Electrification of Buses and Coaches with Success

14Oct 2014

VANNER®

Experience Power... Experience Vanner

Chris Collet
VP Bus and Hybrid Markets
Vanner Inc.
chrisc@vanner.com
614-329-1642

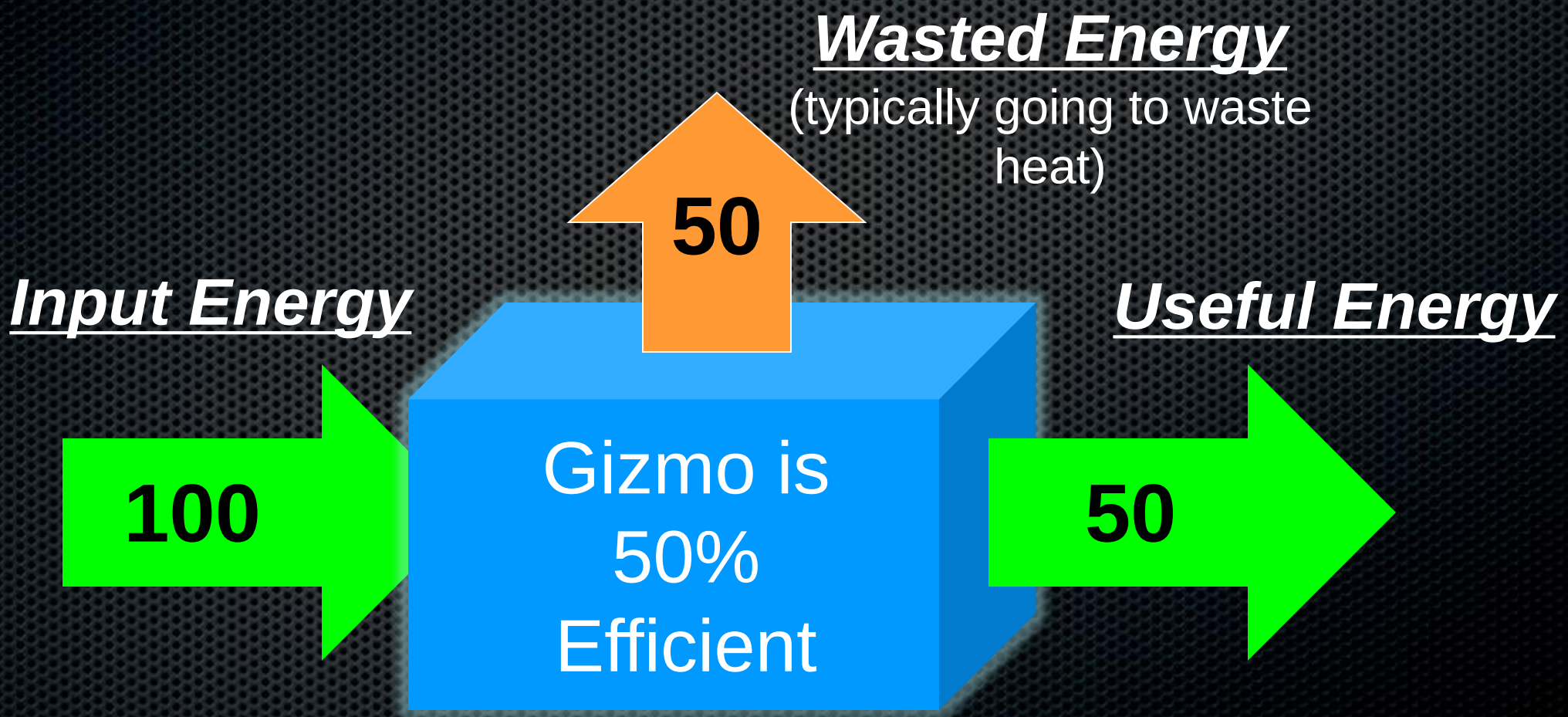
ef·fi·cien·cy \i-ˈfi-shən-sē\

: the ability to do something or produce something without wasting materials, time, or energy:

Without Wasting:

- Materials
- Time
- Energy

Energy Efficiency



Decoupling what does it mean?

- Disconnecting accessories from engine’s running speed

Decoupling Accessories from Engine

Why?

- Allows accessories to run at speeds independent of engine speed
- Enabler for major efficiency gains and engine off

Decoupling Accessories

Why is this important?

- Eliminate parasitic losses at higher engine speeds
- Can now run accessories at optimum speeds
- Allows speed specific accessories to now be used (scroll oil-free air compressors, hermetically sealed freon compressors, etc)
- Accessory operation independent of engine speed


Isaac Newton

Torque X Speed/5252

= Horsepower

Horsepower load at 1000 RPM (Example)

52.52 lb-ft X 1000 RPM/5252 = 10 HP

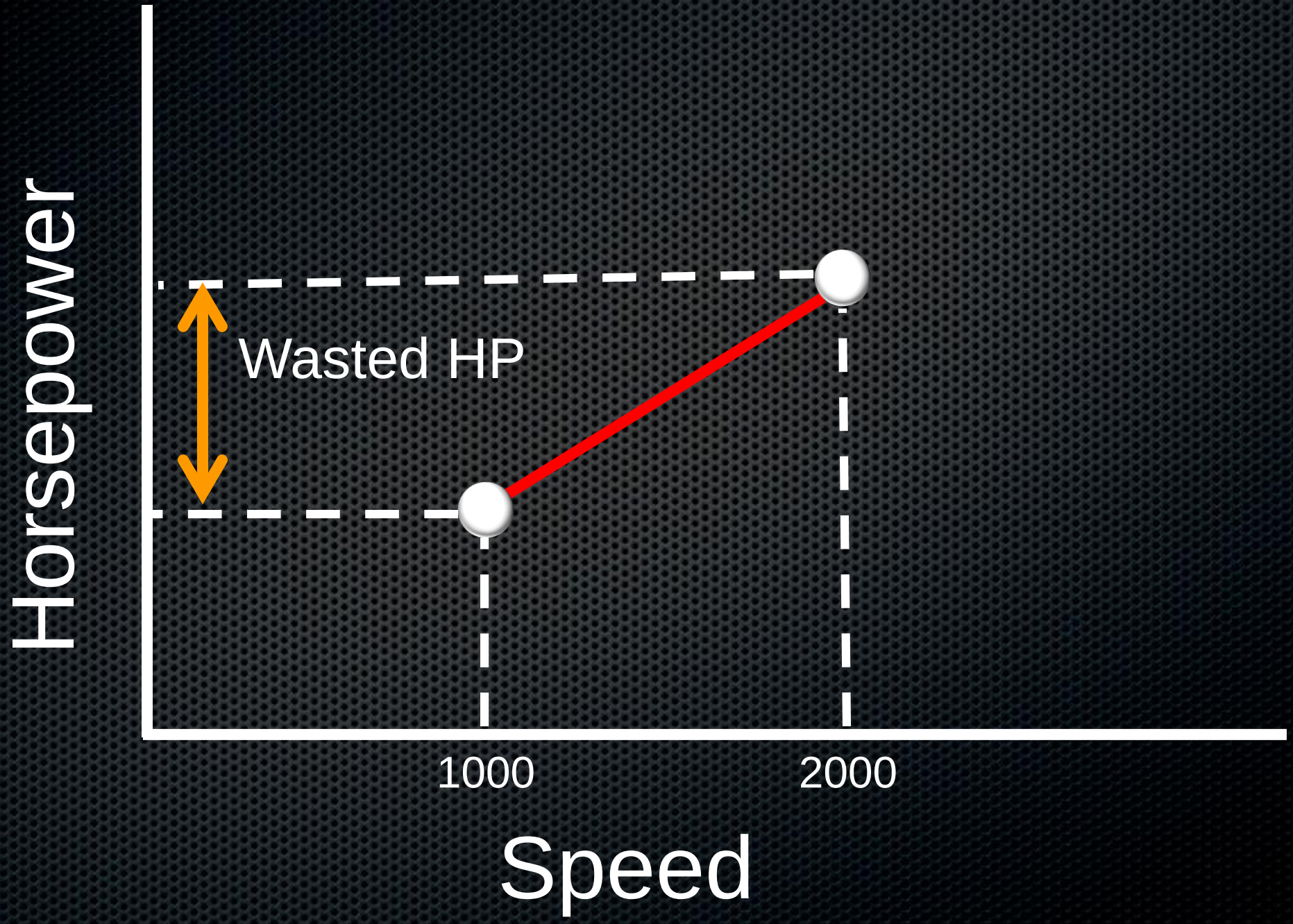
Horsepower load at 2000 RPM (Example)

52.52 lb-ft X 2000 RPM/5252 = ?

Horsepower load at 2000 RPM (Example)

52.52 lb-ft X 2000 RPM/5252

= 20 HP


Horsepower
Wasted HP
1000
2000
Speed

Charging System

or

Air Conditioning

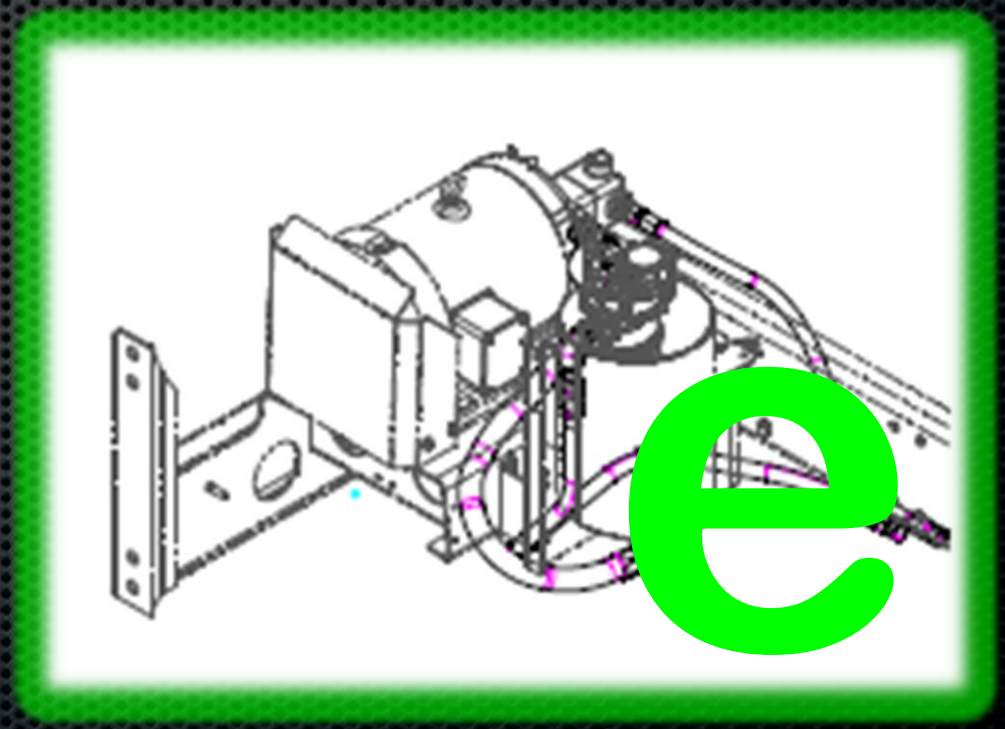
or

Air Compressor

or

Power Steering

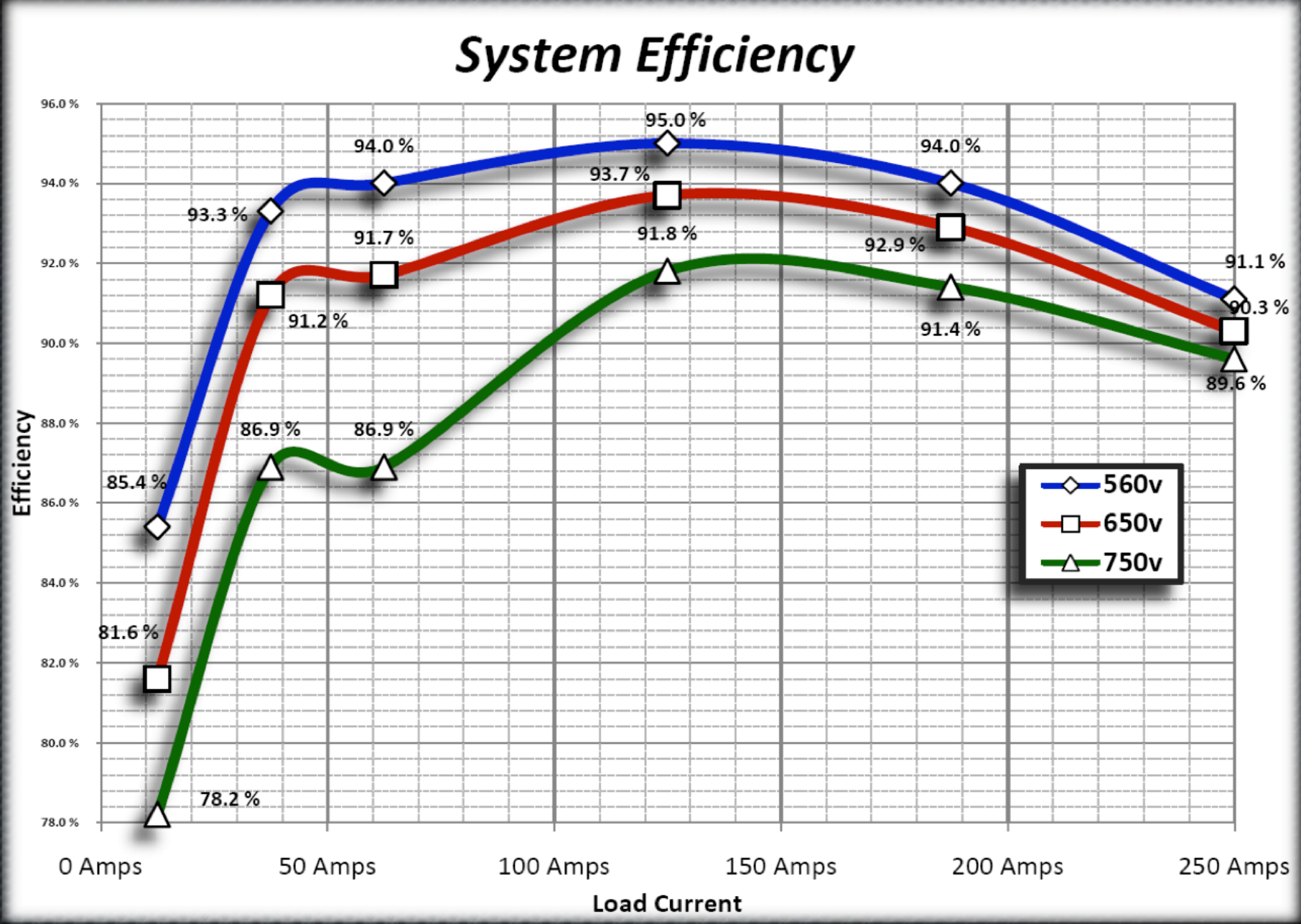
or



Allison Hybrid-basic HBA® configuration

Solid-state DC to DC Converter aka Hybrid Beltless Alternator

DC to DC Converter (HBA)



OEMs that have the Vanner DC to DC Converter Available for Hybrid and Electric Buses

- **Gillig – SOP 2010 (Allison Hybrid)**
- **New Flyer – SOP 1Q2012 (Allison Hybrid)**
- **NABI – SOP 2011 (Allison Hybrid)**
- **Nova – SOP May, 2013 (Allison Hybrid with Dual HBAs)**
- **Eldorado-National – SOP 2011 (Allison Hybrid)**
- **TATA-Motors – SOP 1Q2012 (CNG Hybrid & Fuel Cell)**
- **Solaris-Poland – SOP 2012 (Allison Hybrid)**
- **Siemens (Battery Propulsion System)**
- **SyncRND – Malaysia (Battery Propulsion System)**
- **Karsan/Breda-Turkey (Siemens Hybrid)**
- **VSE-Brazil (Hybrid Bus)**

HBA Life Prediction based on 1300 units since SOP Jan, 2011
(650 HBAs sold in last 12-months)

>20-year mean life between failures

Alec Cook, VP Engineering and CTO

Fuel Economy Gains with Vanner HBA® claimed by Transit Agencies

Bus Agency - USA	Hybrid	Hybrid with Vanner HBA®	% Improvement
Baltimore, MD	5.0 MPG	6.0 MPG	20%
Flagstaff, AZ	5.4 MPG	6.1 MPG	13%
Sound Transit - Seattle, WA	6.1 MPG	7.1 MPG	16%
Lansing, MI	-	-	15%
Hybrid is Allison Transmission's H40EP Hybrid			

Independent Test of HBA vs. Alternator (Ohio State University Center for Automotive Research)

Independent Test of HBA vs. Alternator (Ohio State University Center for Automotive Research)

Bus Configuration:

Gillig with Allison H40EP Hybrid
Cummins ISB-280hp
Hydraulic radiator fan
HBA or belt-driven alternator

Test Results:

3-8% Fuel Economy Improvement with HBA vs. belt-driven alternator

May, 2014

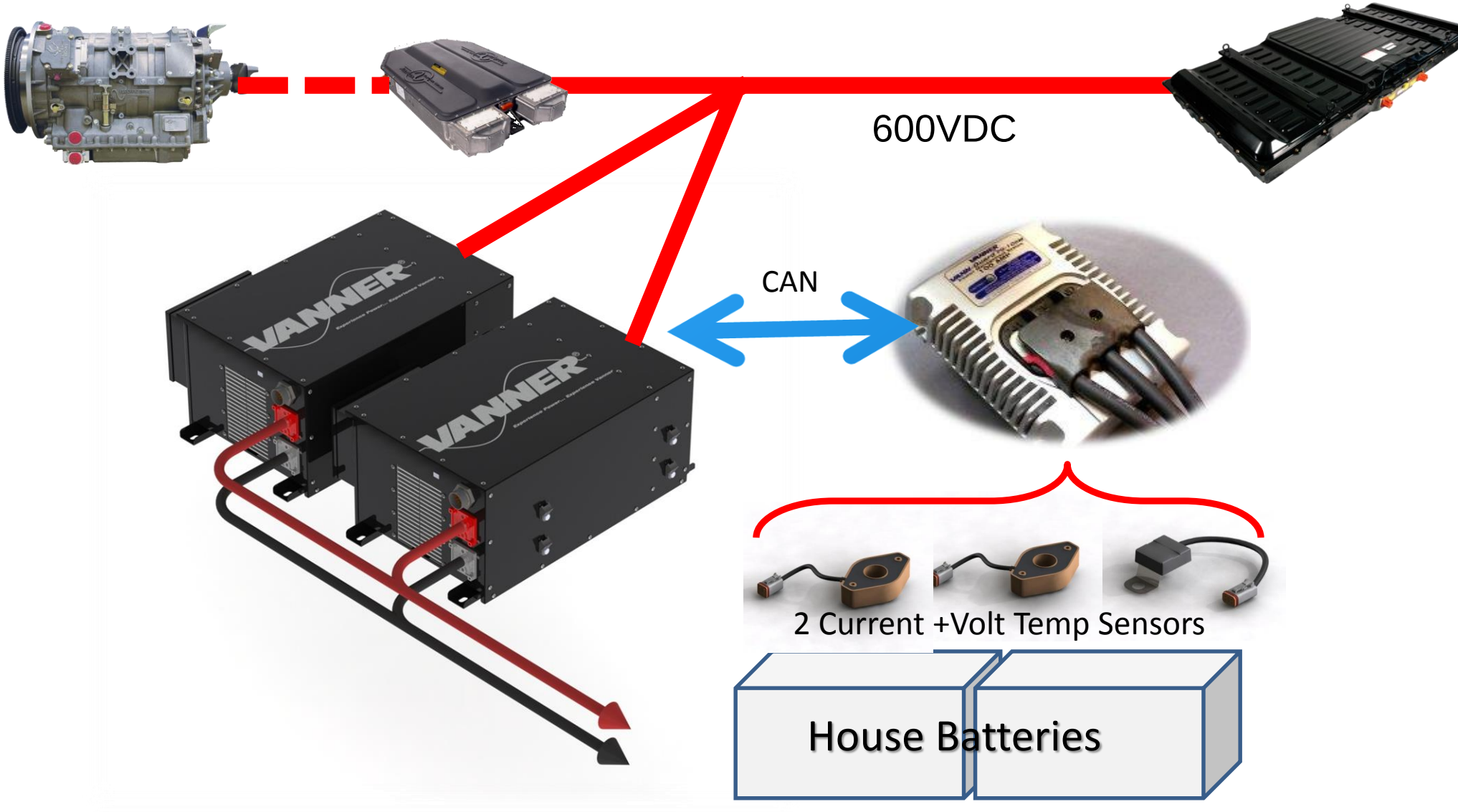
New

Dual HBAs – 500 or 600 amps (April 2013 SOP)

VANNER®

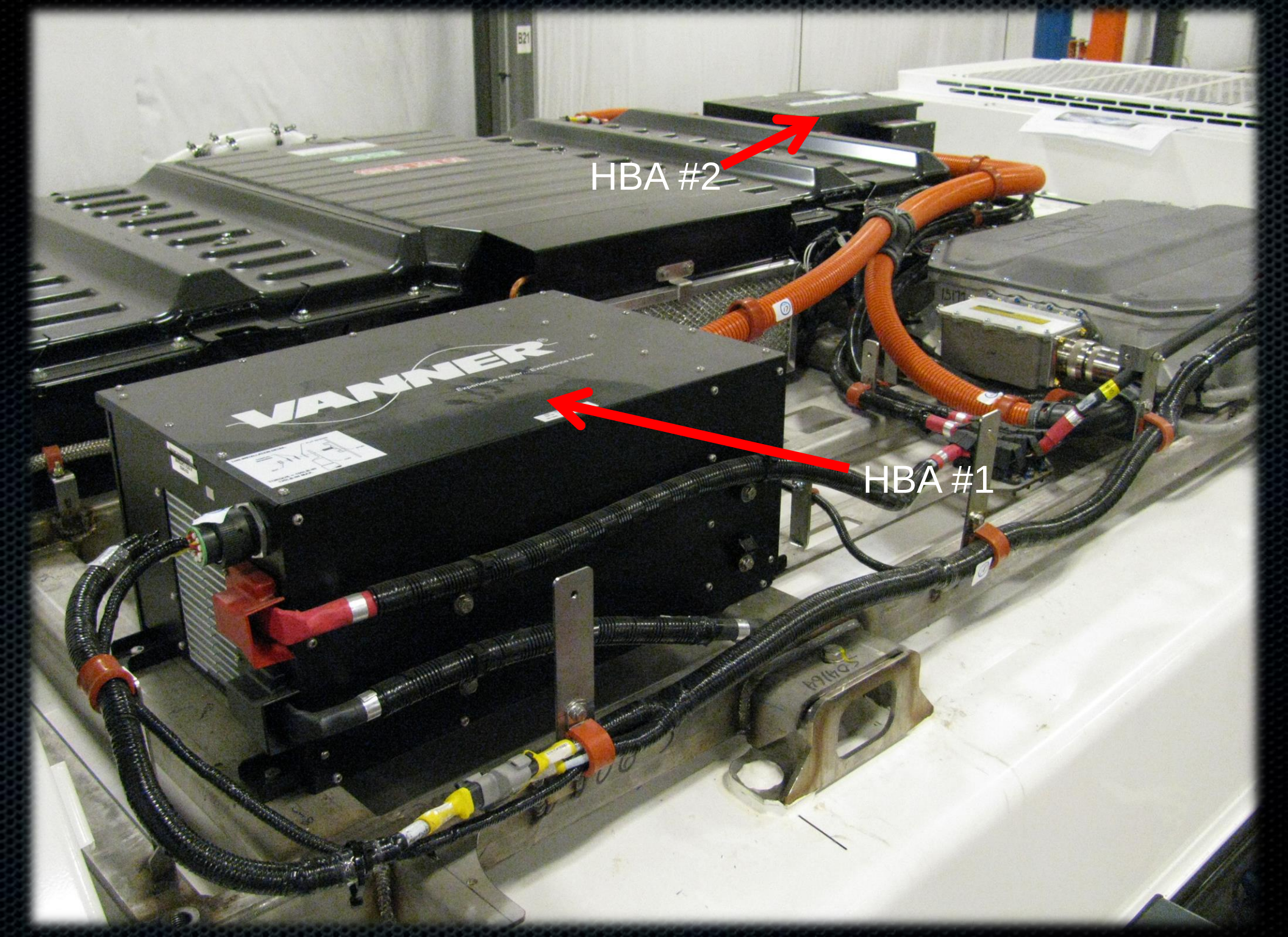
Experience Power... Experience Vanner

Dual HBAs for 600 Amp Capacity and House Battery Dynamic Charging



SEPTA Hybrid with 600 amp Dual Vanner HBAs (February 2014)

Nova (Volvo Group) building both 40 and 60-foot hybrids for SEPTA


HBA #2
VANNER
HBA #1

New

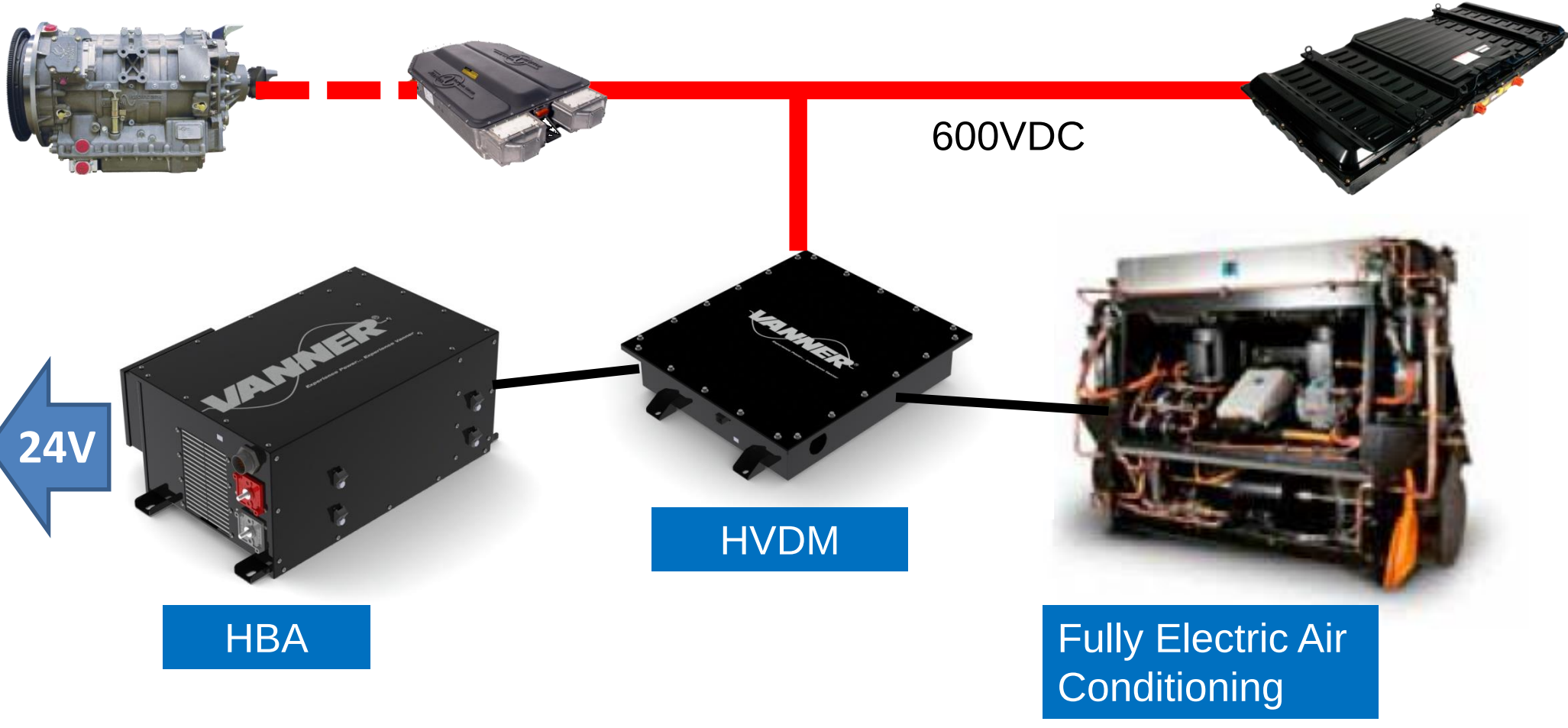
High Voltage Distribution Module (April 2013 SOP) for fully electric air conditioning

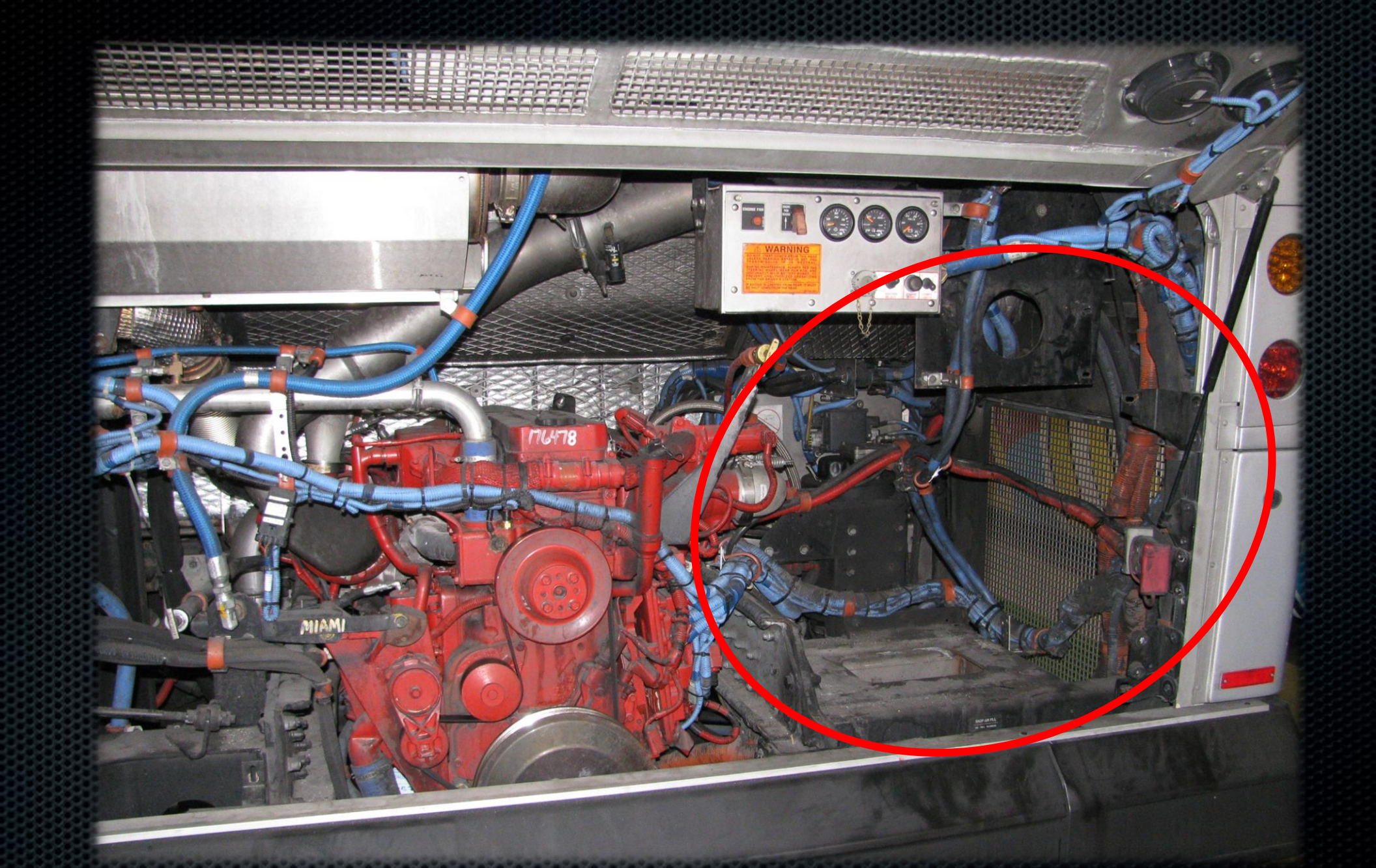
(Allison's Increased Accessory Power 1 for H40/50EP Hybrids)

VANNER®

Experience Power... Experience Vanner

Power Grid in for Increased Accessory Power





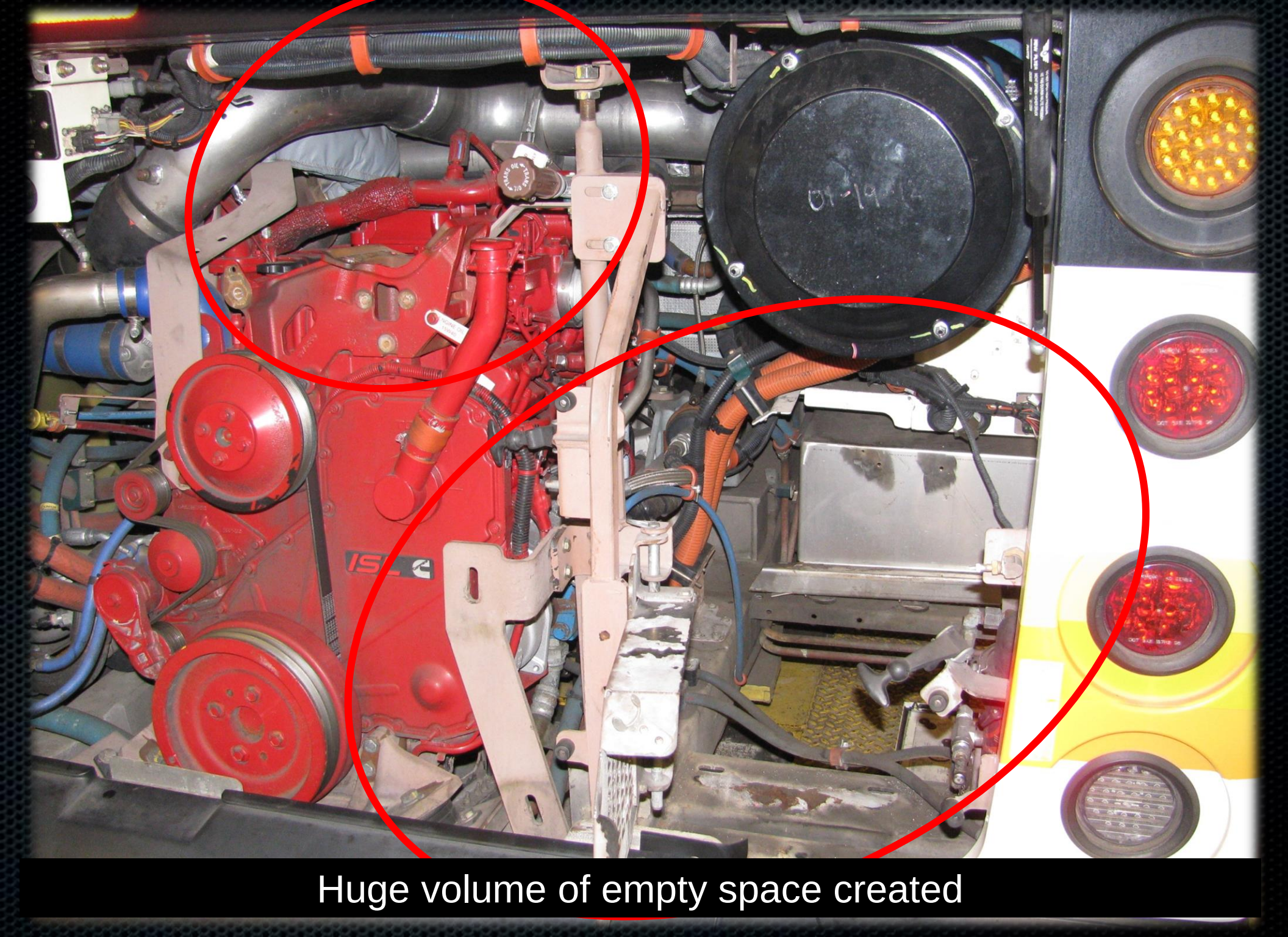
Huge volume of empty space created with removal of HV Alternator

Allison/Vanner CVT of Increased Accessory Power @ Oahu Transit June 2013

- Allison H50EP Hybrid
- Vanner HBA
- Vanner HVDM
- Sutrak Electric A/C
- NF DE60LF

Inside unused rear compartment since roof top A/C

Dual Sutrak Fully-Electric A/C on roof and getting power from HVDM



Huge volume of empty space created

Allison Hybrid powering HVDM, HBA and Twin Sutrak A/C in operation (June 13, 2013)

Broward County getting HVDM with Sutrak Fully Electric A/C with Allison H40EP in NABI hybrids

- In production at NABI
- HVDM is “smart grid”
- Powers HBA
- Powers Sutrak A/C

Coming Soon

Increased Accessory Power 2 (IAP2) Target SOP 4Q2014

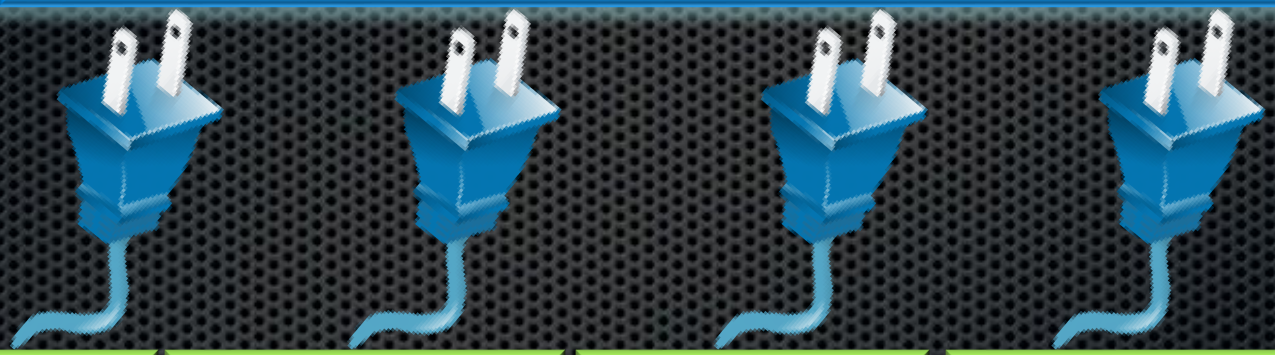
VANNER®

Experience Power... Experience Vanner

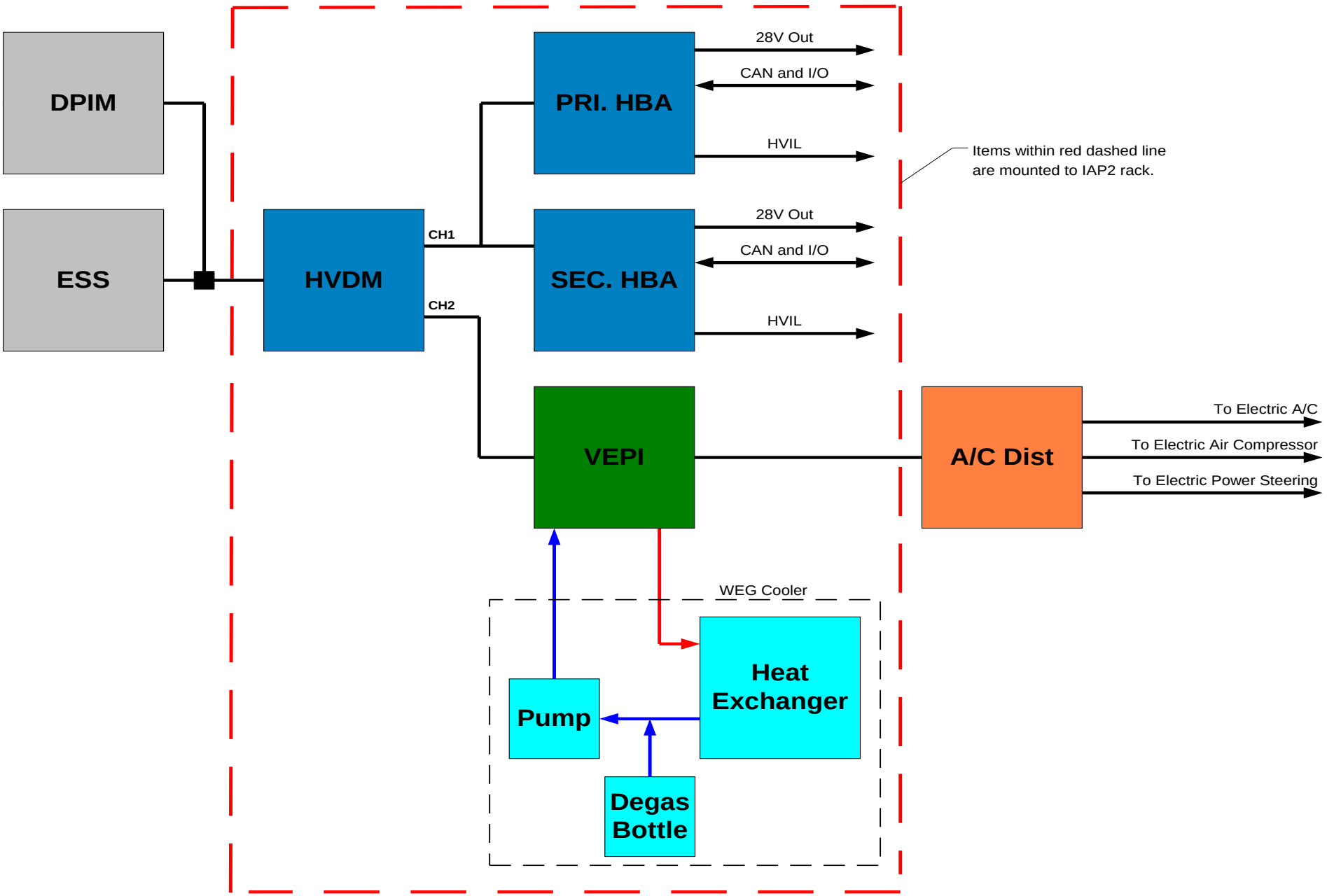
Allison H 40/50 EP™ Hybrid Exporting 30 kWs

30 kWs Continuous ↓ 45 kWs Intermittent

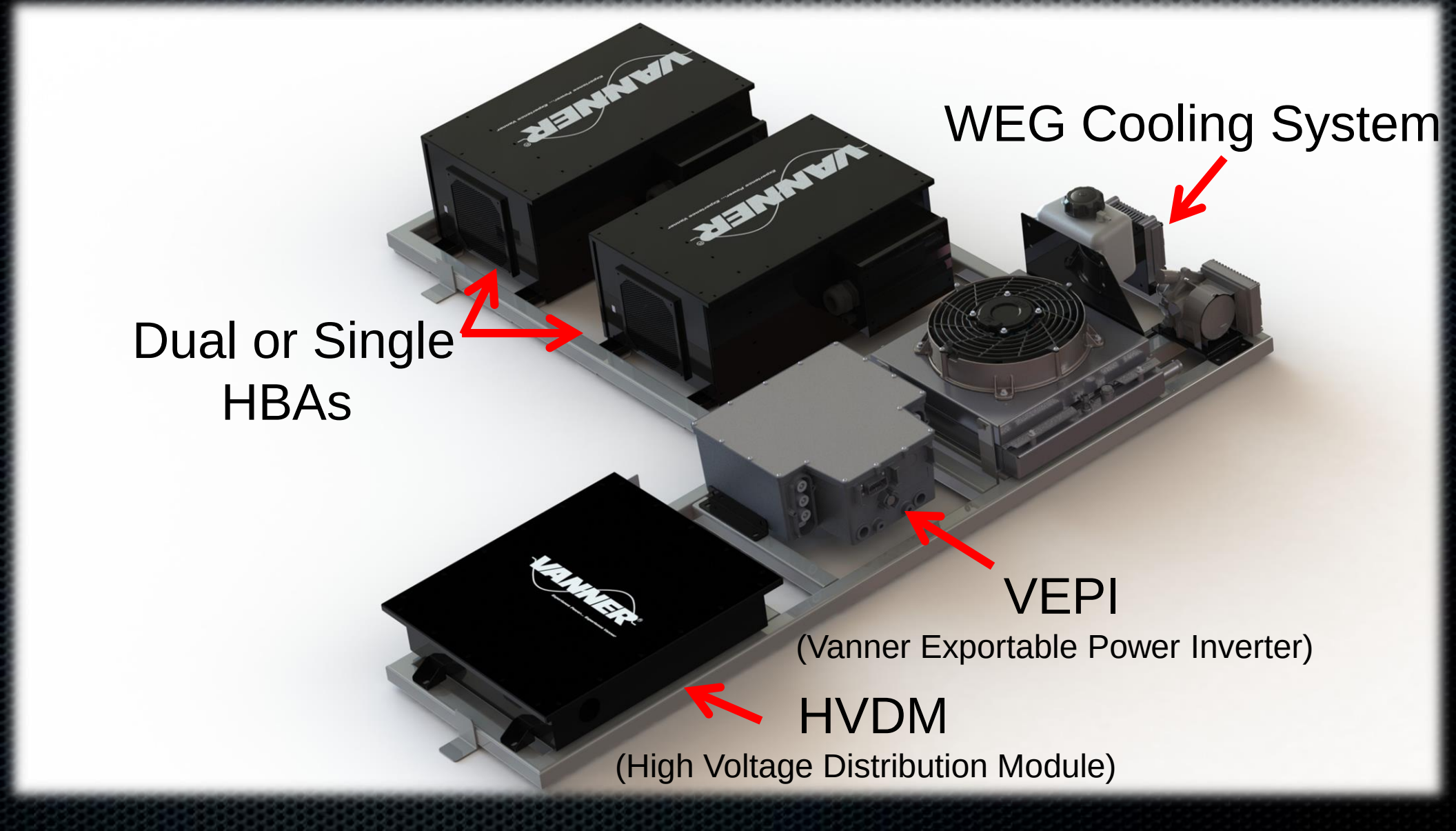
Vanner IAP2™

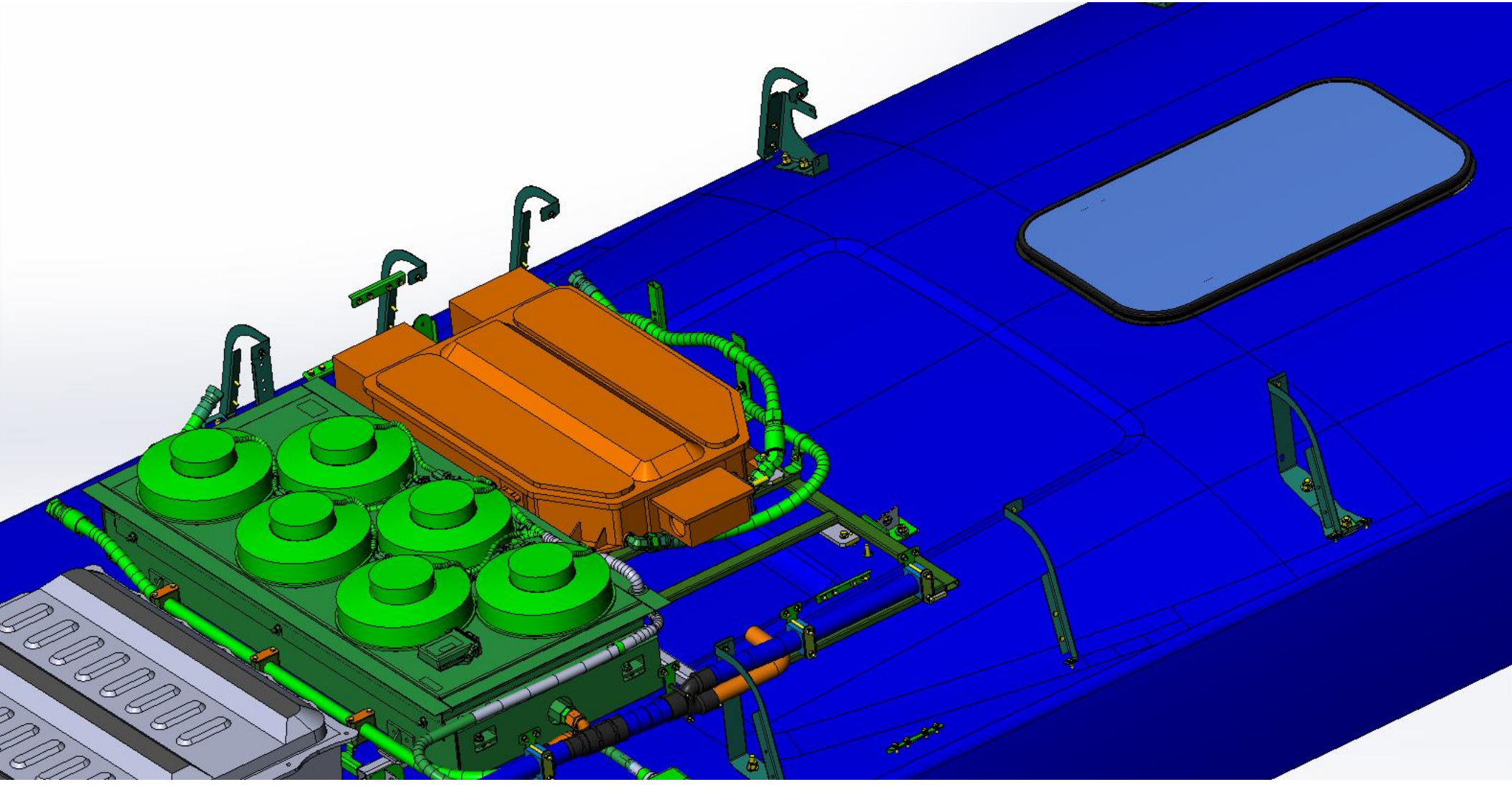


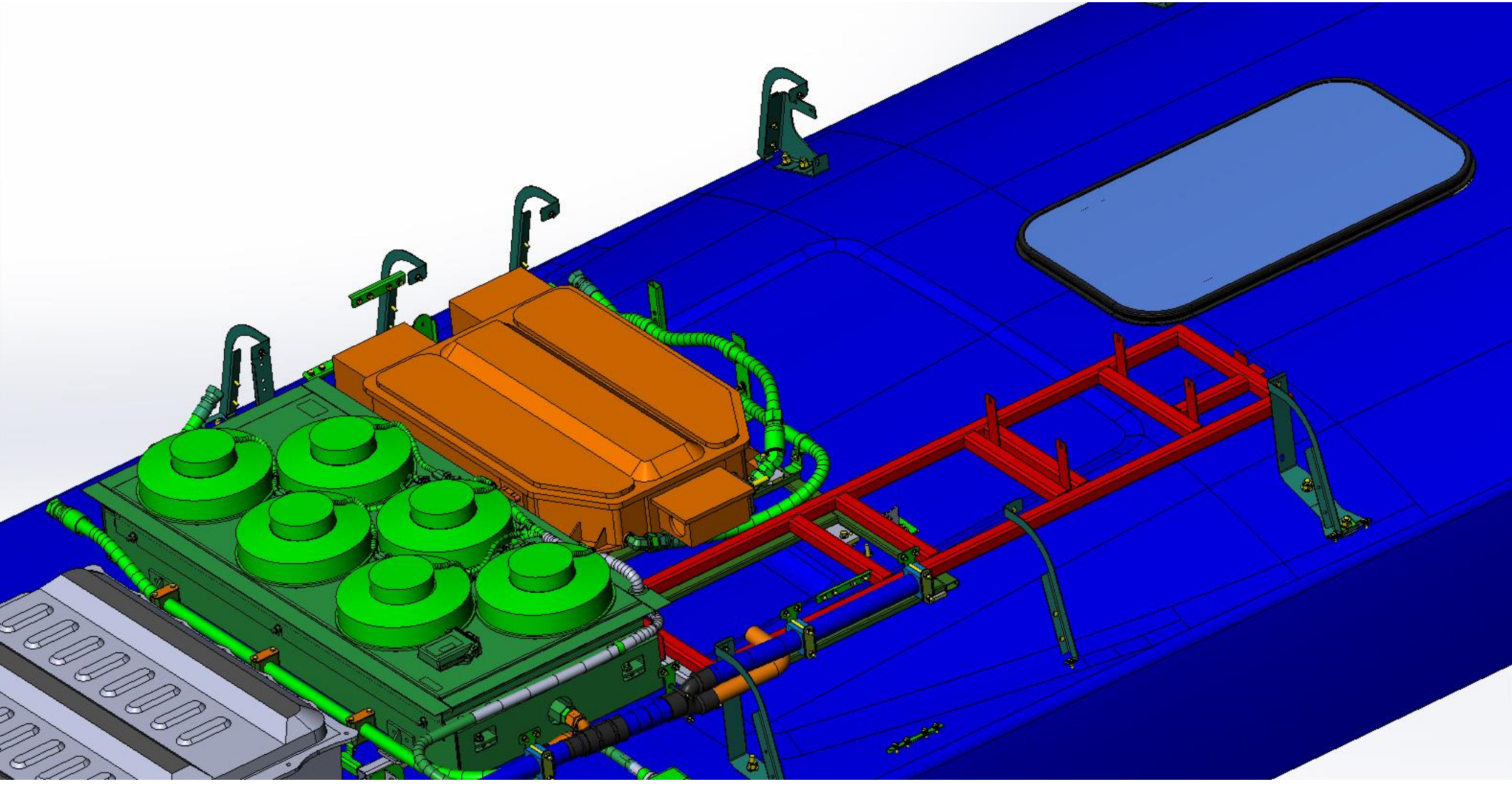
- Fully Electric Air Conditioning (including dual A/C)
- Fully Electric Air Compressor
- Fully Electric Power Steering
- Up to 600 amps-at-idle @24VDC dynamic charging system

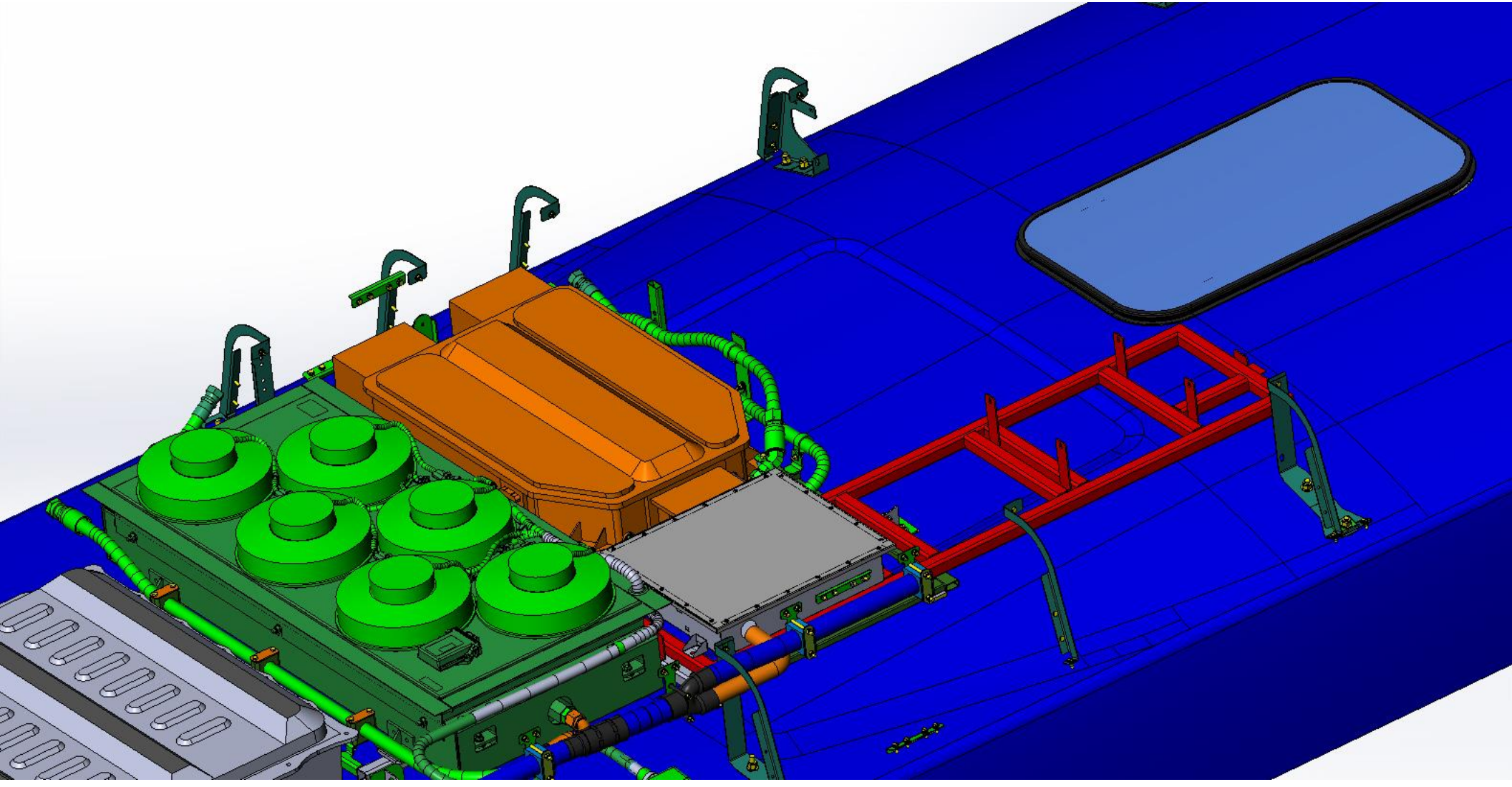

DPIM
ESS
HVDM
CH1
CH2
PRI. HBA
SEC. HBA
28V Out
CAN and I/O
HVIL
28V Out
CAN and I/O
HVIL
Items within red dashed line
are mounted to IAP2 rack.
VEPI
A/C Dist
To Electric A/C
To Electric Air Compressor
To Electric Power Steering
WEG Cooler
Heat
Exchanger
Pump
Degas
Bottle

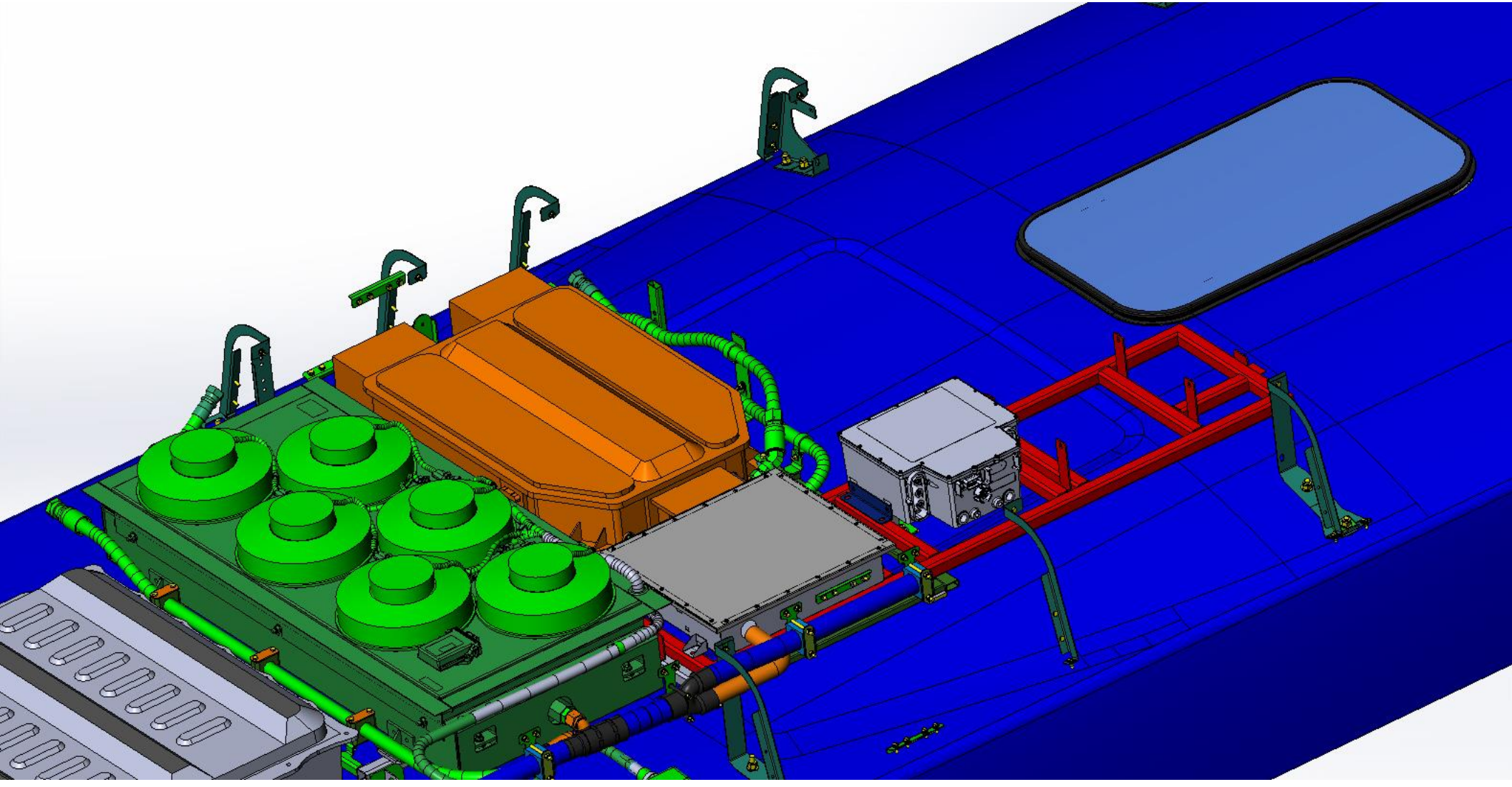
Mechanical Layout of IAP2
(layout can vary for different hybrid buses)

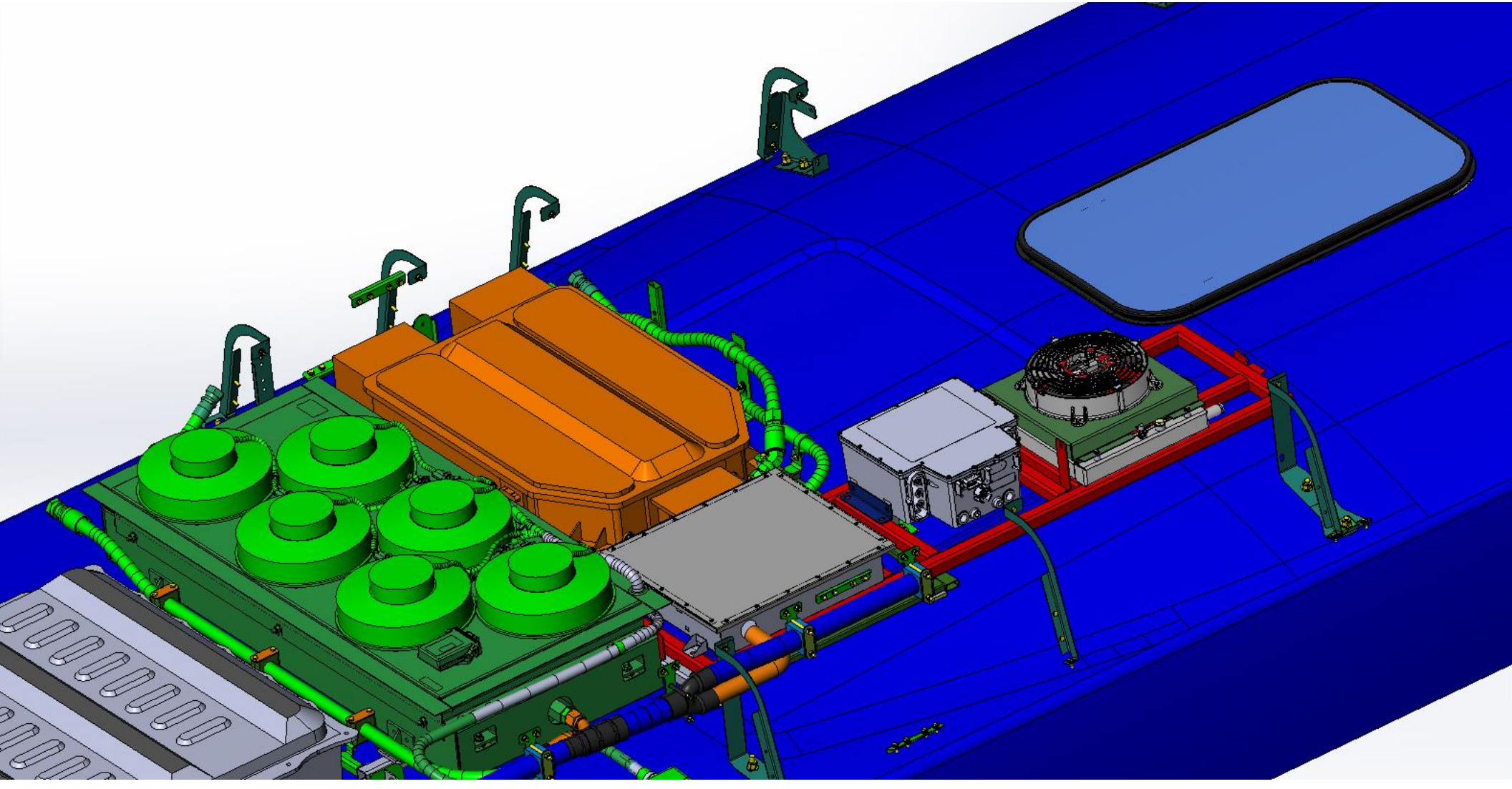


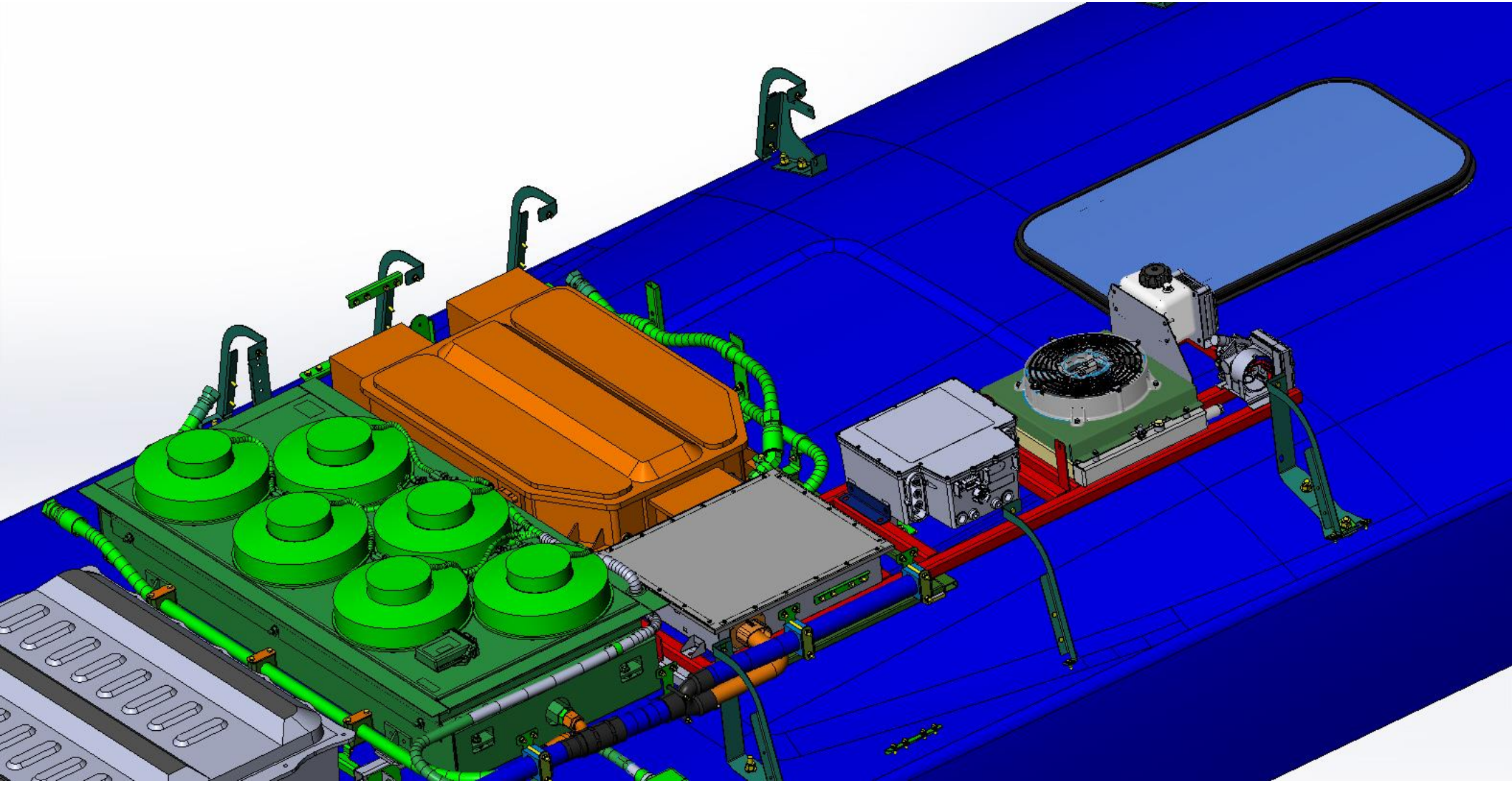


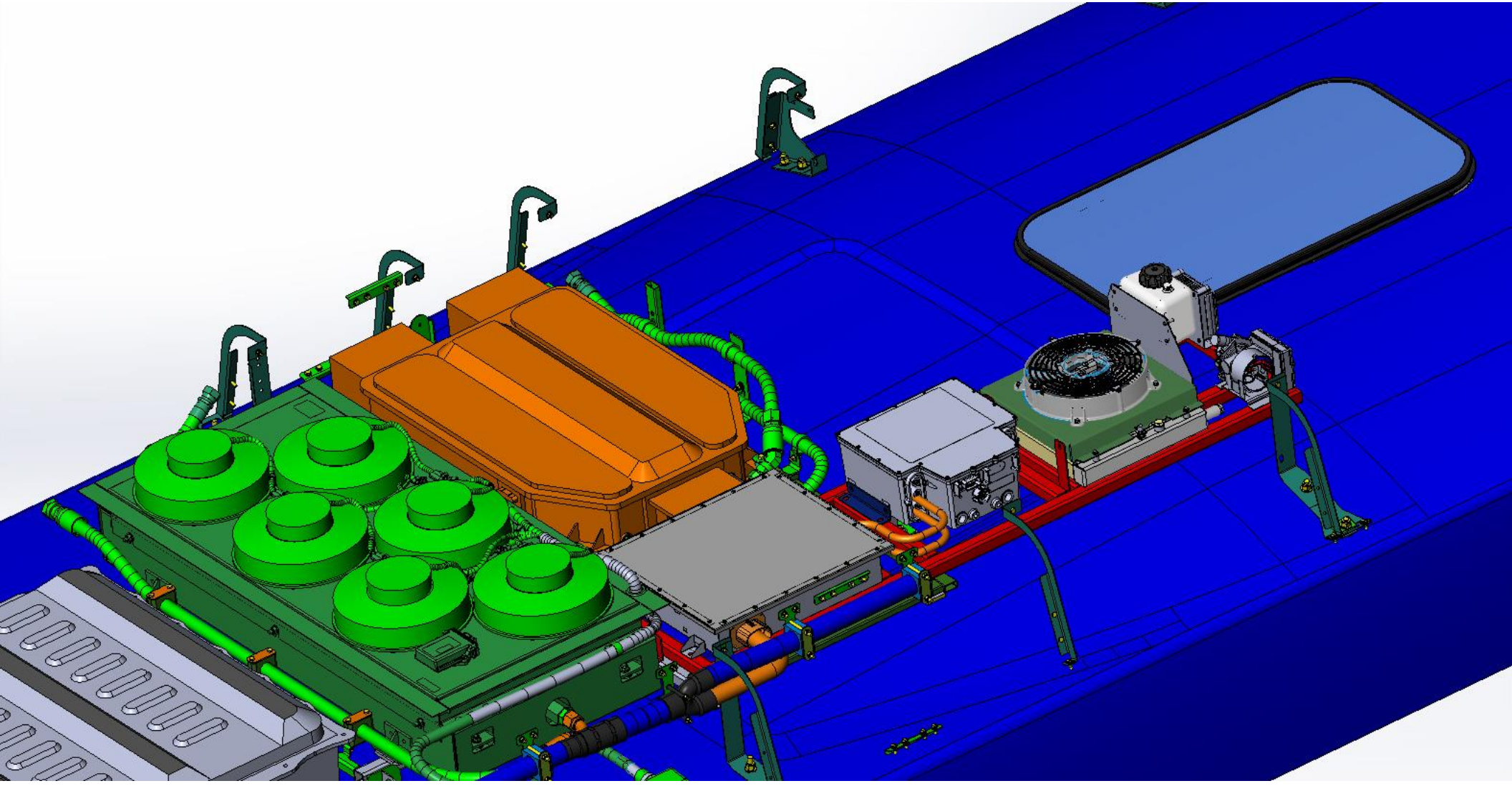


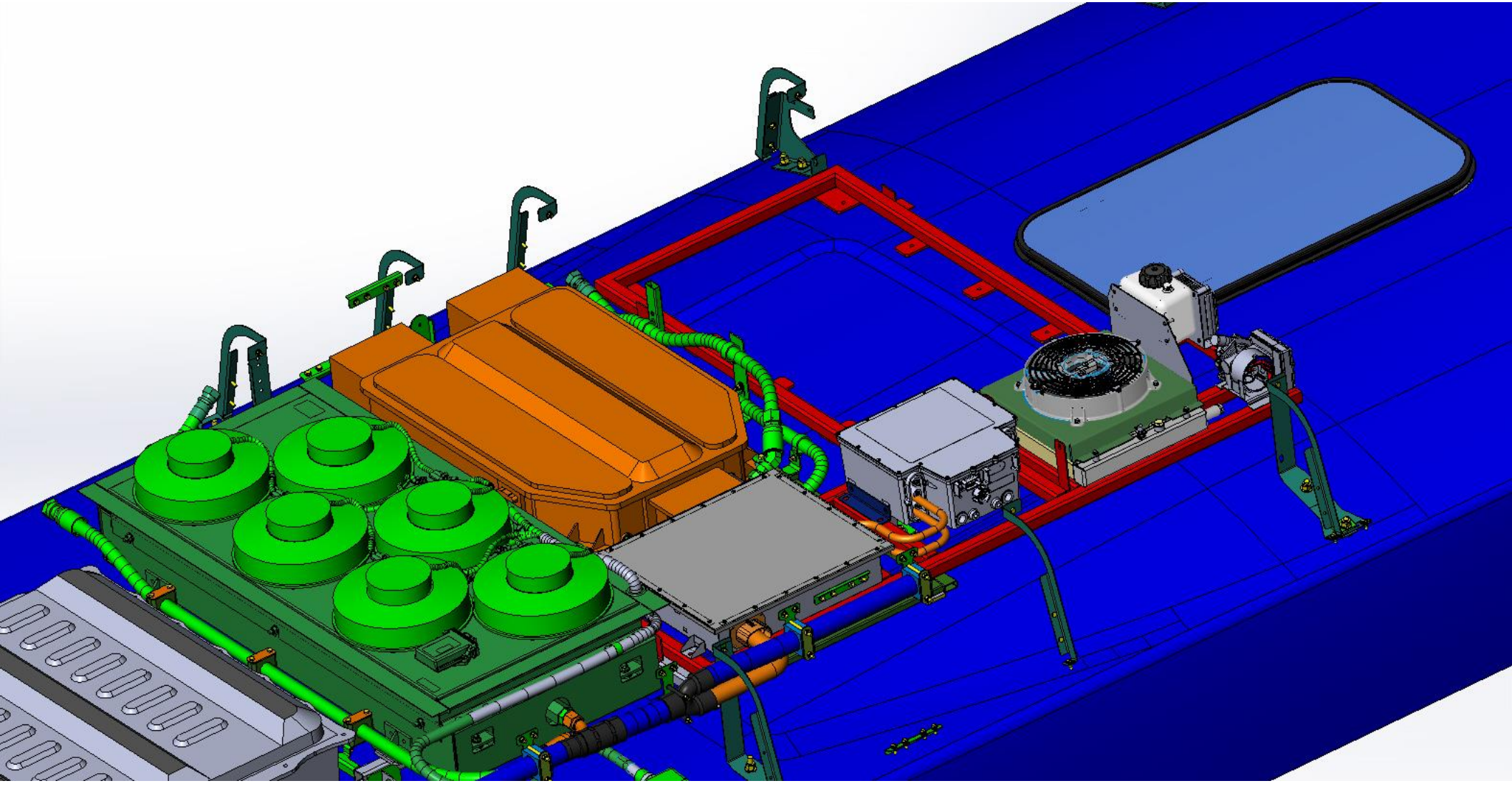


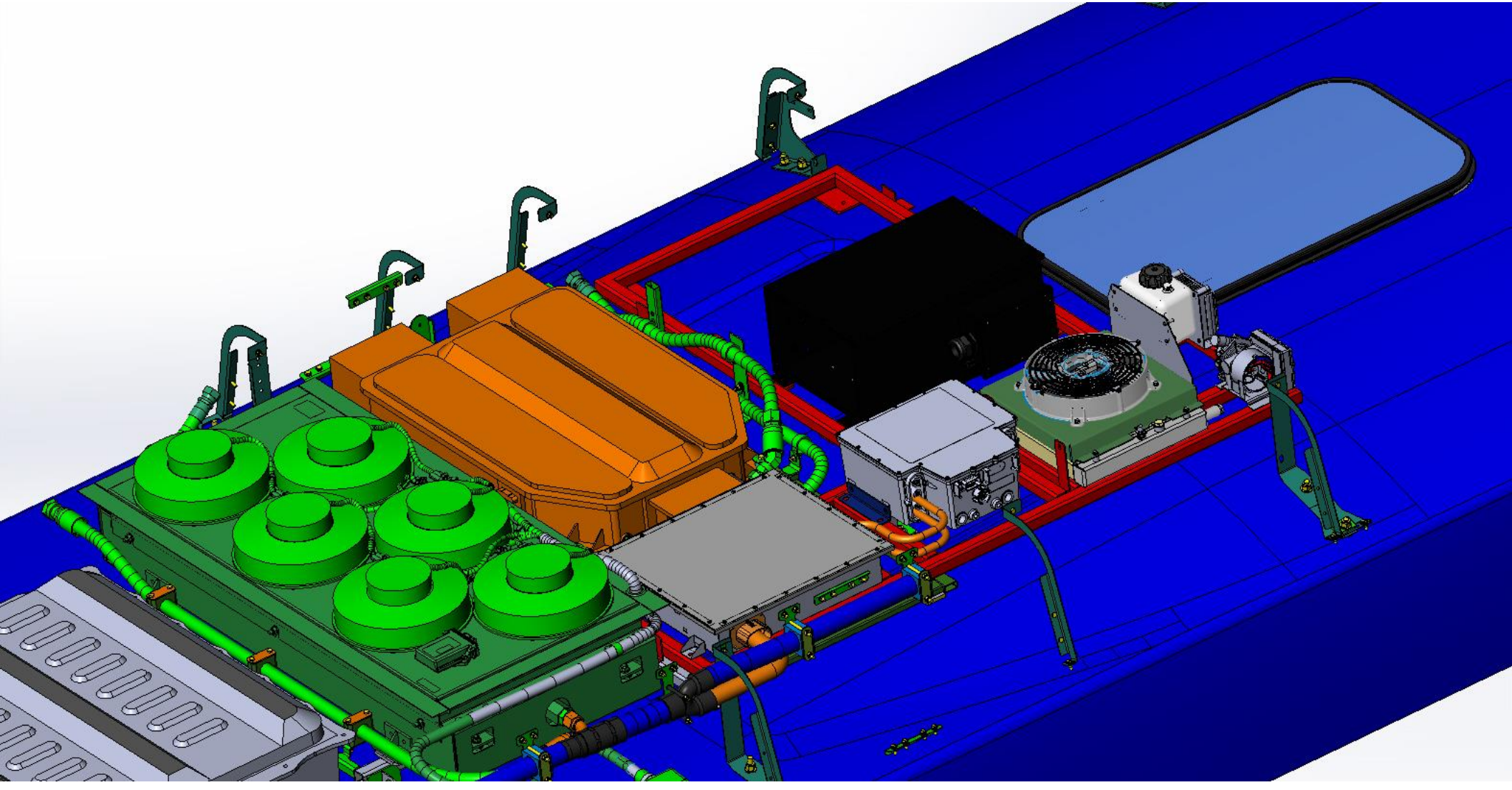


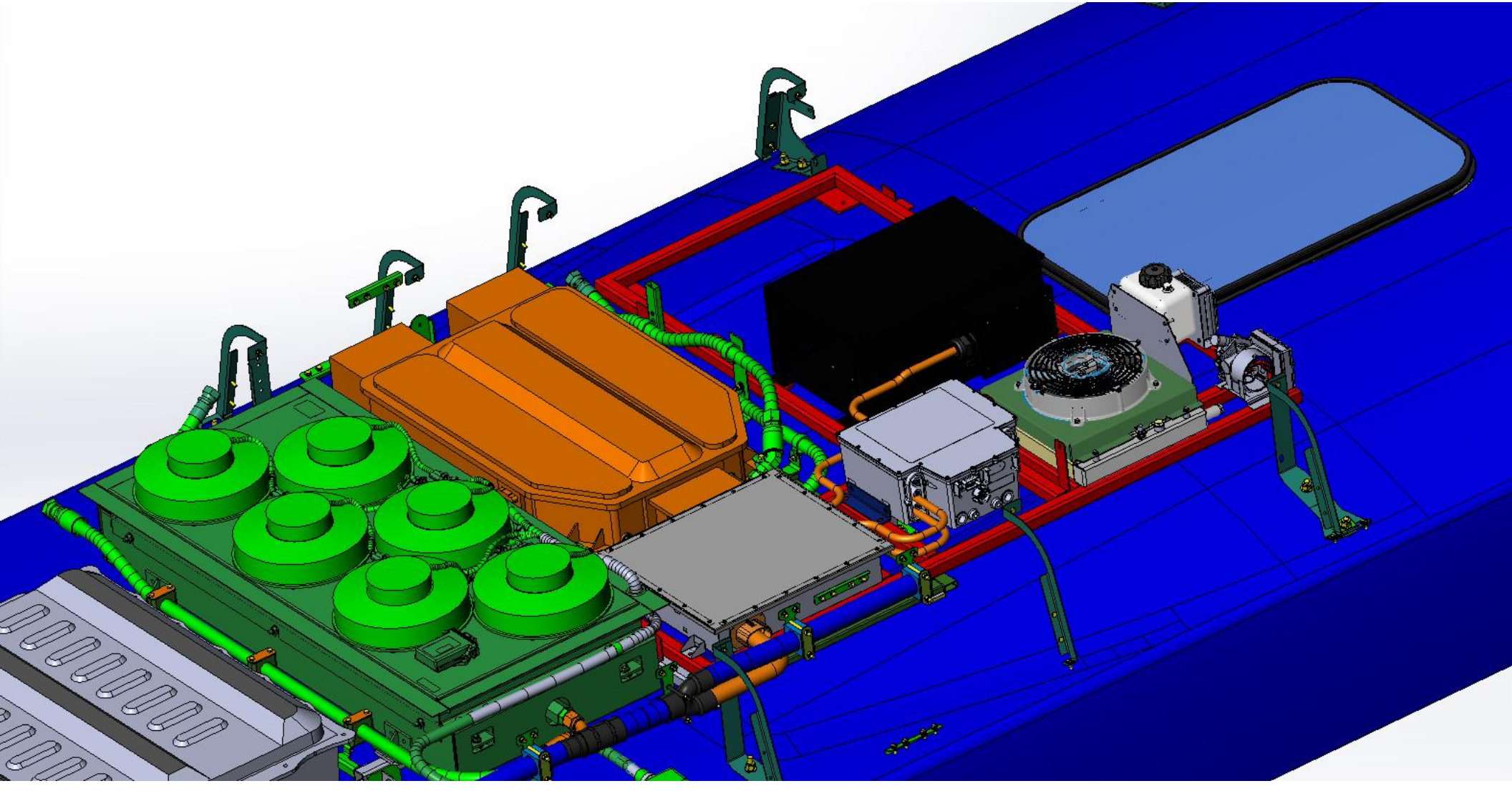


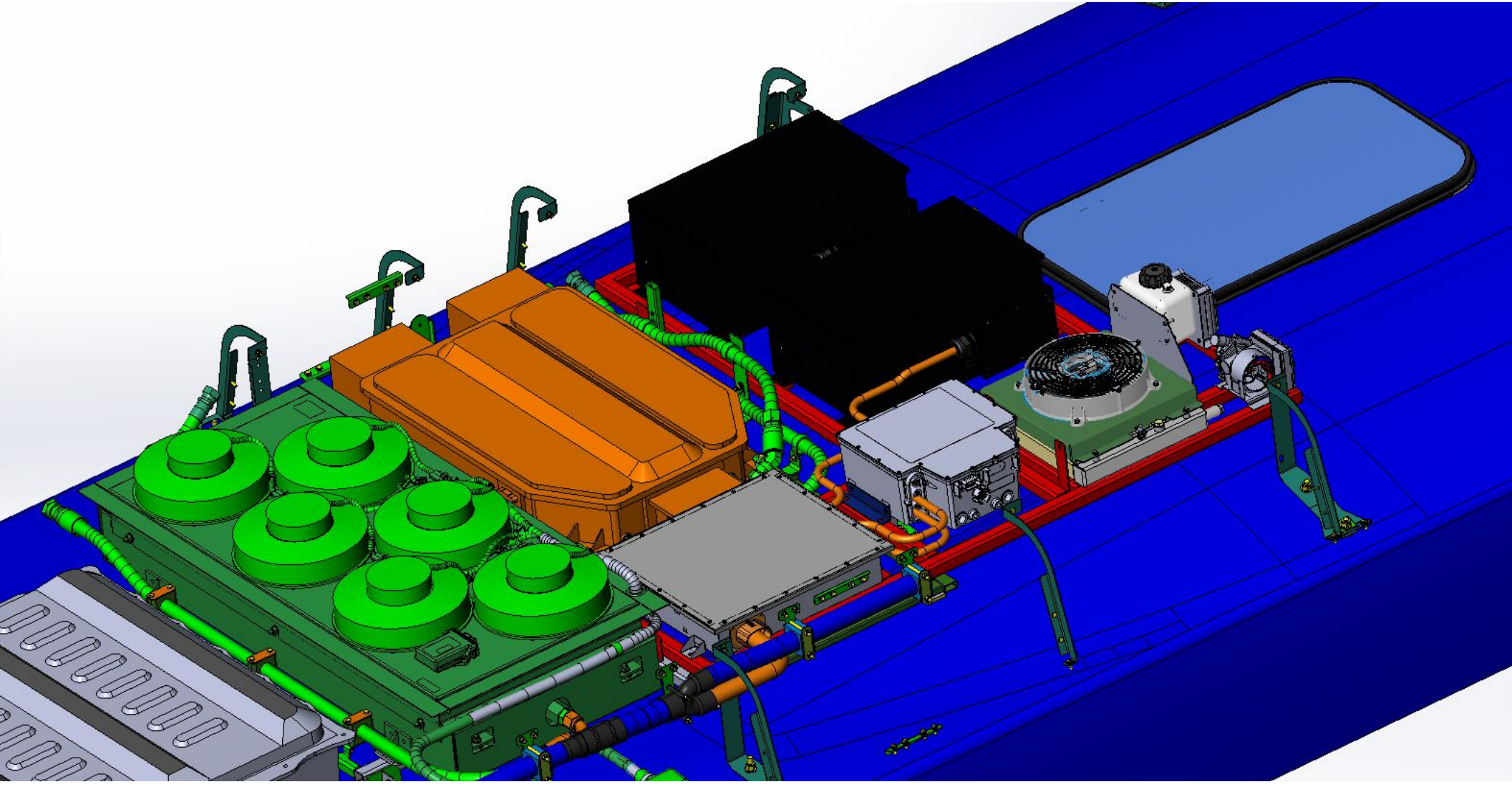


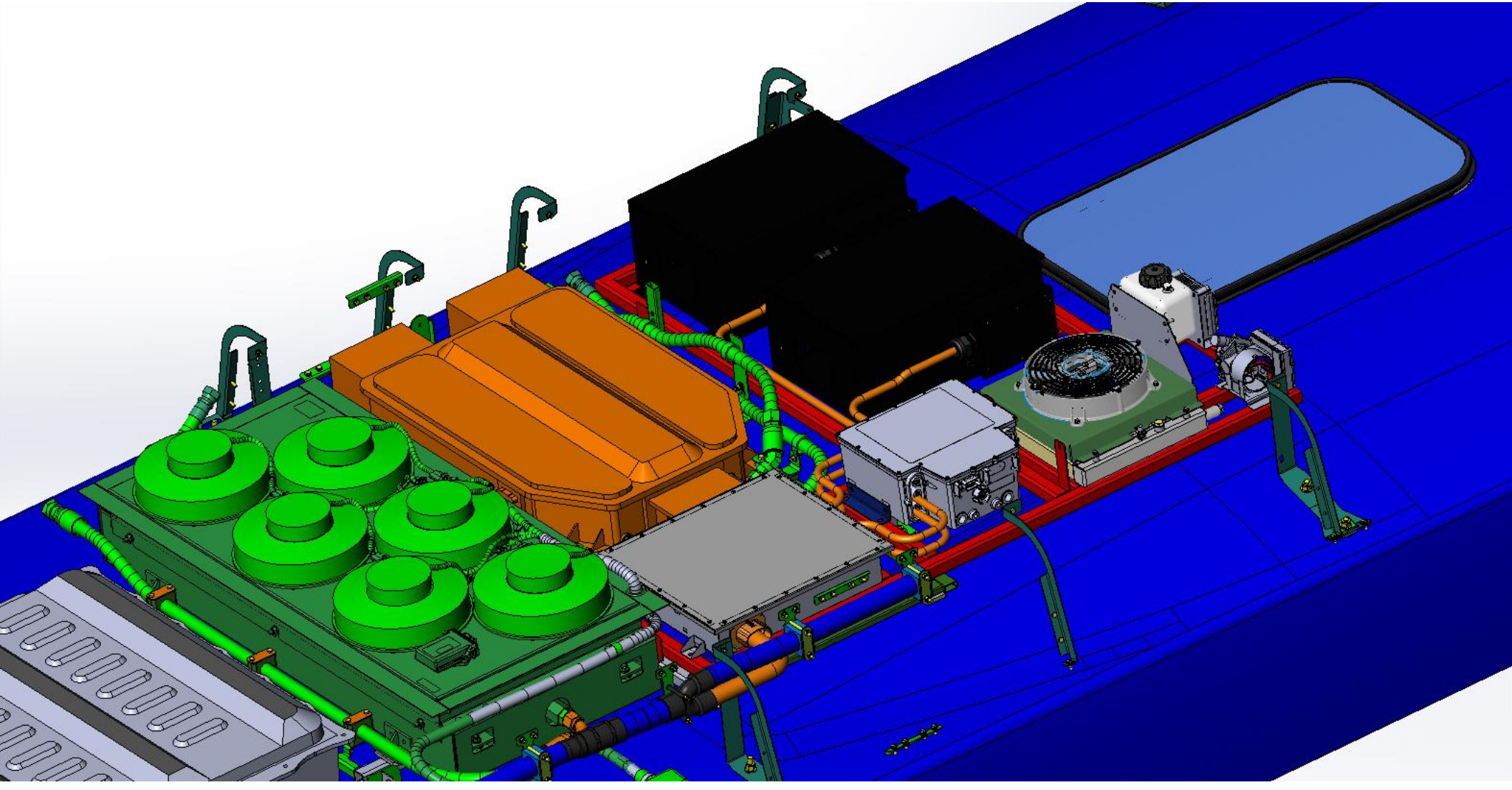


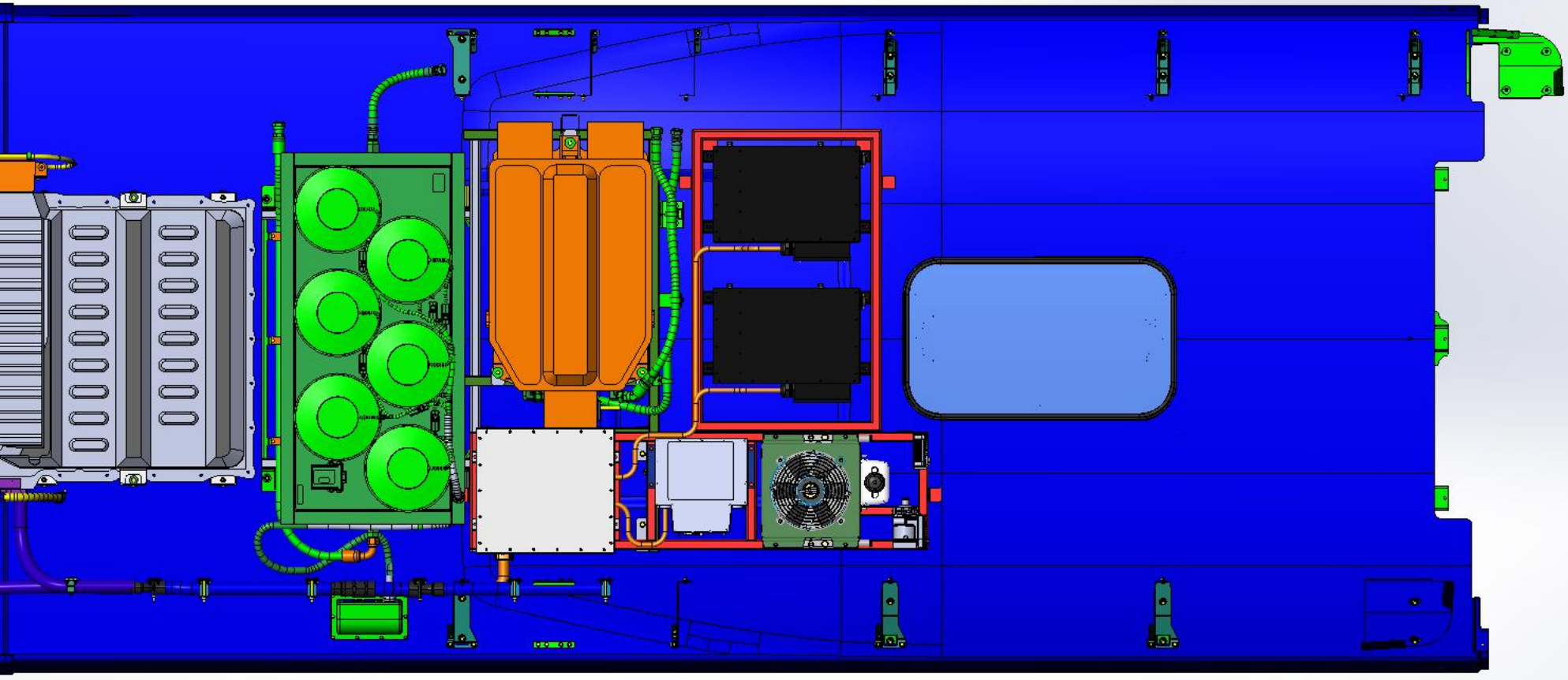


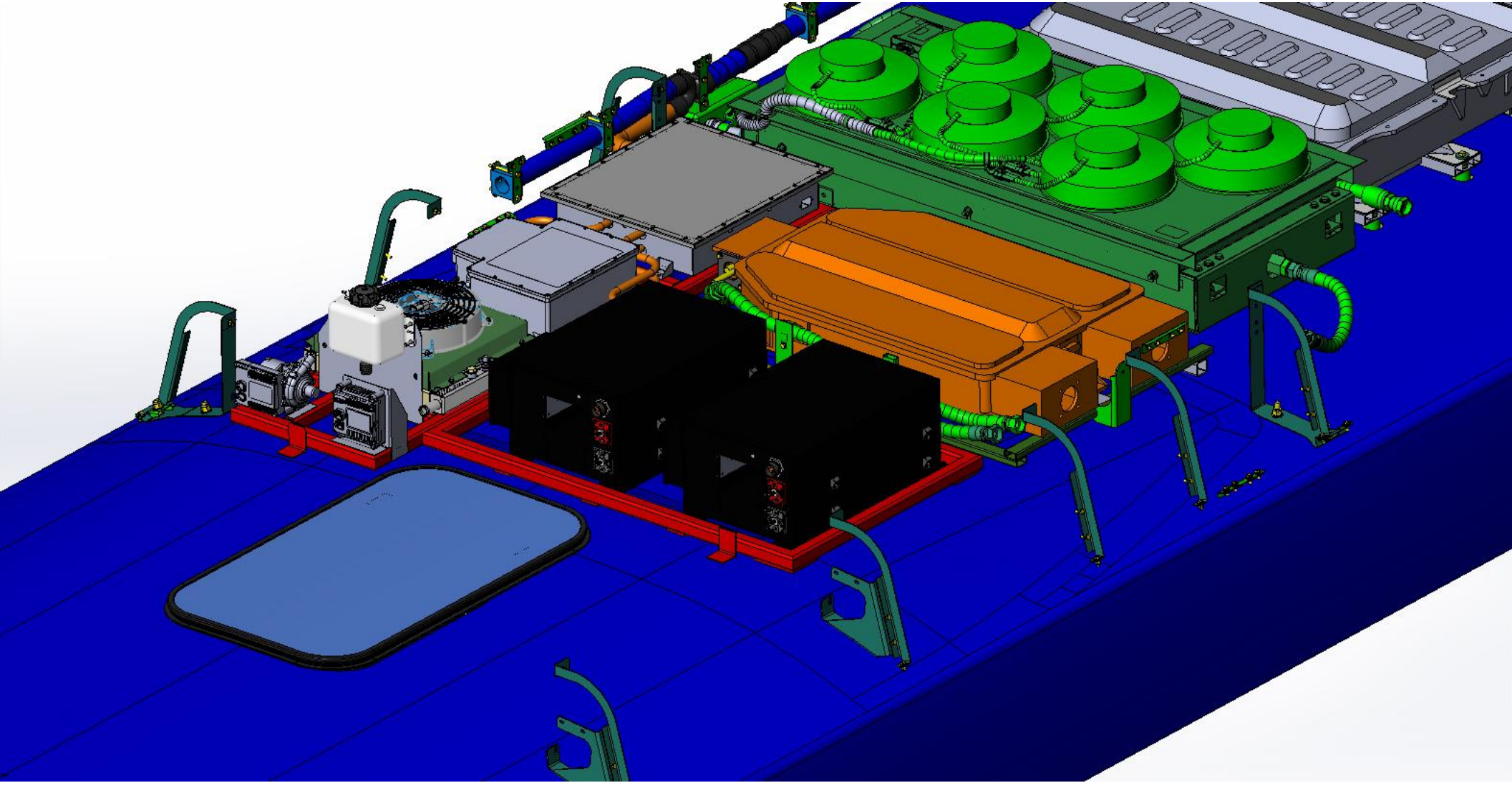












ef·fi·cien·cy \i-'fi-shən-sē\

: the ability to do something or produce something without wasting materials, time, or energy: see **IAP2**

IAP2™

Increased Accessory Power 2

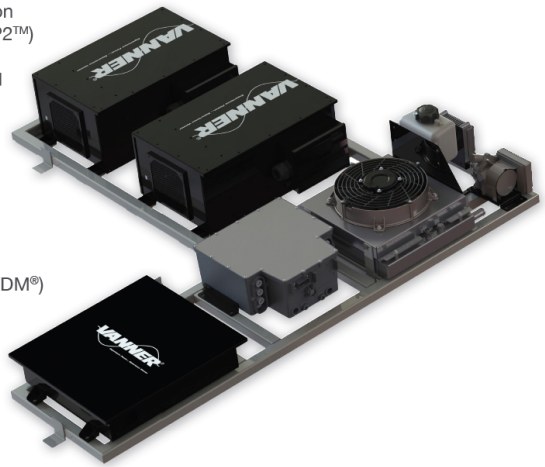
Efficient energy management is the desire of the modern transit fleet. Effectively distributing power to accessories like electric air conditioning, air compressors, and power steering systems is key to providing better fuel economy, reduced emissions and lower maintenance costs.

Full electrification of the transit bus is the mission of Vanner's Increased Accessory Power 2™ (IAP2™)

Building on the success of IAP1, a water-cooled Vanner Exportable Power Inverter™ (VEPI™) is now included and produces 230 VAC 3-Phase for full bus electrification.

IAP2™ includes either a Single or Dual Hybrid Beltless Alternator® for up to 600 amps-at-idle 24 VDC charging.

A Vanner High Voltage Distribution Module® (HVDM®) acts as a smart electrical grid for the hybrid bus and 80-Series Equalizer with Model Based Battery Monitoring® (MBBM®)for dynamic charging.



The result? Up to 30 kWs of continuous export power from the Allison H 40/50 EP™ Hybrid.

All proudly made in the USA.

Allison Hybrid

VANNER®
Power Management For Transit

Hybrid Treasure Hunt!

The Answer to 100% Electrification is Here!

Come see Vanner's New IAP II for Allison H 40/50 EP ™ Hybrids

Have this card punched by visting both Allison Transmission (Booth 3057) and Vanner (Booth 4400) to be eligible to win a daily draw for an iPad Mini and "Stuffed" Ogio Duffel giveaway!

Allison Hybrid
Booth 3057

VANNER
Booth 4400

Thank You

VANNER®

Experience Power... Experience Vanner