U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Technical Assistance and Workforce Development (TAWD)

ARE YOU A CLEAN ENERGY CHAMPION?

Better Plants | Controlled Environment Agriculture (CEA) Accelerator

August 31, 2023

IEDO Technical Assistance Mission

Public /private partnerships to help manufacturers and industrial organizations set and achieve long-term energy intensity reduction goals

Education and training for the current and future manufacturing workforce

No-cost tools and resources for manufacturers to reduce GHG emissions and improve energy efficiency and competitiveness

End-user support, stakeholder engagement, and technical services for the industrial sector

TA WORK PRODUCTS INCLUDE:

ENERGY ASSESSMENTS | PEER-TO-PEER NETWORKING | TOOLS & TRAINING | TECHNOLOGY SCREENING | PROJECT PROFILES

Meet the IEDO Technical Assistance and Workforce Development staff

Anne Hampson
Program Manager

Technology Managers
(Federal Employees)

Meegan Kelly
Onsite Energy, Combined Heat and Power (CHP)

Ethan Rogers
Energy Management Programs, Data Centers, Industrial Technology Validation (ITV) Pilot

John O'Neill
Better Plants, Better Climate Challenge, ITV

Fellows

Mai Kim "Kimmai" Tran
(ORISE Fellow)
Controlled Environment Agriculture Accelerator, Energy-Water Nexus

Kyle Niemeyer
(AAAS Fellow)
Workforce, Decarbonization

Zach Pritchard
(AAAS Fellow, EEII team)
Energy Intensive Initiative

Contractors

Patti Garland
(Energetics) CHP, Onsite Energy

Zac Amigone
(BGS) Onsite Energy

Bruce Lung
(BGS) Better Plants, Energy Intensive Initiative

Andrew Whitlock
(BGS) Better Plants

Jennifer Mosley
(BGS) Communications

Our flagship programs have expanded to help manufacturers reach net zero

IEDO's **R&D** portfolio demonstrates innovative energy and efficiency technology for industry

TAWD takes the baton for the next leg of the race toward deployment at scale

Better Plants®
U.S. DEPARTMENT OF ENERGY

- Expert technical assistance & training on energy efficiency
- Access to innovation & instruments
- National recognition for achievements

Better Climate CHALLENGE
U.S. DEPARTMENT OF ENERGY

- Energy efficiency + decarbonization technical assistance & training
- Facilitated peer-to-peer knowledge sharing
- National recognition for achievements

50001 Ready
U.S. DEPARTMENT OF ENERGY

- Tools, guidance, & recognition for facilities that implement an ISO 50001-based energy management system
- No-cost, self-paced, audit-free

CHP Technical Assistance Partnerships
U.S. DEPARTMENT OF ENERGY

- Expert technical assistance for CHP, microgrids, & district energy
- No-cost resources & training webinars
- Packaged CHP system eCatalog

NO-COST TOOLS & SOFTWARE

- MEASUR Software Suite
- 50001 Ready Navigator Tool
- REopt Web Tool
- Financing Navigator
- Low Carbon Action Plan Tool
- Carbon Inventory Calculator
- Electrification Impact Calculator

How Do Better Plants® U.S. DEPARTMENT OF ENERGY & Better Climate CHALLENGE U.S. DEPARTMENT OF ENERGY Programs Work?

Partners set voluntary long-term strategic goals:

- GHG and energy target for Climate Challenge
- Energy intensity goal for Better Plants

Partners receive free:

- technical assistance
- networking platforms
- national recognition
- access to innovation

Better Climate Challenge Goal

Portfolio-wide reduction in carbon emissions of at least 50% in 10 years
25% for energy intensive industrial sectors*

Goal Parameters

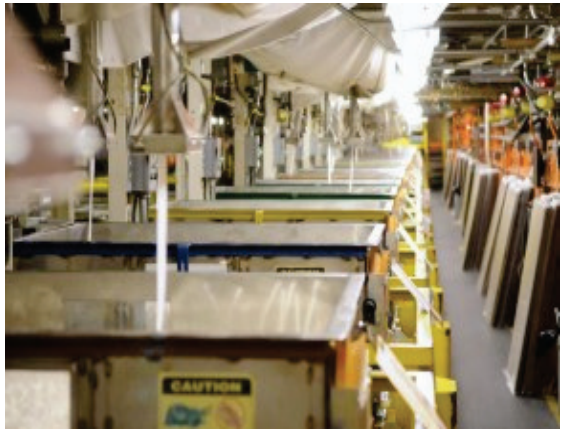
- Reduction includes Scope 1 & 2 emissions
- Baseline up to 5-years back from join date
- Absolute target preferred, but intensity-based targets will be accepted
- Establish an energy efficiency target that will contribute towards the 50% carbon emissions reduction.

Better Climate CHALLENGE
U.S. DEPARTMENT OF ENERGY

* *Energy intensive sectors: Chemicals, Pulp/Paper, Food/Bev, Primary Metals, non-Metallic Minerals*

In Review



To Date, Better Plants Partners Have Cumulatively Saved:

- **10.6 Billion Dollars**
- **2.2 Quadrillion BTUs**

Today:

- ~ 280 partners
- > 3,600 facilities
- 77 goals achieved

All Better Plants Partners

Better Plants®
U.S. DEPARTMENT OF ENERGY

U.S. DEPARTMENT OF ENERGY

Better Climate Challenge – Industrial Partners

Better Plants® U.S. DEPARTMENT OF ENERGY

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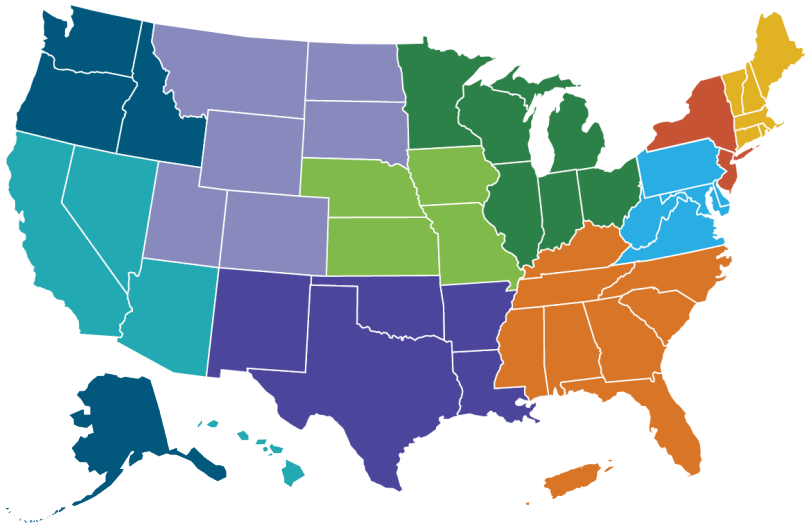
Combined Heat and Power Technical Assistance Partnerships

Upper-West
CO, MT, ND, SD, UT, WY
www.uwchptap.org
Marina Badoian-Kriticos
Houston Advanced Research Center
281-364-6033
mkriticos@harcresearch.org

Midwest
IL, IN, MI, MN, OH, WI
www.mwchptap.org
Cliff Haefke
University of Illinois at Chicago
312-355-3476
chaefke1@uic.edu

New England
CT, MA, ME, NH, RI, VT
www.nechptap.org
David Dvorak, Ph.D., P.E.
University of Maine
207-581-2338
dvorak@maine.edu

Northwest
AK, ID, OR, WA
www.nwchptap.org
David Van Holde, P.E.
Washington State University
360-956-2071
VanHoldeD@energy.wsu.edu



New York-New Jersey
NJ, NY
www.nynjchptap.org
Tom Bourgeois
Pace University
914-422-4013
tbourgeois@law.pace.edu

Western
AZ, CA, HI, NV
www.wchptap.org
Carol Denning
Center for Sustainable Energy
530-513-2799
carol.denning@energycenter.org

Mid-Atlantic
DC, DE, MD, PA, VA, WV
www.machptap.org
Jim Freihaut, Ph.D.
The Pennsylvania State University
814-863-2091
jdf11@psu.edu

Southcentral
AR, LA, NM, OK, TX
www.scchptap.org
Carlos Gamarra, Ph.D., P.E.
Houston Advanced Research Center
281-364-6032
cgamarra@harcresearch.org

Central
IA, KS, MO, NE
www.cchptap.org
Cliff Haefke
University of Illinois at Chicago
312-355-3476
chaefke1@uic.edu

Southeast
AL, FL, GA, KY, MS, NC, PR, SC, TN, VI
www.sechptap.org
Isaac Panzarella, P.E.
North Carolina State University
919-515-0354
ipanzarella@ncsu.edu

End User Engagement

Stakeholder Engagement

Technical Services

Learn More: https://betterbuildingssolutioncenter.energy.gov/chp/chp-taps

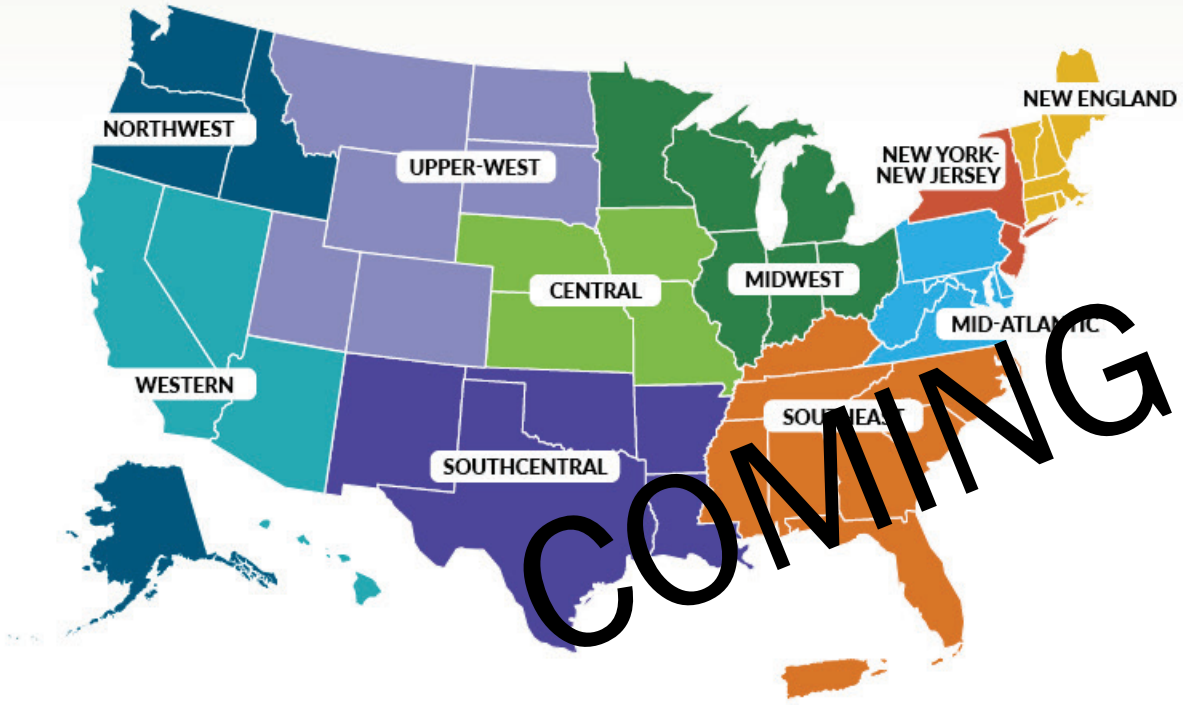
IEDO Onsite Energy Deployment

The Onsite Energy Deployment program is a new initiative to establish a regional network of technical assistance partnerships to help industrial facilities and other large energy users to increase the adoption of onsite clean energy technologies.

battery storage | combined heat and power | district energy | geothermal | industrial heat pumps | renewable fuels | solar PV | solar thermal | thermal storage | wind

DEPARTMENT OF ENERGY SELECTS

Nine Organizations to Implement Onsite Energy Technical Assistance Partnerships to Decarbonize America's Industrial Sector



COMING SOON

Northwest
AK, ID, OR, WA
Washington State Univer… Energy Pro…

Midwest
IL, IN, MI, MN, OH, WI
University of Illinois Chicago

New York-New Jersey
NY, NJ
Pennsylvania State University

Weste…
…Z, C…, HI, NV
Optony Inc.

Central
IA, KS, MO, NE
University of Illinois Chicago

New England
CT, MA, ME, NH, RI, VT
University of New Hampshire

Upper-West
CO, MT, ND, SD, UT, WY
Cascade Energy, Inc.

Southeast
AL, FL, GA, KY, MS, NC, PR, SC, TN, VI
North Carolina State University

National Selection
University of Connecticut

Southcentral
AR, LA, NM, OK, TX
Houston Advanced Research Center

Mid-Atlantic
DC, DE, MD, PA, VA, WV
Pennsylvania State University

Onsite Energy
Technical Assistance Partnerships
U.S. DEPARTMENT OF ENERGY

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INDUSTRIAL EFFICIENCY & DECARBONIZATION OFFICE

https://www.energy.gov/eere/articles/doe-selects-nine-organizations-will-implement-regional-onsite-energy-technical

Looking forward—

Top Priorities over next 5 years

- Expand Better Climate Challenge
- Implement new Onsite Energy Program
- ★ Increase TA to energy intensive manufacturers
- Upskill the manufacturing workforce
- ★ Become a connector for manufacturers to DOE opportunities

Areas for Further Inclusion in TAWD Programs

- Increase focus on tech-to-market activities
- Social/behavioral strategies to speed decarbonization implementation
- Strategies around equity and engaging disadvantaged communities
- Stakeholder engagement around new program activities

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For example…

- Strategies around equity and engaging disadvantaged communities
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Energy Intensive Industries Pilot: What's in it for You?

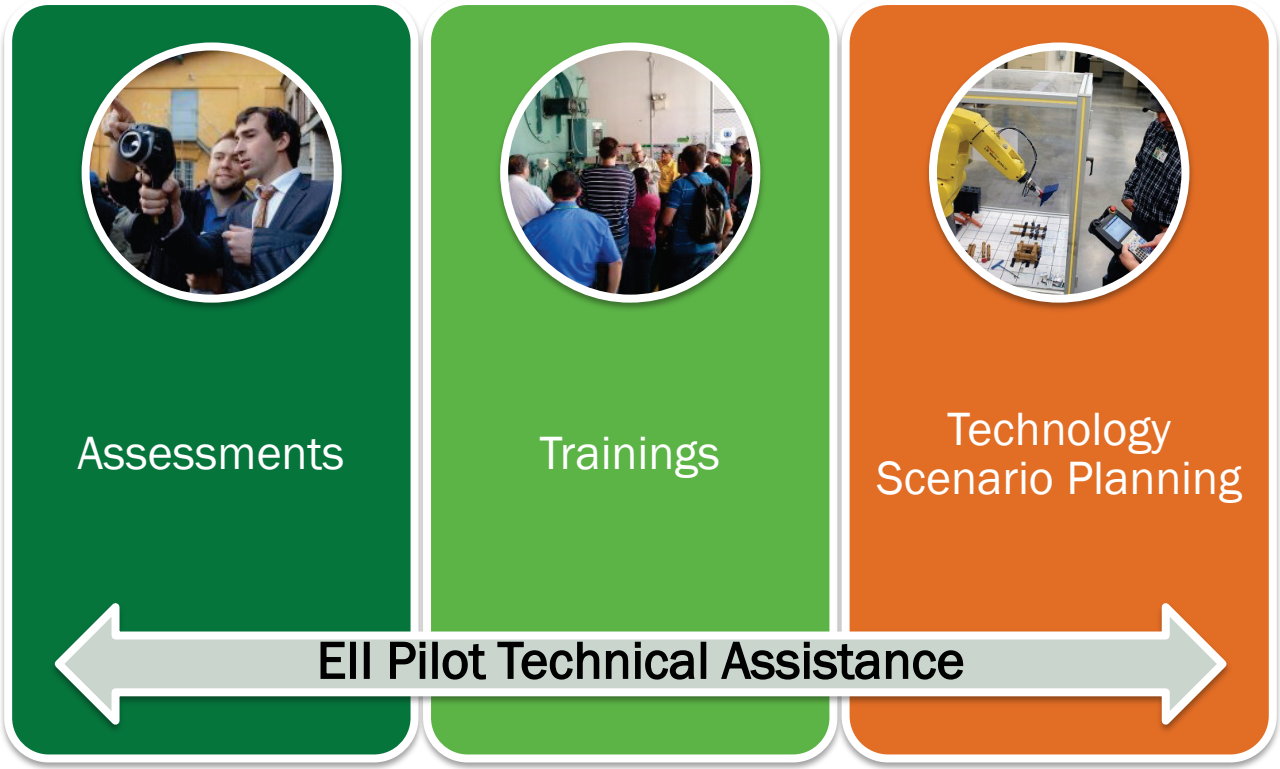
Get Free Technical Assistance

- ✓ **Receive unbiased technical assistance on energy efficiency and decarbonization**
- ✓ **Peer-to-peer networking opportunities though working groups, workshops, conferences and benchmarking activities**

GOAL: Understand your technical assistance needs and determine a programmatic structure/resources that addresses those needs.

Example Technical Assistance Resources:

- Energy and decarbonization assessments
- Customized training on industrial systems/topics
- Technology scenario planning/demonstrations of energy-saving technologies and/or materials



Energy Intensive Industries Pilot: What Are We Asking?

Before Technical Assistance

- Participate in **30-minute interview** on energy and decarbonization priorities and goals
- Submit online **Request for Technical Assistance** (https://eiipilot.ornl.gov/)

Receive Technical Assistance

After Technical Assistance

- **Provide feedback** on technical assistance offerings
- Consider participating in **future opportunities**, including peer-based trainings, scenario planning, and technology demonstrations

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For example…

One opportunity is the potential to translate manufacturing technologies and best practices to the ag sector for more efficient operations

Traditional field farming

supplemented by

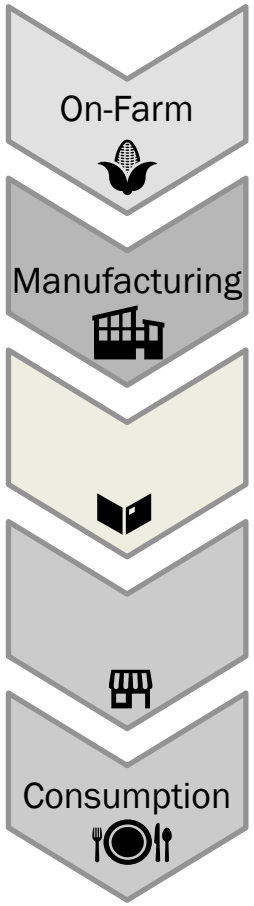
Indoor farming

Photo by Keith Welle, USDA-ARS

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

Ag and other land use activities accounted for ~13% of CO_2, ~44% of CH_4, and ~81% of N_2O globally during 2007-2016, representing 23% of total net anthropogenic GHGs

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, FY23 Appropriations Bill)

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

The Controlled Environment Agriculture (CEA) Accelerator seeks to leverage IEDO's existing programs and optimize its benefits, 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

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

→ **$2.5M 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:

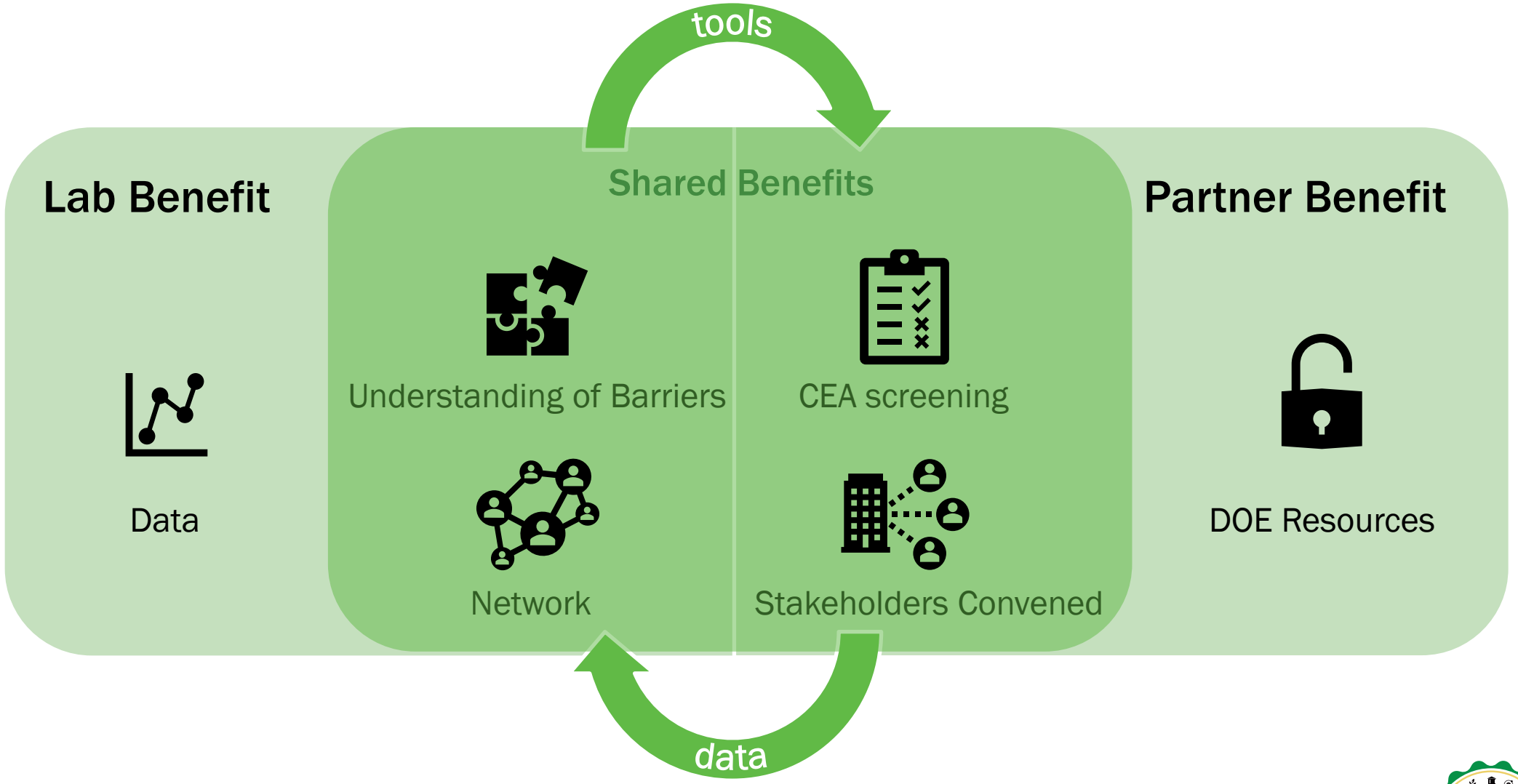
- Networking platform
- End of accelerator conference/career fair

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



Next steps (for YOU!)

- ✓ Join Better Plants or the Better Climate Challenge
- ✓ Get recognized for being 50001 Ready
- ✓ Reach out to your regional CHP TAP (and Onsite Energy TAP coming soon)
- ✓ Request Technical Assistance through Energy Intensive Industries Pilot
- ✓ Engage with CEA Accelerator stakeholders

Anne Hampson (TAWD Program Manager)
Anne.Hampson@ee.doe.gov

Kimmai Tran (Fellow)
mai.tran@ee.doe.gov

Supplementary Slides

EERE Guiding Principles seek to accelerate innovation that can equitably decarbonize the industrial, building, and agricultural sectors

Accelerate the research, development, demonstration, and deployment (RDD&D) of innovative technologies that will transition Americans to a 100% clean energy economy no later than 2050 and ensure the clean energy economy benefits all Americans.

EERE Mission Program Priorities

- 100% decarbonized electric grid by 2035
- Decarbonize transportation across all modes
- Decarbonize the industrial sector
- Reduce the carbon footprint of buildings
- Decarbonizing the **agriculture sector**, specifically focused on the nexus between **energy and water**

Keys to Ensure the Greatest Impact

Environmental Justice and Equity

Diversity in STEM

Workforce Development

State and Local Partnerships

Big Picture: Research, Development, and Demonstration

DOE Energy-Water Crosscut includes:

RD&D Projects

- FY22 FOA: Decarbonization of Water Resource Recovery Facilities
- FY21 FOA: R&D for Advanced Water Resource Recovery Systems
- Small Business Innovation Research (SBIR) Projects

Analysis

- Multi-lab Foundational Analysis
- **Water** Technoeconomic Assessment Platform (**TAP**) and Data Analysis and Management System (**DAMS**)
- Internal Strategic Analysis

National Alliance for Water Innovation (NAWI) Hub

- Technology Roadmaps
- Desalination Projects

Interagency Working Groups

- (DOE-DOI) NEWS RD&D
- (DOI) WaTr
- (EPA) WRAP
- (EPA) Urban Waters

CHP Technical Assistance Partnerships

Controlled Environment Agriculture Accelerator

Tech Assistance

Legend

der Secretary for Science and Innovation

RD&D

Technical Assistance

er agency-led

Research, Development, & Demonstration (RD&D) helps address societal needs in areas in which the private sector does not have sufficient economic incentive. Universities, National Labs, industry, and partnerships thereof conduct this research project and pilot work through mechanisms like funding opportunity announcements (FOAs).

Big Picture: Energy-Water Nexus at IEDO and beyond

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- CHP Technical Assistance Partnerships
- Industrial Water Savings Network
- Sustainable Water Infrastructure of the Future (SWIFt)
- Controlled Environment Agriculture Accelerator
- Virtual In-Plant Trainings
- 50001 Ready Energy Management Program

(including through Better Buildings, **Better Plants**)

Legend

- Under Secretary for Science and Innovation
- RD&D
- Technical Assistance
- Other agency-led

Big Picture: Interagency Engagements

DOE Energy-Water Crosscut includes:

INTERAGENCY ENGAGEMENTS ensure DOE's water programs align with EPA's and USDA's:

Working Groups

- DOE's Nexus of Energy and Water for Sustainability (NEWS) RD&D
- EPA's Water Reuse Action Plan (WRAP)
- EPA's Urban Waters
- Department of Interior (DOI)'s Water Treatment (WaTr)

Other Engagements

- Memorandum of Understanding (MOU) and Action Plan:
  USDA, Water Power Technologies Office, Bureau of Reclamation, Army Corp of Engineers
- USDA-Rural Development's Rural Energy Partnership Program

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Tech Assistance

Better Buildings, Better Plants

Legend

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National Alliance for

Desalination Projects

Interagency Working Groups

(DOE-DOI) NEWS RD&D

(DOI) WaTr

(EPA) WRAP

(EPA) Urban Waters

Technical Assistance helps companies identify and implement energy-saving projects and improve energy management programs and energy performance. National Lab staff often help execute these initiatives.

CHP Technical Assistance Partnerships

Industrial Water Savings Network

Sustainable Water Infrastructure of the Future (SWIFt)

Controlled Environment Agriculture Accelerator

Virtual In-Plant Trainings

50001 Ready Energy Management Program

(including through Better Buildings, **Better Plants**)

Legend

- Under Secretary for Science and Innovation
- RD&D
- Technical Assistance
- Other agency-led

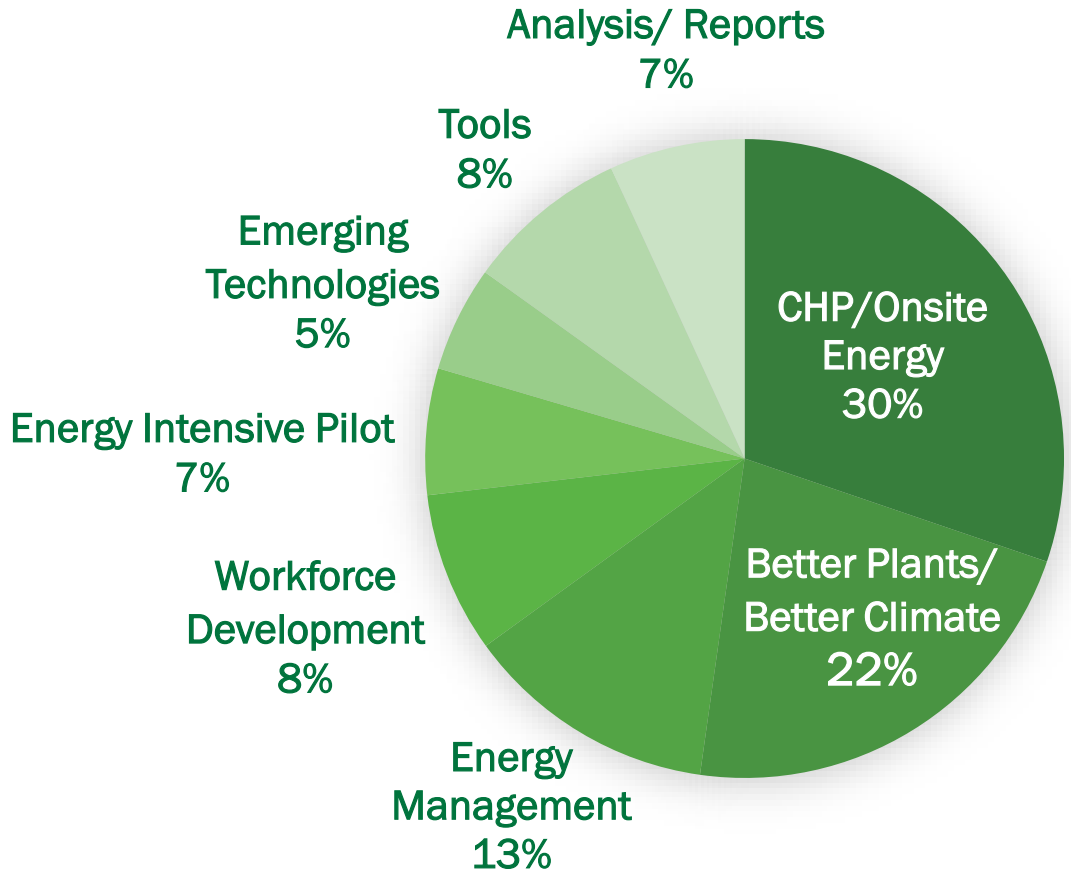
TAWD allocates these investments though various funding mechanisms

$45M | FY23

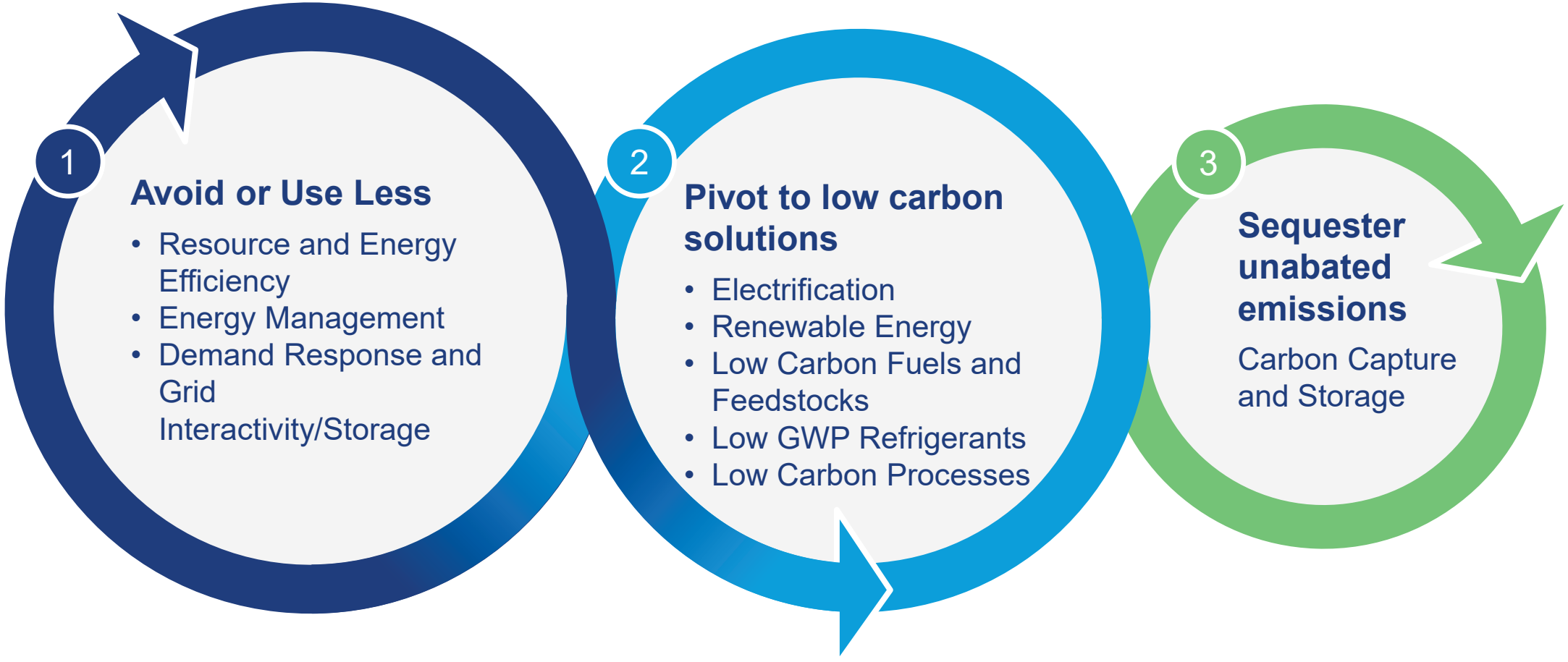
For example, the **Onsite Energy Program** is a new initiative to provide technical assistance for industrial facilities and other large energy users to increase the adoption of onsite clean energy technologies.

Operational Methods:

- Strong reliance on National Labs to support programs
- Resource and tool development
- Subject matter experts
- Use of cooperative agreements for regional Technical Assistance Partnerships
- Interagency partnerships
- EPA – energy intensive pilot
- Workforce development – National Strategy for Advanced Manufacturing



Three Categories of Solutions will Count Towards GHG Emissions Reduction Goals



Technical Assistance: Tools and Resources

Diagnostic Equipment Program

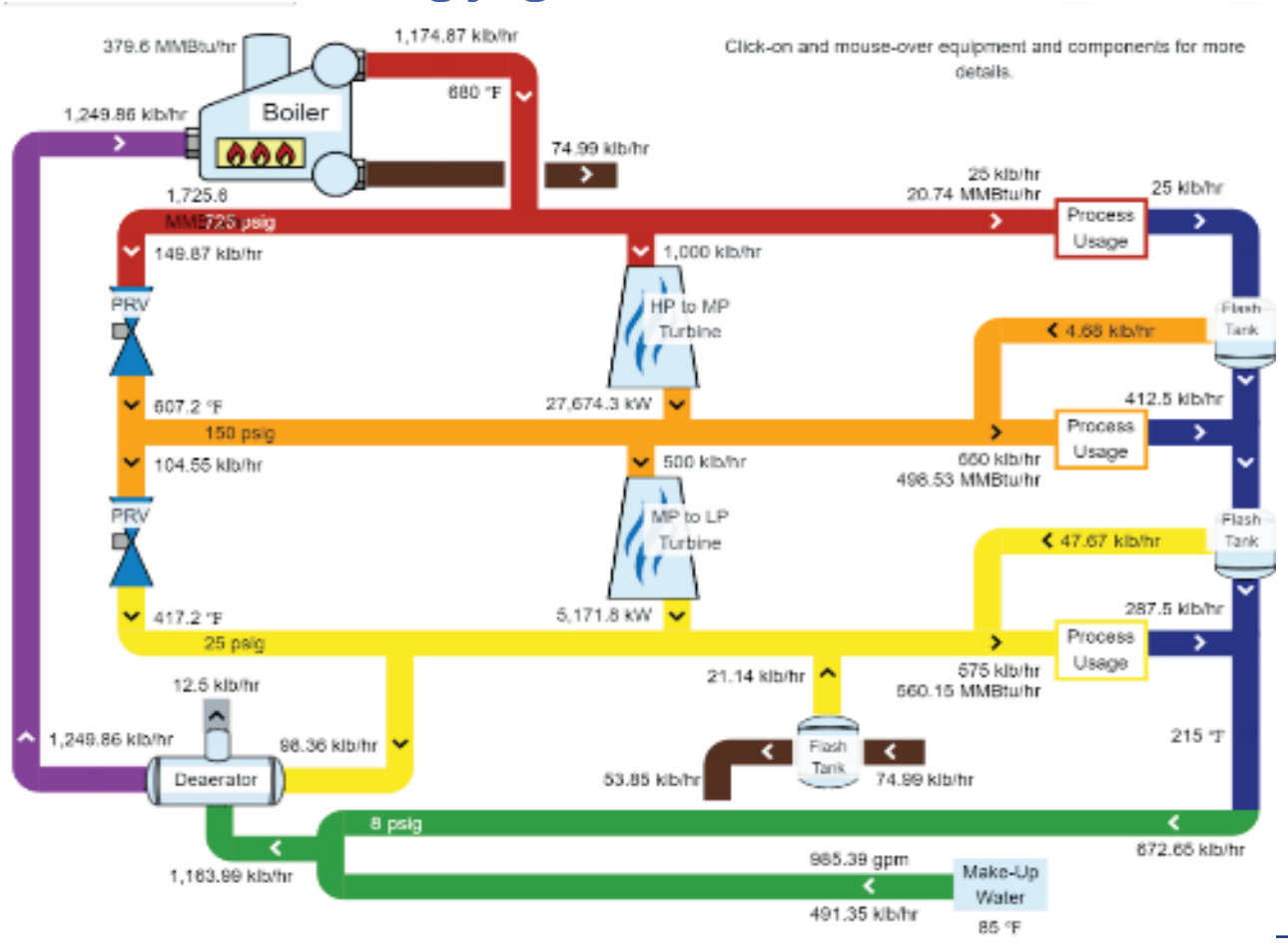
- Evaluate system performance
- Measure energy losses
- Quantify savings opportunities

Field data is best for evaluating system performance

Technical Assistance: Software Tools

MEASUR Tools Suite

https://www.energy.gov/eere/amo/measur



[Steam/Boiler Systems](#)

[Pumping Systems](#)

[Fan Systems](#)

[Motor Systems](#)

[Compressed Air](#)

[Process Heating/Furnace Systems](#)

[Energy Treasure Hunts](#)

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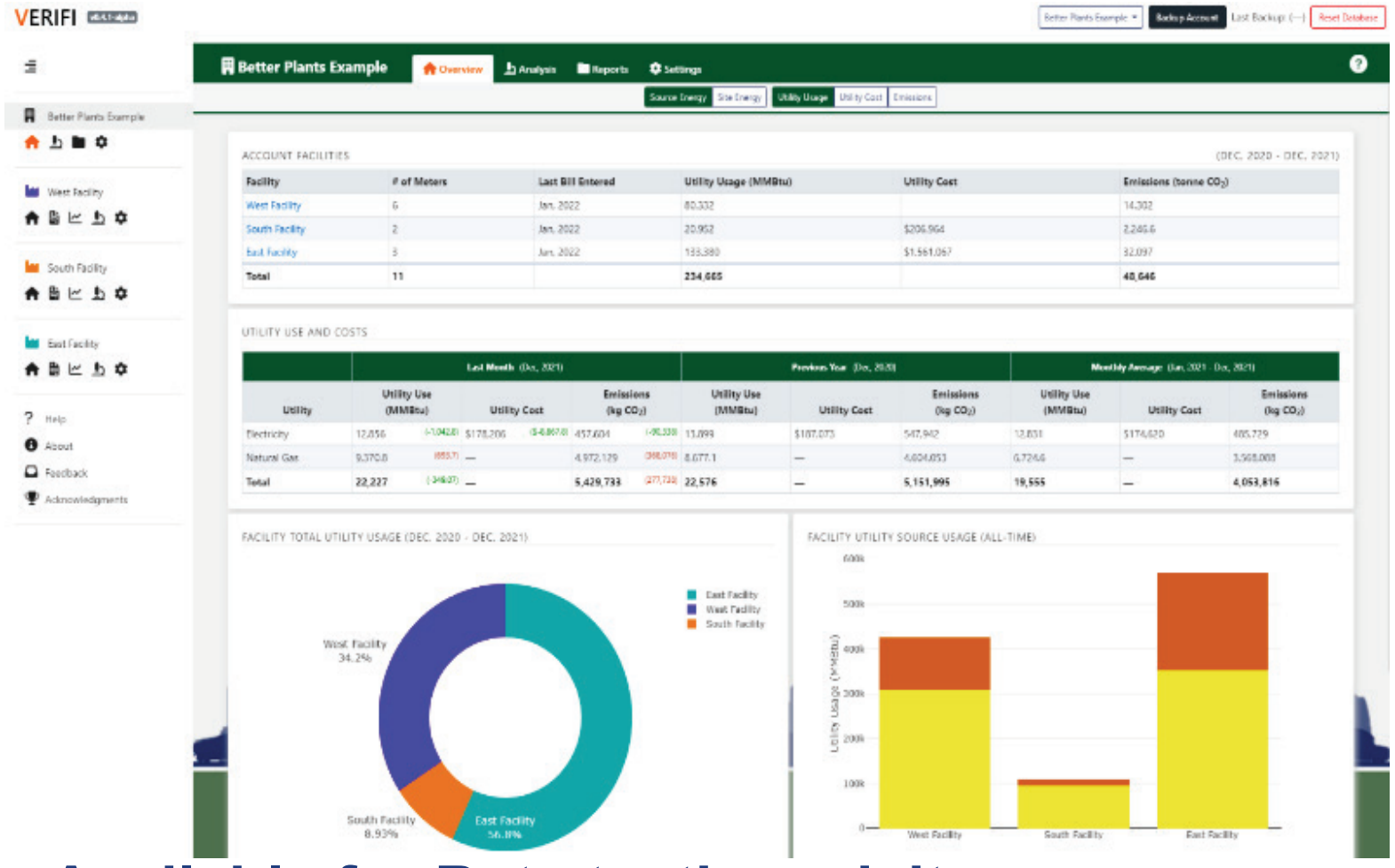
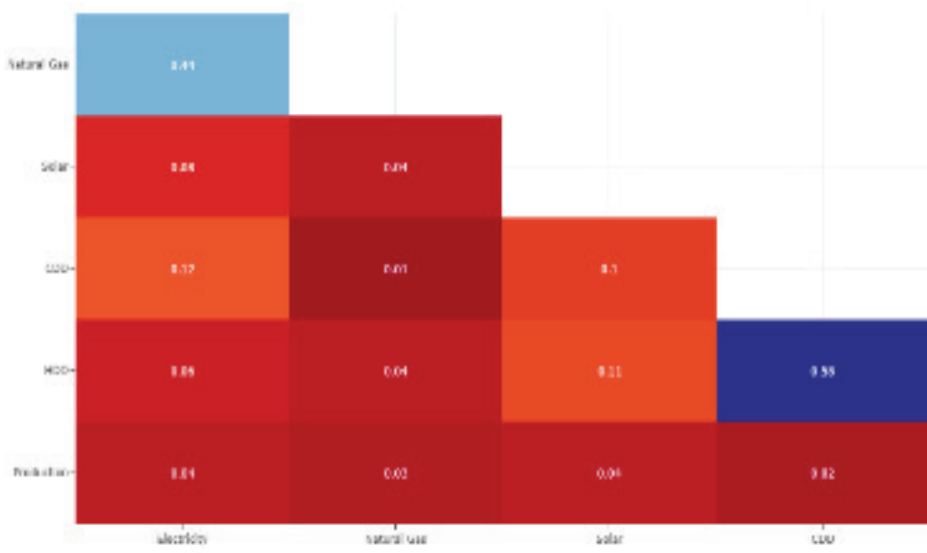
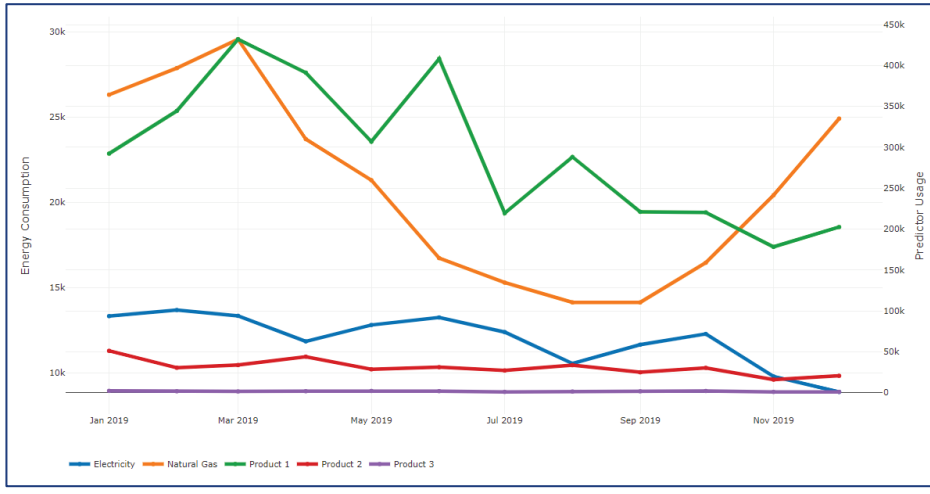
Technical Assistance: Software Tools: VERIFI







- **Available for Beta testing, visit:**

https://verifi.ornl.gov/ https://github.com/ORNL-AMO/VERIFI/releases

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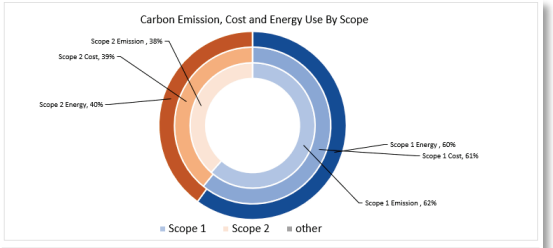
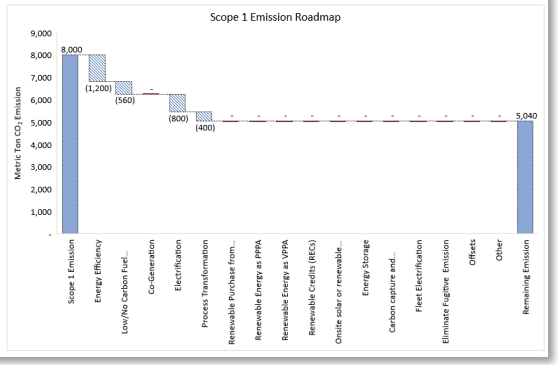
U.S. DEPARTMENT OF ENERGY

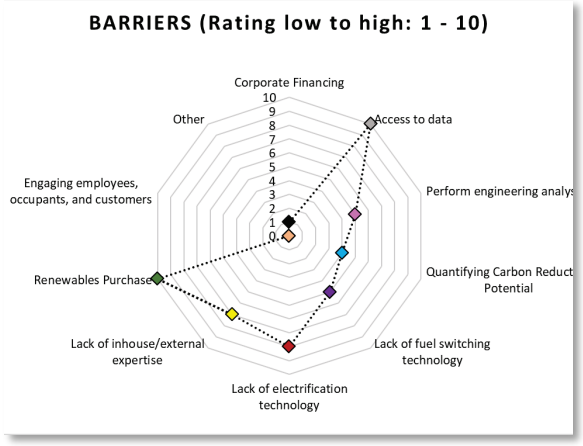
Technical Assistance: Industrial Action Plan Tool

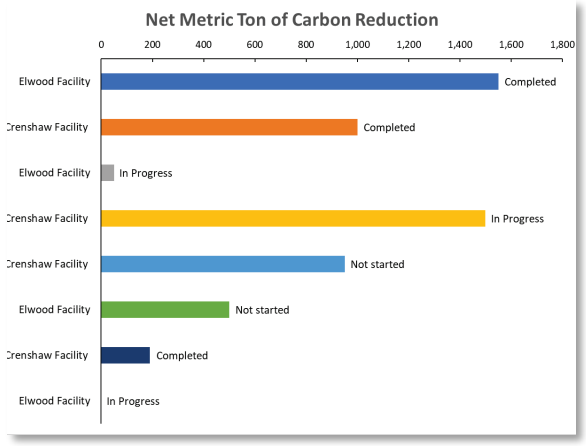
Showcase Plant Name	Elwood Facility			
Scope of Emission	Description	Energy Source (MMBTU)	Energy Cost ($)	CO_{2eq} Emission (Metric Ton)
Scope 1 Emission		15,000	7,000	8,000
Stationary Emission		15,000	7,000	8,000
Natural Gas		15,000	7,000	8,000
Mobile Emission		-	-	-
Fugitive Emission				
Scope 2 Emission		10,000	4,500	5,000
Purchased Electricity		10,000	4,500	5,000
Other				

Pillars of Decarbonization	Opportunity	Barrier	Scope 1 % Carbon Reduction	Scope 2 % Carbon Reduction
Energy Efficiency			15%	30%
Low/No Carbon Fuel Switching			7%	
Co-Generation				
Electrification			10%	-20%
Process Transformation			5%	
Renewable Purchase from Utility				10%
Renewable Energy as PPPA				15%
Renewable Energy as VPPA				
Renewable Credits (RECs)				30%
Onsite solar or renewable energy generation				20%
Energy Storage				
Carbon capture and sequestration				
Fleet Electrification				









The Action Plan Tool helps partners visualize and facilitates reporting scope 1 and 2 emissions, both at the corporate and facility levels.

Other Useful Resources

Electrification for Decarbonization
Electrification.ORNL.gov

Carbon Emissions Calculator
Carboncalc.ORNL.gov

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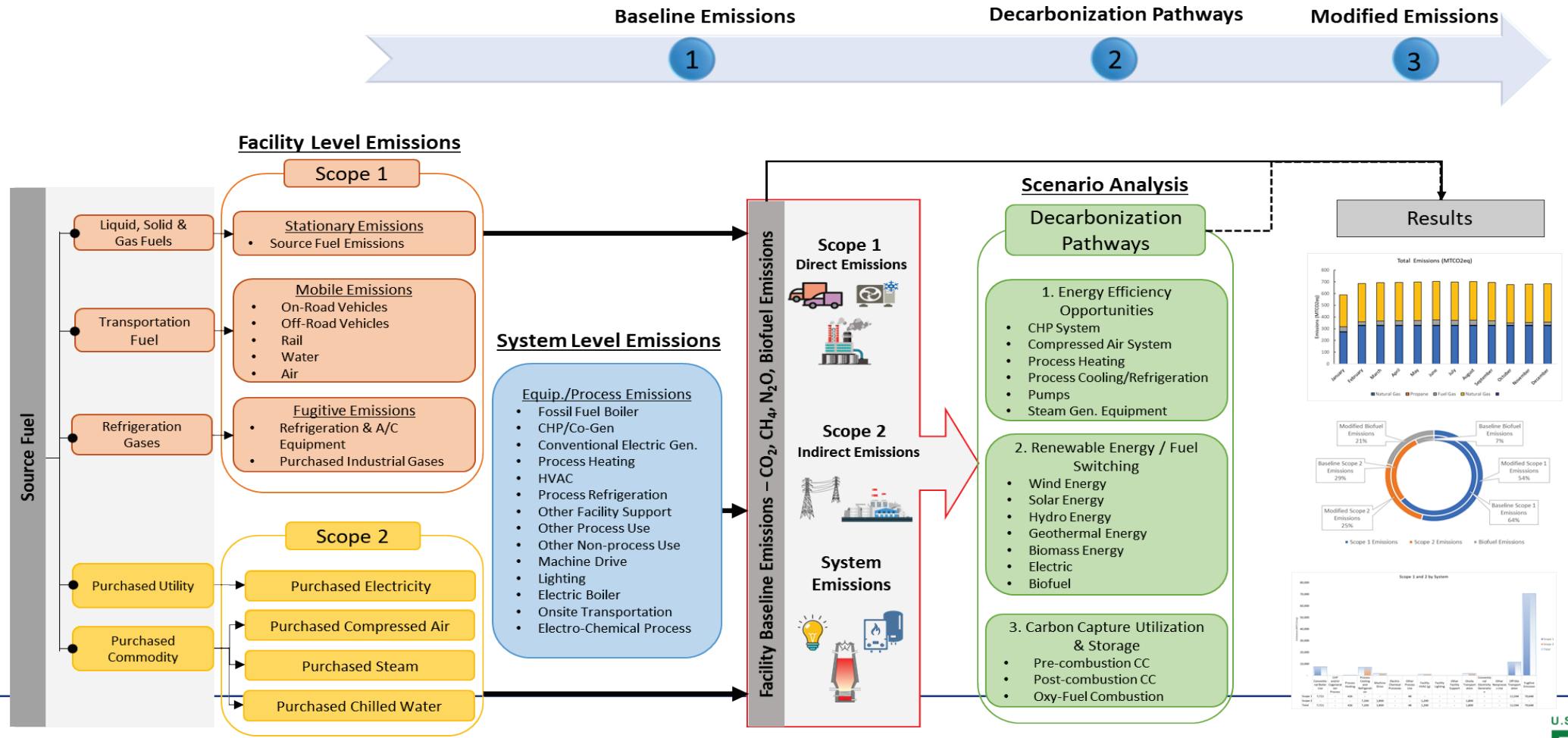
Technical Assistance: Carbon Footprint and Decarbonization Scenario Analysis Tool

- Enables users to create and analyze baseline emissions
- Provides users the ability to evaluate decarbonization scenarios and perform techno-economic analyses (in development)



Technical Assistance: Supply Chain Initiative

Around 40-60% of a manufacturing company's energy and carbon footprint can reside upstream in its supply chain.

DOE works with partners to sponsor Supply Chain cohorts of suppliers to leverage Better Plants resources, and collectively set, track, and meet energy savings goals.

Not Just Goal Setting – Technical Assistance to Get there

Raytheon Technologies

VOLVO
VOLVO GROUP

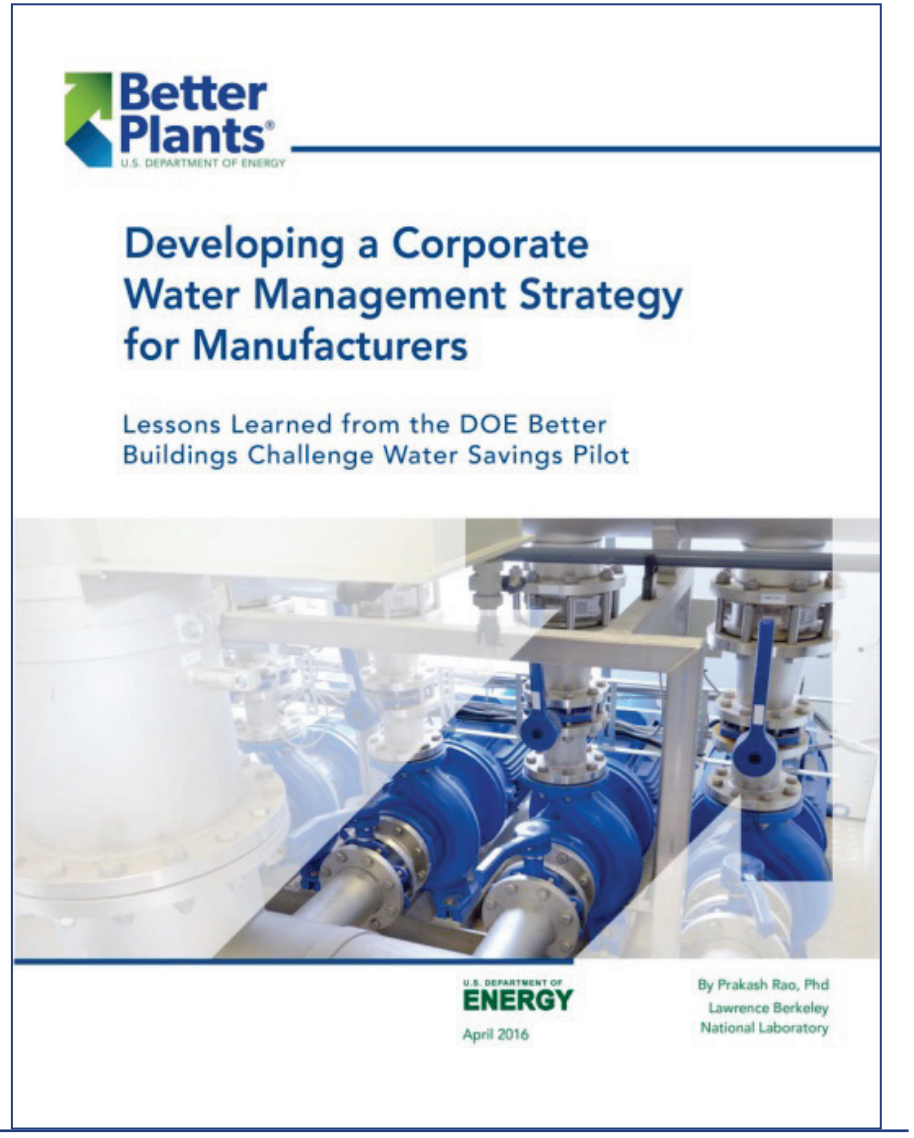
HONDA

LOCKHEED MARTIN

legrand®

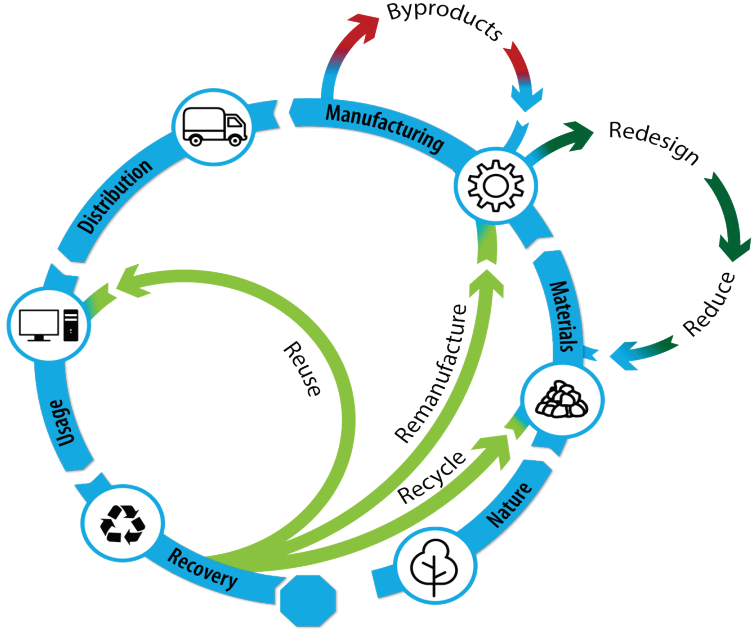
Technical Assistance: Water Efficiency

- FREE Water management guidance document – topics:
  - Making the business case for water efficiency
  - Prioritizing facilities to focus initial efforts
  - Establishing water baselines and targets
  - Industrial water efficiency examples
  - NEW: Plant Water Profiler tool
- Additional resource:
  - Webinar on starting a corporate water efficiency program



Technical Assistance: Waste Reduction Network

- Three-year pilot completed:
  - 32 Industrial partners
  - 30 Commercial partners
- Outcomes:
  - Strong links between waste & energy
  - Uncovered technology gaps to inform R&D
  - Strong variety of ways to reduce waste
- Future resources:
  - Guidance materials/standards
  - Software tools/modeling frameworks
  - Knowledge-sharing structure



Energy-Water-Food Nexus in the IEDO/EERE context

IEDO's Energy-Water-Food Nexus Goals:

1. Reduce GHG emissions through maximizing resource recovery including energy and nutrients from water and wastewater
2. Reduce energy footprint of water supply, treatment, and conveyance through analysis and RD&D

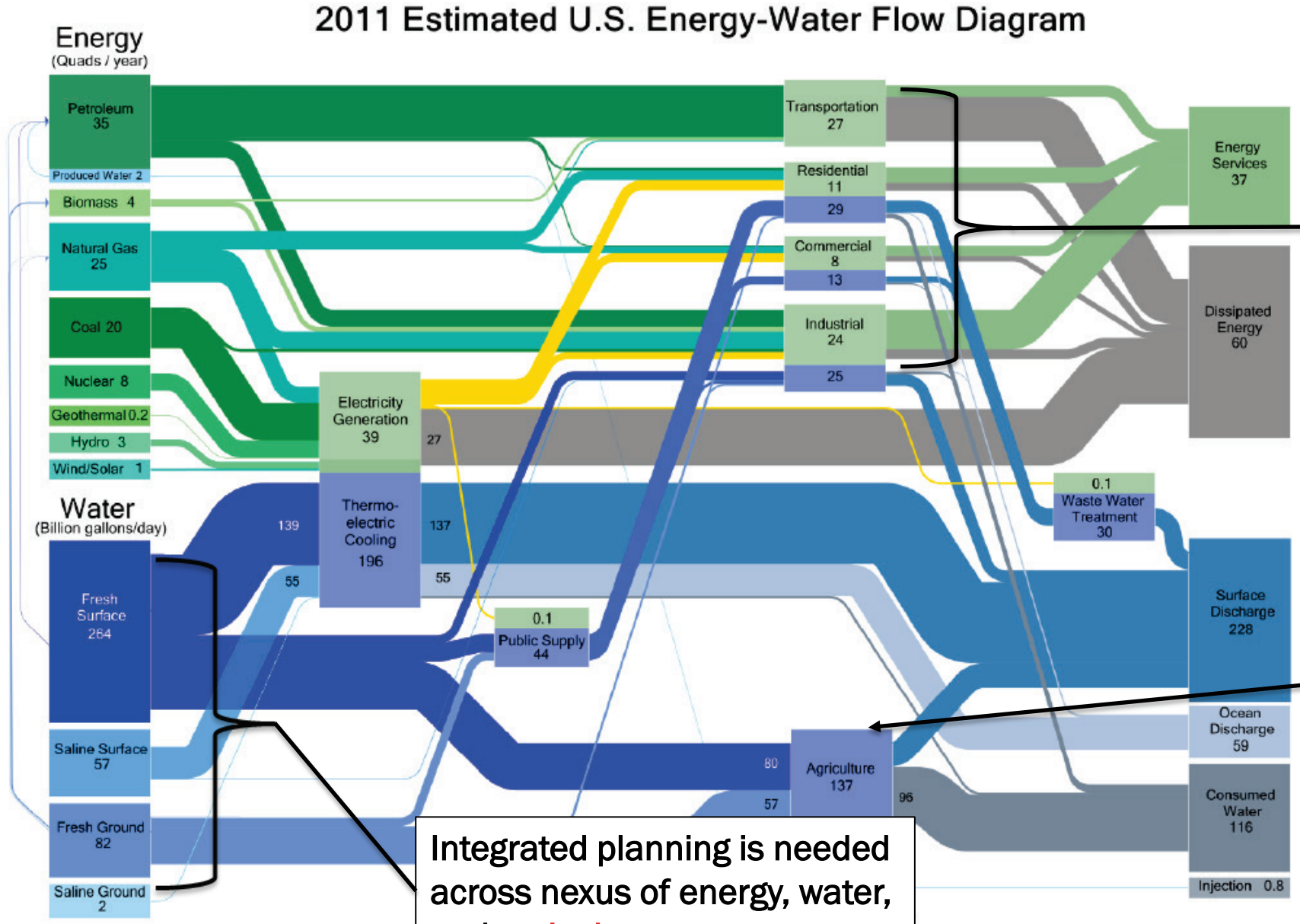
Vision: Transition to a circular water economy through next-generation integrated water systems (Water 4.0)

EERE Priorities:

- Decarbonizing the electricity sector
- Decarbonizing transportation across all modes: air, sea, rail, and road
- Decarbonizing the industrial sector
- Reducing the carbon footprint of buildings
- **Decarbonizing the agriculture sector, specifically focused on the nexus between energy and water**

The Energy-Water-Food Nexus addresses all EERE's Priorities

Energy-Water cannot be discussed without Agriculture (Water-Energy Nexus June 2014 Report)



U.S. Energy use is ~100 Quads/year. The fully aggregated agriculture sector accounts for ~11 Quads/year[1, 2]

42% of all U.S. water withdrawals go to irrigation

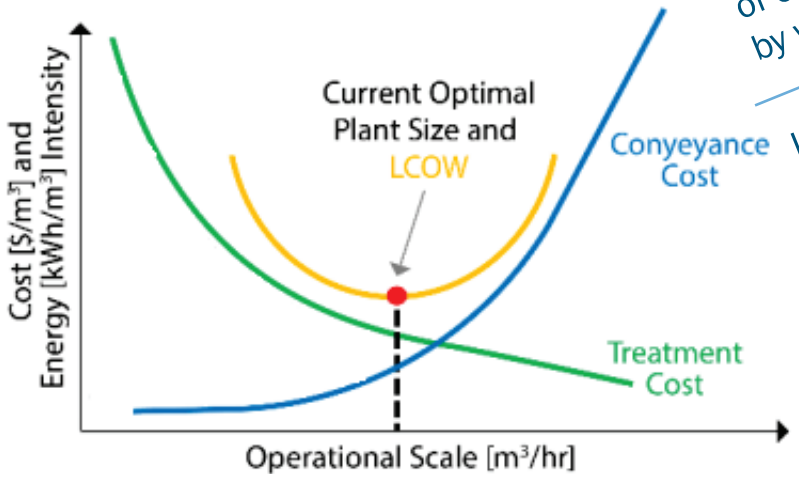
- 60-70% is consumed
- 30-40% is discharged

~20 trillion gallons per year available for efficiency, reuse or repurpose[3]

Integrated planning is needed across nexus of energy, water, and agriculture

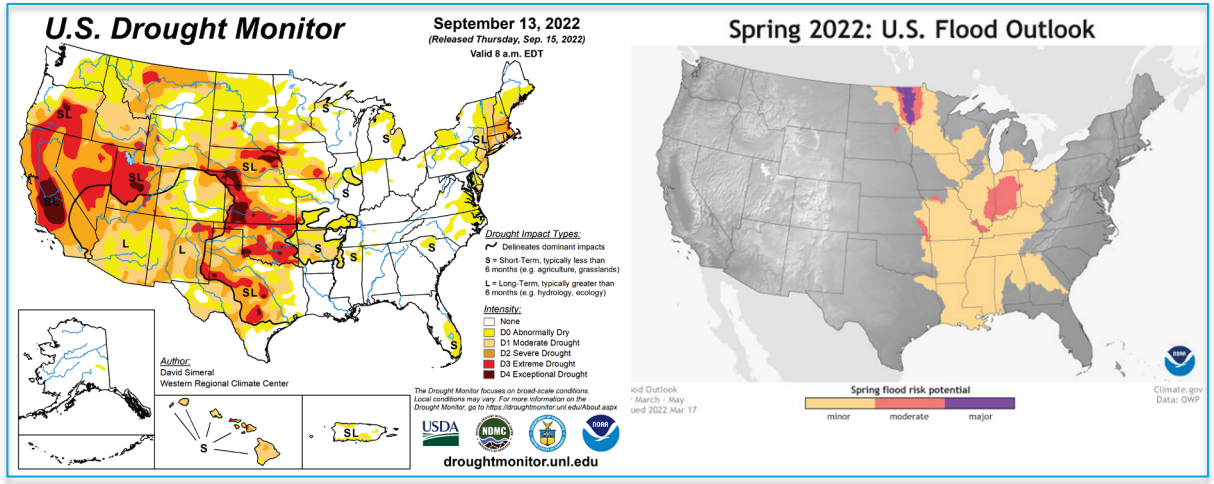
Regional water needs lead to increasing energy cost and intensity

Current centralized systems benefit from economies of scale, but at a cost:

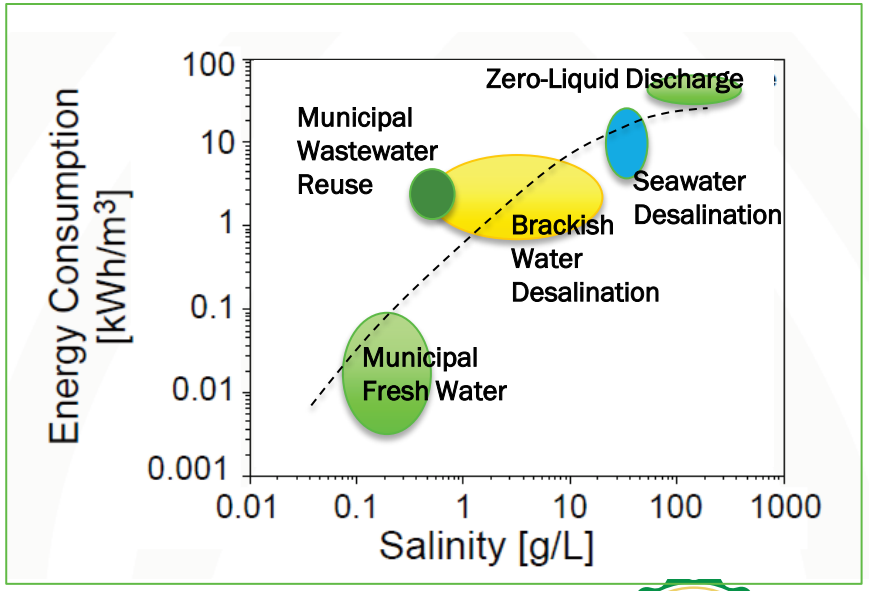


Pumping operations ~80% of electricity consumption by water utilities [4]

Issues are compounded by climate change, aging infrastructure, & pollution



Advanced treatment processes are increasingly energy intensive depending on the water source and salinity



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EERE's 5th programmatic priority states the need for "Decarbonizing the agriculture sector, specifically focused on the nexus between energy and water"

Work on the controlled environment agriculture subsector can:

Action	Impact	IEDO Alignment	Admin Interest
Improve overall facility operation (e.g. waste heat recovery)	Reduced cost, particularly with electricity generation for lighting and HVAC	Meets core mission of achieving energy efficiency	Decarbonization, demonstrations *Cross-agency: USDA*
Facilitate more inter-connected energy infrastructure	District energy connection + microgrid creation can provide safe, reliable, and locally sourced energy	Leverages diverse domestic energy resources; increases manufacturing resiliency	Demo; energy equity; regional solutions; environ justice; decarb
Deploy greenhouses/ vertical farms in distressed areas: urban, brownfield, remote	Efficient land use in retrofitted buildings or new construction; local production = alleviation of food deserts while reducing transportation fuel use	Reduces resource impacts; strengthens environmental stewardship in underserved regions	Regional solutions; decarb; demo; EJ *Cross-agency: EPA, USDA, DOI, DOC-MBDA*
Improve RD&D of CEA technologies and other environmental controls	Reduced overall cost (and risk) for greater CEA technology and infrastructure penetration into the market	CESMII and NAWI consortia support technologies that can be transitioned into U.S. mfg capabilities	Decarb; demo *Cross-agency: USDA, EPA, DOC*
Educate and engage stakeholders on indoor farming benefits	Stimulation of skilled local jobs providing diversified income for farmers; increased facility resilience and food security	Strengthens and advances the U.S. manufacturing workforce	Diversity, Equity, Inclusion *Cross-agency: USDA, DOI, DOC-MBDA*