



EVs4ALL Annual Meeting

Dr. Halle Cheeseman

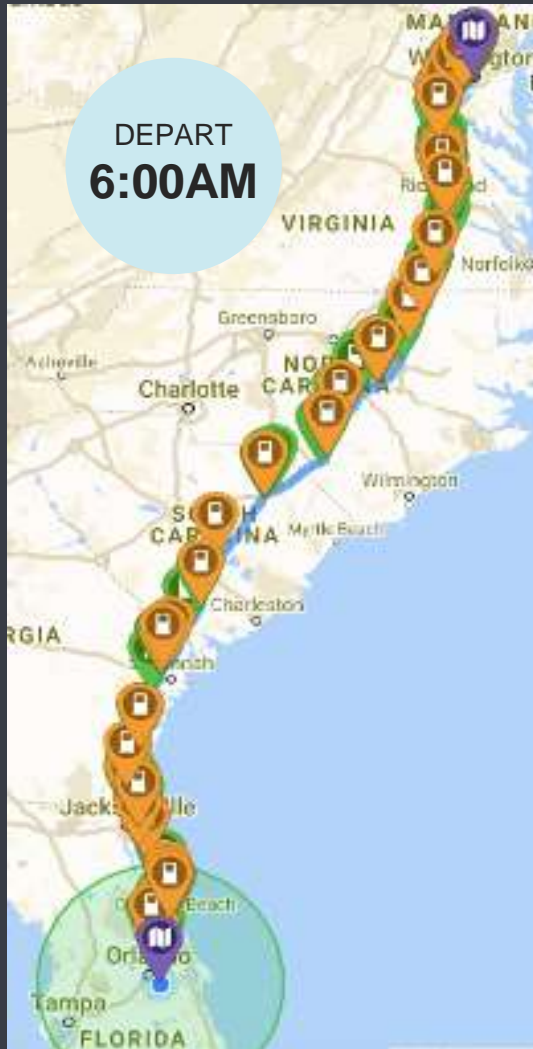
Program Director

Advanced Research Projects Agency – Energy (ARPA-E)

June 17, 2025

It All Started With

Let's Play a Car Game – Who Gets to D.C. First



Orlando, FL → Washington D.C.
860 miles @ 70mph
Departing @ 6.00am



Range	400 miles	200 miles
Charge Time	60 mins	15 mins
Battery Energy	133kWh	67kWh
Vehicle Cost	\$40,000	\$30,000

Assumptions:

Base car price = \$20,000; Battery Price = \$150/kWh; 3 miles = 1kWh
5-minute ramp on 5-minute ramp off, 40 miles min "tank", 80% charge

ARRIVES
8:37PM

ARRIVES
8:22PM

Workshop & Ongoing

EVs4ALL Workshop: October 24th and 26th 2021

70 Organizations & 120 attendees
50% companies; 25% Universities; 25% Agencies/NLs

David Howell (VTO) gave the keynote
VTO attendees: Steven Boyd, Tien Duong, Simon Thompson

OEM Panel: Mercedes-Benz Research & Development North America  

Charger Panel:    

Battery Panel:    

Government Agency Engagement

VTO ongoing: Steven Boyd & Tien Duong
I-ARPA ongoing: Dawson Cagle
DARPA ongoing: Vishnu Sundaresan
NASA ongoing: Ralph Jansen



EVs4ALL – Executive Summary



Exploring EV Needs, Opens the Door for Off-Roadmap Chemistries

- Very Fast Charging for the convenience of those who will not have Home based charging
- Better low temperature performance for those who live in Northern States
- Capacity retention for compelling used EV proposition
- Safety: As good or better than today's Lithium Ion
- Finally: Affordable & producible with abundant materials.

EVs4ALL – Electric Vehicles for American Low-carbon Living

A Battery Program Designed to Eliminate Passenger EV Purchase Detractors



I

Very fast charging for the 37% of Americans who may not have access to home charging



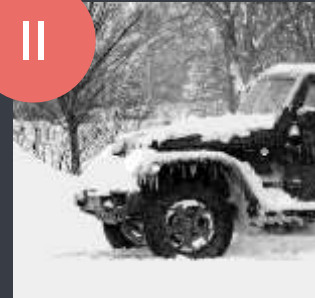
200Wh/Kg
Small Vehicles
5 minute charging



400Wh/Kg
Large Vehicles
15 minute Charging

Cat 3: Develop Safety Protocols for Cat 1/2

II



Improved low temperature performance for the Americans who live in Northern States

- **Cut low temperature battery performance losses in half**

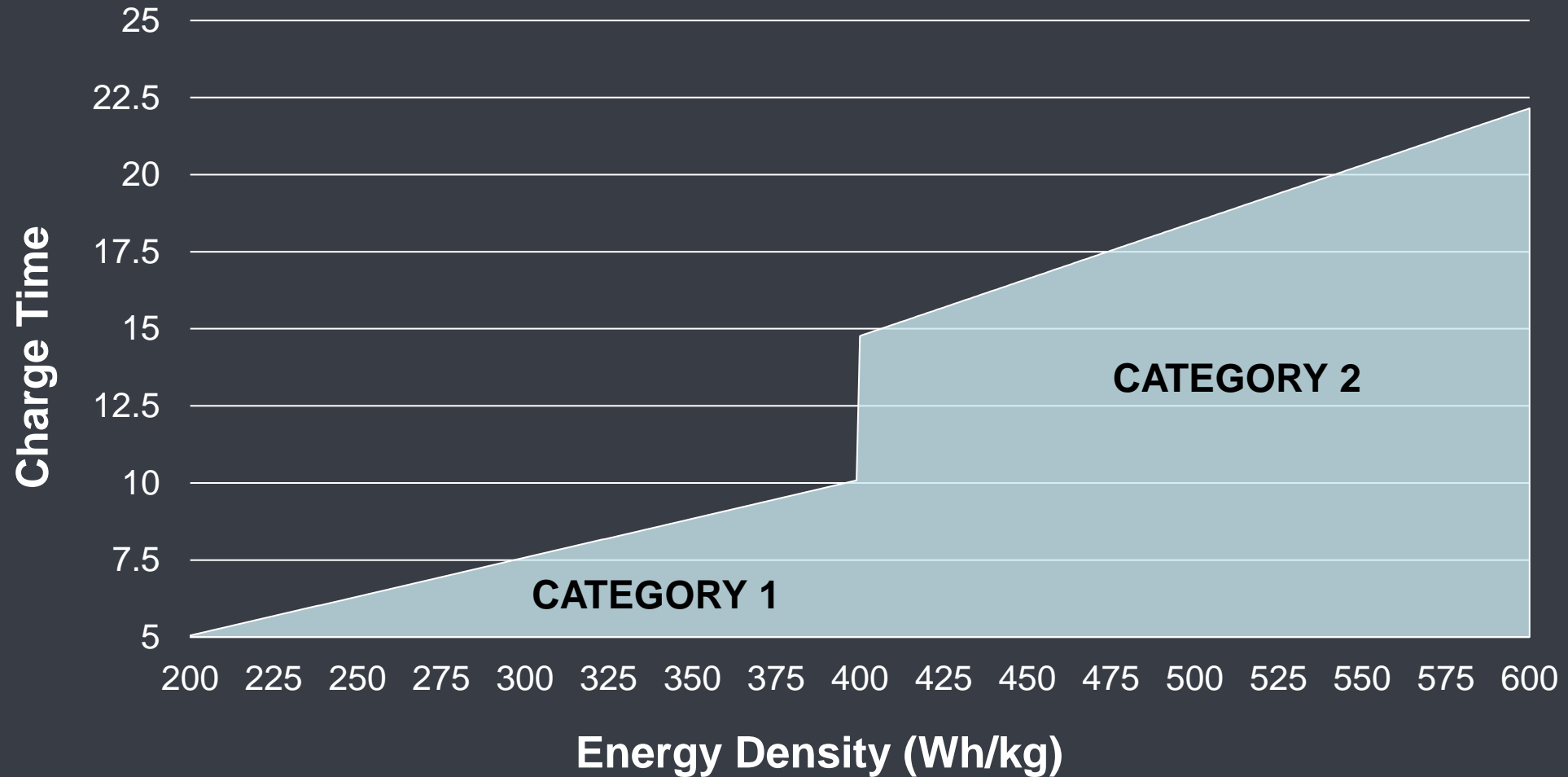
III

Better Affordability for New Vehicles with Abundant Materials & Range Retention for Used Vehicles.

- **< \$75/kWh versus SOA \$120/kWh**
- **Cut battery degradation losses in half**

FOA released May 3rd, 2022; Approved funding of \$45 Million, PD: Dr. Halle Cheeseman

Program Description for Energy Density & Charge Time



1° Metrics Address Charge Time, Winter Range & Used Vehicle Performance

The Need for Cat 1 & Cat 2 is Driven in Part by the Drive to Leverage Trade-offs#

Ref	Key Metric	Cat 1 (Power)	Cat 2 (Energy)
1	Cell Gravimetric Energy Density Wh/kg	>200	>400
2	Cell Volumetric Energy Density Wh/L	>500	>900
3	Ave. Cell Charge Power kW/kg sustainable 80% SOC	>1.9	> 1.3
4	Ave. Performance loss per °C below 30°C down to -20°C	< 0.3%	< 0.5% 0.4%
5	Cell Cycle life (80% SOC swing) to 90% of initial	>1500	>750
6	Cell Cost Target \$/kWh	<60	<60

#Applications will be instructed to provide models that relate the key metrics.

Projects Progress But the State of the Art is Not Standing Still



Over the Last 3 Years China Has Not Been Idle

- Increasing production output
- Increasing % of LFP* versus NMC**
- Driving down cost
- Improving charge time drastically
- Developing Sodium Ion and therefore better low temperature performance

*lithium iron phosphate

**nickel manganese cobalt

LFP Has Taken EV Share from NMC and Is Often Preferred for Applications



Year	LFP Share	NMC share	Ratio
2021	25%	75%	1:3
2025	45%	55%	1:1.2
2030 proj	50-60%	35-45%	1.3:1

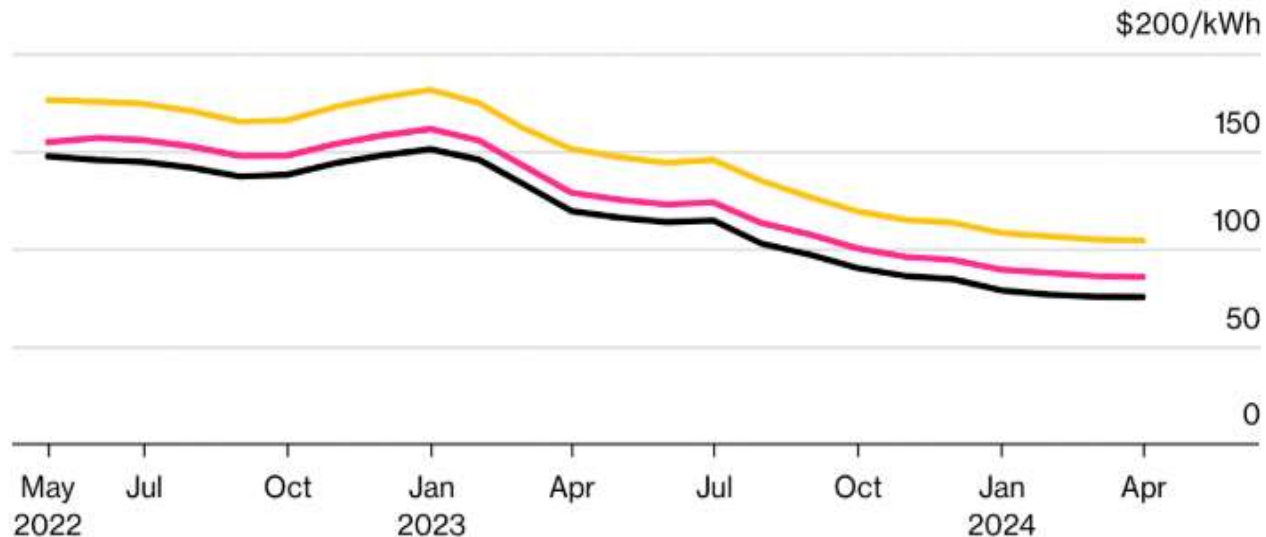
Early in 2024 CATL Announced Major LiB Price Reductions

Costs Targets of Cell <\$60/kWh and Pack <\$75/kWh Seemed Reasonable in 2022

Lithium-ion Battery Prices Are Dropping Fast

Battery pack prices in China

- Black line: Lithium iron phosphate (LFP) packs
- Pink line: Nickel manganese cobalt (NMC) packs
- Yellow line: High nickel NMC packs



Source: BloombergNEF, ICC Battery

Lithium Ion Battery Cell Prices Set to Decrease To Record Low \$50 Per Kilowatt Hour in 2024, Surpassing Expectations by 6 Years

In a groundbreaking development, CATL, the world's leading battery manufacturer, has announced plans to slash battery costs by 50% from \$110 per kWh in mid-2023 to \$56 per kWh by mid-2024. A move expected to be followed by BYD, and other major battery manufacturers.

Many Things Have Changed Since the EVs4ALL Program Was Initiated

The Program and Projects Must Respond Accordingly



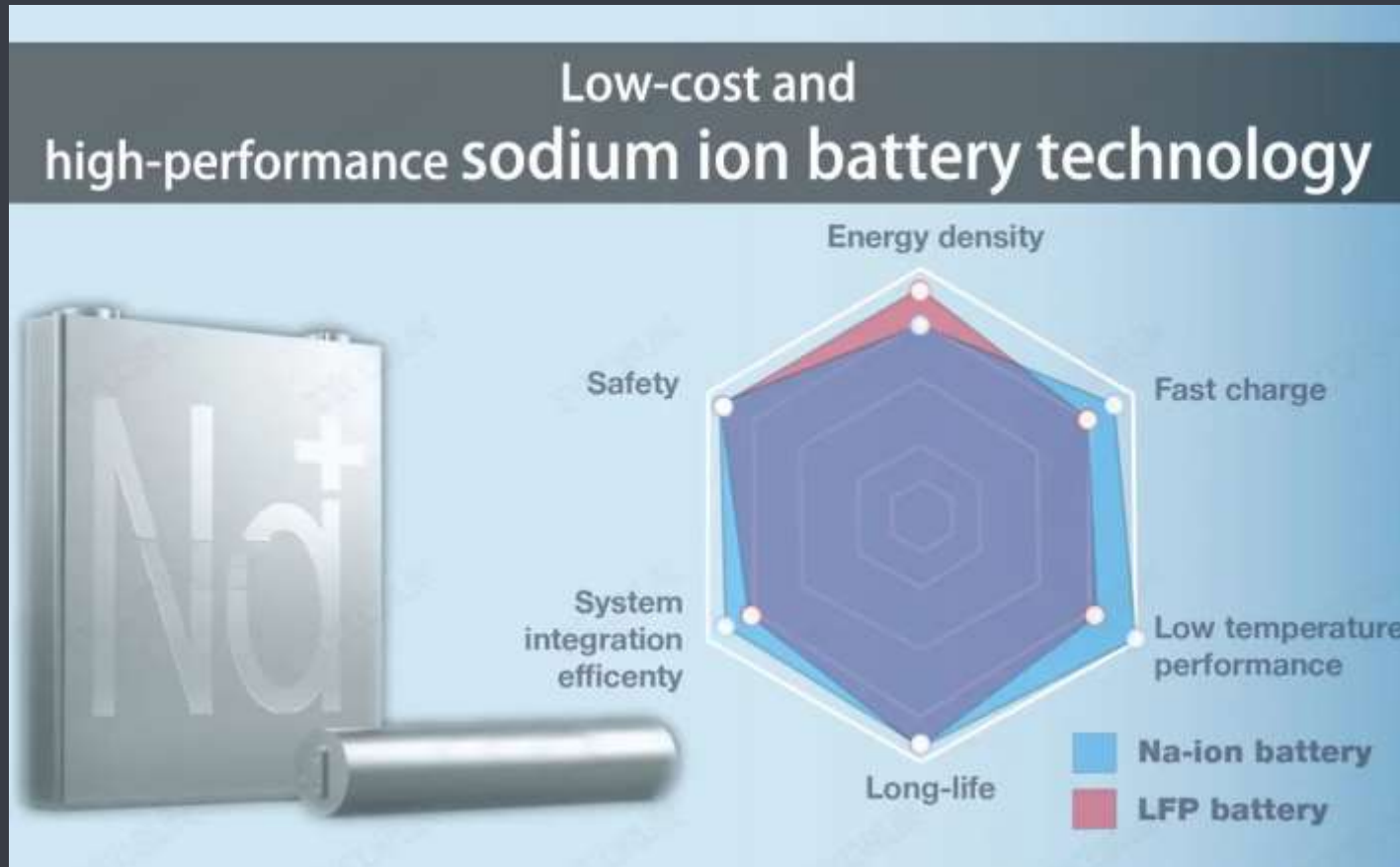
March 17, 2025



April 21, 2025

And Sodium is Here and Ramping Up

Natron Energy Started the Sodium Ball Rolling, But CATL Are Racing Ahead



CATL Naxtra battery launch 4/21/25



90% Energy retention at minus 40°C



We Have Some Chemistries That Have Merit



EVs4ALL Projects Give the U.S.A. Options to Compete with China

- At least one of you is achieving 5-minute charging
- A couple of you are substantially beating the cold temperature metric
- Many of you are offering alternatives to critical minerals
- A couple of you are confidently projecting 400Wh/kg....
- Several of you are on track to deliver 10 Wh cells by the end of the POP
- A few of you have good cost fundamentals

Achieving All Metrics Beats China!

The EVs4ALL Portfolio Is Diverse



EVs4ALL Projects Give the U.S.A. Options to Compete with China

- Two anode oxides, one sodium metal, one potassium ion
- Many new and cleverly designed electrolyte systems
- Four all/hybrid solid state architectures
- A plethora of different cathodes; the majority cobalt free & no/low nickel
- All have participated to varying extents with Sandia and NREL for Safety

You Are Making Some Progress With Customers



EVs4ALL Projects Give the U.S.A. Options to Compete with China

- Most of you are working closely with automotive OEMs
- More than half of you are working with the DOD
- Several of you are working with Consumer Electronics
- A few of you are working with Drone Manufacturers
- A few of you are talking to customers who require extreme temperatures

Voldemort – The EVil that Shall Not Be Named



Why is Electric Compelling?

- Electric Motors deliver superior performance
- Energy infrastructure already in-place globally
- Potentially more Energy Efficient & Economical
- Could enable new business platforms & Operations
- Reduce Noise Pollution
- Zero Emissions/cleaner air



And Therefore, The Key Messages Are:

The World of Batteries Is Growing like Never Before

- Batteries are a strategic resource that we cannot neglect
- Superior batteries for EVs can be used for a myriad of applications
- Supply Chain independence remains a national imperative
- The technologies play into the Cuckoo-Leapfrog strategy



And on Friday June 6th We Had a Very Encouraging Executive Order

Fact Sheet: President Donald J. Trump Unleashes American Drone Dominance

The White House | June 6, 2025

UNLEASHING AMERICAN DRONE DOMINANCE: Today, President Donald J. Trump signed an Executive Order to ensure continued American leadership in the development, commercialization, and export of unmanned aircraft systems (UAS)—otherwise known as drones.

- The Order directs the Administrator of the Federal Aviation Administration (FAA) to expand drone operations by enabling routine “Beyond Visual Line of Sight” drone operations for commercial and public safety missions, and to accelerate the development, testing, and scaling of American drone technologies, including advanced air mobility and autonomous operations.
- The Order establishes an electric “Vertical Takeoff and Landing” integration pilot program to accelerate the deployment of safe and lawful vertical operations in the United States, selecting at least five pilot projects to advance applications like cargo transport and medical response.
- It directs the FAA Administrator to deploy artificial intelligence (AI) tools to streamline and expedite UAS waiver reviews.
- The Order directs the FAA Administrator to publish an updated roadmap for the integration of civil UAS into the National Airspace System.
- It strengthens the domestic drone industrial base by prioritizing U.S.-manufactured UAS, promoting their export and taking action to ensure our technology remains secure from undue foreign influence and exploitation.

Flying cars and supersonic flights? Trump turns on boosters for new-age tech

President Donald Trump's newest executive orders aim to speed development of aviation tech, including high-speed flights and flying cars.



Francesca Chambers
USA TODAY

Updated June 6, 2025, 3:57 p.m. ET



A photograph of Michael Phelps, a professional swimmer, wearing a medal around his neck. He is shirtless and looking slightly to the right with a determined expression. The background is a blurred outdoor setting with trees and a blue sky.

There will be obstacles. There will be doubters.
There will be mistakes. But with hard work...
There are no limits.

—— *Michael Phelps* ——

AZ QUOTES