Opportunities and Considerations for Transitioning to Fuel Cells in Vehicles and Power Systems

Dr. Daryl Musselman | P.Eng.
Chief Operating Officer at Loop Energy Inc.

Diesel Progress Summit | September 27, 2022

LOOP™ ENERGY

LOOP ENERGY

Today's Presentation Topics

Introduction to Hydrogen Fuel Cells

Integrating Fuel Cells into Commercial Applications

How Fuel Cells Compare to Diesel Engines: *Performance and Durability*

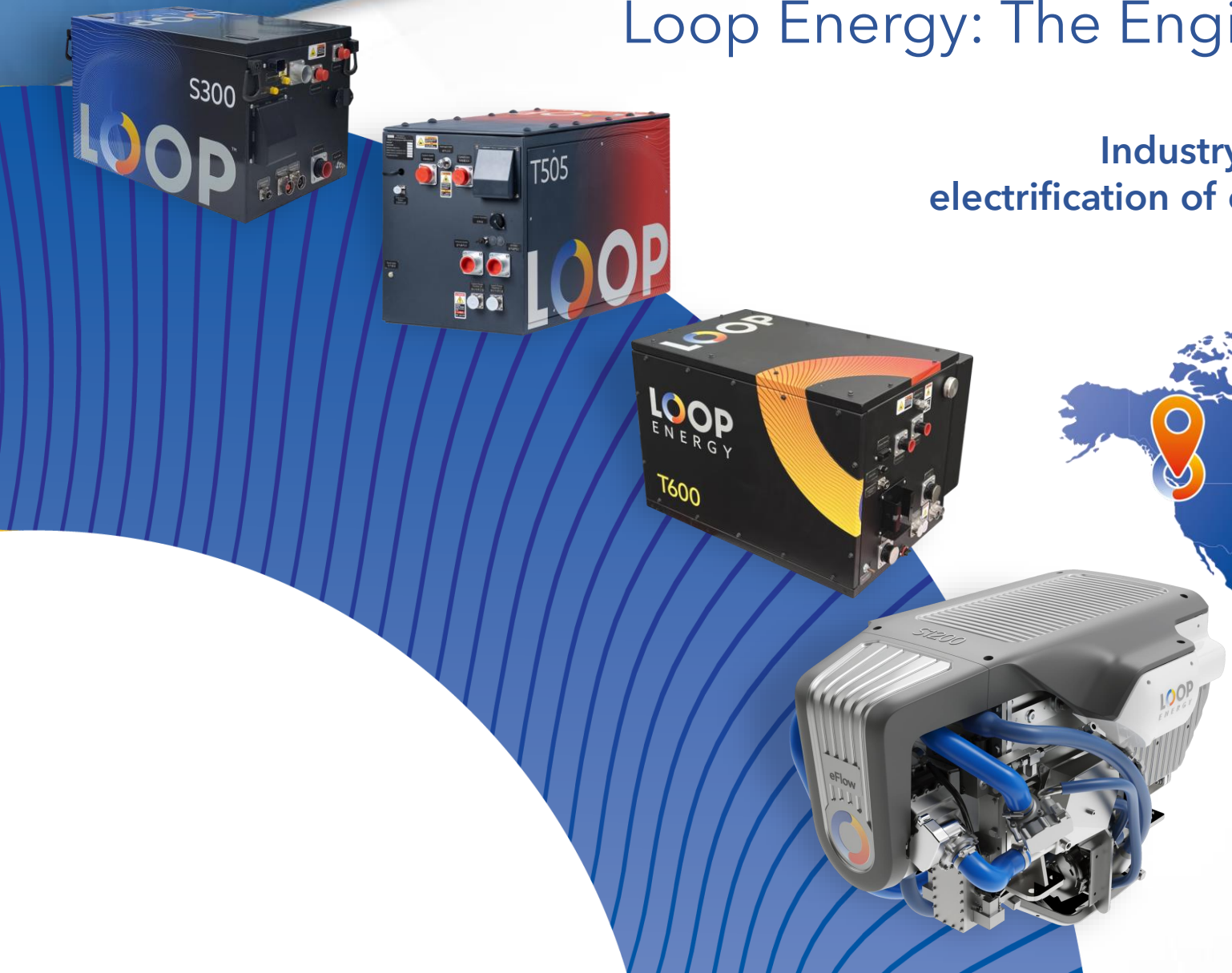
How Fuel Cells Compare to Diesel Engines: *Service and Maintenance*

Adopting Fuel Cells in Commercial Vehicles and Equipment

LOOP ENERGY

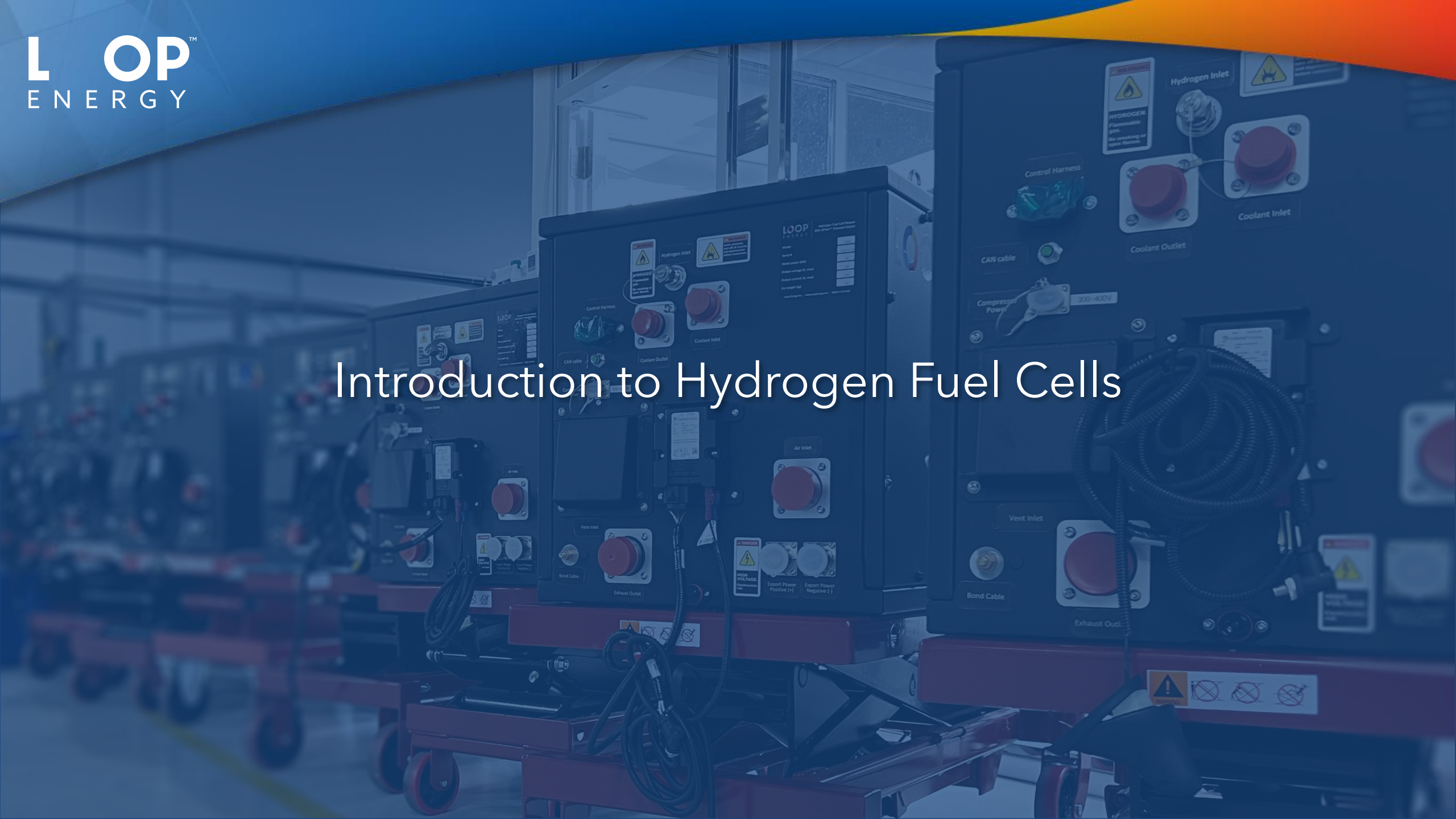
Loop Energy: The Engine Driving Zero-Emissions

Industry-leading hydrogen fuel cell solutions for electrification of commercial mobility and power systems.



LOOP ENERGY

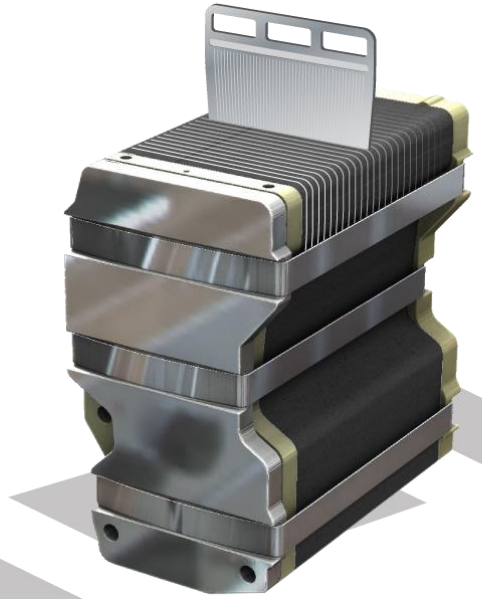
Introduction to Hydrogen Fuel Cells



Understanding a Hydrogen Fuel Cell Engine

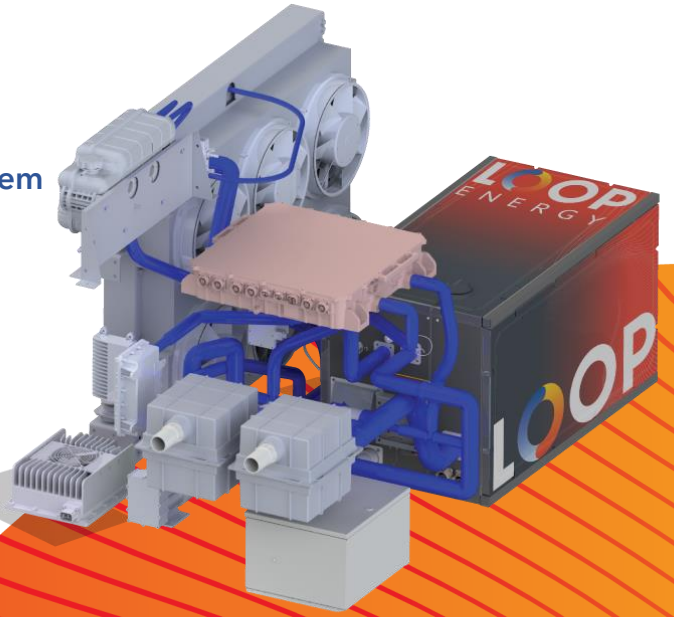
eFlow™ Bipolar Plate

eFlow™ Fuel Cell Stack



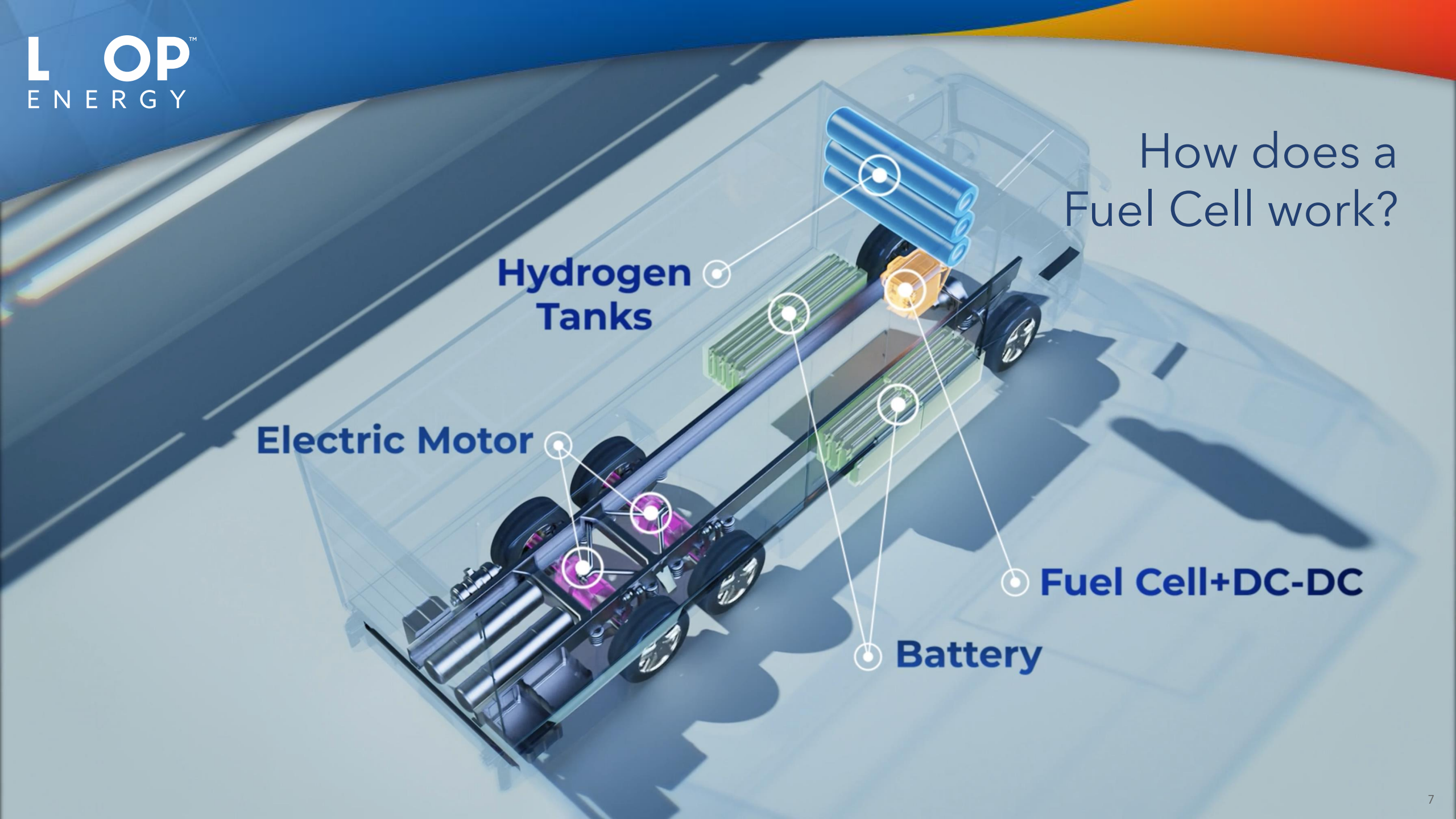
eFlow™ Fuel Cell Module

Complete Fuel Cell System



LOOP ENERGY

How does a Fuel Cell work?



LOOP ENERGY

Integrating Fuel Cells into Commercial Applications

LOOP ENERGY

Where we are Seeing Fuel Cells in Action Today

Buses

ARCC

Skywell NGVI

Trucks

TEVVA

MORELLO

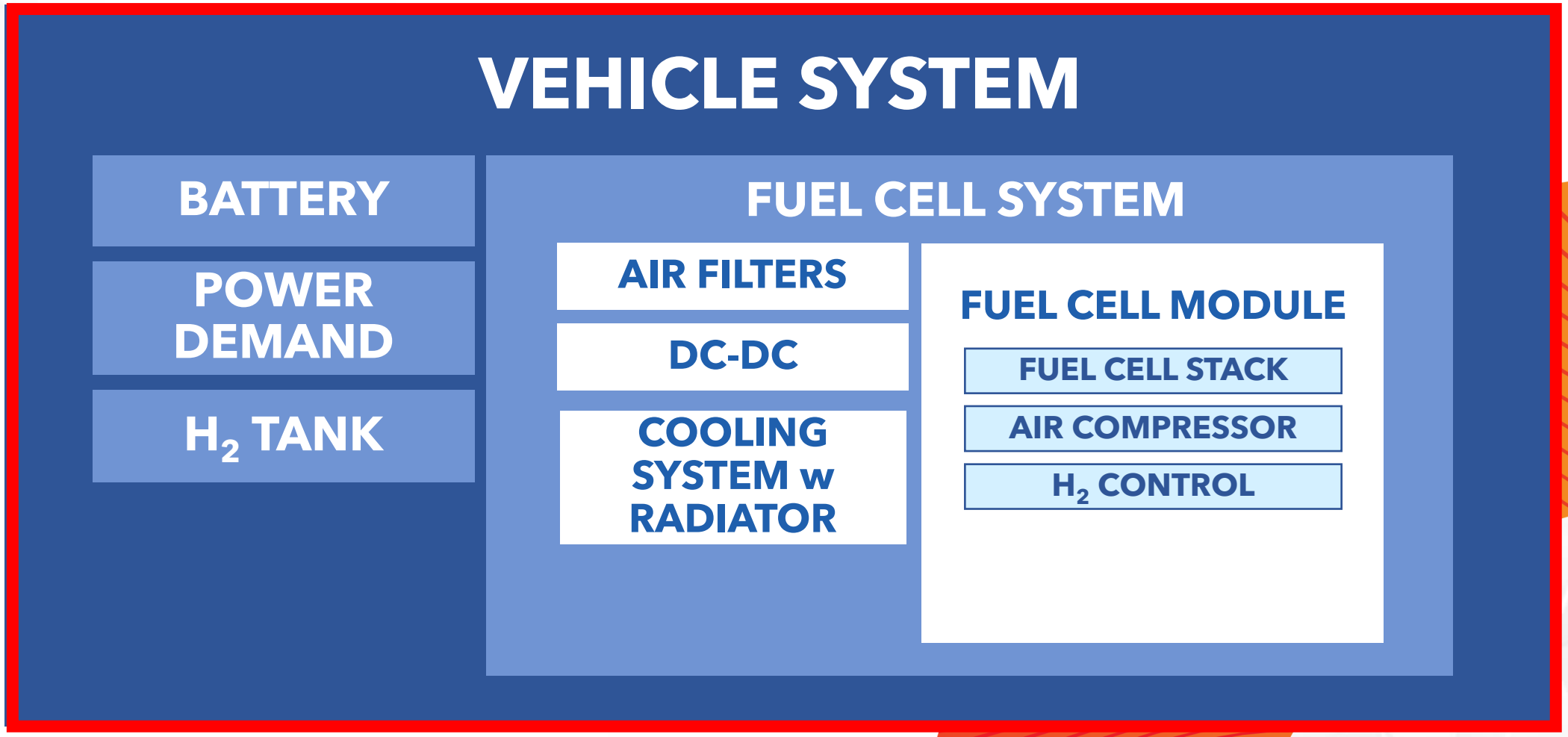
Gen-Set & Power Systems

ALIANT ULTRALIGHT BATTERY

Hylife INNOVATIONS

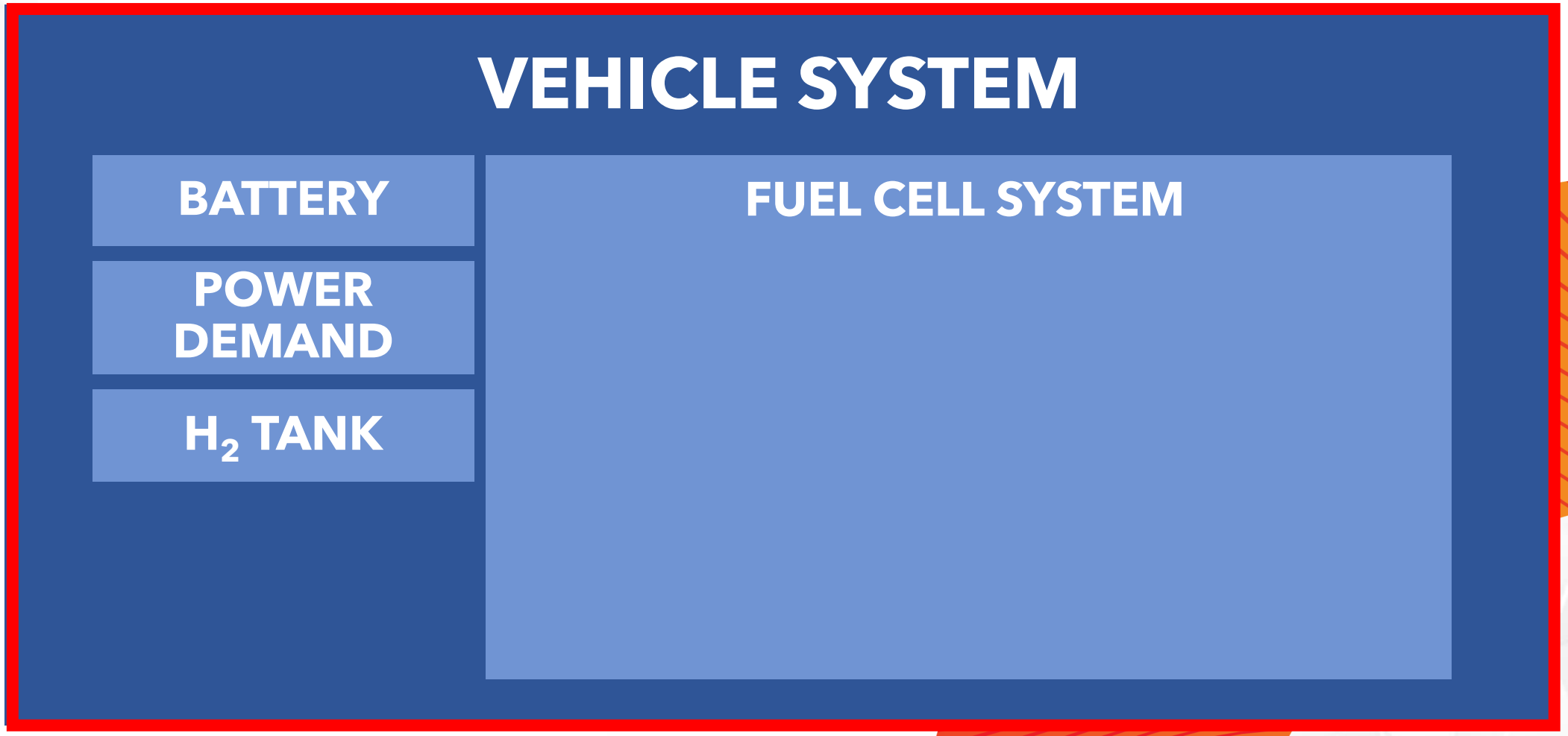
LOOP ENERGY

Overview: Fuel Cell and Vehicle System



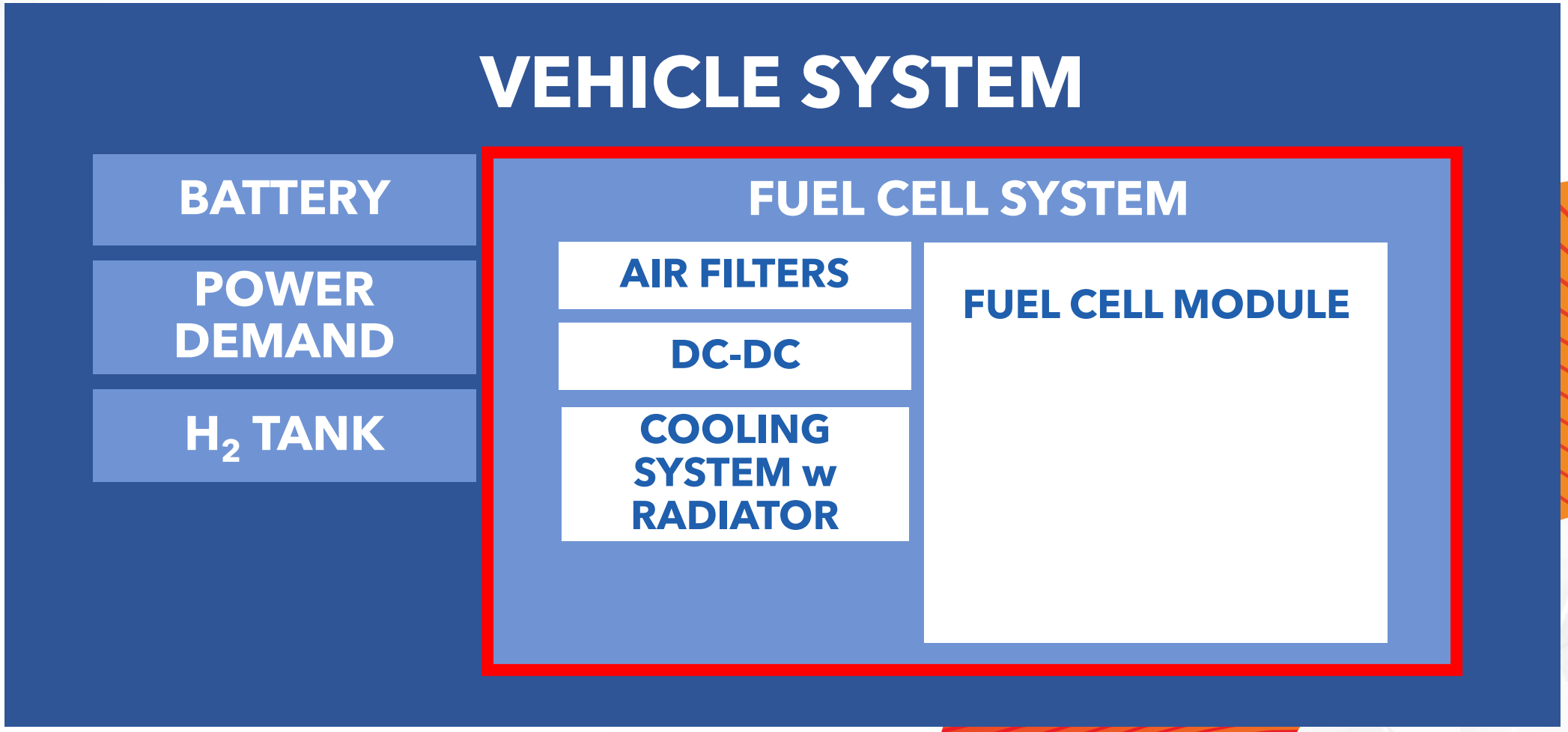
LOOP ENERGY

Overview: Fuel Cell and Vehicle System



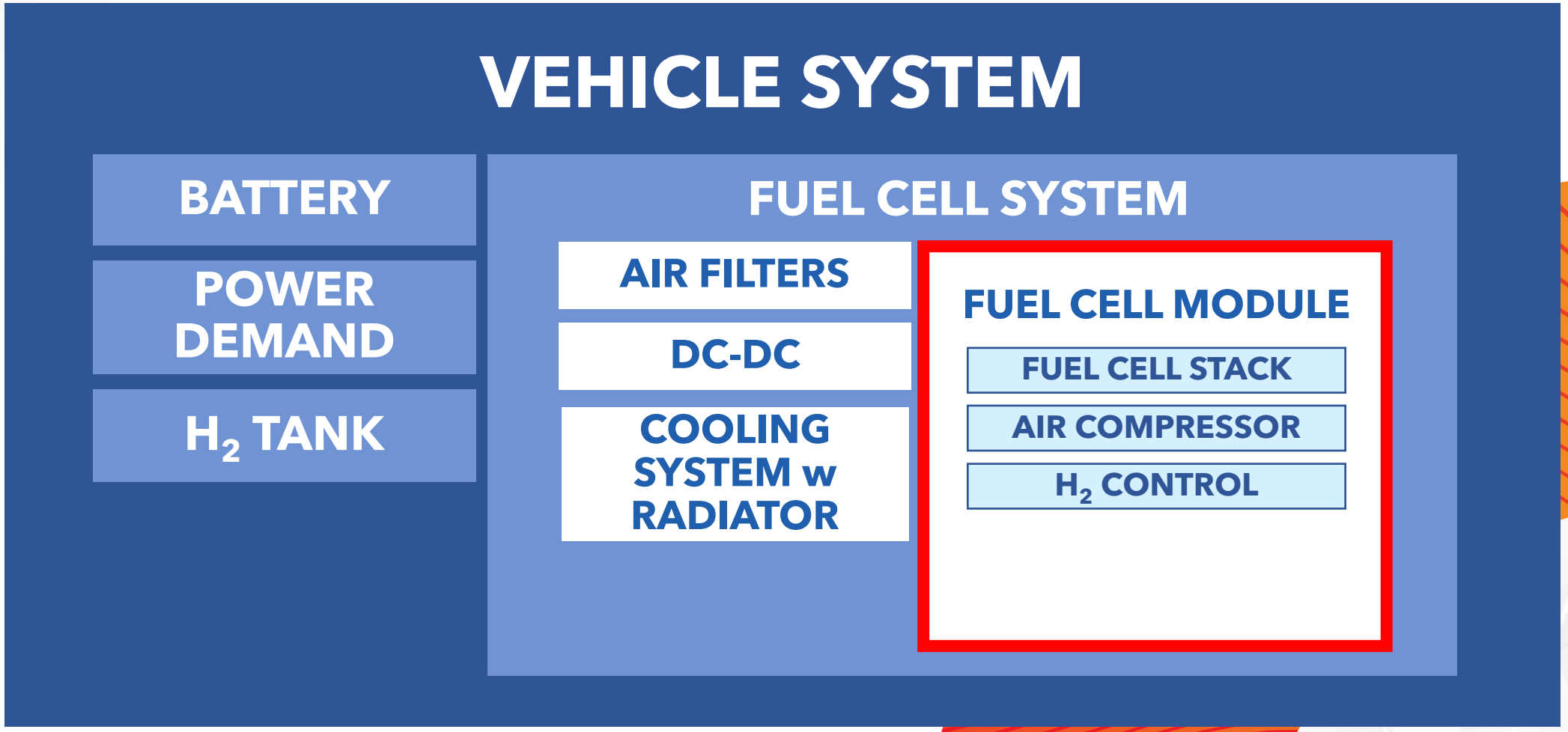
L OP ENERGY

Overview: Fuel Cell and Vehicle System



LOOP ENERGY

Overview: Fuel Cell and Vehicle System



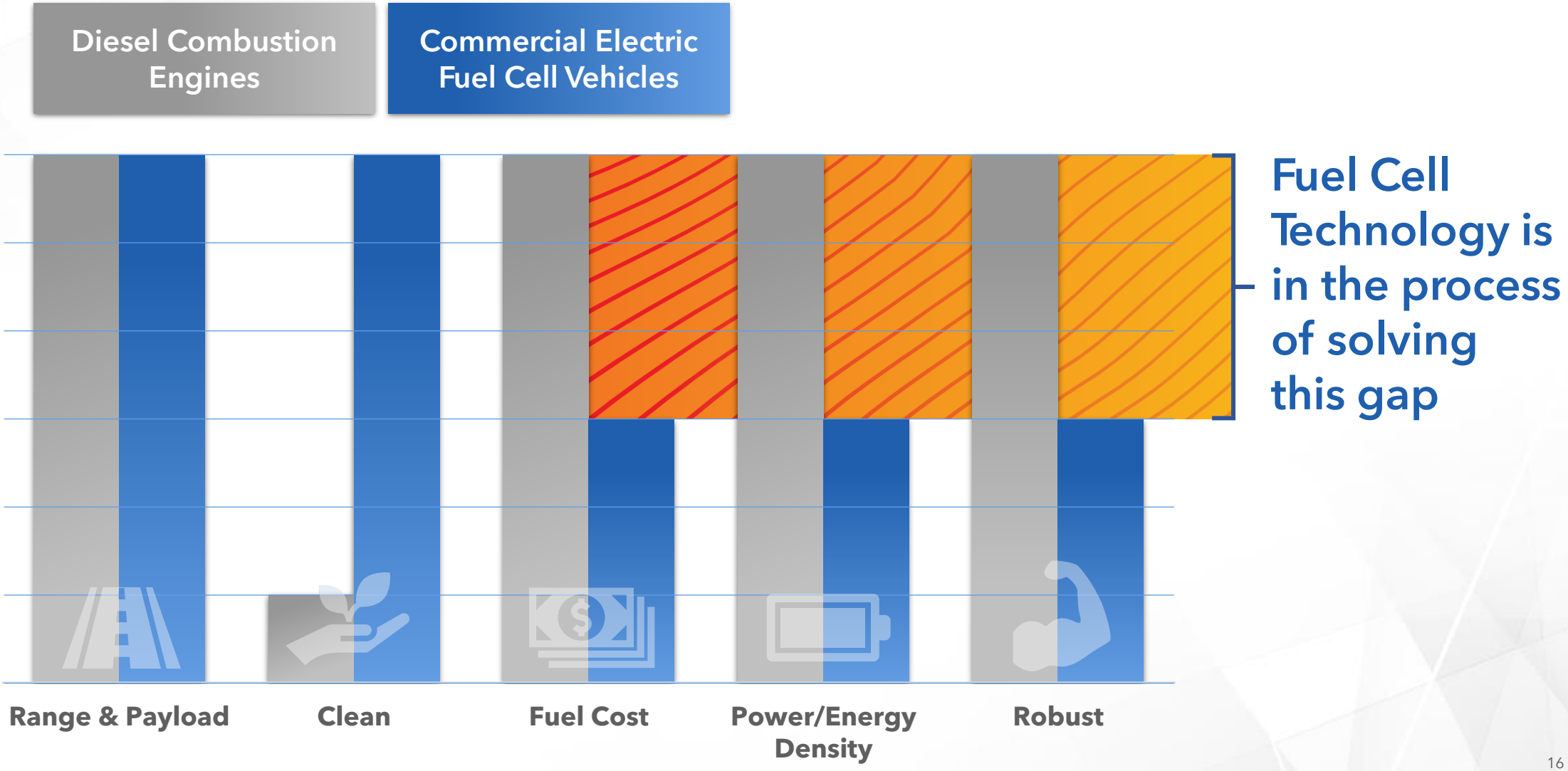
LOOP ENERGY

Approaches to Integration

LOOP ENERGY

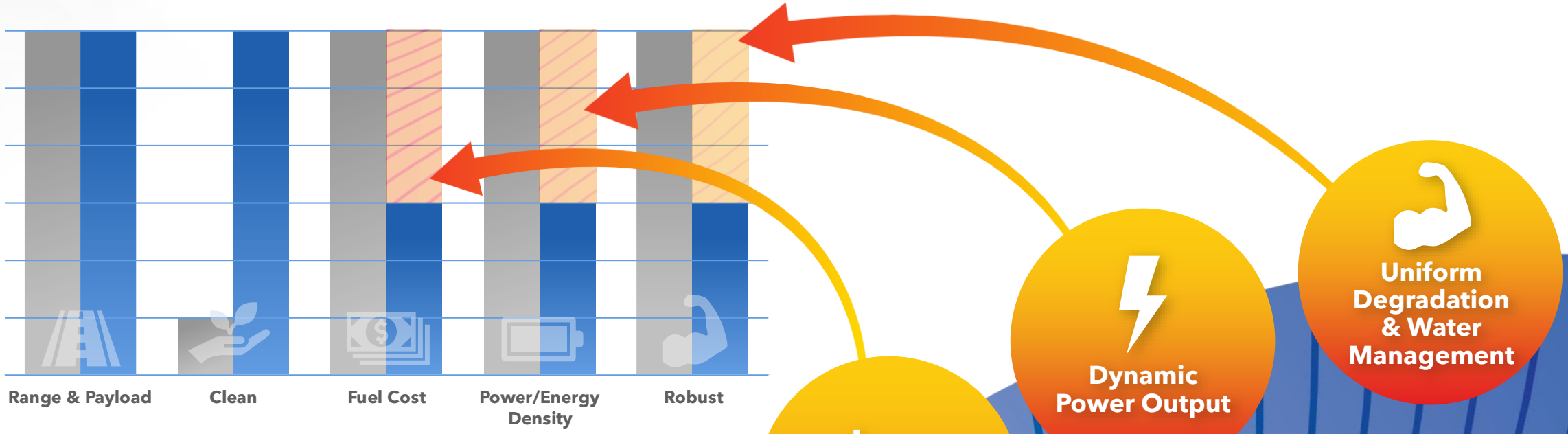
How Fuel Cells Compare to Diesel Engines: Performance and Durability

How Fuel Cells have Performed Compared to Diesel



LOOP ENERGY

How Hydrogen Fuel Cell Technology is Closing the Gap

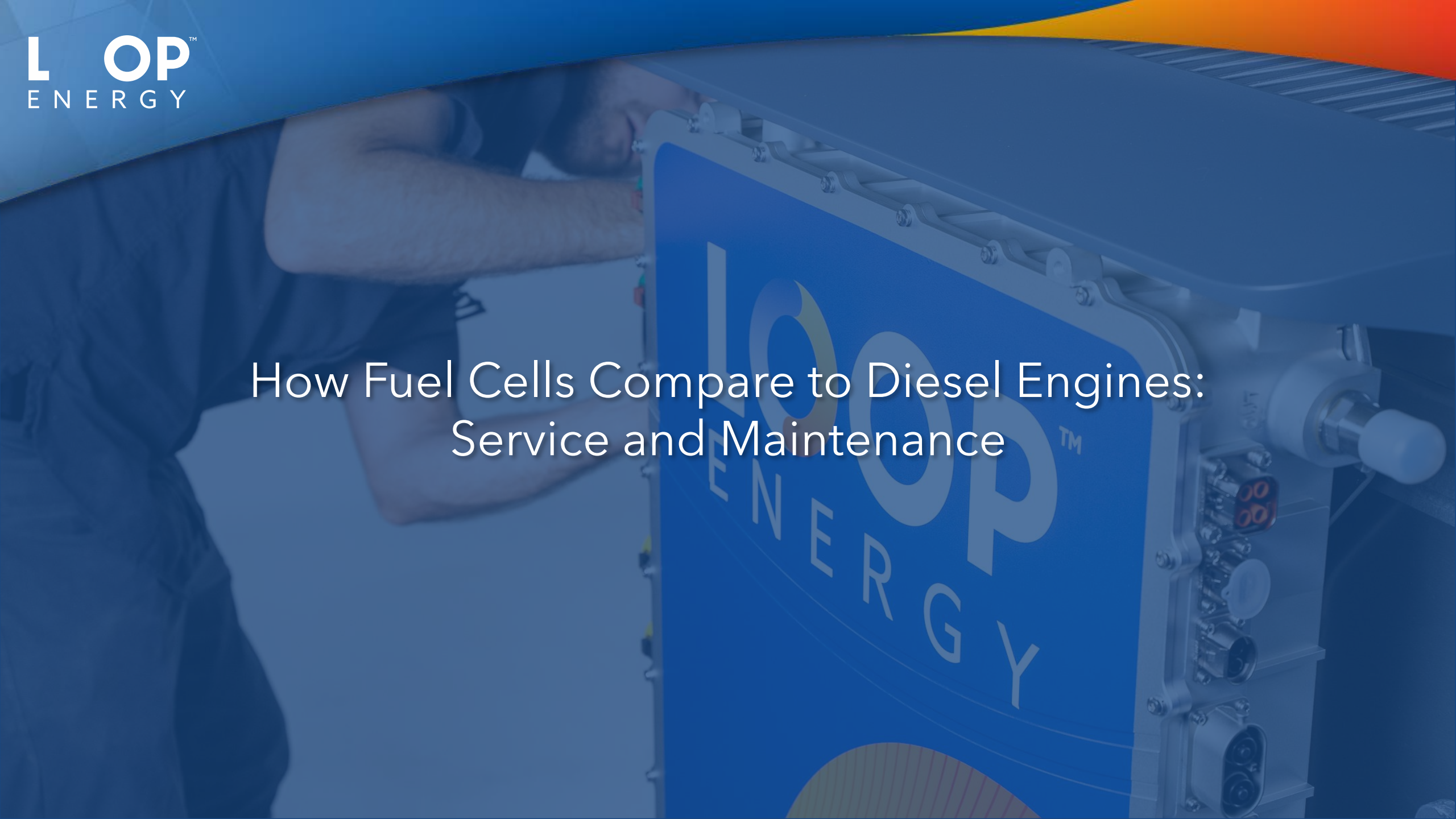


A 120 kW Fuel Cell for Heavy-Duty Vehicles

Efficiency Where it Counts
Up to 60% net system efficiency in cruise mode

Wide Cruise Range
Across a wide net power range of 17-83 kW

Easy Integration
With factory integration and flexible packaging



How Fuel Cells Compare to Diesel Engines: Service and Maintenance

Maintenance Practices

What's the same?

- Filters need changing
  - but air filters are for more than just particulates
  - and coolant deionizing filters are very important
- Diagnostics from control system
- Maintenance service is critical to consider when integrating

What's different?

- No combustion and fewer lubricants means cleaner engines
- High voltage connections and pressurized gases
- More training of controls and software

LOOP ENERGY

Fuel Cell Lifespan

Beginning of Life

- A well-maintained fuel cell can reach 10,000 operational hours
- The goal for the industry is to reach 30,000 operational hours

Mid Life

- A stack can be re-cored and returned for operation

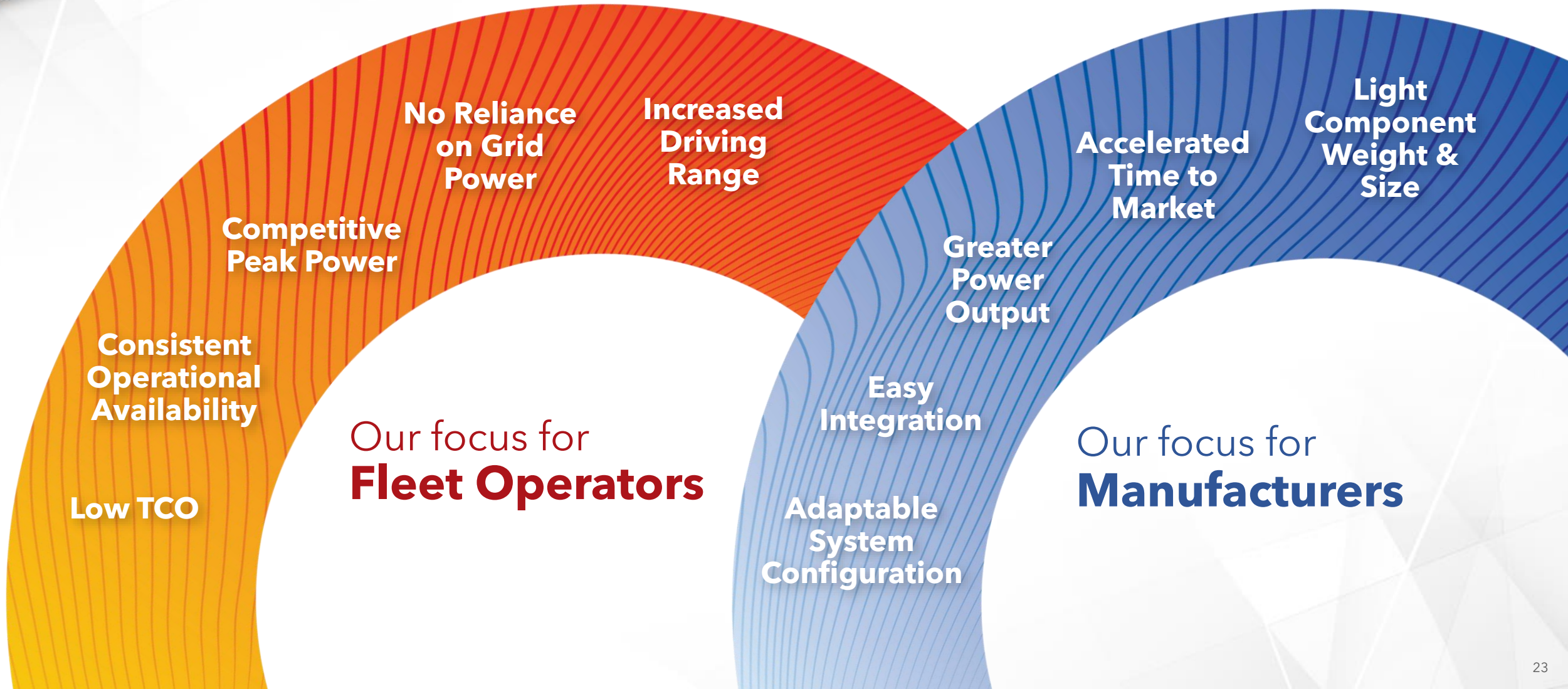
End of Service Life

- 95% of precious metals can be recycled
- Components like electronics, pumps, valves, hoses and metal for housing and frames can be recycled using regular recycling processes
- Stack hardware and plates can be refurbished and reused

LOOP ENERGY

Adopting Fuel Cells in Commercial Vehicles and Equipment

Our Focus is to Provide a Fuel Cell that Achieves:



Integration Support is Key from Design to Scale-Up

Technology alone isn't enough

Qualification & System Design

Sales Application Engineer

Integration & Start-up

Operations Team

Supply

Manufacturing Team

Maintenance, Warranty & Recycling

Field Service Manager

Key Considerations for Transitioning to Fuel Cells

Start the transition early – many US States will ban diesel engine production by 2035

Understand the needs of your application

Choose a technology partner that will lower your TCO and provide integration support

Q&A

Dr. Daryl Musselman | P.Eng.
Chief Operating Officer at Loop Energy Inc.

Loop Energy Inc. @LoopEnergyInc
www.loopenergy.com

LOOP™
ENERGY