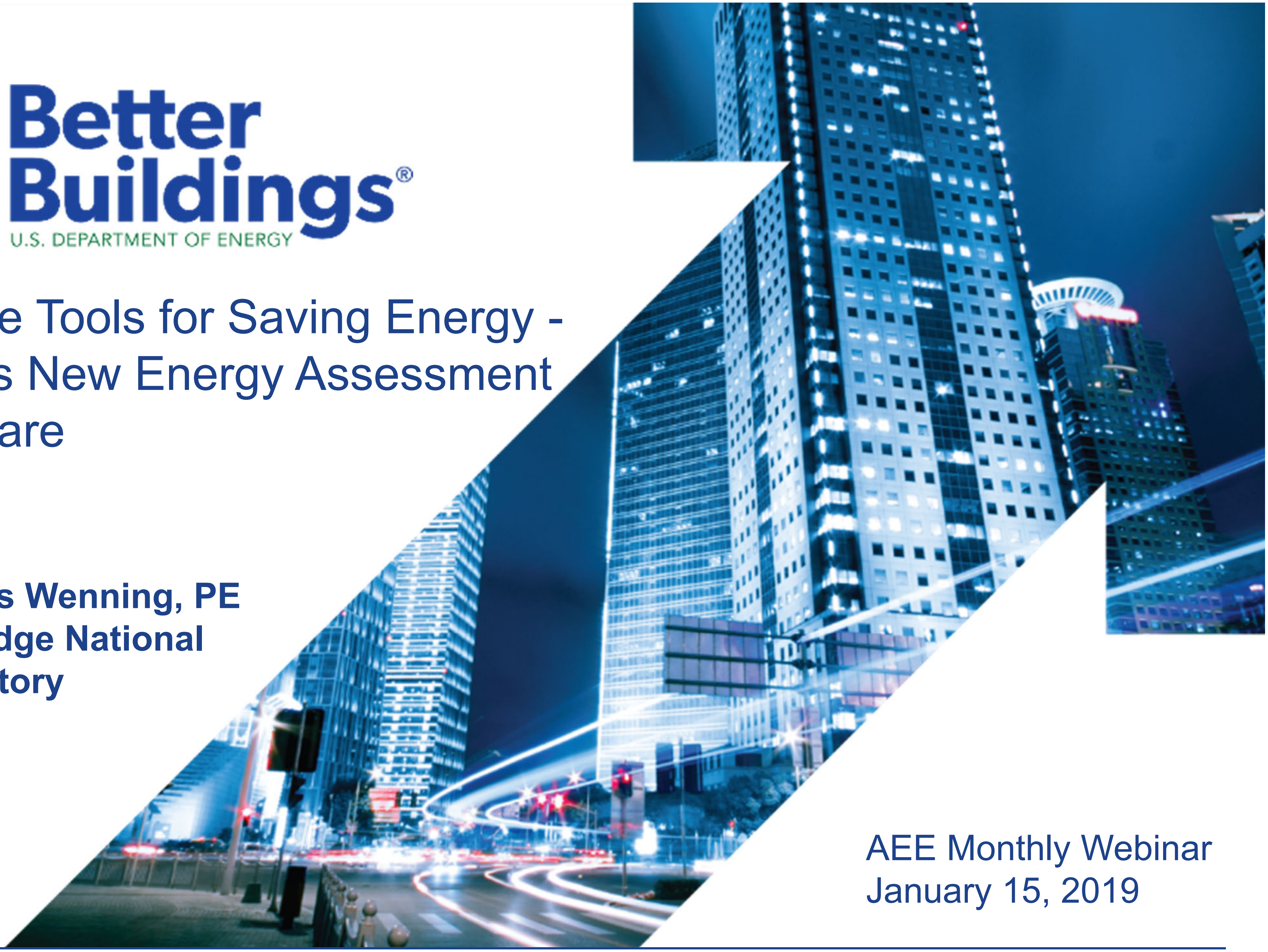
Better Buildings®
U.S. DEPARTMENT OF ENERGY

Simple Tools for Saving Energy - DOE's New Energy Assessment Software



Thomas Wenning, PE
Oak Ridge National Laboratory

AEE Monthly Webinar
January 15, 2019

U.S. DEPARTMENT OF ENERGY

Better Buildings, Better Plants

Better Plants®
U.S. DEPARTMENT OF ENERGY

- **What is Better Plants? A voluntary**, public-private partnership program for **manufacturers** and industrial organizations
- Through Better Plants:
  - Partners set long-term efficiency goals
  - Receive **technical assistance, networking platforms** and **national recognition**
- Manufacturers have two opportunities to engage in Better Plants:
  1. Broader-based ***Program*** level
  2. Higher-level ***Challenge***

Productivity + Cost Savings = Competitiveness

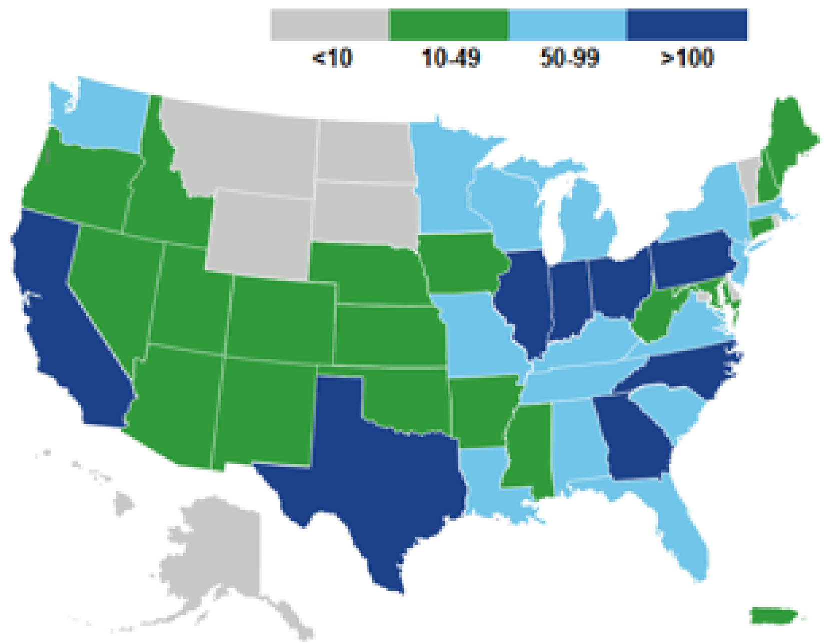
Better Plants Overview

Energy savings and program footprint continue to grow

Better Plants Snapshot

Accomplishments	Total
Number of Partners	202
Approximate Number of Plants	3,000
Percent of U.S. Manufacturing Energy Footprint	12%
Reported Savings	
Cumulative Energy Savings (TBtu)	1,056
Cumulative Cost Savings (Billions)	$5.3
Cumulative Avoided CO_2 Emissions (Million Metric Ton)	36
Average Annual Energy Intensity Improvement Rate	3.2%

Regional Distribution of Better Plants Facilities



52 goal achievers total, 9 this year!

Better Plants Challenge Partners

Simplot
Bringing Earth's Resources to Life
3M
CF Martin & Co. EST. 1833
United Technologies
Schneider Electric
Pharmavite
LA DWP
Briggs & Stratton
Cummins
Volvo
NEW Water
The brand of the Green Bay Metropolitan Sewerage District
Solberg
GM
Johnson Controls
Ford
Nissan
VVWRA
Ingersoll Rand
Electrolux
General Mills
Lennox International
Eastman
HARBEC
BD
OWASA
BCW&SA
GE
Bentley
City of Ithaca, N.Y. Incorporated 1888
Holcim
TE connectivity
Darigold
Since 1918
Des Moines Water Works
Water You Can Trust for Life
Toyota
L'ORÉAL USA
Encina Wastewater Authority
Environmental Services
Alcoa
Celanese
The chemistry inside innovation™
legrand®
Saint-Gobain

Why Partner with Better Plants?

Technical Assistance

- **Technical Account Manager:** navigate program and access resources
- **In-Plant Trainings**: expert instructors come to your plant
- **Resources:** Diagnostic & Software Tools/Industrial Assessment Centers/CHP TAPs/Water Savings Tools/Connection to National Labs
- **Supply Chain Engagement:** resources to advance supplier energy efficiency

National Recognition

- **Awards** for Goal Achievers
- **Better Project/Better Practice Awards**

Cummins' green initiative takes root

Nov 5, 2014, 12:26pm EST

Save Order Reprints Print

David Bertola
Buffalo Business First Reporter-
Buffalo Business First
Email | Twitter | Google+

The U.S. Department of Energy is recognizing the Cummins Inc. Jamestown engine plant as a showcase project for its Better Buildings Better Plants Challenge.

According to the Department of Energy's

Enlarge Photo

A Cummins engine at the Jamestown plant. (file photo)

Peer-to-Peer Networking Opportunities

Technical Assistance: Diagnostic Equipment Program

Field data is best for evaluating system performance






- Free of charge, including shipping
- Use equipment for one day, or up to four weeks
- Some technical assistance with selection and usage
- First come, first serve application

Advanced Technology Partnerships

Better Plants hosts events at National Laboratories to:

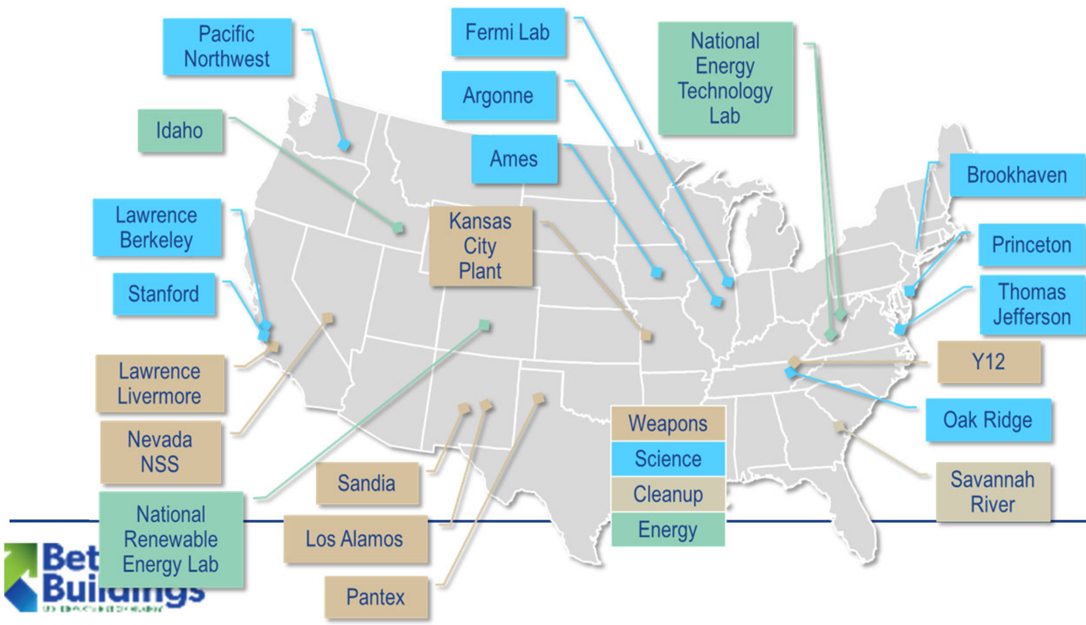
Tour World-Class Facilities

View Demonstrations of innovative technologies

Hear from experts and Industry peers

Learn about research partnerships

Network with BP partners and researchers



Treasure Hunt Toolkit

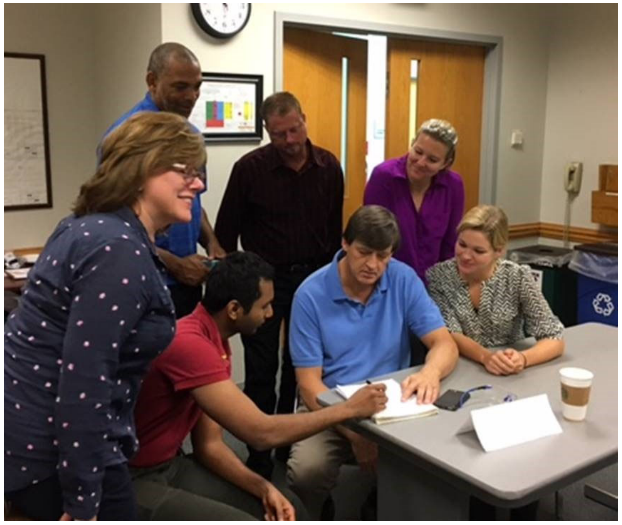
PHASE 1 — Preparation
- Agenda - Template
- Pre-event Data Collection Form
- Plant Energy Profiler (PEPEx) Tool

PHASE 2 — Event
- Kick off Presentation
- Handouts
- Energy Efficiency Calculators
- Opportunity Sheet and Summary Report Generator

PHASE 3 — Follow-up
- Event Certificate - Template
- Evaluation Form - Template
- Project Implementation Tracker

Key Aspects:

- Empower and enable plant personnel
- Focus on low-cost/no-cost opportunities
- Observing the idle facility
- Facility employees conduct and have ownership of the ideas / opportunities



DOE Software Tools

www.energy.gov/eere/amo/software-tools

Overview: Current DOE Software Tools

Energy Management & Performance Tracking

- 50001 Ready Navigator
- Energy Footprint Tool
- Automated Register of Implemented Actions
- EnPI and EnPI Lite Tools
  - Corporate Energy Performance Tracking for Better Plants partnership
  - Facility Energy Performance Tracking for Superior Energy Performance
- PEP (Plant Energy Profiler)
- PWP (Plant Water Profiler)

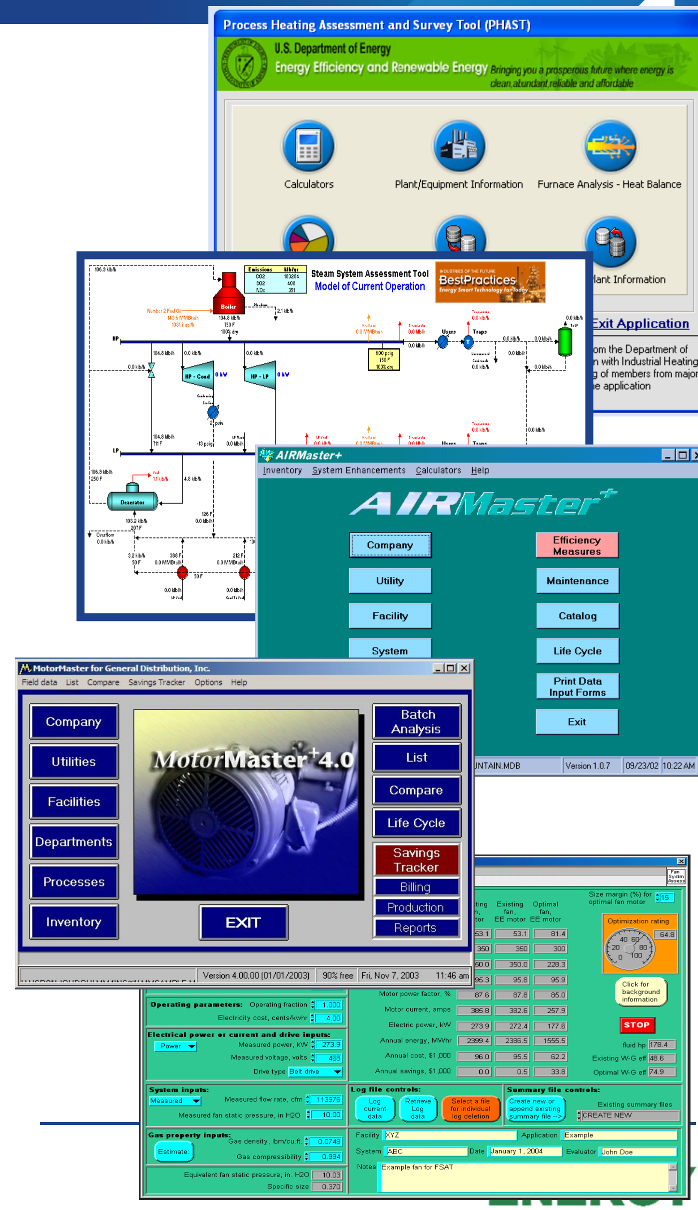
Energy Systems Analysis

- Motors
- Pumps
- Fans
- Compressed Air
- Steam
- Process Heating
- Data Centers
- Simple Calculators
- Treasure Hunt Toolkit

www.energy.gov/eere/amo/software-tools

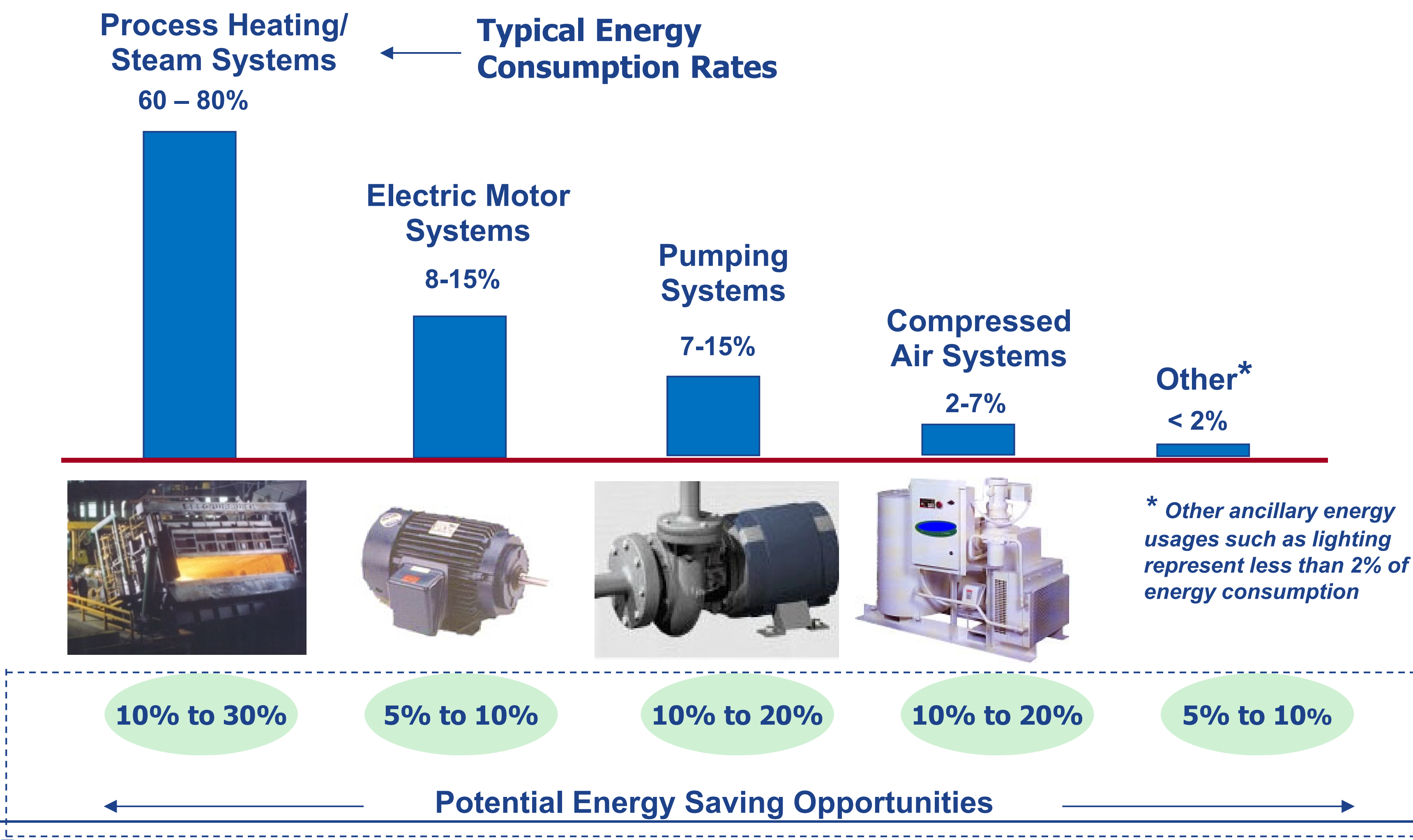
Overview – DOE Software Tool History

- **Technology and Vendor Agnostic** tools to identify, quantify and validate energy saving opportunities
- Most DOE software tools were **developed in the ’90’s**
    - Operating Systems updated…DOE did not!
    - Many **no longer work** with current operating systems
- Original tools were **developed with industry experts**
- **Highly valued by the manufacturing community** – including end-users, trade associations, utility programs, etc.
- Foundational tools to support other DOE activities
    - Energy Saving Assessments (ESAs)
    - Better Plants In-Plant Trainings
    - Industrial Assessment Centers
    - Case Studies & Fact Sheets



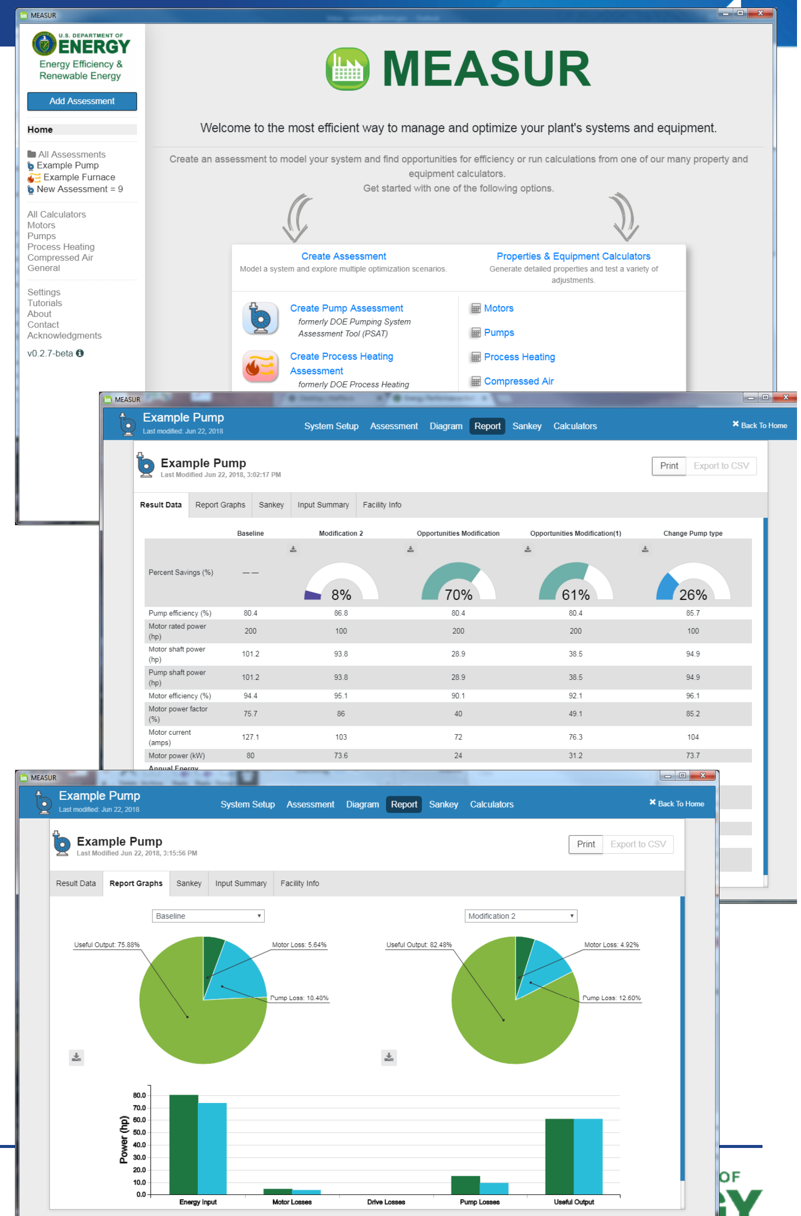
Software Changes, Systems Don't

High-level Plant Energy & Savings Profile

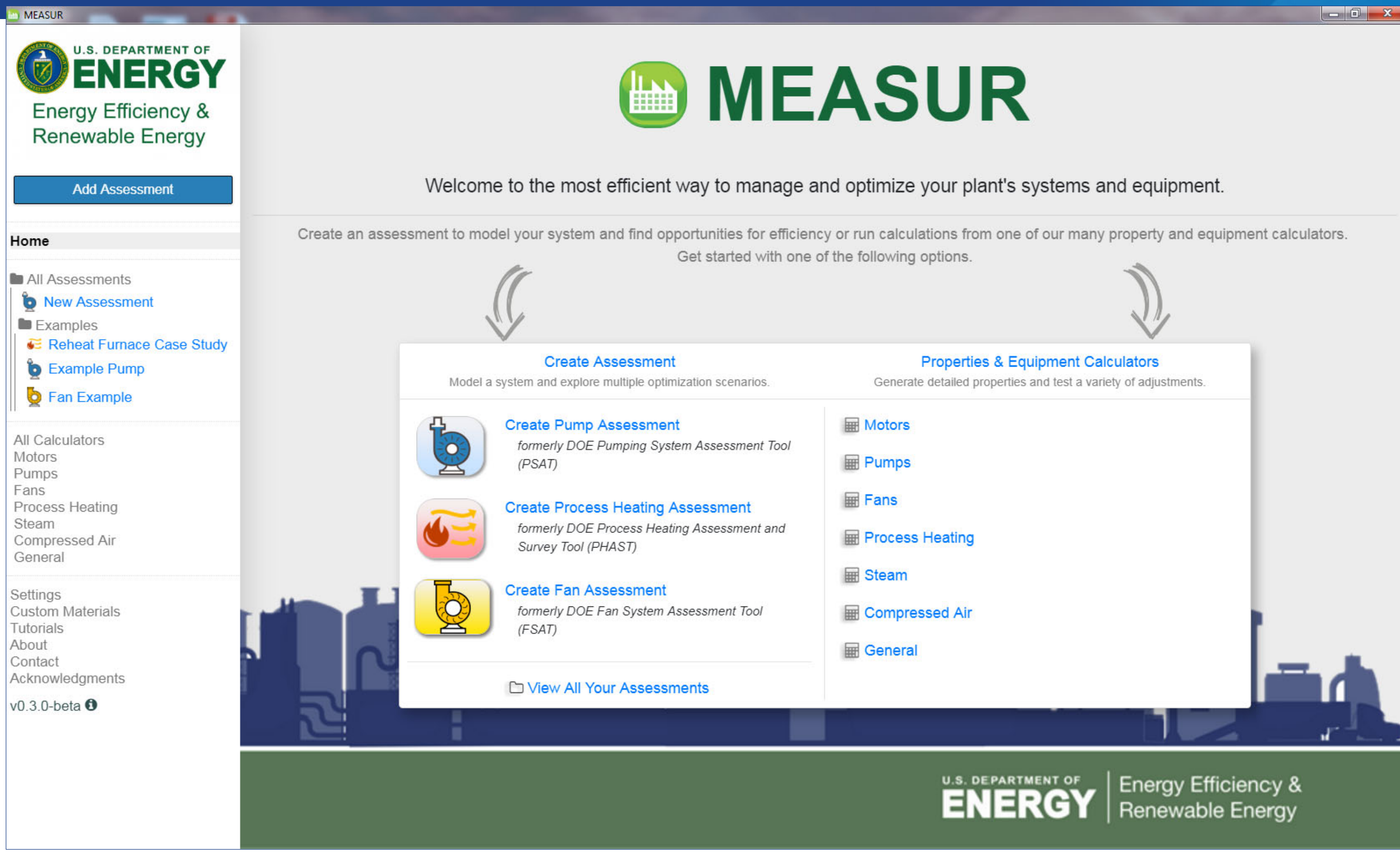


MEASUR Software Tools

- Modernize to **Open-Source Software**!
  - DOE will own and control code
  - Upgrading tool capabilities where feasible
    - **Ex: Auto-Update** capability (silent updates)
  - Government-wide Open-Source Software - https://github.com/ORNL-AMO
    - UT-Battelle Permissive License – *"Do whatever, but please provide attribution"*
  - Desktop (Windows, Mac & Linux) & Web/Mobile
- Provide industry with **technology/vendor agnostic** analysis and evaluation tools

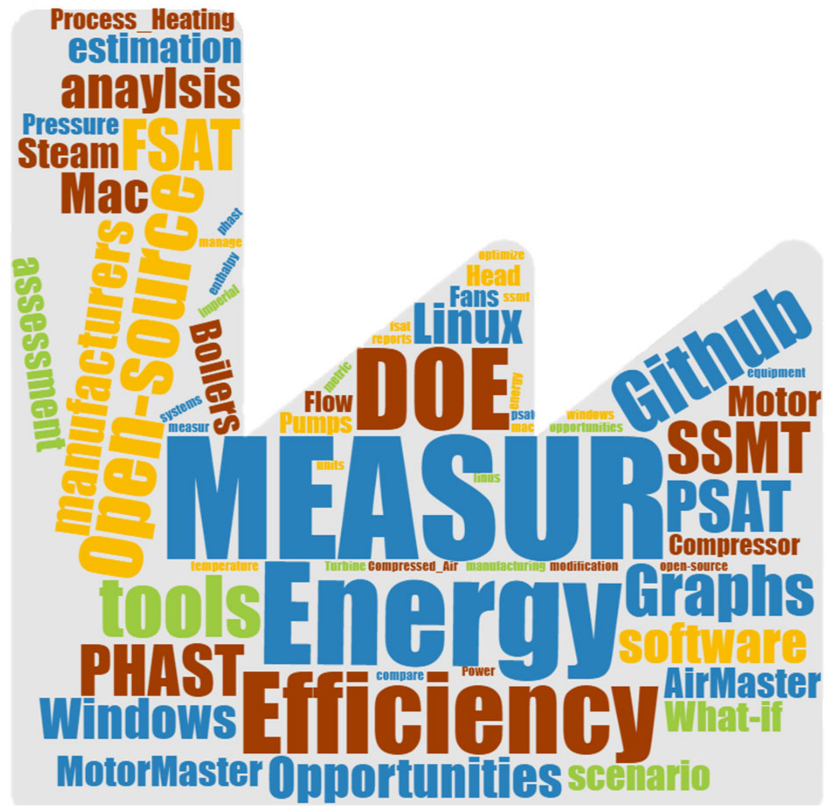


Integrated Energy Software - MEASUR

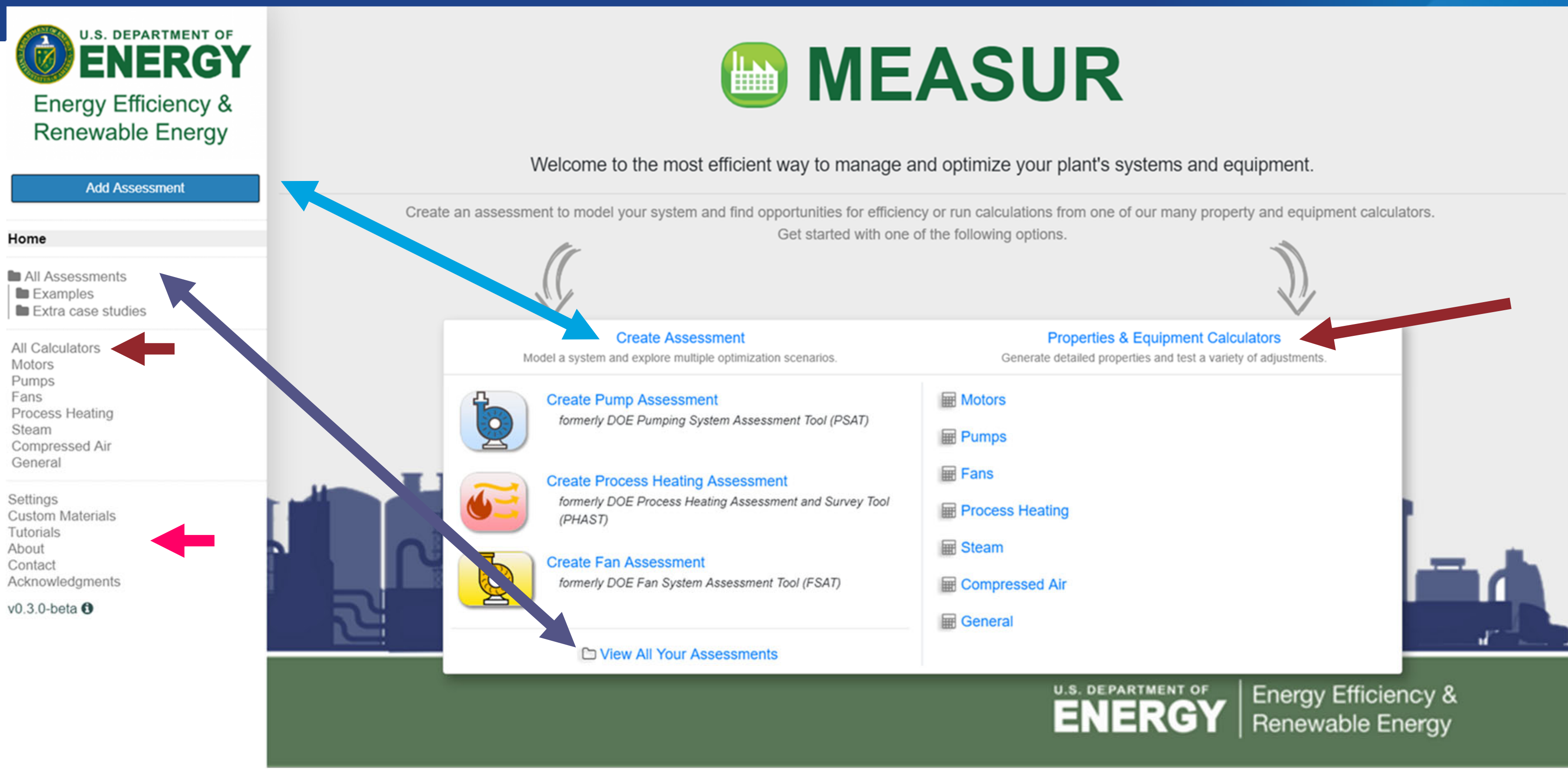


- All system level software tools will be available to through **one platform**
- Includes system modelers and individual calculators for **field validation**
- Includes **built-in guides** and **tutorials**

Using MEASUR



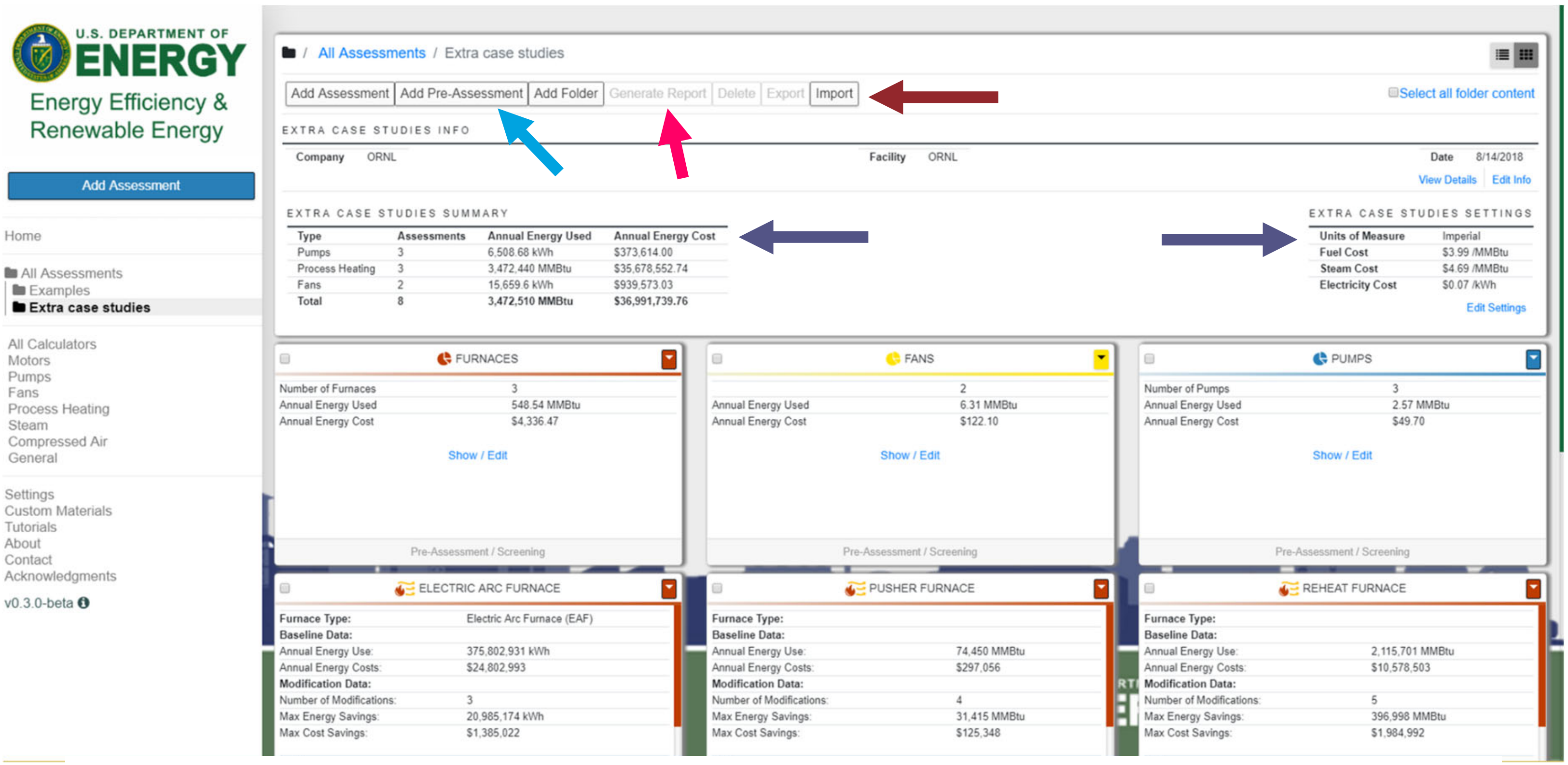
Getting Started



- Start an assessment
- View Assessment Dashboard
- Use Properties & Equipment Calculators
- Change Settings, view tutorials, manage custom materials

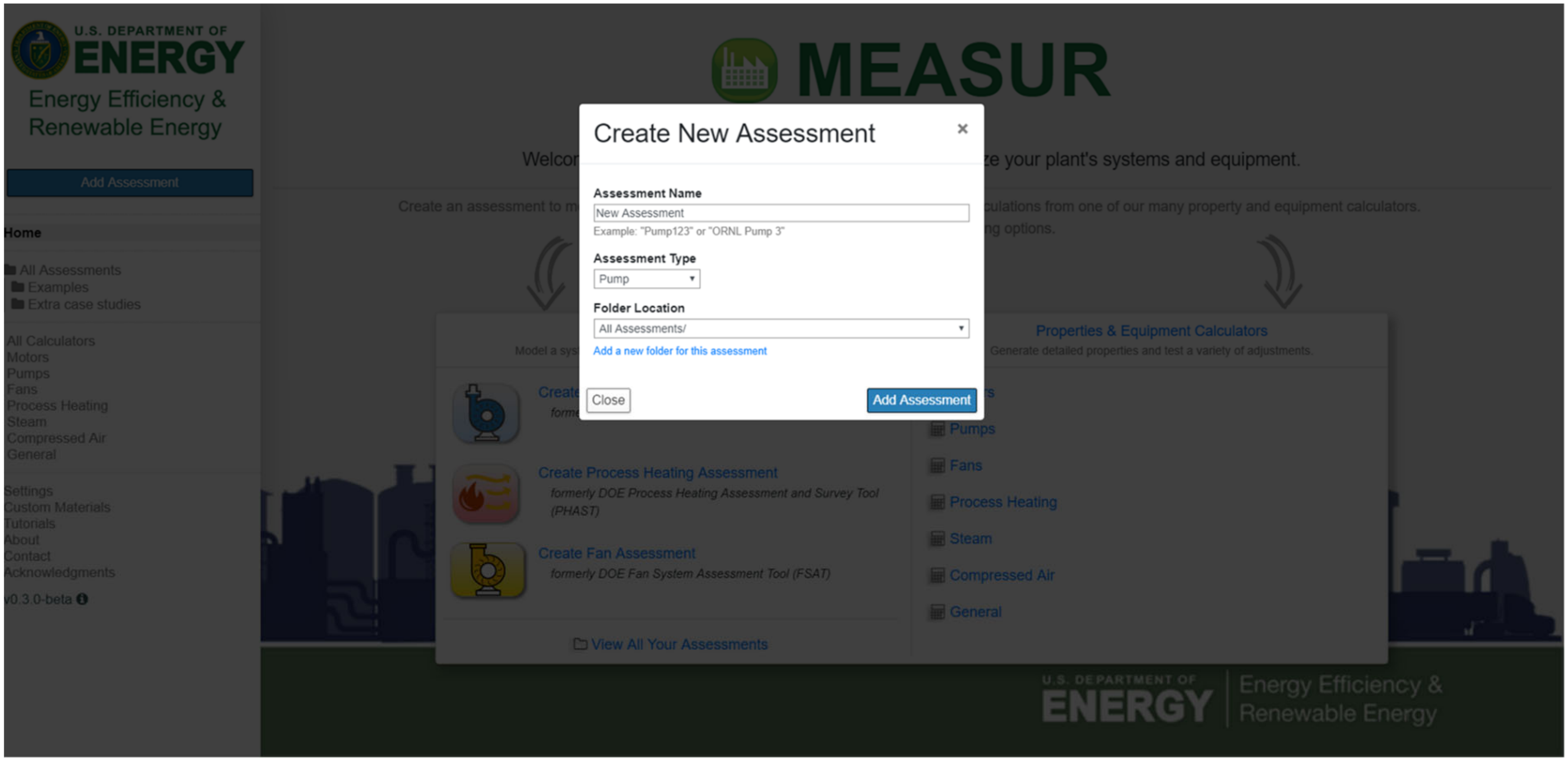
Assessments Dashboard

View all your assessments in a folder-based organization



- Move, copy, import and export assessments
- Add/view facility information and folder-wide settings
- Make pre-assessment screenings
- Generate rollup reports of several assessments

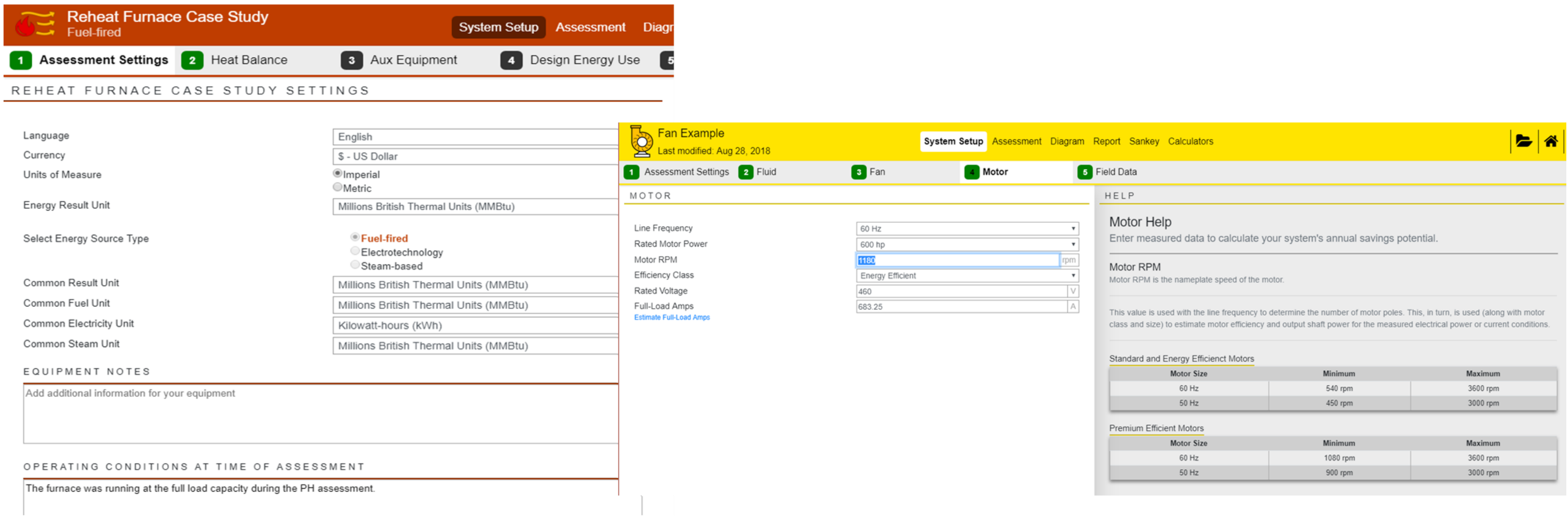
Starting an Assessment



- Choose a unique name for the folder
- Set Equipment type (Pump, Fan, Process Heater)
- Choose folder location
  - Or make a new folder

System Setup

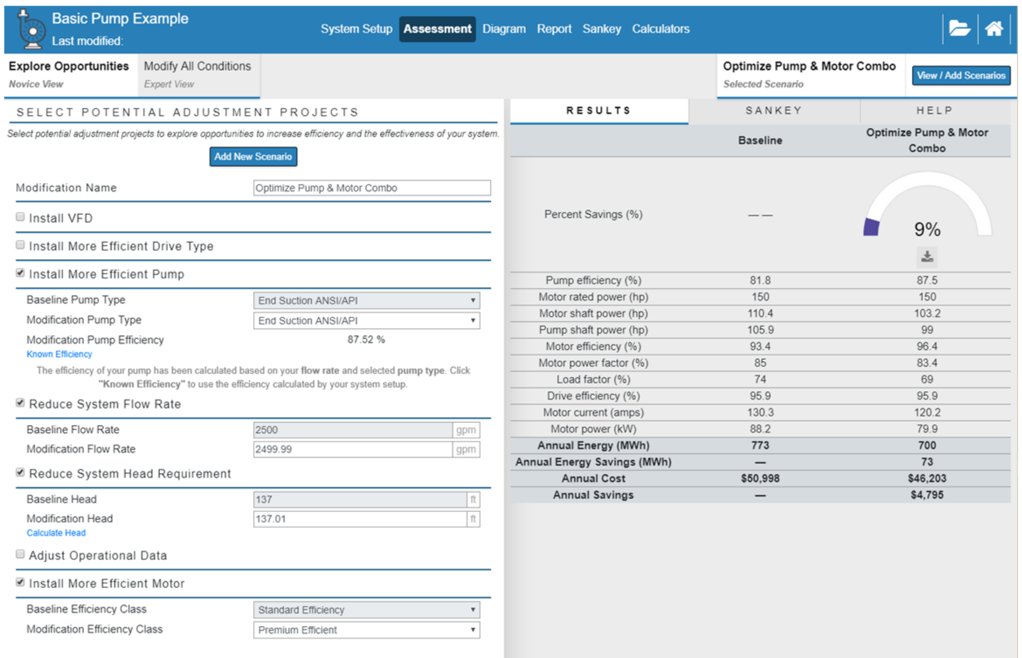
Start with current equipment and operations - baseline

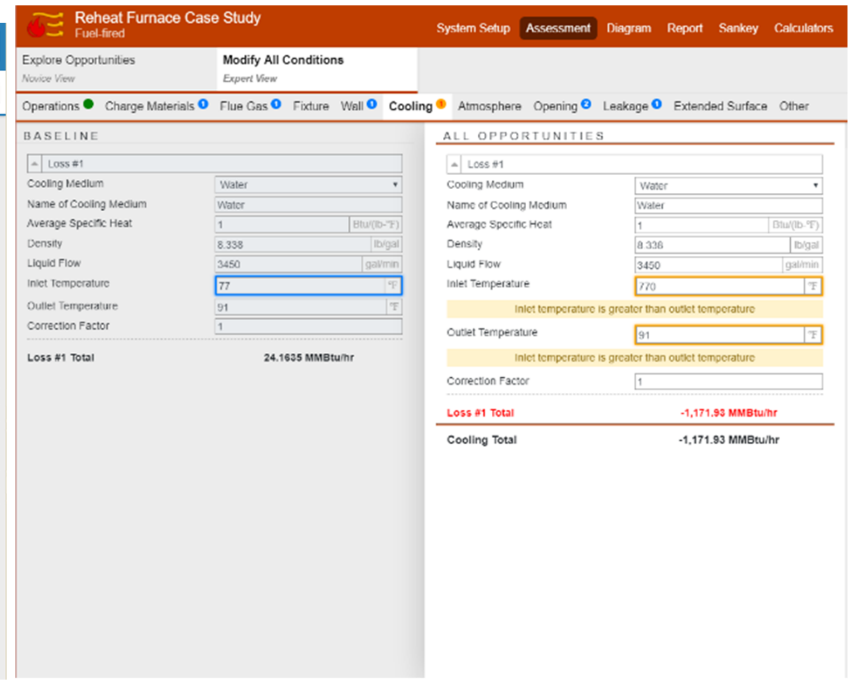


- Assessment Settings: Set units and basic assessment settings
- Assessment Specific Tabs
  - Data Entry for baseline assessment
  - Intermediate Results
  - Help text for each data entry field

Assessments

Explore energy savings opportunities

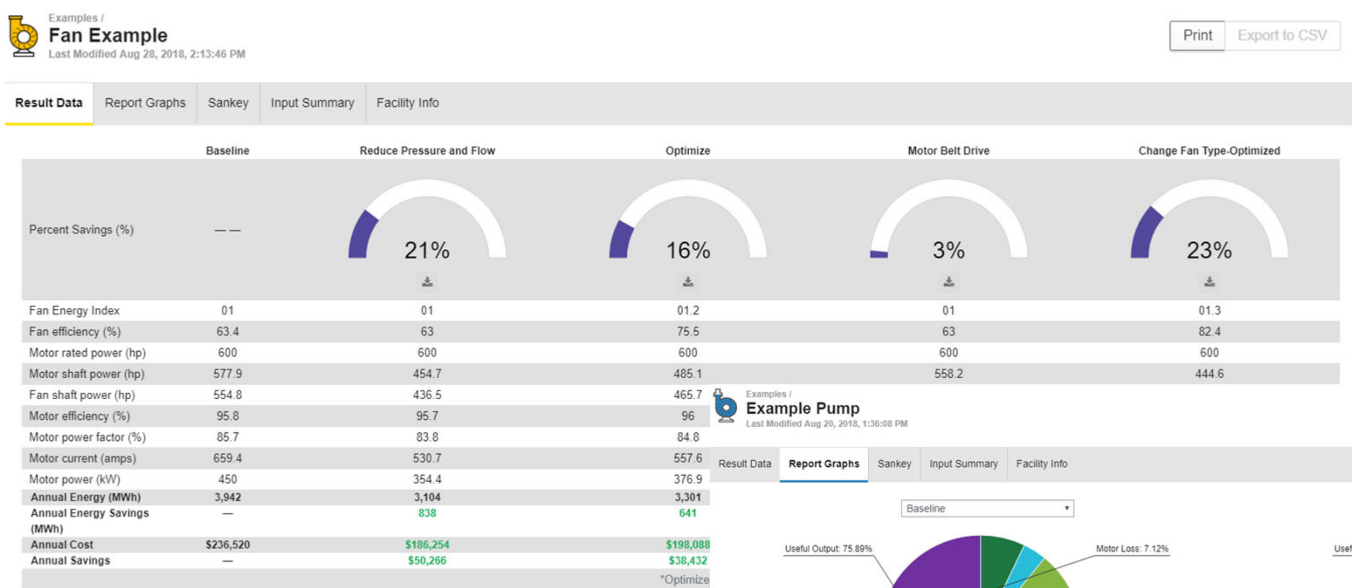




- Explore Opportunities: build scenarios from pre-established energy savings measures
- Modify All Conditions: build scenarios using same forms as baseline
    - Badges and field highlighting for visual cues

Reports

View side-by-side comparison of all scenarios and graphs for data visualization

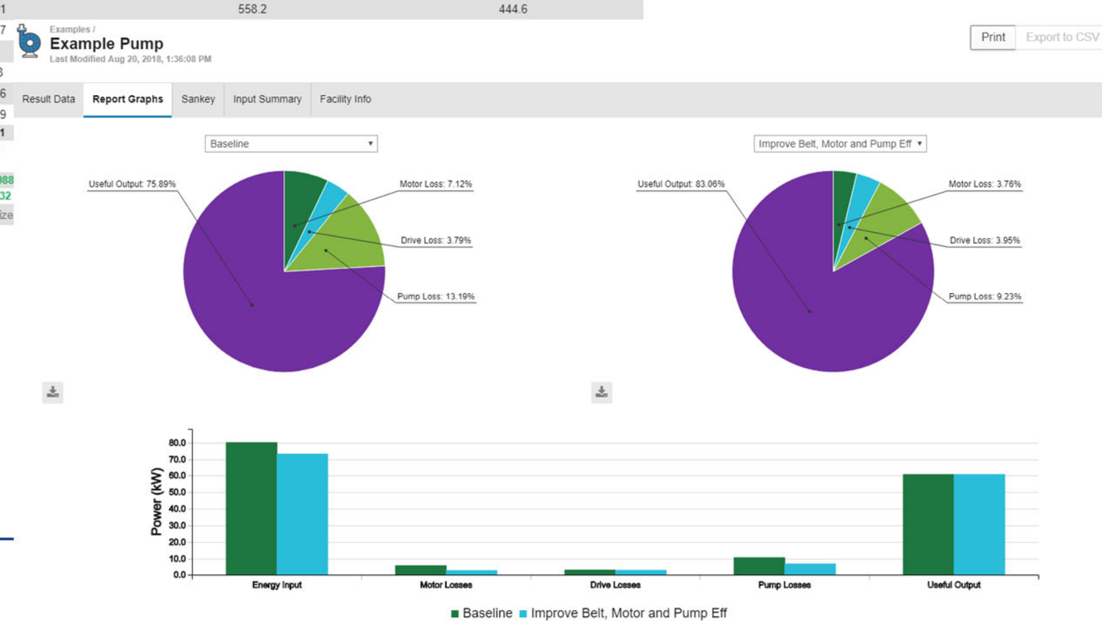


Examples /
Fan Example
Last Modified Aug 28, 2018, 2:13:46 PM

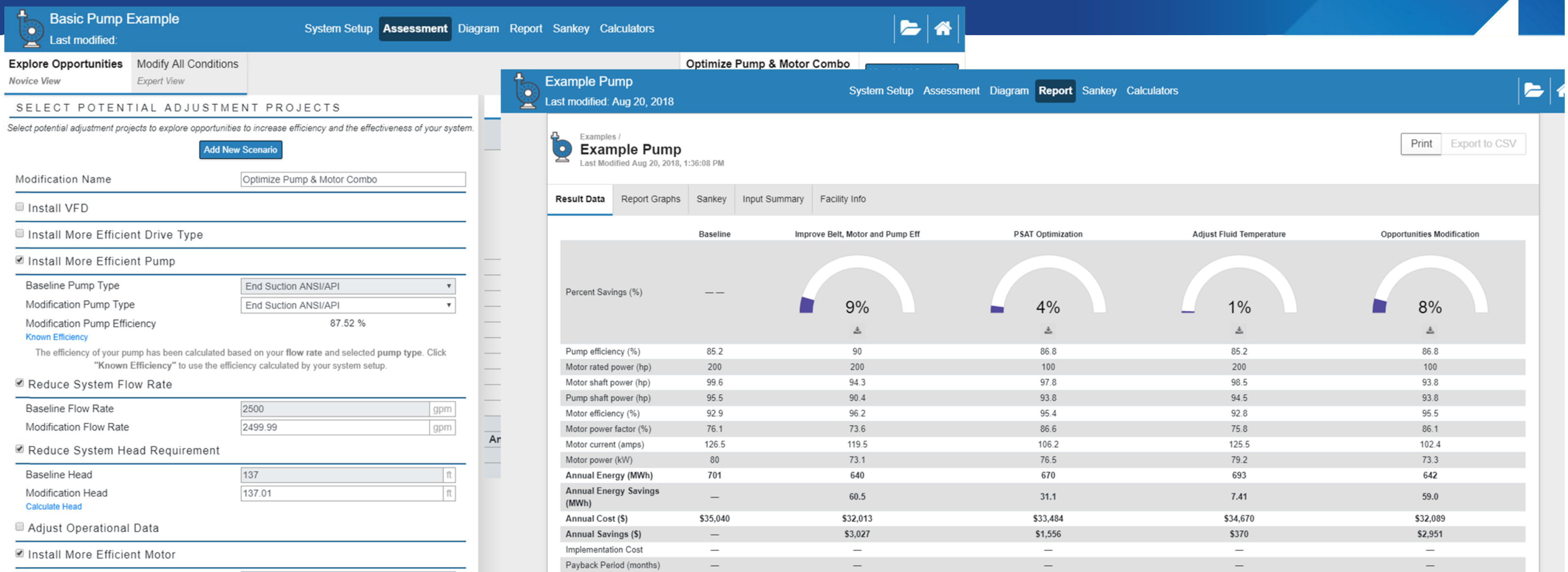
Print | Export to CSV

Result Data | Report Graphs | Sankey | Input Summary | Facility Info

	Baseline	Reduce Pressure and Flow	Optimize	Motor Belt Drive	Change Fan Type-Optimized
Percent Savings (%)	— —	21%	16%	3%	23%
Fan Energy Index	01	01	01.2	01	01.3
Fan efficiency (%)	63.4	63	75.5	63	82.4
Motor rated power (hp)	600	600	600	600	600
Motor shaft power (hp)	577.9	454.7	485.1	558.2	444.6
Fan shaft power (hp)	554.8	436.5	465.7		
Motor efficiency (%)	95.8	95.7	96		
Motor power factor (%)	85.7	83.8	84.8		
Motor current (amps)	659.4	530.7	557.6		
Motor power (kW)	450	354.4	376.9		
Annual Energy (MWh)	3,942	3,104	3,301		
Annual Energy Savings (MWh)	—	838	641		
Annual Cost	$236,520	$186,254	$198,088		
Annual Savings	—	$50,266	$38,432		
			*Optimize		

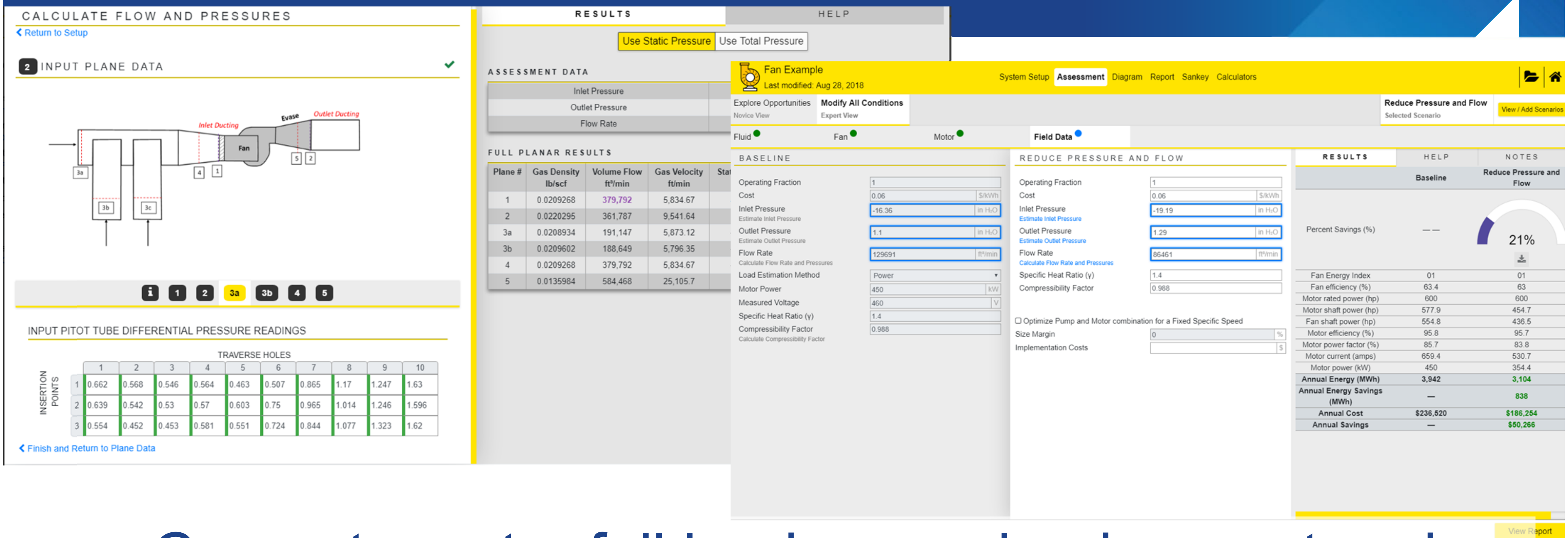


Pumps



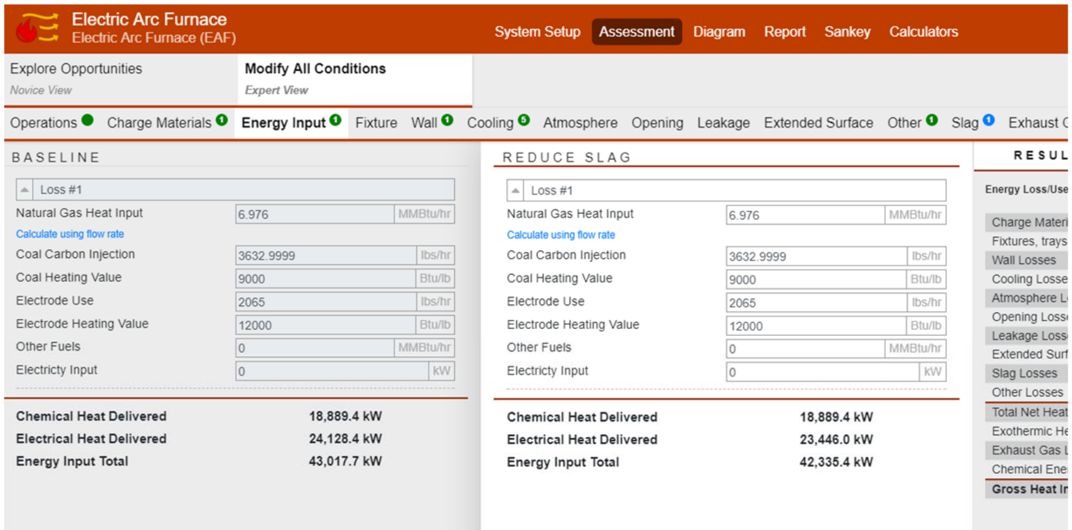
- Compute motor full load amps, load current and power factor, fluid head, and fan and motor efficiency
- Explore the savings from changing pump and motor efficiency (which can be optimized automatically), flow and head, or even fluid temperature

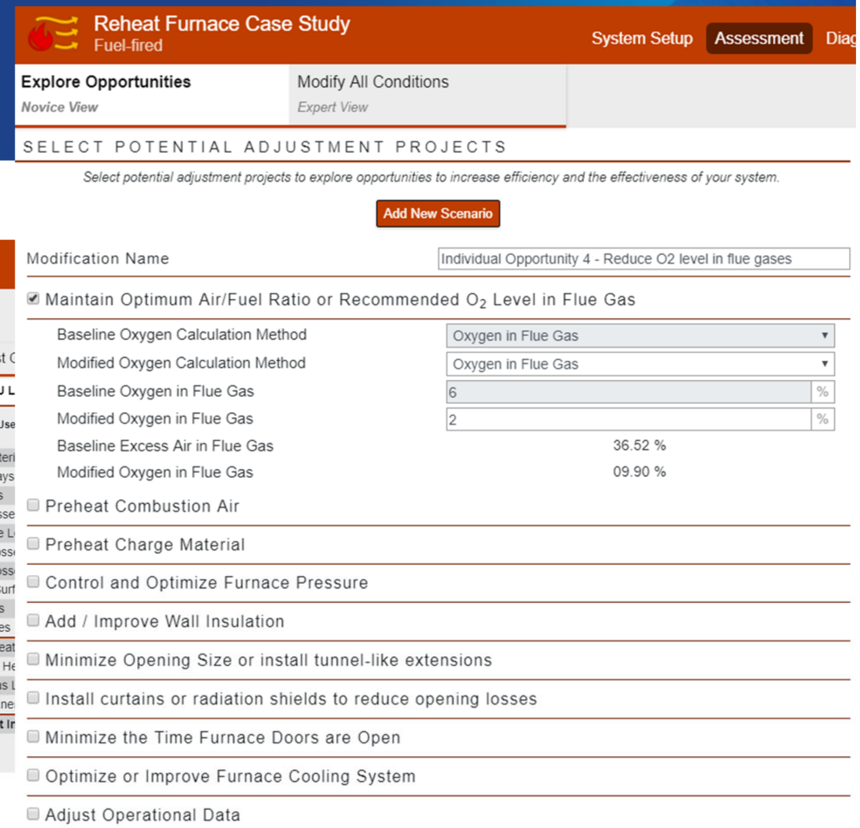
Fans



- Compute motor full load amps, load current and power factor, pressure and flow from a traverse analysis, and fan and motor efficiency
- Explore the savings from changing fan and motor efficiency (which can be optimized automatically), flow and pressure, or even fluid characteristics

Process Heating

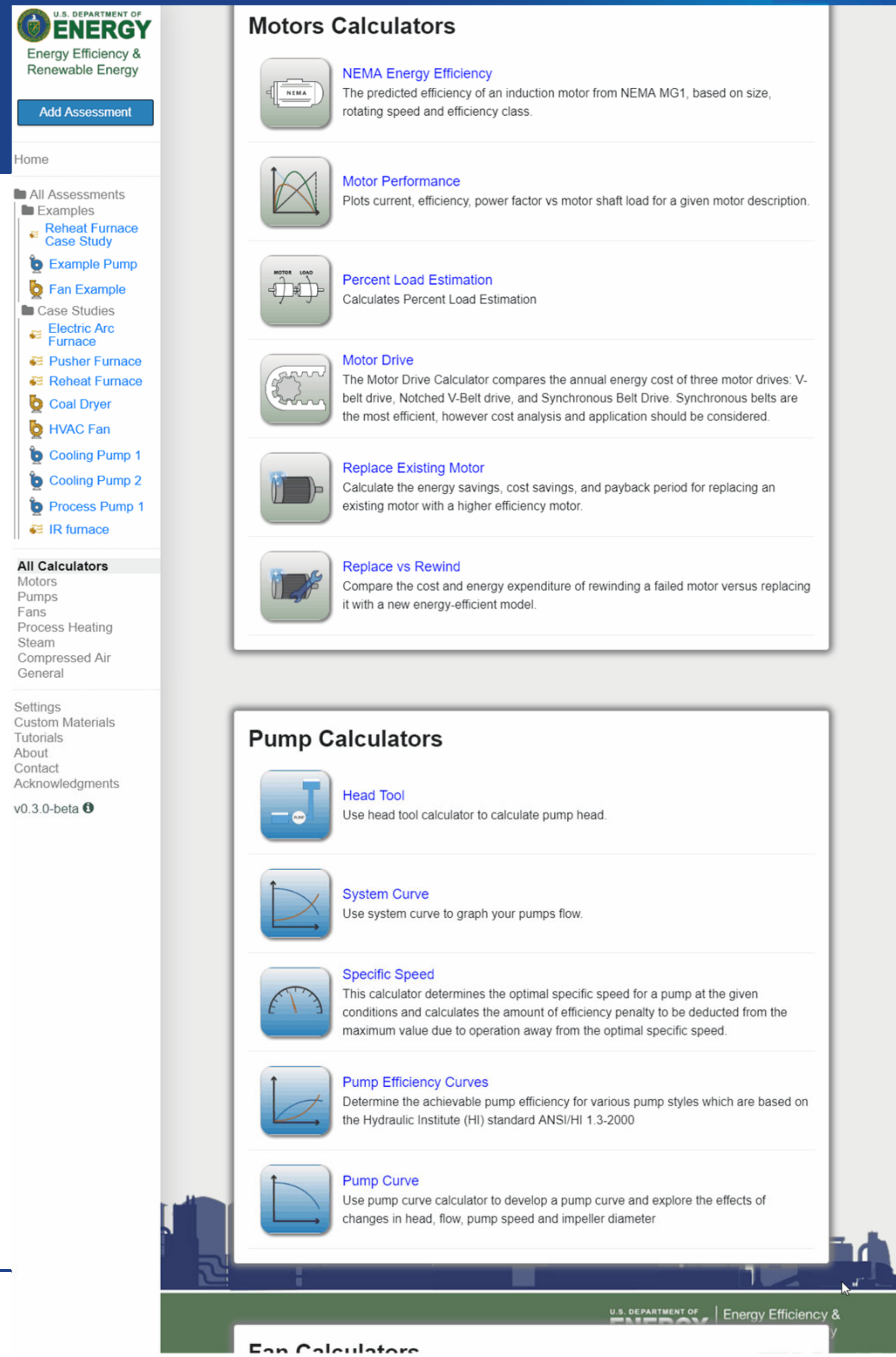




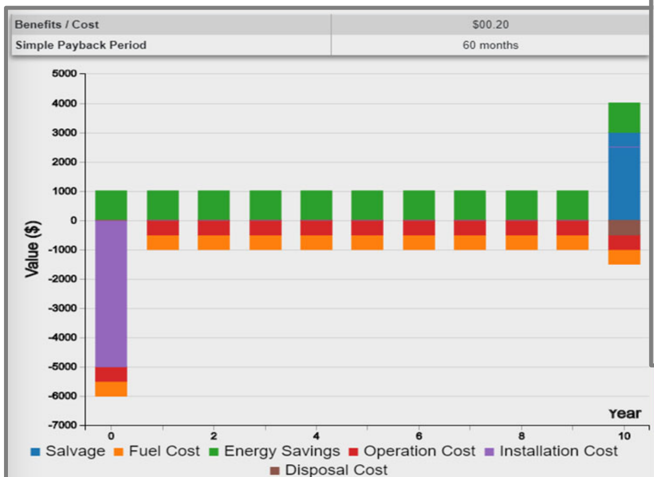
- Calculate heat losses from several heater components
- Explore the savings from reducing flue gas oxygen or temperature, preheating air or charge materials, controlling furnace pressure, closing openings, etc.

Calculators

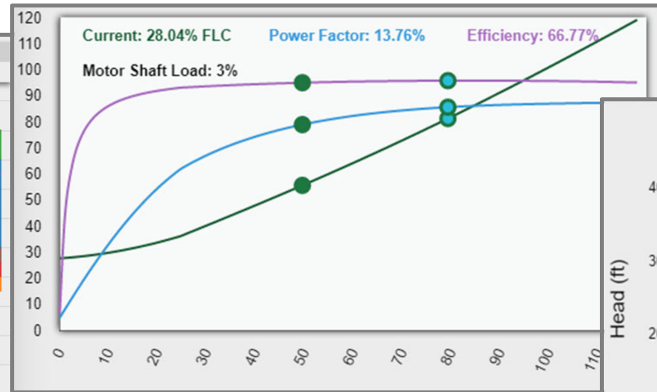
- 40+ Stand alone Calculators
  - Motors
  - Pumps
  - Fans
  - Process Heating
  - Steam
  - Compressed Air
  - Lighting
  - General
- Most have graphical results



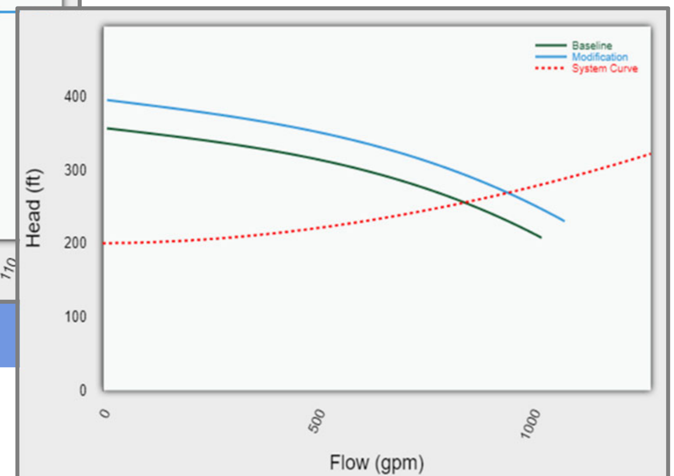
Example Calculators



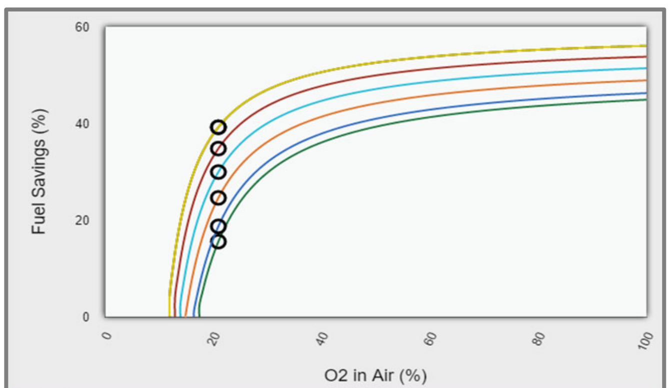
Cash Flow Diagram



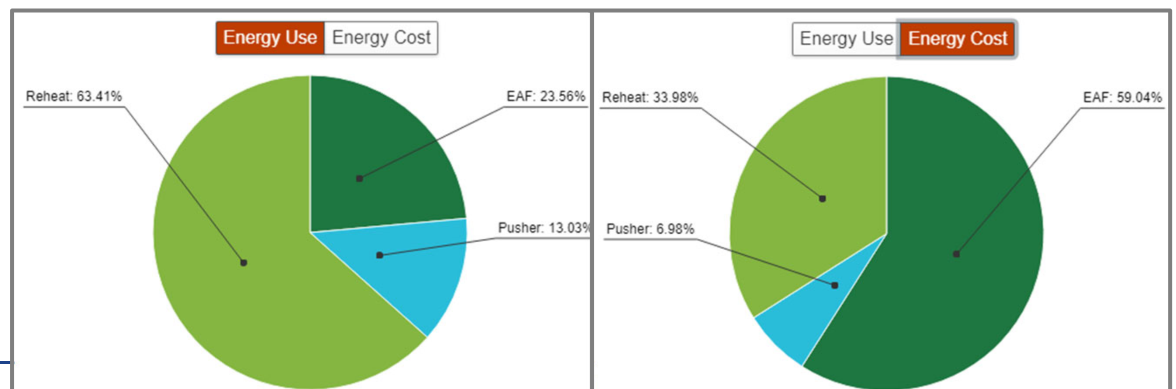
Motor Performance



Pump Curve



O_2 Enrichment



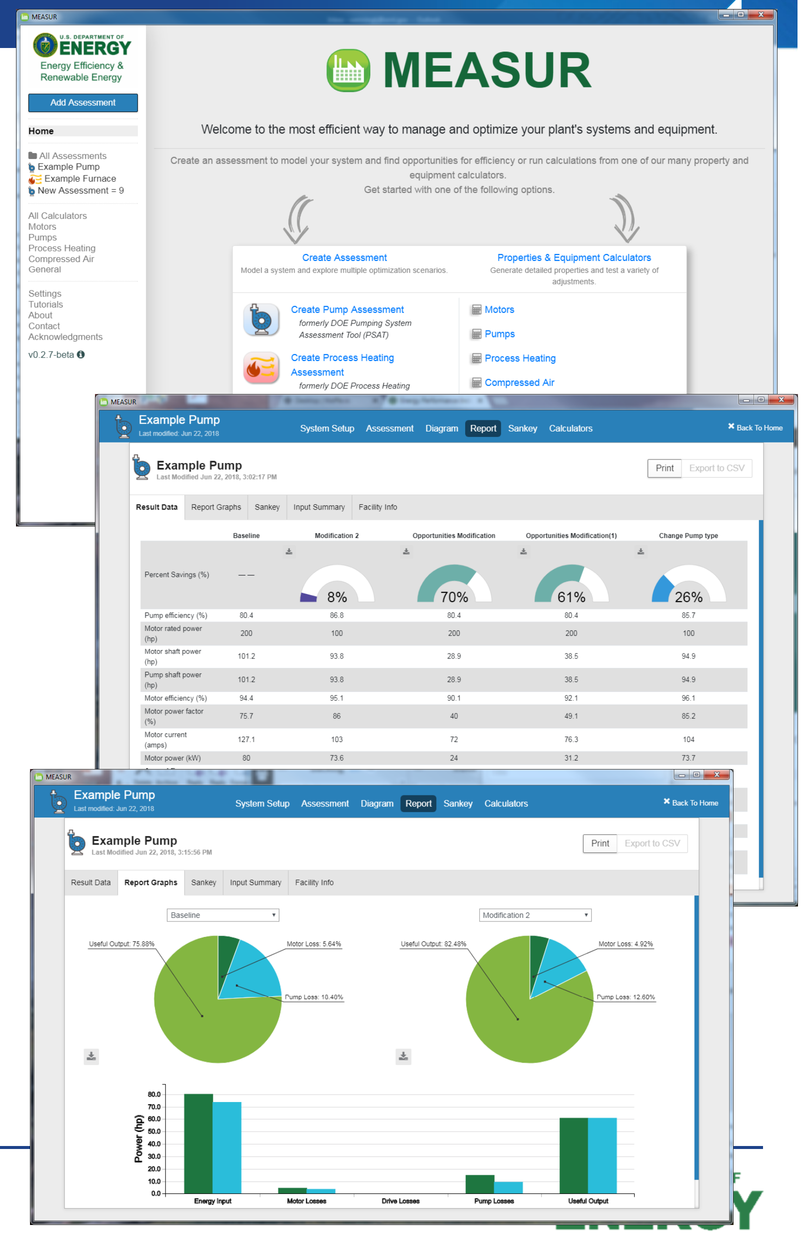
Pre-assessment

Better Buildings

ENERGY

Results and Accomplishments

- **Community Engagement**: <u>Key Point</u> – want to engage end users!
- Tool Development Schedule
  - Systems completed:
    - Process Heat (PHAST)
    - Pumps (PSAT)
    - Fans (FSAT)
  - Under Development:
    - Steam (SSMT/SSAT) – Jan 2019
    - Compressed Air (AirMaster+) – May 2019
    - Motors (MotorMaster+) – May 2019
- www.energy.gov/eere/amo/measur
- Ongoing Feedback link - https://www.surveymonkey.com/r/DOE-AMO-TOOLS



Transition (beyond DOE)

What will this effort help enable going forward?

- **Open-Source** Library Suite - https://github.com/ORNL-AMO
  - Greater transparency
  - Future-proofing
  - New algorithms can be added to characterize other plant processes and equipment
  - Equipment providers can develop equipment specific databases that interface with the tool
- Library can be used to **effectively test** real-world equipment performance versus theoretic capabilities
- **Leverage sensors** for real-time data collection, monitoring and optimization
  - Leverage the Internet of Things devices coming online within manufacturing
- Enable **real-time system analysis and optimization**
  - Possibilities for exploring machine learning algorithms for system optimization

Acknowledgements

Subject Matter Experts

- Don Casada, Diagnostic Solutions, LLC
  - Developed the previous versions of PSAT and FSAT, and contributed the PSAT algorithms for this version.
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Raul Rios

Questions & Discussion?

Thomas Wenning, PE
wenningtj@ornl.gov
https://energyefficiency.ornl.gov/

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