

# Welcome to the Cummins Technical Center

1900 McKinley Avenue  
Columbus, Indiana

# CTC Campus

- Founded in 1967 under the leadership of J.I. Miller
- 500,000 square feet
- ~1200 employees
- Home for Research & Technology, Technical Service labs, Accelera labs, and Engine Test Operations
- Promotes collaboration between business units, engineers, scientists and technicians
- ISO 9001, ISO 14001, ISO 50001 and ISO 45001 certified

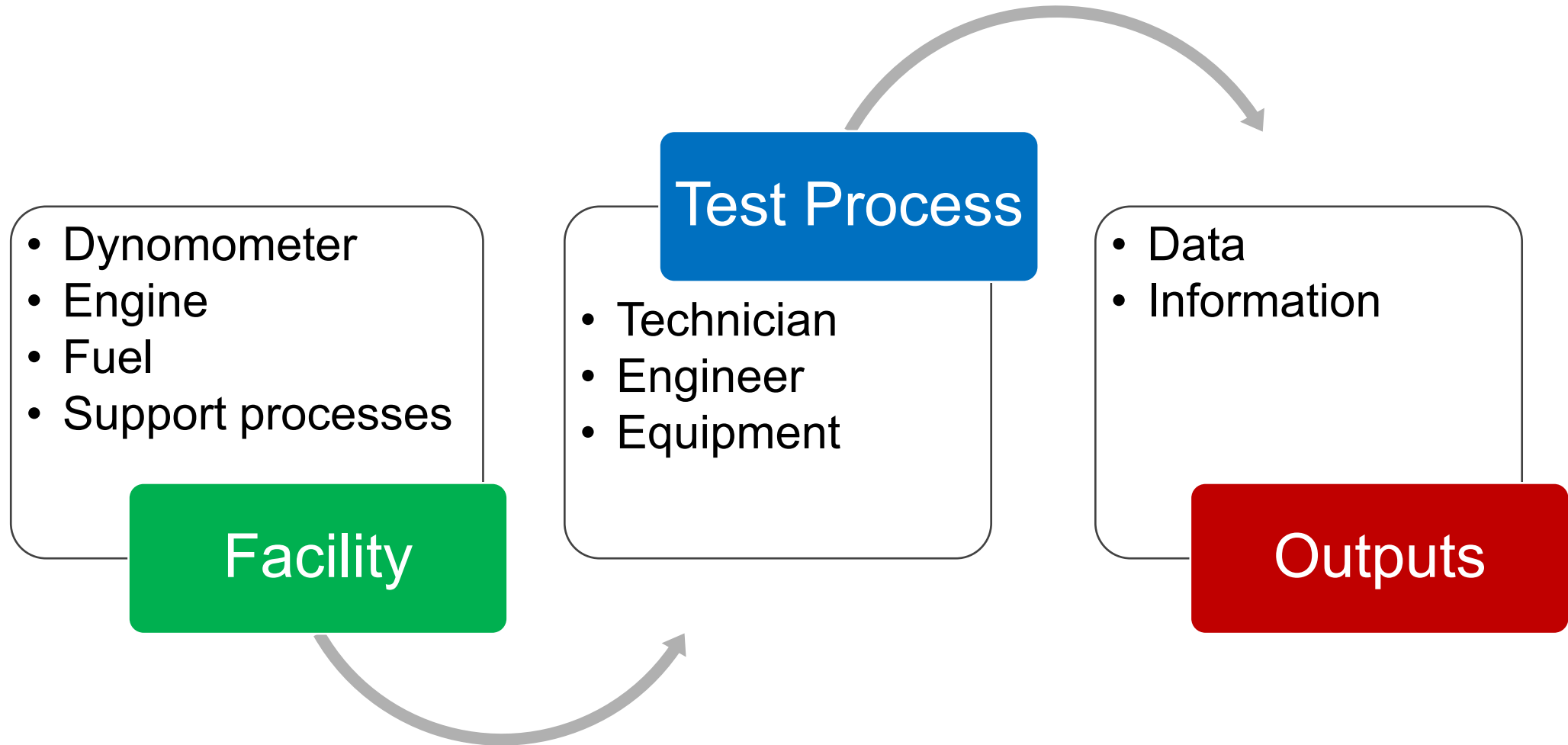


# CTC Test Operations

- 89 Engine Test Cells
  - 8 1065 Compliant CVS Test Cells
  - Capable of testing 100 – 3,000 hp
- Equipped to run a variety of fuels – including research fuels
- 18 Bay Build Area
- Instrumentation and Emissions support laboratories
- 350 Employees, 24X7 Operation
- Electrified Power Lab
  - 5 cells dedicated to battery, traction motor and power electronics
- 1 Environmental Cold Cell
  - Capable of reaching -40 C
- 2 Altitude Test Cells
  - Simulate 10,000 ft elevation
- 1 Angularity Test Cell



# What is a Test Cell?





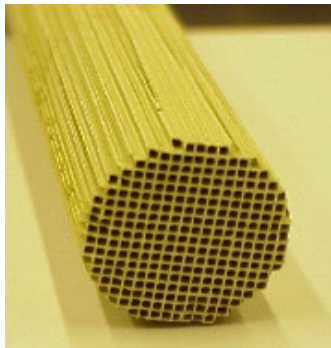
# CTC Corporate Research and Technology Laboratories

## ▪ Competency Centers in Key Technical Disciplines

- Material Sciences and Chemistry
- Applied Mechanics and NVH
- Advanced Manufacturing
- Fluid Dynamics
- Catalyst, Fuel Cell and Battery Technologies
- Mechanical System Efficiency

## ▪ R&T Laboratories support:

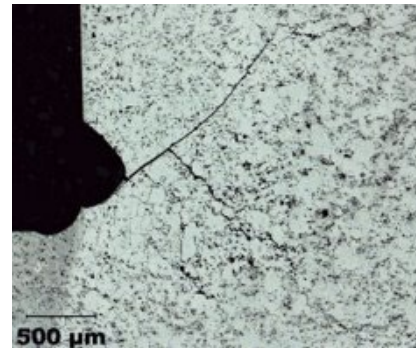
- Advanced Technology Development
- New Product Development
- Global Engineering Projects



Catalyst Core Sample



Anechoic Test Facility



Metallurgical Failure Analysis



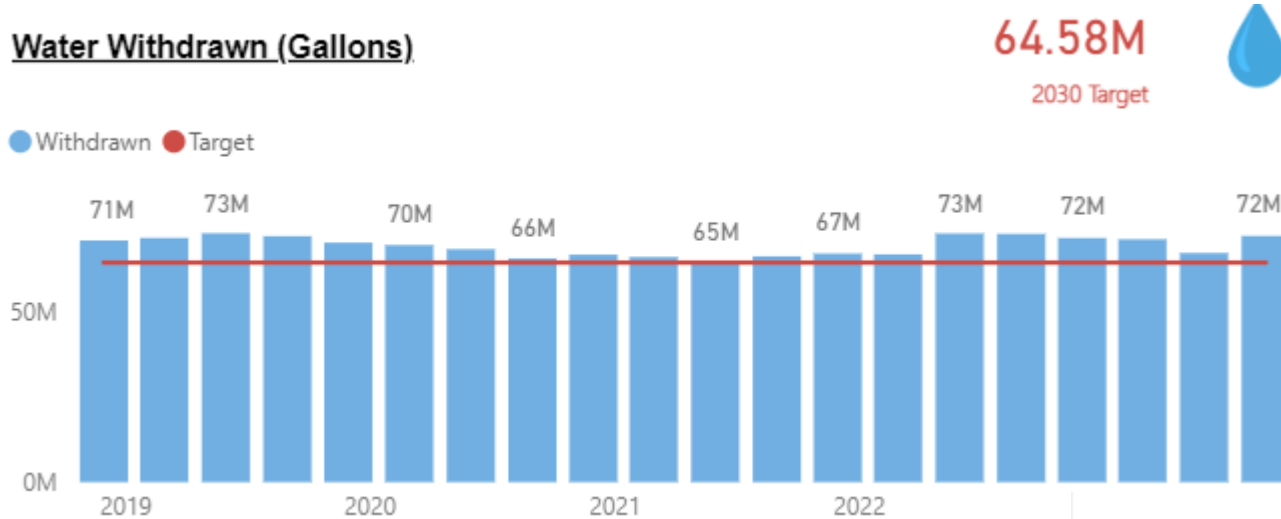
Metal 3D Printed Parts

# CTC – Environmental Perspective

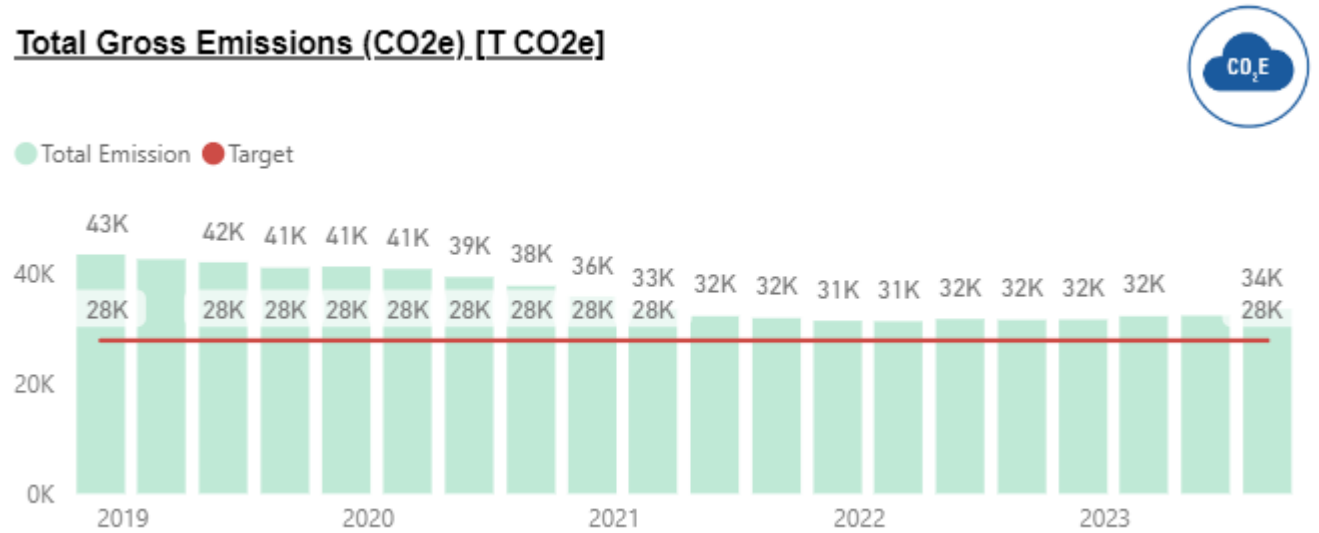
- Title V Air Permit
- Waste Water Pretreatment Permit
- Small Quantity Generator
- 98% Non-Landfill
- EMS – Spills and Releases

# CTC – Environmental Footprint

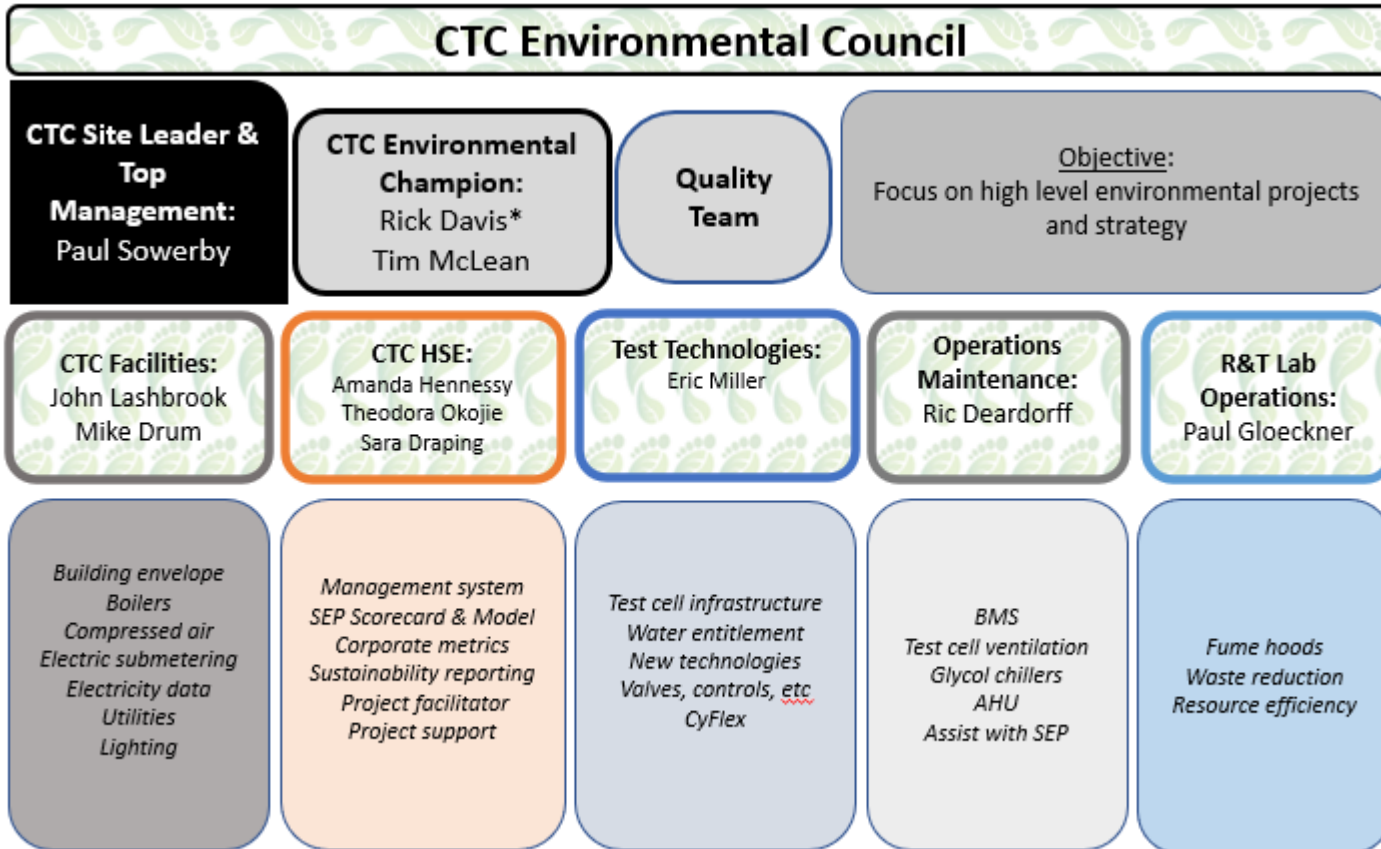
Water Withdrawn (Gallons)



Total Gross Emissions (CO2e) [T CO2e]

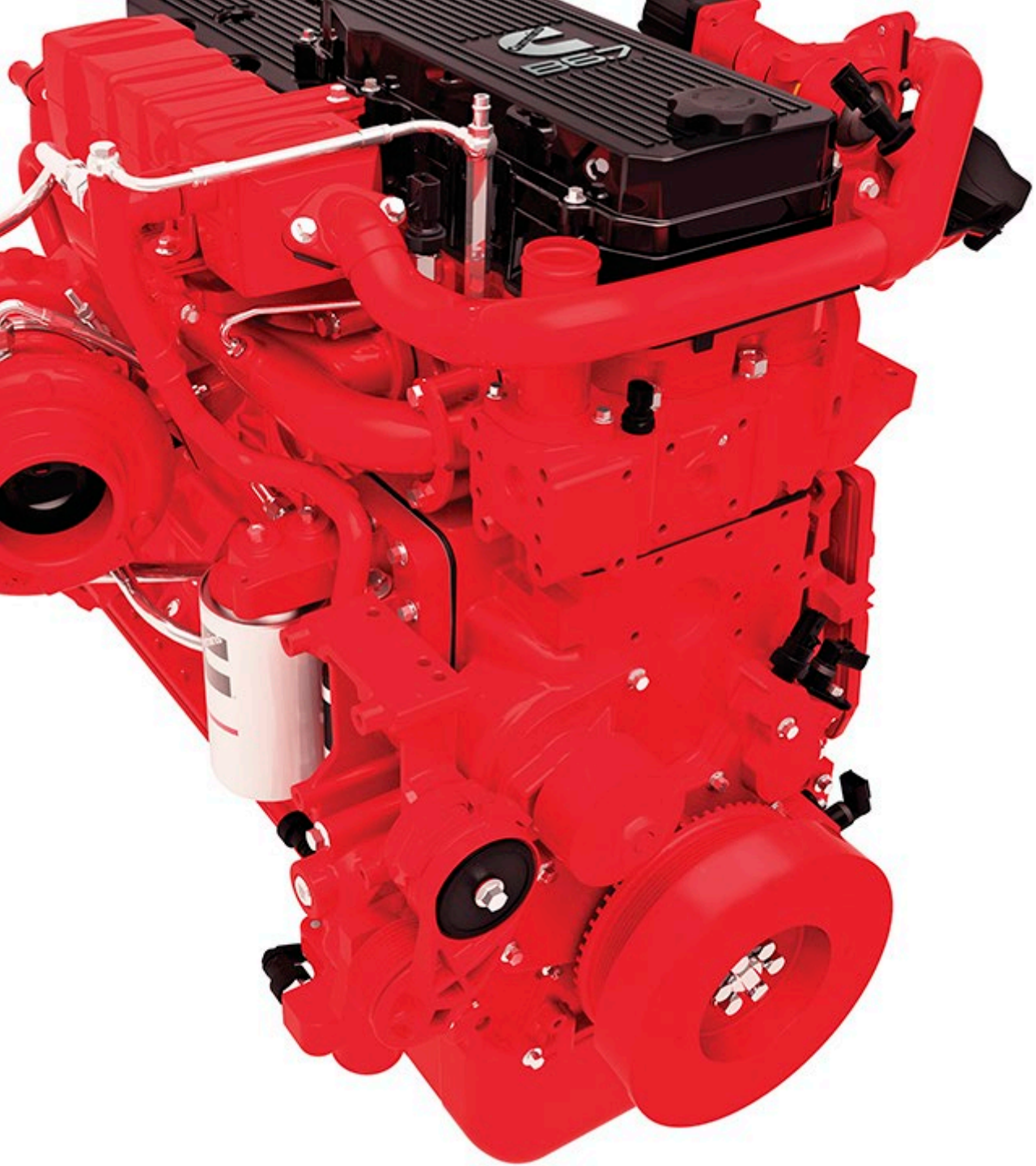


# CTC Environmental Council



- **Energy Review, Water Balance, Waste Review**
- **KPIs and Targets**
- **Training and Operational Controls**
- **Improvement Projects**
  - **LED lighting**
  - **Controls**
  - **Metering**
  - **Water reuse**
  - **Regenerative Dyno**





# **CTC REGENERATIVE DYNAMOMETERS**

Ramiro Chavez

Sam Maier

4/11/24

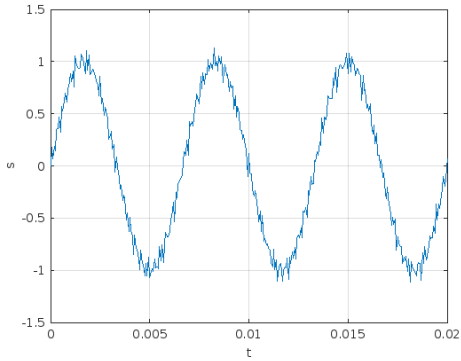
Internal use only

# Agenda

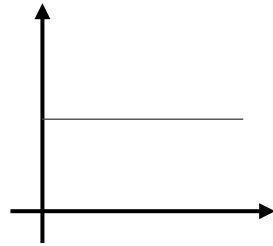
- Basics of regenerative dynamometers
- Electricity consumption at CTC
- Water consumption at CTC

# Regenerative dyno drives

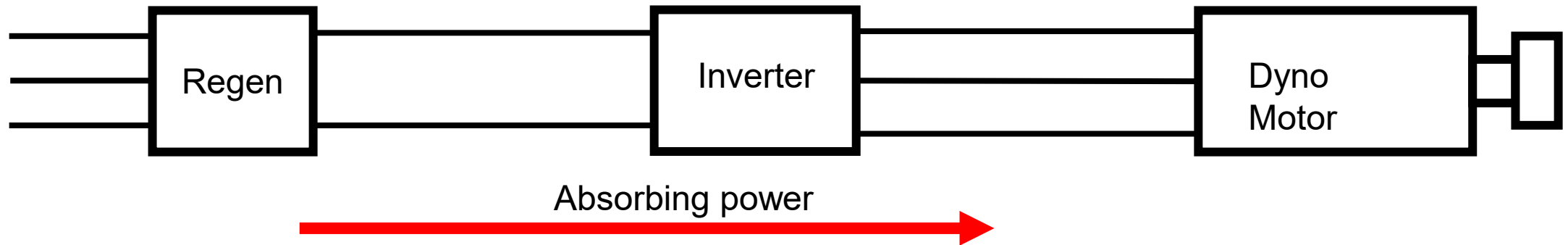
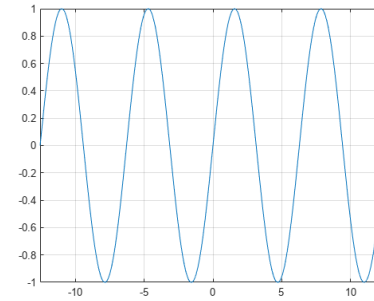
AC



DC

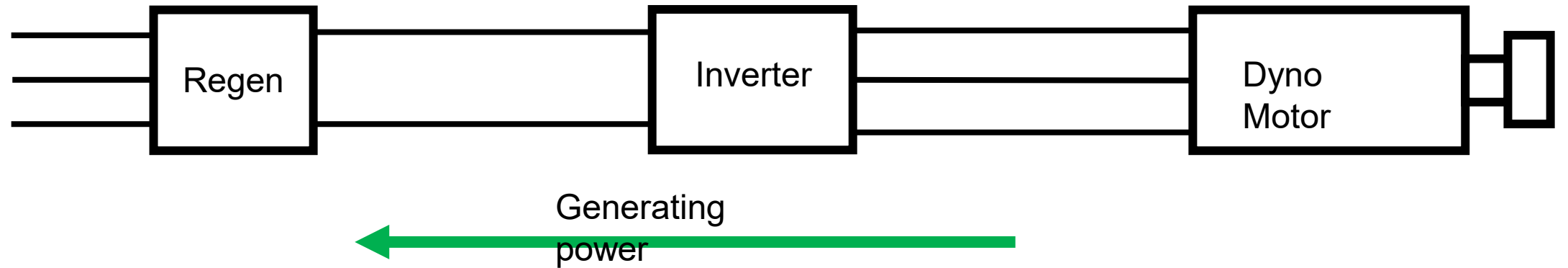
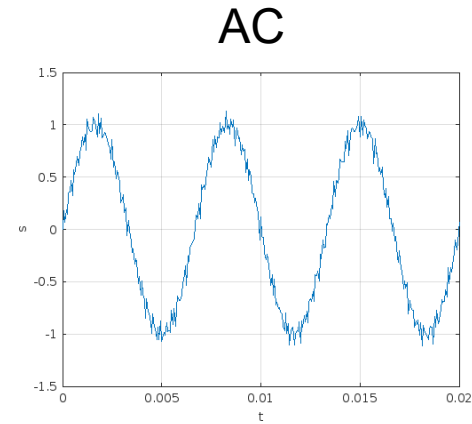
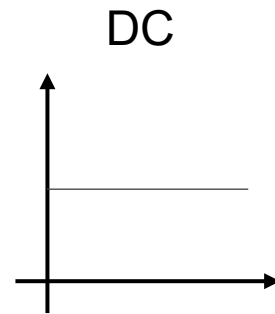
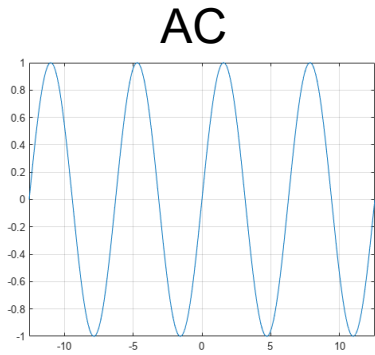


AC



<https://www.mathworks.com/matlabcentral/answers/2021241-generating-an-example-noisy-sine-wave-signal>  
<https://www.mathworks.com/help/symbolic/sin.html>

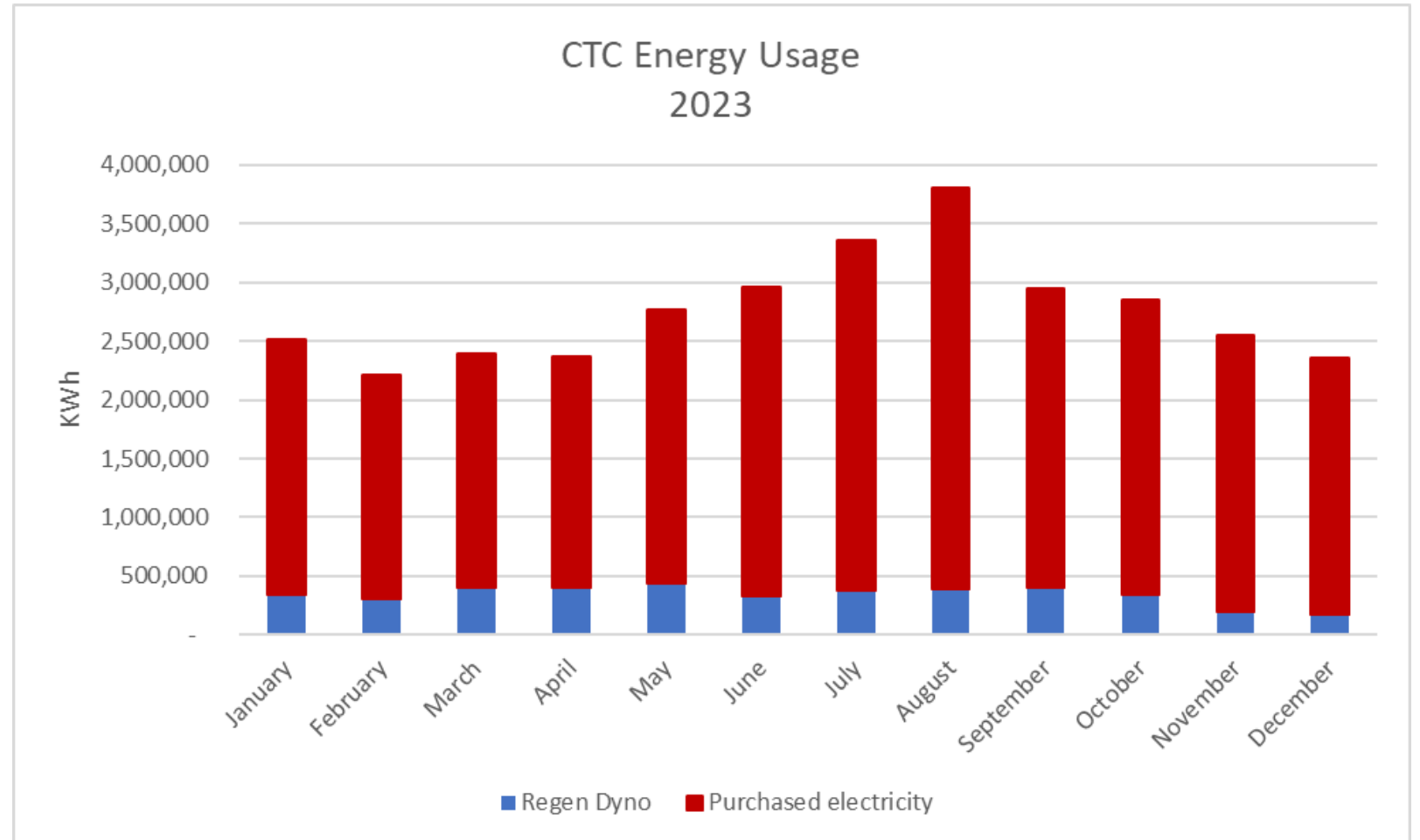
# Regenerative dyno drives



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<https://www.mathworks.com/help/symbolic/sin.html>

# Site electricity usage

- About 15% of site usage comes from regen dynos
- ~70% of our dynos are regen systems





# Water consumption

- Dyno types at CTC: Eddy current and regenerative dynos
- Eddy current dynos are cooled down with water
- Dyno water consumption  $\approx$  10 gal/min per 100hp
- **Example: Engine test running at 250hp for 1 week  $\rightarrow$  252,000 gallons**
- **Average American family uses about 2,100 gallons per week**
- Most of our dynos are now regen systems  $\sim$ 70%
- Regen systems in 2006  $\rightarrow$   $\sim$ 10%

<https://www.epa.gov/watersense/how-we-use-water#:~:text=The%20average%20American%20family%20uses,in%20more%20water%2Dintensive%20landscapes.>