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DoD Advanced Battery Supply Chain Risk Assessment

Military Power Sources Consortium

28 September 2023

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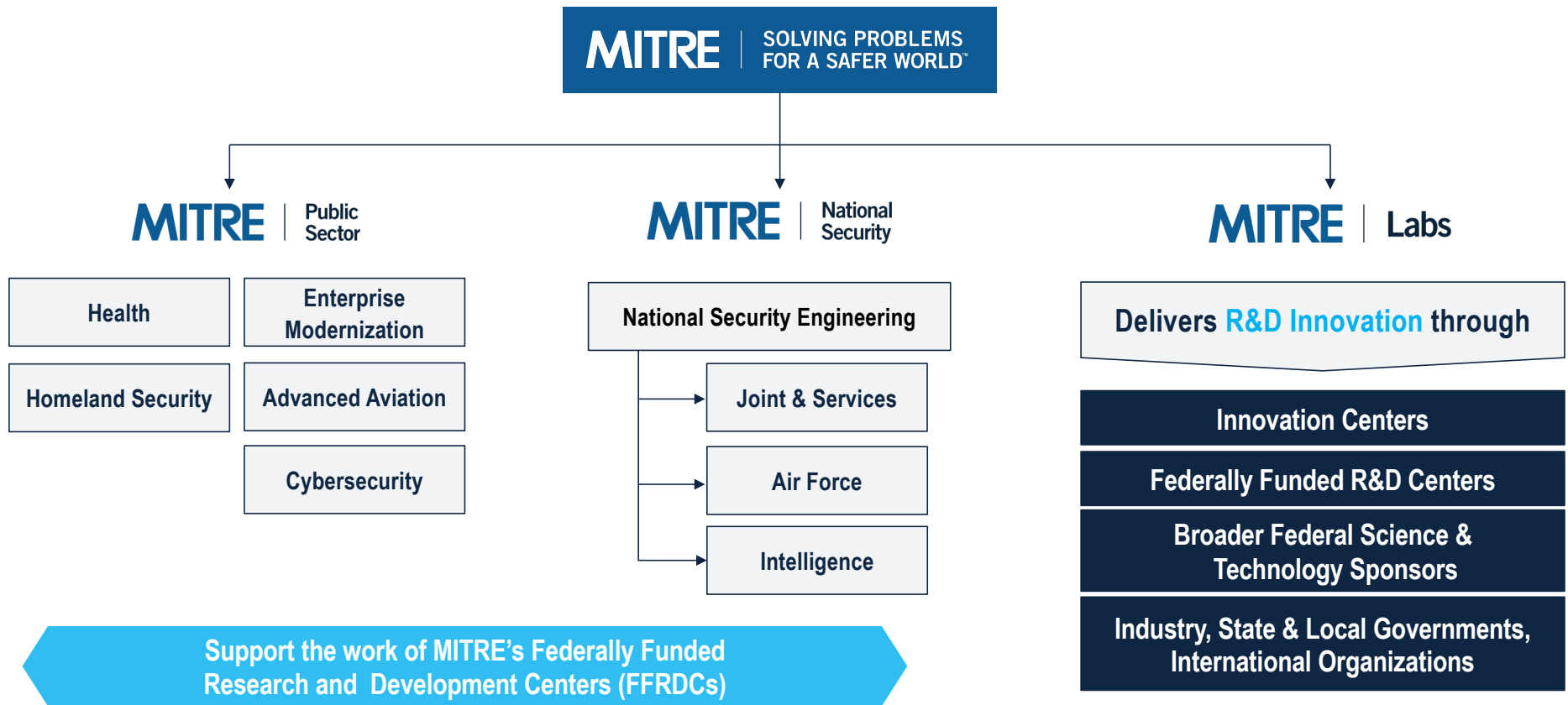
OUR DIFFERENTIATED VALUE

- Mission-Driven
- Innovative Approach
- Objective Insight
- Unique Vantage Point
- Technical Know-how
- Pioneering Together

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MITRE Labs Advanced Energy



**CAPTURING CRITICAL
MISSION VULNERABILITIES
TO EXTREME EVENTS**



**BATTERY TECHNOLOGIES
AND CAPABILITIES**



**Arctic Energy and Power
System Evaluations**

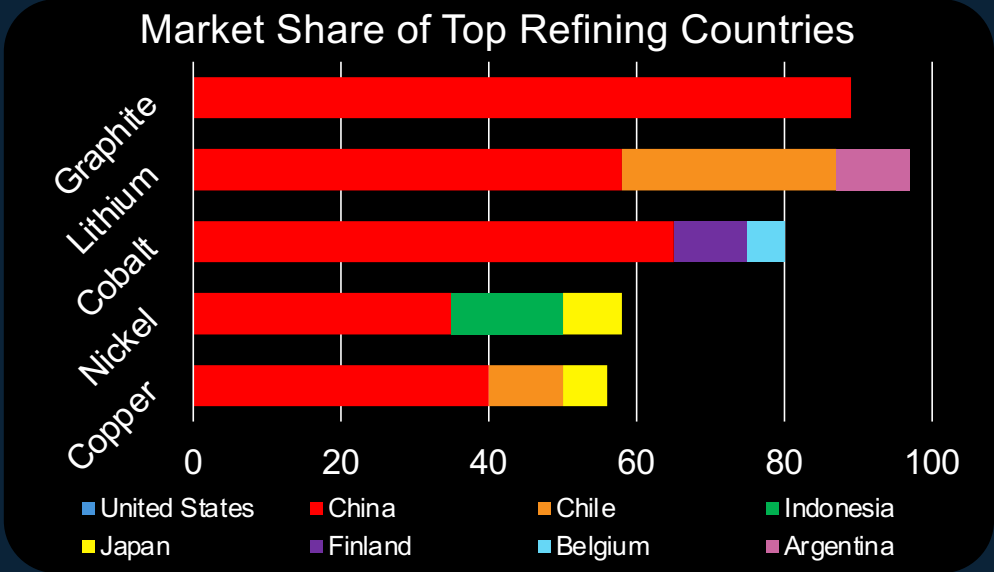
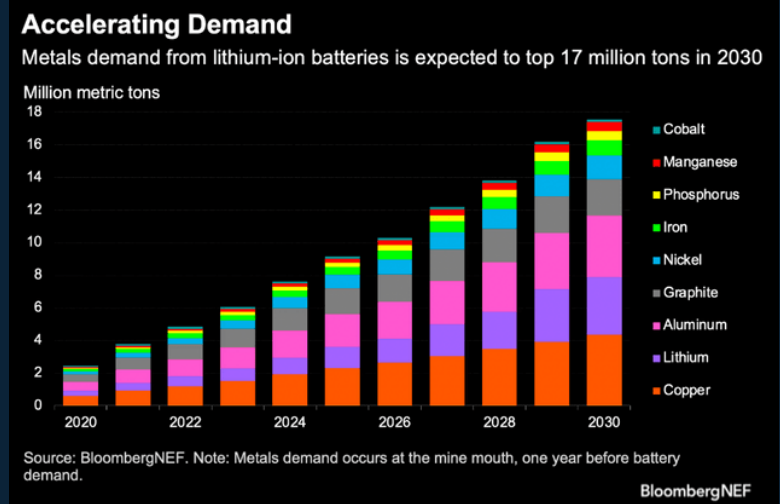
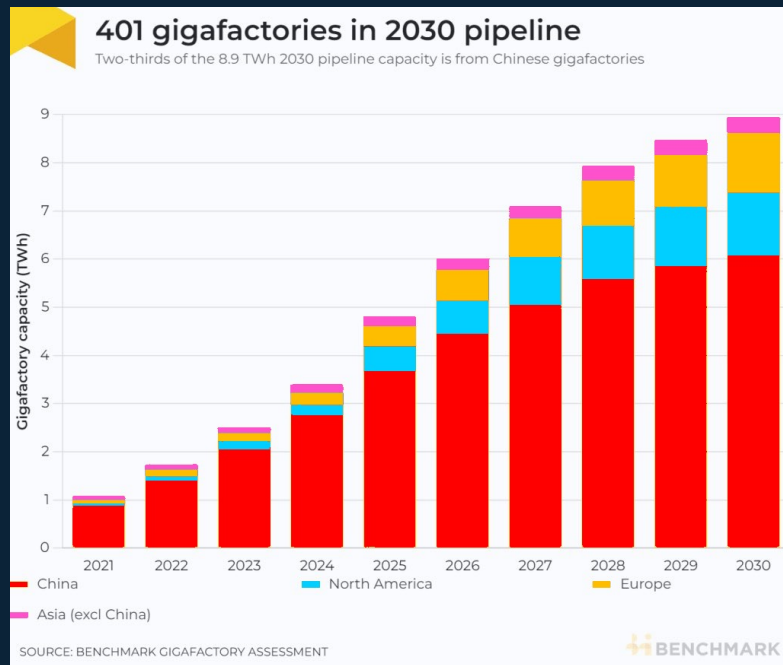
energy@mitre.org

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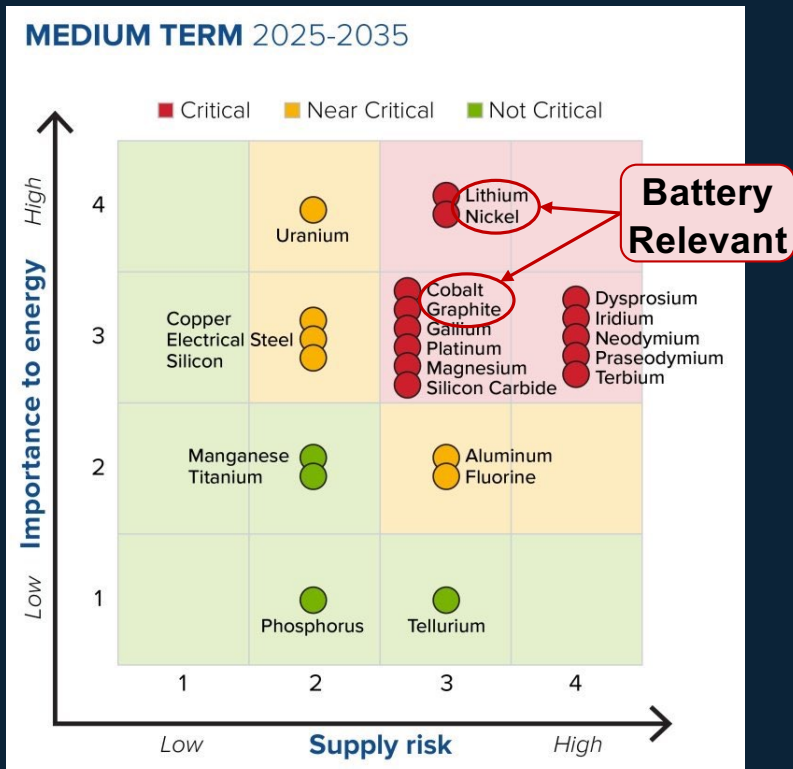
Global Lithium-ion Battery Landscape and Supply Chains

Battery industry is growing at an unprecedented rate with China in the lead



Source: International Energy Agency, Benchmark Minerals Intelligence, Bloomberg

Domestic capacity limits the ability to access materials through DPA Title I mechanisms



2023 DOE Minerals Criticality Matrix includes multiple battery minerals



Supply Chain Risk Assessment

Advanced battery supply chain risk assessment



**Multi-Disciplinary
Project Team**



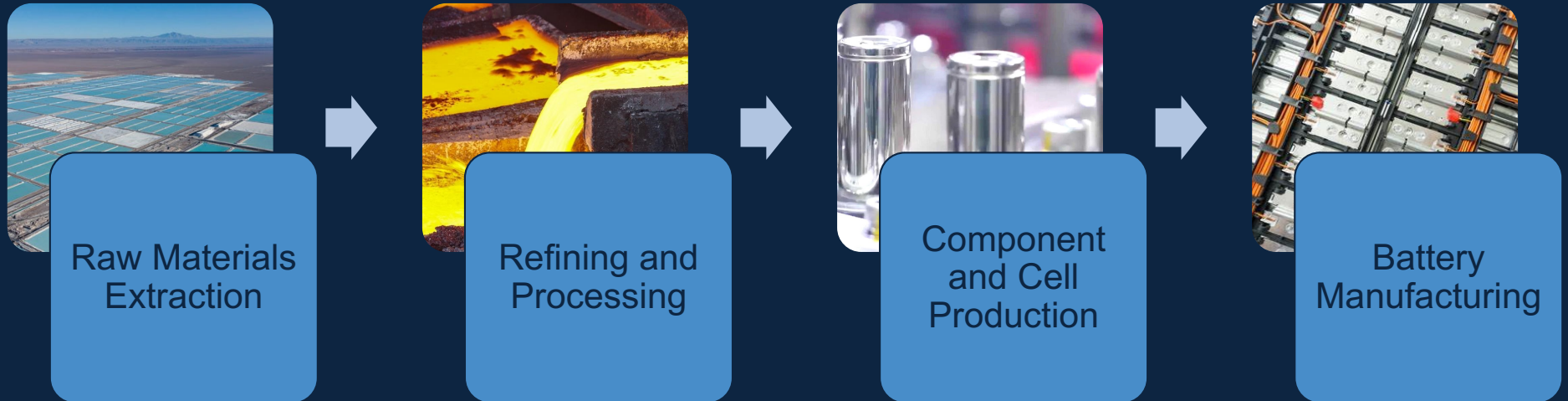
**Analysis of DoD
Battery Usage**



**Data Collection
Across Supply Chain**

What are the risks to the DoD's ability to procure cost-effective advanced batteries to meet operational capability needs now and through the mid-term?

End-to-end supply chain analysis and data collection



Companies



Countries

Materials



Facilities

Comprehensive risk assessments across multiple areas



Geopolitical Risk



Business &
Financial Risk



Economic Risk



Logistics Risk



Technical Risk

DoD Battery Landscape

Deputy Secretary of Defense - Wayne State University November 2021

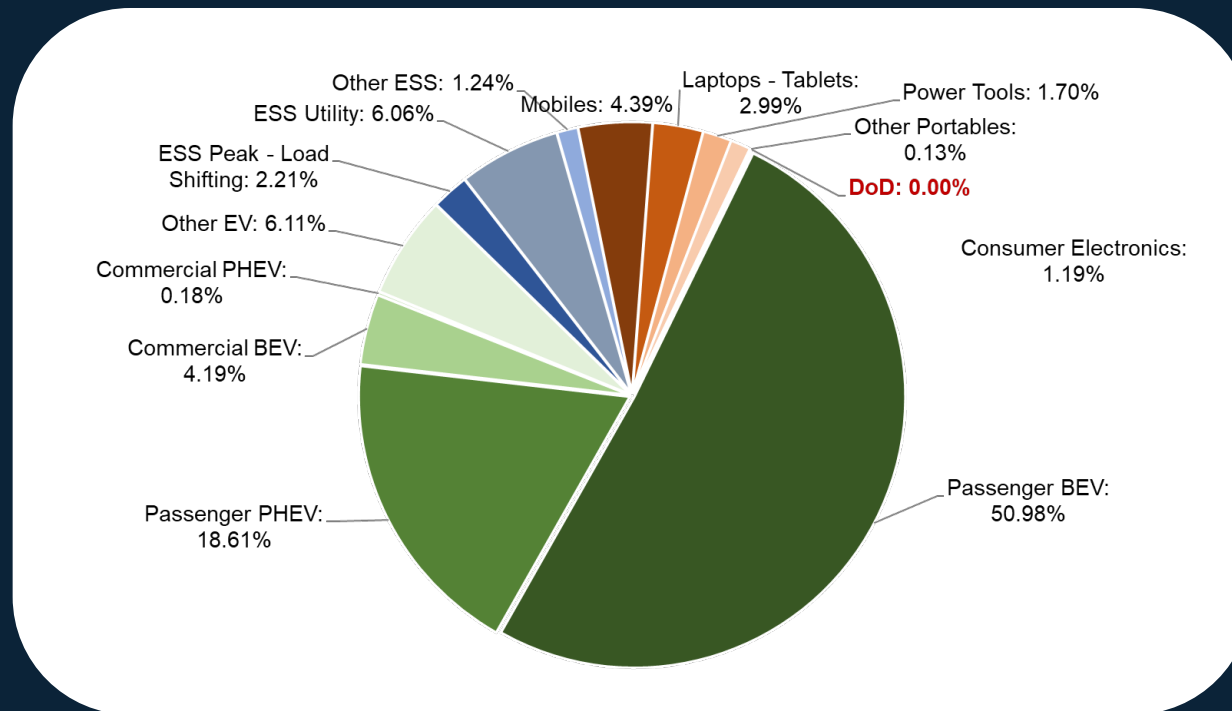
“...Batteries are also essential to thousands of military systems from handheld radios, to unmanned submersibles and to future capabilities like lasers, directed energy weapons, and hybrid electric tactical vehicles”



Deputy Secretary of Defense
Kathleen H. Hicks

“When it comes to batteries, America needs to lead the world. That means innovation, but it also means manufacturing, ensuring we have healthy supply chains to get what we need, when we need it...The problem, however, is that China presently dominates that supply chain.”

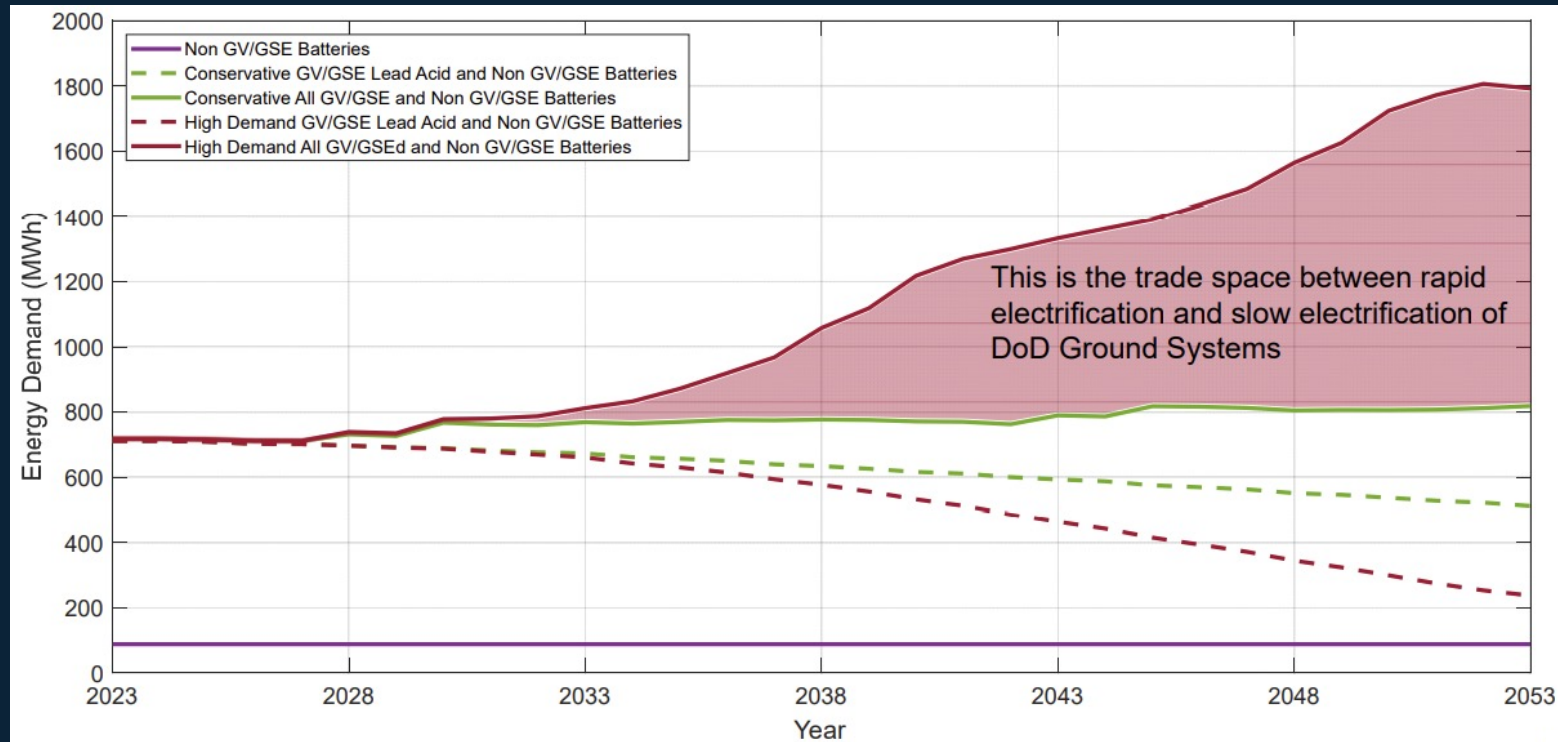
DoD is a small player in the global lithium-ion market



Global lithium-ion battery market breakdown. Category labels are followed by percentage of the total lithium-ion market. In 2022, total global lithium-ion battery demand was **642 GWh.**

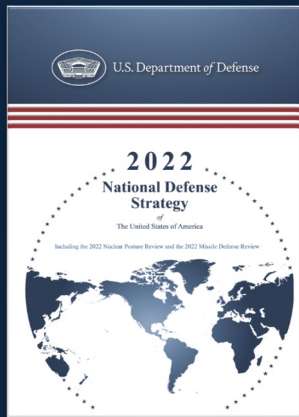
Source: Benchmark Minerals Intelligence

DoD lithium-ion battery demand is growing but the magnitude of growth remains uncertain

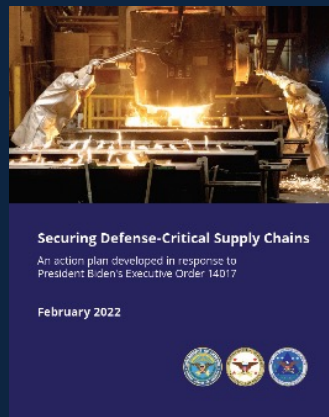


Growth of lithium-ion demand is expected to be driven by tactical vehicle and ground support equipment domains, though dismantled warfighter and unmanned systems applications are expected to contribute to growth.

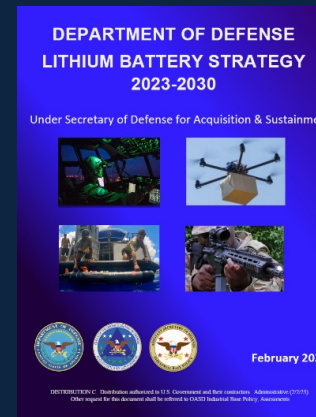
Securing the advanced battery supply chain is a DoD priority with planning for significant investments



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Battery Enabled Weapon Systems in the NDS

1. Space
2. Long-range strike
3. Hypersonics
4. Autonomous systems
5. Directed Energy
6. Clean energy technology
7. Renewable energy generation and storage

Recommendations

1. Develop a defense-specific lithium battery strategy
2. Develop a prioritized plan to resolve battery infrastructure and analytic gaps
3. Use DoD investment authorities to leverage commercial incentives
4. Work with DOE and interagency partners on integrated investment plans
5. Coordinate recycling initiatives with DOE
6. Enhance interoperability and supply chain coordination
7. Standardize and aggregate battery demand

Strategic Objectives

1. Provide DoD program offices with safe, effective, affordable, and standard energy storage options
2. Ensure access to battery systems when the supply chain is threatened
3. Reduce the total time required to develop, certify, and field safe advanced energy storage-enabled systems
4. Reduce the logistics burden associated with fielding and sustaining advanced batteries to the warfighter
5. Support the Department's climate objectives to achieve enduring readiness

DoD battery demand and priorities can be interpreted through legislation such as the NDAA

TITLE I--PROCUREMENT	\$ 169,840,643
AIRCRAFT PROCUREMENT, ARMY	\$ 3,012,440
MISSILE PROCUREMENT, ARMY	\$ 4,962,017
PROCUREMENT OF W&TCV, ARMY	\$ 3,765,521
PROCUREMENT OF AMMUNITION, ARMY	\$ 2,967,578
OTHER PROCUREMENT, ARMY	\$ 8,672,979
AIRCRAFT PROCUREMENT, NAVY	\$ 17,336,760
WEAPONS PROCUREMENT, NAVY	\$ 6,876,385
PROCUREMENT OF AMMO, NAVY & MC	\$ 1,293,273
SHIPBUILDING AND CONVERSION, NAVY	\$ 34,783,950
OTHER PROCUREMENT, NAVY	\$ 14,535,257
PROCUREMENT, MARINE CORPS	\$ 3,983,712
AIRCRAFT PROCUREMENT, AIR FORCE	\$ 20,328,837
MISSILE PROCUREMENT, AIR FORCE	\$ 5,530,446
PROCUREMENT OF AMMUNITION, AIR FORCE	\$ 703,158
PROCUREMENT, SPACE FORCE	\$ 4,253,594
OTHER PROCUREMENT, AIR FORCE	\$ 30,721,901
PROCUREMENT, DEFENSE-WIDE	\$ 6,112,835

MQ-4 TRITON	\$ 416,010
MQ-25	\$ 596,273
Marine Group 5 UAS (MQ-9)	\$ 187,626

NGC funded for 2x MQ-4
Boeing/LM funded for 3x MQ-25
GA funded for 5x MQ-9

SMALL & MEDIUM UUV	\$ 61,951
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RADIO SYSTEMS	\$ 544,059
UNMANNED EXPEDITIONARY SYSTEMS	\$ 13,564
POWER EQUIPMENT ASSORTED	\$ 28,899
SPARES AND REPAIR PARTS	\$ 35,657

System Type	R&D	Invest (Proc)	O&S / Disposal
Space	18%	66%	16%
Fixed Wing AC	20%	39%	41%
Rotary Wing AC	15%	52%	33%
Missiles	27%	33%	39%
Electronics	22%	43%	35%
Ships	1%	31%	68%
Surface Vehicles	9%	37%	54%
AIS		30%	70%

Source: Status of DoD's Capability to Estimate the Cost of Weapon Systems: 1999 Update

NDAA (FY24) (\$K)

Additional NDAA Legislation for Energy/Batteries (excerpts/examples)

FY2023

- PILOT PROGRAM TO FACILITATE THE DEVELOPMENT OF BATTERY TECHNOLOGIES FOR WARFIGHTERS
- PILOT PROGRAM FOR DEVELOPMENT OF ELECTRIC VEHICLE CHARGING SOLUTIONS TO MITIGATE GRID STRESS
- ESTABLISHMENT OF JOINT WORKING GROUP TO DETERMINE JOINT REQUIREMENTS FOR FUTURE OPERATIONAL ENERGY NEEDS OF DEPARTMENT OF DEFENSE
- POLICY TO INCREASE DISPOSITION OF SPENT ADVANCED BATTERIES THROUGH RECYCLING
- DEPARTMENT OF DEFENSE READINESS TO SUPPORT PROLONGED CONFLICT

FY2024 (Proposed)

- NEXT GENERATION HYBRID AND ELECTRIC VTOL VEHICLES FOR ARMY MODERNIZATION
- TALENT AND TECHNOLOGY FOR NAVY POWER AND ENERGY SYSTEMS
- ADDITIVES FOR BATTERY SAFETY IN THE AREMD SERVICES
- STREAMLINING PORTABLE BATTERY CHARGING SYSTEMS

Battery demand and priorities can also be interpreted through the President's Budget

Department of the Navy

Aircraft (QTY)	FY22 Actuals	FY23 Enacted	FY24 PB	FY25 PB	FY26 PB	FY27 PB	FY28 PB	FYDP PB
Fixed Wing	55	48 64	63	69	47	50	53	282
FA-18E/F (Navy)	12	0 8	0	0	0	0	0	0
F-35C JSF CV (Navy)	12	9 13	15	15	15	15	15	75
F-35C JSF CV (USMC)	3	4 6	4	4	4	3	0	15
F-35B JSF STOVL (USMC)	17	15	16	16	16	17	20	85
E-2D AHE (Navy)	5	5 7	0	0	0	0	0	0
T-45TS (Trainer) (Navy)	0	0	0	7	12	12	12	43
Multi-Engine Training System (Navy)	0	6	14	15	0	0	0	29
Multi-Engine Training System (USMC)	0	4	12	12	0	0	0	24
KC-130J (USMC)	6	5	2	0	0	0	0	2
E-XX (TACAMO) (Navy)	0	0	0	0	0	3	6	9
Rotary Wing	59	36 43	15	21	21	21	21	99
CH-53K (USMC)	11	10 12	15	21	21	21	21	99
CMV-22 COD (Navy)	3	0 4	0	0	0	0	0	0
MV-22B (USMC)	9	0 1	0	0	0	0	0	0
TH-73A (Navy)	27	21	0	0	0	0	0	0
TH-73A (USMC)	9	5	0	0	0	0	0	0
UAV	10	12 9	10	4	4	4	7	29
MQ-4C (Navy)	2	3	2	0	0	0	0	2
MQ-25 (Navy)	0	1	3	4	4	4	7	22
MQ-9A (USMC)	8	5	5	0	0	0	0	5
TOTAL	124	96 116	88	94	72	75	81	410

Department of the Army

Program (Quantities)	FY 2023 Enacted	FY 2024 Request
AH-64E Apache Remanufacture	33	42
UH-60M Blackhawk	35	24
Missile Segment Enhanced (MSE)	252	230
Precision Strike Missile (PrSM)	72	110
Guided Multiple Launch Rocket System (GMLRS)	5910	5016
Mid-Range Capability (MRC)	0	58
Armored Multi-Purpose Vehicle (AMPV)	43	91
Mobile Protected Firepower (MPF)	29	33
Next Generation Squad Weapon (NGSW)	16,186	33,473
Paladin Integrated Management (PIM)	43	24
Joint Light Tactical Vehicle (JLTV) Trucks	1,355	1,753
Handheld Manpack Small Form Fit (HMS)	12,347	13,701

President's Budget FY24 Excerpts

DoD is leveraging DPA Title III to improve battery supply chain resilience

Defense Production Act Title III Presidential Determination for Critical Materials in Large-Capacity Batteries (31 Mar 2022)

- The President can determine when to invoke DPA Title III for the expansion of productive capacity through incentives such as loans, loan guarantees, direct purchases, purchase commitments and subsidizing equipment purchases.
- This DPA Title III Presidential Determination directs the DoD to implement this this by supporting the following:
 - Feasibility studies for “mature mining, beneficiation, and value-added processing projects” for such critical materials;
 - Byproduct and co-product production at existing mining and other industrial facilities; and
 - Improvements to increase productivity, workforce safety, and sustainability in critical minerals mining, beneficiation, and processing.

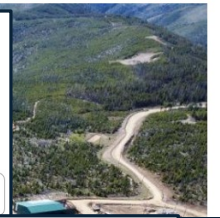
Jervois enters \$15M agreement with U.S. military to accelerate cobalt exploration, extraction in central Idaho
Drilling to begin next week

By EMILY JONES Express Staff Writer Sep 1, 2023 13

Albemarle to get \$90 million grant from Pentagon for raising domestic lithium output

Reuters

September 12, 2023 4:35 PM EDT - Updated 2 days ago

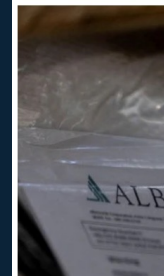


Department of Defense awards \$37M to Graphite One mining project near Nome

By Riley Rogerson

Updated: July 18, 2023

Published: July 17, 2023



We Need Industry Feedback!

- **How beneficial are existing avenues (e.g., public strategies, legislation) in communicating DoD battery demand expectations?**
 - National Defense Authorization Act
 - DPA Title III Presidential Determination for Critical Materials in Large Capacity Batteries
 - DoD Lithium Battery Strategy 2023-2030
- **What are the challenges when working with Prime Contractors and Lead System Integrators?**
 - Uninterrupted Power Supplies, Unmanned Systems, Auxiliary Systems, Radios and Small Electronics
 - Are lower tier suppliers viewed as an after thought as opposed to being included in the planning?
- **What are effective signals that industry can plan investments around?**
 - Purchase minimums/guarantees
 - Grants, incentives, “seed funding”
 - Public-Private Partnerships
- **What solicitation criteria have been hardest to meet?**
 - Best Value vs. Lowest Price Technically Acceptable
 - Domestic vs. Foreign vs. Allied / “Friendly” Sources

