OUR CUSTOMERS’ GOALS. 
OUR COMMITMENT.

ADVANCED POWER

Mike Rochford
General Manager, Advanced Power Systems
Caterpillar Inc.

NREL Off-Road Decarbonization Workshop
March 2022
Diverse customers.
Diverse goals.
A common set of solutions.

All offering Caterpillar performance, delivering Caterpillar value and supported by Caterpillar’s lifecycle services.
COLLABORATIONS ACCELERATE DEVELOPMENT AND COMMERCIALIZATION

**Electric Medium Excavator**
Zero exhaust emissions excavator developed with Cat® dealer PON

**Certarus MOU**
Creating collaboration for a lower carbon future

**CarbonPoint Solutions Acquisition**
Creating solutions for a lower-carbon future

**Microsoft Swedish Data Center**
Cat® standby power capable of running on renewable liquid fuel

**Hydrogen-Fueled Generators**
Cat generators capable of operating on 100% hydrogen

**Microsoft, Ballard Hydrogen Fuel Cell**
Power system incorporating large-format hydrogen fuel cells for data center backup power

**Chevron Hydrogen Collaboration**
Exploring hydrogen as alternative fuel; locomotive prototype

**Union Pacific Railroad**
EMD Joule® will be tested in rail yards to identify locomotives’ capabilities and challenge

**Nouveau Monde Graphite**
Zero-emission mine site with Cat machines

**Rio Tinto**
Zero-emissions autonomous mining trucks

**Newmont**
Fully connected, automated, zero carbon emitting, end-to-end mining system

**BHP**
Battery-powered mining trucks

Battery-electric locomotives

**ADVANCED POWER**

Caterpillar: Non-Confidential
Power drives our customers’ work.

Innovation and integration drive ours.

Whatever our customers’ goals — lower GHG emissions, energy flexibility, business sustainability — we provide the advanced power that keeps them working.
Low Carbon Intensity Fuels
Enable increased use of reduced-carbon options and hydrogen blends.

Fuel Cells
Use renewable hydrogen fuel as a scalable source of electric power.

Electric & Hybrid Powertrains
Employ an electric drive transmission with power components.

Batteries
Power the work with stored electrical energy.

Microgrids
Integrate renewable energy sources into electric power systems.

Multiple Solutions
Made to Match the Work

• Making established power sources even more efficient and fuel-flexible
• Pairing established power sources with new technologies in a hybrid format
• Replacing established power sources with stand-alone new technologies
• Delivering reman, repair, rebuild, retrofit and repower services
BATTERY-ELECTRIC MINING EQUIPMENT

Power the work with stored electrical energy.

R1700 XE Underground Loader + MEC500 Charger

- 100% battery electric powered
- 15 tonnes of payload
- 2.5 hours aggressive run time between charges
- <20-minute charge with two parallel MEC500 chargers
INDUSTRY CHALLENGES

• Innovation on a variety of established and advanced power sources will be required to meet off-road equipment customers’ environmental and operating requirements.

• Significant technology and infrastructure development is required for many advanced power solutions to achieve value parity (cost, performance, availability) with today’s established solutions.

• Operational requirements and conditions for off-highway equipment and worksites differ significantly from on-highway – higher power capability, longer life, varied re-fueling / re-charging rates, thermal management, etc.

• Off-highway systems at higher power nodes, including grid support, would benefit all stakeholders.