U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

AMMTO & IEDO JOINT PEER REVIEW

May 16th-18th, 2023

Washington, D.C.

Workforce Development Consortium

Kyle Niemeyer, AAAS Science & Technology Policy Fellow

IEDO, Technical Assistance & Workforce Development

This presentation does not contain any proprietary, confidential, or otherwise restricted information

Key Industry Workforce Barriers

The three most pervasive EWD challenges in the manufacturing sector:

Labor Shortage

4 million hires needed by 2028; 2.1 million could go unfilled by 2030 (Deloitte & MI).

Skills Deficiencies

Number of skills required for entry-level jobs has doubled since 2010 (Deloitte).

Negative Industry Perception

Most people do not see these jobs as rewarding, interesting, clean, safe, or stable (Deloitte 2017).

There is an overall lack of sustainability, energy efficiency, and decarbonization manufacturing curricula or certifications due to perceived lack of demand from employers and students.

(Identified by NREL in 2022 Roadmap & Landscape Assessment)

IEDO Workforce Activities

Workforce development focus: a workforce supporting energy efficiency, electrification, and the transition to low carbon fuels and feedstocks in the industrial sector

Existing workforce activities:

Better Plants trainings & software tools

Energy Management Systems (ISO 50001) tools & cohort trainings

CHP trainings & online program resources

Workforce development activity priority areas:

- Retraining & upskilling for current and future workers, incorporating energy efficiency & decarbonization
- Pilot programs for expanded career and technical education (CTE)
- Reusing, building on, and/or expanding existing training activities
- Registered Apprenticeships & competency models that include energy efficiency & decarb.

Alignment with National Strategy for Advanced Manufacturing

Goal 2. Grow the Advanced Manufacturing Workforce:

Objective 2.1. Expand and Diversify the Advanced Manufacturing Talent Pool:

- 2.1.1 Promote Awareness of Advanced Manufacturing Careers
- **2.1.2. Engage Underrepresented Communities**
- 2.1.3. Address Social and Structural Barriers for Underserved Groups

Objective 2.2. Develop, Scale, and Promote Advanced Manufacturing Education and Training

- 2.2.1. Incorporate Advanced Manufacturing into Foundational STEM Education
- **2.2.2. Modernize Career and Technical Education (CTE) for Advanced Manufacturing**
- **2.2.3. Expand and Disseminate New Learning Technologies and Practices**

Objective 2.3. Strengthen the Connections Between Employers and Educational Organizations

- **2.3.1. Expand Work-Based Learning and Apprenticeships**
- **2.3.2. Promote Industry-Recognized Credentials and Certifications**

Announcing the National Strategy for U.S. Leadership in Advanced Manufacturing | U.S. Department of Commerce

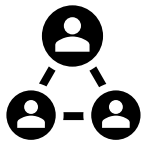
New Program: Workforce Development Consortium

Consortium model: convene and financially support three-to-five key manufacturing workforce organizations that have existing national and/or industry-wide networks and reach. Consortium members use funding to develop, expand, and/or scale successful and innovative Education and Workforce Development programs that meet shared goals, embedding energy efficiency and decarbonization into industry-focused training programs. Consortium RFP will include a focus on expanding training in DACs.

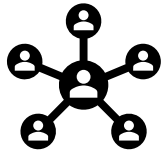
Potential Consortium members:

- Educators and trainers
- Trade, industry, and labor groups
- Diversity organizations/professional societies/associations

Program plans:



FY23



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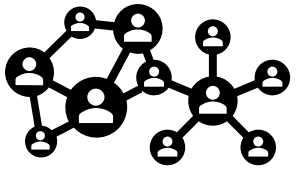

FY25

Questions?

Kyle Niemeyer, AAAS Science & Technology Policy Fellow

IEDO, Technical Assistance & Workforce Development

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Energy System Tools | IEDO

Thomas Wenning, PE | Oak Ridge National Laboratory

DE-AC05-00OR22725 | FY23

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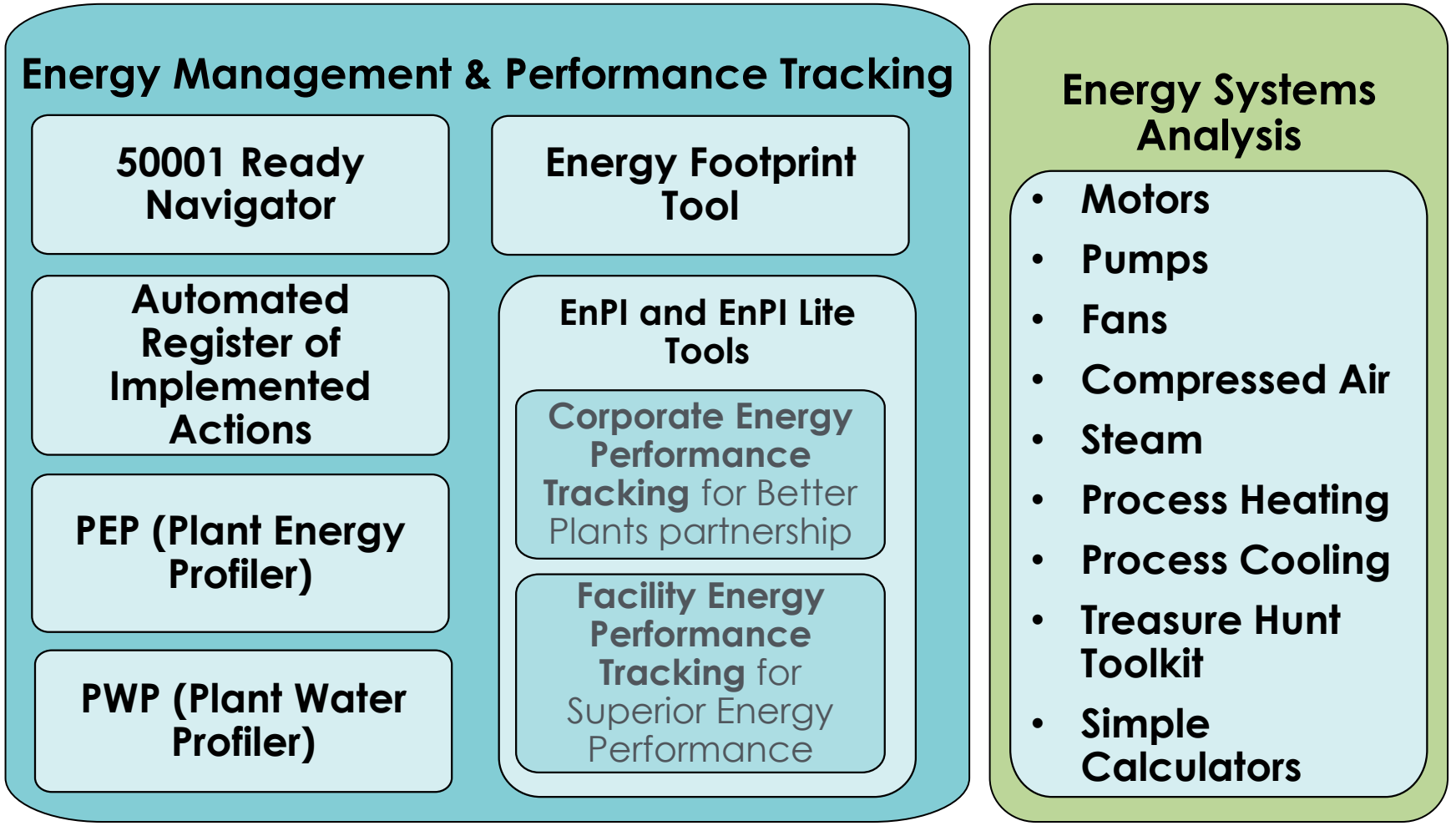
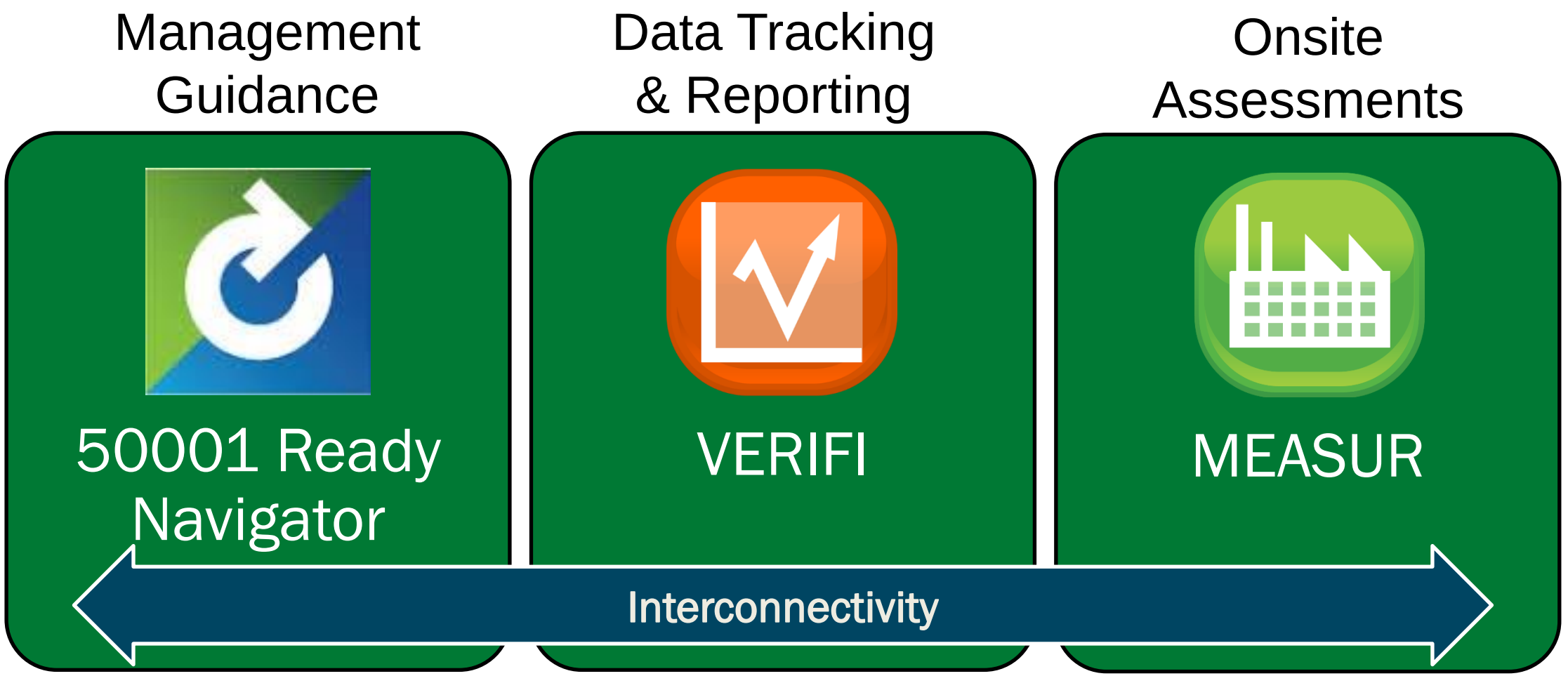
Overview: IEDO's Historic Energy Software



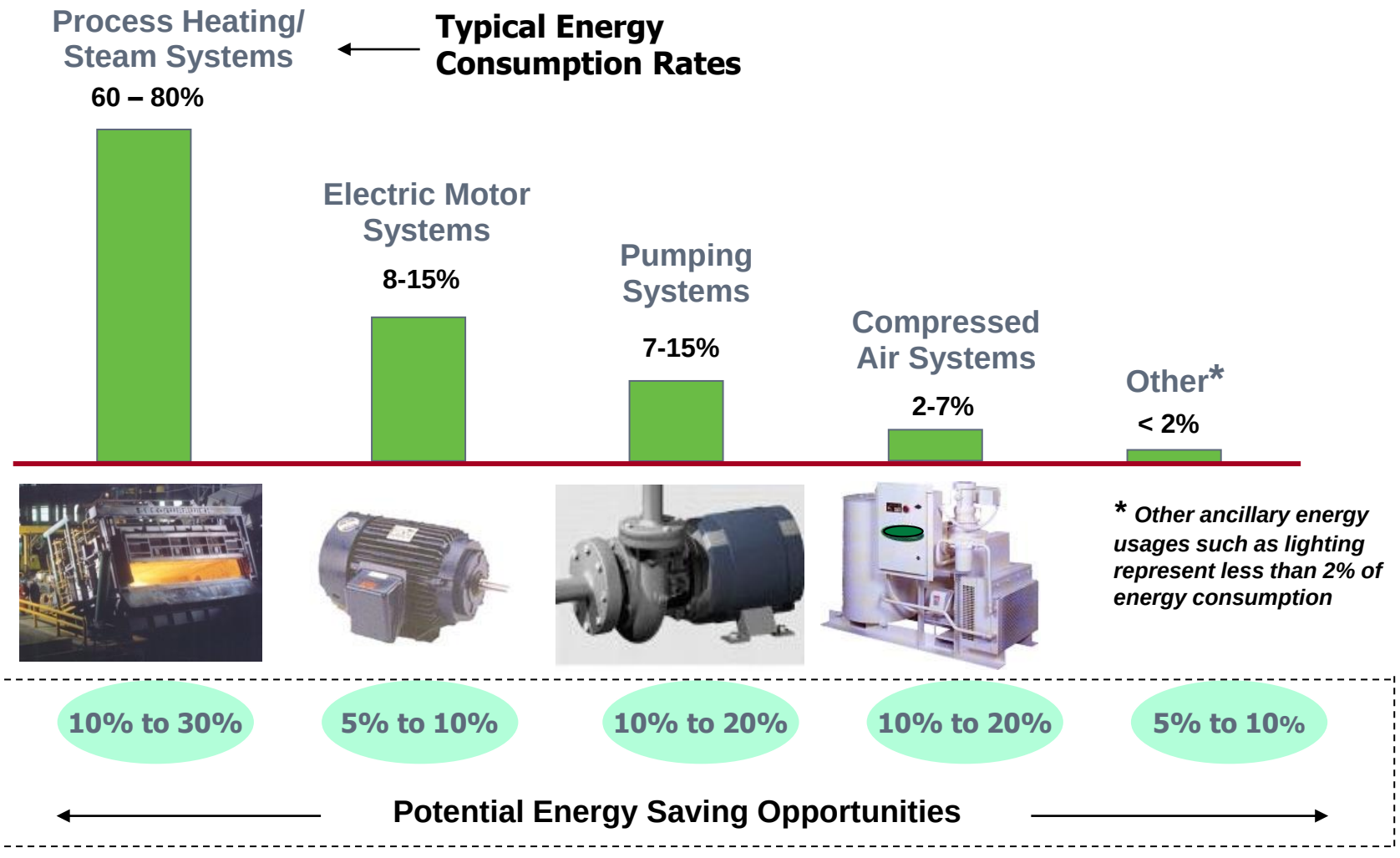
www.energy.gov/eere/amo/software-tools

Easier-to-Access Future



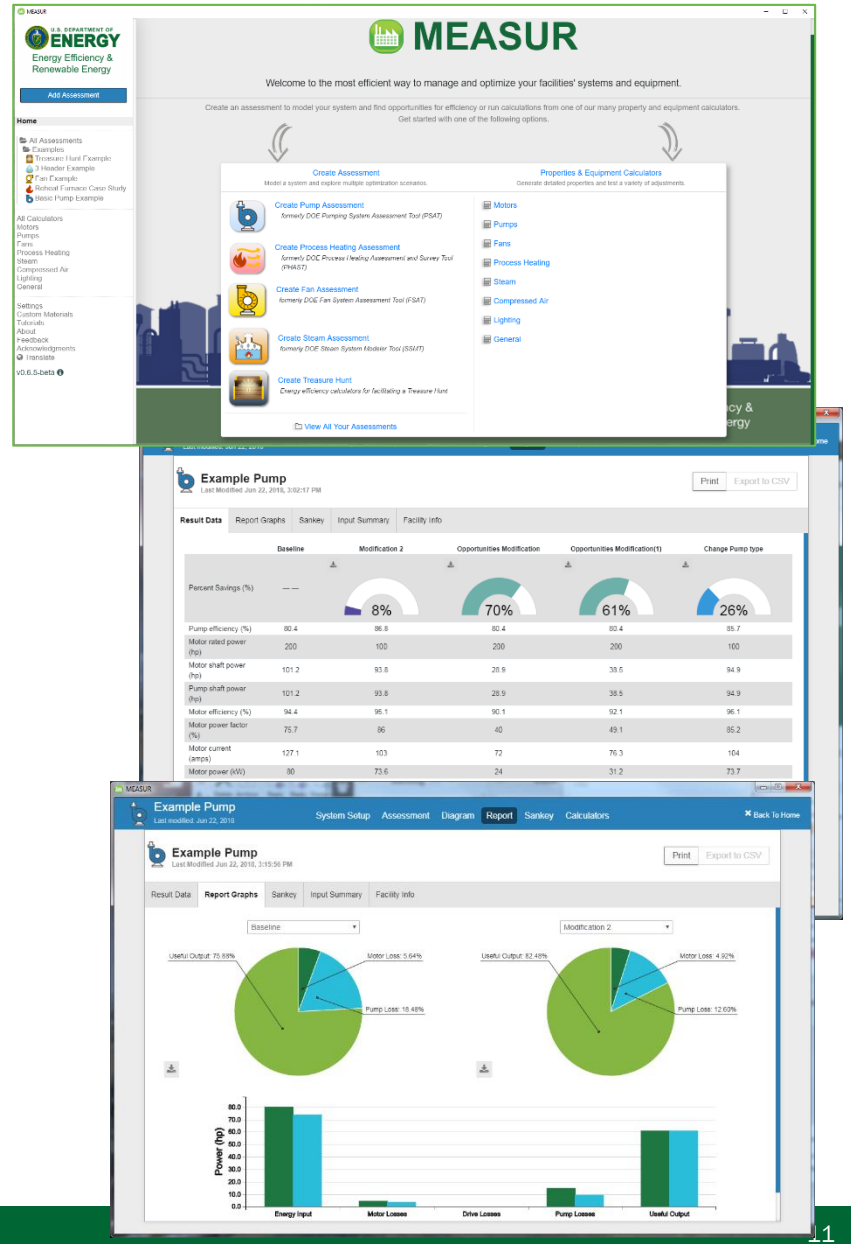
Project Objectives - Background

High-level Plant Energy & Savings Profile

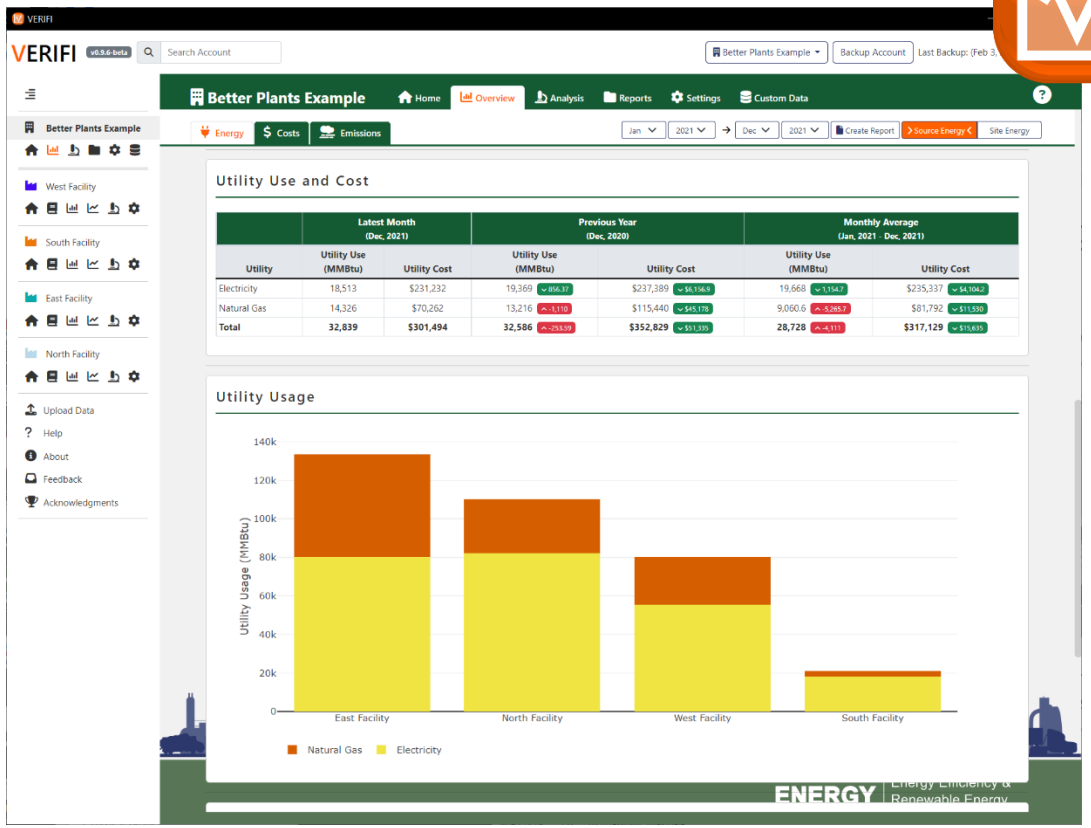


Project Objectives – Software Tools

- Expand Focus From **Energy Efficiency To Decarbonization**
- Enable Technology Field Validation, Optimization and Decarbonization
- Provide industry with **technology/vendor agnostic** analysis and evaluation tools
- Modernize to **Open-Source Software**!
  - Government-wide Open-Source Software
    - UT-Battelle Permissive License – *"Do whatever, but please provide attribution"*
- **Improved Accessibility** - Desktop / Web / Mobile
- Underpins DOE's Better Plants Program technical assistance efforts



Approach: Integrated Energy Tools – MEASUR & VERIFI



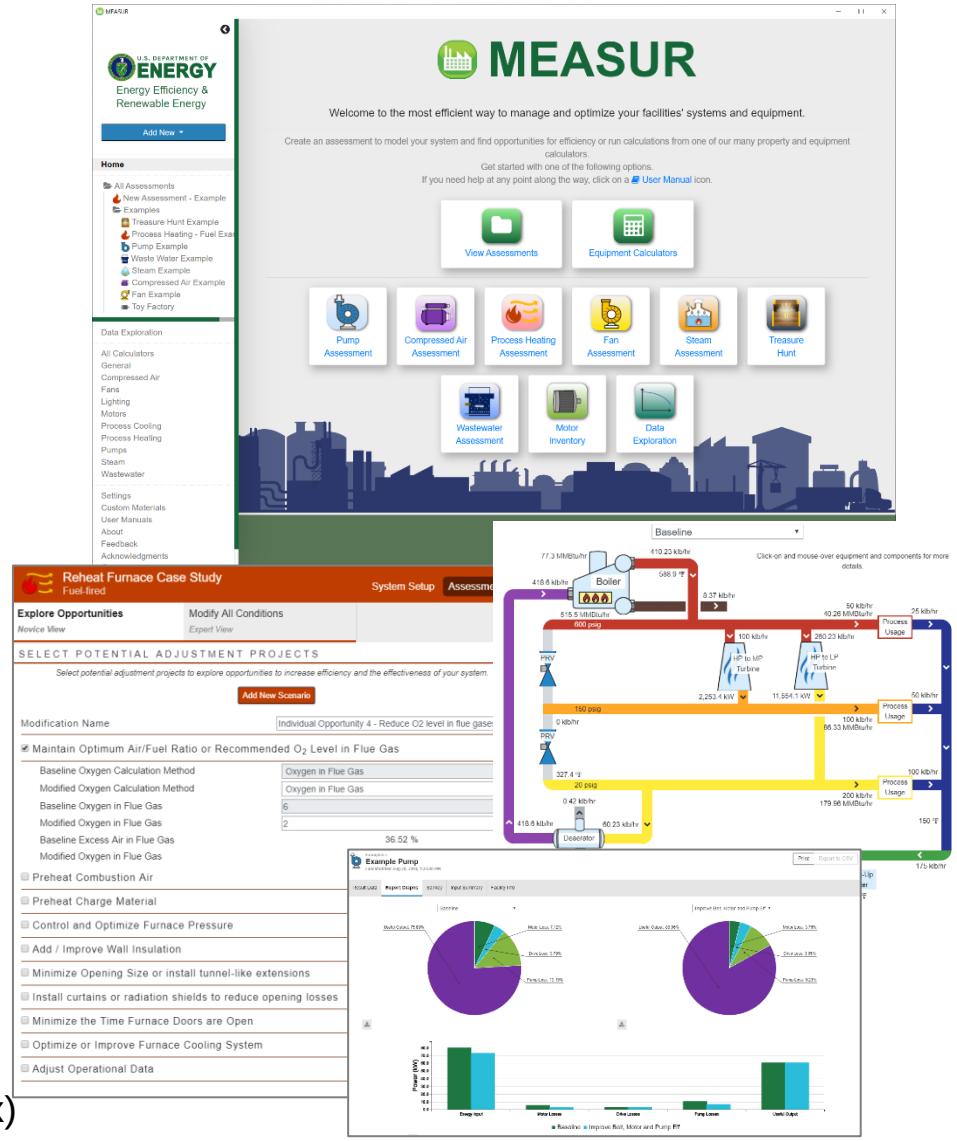
- Software tools are available through **simple, open-source platforms**
- Includes built-in guides and tutorials

https://www.energy.gov/eere/iedo/software-tools

MEASUR Software Suite
Manufacturing Energy Assessment Software for Utility Reduction

- **Energy and Carbon optimization software tool** to help manufactures improve the efficiency of systems and equipment within a plant
- **Model common energy systems** and evaluate unlimited "What-if" Scenarios
  - Perform full assessments on Steam, Process Heating, Pumps, Fans, Compressed Air Systems, etc
  - Identify and quantify major areas of energy and carbon use and savings
  - Dynamically create custom reports
- 70+ simple standalone calculators
  - **Quantify savings** for common opportunities
  - Perform your own facility Treasure Hunt

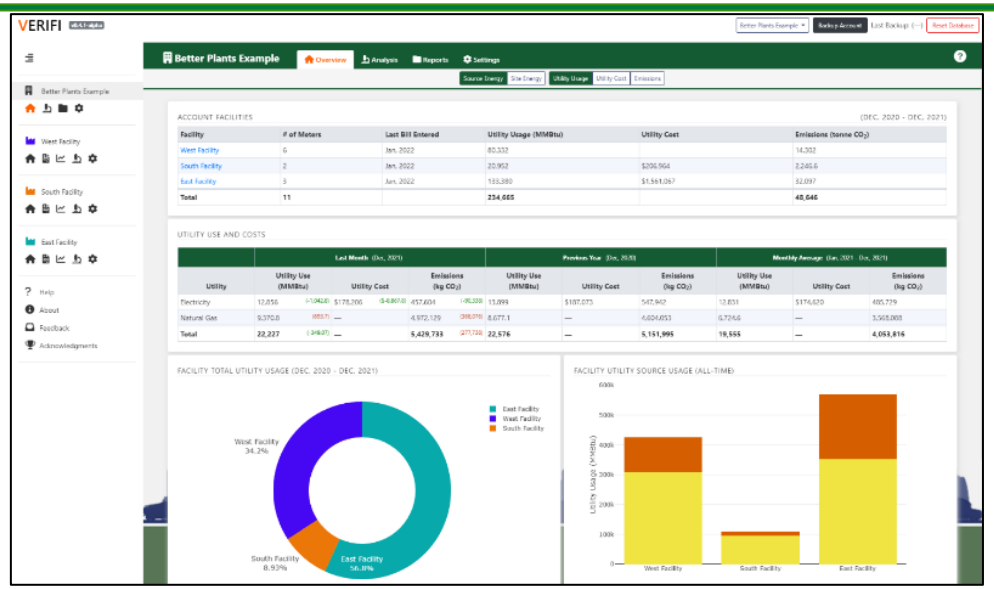
– Audience: Energy Managers, Plant Engineers, Maintenance Leads, Consultants, etc

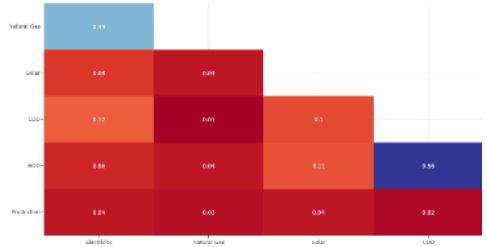


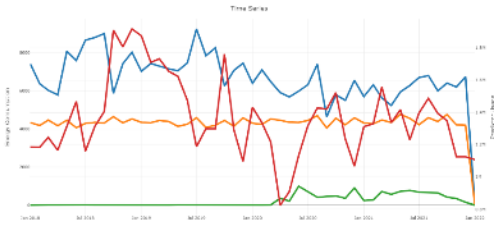
https://www.energy.gov/eere/amo/measur (Available for Windows, Mac & Linux)

VERIFI Software Suite

- Comprehensive **Utility Tracking and Reporting** Dashboard tool
- Promotes a **common framework** for analysis and reporting
- **Simplify and standardize** data entry, tracking, benchmarking and baselining for companies
- **Streamlines reporting** for companies
- Continue moving companies to more robust tracking methodologies
- Audience: Energy & Sustainability Managers, Data Analysts, Procurement





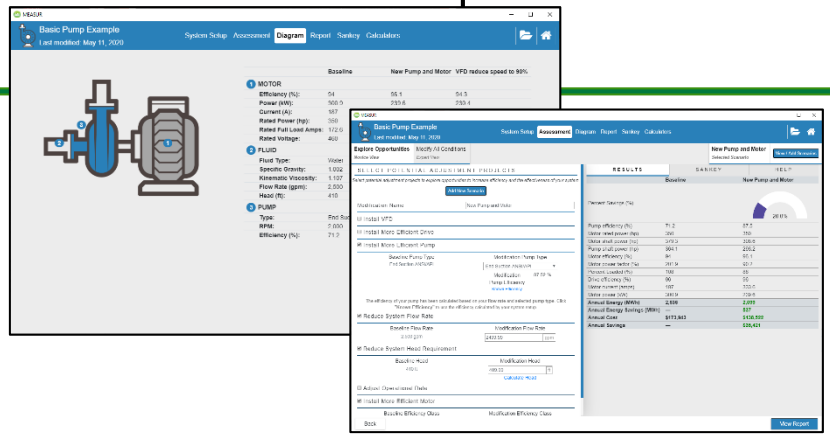


	Energy (MMBtu)			Incremental Improvement	
Year	Actual	Modeled	Adjusted for Normalization	Total Savings % Improvement	Cummulative Savings
2018	32,240	32,302	32,240	—	—
2019	30,917	31,892	31,831	2.87 %	913.91
2020	19,407	21,232	21,171	8.33 %	2,677.7
2021	20,952	23,176	23,115	9.35 %	4,840

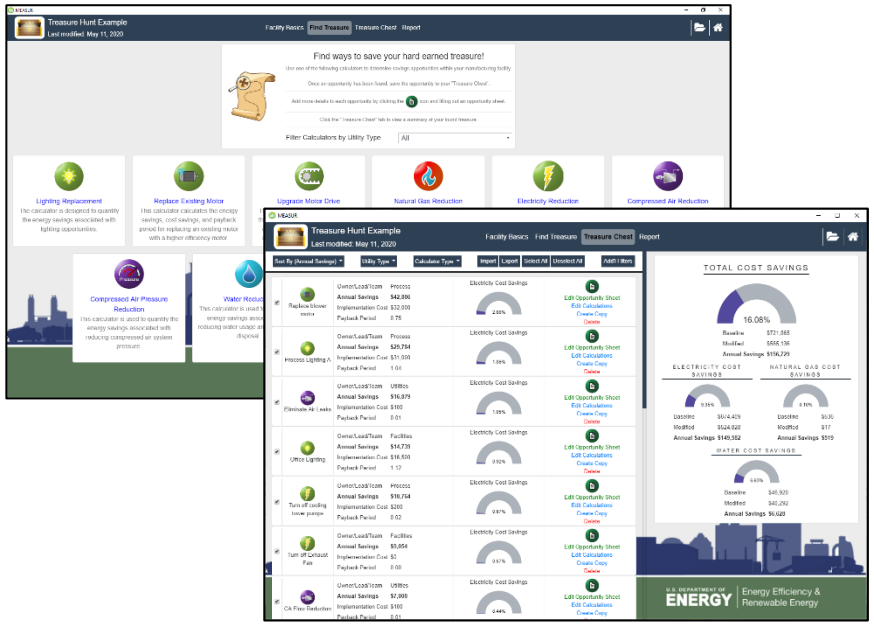
Online - https://verifi.ornl.gov/ Download - https://ornl-amo.github.io/

Results and Accomplishments - Select Screenshots

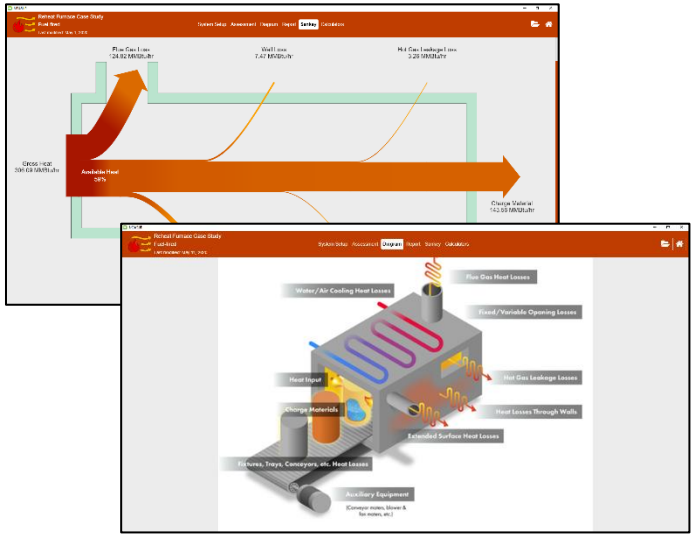
Pumps



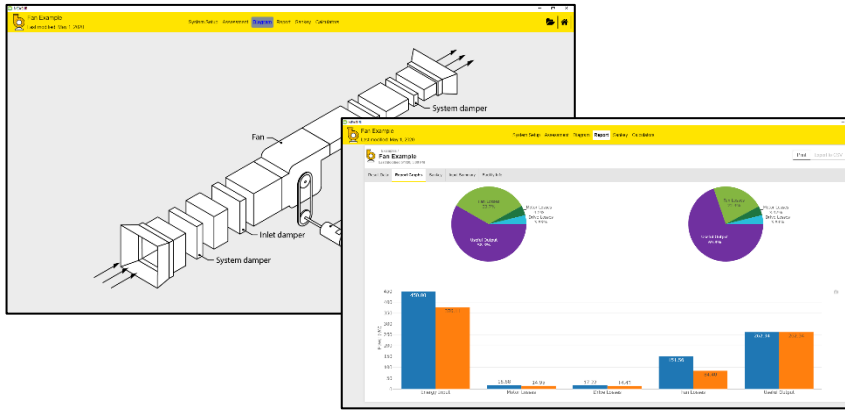
Treasure Hunt Module



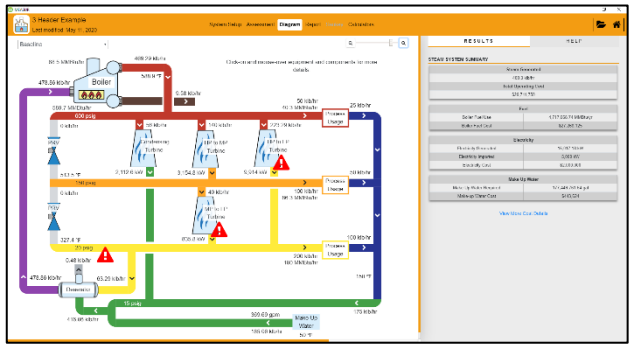
Process Heat



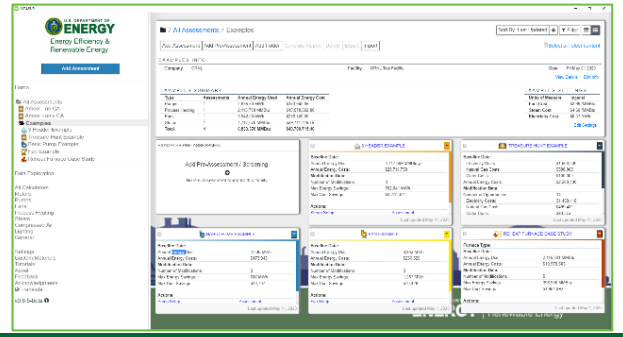
Fans



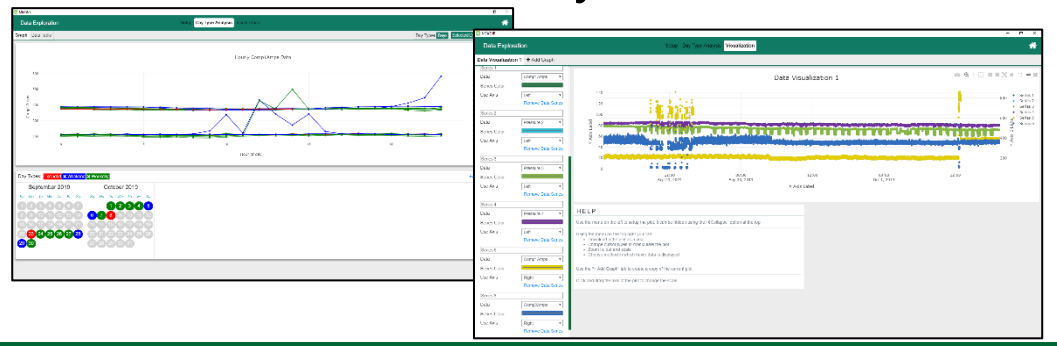
Steam



Assessment Dashboard

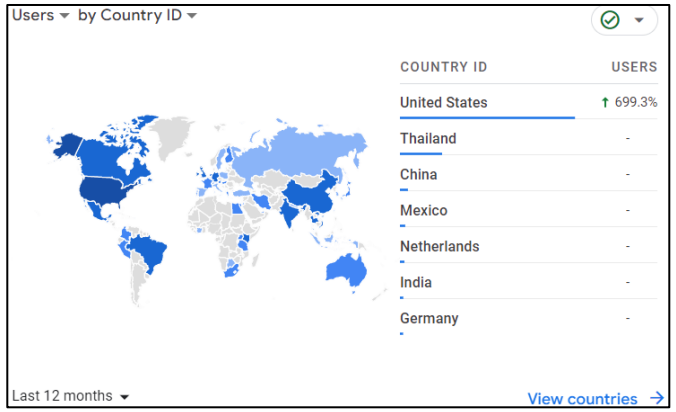


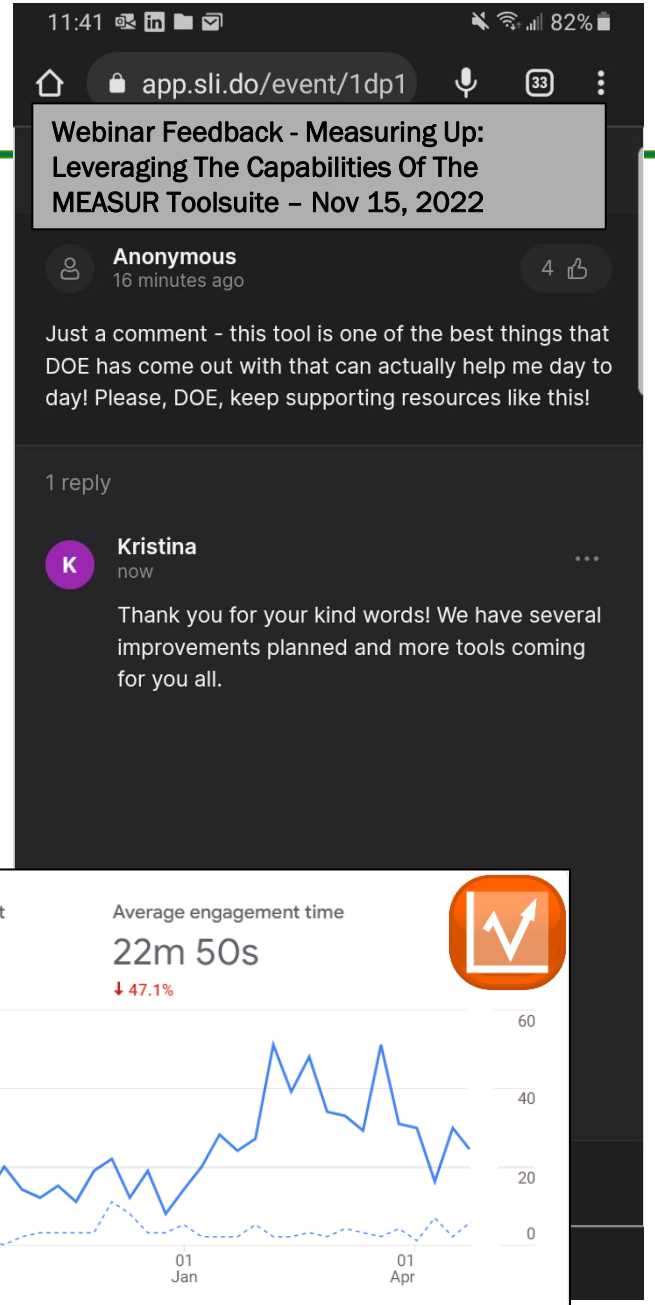
Data Visualization & Analysis

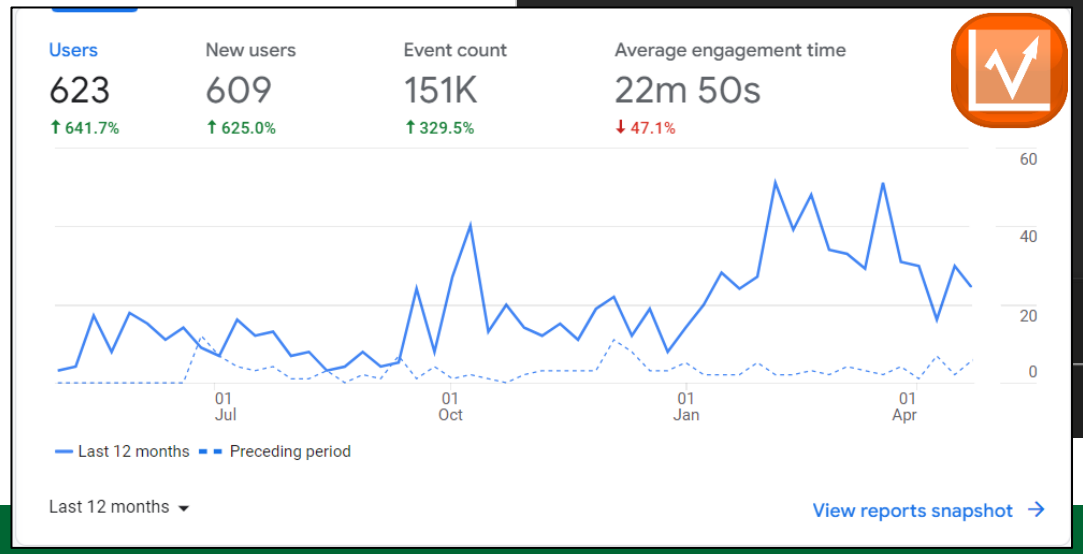


Results and Accomplishments

- **Website Usage (Online Version)**
  - MEASUR: 3,400+ unique users
  - VERIFI: 620+ unique users
- **Total Downloads (Downloaded Version)**
  - MEASUR: 25,600+
  - VERIFI: 980+
- **Open-source Utilization Examples**
  - Industrial Assessment Center Universities - incorporating into engineering curriculum
  - Capstone project at TN Tech University - connecting MEASUR to real-time sensors
  - Confederation of National Industries used code to develop software for Electrobras







Vision for the Future

- **Assist companies** who are looking to develop decarbonization roadmaps, report carbon inventories, and decarbonize operations
- Hands-on **training available** through Better Plants Technical Assistance Activities
  - In-Plant Trainings, Virtual In-Plant Trainings, Bootcamps, Webinars, etc
- Open-Source Library Suite **enables private sector** opportunities
  - Providers can add equipment specific capabilities and databases
- Expand upon current capabilities
  - New algorithms can be added to characterize other plant processes and equipment
  - Leverage sensors for real-time data collection, monitoring and optimization
  - Enable real-time analysis and optimization
  - Possibilities for machine learning algorithms for system optimization

Questions?

Energy System Tools | IEDO

Thomas Wenning, PE, ORNL
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Energy Intensive Pilot | IEDO

Robert Bruce Lung, BGS-LLC

This presentation does not contain any proprietary, confidential, or otherwise restricted information

Project Overview

- The Energy Intensive Pilot is a technical assistance effort to understand how IEDO can best serve energy intensive manufacturers
  - Align with EEII R&D subprogram

- The pilot is providing technical assistance based on requests and needs of energy intensive manufacturers

- This pilot supports IEDO's mission by reaching out and connecting with energy intensive manufacturers to improve energy performance and decarbonization

Background & Strategic Approach

Two Parallel Pathways

Project Outline & Approach

Project Need:

Energy intensive sectors account for a substantial share of the energy use and emissions in the industrial sector.

- Reach out to energy intensive manufacturers to see what types of technical assistance yields value and then deliver the assistance they want
- Once energy intensive manufacturers complete an interview, they are eligible for technical assistance

Project Partners: U.S. EPA, ORNL

Timeline: Fall 2022 – Fall 2024

Budget: $2 million over 2 years

- **Three types of technical assistance:**
  - Assessments
  - Trainings
  - Scenario planning/technology demonstration

Current Activities

- **Outreach approach**
  - Outreach to energy intensive manufacturers that have not worked with federal programs
  - Outreach to trade associations and industry groups:
    - Portland Cement Association
    - AIChe meeting in March 2023 to ~45 people

- **Collaboration with ENERGY STAR**
  - Established working group with ENERGY STAR for industry partners on an energy performance indicator (EPI) on chlor-alkali.
  - Supported recruiting effort and helped secure participation from two manufacturers that produce chlor-alkali

Future Work & Impact

Future Work:

- **Outreach to Energy Intensive Manufacturers**
  - Deliver technical assistance
  - Analyze data from questionnaires and technical assistance events
  - Create new technical assistance resources that address the needs of energy intensive sectors
- **EPA Collaboration**
  - Finalize current Energy Performance Indicator (EPI) on chlor-alkali
  - Identify tools, trainings and other resources that can be developed jointly
  - Joint recognition of partner accomplishments

End Project Goal:

- **Understand the technical assistance needs of energy intensive sectors and develop a programmatic structure that addresses those needs**

Questions?

Energy Intensive Pilot | IEDO

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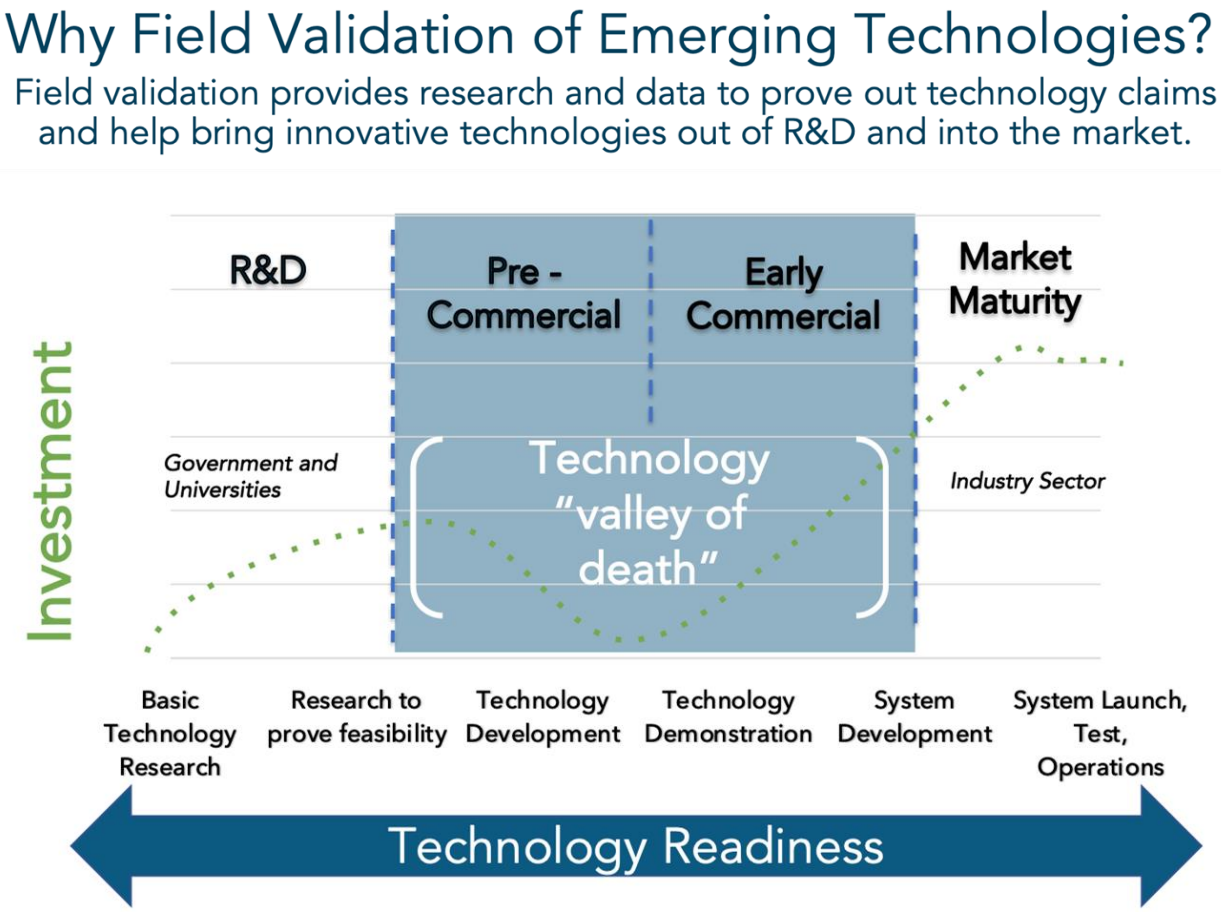
Industrial Technology Validation Pilot

Prakash Rao, LBNL

ITV pilot program addresses tech-to-market challenges

- The problem:
  - Technology developers face 'Valley of Death'
  - Facilities need credible evaluation of installed performance of emerging technologies
- IEDO objectives:
  - Accelerate the adoption of emerging technologies
- ITV objectives:
  - De-risk the adoption of emerging technologies by conducting measurement and verification
  - Disseminate results broadly to accelerate industrial decarbonization
- ITV benefits
  - To vendor: credible 3rd party validation of claims
  - To facility: Allows piloting before scaling



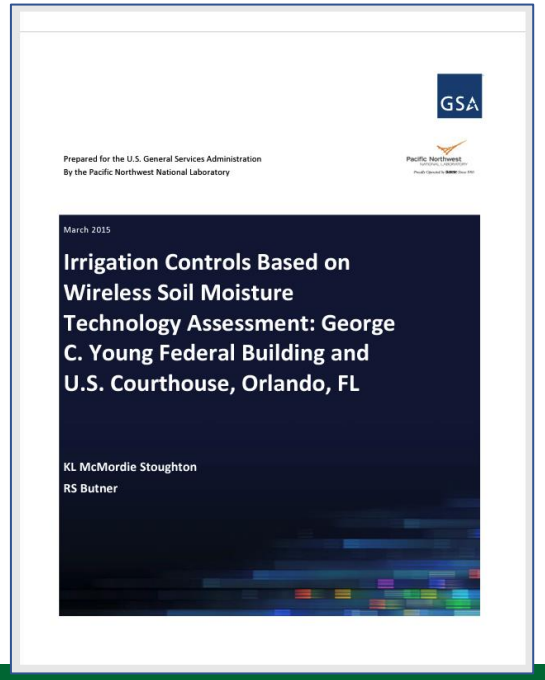
ITV pilot program design

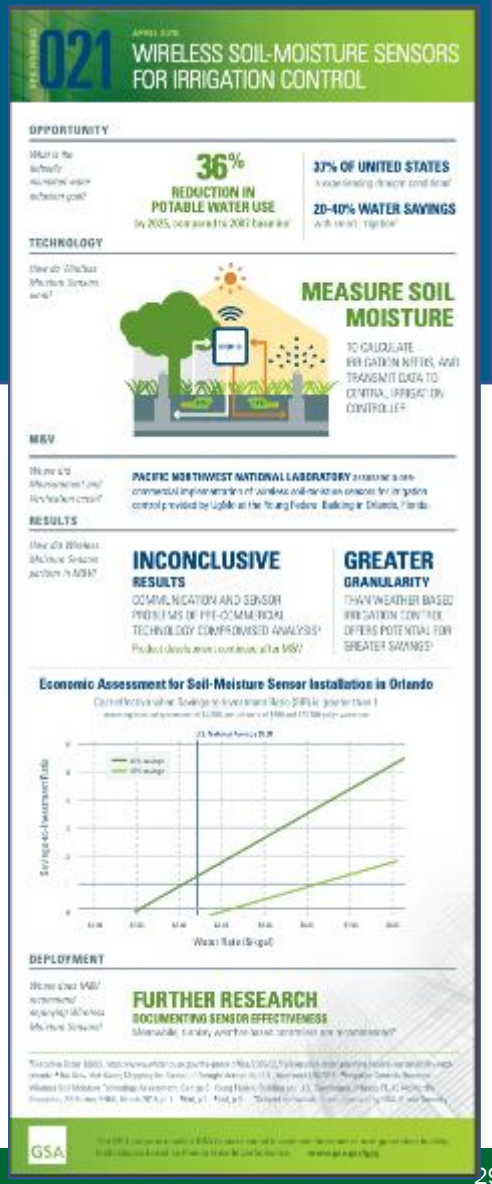
- Call for applications - emerging technologies not previously evaluated in an industrial setting that claim to deliver energy/CO_2, water, and/or waste reductions AND have potential for widespread adoption and savings
- Competitive selection process
- Once selected:
  - LBNL, site, and vendor establish measurement and verification (M&V) process
  - M&V plan executed (period of testing can span two weeks to two years)

Disseminating Results

- Full-scale M&V report
- Four-page high level summary
- Single page graphic overview

- Conference presentations
- Website hosting library of reports and program information
- Once critical mass is reached, create searchable database





Current portfolio (1 of 2)

Energy efficiency:

- Nissan - Electrocell: cooling tower side stream particle precipitator (to be compared with Toyota)
- Toyota - Electrocell: cooling tower side stream particle precipitator (to be compared with Nissan)
- Stryker - Turntide: High Rotor Pole Switched Reluctance Electric Motor
- EPRI - Atlantium: High Optical Density Ultraviolet (HOD-UV) for chemical free de-chlorination and microbial de-activation for protection of reverse osmosis membranes

Electrification:

- Graphic Packaging - KPES SPG: Soot-blowing in a recovery boiler
- Ahlstrom-Munksjo - Via Separations: membrane system for black liquor concentration

Current portfolio (2 of 2)

Low Carbon Fuels and Feedstocks:

- Holcim - Advanced Thermovoltaic Systems: Thermoelectric generator to produce electricity from waste heat
- Solar Flux (site dropped out): Parabolic dish solar water heating

Water savings:

- Cleveland Cliffs - Dynamic Water Technologies
  - Electrochemical water treatment for cooling towers
  - Electrocoagulation for oil and hydrocarbon removal from wastewater

Evolving from pilot to program

- Creating foci:
  - Technology (e.g., electrification, deep energy efficiency)
  - Sectors (e.g., Energy and Emissions Intensives Industries)
- Partnering:
  - Within IEDO: Better Plants/Climate Challenge to identify foci, solicit applications
  - Within DOE: create/identify channels for funding technology; identify promising techs and close R&D to deployment loop
  - Outside of DOE: create multiplier impact (e.g., with utility programs)
- Improving applications
  - Require letters of commitment from site
  - Include emerging sectors of interest to IEDO (e.g., data centers, controlled environment agriculture)

Questions?

Industrial Technology Validation Pilot

Prakash Rao, Lawrence Berkeley National Laboratory

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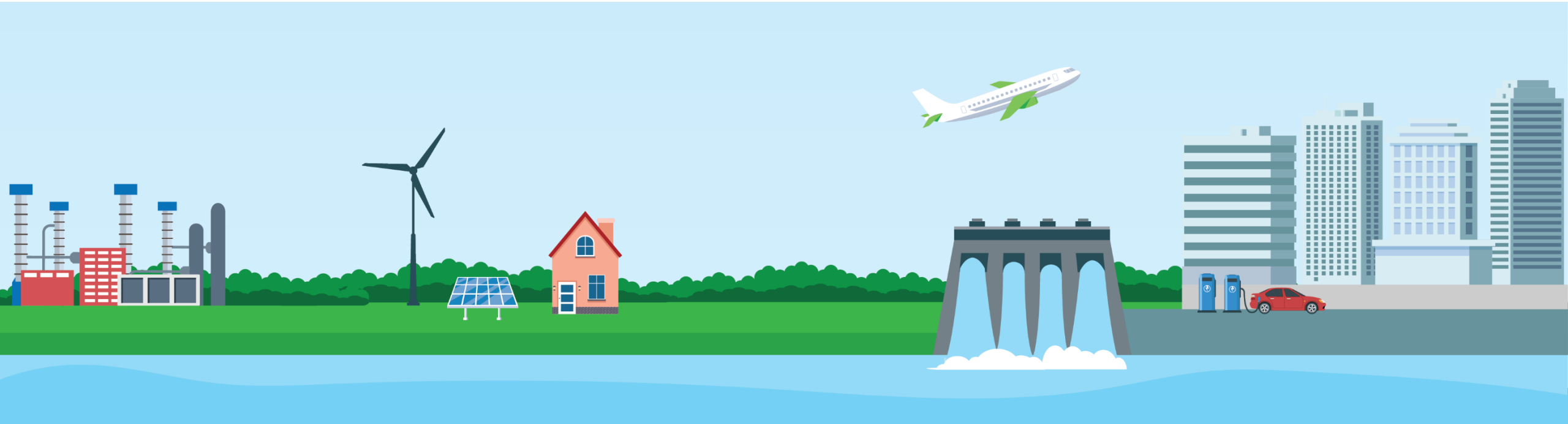
ARE YOU A CLEAN ENERGY CHAMPION?

Energy-Water → Energy-Water-Food Nexus

Controlled Environment Agriculture (CEA) Accelerator

Kimmai Tran | Peer Review May 2023



One of EERE's program priorities is "decarbonizing the agriculture sector, specifically focused on the nexus between energy and water"

Traditional field farming

supplemented by

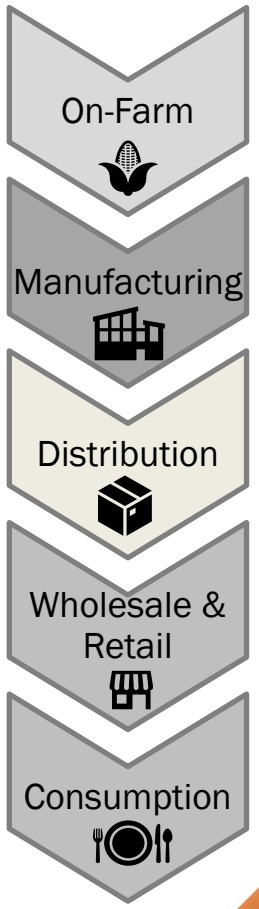
Indoor farming

Photo by Keith Welle, USDA-ARS

Photo by https://commercialwaste.trade/future-concrete-jungles-rise-vertical-farming/

Agriculture & other land use activities represents 23% of total net anthropogenic GHGs[1]

Food Supply Chain



- **70% of freshwater goes to agriculture globally** (~80% in US)[1]
- Irrigation volume has increasing by >25% since 2000[1]

- Manufacturing exhibits a high amount of food loss and waste; most becomes animal feed[2]
- **Food and beverage manufacturers were identified as a top 5 carbon emitter**[3]

- **Farming has grown into an industrial scale**, with a growing supply chain in need of mfg. resiliency
- Cross-country transportation takes about 7-10 days, so ~50% of produce shelf life is spent on trucks[4]

- **>10% of food is lost at the retailer level due to inconsistent food quality**[2,5]
- The demand for organic foods has increased by 44% from 2016 to 2020[5]

- **>25% of the food planted/raised for human consumption is lost or wasted, globally**[1]

Congressional interest in the Energy x Water x Food nexus has identified DOE (specifically EERE, AMO) to collaborate with the USDA on 4-season production

(MOUs, FY22 Appropriations Bill)

[1] IPCC 2021 report, [2] ORNL food waste analysis, [3] AMO industrial decarb roadmap, [4] s2gventures, [5] CRS reports + USDA-ERS

The winning 2021 Big Idea (Urban DIGs – Decarbonization In Greenhouses) seeks to leverage IEDO's existing programs and optimize the benefits of Controlled Environment Agriculture (CEA), particularly for food insecure communities

Smart sensors enable precision agriculture

CESMII THE SMART MANUFACTURING INSTITUTE

Water management can include unconventional sources of water, e.g. brackish water

NAWI National Alliance for Water Innovation

Summary of Annual Data for Conventional vs. CEA Grown Lettuce

adapted from Avgoustaki and Xydis[1]

	Conventional Farm (Outdoor Field)	CEA- Vertical Farm	CEA- Greenhouse
Energy Use[2],[3]	0.3 kWh/kg	250 kWh/kg	60-180 kWh/kg
Water Use Efficiency[4],[2]	250 L/kg	1 L/kg	20 L/kg
CO_2 Emissions[5]	540 kg/ton lettuce	158 kg/ton lettuce	352 kg/ton lettuce
Crop Yield [4]	3.9 kg/m^2	80-120 kg/m^2	41 kg/m^2
Typical Transportation Distance[6]	3200 km	43 km	800-1600 km

CHP's excess energy generation can be sold to the grid and has potential to have zero or negative GHG emissions with H_2 or RNG

Better Plants® U.S. DEPARTMENT OF ENERGY

U.S. Department of Energy CHP Technical Assistance Partnerships

[1] Avgoustaki *et al.*, *Advances in Food Security and Sustainability*. 2020.
[2] Barbosa *et al.*, *Int. J. Environ. Res. Public Health.* 2015; 2015(12):6879–6891.
[3] Graamans *et al.*, *Agr. Syst.* 2017; 160:31–43.
[4] Coyle and Ellison, *Agric. Appl. Econ. Assoc.* 2017; 32(1):1–8.
[5] Gerecsey, OneFarm Report CO2 Emissions Scoping Report; 2018.
[6] Food miles calculations are regionally dependent on farm locations; assumptions and calculators are available in H. Hill's "Food Miles: Background and Marketing" report, produced by the National Center for Appropriate Technology through the ATTRA Sustainable Agriculture program, under a co-op agreement with USDA Rural Development.

The two-year CEA Accelerator seeks to understand regional barriers to Controlled Environment Agriculture and enable their growth in local communities

→ **$2M over 2 years**

1 Design outreach plan and milestones

- Identify community partners (10+) and USDA contact (at least 1 required)

Products:

- CEA Accelerator workplan and market transformation plan

2 Develop tools to assess feasibility

- Research CEA R&D and market barriers
- Baseline community partner needs

Products:

- Existing/emerging technology catalogue
- CEA feasibility tool

3 Connect partners to DOE resources

- Provide education and training opportunities for communities

Products:

- Webinar series of energy/water best practices, tools, and applying to funding

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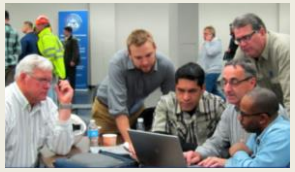
4 Engage stakeholders and workforce

- Convene stakeholders:
  - *R&D technologists
  - *State energy offices
  - *Business developers
  - *Food distributors

Products:

- Networking platform
- End of accelerator conference/career fair



Pre-Launch

Year 1

Year 2

The CEA accelerator will benefit community partners by providing tools, and the communities will benefit the lab by providing technical, economic, and social data

Questions?

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