

Advanced Manufacturing Office

Securing a Decarbonized Future

Bob Gemmer, CHP Program Lead

March 9, 2022



OE Priorities: Catalyze Economy-Wide Decarbonization

BIDEN ADMINISTRATION CLIMATE GOALS

A carbon pollution-free power sector by 2035

Net-zero emissions by 2050

Make basic and applied research breakthroughs



Turn that research into deployable technologies



Catalyze deployment of clean energy and decarbonization technologies

CREATE GOOD-PAYING JOBS

associated with the fast-growing global market for products that reduce carbon emissions

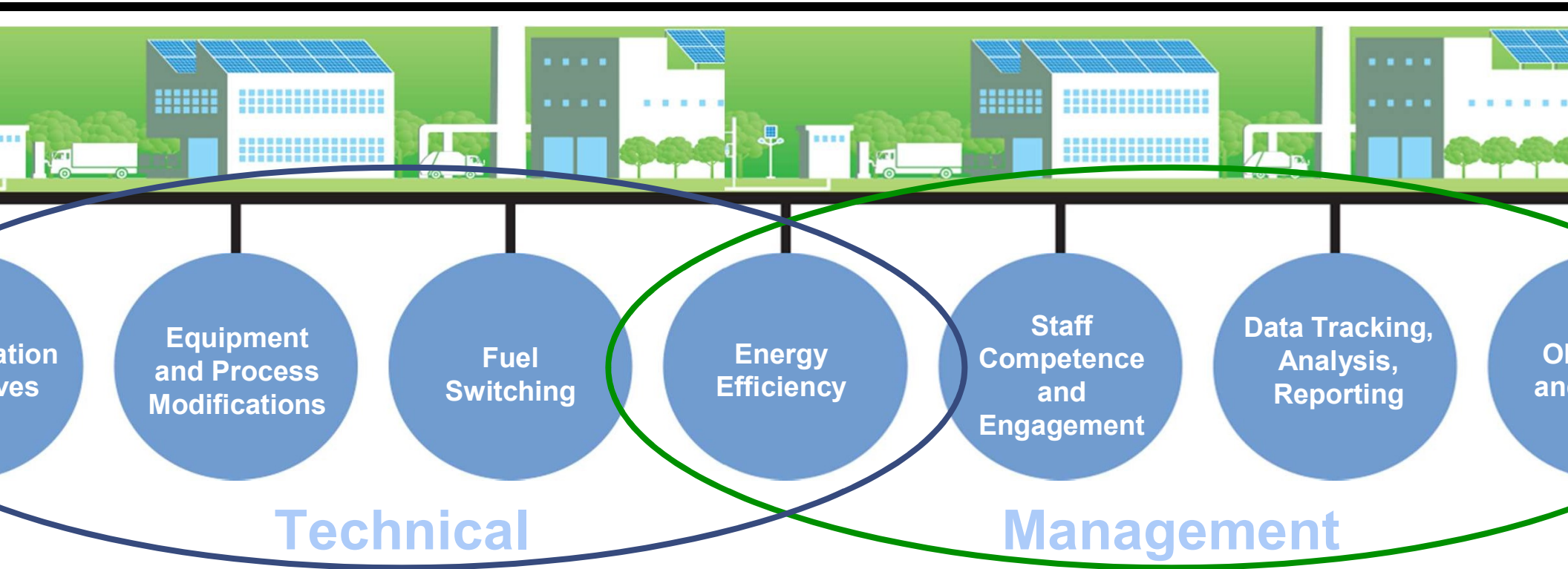
PURSUE ENVIRONMENTAL AND ENERGY JUSTICE

and target disadvantaged communities for new clean energy investments, jobs, and businesses

COLLABORATE ROBUSTLY

across the federal government, the fifty states, and the private sector

Carbonization requires technical and management change



Carbon targets to meet global, regulatory, and corporate goals

GLOBAL

- Reduce emissions by 7.6% annually for the next 10 years to meet the 1.5° C ceiling on temperature rise.
 - United Nations Environment Programme

NATIONAL

- 2015 Paris Agreement
- Goal of **Net-zero carbon emissions by 2050**
 - US, President Joe Biden's EO directs agency pursuit of this goal

CORPORATE

- “Limiting global warming to well-below 2°C above pre-industrial levels.”
 - More than 500 companies established these Science Based Targets
- Zero carbon and Zero net carbon

FACILITY and SITE

- Regulatory
- Corporate
- Science based

ISO 50001
EnMS

ISO 50001 business practice is:

Framework for continual improvement of energy performance
Global standard developed by 56 countries with US leadership
Flexible roadmap used by over 42,000 sites



ISO 50001's data-driven, flexible design helps organizations of all kinds and sizes to achieve significant energy and cost savings over the long term



ISO 50001 Saves Energy



ISO 50001 Drives Decarbonization

ISO 50001 Builds Resilience



ISO 50001 Promotes Efficiency

Technical Assistance: Tools and Resources

MEASUR Tools Suite

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

User friendly

Open source

Developed by subject matter experts

Coming in 2022: VERIFI (dashboard)



[Steam/Boiler Systems](#)



[Pumping Systems](#)



[Fan Systems](#)



[Motor Systems](#)



[Compressed Air](#)



[Process Heating/Furnace Systems](#)



Adding Carbon in MEASUR Tool Suite

Adding carbon mitigation determination to the energy savings calculations in existing tools in MEASUR

MEASUR tools and calculators are useful for performing ground-up analysis of energy saving opportunities

New decarbonization tools

- Some are already in MEASUR
- Some are standalone
- More in development

The image displays two screenshots of the MEASUR tool suite. The top screenshot shows the main dashboard with a sidebar menu and a central area for creating assessments and using calculators. The bottom screenshot shows a detailed view of the 'CO₂ SAVINGS' calculator, which compares baseline and modified energy use to determine emission reductions.

MEASUR Dashboard Overview:

- Home:** All Assessments, New Motor Inventory, Examples, Treasure Hunt Example, Steam Example, Process Heating - Fuel Example, Waste Water Example, Fan Example, Toy Factory, Pump Example.
- Data Exploration:** All Calculators (General, Compressed Air, Fans, Lighting, Motors, Process Cooling, Process Heating, Pumps, Steam, Waste Water), Settings, Custom Materials, Tutorials, About, Feedback, Acknowledgments, Translate.
- Central Area:** Create Assessment (Model a system and explore multiple optimization scenarios), Properties & Equipment Calculators (Generate detailed properties and test a variety of adjustments).
- Calculators:** Create Pump Assessment (formerly DOE Pumping System Assessment Tool (PSAT)), Create Process Heating Assessment (formerly DOE Process Heating Assessment and Survey Tool (PHAST)), Create Fan Assessment (formerly DOE Fan System Assessment Tool (FSAT)), Create Steam Assessment (formerly DOE Steam System Modeler Tool (SMT)), Create Treasure Hunt (Energy efficiency calculators for facilities a Treasure Hunt).
- Inventory Management:** Create Motor Inventory (based on DOE's Motor/Master+ tool).

CO₂ SAVINGS Calculator Details:

BASELINE		MODIFICATION	
+Add Energy Use		+Add Energy Use	
Energy Use #1			
Energy Type	Fuel	Energy Type	Fuel
Energy Source	Natural Gas	Energy Source	Natural Gas
Fuel Type	Natural Gas	Fuel Type	Natural Gas
Total Emission Output Rate	53.08	Total Emission Output Rate	53.08
Fuel Use	1995 (MMBtu)	Fuel Use	1500 (MMBtu)

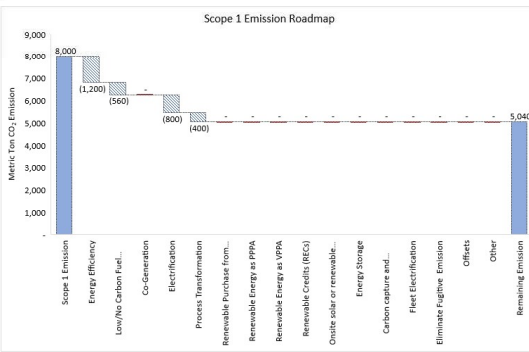
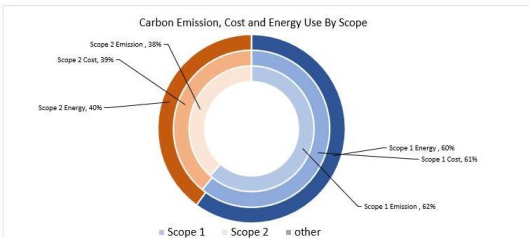
RESULTS

Total Emission Output Rate	
Baseline Summary	Energy Use #1: 105.9 tonne CO ₂
Modification Summary	Energy Use #1: 79.6 tonne CO ₂
Baseline Total	105.9 tonne CO ₂
Modification Total	79.6 tonne CO ₂
Total Savings	26.3 tonne CO ₂

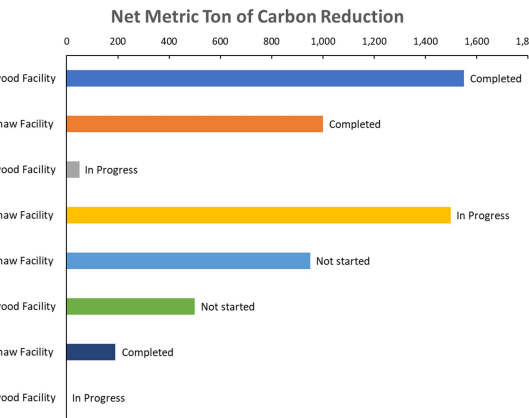
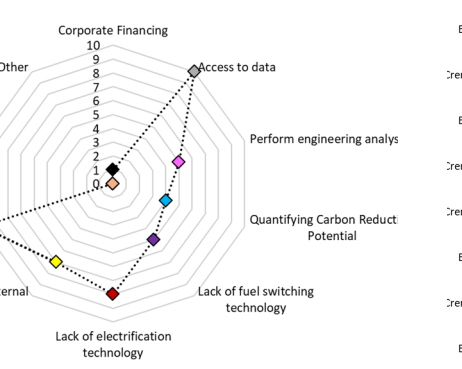
Industrial Action Plan Tool

Facility	Energy Source (MMBTU)	Energy Cost (\$)	CO _{2e} Emission (Metric Ton)
Elwood Facility	15,000	7,000	8,000
Trenshaw Facility	15,000	7,000	8,000
Elwood Facility	15,000	7,000	8,000
Trenshaw Facility	15,000	7,000	8,000
Elwood Facility	10,000	4,500	5,000
Trenshaw Facility	10,000	4,500	5,000

Opportunity	Barrier	Scope 1 % Carbon Reduction	Scope 2 % Carbon Reduction
		15%	30%
		7%	
		10%	-20%
		5%	
			10%
			15%
			30%
			20%



Opportunity (Rating low to high: 1 - 10)



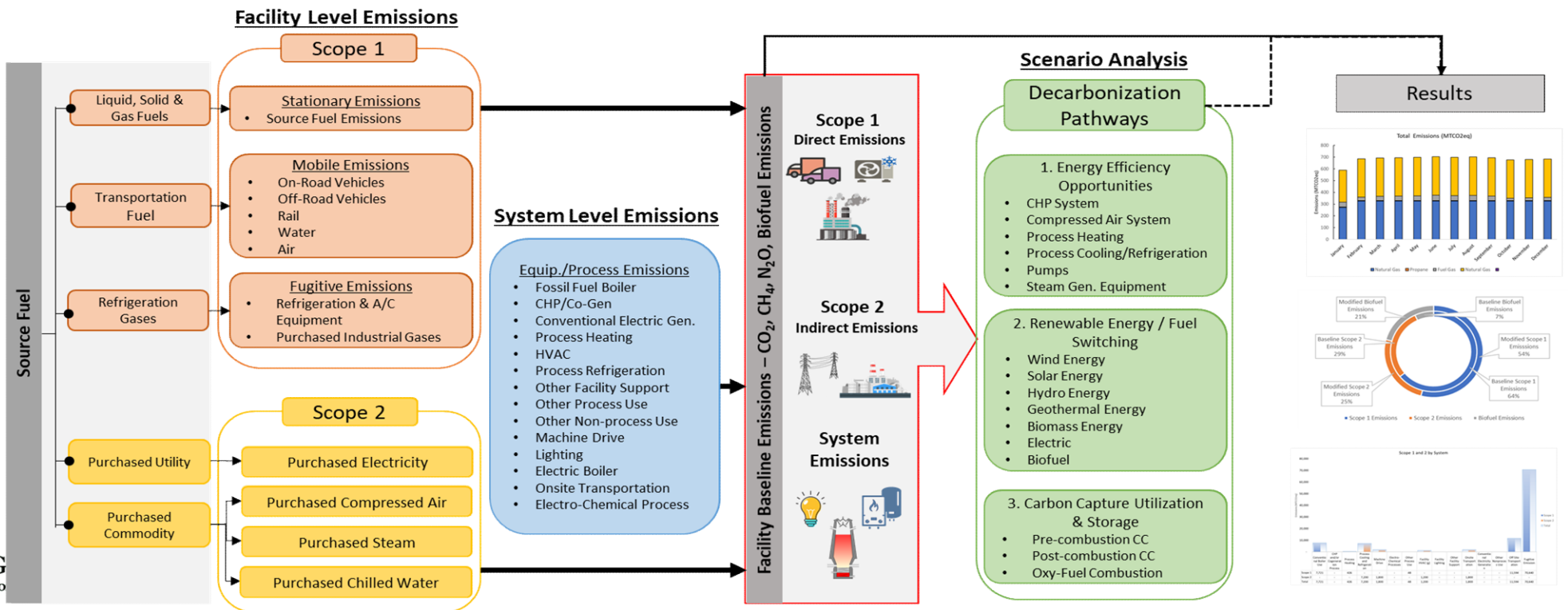
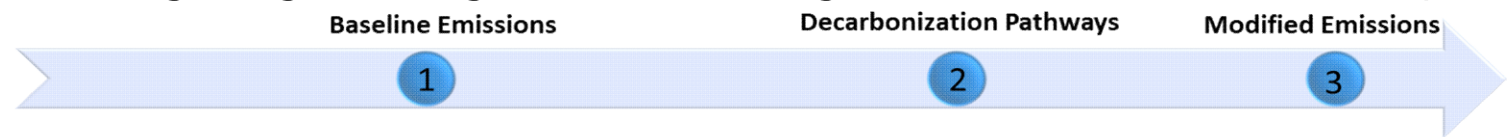
- The Action Plan Tool developed for industrial L partners
- Aids in reporting and visualizing their scope 1 and scope 2 carbon emissions both at the corporate and facility levels
- Helps partners create/evaluate high-level roadmaps to decarbonization

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)

the baseline analysis part is going through Beta testing with few Better Plants partners



Carbon Emissions Inventory Calculator

[carboncalc.ORNL.gov](http://carboncalc.ornl.gov)

Allows users to quickly calculate carbon emissions based on various fuel sources

Includes built-in carbon conversion factors for fossil fuels and the various electric grid regions

The screenshot shows the Carbon Emissions Calculator web application. The interface is divided into three main sections: BASELINE, MODIFICATION, and Results. The BASELINE section contains three emission sources with their respective fuel types and fuel use values. The MODIFICATION section contains three emission sources with their respective fuel types and fuel use values. The Results section includes a bar chart showing CO_{2e} Emissions in tonne CO_{2e} for Baseline and Modification, and a table showing the Total Emission Output Rate for Baseline and Modification.

Section	Source	Fuel Type	Fuel Use (MMBtu)	Carbon Emissions (kg CO ₂ /MMBtu)	Methane Emissions (g CH ₄ /MMBtu)	Nitrous Oxide Emissions (g NO ₂ /MMBtu)
BASELINE	Emission Source #1	Fuel	1995	53.06	1	0.1
		Emission Source	Natural Gas			
		Fuel Type	Natural Gas			
	Emission Source #2	Fuel	500	94.67	11	1.6
		Emission Source	Coal			
		Fuel Type	Mixed - Industrial Sector			
Emission Source #3	Fuel	1000	73.96	3	0.6	
	Emission Source	Petroleum-based fuels				
	Fuel Type	Diesel (Distillate Fuel #2)				
MODIFICATION	Emission Source #1	Fuel	1500	53.06	1	0.1
		Emission Source	Natural Gas			
		Fuel Type	Natural Gas			
	Emission Source #2	Fuel	300	94.67	11	1.6
		Emission Source	Coal			
		Fuel Type	Mixed - Industrial Sector			
Emission Source #3	Fuel	800	73.96	3	0.6	
	Emission Source	Petroleum-based fuels				
	Fuel Type	Diesel (Distillate Fuel #2)				

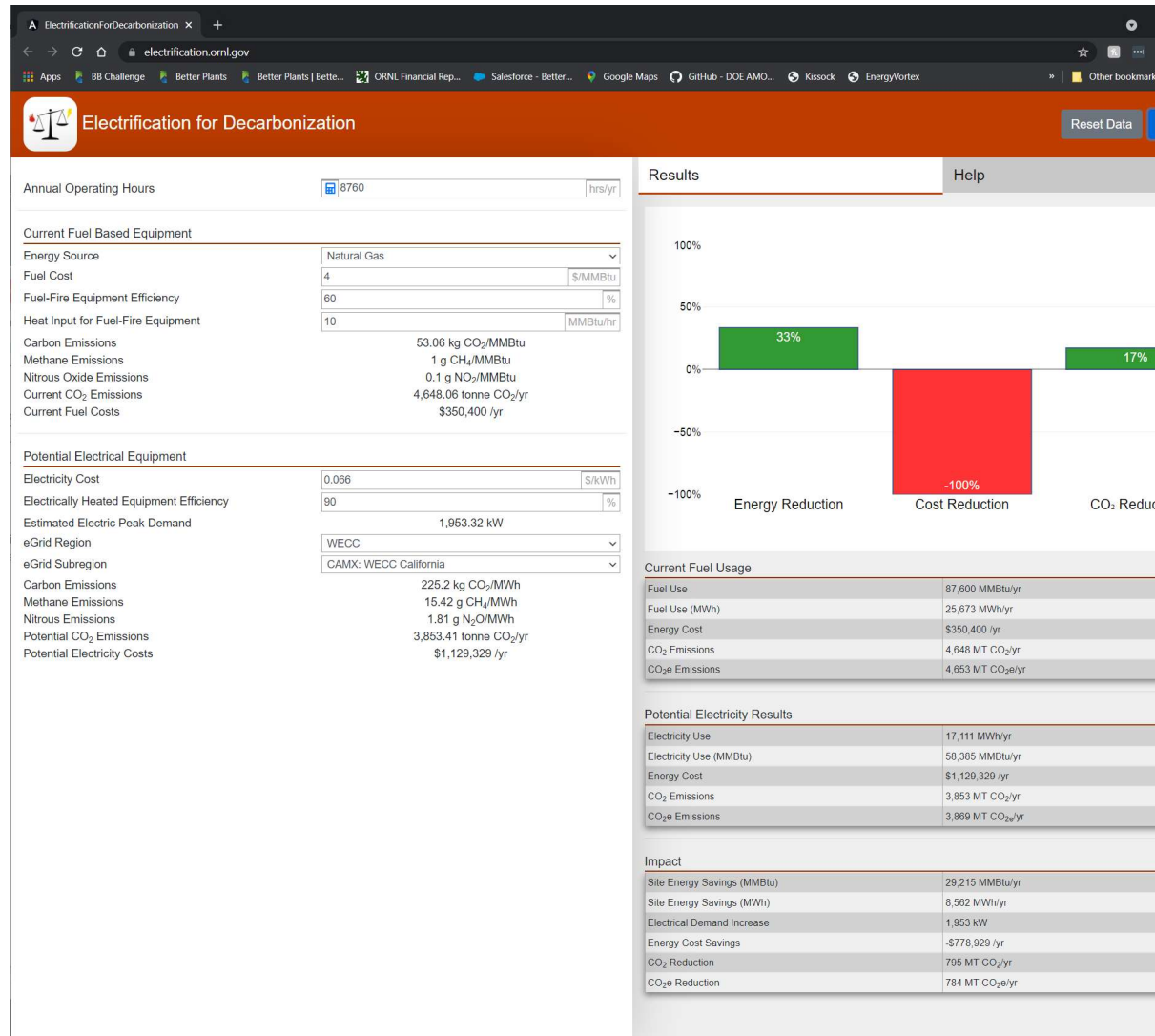
Summary	Emission Source #1	Emission Source #2	Emission Source #3	Total
Baseline Summary	106.0 tonne	47.7 tonne	74.2 tonne	
Modification Summary	79.7 tonne	28.6 tonne	59.4 tonne	
Baseline Total				227.9 tonne

Electrification for Decarbonization

[electrification.ORNL.gov](http://electrification.ornl.gov)

Provides users with a quick way to estimate the impacts of electrifying a fossil fuel process

- Emissions impact
- Cost impact
- Consumption impact
- Demand Impact



Verification Bottom-up Analysis Tool: Cost Comparison Calculator

Excel-based calculator to compare total process heating cost between fuel fired heating system and electrotechnology (ET).

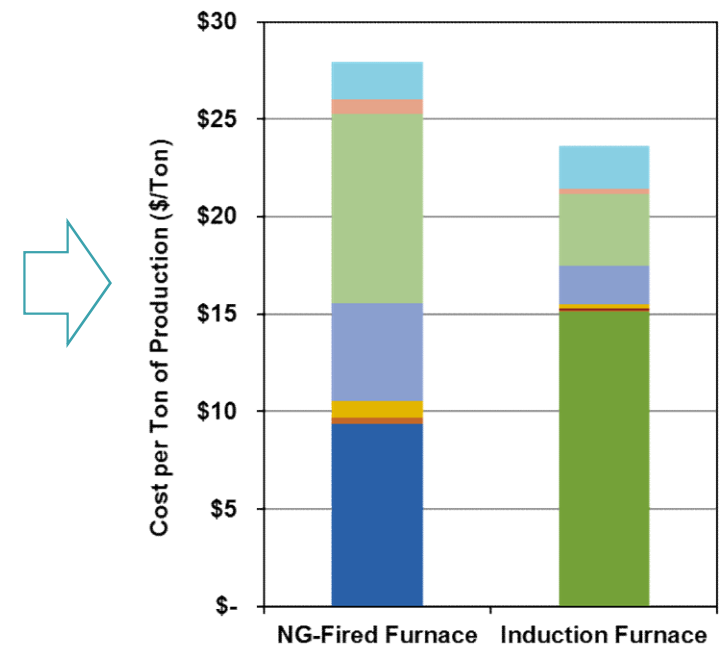
Inputs

Energy use data for fuel fired and ET based systems. (electricity, natural gas, steam usage)

Operational data including hours, production rate, product yield (reject rate), product losses due to thermal processing (i.e. oxidation, shrinkage etc.).

Cost data for utilities (i.e. fuel, electricity, water, etc.), product loss cost, labor cost, O & M cost, amortization cost and other costs related to the system operation.

Output



From case study on NG-Fired Furnace vs Induction Furnace Forging Plant

EnPI (aiming to release beta version in several months)

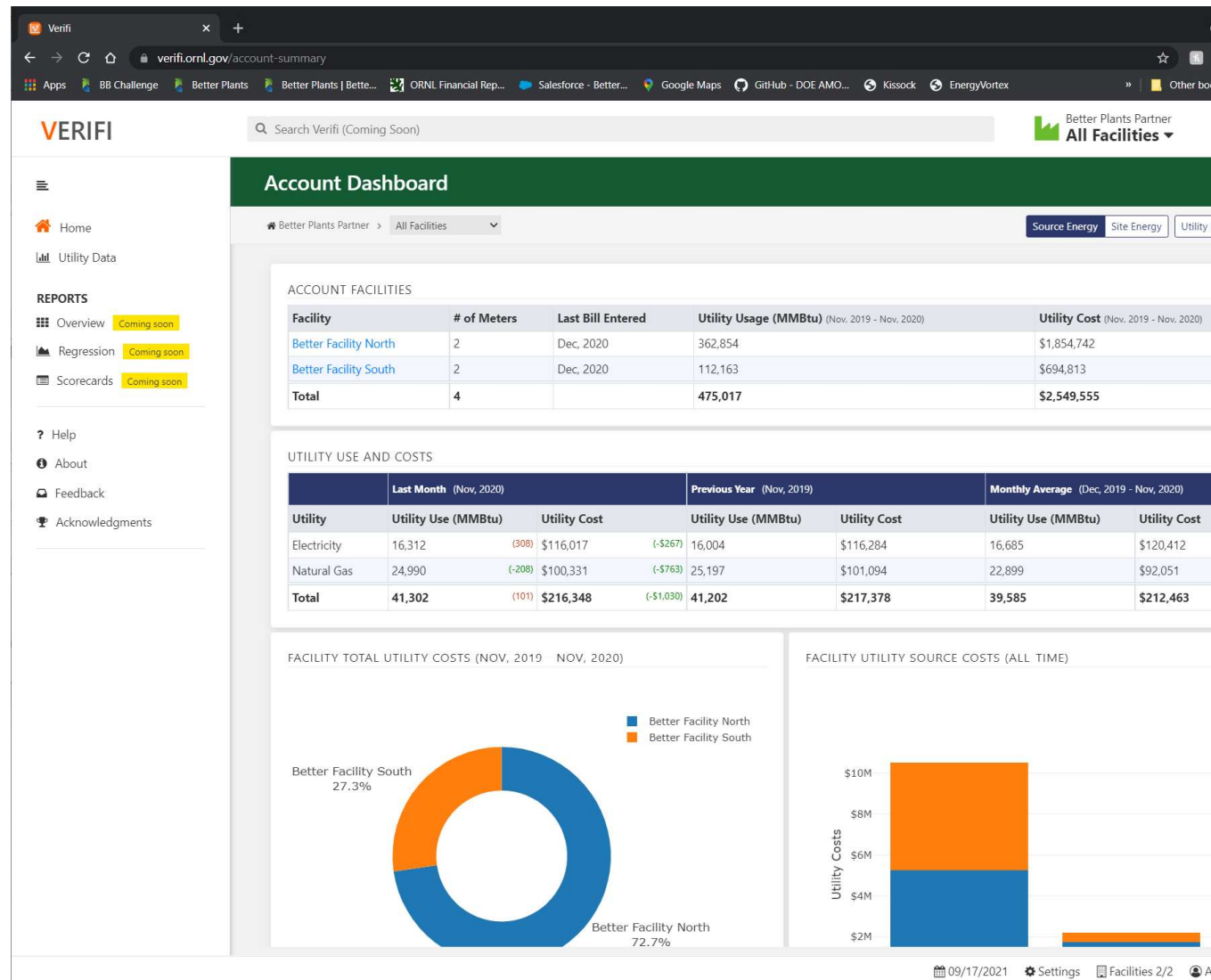
the future iteration of the EnPI tool

allows users to manage all energy and carbon utility-level data

users can create facility or corporate level dashboards

will provide users with a variety of customizable reporting options (Better Plants, 50001 Ready, PE, etc)

will incorporate smaller DOE tools (PEPEX, PWP, Footprint Tool, etc)



More Information?

See [Technical Partnerships | Department of Energy](#)