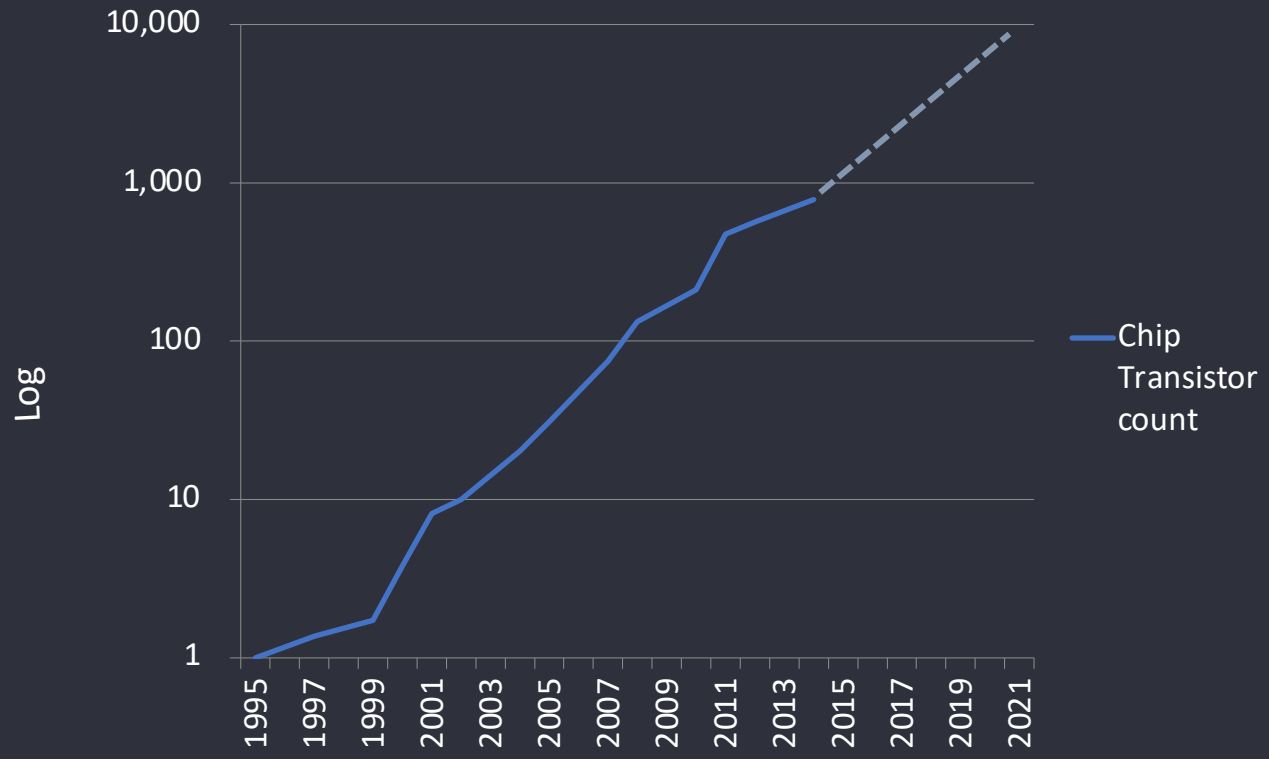
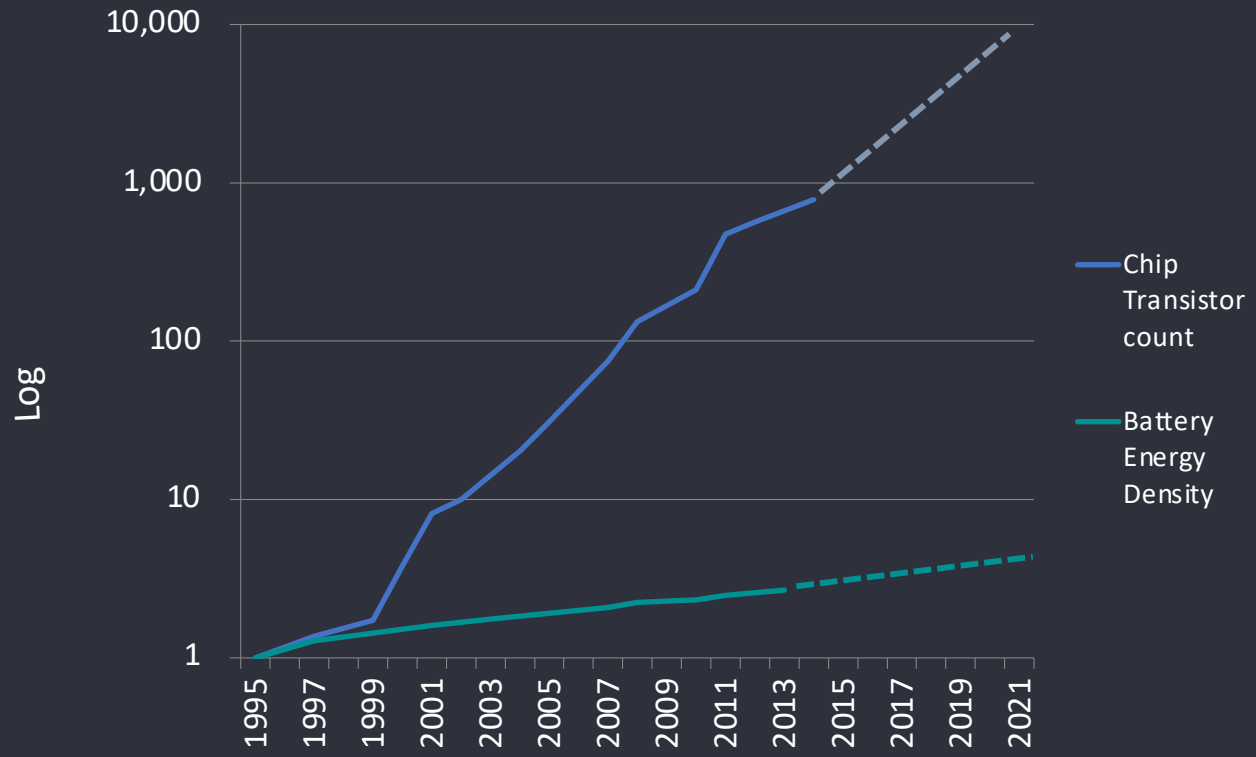
Enabling Electric Aviation Applications with High Energy Density Silicon-based Lithium-ion Batteries

39th Annual Space Power Workshop
The Aerospace Corporation
April 26-29, 2022

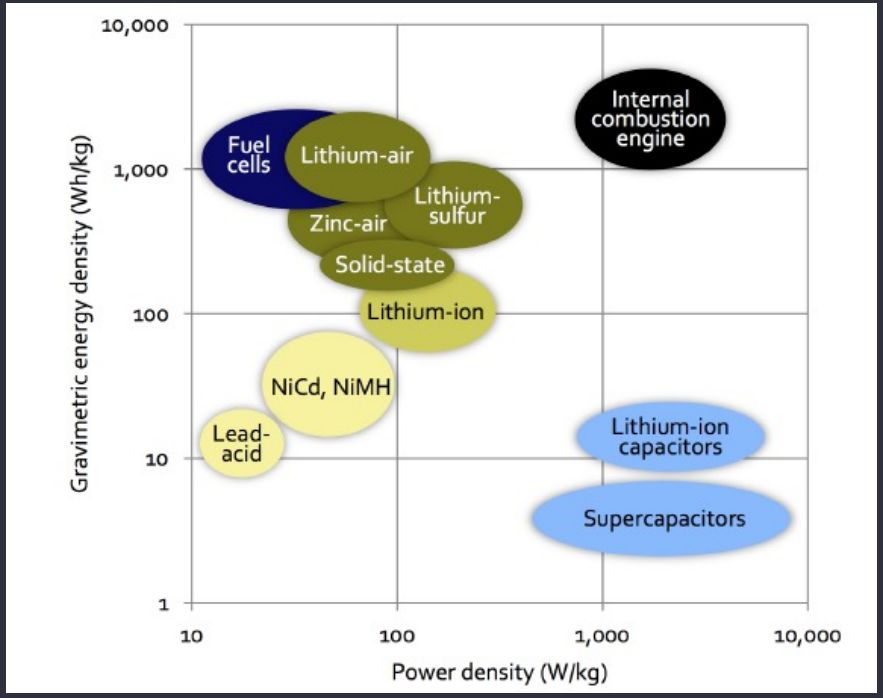
Moore's Law


10,000
1,000
100
10
1
Log
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
2021
Chip Transistor count

Moore's Law in batteries?

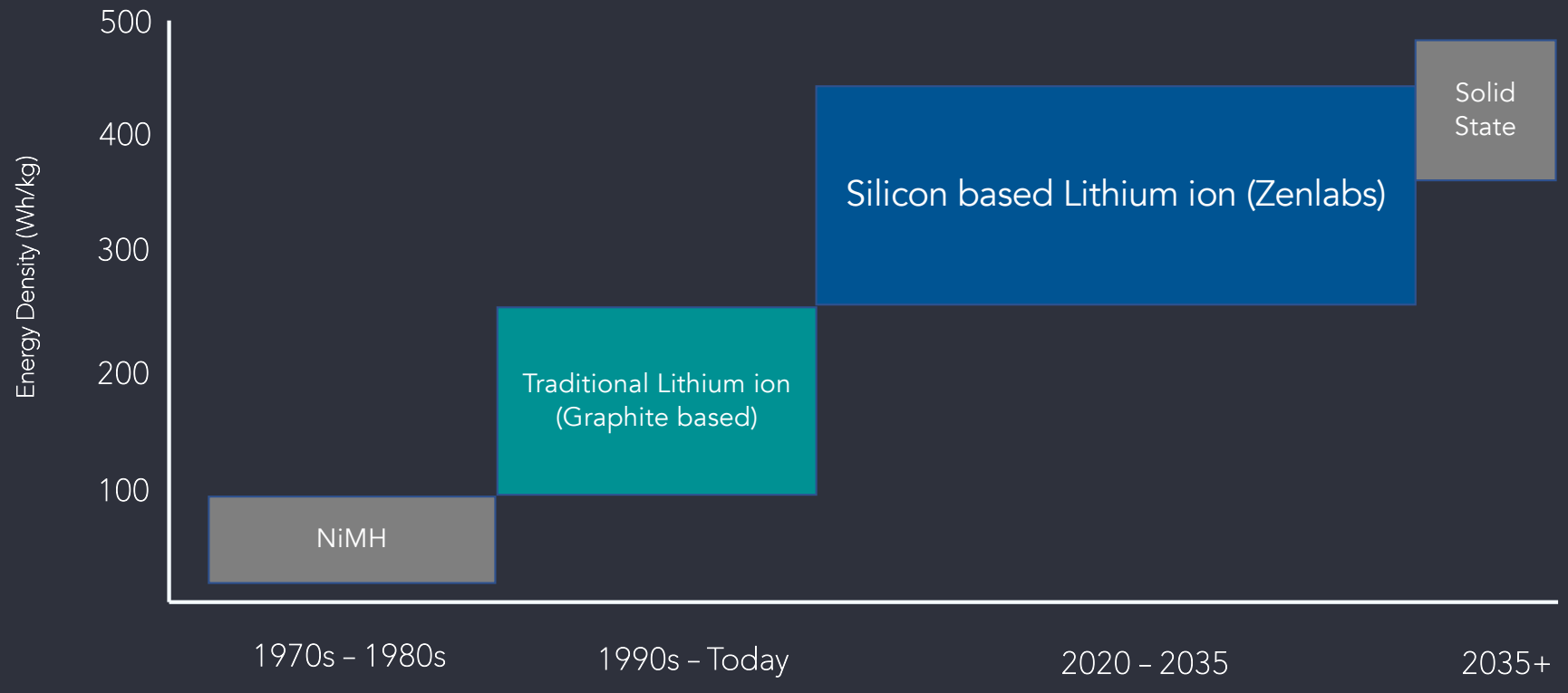


Power versus Energy: Next Gen Technology

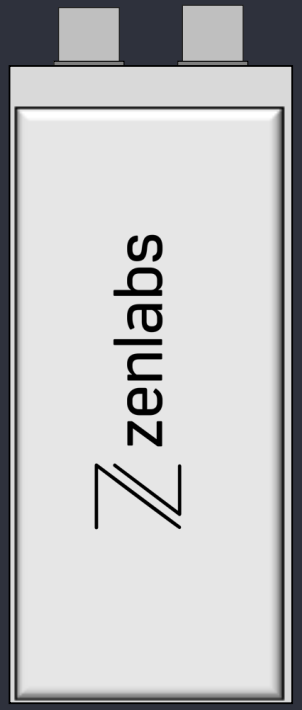


Source: Lux Research

Silicon based technology will dominate for the foreseeable future



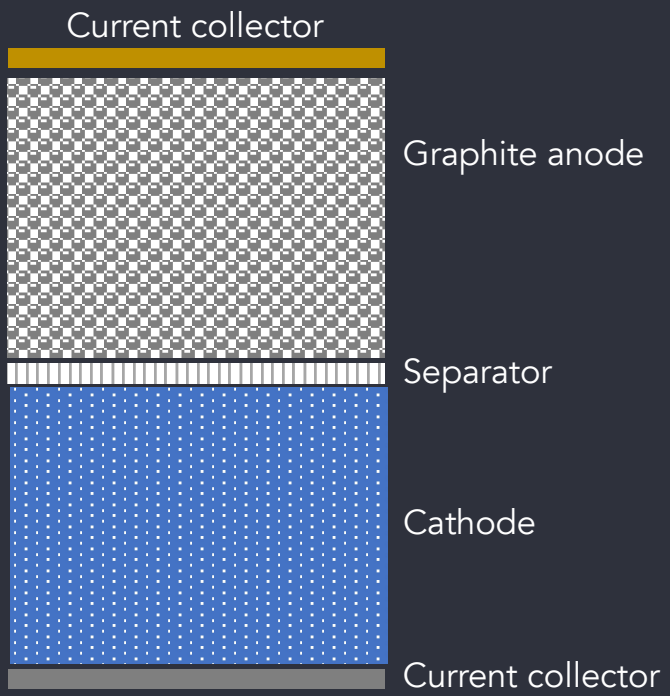
Zenlabs at a Glance



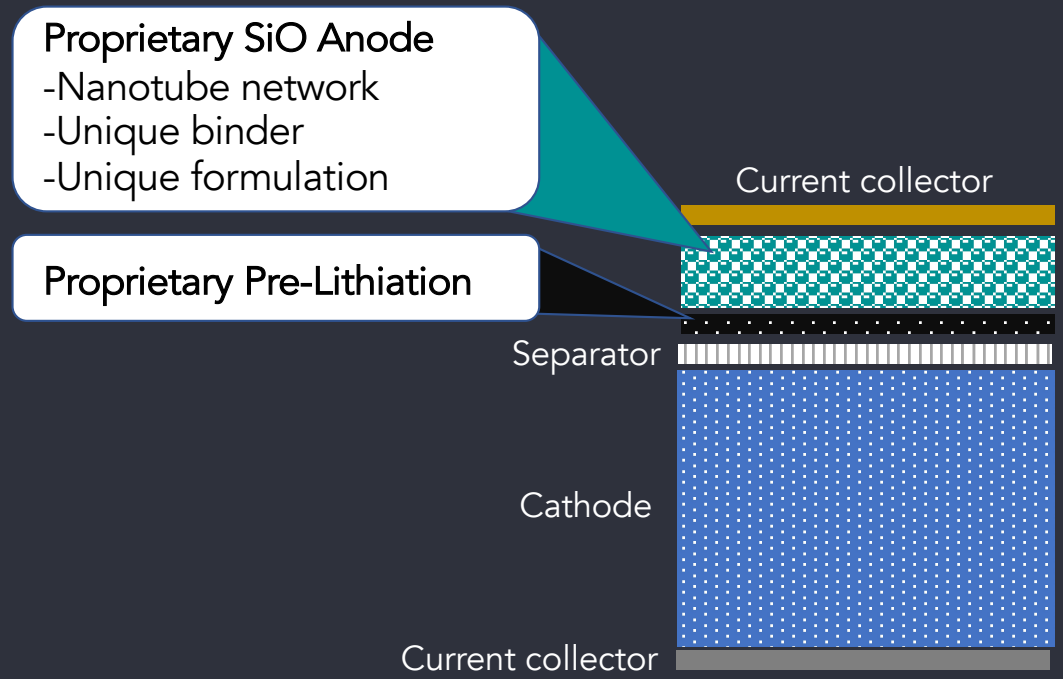
PRODUCT	High Power/Energy lithium ion batteries, up to 400 Wh/kg
TECHNOLOGY	Silicon based anode (43 granted patents)
MARKET	Initial entry in the aviation market, enabling scale for leadership in the EV market
CUSTOMERS	Electric mobility OEMs
TEAM	World class team of PhDs wit h100s of years of battery experience and 100s of patents issued
PRODUCTION	Expanding production at our China facility for small volume manufacturing and partnering with gigafactories for mass production

Zenlabs silicon technology is the clear differentiator

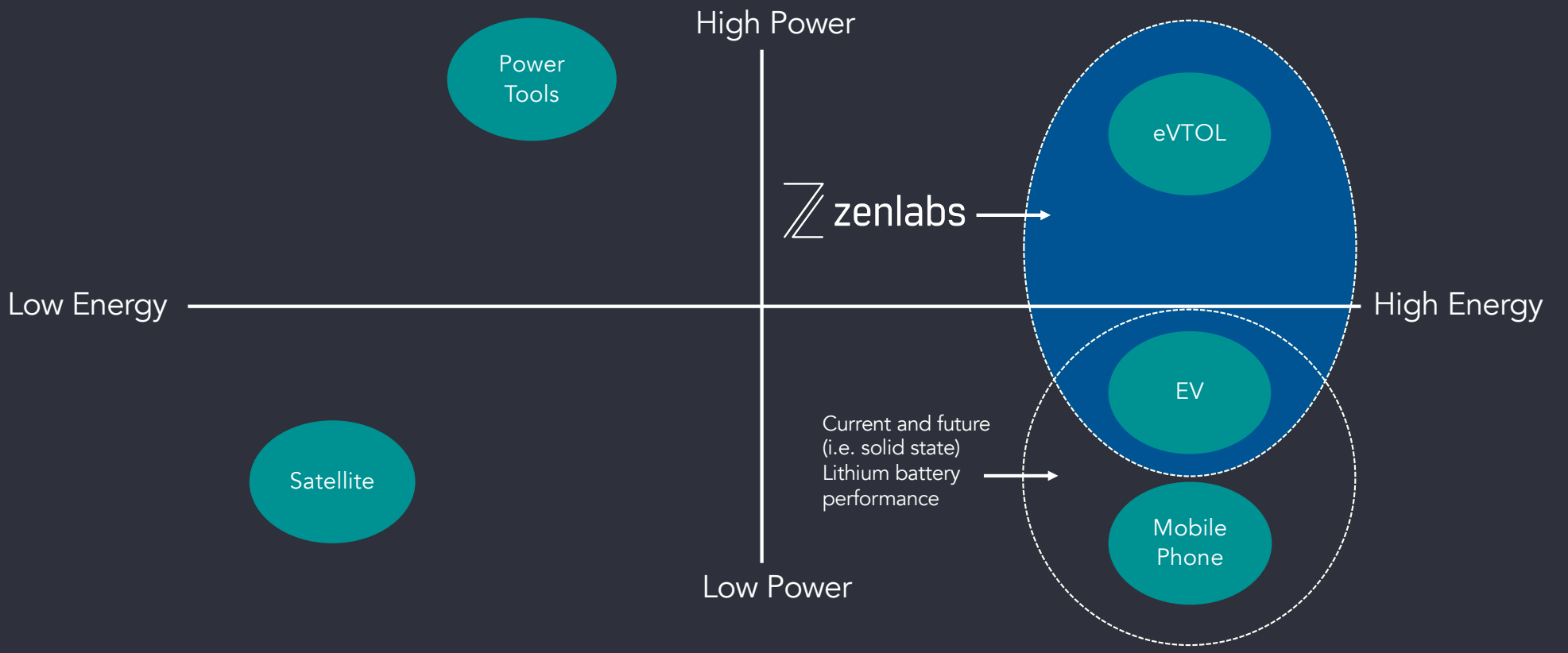
Industry Standard



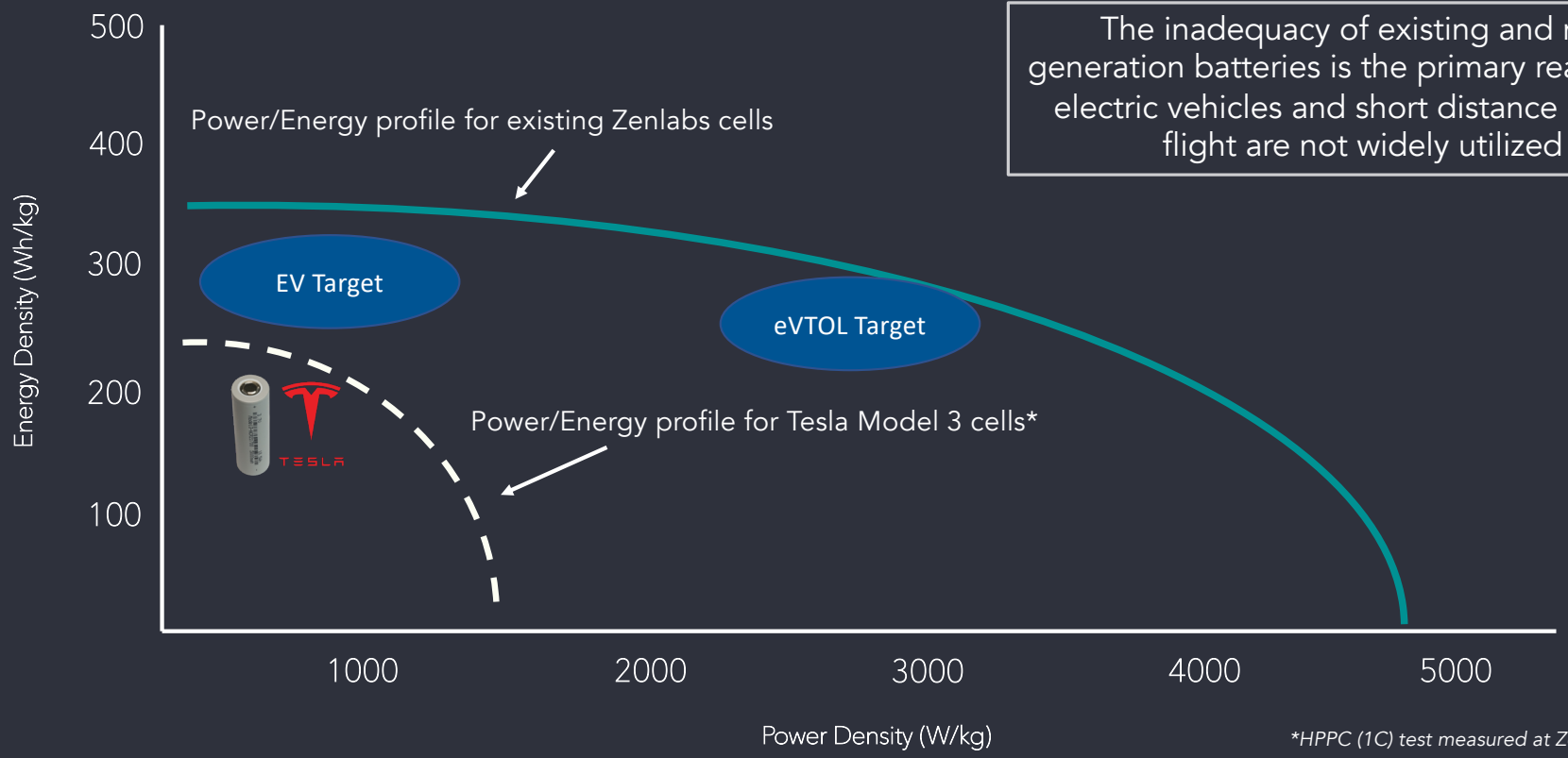
Zenlabs



Performance Differentiation



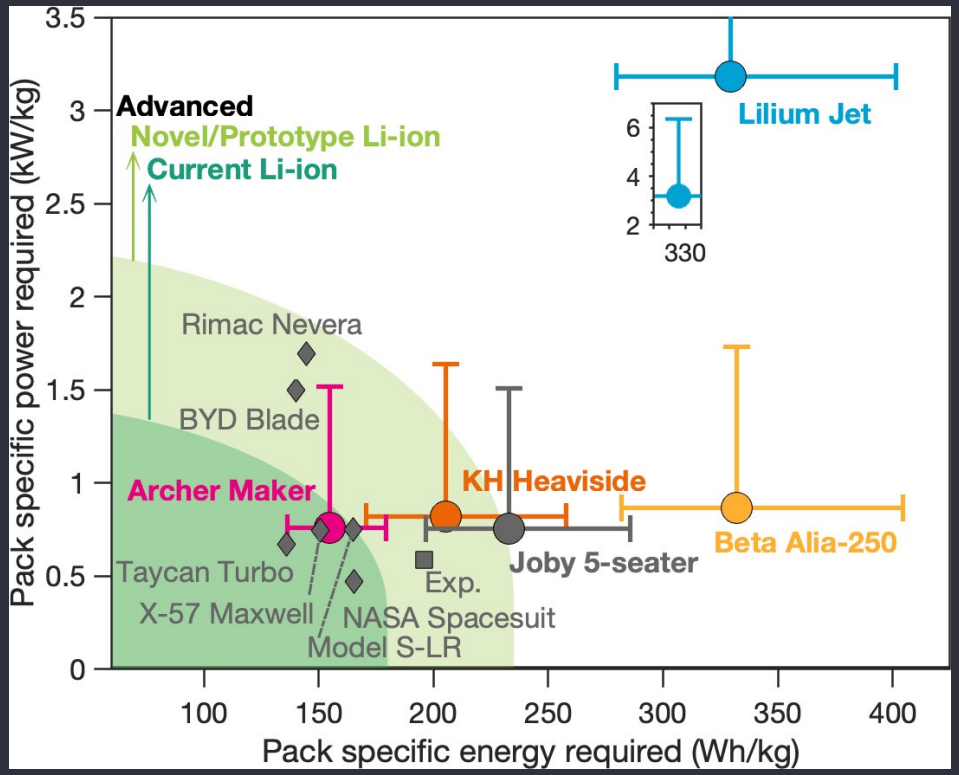
Improving BOTH energy and power



The inadequacy of existing and next generation batteries is the primary reason why electric vehicles and short distance electric flight are not widely utilized

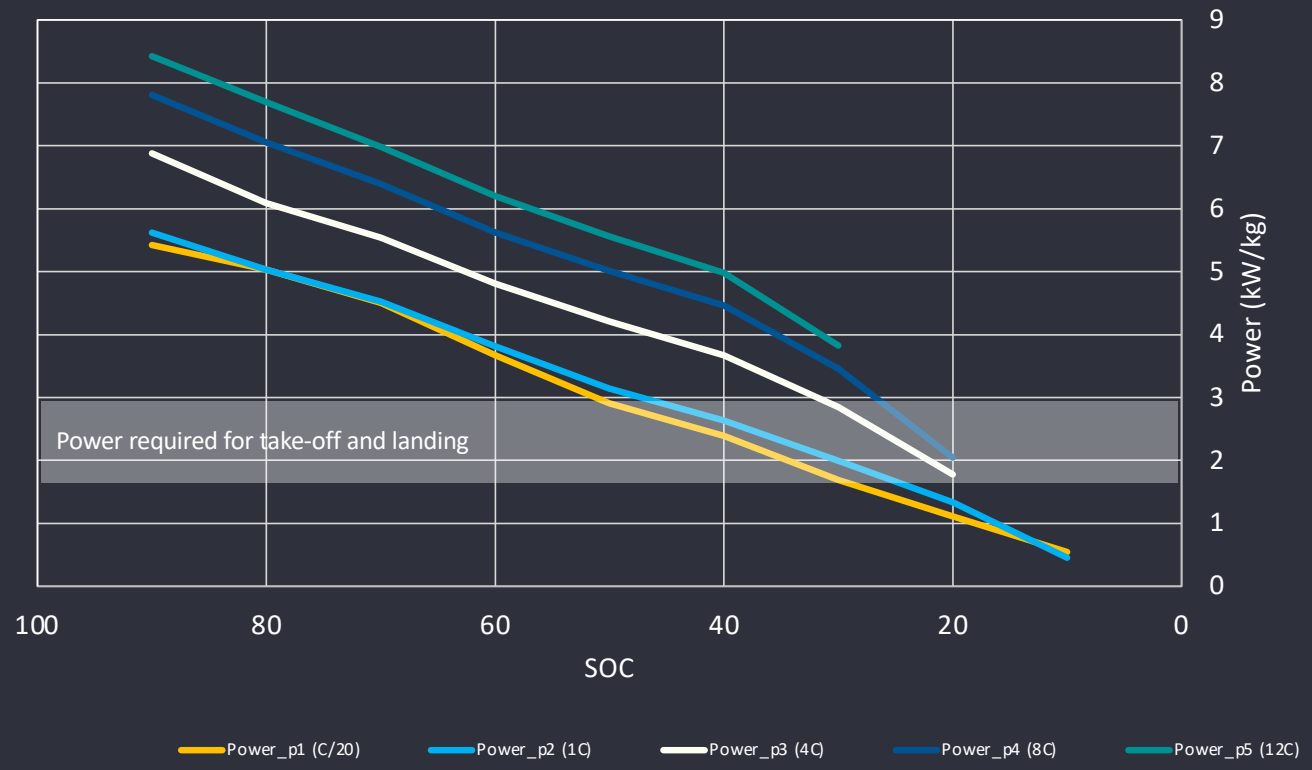
HPPC (1C) test measured at Zenlabs

Power and Energy needs of eVTOL applications

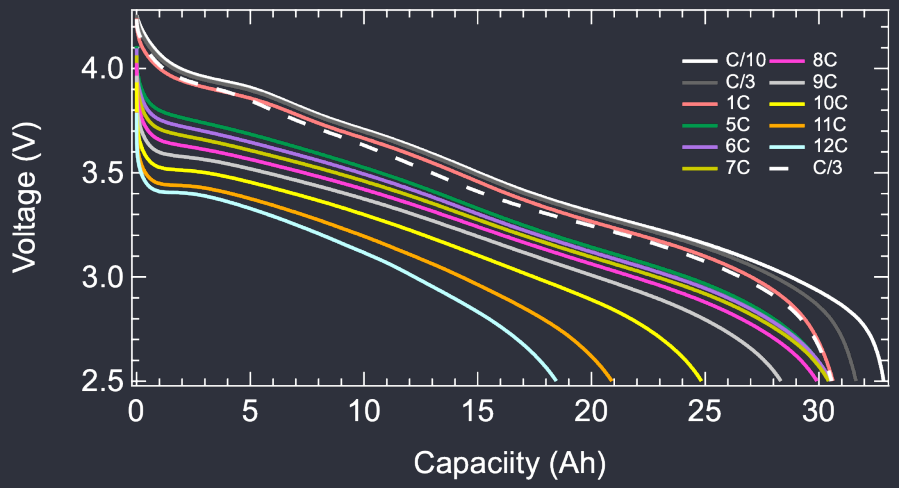


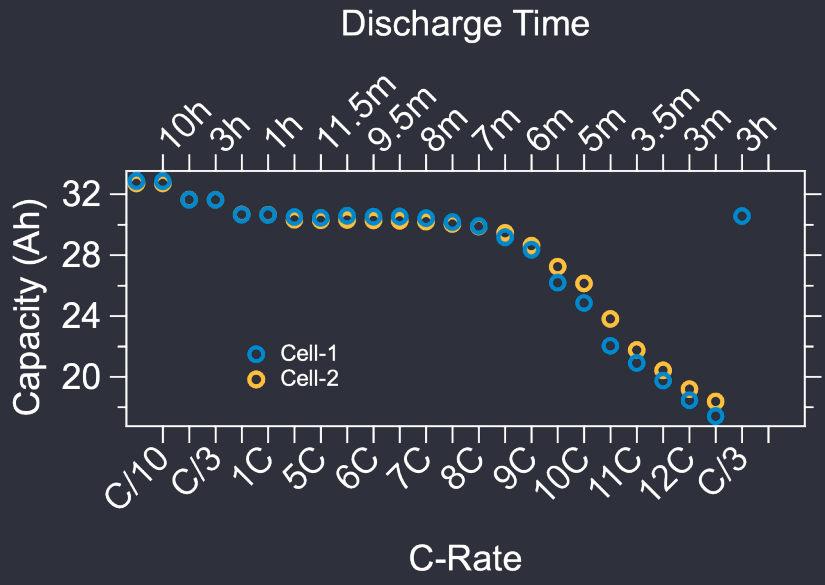
Shashank Sripads, Venkatasubramanian Viswanathan*, The promise of energy-efficient battery-powered urban aircraft, ***PNAS* , 2021, DOI**:10.1039/D0EE03659E

Power profiles of 32Ah cell (HP1) at high rates



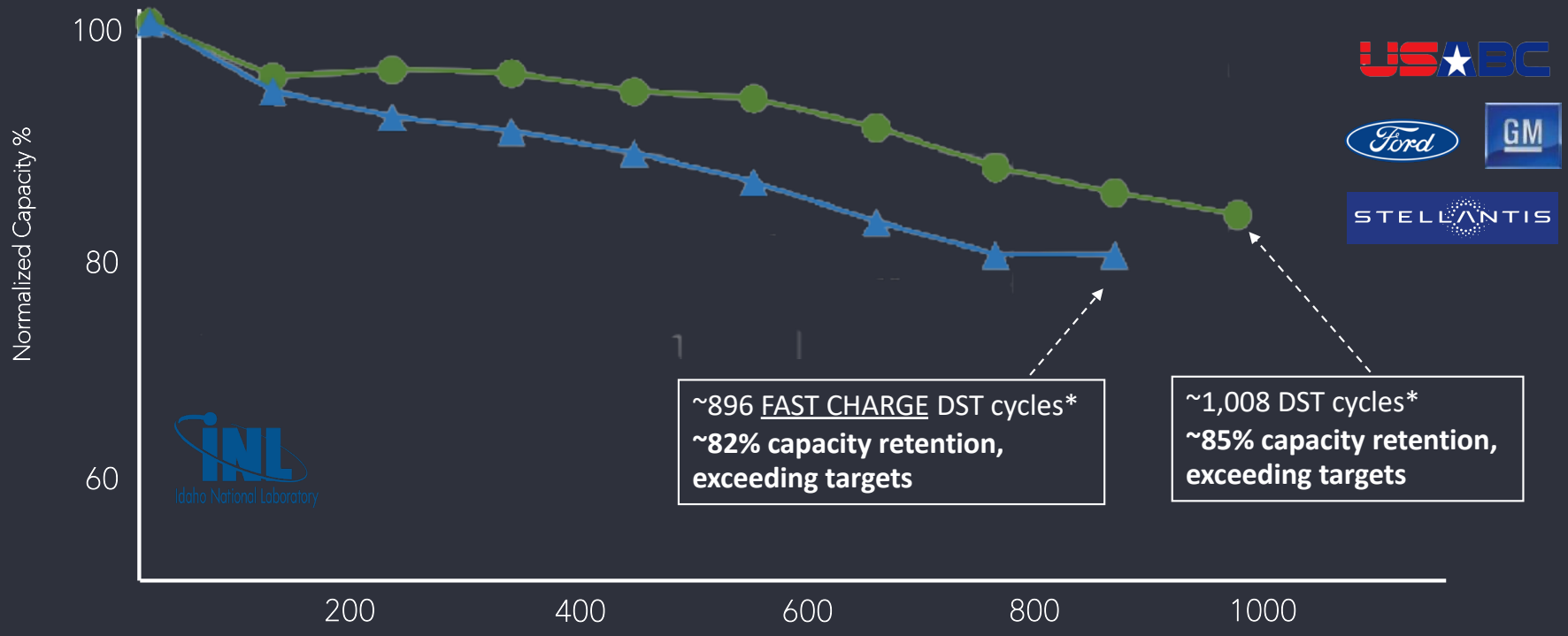
Discharge rate tests for 32Ah cell (HP1)





The HP1 is able to deliver nearly all of its rated capacity up to 8C, which is extraordinary for a high energy density cell

Technology validated by US National Laboratories



*11.7Ah Pouch Cell, 311 Wh/kg
as measured by INL

Industry Leading Performance

	Energy Density Wh/kg (C/3)	*Energy Density Wh/kg (2C)*	*Max pulse (60 seconds) discharge rate*	*Max continuous discharge rate*	*Cycle life (100% DoD @ 1C/1C)*	Cell Capacity
HP1	*330*	*315*	*15C*	*5C*	*800*	32
HE1	*350*	*320*	*7C*	*5C*	*1,000<*	12
HP2	*350*	*330*	*15C*	*5C*	*1,000<*	TBD
HE2	*400*	*320*	*5C*	*3C*	*500*	TBD

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