Mohawk Industries
Mulgrew Aircraft Components, Inc.
Narragansett Bay Commission
Navistar International
Neenah Foundry
NEW Water (Green Bay Metropolitan Sewerage District)
Nissan North America, Inc.*
Novati Technologies
Novelis Inc.
NSK Americas
NY DEP – Bureau of Wastewater Treatment
O'Fallon Casting
OFD Foods, Inc.
OMNOVA Solutions Inc.
Orange Water and Sewer Authority
Oshkosh Corporation
OSRAM SYLVANIA*
Owens Corning
Pactiv
PaperWorks Industries
Parker Hannifin
Patrick Cudahy, Inc.*
Patriot Foundry & Castings*
PepsiCo
Pharmavite
Philadelphia Water Department
Pima County Regional Wastewater Reclamation Dept.
PPG Industries
Procter & Gamble*
Quad/Graphics, Inc.
Raytheon Company
Research Electro-Optics
Richmond Industries Inc.
Roche Diagnostics Operations*
Rowley Spring and Stamping
Saint-Gobain Corporation
Savage Precision Fabrication
Schneider Electric*
Selmet, Inc.
Shaw Industries Group, Inc.*
Sherwin-Williams*
Solberg Manufacturing, Inc.
Sony DADC
Spirax Sarco, Inc.
St. Petersburg Water Resources Department
Stanley Spring & Stamping Corporation
Steelcase, Inc.
SunOpta, Inc.
TE Connectivity*
Tenaris
Texas Instruments*
Textron
ThyssenKrupp Elevator*
Toyota Motor Engineering and Manufacturing North America*
TPC Group
Tri-State Plastics, Inc.
United Technologies Corporation*~**
Vanguard Space Technologies
Vermeer
Verso Paper Corporation
Victor Valley Wastewater Reclamation Authority*
Volvo Group North America*
W. L. Gore and Associates
Waupaca Foundry
Weber Metals Inc.
Western Lake Superior Sanitary District
WestRock
Weyerhaeuser*
Whirlpool Corporation

KEY

Bold – Better Plants Challenge Partner
Underline – New Partner
Asterisk* – Energy Goal Achiever
Tilde~ – Water Goal Achiever

Better Plants Challenge Energy and Water Goal Achievers Since 2009

3M
Celanese — The chemistry inside innovation™
Cummins
Encina Wastewater Authority
GM
HARBEC — Technical Innovation With Environmental Responsibility
Holcim
ingevity
legrand®
Johnson Controls
NISSAN
Schneider Electric
TOYOTA
United Technologies
VOLVO
VVWRA — Apple Valley • Hesperia • Victorville — Taking the Waste Out of Wastewater

Better Plants Program Energy Goal Achievers Since 2009

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BPM Inc — A Specialty Paper Mill
BRADKEN
COMAU
DAIKIN
EATON — Powering Business Worldwide
EXPERA specialty solutions™
GENERAL DYNAMICS
Graphic Packaging INTERNATIONAL
Ingersoll Rand
Johnson & Johnson
Kingspan
LENNOX INTERNATIONAL
METAL INDUSTRIES, INC.
OSRAM SYLVANIA
PATRICK CUDAHY — SINCE 1888
PATRIOT FOUNDRY & CASTINGS
P&G
Roche
Shaw FLOORS
SHERWIN WILLIAMS — COVER THE EARTH
TE connectivity
ThyssenKrupp
VERSO
TEXAS INSTRUMENTS
Weyerhaeuser

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