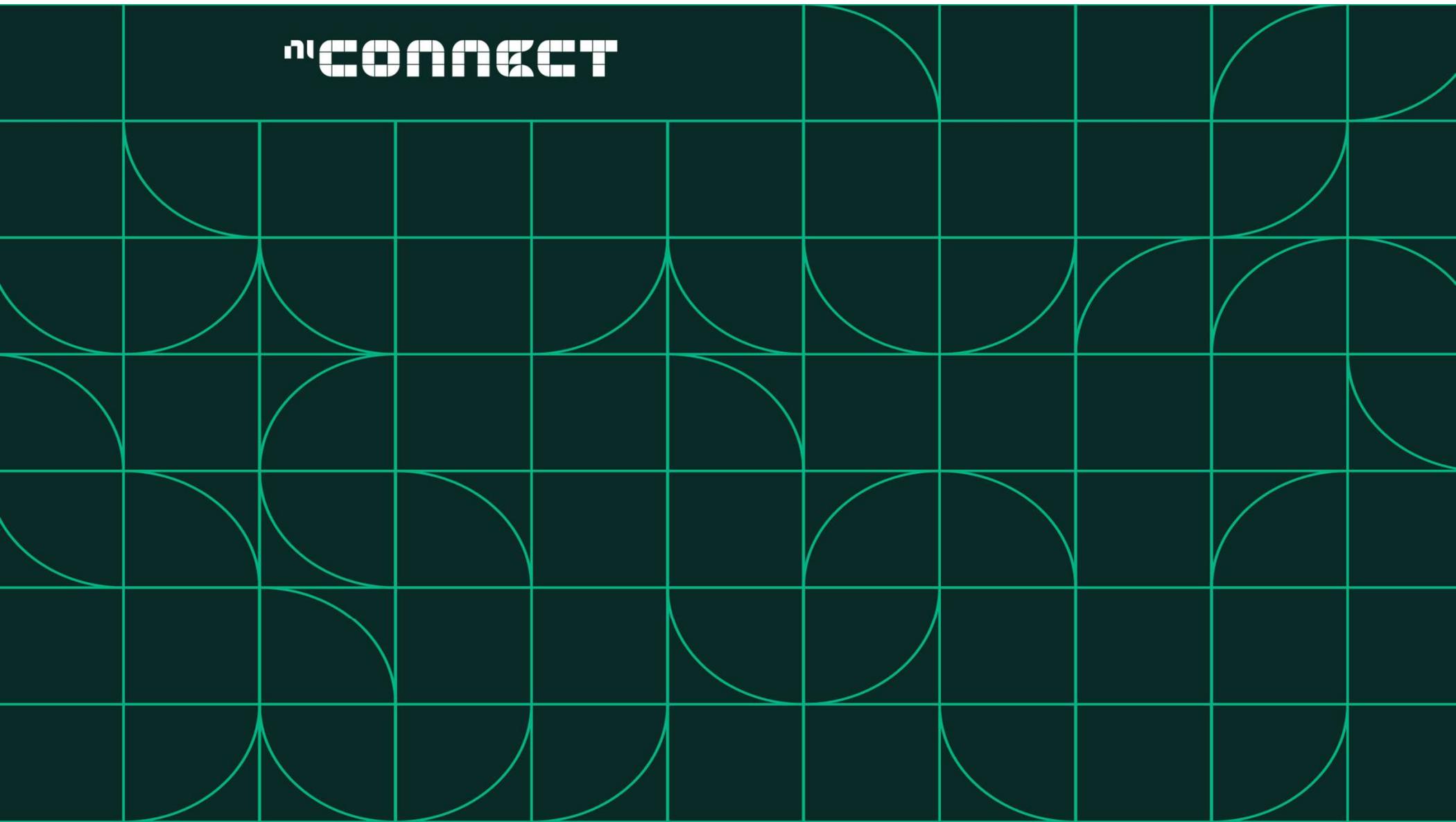


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CONNECT





Key Considerations for EV Battery Testing & Validation

May 24th, 03:30 PM

Martin Weiss,

Product Director at NH Research (NHR)

Key Considerations for EV Battery Testing & Validation



Presenter: Martin Weiss



Martin Weiss - Product Director at NH Research

Martin has over 25 years of experience developing automated test systems for evaluating power electronics and battery systems.

As the Product Director at NH Research (NHR), Martin is responsible for the technical development and launch of new, industry-driven hardware and software test solutions. Previously, he worked as a Principal Design Engineer for high-tech companies including Vocollect, Marconi Communications, and Telxon.

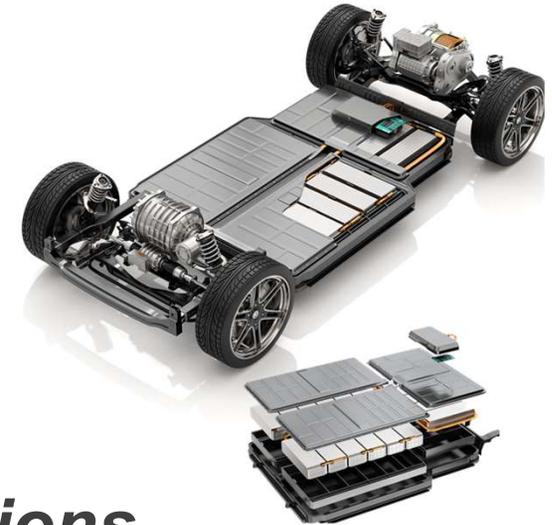


NH Research: Enabling Electrification

Industry Leading EV Test Solutions

Over 50 years of experience

- ✓ Best in class performance
- ✓ Ease of use
- ✓ Modular & scalable solutions
- ✓ Reduced testing time
- ✓ Improved safety
- ✓ Energy savings



Battery, DC, AC Test Solutions

Acquired by NI in Oct. 2021

Agenda

1. **Industry Trends Impacting Battery Test**
2. Testing & Validation Use Cases
3. Next Generation Battery Test Solutions

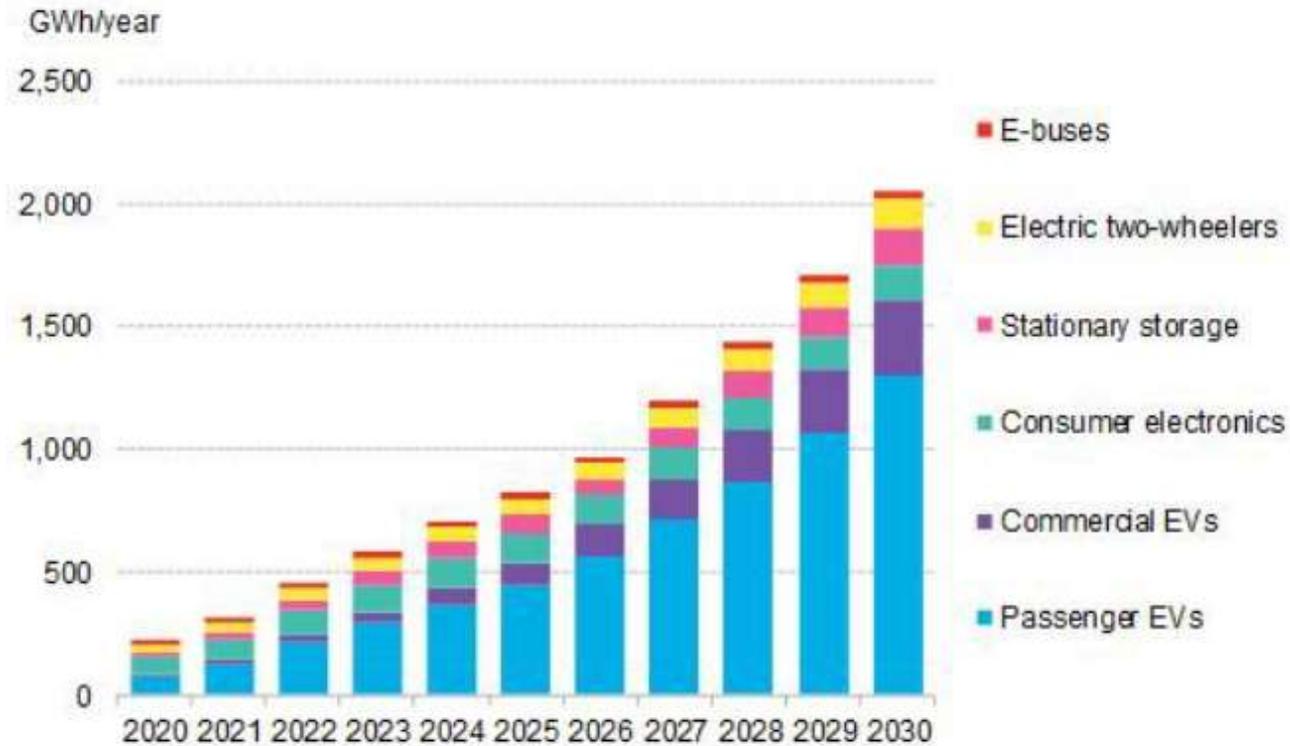


“Batteries have become the pivotal component for transportation electrification and storing clean energy.”



Battery Growth Industry Trends

Figure 25: Lithium-ion battery demand outlook



Source: BNEF. Note: See respective section for details.

Industry Trends Driving Test Requirements

Higher energy demands
need higher voltage levels ...



$$P = V \cdot I$$



E-Motorcycles



Electric Vehicles



E-Truck, E-Bus



Electric Flight

Agenda

1. Industry Trends Impacting Battery Test
2. **Testing & Validation Use Cases**
3. Next Generation Battery Test Solutions



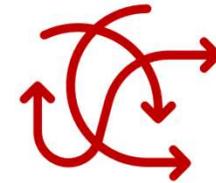
Battery Test Challenges



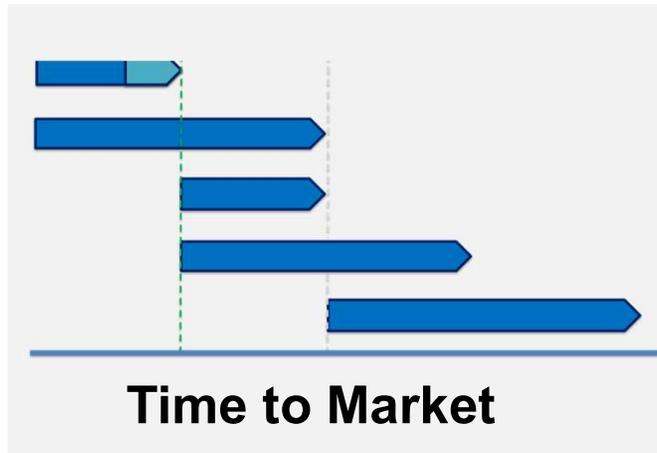
Testing Batteries Take a Very Long Time



Post Processing Data is Time-Intensive



Varying Test Parameters



Errors Lead to Re-running Tests



Batteries are Hazardous

Battery Testing Involves More Than Cycling



NHR's Battery Cycler

Innovation: Enhancing EV Performance



Image Source: Tesla Roadster



Image Source: Jeep Wrangler



Image Source: Toyota

- **Pushing the Boundaries of EVs**
 - Performance
 - Reliability
 - Range
- **Examples of Performance Factors**
 - Motor size
 - Tire traction
 - Wind resistance
 - Vehicle weight
 - Battery maximum power

Opportunity: Optimize BMS Control

Advanced BMS algorithms optimize peak performance by accounting for:

- State of charge (SOC)
- State of health (SOH)
- Additional parameters

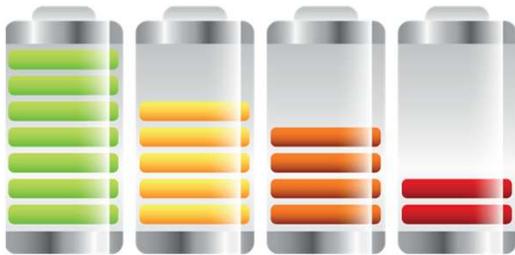
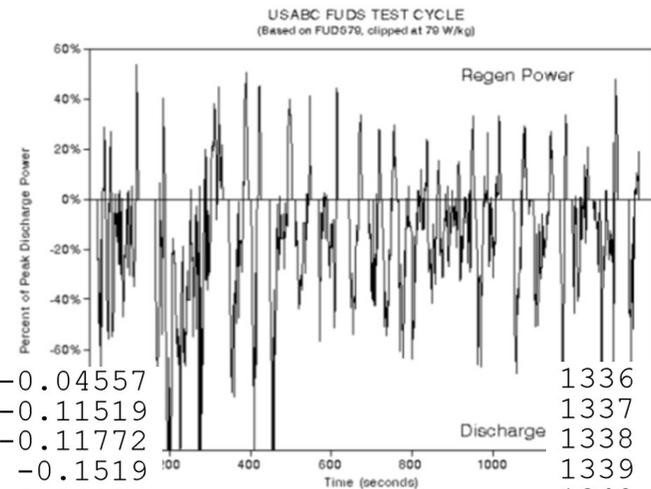
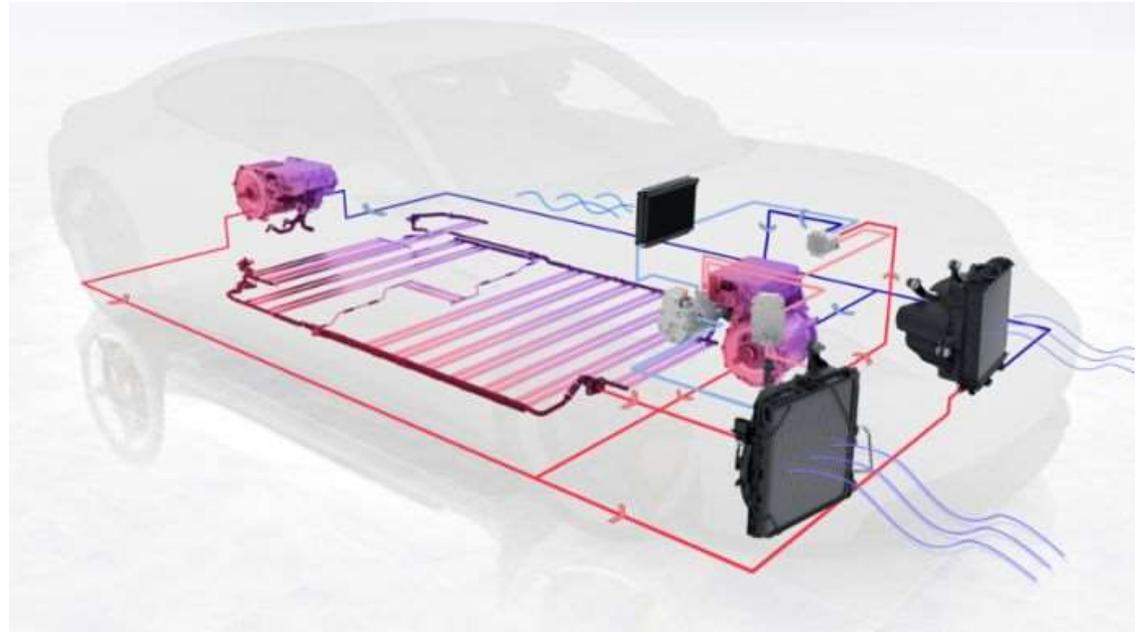


Image Source: <https://avt.inl.gov>



40	-0.04557	1336	0
41	-0.11519	1337	0
42	-0.11772	1338	-0.12278
43	-0.1519	1339	-0.26582
44	-0.30127	1340	-0.44557
45	-0.5038	1341	-0.46709
46	-0.55823	1342	-0.41392
47	-0.51392	1343	-0.37595
48	-0.13544	1344	-0.23924
49	-0.01392	1345	-0.65316
50	-0.0481	1346	-0.17722
51	0.144304	1347	-0.35316
52	0.268354	1348	-0.27848

Innovation in Thermal Management Systems



The Porsche Taycan battery is integrated into EV Cooling System

- The battery provides both electrical and thermal storage

Source: Porsche - <https://newsroom.porsche.com/en/products/taycan/battery-18557.html>

Opportunity: Emulate the Thermal System

Real-world stress simulation

Can the battery endure..?

- Thermal Cycling Stress
- Performance Degradation
- Sealing and Reliability

Reduce testing time

- Use the emulated thermal system to get the battery to temperature faster and safer in order to test.



Agenda

1. Industry Trends Impacting Battery Test
2. Testing & Validation Use Cases
3. **Next Generation Battery Test Solutions**



NHR + NI = Open, Flexible & Complete Test Solutions

Advantages:

- Reduce time to market & improve engineering productivity
- Confidently test today's technologies AND tomorrow's innovations
- Decrease capital & operating expenses (CAPEX/OPEX)
- Improve safety & reduce risk



Wide Operating Range



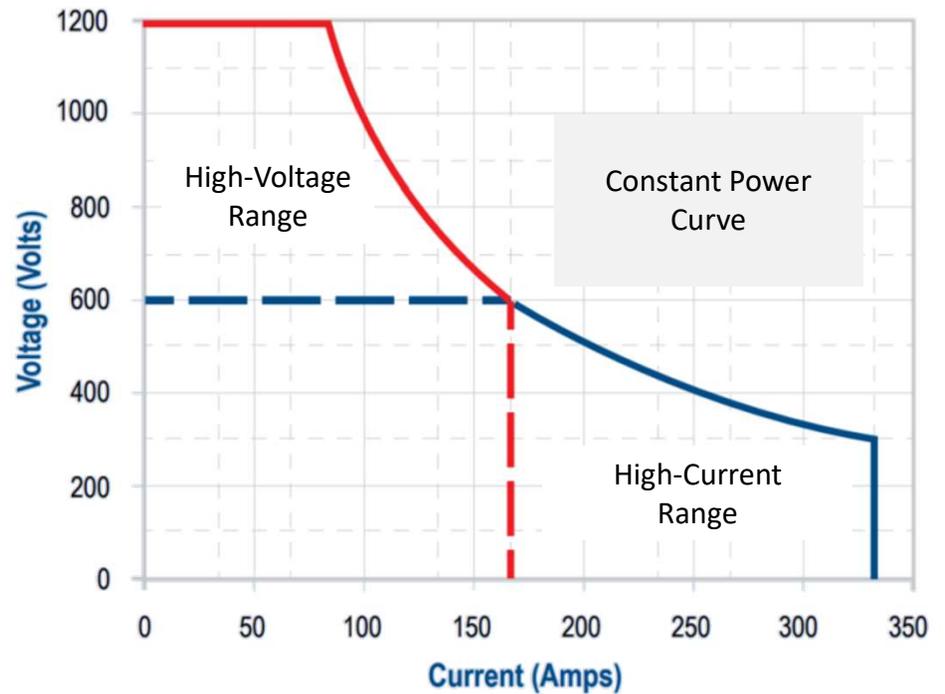
Image: Courtesy of Volkswagen Group (Porsche)

800 VDC



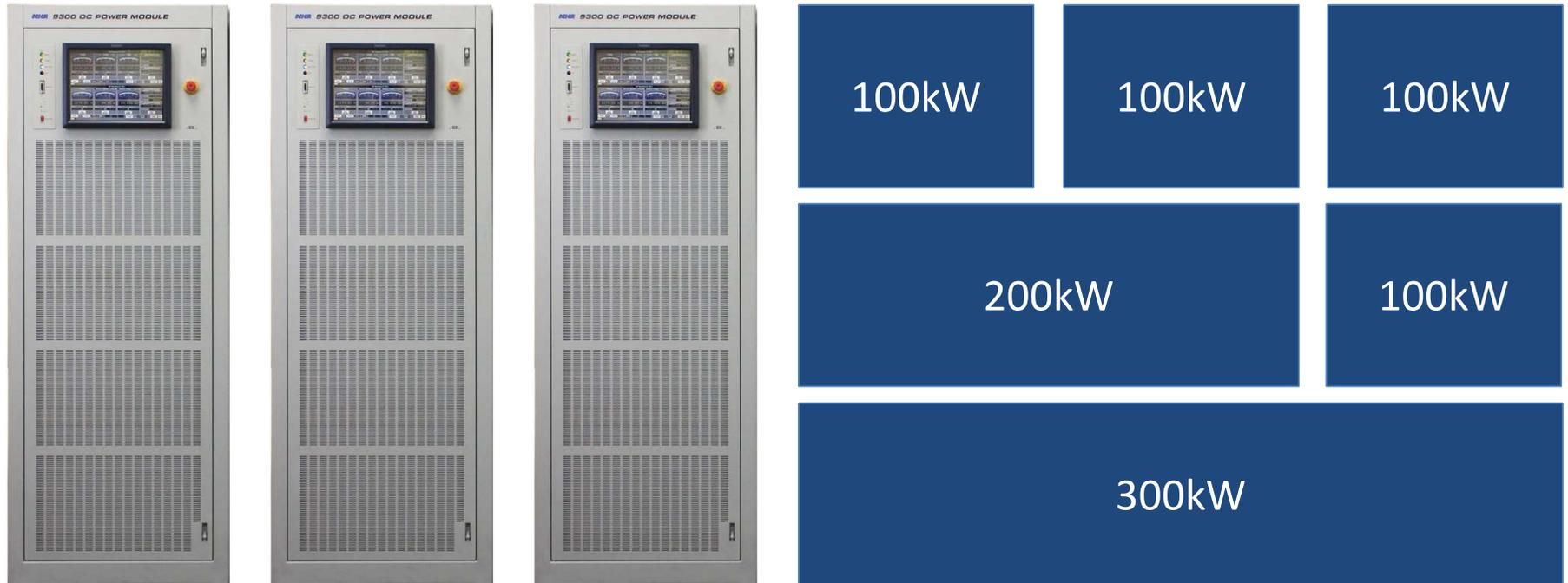
Image: Courtesy of Tesla Motors

<500 VDC



NHR 9300 Series

Modular & Scalable Power



You Control Size to Maximize Use In Test!

Comparing Battery Test Approaches

Manual

Source & Load

Automated System

NI + NHR Solutions



Manual



Source & Load



Automated System

NI + NHR

Open and flexible HW + SW
reduces time to market.

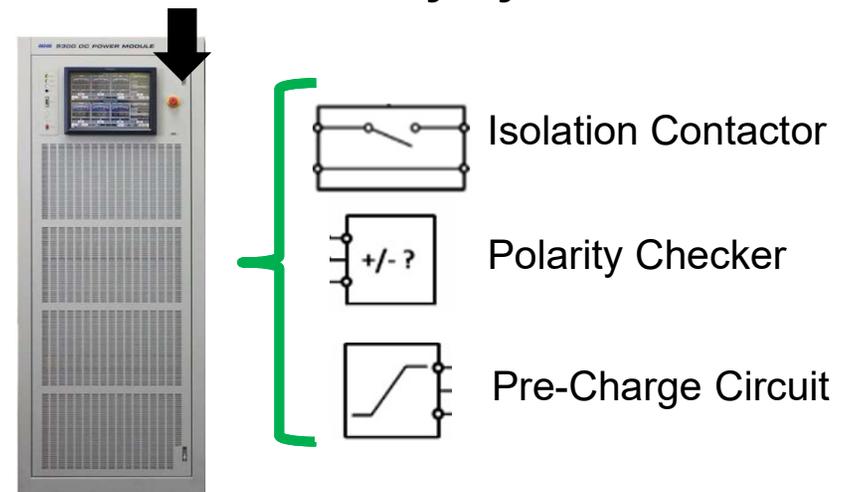
Traditional Methods

- Limited test profiles, control, flexibility, time-to-results
- Expandability is often limited to “options” at purchase
- Difficult if not impossible to integrate other parts

Keep it Simple, Use a Battery Cycler

- Battery cyclers are designed to test batteries.
 - High precision
 - Low leakage current
 - Built-in safety
 - Future-proofing: expandable power
- Not all battery cyclers are created equal.
 - Fixed vs. Flexible
- Build your own solutions (is generally bad):
 - Power supply issues
 - Complex HW/SW integration
 - Safety features (requires add-ons)
 - Time-consuming to develop

NHR Battery Cycler



Battery testing starts faster with a *battery cycler.*

The Power of Choice: Multiple Control Options

NI BTS / Enerchron® Software - Work with your favorite Integrator - Write your own software



Touch I/F

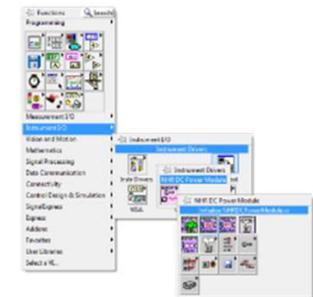


Remote



	Details	Insert	Label	Action	Action Data
7			Procedure 1.2.7	49ox Operation	DC PM 2 Discharge @ A=48
8			Procedure 1.2.8	Set Variables	U60 = (DC PM 2 Voltage V)
9			Procedure 1.2.9	49ox Operation	DC PM 2 Discharge @ A=300
10			Procedure 1.2.10	Set Variables	U61 = (DC PM 2 Voltage V)
11			Procedure 1.2.11	Set Variables	Uin = iff(Cycle_Count)>1, (Uin = iff(Cycle_Count)=1, Stand By)
12			Procedure 1.2.12	49ox Operation	DC PM 2 Stand By
13			Procedure 1.2.13	Set Variables	U61 = iff(Cycle_Count)=1, C601 = iff(Cycle_Count)=1

NI BTS or Enerchron



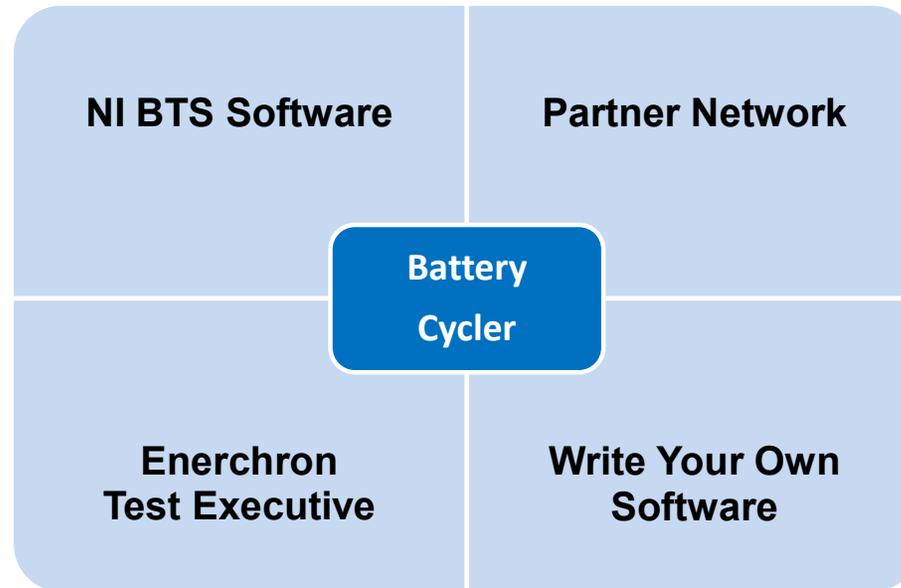
NI LabVIEW



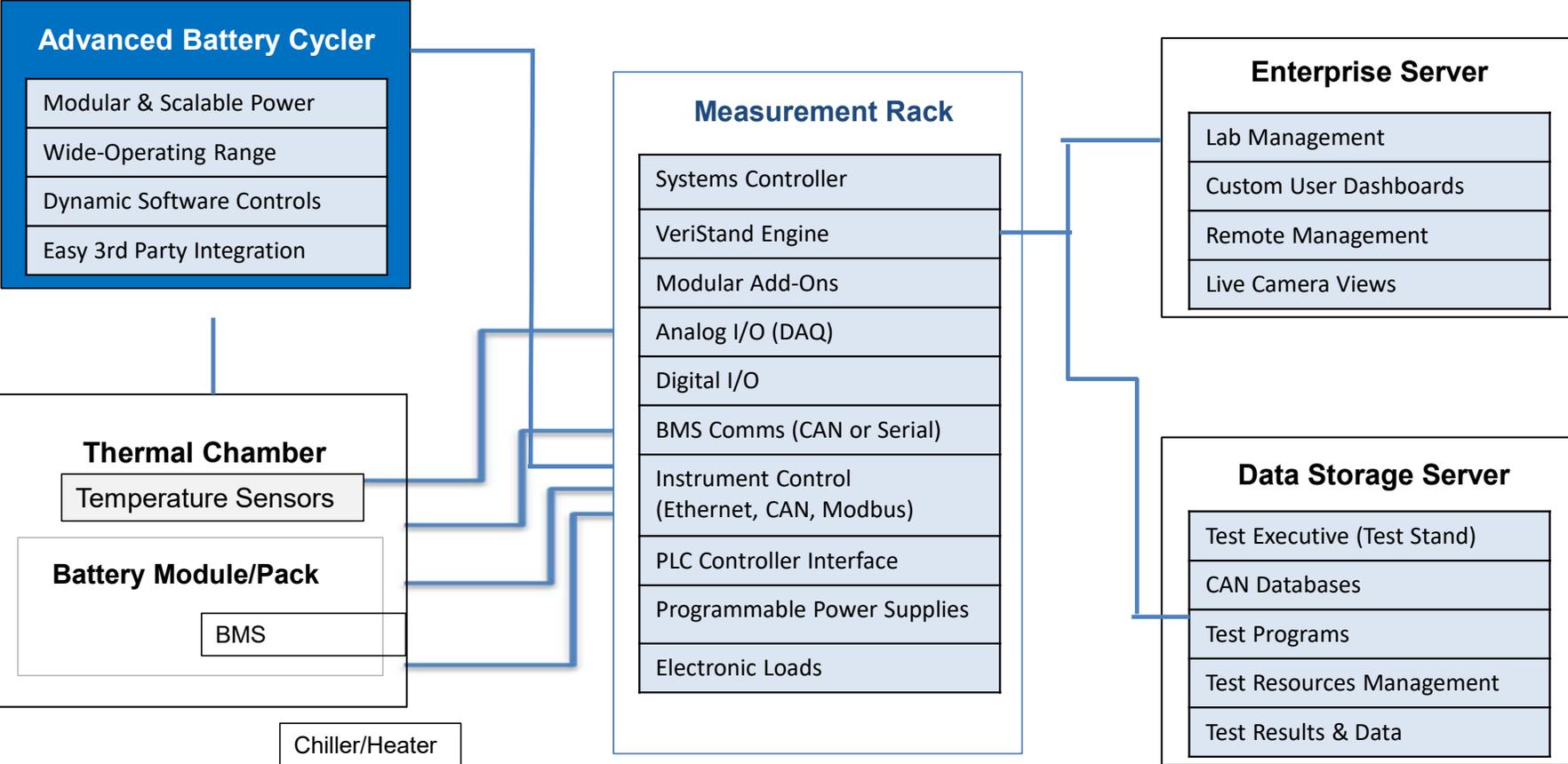
Accelerate Battery Test Automation

NI BTS – Work with your Partner – Enerchron® Test Executive – Write your own Software

Open and Complete Solutions



NI's Battery Test System (BTS) Scalable Architecture



NI + NHR Key Advantages

- **Future-proof** design with modular and scalable power up to 2.4MW
- **Advanced Hardware Performance** to optimize test and validation
- **Powerful Software Control** to get your testing started quickly
- **Integration & Integrator-Friendly** adds customization to your test setup
- **Flexible, Open Test Platform** to evolve with your future battery test requirements

We got you covered with our Battery Test Expertise and Network of Solutions Partners!



Your Partner in Test

Access Battery Test Resources

Visit us at <http://nhresearch.com>

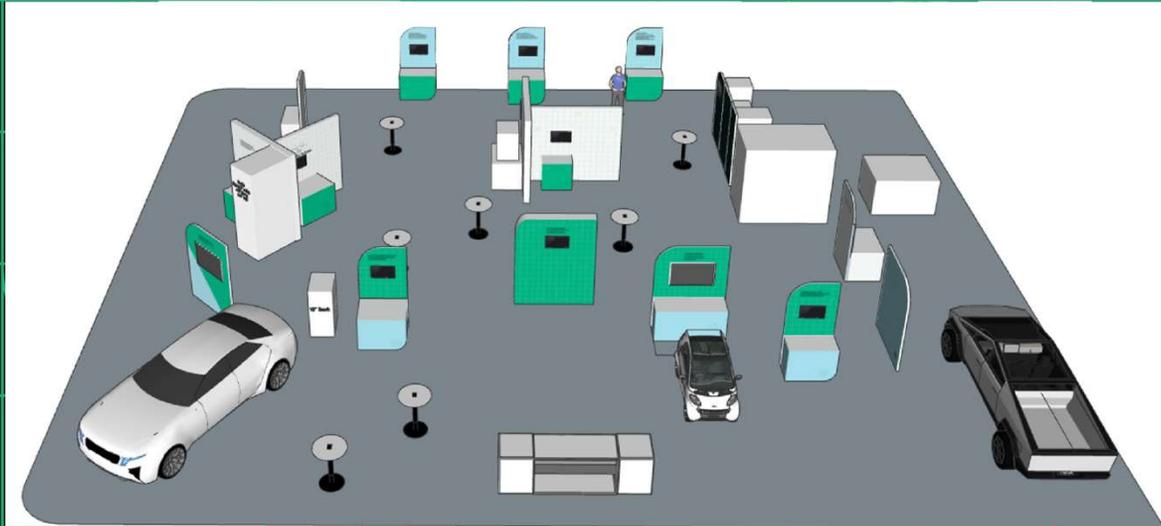


The Fundamentals of Battery Module/Pack Test



	THE EVOLUTION OF BATTERY TEST APPROACHES		
	Manual	Automated Source/Load	NHR's Next-Generation
Wide Operating Range	-	-	●
Modular, Scalable Power	-	-	●
Fast Set-Up & Accuracy (CV, CC, CR, CP)	-	-	●
Layers of Built-in Safety	-	⊖	●
Choice of Software Options	-	⊖	●
Easy & Powerful Software	-	⊖	●
Easy Third-Party Integration	-	⊖	●
Multiple Control Options (SW, GUI, Remote)	-	⊖	●
Built-in Measurements	-	⊖	●
Regenerative Energy Storage	-	⊖	●
Reduced Testing Time	⊖	⊖	●

- [NHR's 9200/9300 Battery Test Solutions](#)
- [Download The Fundamentals of Battery Test White Paper](#)
- [Schedule a consultation](#)



EXPERIENCE LOUNGE

BATTERY TEST SYSTEM DEMO
NHR Power Electronics



Questions?
Thank you for attending

For more resources

Visit: <http://nhresearch.com>

Call: **949-474-3900**

Email: sales@nhresearch.com



...Your Partner in Test