A Year of Energy Innovation

Over the past year, partners in the U.S. Department of Energy's (DOE) Better Buildings, Better Plants Program (Better Plants) and Challenge have implemented innovative practices, integrated new technologies, and shared their successes in order to substantially cut their energy costs. Through this voluntary initiative, manufacturers and water and wastewater treatment agencies step up to meet the challenge to reduce energy intensity by 25 percent over a 10-year period across all their U.S. operations. Better Plants Challenge partners further demonstrate their leadership by also publicly sharing best practices and energy performance data. DOE supports partners by providing technical expertise, convening peer exchange opportunities, and highlighting successful solutions.

There are now more than 200 partners leading the way and providing an example for their industry peers to follow. To date, Better Plants partners have reported estimated cumulative energy savings of 1.06 quadrillion Btu, which translates into energy cost savings of roughly $5.3 billion (see Figure 1).[1] Last year, three Challenge partners and seven program partners met their ambitious energy savings goals – the total number of goal achievers now stands at 53.

Figure 1: Better Plants Snapshot, October 2018

Partnership Size	Total
Number of Partner Companies	202
Approximate Number of Facilities	3,000
Approximate Percentage of U.S. Manufacturing Energy Footprint	12%
Reported Savings Through 2017	
Cumulative Energy Savings (QBtu)	1.06
Cumulative Cost Savings (Billions)	$5.3
Average Annual Energy-Intensity Improvement Rate	2.8%

A look inside ArcelorMittal's Cleveland-area steel mill.

Figure 2: Estimated Cumulative Energy Cost Savings Over Time:

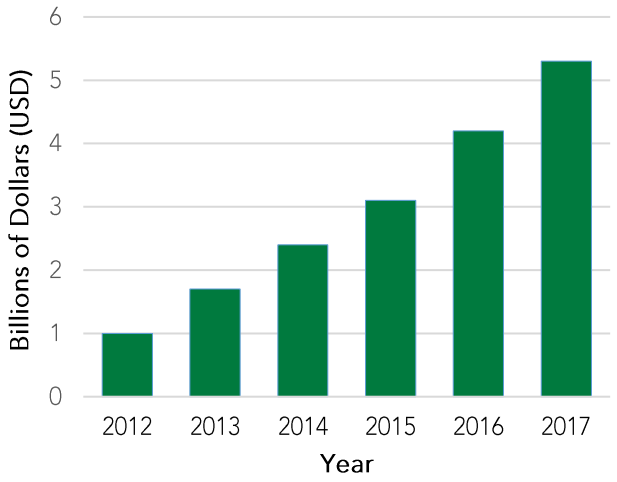


Figure 3: Estimated Cumulative Energy Cost Savings Are Roughly Equivalent to:[2]

63,000
annual average salaries of U.S. manufacturing workers

New Program Partners

In the past year, DOE welcomed the following industrial energy efficiency leaders into the program, including single-facility companies like **Plastics Engineering Company** (Plenco) and **Texas Nameplate Company**; Better Plants' first mining company, **Imerys Carbonates North America**; and the world's eighth largest automotive manufacturer, **Fiat Chrysler Automobiles**.

Avon Lake Regional Water

Water and sewer service provider to 200,000 residents in northeast Ohio

Leggett & Platt Incorporated

Diversified manufacturer of engineered residential and industrial furniture and specialized products

DIXIELINE

Metal fabrication and finishing company that sells to a worldwide market

plenco

Family-owned manufacturer of phenolic resins and thermoset molding materials

DONSCO

North America's leading single source provider of machined iron castings

PPC Innovate. Connect. A BELDEN BRAND

Manufacturer and developer of connectivity solutions for broadband service provider market

FCA FIAT CHRYSLER AUTOMOBILES

The world's eighth largest automotive manufacturer, including brands like Chrysler, Dodge, Fiat, and Jeep

City of Sheboygan spirit on the lake.

Provider of wastewater treatment services for 68,000 residents in the Sheboygan, Wisconsin, area

IMERYS Carbonates

Provider of over 250 calcium carbonate and multi-mineral solutions

Texas Nameplate Company

Manufacturer of metallic and non-metallic nameplates, custom labels, name tags, and ID tags

Krage Manufacturing LLC

Family-owned specialist in sheet metal fabrication, powder coating, and electrical assembly

ZIMMER BIOMET Your progress. Our promise.

Designer, developer, and manufactuer of a wide range of orthopaedic products

New Challenge Partners

Two Better Plants program partners have joined the Better Plants Challenge, further demonstrating leadership by committing to publicly sharing energy performance data and solutions in addition to striving for an energy saving goal.

Producer of torque converters, catalytic converters, and automotive exhaust systems, based in Cardington, Ohio

L'ORÉAL USA

Makeup, cosmetics, hair care, and perfume-products manufacturer

Goal Achievers

Three Challenge partners and seven program partners met their goals last year to reduce energy intensity in their U.S. facilities by up to 25 percent within ten years, bringing the total number number of goal achievers to 53 – more than a quarter of all Better Plants partners.

2018 Better Plants Challenge Goal Achievers

27% energy intensity improvement in three years

26% in nine years

20% in five years

2018 Better Plants Program Goal Achievers

25% in four years*

28% in four years

30% in five years**

28% in two years

28% in ten years

31% in seven years

51% in eight years

*Cardington Yutaka Technologies **Johnson Matthey Emission Control Technologies Division

Message from the Director of DOE's Advanced Manufacturing Office

The Advanced Manufacturing Office (AMO) is the only technology development office within the U.S. Government that is dedicated to improving the energy and material efficiency, productivity, and competitiveness of manufacturers across the industrial sector. With programs like Better Plants, AMO brings together industrial stakeholders to identify challenges; catalyze innovations; and develop cutting-edge material, process, and information technologies needed for an efficient and competitive domestic manufacturing sector. From my position, it is very gratifying to see the more than 200 Better Plants partners not only driving meaningful energy productivity improvements through technical assistance and knowledge sharing, but also leveraging the DOE national labs and supporting the development and validation of technologies and innovation. Cheers to a very productive 2018, and my office looks forward to continuing to partner with you for years to come.

Rob Ivester
Director, Advanced Manufacturing Office

Recognizing Success

Better Plants partners are pushing the envelope and overcoming energy efficiency barriers through increasingly innovative solutions. Every year, DOE honors partners' particularly impressive endeavors through two awards. 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.

Hi Sang Kim and Naguib Yakoub present on LA Sanitation's 2018 Better Project Award-winning project.

2018 Better Practice Award Winners

ArcelorMittal — *For creating a virtual "USA Energy Management Toolbox" composed of technical best practices; a database of replicable, quick-win projects; and more*

Celanese — *For developing a sophisticated Energy Assessment Matrix to measure and track the strength and continuous improvement of energy management systems*

Ingersoll Rand (Inspiring Progress™) — *For forming a Green Team at its Waco, Texas, facility that helped double energy productivity, cut electricity costs by 70%, and standardize a method for tracking multiple key sustainability indicators*

Owens Corning — *For launching the Composites Solutions Business Energy Team Challenge with cash prizes to inspire competition between plant energy teams to reduce energy intensity*

Quad Graphics — *For initiating a baseload energy reduction program at its Merced, California, facility that reduced downtime baseload to less than 10%, avoiding an estimated $465,000 in energy costs*

TE connectivity — *For deploying energy treasure hunts across the company, giving sites tools, guidance, and support for a largely "do-it-yourself" approach, with the 30 treasure hunts conducted since the program's inception identifying $2.7 million in savings opportunities*

2018 Better Project Award Winners

GM — *For implementing a building automation system upgrade at its Romulus, Michigan, facility encompassing plant floor lighting, energy metering, and floor HVAC, with an estimated payback of 1.5 years*

Simplot — *For implementing a blending tank system requiring less pumping energy, less fresh water, and less cooling tower load at its Pocatello, Idaho, facility, resulting in $161,000 in annual energy savings*

LA Sanitation (Environment) — *For implementing a digester biogas generation & CHP project at its Hyperion Water Reclamation Plant to produce electricity and heat, reducing the plant's energy intensity by 37% in two years*

MedImmune (A member of the AstraZeneca Group) — *For installing a 2.5 MW natural gas fired-combined heat and power system at its Gaithersburg, Maryland, facility, helping the site achieve 13.9% energy savings over the previous year*

Raytheon — *For implementing the company's first energy storage system at its Fullerton, California, facility, with an expected return on investment of over 500% through avoided utility peak demand costs*

SAINT-GOBAIN — *For piloting an advanced energy monitoring system with wireless submeters at its Soddy-Daisy, Tennessee, facility that has increased operational efficiency and inspired energy reduction projects yielding approximately $30,000 per year in energy cost savings*

Increasing Access to New Technology

Through the Better Plants program, DOE is helping partners find the latest technological innovations and advances to help meet their energy goals. A key focus area is improving communication and collaboration between the private sector and the DOE national labs, which have already been critical to the development and field validation of technologies like electric vehicle batteries and additive manufacturing.

Technology Days at National Laboratories

Technology Days are designed to expose Better Plants partners' energy and R&D staff to early-stage technologies best positioned to enable American industrial competitiveness and innovation. At Technology Days, tours of state-of-the-art national lab facilities are interspersed with presentations from lab experts on research projects with industrial applications. There are also opportunities to see technology demonstrations and learn how other companies took advantage of lab-industry partnerships.

Better Plants Energy System Validation Working Groups

At the Industrial Energy Technology Conference (IETC) in June 2018, Better Plants hosted the first industrial energy system validation working group meeting, with a focus on steam systems. The working groups bring together representatives from multiple partners and are meant to be platforms to share best practices, identify industry trends and challenges, and gather feedback on industry needs in regard to technology R&D. Working groups on several other focus areas are planned.

New Technology Focus Pages Created on Solution Center

Information for Better Plants partners has been reorganized around thirteen separate technology focus areas to make it easier to find in the online Better Buildings Solution Center. These individual technology focus area webpages are meant to be one-stop shops for partners looking for actionable solutions for energy efficiency challenges involving specific systems. Each page contains links to DOE publications, software tools, webinars, contact information for a subject matter expert, and other helpful resources. Learn more at https://betterbuildingssolutioncenter.energy.gov/better-plants/technology-focus-areas.

Research and Development (R&D) Forum

Better Plants has begun to identify and reach out to R&D staff at partner organizations to further the conversation about industrial technology trends and needs. The ultimate goal is to convene annual R&D forums, enabling industrial stakeholders to provide critical feedback to DOE and national lab researchers and inform their focus areas.

What's New in 2018

Partnership with National Association of Manufacturers Announced

AMO Director Rob Ivester presents to the NAM's Energy Efficiency and Sustainability Task Forces.

In April 2018, DOE and the National Association of Manufacturers (NAM) announced the Sustainability in Manufacturing partnership. The partnership provides DOE – through Better Plants – and the NAM a new opportunity to engage directly with manufacturers, promote program resources, identify opportunities for energy efficiency improvements, and serve as a platform to recognize companies and leaders that have led the way in the application of innovative strategies.

Learn more at https://www.energy.gov/articles/us-department-energy-and-national-association-manufacturers-announce-sustainability.

DOE Visits Martin Guitar to Celebrate Energy Savings

DOE officials tour Martin Guitar's manufacturing facility in Nazareth, Pennsylvania.

DOE officials toured C.F. Martin & Co.'s (**Martin Guitar**) Nazareth, Pennsylvania, flagship plant in June 2018 to promote the Challenge partner's leadership. Through an investment of more than $8 million in an HVAC overhaul, **Martin Guitar** cut electricity use by 46 percent and natural gas consumption by 20 percent. The partner is a goal achiever and winner of a 2017 Better Project award.

Learn more at https://www.energy.gov/eere/articles/energy-department-recognizes-american-guitar-manufacturer-achieving-energy.

General Motors and L'Oréal USA SWAP Energy Teams

*The **General Motors** and **L'Oréal** energy teams put on Kevlar protective sleeves; the **General Motors** energy team uses an infrared temperature gun to read equipment temperatures.*

The fourth season of the Better Buildings Challenge SWAP, the hit DOE web series, featured Better Plants Challenge partners, **L'Oréal USA** and **General Motors**, and debuted in April 2018. Viewers follow along as the two companies swap energy teams and learn from each other's energy efficiency best practices. "None of us are as smart as all of us," **L'Oréal** VP and Plant Manager Eric Fox reflected.

Learn more at https://betterbuildingssolutioncenter.energy.gov/swap/season-4.

"Power Couple" of Kurt and Tari Emerson Featured in Direct Current Podcast

*Tari Emerson and other **Charter Steel** employees participate in an energy treasure hunt; Kurt and Tari Emerson.*

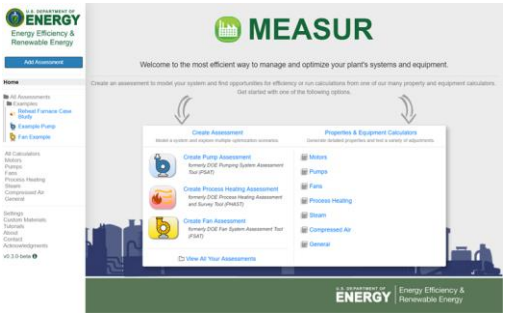
The second season finale of DOE's *Direct Current* podcast featured Kurt and Tari Emerson, husband and wife from two members of Better Plants' own family: **Harley-Davidson** and **Charter Steel**, respectively. The episode explores how the "power couple" met and how they uncover energy savings at their companies. It was downloaded almost 15,000 times in February 2018, the highest monthly total for any *Direct Current* episode to date.

Learn more at https://www.energy.gov/podcasts/direct-current-energygov-podcast/s2-e9-power-couple.

New MEASUR Software Tool Suite

AMO has developed the Manufacturing Energy Assessment Software for Utility Reduction (MEASUR) tool suite to aid Better Plants partners and others in the industrial sector in improving the efficiency of energy systems and equipment within a facility. MEASUR can analyze most major support systems found within industrial facilities, including: compressed air, fans, process heat, pumps, and steam. The tool suite is on an open source platform and enables users to evaluate the energy efficiency opportunities of energy systems using an unbiased approach.

Based on facility-specific operating data, MEASUR estimates how much energy each piece of equipment uses annually – plus the estimated annual energy costs. Assessments are organized to distinguish those with lower levels of opportunities from those that warrant additional equipment analysis. The tool suite suggests methods to save energy in each area where energy is used or wasted and offers a list of additional resources. MEASUR also displays schematics of specific systems to help users better understand their energy systems, as well as a "Sankey diagram" view that breaks down all energy flows for specific scenarios. Finally, users can both view and print or export any information from assessments, including raw data, report graphs, Sankey diagrams, input summaries, or the like. Learn more at https://www.energy.gov/eere/amo/measur.



A look at the MEASUR tool suite interface.

MEASUR's Equipment Calculators

In addition to assessments, MEASUR offers more than 40 equipment calculators, which can, for example:

- Analyze motor performance;
- Calculate steam properties;
- Conduct cash flow analysis;
- Traverse analysis calculations for fans; and
- Build pump and system curves, and much more.

Technology Days 2018 at the National Renewable Energy Laboratory

On April 24 - 25, 2018, Better Plants partners and prospects gathered at the National Renewable Energy Laboratory (NREL) in Golden, Colorado, for the 2018 Technology Days. The event began with overviews of Better Plants and AMO and presentations on lab projects. It included tours of several of NREL's state-of-the-art facilities, talks with onsite researchers, and firsthand looks at their projects. There was also an optional tour of the National Wind Technology Center and Composites Manufacturing Education and Technology Facility; these facilities are located several miles from the main NREL campus, where they take advantage of unique wind patterns.

Technology Days 2018 participants tour the NREL Integrated Biorefinery Research Facility.

Technology Days 2018 inspired partners to think outside the box and consider ways to tap into the national labs. Participants are exploring next steps. "One thing I was particularly interested in was the discussion about how to make fume hoods more efficient," **Eastman Chemical's** Sharon Nolen said. "That is a big energy hog for our company, and we think we've looked at a lot of ideas, but I'm very interested in some additional discussions just to make sure there's nothing we've overlooked. We hope we can learn something new about that."

Dynamic Resources to Drive Savings

Better Plants strives to provide partners with helpful tools and resources to overcome barriers and identify opportunities to save energy. In-Plant Trainings (INPLTs) have long been a key program resource, but partners are also taking ample advantage of newer offerings like the Diagnostic Equipment Program and the previously mentioned MEASUR tool suite.

In-Plant Trainings

INPLTs are multi-day, hands-on workshops held at partner facilities that train participants how to identify, implement, and replicate energy saving projects. INPLTs are led by DOE-certified energy experts and focus on a wide range of topics, including traditional energy systems like compressed air and pumping, but also processes like treasure hunt exchanges and water and wastewater treatment.

This past year, Better Plants offered the new 50001 Ready topic, which features the 50001 Ready Navigator tool and practical exercises to help partners apply the structure of ISO 50001 to their facilities. As of fall 2018, more than 110 INPLTs have been conducted with over 1,500 participants, identifying more than $37 million in potential energy cost savings. Several new topics for INPLTs are being explored, including motors and drives, industrial water efficiency, and advanced trainings on existing topics.

AbbVie Hosts Inaugural 50001 Ready In-Plant Training

AbbVie held the very first 50001 Ready INPLT at their North Chicago, Illinois, facility in September 2017. The facility consumes a significant amount of energy to manufacture active pharmaceutical ingredients and thus plans to implement the ISO 50001 standard by the end of 2018 to streamline energy savings efforts.

Field Validation and Diagnostic Equipment Program

The Field Validation and Diagnostic Equipment Program (DEP) enables Better Plants partners to borrow 19 different tools to collect energy data and improve equipment performance. Through the DEP, partners' plant personnel can test tools before deciding to purchase their own, or even help justify the cost of purchasing tools by demonstrating their value first hand. The full list of available tools is as follows:

- Anemometer
- Combustion Analyzer
- Conductivity Meter
- Current Transformer
- Digital Manometer
- Digital Multimeter
- Digital Thermometer
- HOBO Data Logger
- Infrared Camera
- Infrared Thermometer
- Manometer-Hydronic
- Pitot Tube
- Power Logger
- Pressure Transducer
- Strobe Tachometer
- Thermocouple
- Time-of-use Logger
- Ultrasonic Flow Meter
- Ultrasonic Leak Detector

Borrowing tools from the DEP is free of charge, including shipping. Equipment can be used for up to four weeks at a time, first come, first serve. While the tools were traditionally loaned to energy experts for use during Better Plants INPLTs, through DEP, partners can access them to conduct their own energy system measurements and verification. For example, in the past year **TE Connectivity** has borrowed tools for use in their own energy treasure hunts, and **Nissan North America** has utilized the DEP to assess compressed air equipment.

Supply Chain and Water Savings Initiatives Updates

Better Plants provides partners with opportunities to extend their energy savings through improved supply chain-energy efficiency and water use reduction.

Supply Chain Initiative

Through the Supply Chain Initiative, partners sponsor cohorts of their suppliers to participate in Better Plants. These partners receive customized technical assistance in the form of training webinars and tools to help them meet their energy saving goals. In the past year, two supply chain partners met their goals: **Cardington Yutaka Technologies** (Honda North America cohort) and **Complete Design and Packaging** (Legrand North America cohort); see page 3.

*The rear disc production line at **Asama Coldwater Manufacturing**, a member of **Honda North America**'s supply chain cohort.*

Two supply chain partners, **Asama Coldwater Manufacturing** and **KYB Americas Corporation**, hosted INPLTs. More than 30 employees attended the trainings and came away with a solid understanding of how to optimize compressed air and process heating systems. These trainings also yielded estimated energy cost saving opportunities of more than $330,000 a year. Several other supplier companies received 12 assessments from Industrial Assessment Centers (IACs; see page 12), yielding aggregate energy cost savings potential of more than $2 million per year. By implementing these recommendations, suppliers can drive greater energy savings and move closer to achieving their goals.

Water Savings Initiative

Through the Water Savings Initiative, Better Plants Challenge partners set goals to save water in addition to energy and receive recognition and technical support. Two Challenge partners, **Bentley Mills** and **Electrolux**, joined the initiative in the past year.

BENTLEY® set a goal to reduce water intensity by 20% from 2017 to 2027

Electrolux set a goal to reduce water intensity by 20% from 2015 to 2025

In addition, Better Plants has created a water-focused page on the online Better Buildings Solution Center to gather multiple water efficiency resources in one place (see page 5). The page includes links to a water management primer, several helpful webinars, as well as showcase projects and implementation models by partners in the Water Savings Initiative.

Plant Water Profiler Tool

Water-consuming systems in industrial manufacturing plants include a wide range of processes from cooling and condensing to power generation and steam. The new Plant Water Profiler Tool helps assess total plant water intake, wastewater disposal, and the "true cost"of water in the plant. Thus, it helps management identify systems that contribute to water consumption and cost and enables efforts to prioritize water efficiency measures. Results can also be used to establish a baseline and track water use during subsequent years.

The tool evaluates "water balance" by individual systems, accounting for the source water intake, recirculated water, consumptive water use, and wastewater disposal. This helps users understand water losses and potential water savings. The tool can also provide a tailored list of water efficiency measures and opportunities specific to the plant. It's a "first step" that industrial facilities can follow to minimize their water use and achieve cost savings. Learn more at https://www.energy.gov/eere/amo/plant-water-profiler-tool-excel-beta-version-pwpex-v01.

Getting Partners 50001 Ready

DOE also offers 50001 Ready and Superior Energy Performance (SEP 50001) recognition for facilities and organizations that practice ISO 50001-based energy management. Several Better Plants partners are going through the process of earning 50001 Ready recognition, which can help them meet their energy goals:

1. Complete 25 tasks in the 50001 Ready Navigator

   Track your progress through the Navigator, an online guide for establishing an energy management system (EnMS) to plan, identify, prioritize, and implement projects to improve a facility's energy performance.

2. Self-attest to the tasks' completion

   Submit a simple self-attestation form to confirm the establishment of an EnMS.

3. Measure and improve energy performance over time

   For initial 50001 Ready recognition, organizations must report facility-level energy consumption for operations included in their 50001 Ready EnMS. In subsequent years, organizations must demonstrate continued performance improvement.

50001 Ready
U.S. DEPARTMENT OF ENERGY

Better Plants Partners With 50001 Ready Facilities

ArcelorMittal	Cleveland, Ohio
CHARTER STEEL	Saukville, Wisconsin
COMAU	Novi, Michigan
NISSAN	Canton, Mississippi Decherd, Tennessee Smyrna, Tennessee

Through SEP 50001, facilities with an EnMS that meets the ISO 50001 standard and demonstrate improved energy performance – up to 30 percent over three years – can receive third-party verification and certification. By going beyond ISO 50001 and investing the extra effort in SEP 50001, facilities reveal new energy savings opportunities and develop cultures of continual improvement.

New Better Plants Showcase Projects and Implementation Models

Showcase projects and implementation models are opportunities for Better Plants Challenge partners to document and share their energy efficiency best practices for others to emulate. Here are some of the latest posted on the online Solution Center:

- **Electrolux:** Internal Energy Management Certification Driving Best Practices in Monitoring, Management, and Awareness (https://betterbuildingssolutioncenter.energy.gov/implementation-models/internal-energy-management-certification-driving-best-practices-monitoring)
- **Martin Guitar:** Retrofitted HVAC System at Nazareth, Pennsylvania, Facility (https://betterbuildingssolutioncenter.energy.gov/showcase-projects/retrofitted-hvac-system-at-nazareth-pa-facility)
- **Nissan North America:** Chilled Water System Upgrades and Dashboard (https://betterbuildingssolutioncenter.energy.gov/showcase-projects/chilled-water-system-upgrades-and-dashboard)

Additional Complementary Programs

One of the most valuable features of Better Plants is access to complementary programs offered by AMO. Working with their Technical Account Managers, Better Plants partners can tap resources to help them save money, improve resiliency, and receive no-cost energy assessments. In the past year, many partners leveraged these programs and reaped the benefits.

Industrial Assessment Centers

Better Plants partners can take advantage of no-cost energy assessments from DOE's IACs. Teams at 28 universities around the country conduct the energy audits to identify opportunities to improve productivity, reduce waste, and save energy. To date, IACs have assessed more than 17,600 manufacturers, resulting in over 134,000 savings recommendations. The average IAC assessment leads to 5-7% implemented energy savings and productivity improvement.

Honda North America has eight of its suppliers participating as a cohort in Better Plants' Supply Chain Initiative. As small businesses, these partners have greatly leveraged the IAC assessments as a no-cost way of identifying energy savings opportunities. In total, five **Honda North America** suppliers in Better Plants – **Asama Coldwater Manufacturing**, **Cardington Yutaka Technologies**, **KYB Americas Corp.**, **Newman Technologies**, and **NSK Americas** – have received 11 IAC energy assessments.

Combined Heat and Power Technical Assistance Partnerships

Combined heat and power (CHP) is an efficient and clean approach to generating on-site electric power and useful thermal energy from a single fuel source. DOE's CHP Technical Assistance Partnerships (TAPs) are available to help identify CHP market opportunities through vendor, fuel, and technology neutral assessments of CHP viability. Additionally, CHP TAPs help provide technical assistance to end-users and stakeholders considering CHP, and to help them through the project development process, from initial CHP screening to installation.

Shaw Industries' *Columbia, South Carolina, plant.*

In May of 2018, **Shaw Industries**, a Better Plants goal achiever, completed the construction of a 14.1 MW CHP system in their Columbia, South Carolina, plant. This project was in many ways a product of their engagement with the Southeast CHP TAP. In 2013, the TAP had provided some initial CHP screening and recommendations, which was followed up the next year by a CHP feasibility analysis. And in 2017, the Southeast CHP TAP hosted two groups of operators from the partner to visit NC State University's CHP facilities as part of their training, with a wide-ranging discussion on CHP.

Technologist in Residence Program

The Technologist in Residence (TIR) Program pairs senior technical staff from national laboratories and manufacturing companies to work together towards long-term strategic collaborative partnerships and impactful manufacturing solutions. TIR's vision is to catalyze strong national laboratory-industry relationships that result in significant growth in high-impact R&D. More than a one company-one lab partnership, industry gains insight and builds relationships across the national laboratory system, developing streamlined methods for establishing long-term relationships that result in collaborative R&D. Three Better Plants partners, **Alcoa**, **Cummins**, and **Procter & Gamble**, were selected for the first class of TIR pairs.

R&D Projects and Consortia

Through AMO's public-private R&D consortia, manufacturers, small businesses, universities, national laboratories, and state and local governments come together to pursue coordinated early-stage R&D in high-priority areas essential to energy in manufacturing. By participating, Better Plants partners gain access to collaborative communities, expertise, and physical and virtual tools to foster technology innovation; Ford Motor Company, for example, is working with IACMI to develop lightweight carbon fiber composites.

Clean Energy Smart Manufacturing Innovation Institute (CESMII)

Advancing sensors, controls, modeling, data analytics simulation, and platform development to radically improve the efficiency of U.S. manufacturing. Learn more at https://www.cesmii.org/.

Critical Materials Institute: An Energy Innovation Hub

Diversify supply, develop substitutes, improve reuse and recycling of rare earth metals and materials that are crucial for clean energy technologies. Learn more at https://cmi.ameslab.gov.

Institute for Advanced Composites Manufacturing Innovation (IACMI)

Developing cutting-edge technologies for low-cost, energy-efficient manufacturing of advanced polymer composites for many applications. Learn more at https://iacmi.org.

Manufacturing Demonstration Facility (MDF) at Oak Ridge National Laboratory

Collaborations with industry aim to develop additive manufacturing technologies that reduce life cycle energy, lower costs, and create new products. Learn more at https://www.ornl.gov/mdf.

The Rapid Advancement in Process Intensification Deployment (RAPID) Institute

Focused on breakthrough technologies to dramatically improve energy efficiency of novel chemical manufacturing processes. Learn more at https://www.aiche.org/rapid.

Clean Energy Manufacturing Innovation Institute for Reducing Embodied-Energy and Decreasing Emissions (REMADE)

Dramatically reduce life cycle energy consumption through the development of technologies for reusing, recycling, and remanufacturing materials. Learn more at https://remadeinstitute.org.

PowerAmerica

Accelerating development of advanced semiconductor components made with silicon carbide and gallium nitride into a wide range of products and systems. Learn more at https://poweramericainstitute.org.

Better Plants partners interested in the R&D consortia should contact their Technical Account Manager.

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. In addition to expanding initiatives highlighted in the report, here's how Better Plants plans to carry the momentum forward in the next year:

Energy System Validation Working Groups

At the 2018 IETC, Better Plants piloted a steam working group meeting, designed to allow partners to share successful strategies and challenges, as well as to present DOE tools and resources; see page 5. Better Plants aims to expand to new topics like process heating, compressed air, and pumping.

New In-Plant Training Topics

To date, DOE has offered over 110 INPLTs, which have trained more than 1,500 workers at Better Plants facilities. Better Plants will continue to expand the resource offerings through new potential topics such as motors and drives and industrial water efficiency.

Better Plants Connections and Mentoring Program

This new initiative will leverage the deep knowledge and experience of some of our partners to forge strong relationships and share advice and solutions.

Small-to-Medium Manufacturers Quick Start Guide to Energy Savings

Small and medium manufacturers frequently lack the same dedicated staff and resources to tackle energy efficiency opportunities, and this all too often will deter them from taking first steps. Better Plants will develop a quick start guide to help these manufacturers hit the ground running on the path towards savings.

Energy-Intense Manufacturers Program

Manufacturers in energy-intense sectors like chemical processing face unique challenges, but also the potential to save substantial amounts of energy. Better Plants will dedicate resources – such as specialized guidance for meeting energy goals – to help these partners and bring new, similar partners in.

Greater Engagement with Manufacturing USA Institutes

Manufacturing USA is a network of regional institutes, each with a specialized technology focus. The institutes share one goal: to secure the future of manufacturing in the U.S. through innovation, collaboration and education. Better Plants will facilitate our partners to learn more and potentially participate in these institutes.

Endnotes

1. Better Plants cumulative energy cost savings values are calculated using EPA unit price values and MECS 2010 manufacturing energy distribution summary statistics.
2. Savings equivalency for manufacturing workers' annual average salaries ($84,832 in 2017) is derived from NAM, http://www.nam.org/Newsroom/Facts-About-Manufacturing.

Better Plants Challenge Energy and Water Goal Achievers Since 2009

Better Plants Program Energy Goal Achievers Since 2009

Partners as of October 2018

3M*
AbbVie Inc.
Alcoa Inc.
Alexandria Renew Enterprises
Amcor Rigid Plastics
American Mitsuba Corp.
ArcelorMittal USA
Armstrong Flooring
Asama Cold Manufacturing
AT&T*
Avon Lake Regional Water
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
Dixline Corporation
Donsco Inc.
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*
Fiat Chrysler Automobiles
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
Imerys Carbonates North America
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.*
Krage Manufacturing
KYB Americas Corporation
L'Oréal USA
Land O' Lakes
Leggett & Platt
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)
Newman Technology, Inc.
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.
Plastics Engineering Company (Plenco)
PPC Broadband
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.*
Sheboygan Regional Wastewater Treatment Facility
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*
Texas Nameplate Co.
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
Zimmer Biomet

KEY

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