



Creating a Cleaner World™



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Industrial Lead Battery Global Market Trends



H&V is proud to support



Women in the
Global Battery Industry

SUSTAINING SPONSOR

- WGBI's purpose is to help promote and develop the growth of women in the Battery Industry
- WGBI provides relationship-building, education, and shared knowledge resources
- WGBI is in its 3rd year and 250 members strong
- WGBI is a model for H&V's employee resource group, **WAHV** | WOMEN and ALLIES at H&V

Agenda

1. Housekeeping

- Acknowledgments and clarifications

2. Market Trends, Challenges, and Opportunities

- Motive Power & Stationary

3. ESS & Conclusion

Thank you, industry experts

CURTIS ASHTON – American Power Systems

TOBIAS BECKER – Exide

MARINO CAVAGGION – SAFT

ANNIE CHENG – Leoch

BRUCE COLE – East Penn

DAVID COREY – East Penn

BILL CUNNINGHAM – GS Yuasa

STEVE DWORKIN – MPINarada

BRIAN FEEHAN – Industrial Truck Assoc.

JAY FRANKHOUSER – EnerSys

JAVIER GONZALEZ – Saft

MATT GOULD – Stryten Manufacturing

HARRY HANDLIN – ABB

MARK JESKO – Stryten Manufacturing

MATT JOHNSON – T-Mobile

MARK KELLEY – Crown Battery

CHRIS MANGUM – Servato

ERWIN MARCKX – Eurobat

CHUCK MATHIAS – East Penn

LEE MOSS – Zavtek

SHAWN O'CONNELL – EnerSys

ISABELA OMENA – Grupo Moura

GABRIEL PAIVA – Grupo Moura

DOUG PIERCE – GS Yuasa

MATT RAIFORD – CBI

BERNHARD RIEGEL – Hoppecke

JOHN SEMENIUK – Eternity

MARK STEVENSON – Eternity

CHAD UPLINGER – EnerSys

STEVE VECHY – Concentric

STANISLAS VERDONCKT – Exide

MARK WELS – East Penn

Lead battery segment definitions

MOTIVE

▶ Industrial Truck



▶ On-Rail



▶ Mining



▶ Excludes E-bikes, LSEV, etc

STATIONARY

▶ Telecom



▶ UPS



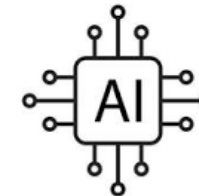
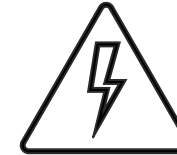
▶ Utility, Rail-side, Micro-grid, etc

▶ >25Ah

▶ ESS discussed separately

Drivers influencing all industrial battery markets

- Decarbonization
- Electrification
- Low-cost LFP cells
- Industrial policies
- Artificial intelligence



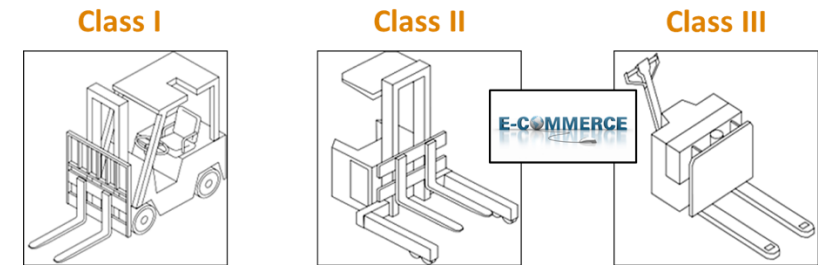


Motive Power Market



Motive Power Trends

- Electrification
- Automation - labor shortage and cost!
- Lithium adoption (sodium someday?)
- Growth market in mature economies, 3-5%

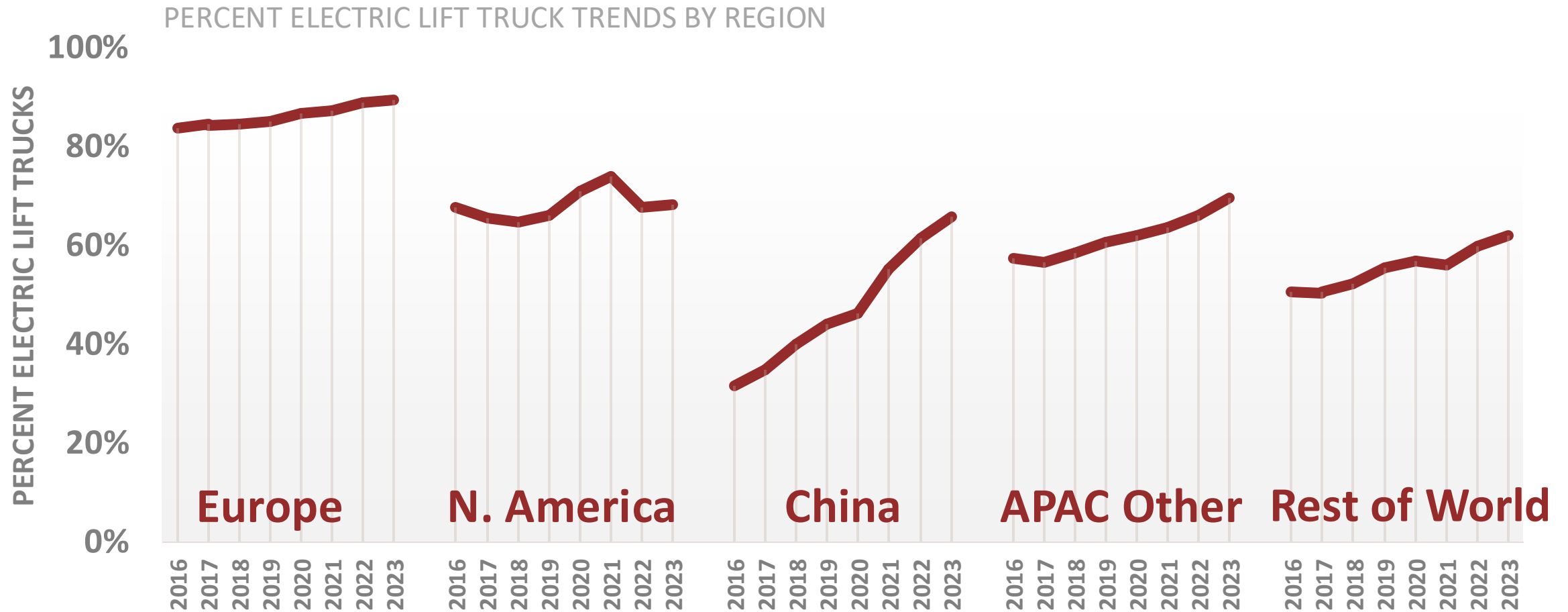


EU = 20-25%

US = 10-15%

CN = 30-40%

Electrification trend continues for industrial lift trucks: 62% in 2016 to 73% 2023



SOURCE: WITS

Motive Power Challenges

- Truck OE backward integration, designed-in lithium
- Cheap LFP from global oversupply, slowing EV sales
- Lithium battery applications: new fleet, 24-hour operation

Motive Power Opportunities



- Batteries that enable productivity and **automation**
 - *Don't let your battery be the reason the truck or person isn't being productive*
 - Maintenance-free, fast charge, longer life, data integration
- Further electrification
 - What will it take to electrify the historically-ICE truck applications? With lead?
- Lead battery applications: 1-shift, existing fleet and charging network
- Development of industrial material handling in developing economies



Stationary Market



Telecom Trends

- 5G implementation
- More data > more gear > more power > more backup
- Lithium adoption (and some other technologies)
- Regional differences
 - Growth in Europe & China
 - Slow in N. America
 - Mixed in developing regions



EU = 10-15%

US = Low

CN = >50%

Macro-sites, excluding 5G small cells

Telecom Challenges

- Lithium adoption, especially China and developing regions
 - Policy, anti-theft, low-cost LFP
- Geopolitical issues
- Telecom carrier 5G **monetization**, slowing spending
- 5G small cell backup technology



Telecom Opportunities

- Higher temperature tolerant batteries, for life and operating cost
- 5G (Europe) and infrastructure (developing regions) buildout
- Higher power-consuming towers
- Micro-grid + backup **stacking**



UPS Trends

- AI and Data!
- Power demand and rethinking backup
- Regulatory issues: fires, fire codes, etc
- Growth application globally

Used as much energy as
charging a smartphone.

<https://www.theverge.com/24066646/ai-electricity-energy-watts-generative-consumption>



“Create an image of a lead-acid battery conference in Milan Italy”

Google Gemini AI

UPS Challenges

- Data centers getting **too big?**
 - By 2030, the power needs of Europe's data centers will match the current total consumption of Portugal, Greece, and the Netherlands combined.*
- Forced to rethink backup
- Alternative backup technologies
 - Li-ion, NiZn, low Ah on-rack, redundancy
 - China seems to be sticking with lead, for now
 - Short backup times



Microsoft & OpenAI
consider \$100bn, 5GW
'Stargate' AI data center

<https://www.datacenterdynamics.com/en/news/microsoft-openai-consider-100bn-5gw-stargate-ai-data-center-report/>



EU = 20-30%
US = 40-80%
CN = <20%

New data centers;
Replacement is mostly lead-for-lead

*<https://www.goldmansachs.com/insights/articles/AI-poised-to-drive-160-increase-in-power-demand>

UPS Opportunities

- Lead technology improvement opportunities:
 - Higher temp tolerance, 10-year life, power density
- Data privacy regulations (more regional data centers)
 - Lead batteries are good for smaller data centers, <1MW racks
- Edge computing: data near the use to reduce latency
- Backup mechanical power, e.g. cooling systems
- ESS stacking
- Non-data center applications: critical infrastructure, oil & gas, etc

Other Opportunities

All this electricity demand has to be distributed!

- Growing demand for electricity for will drive demand for substations and switchgear
 - Data centers
 - Semiconductor and giga-factories
 - EV charging networks
- Mostly flooded, could see growth of 2V VRLA



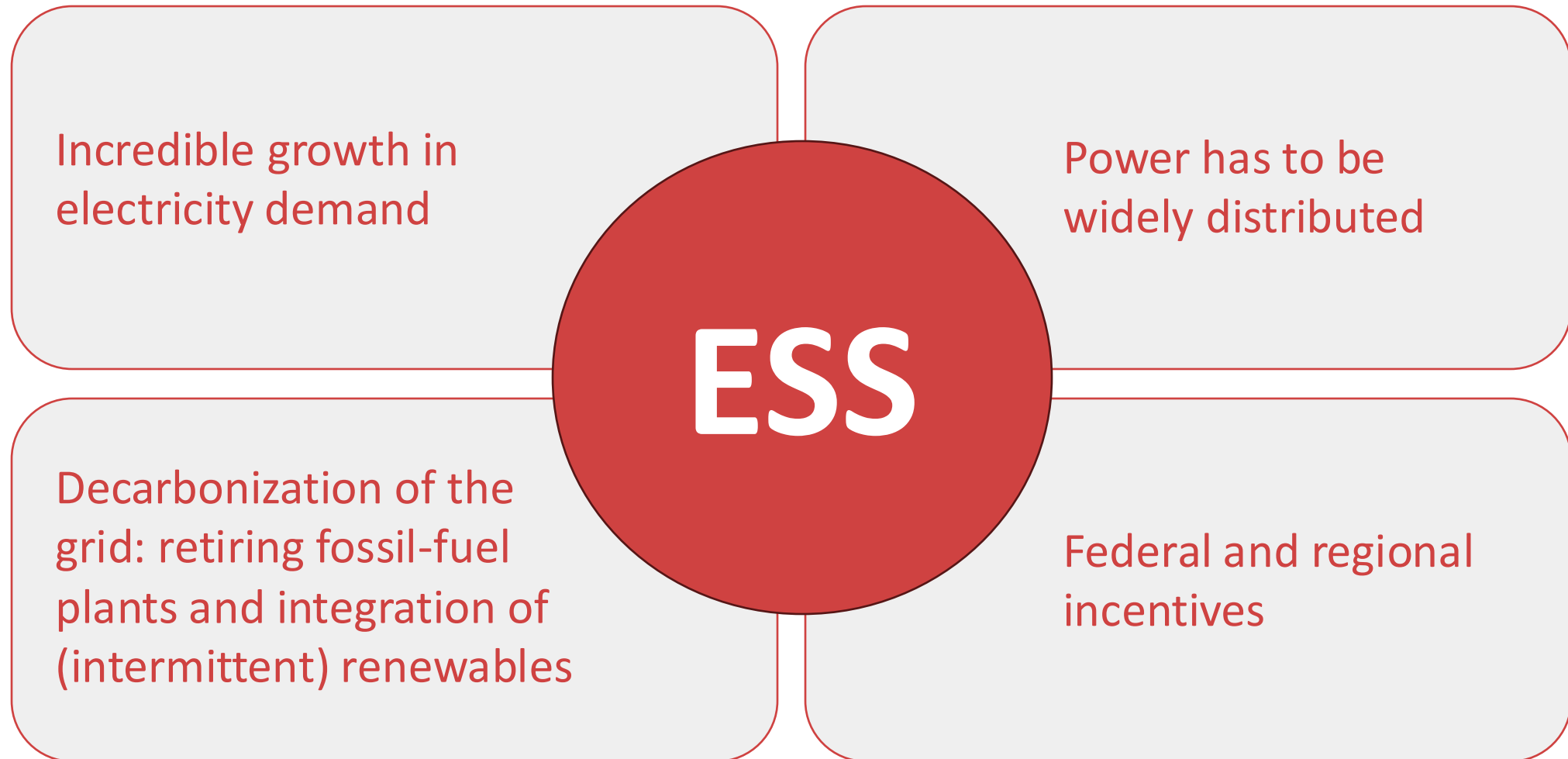
https://energyeducation.ca/encyclopedia/Electrical_substation



Energy Storage Systems Market



Trends driving the massive demand for...



ESS - Differing lead battery views...

Optimist: ESS will be so big, lead batteries will get something

Pessimist: Lead battery is blocked out by perception and technology

Technologist: the lead battery needs a technical breakthrough in cycling

Integrator: Lead battery technology is fine, we need the right application and integration standardization

They're all probably right...

- ESS opportunity will be big.
- Lead batteries, for once, aren't the incumbent.
- It will take improvements, mostly in cycling.
- It's an engineering system solution, not a lead battery sale.

“But look at the India Inverter market, and lead battery ESS installations in Asia and developing countries...”

Conclusion

- Fundamental growth in traditional markets.
 - Motive power: electrification, ecommerce, material handling.
 - Stationary: data-driven power demand growth in telecom and data centers.
- Alternative technologies will compete for new growth.
- ESS will be the biggest business opportunity in a lifetime.

Keep innovating and discovering where lead and you can compete!



Creating a Cleaner World™



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