



A REVOLUTION IN ENERGY STORAGE

Seth R Sanders, CTO and Co-founder

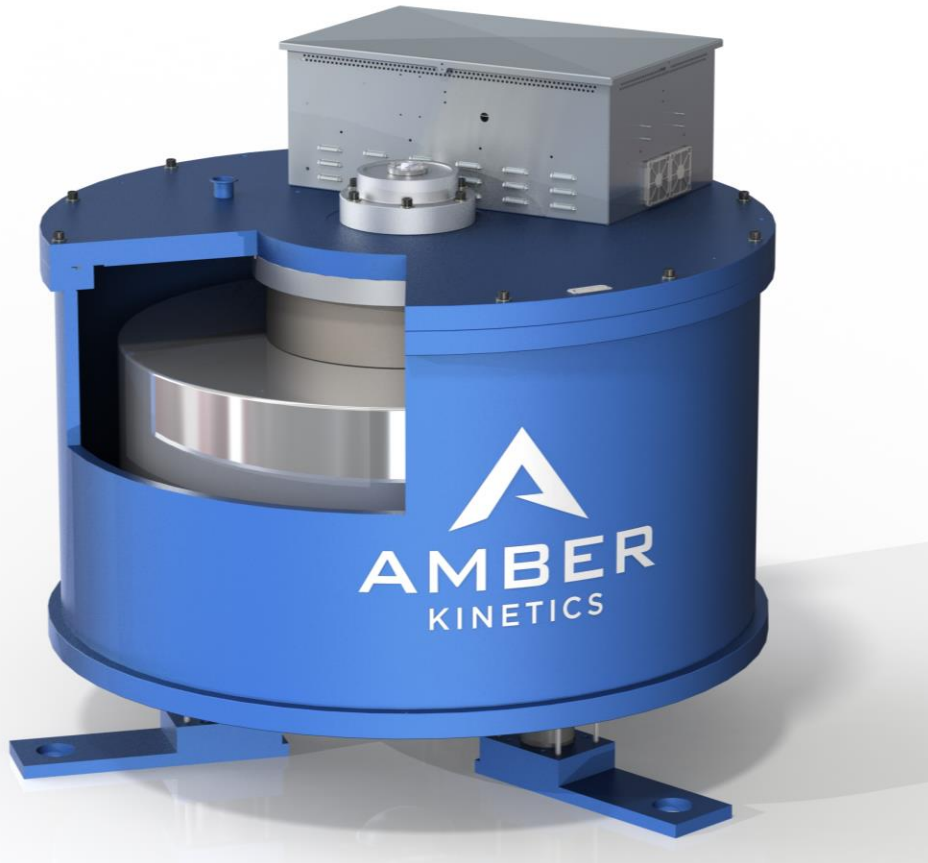
June 27, 2023

Revolutionizing energy storage with our innovative flywheel energy storage systems (FESS)

- Only 4-hour+ FESS on the market
- Safe, reliable, simple and flexible energy storage alternative
- Deployed worldwide with over 1 million cumulative operating hours

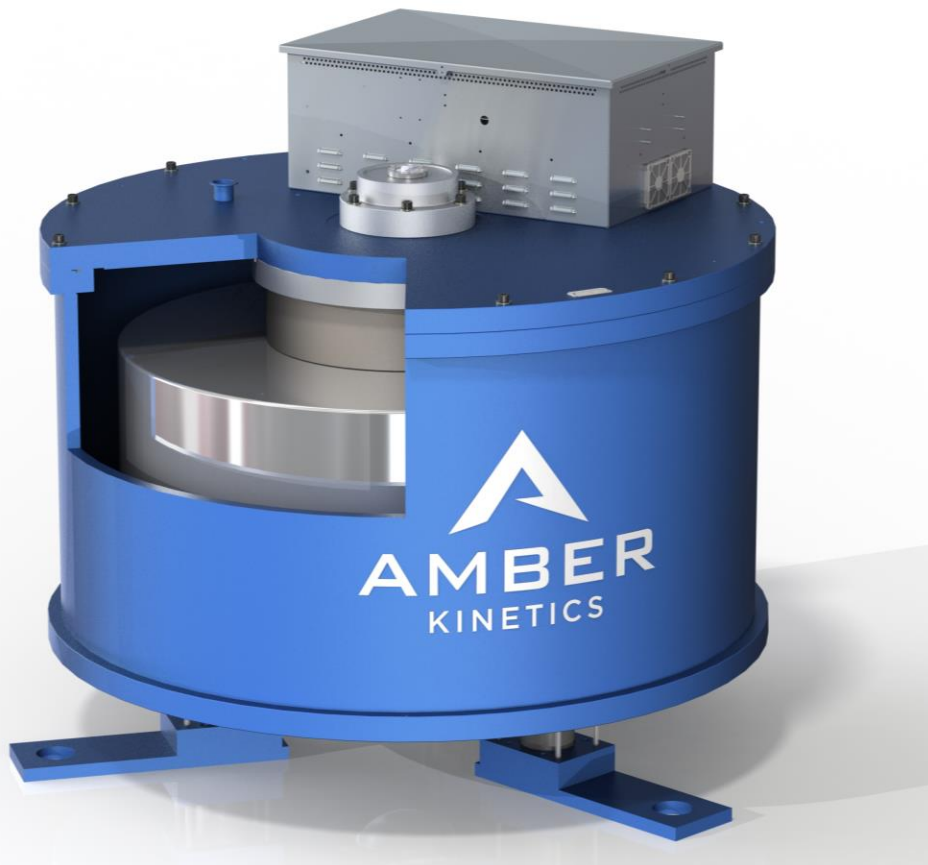
What is a Flywheel Energy Storage System (FESS)?

Kinetic energy stored by a rotor supported magnetically and in vacuum



- Ultra-low coasting loss => high efficiency
- On-demand energy with:
 - no limits on depth of discharge
 - no dependence on SOC
 - multiple cycles per day
- Connects to end-user systems similarly to traditional battery energy storage for easy deployment
- No fire risk, no scarce metals and 95% end of life recyclability

Key features of the M32 FESS unit



Max Power: 8 kW

Energy Capacity: 32 kWh

RTE >85% DC

Full power response time: < 100 ms

Integrated Power Electronics "E-box"

Temp range: -20 C to +50 C

Safe Solution based on Steel and Non-Toxic Materials



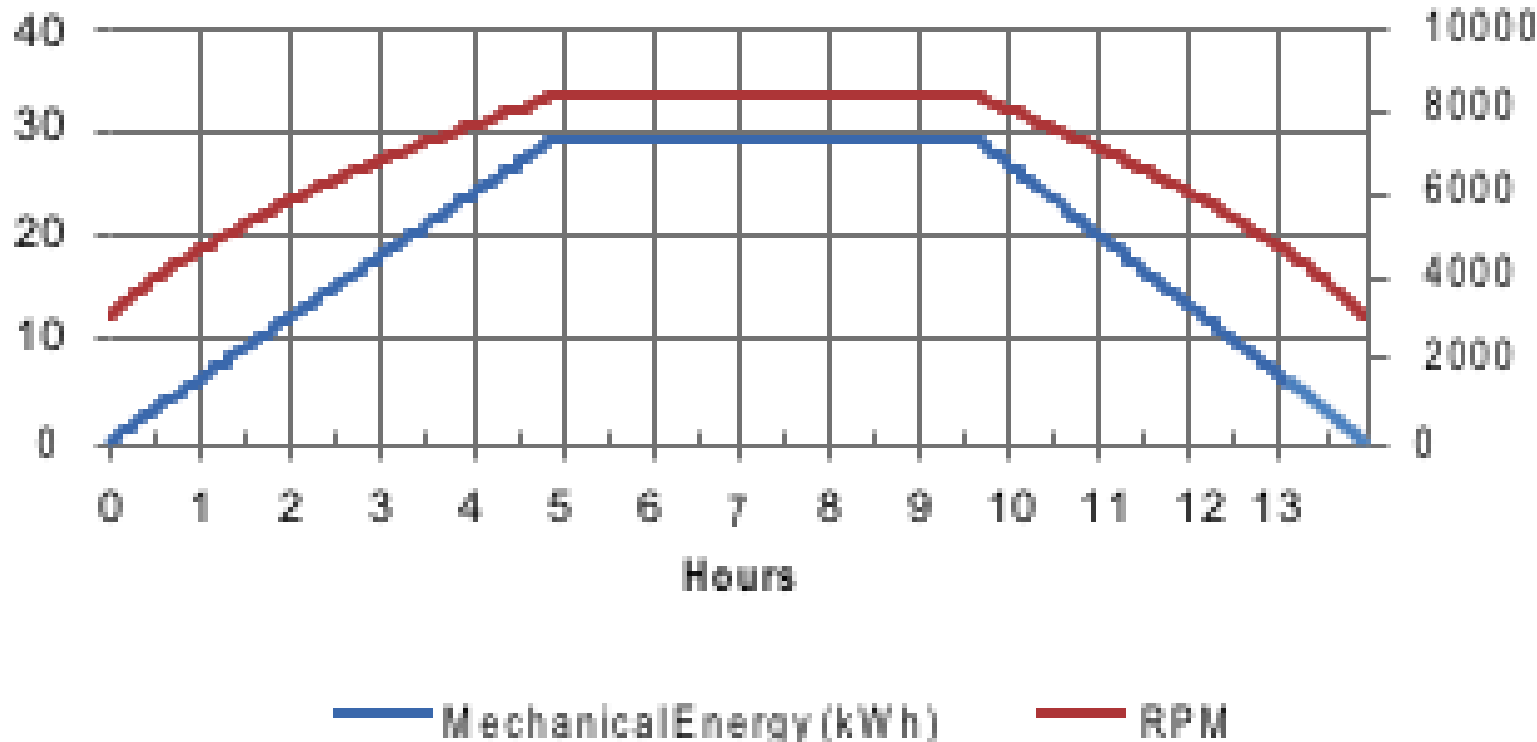
- The M32 is 98% steel by weight and cannot burn or release toxic liquids or gasses
- Rotor integrity guaranteed by:
 - Design and material criteria based on fracture mechanics, same methodology as in mission critical aerospace equipment
 - 100% ultrasonic and surface inspection of rotors
 - Periodic laboratory destructive testing of rotor samples
 - Factory cycle test
- Design validation testing of all failure modes

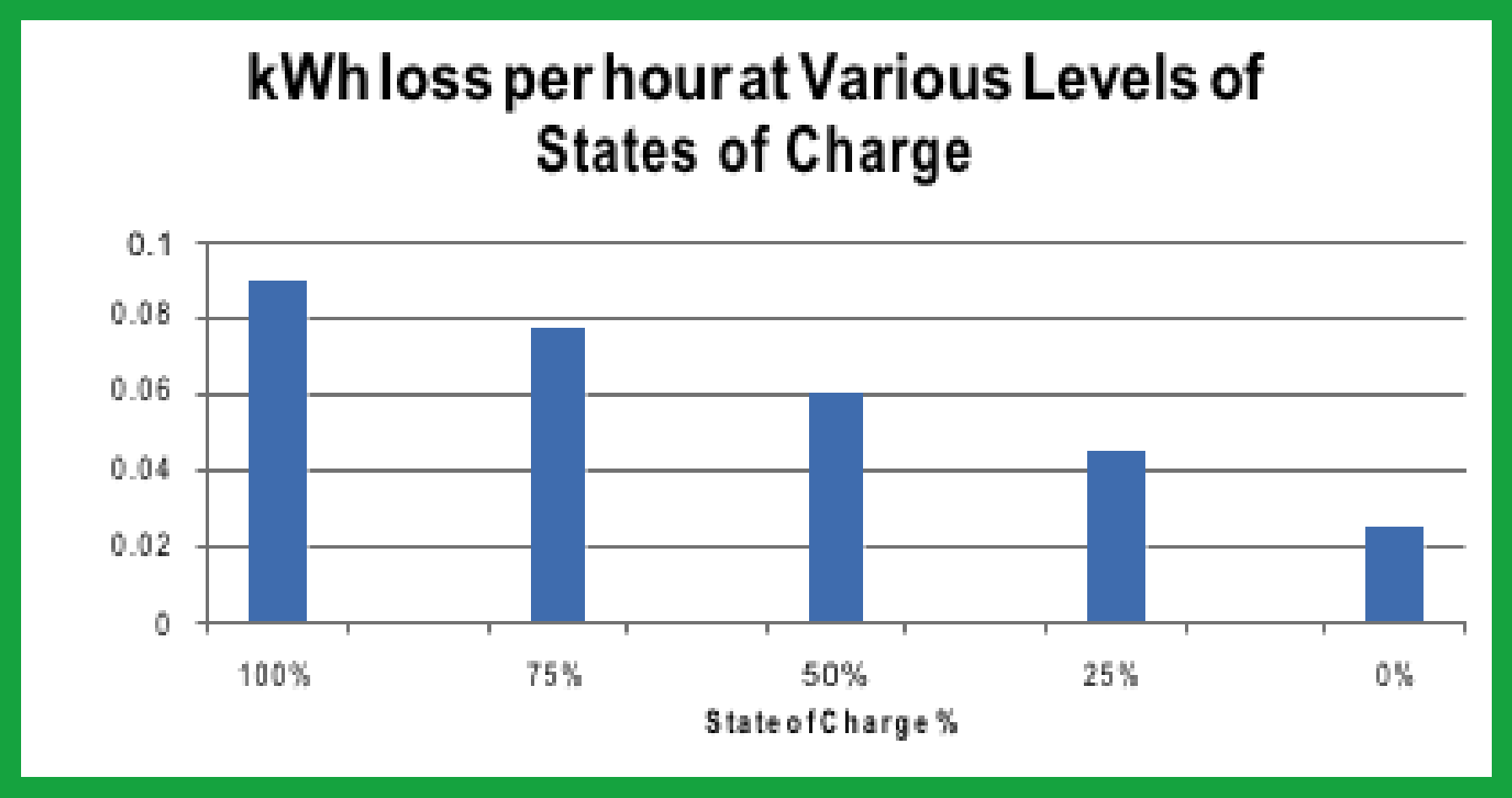


Flywheel Energy Storage Study
Emerging Technologies Program
San Diego Gas & Electric
3/22/2017

Prepared by: John Baffa, PE
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<http://www.aswb-engineering.com/>

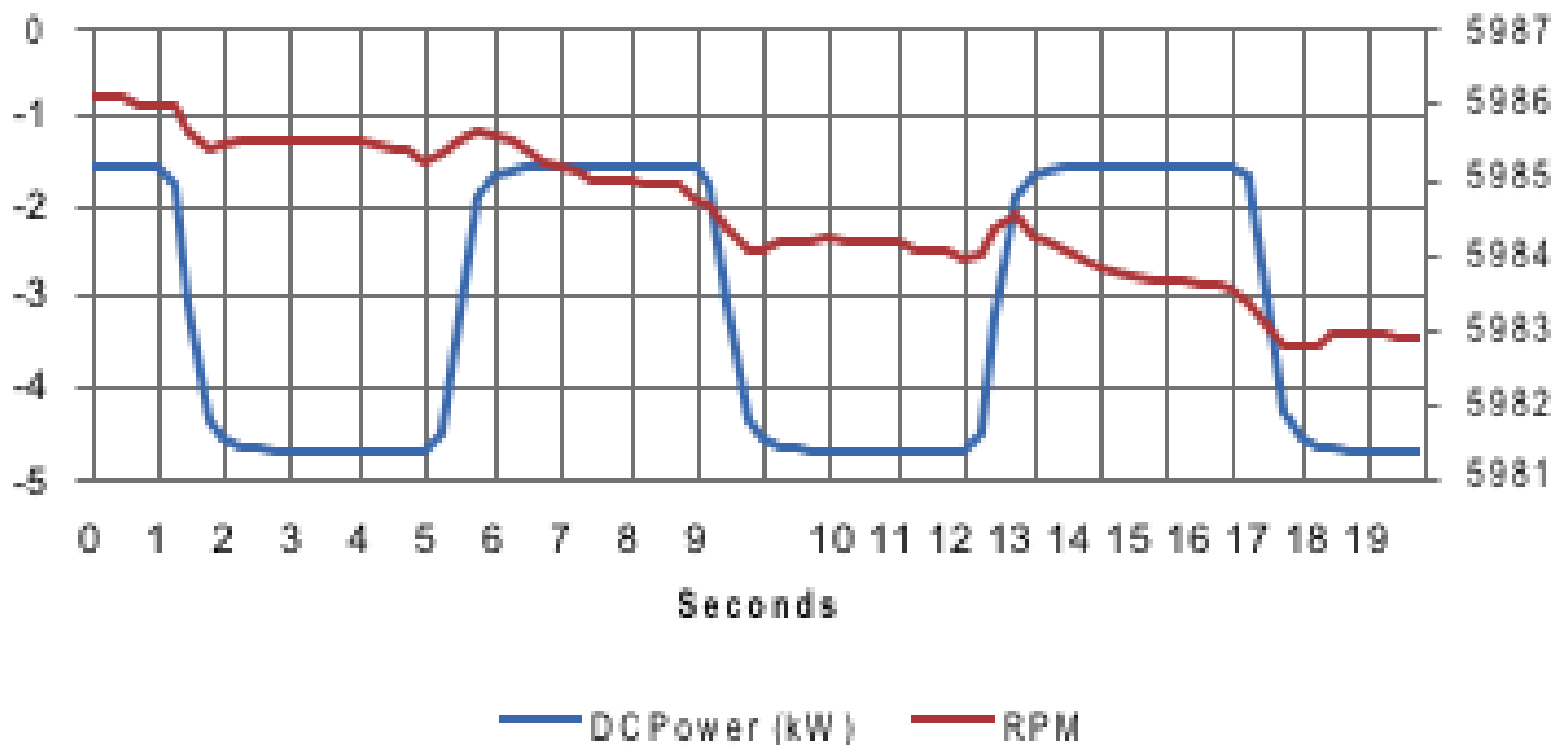
Full Cycle 4 Hour Mechanical Energy kWh



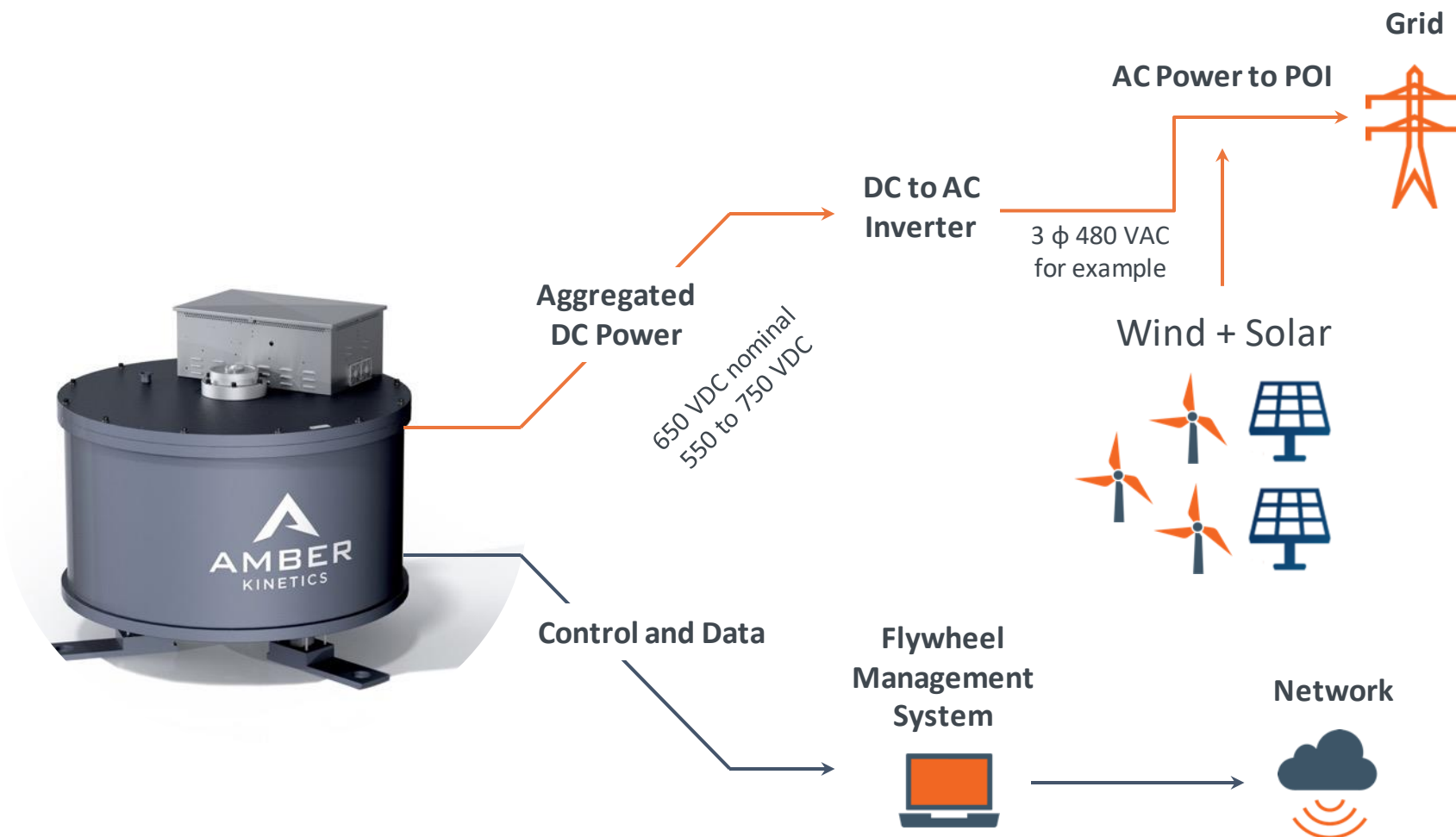




4 Second Ancillary Services Test



Kinetic Energy Storage System Solution Connects Similarly to Other ESS



Amber Kinetics Current Solution Overview

Solution Overview:

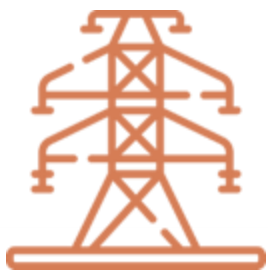
- Two Installation Options:
 - **Below Grade:** The flywheels can be installed in a below grade capsule, providing protection from adverse weather conditions or extreme temperatures
 - **Containerized:** Our containerized solution is a compact, ready-to-use solution in a standard 20ft shipping container, minimizing installation time and reducing site works



Below Grade (Australia) (4xM32 = 32kW/128kWh)



20' Containerized Solution: 3 x M32 = 24kW/96kWh



Utility - IPP

“Front of the Meter”

- Renewable + Storage
- Firming and Dispatchability
- Peak Shaving, Load shifting
- T&D Upgrade Deferral
- Ancillary Services: Capacity, Frequency Regulation, Inertial Response



Commercial / Industrial

“Behind the Meter”

- Demand Charge Reduction
- Time of Use Optimization
- Backup Power
- Renewable + Storage
- Energy Firming



Microgrids

Distributed Energy Resources

- Resiliency
- Stability
- Backup Power
- Islanding
- Renewable + Storage
- Energy Firming

Deployed Globally with Over 1 Million Cumulative Operating Hours



Flywheels installed as at March 31, 2023. 1. Greece site is ready for installation pending the customer, not included in total.

Lithium-Ion represents 98%¹ of the ESS market, but customers are looking for alternative ESS solutions like FESS with no fire risk and end-of-life concerns

Immense demand for energy storage to enable the global clean energy transition calls for multiple ESS technologies with varied performance parameters

Amber Kinetics: No fire risk, high efficiency, safe, flexible, and easy to operate

Ruggedized Energy Storage Solution



Lhasa, Tibet

CHALLENGES

- Harsh weather conditions
- Remote site (a challenge for both installation and maintenance)
- Extremely high altitude at 4000+ meters

SOLUTION

Amber Kinetics' highly ruggedized flywheel technology makes it the ideal solution to address the challenges surrounding the high altitude and harsh environment.

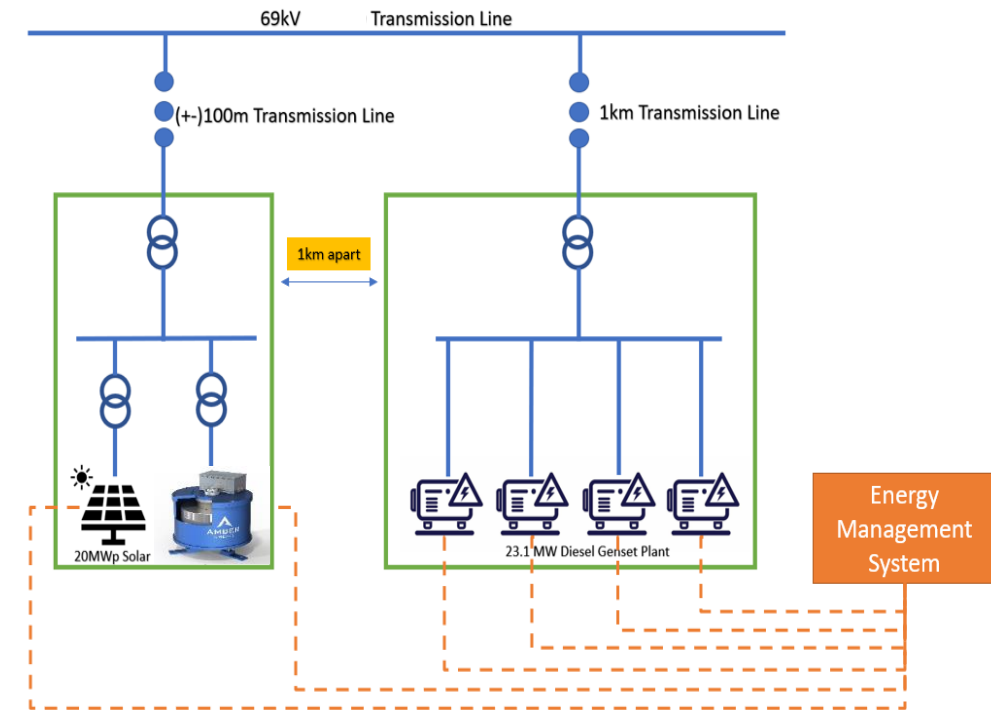
Successfully commissioned in July 2018, this demo addressed energy firming, curtailment capture, and smoothing.

Slam dunk winner in bake-off vs. adjacent Li-ion demonstration.



Recently signed a contract for 2.5MW/10MWh FESS project with delivery in 2024

- 20 MW of Solar PV supported by 2.5MW/10MWh of FESS
- FESS will store excess generation from Solar PV to discharge during night-time providing time shift service.
- Energy Shifting services, but also addresses the intermittency and variability of the Solar PV reinforcing the stability and reliability of the grid.













Our Company



Amber Kinetics Company History

Over 14 Years of Field and Technical Expertise with Worldwide Deployments

<p>2009: Amber Kinetics founded by Dr. Seth Sanders and Ed Chiao</p>	<p>2012: Amber completes 5 kWh long-duration FESS prototype</p>	<p>2014: Amber's 25kWh long-duration FESS operational in Alameda, CA test facility, funded with CEC Grant (\$1.8mn)</p> 	<p>2016: Amber signs supply agreements with HECO; completes Series B round; awarded second CEC Grant (\$2.0mn)</p> 	<p>2017: 1st commercial supply agreements with multiple global customers</p> 	<p>2018: • Mfg factory set up in Philippines • Projects operational in Hawaii and Massachusetts (US) and Tibet (China)</p>	<p>2020: Amber signs 1st commercial supply agreement with customer in Australia</p>	<p>2022: 1st project operational in Japan</p> 	<p>2023: Flywheel fleet reaches 1 million hours of global operations 1st MW-scale contract signed with PAVI (Phil)</p> 
<p>2010: Awarded DOE Grant (\$3.6mn)</p> 	<p>2013: Amber completes Series A round</p>	<p>2015: Amber signs agreement with Elemental Exclerator, based in Honolulu, HI</p>	<p>2016: Amber deploys two FESS units with customers in the Philippines</p> 	<p>2017: Two-year cooperation agreement with Enel</p> 	<p>2019: Project with Taiwan Power operational</p> 	<p>2021: 3 Projects operational in Australia</p>  	<p>2023: MOU with Philippine-Japan Consortium to develop integrated solutions</p>    	

State of the Art Manufacturing Facilities: First Facility Operational since 2018 (B1)

B1 (total capacity of 800FW)

- Located in Philippine Special Economic Zones w/ income tax holiday for exports and zero duty for imports
- Implementing LEAN best practices and regular Kaizen activities



State of the Art Manufacturing Facilities: Second Facility 2023 (M1)

M1 (total capacity of 1,600FW)

- Also located in Philippine Special Economic Zones w/ income tax holiday for exports and zero duty for imports
- Acquired operating permits in early 2023



R&D and Engineering Headquarters in the San Francisco Bay Area (Union City, CA)



- Center Of Expertise
- In charge of Mechanical, Electrical, Electronics and Software engineering
- Supports existing products and developing next gen products
- Supports customers in execution and piloting of our test sites
- Workshops to assemble and test flywheels, flywheel management systems, and all balance of systems components (e.g., inverters, electronics)

Key Product Highlights

4-hour discharge duration



30 years design life



Unlimited daily cycling with over 11,000 cycles



Not dependent on rare earth minerals



Zero degradation; state-of-charge known accurately



No fire hazard or explosion concerns



High resiliency with -20 °C to +50 °C range



Full power over entire state-of-charge range

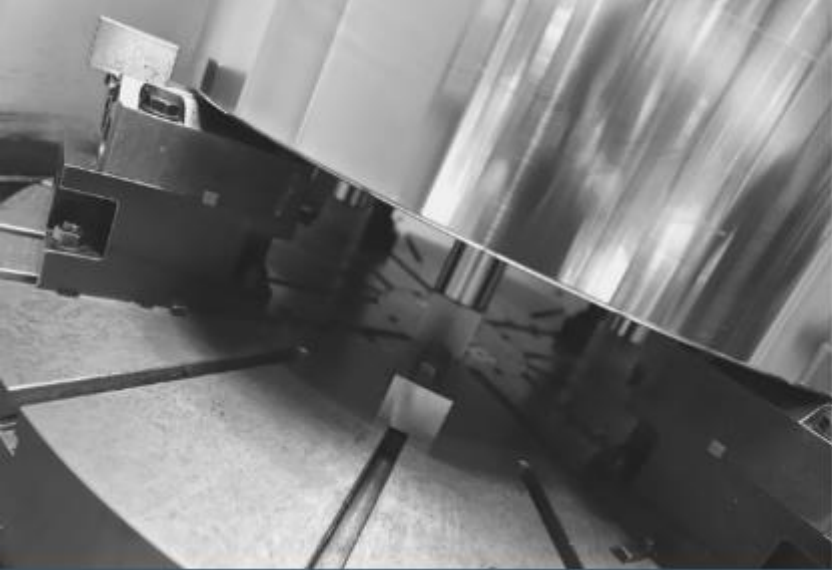


>95% recyclable and free of hazardous materials and waste



High efficiency & low stand-by losses (>85% for DC RTE)





Thank you!

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