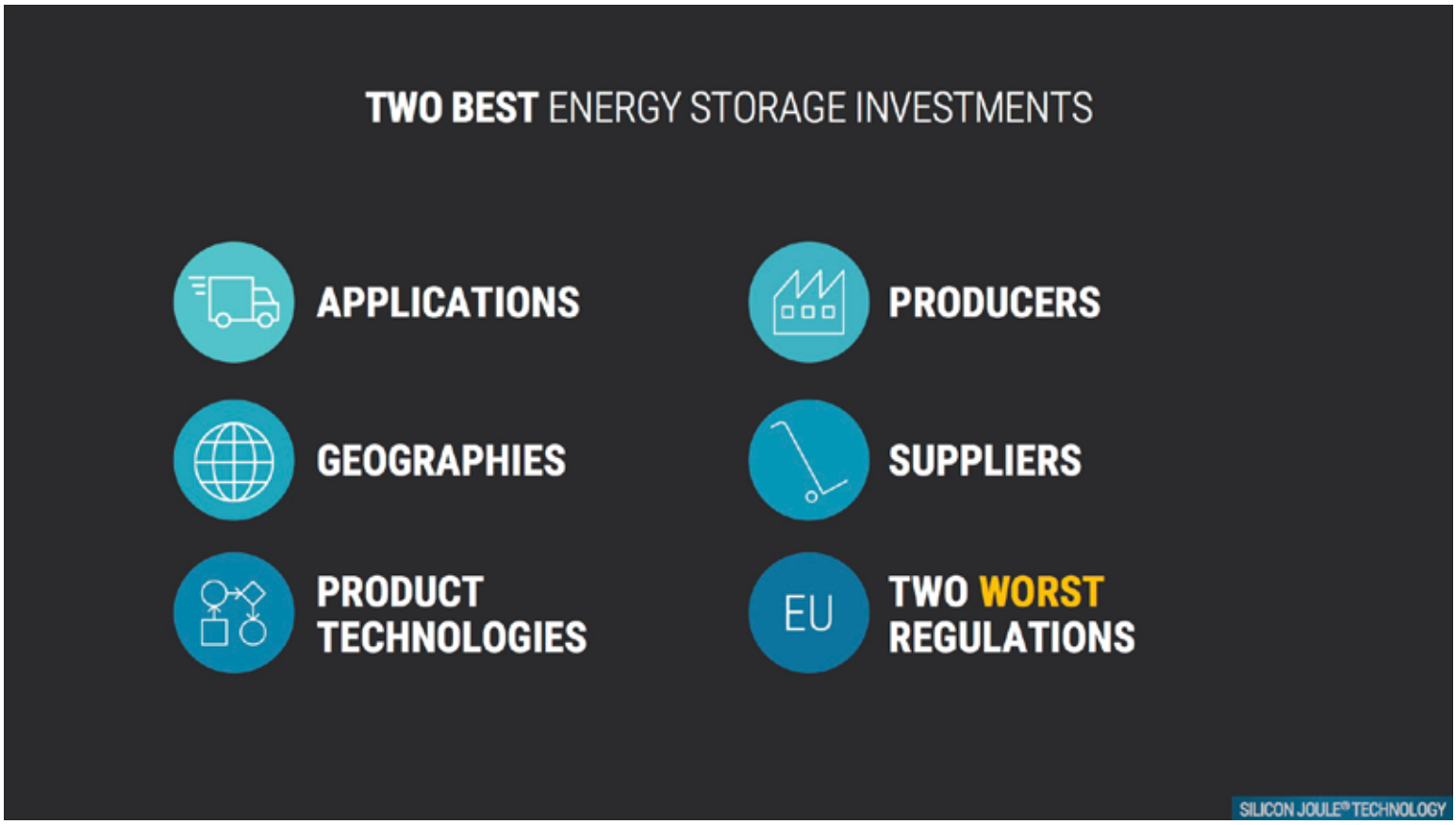
01

Good Morning. Thank you for having me back to share my input at the heart of the energy storage industry, which surely is in Asia.

Across my years in this industry, working together with some great colleagues, we have had some success achieving profitable and sustainable growth. Yet, these are the most exciting and challenging times I have seen. There are higher growth opportunities, yet we have more demanding application challenges for our engineers, and complex development choices for our companies across technologies and markets.

The competitive challenge is amplified by the billions being invested in product development and capacity by many companies, often aided by governments.

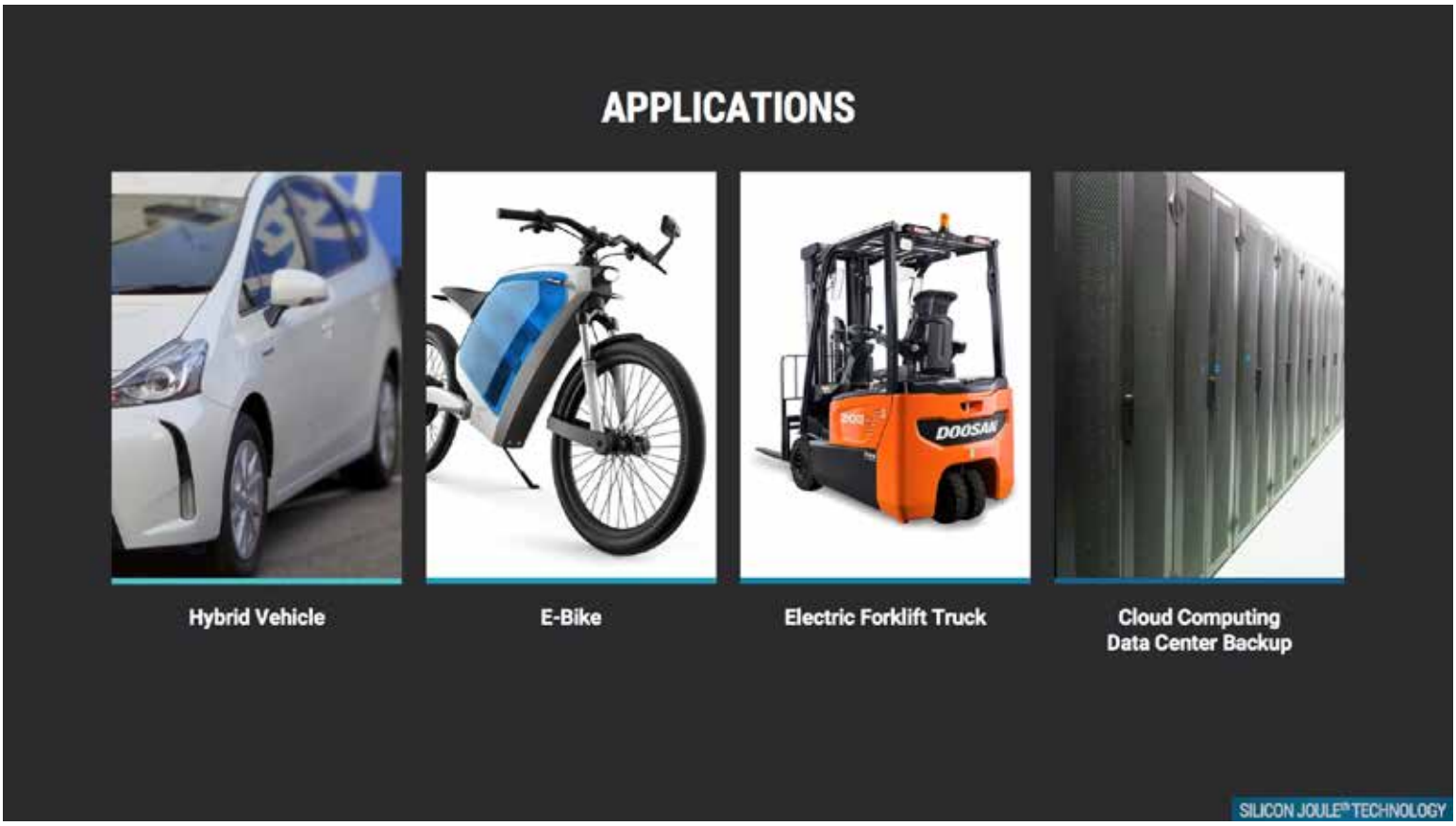
The goal is clear… to provide higher performing, lower cost and sustainable energy storage.



02

I will share my opinions on the best investments considering applications, geography, technology and companies.

Usually, I summarize my conclusions first, yet this time I encourage you to second guess all my assumptions and forecasts, and assess the best paths for your companies.

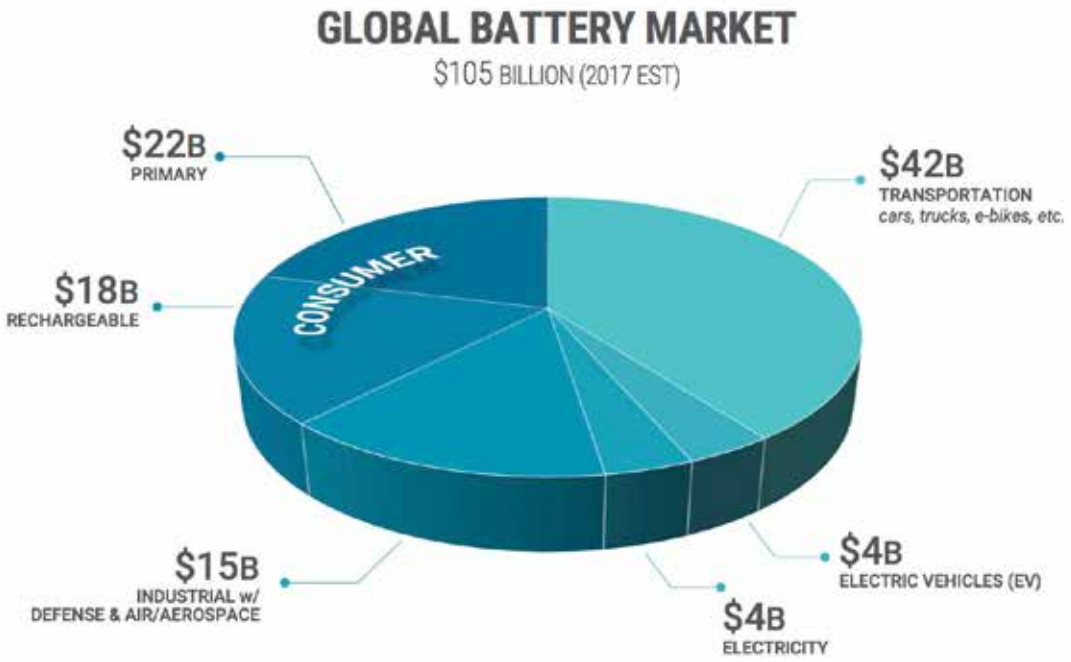


03

There is a lot of press coverage on the electrification of vehicles, yet let's look the growth across other applications, be it further electrification of material handling in warehouses with the explosive e-commerce growth, even higher power security levels for cloud commuting, and notable growth in low speed electric vehicles for delivery of anything and even more e-bikes.

Many think of e-bikes as a China phenomenon, but even in Europe, the bicycle trade association has reported that nearly 2m or 10% of the 20 million bicycles sold in Europe last year were battery assisted. To this we can add more powered scooters, wheelchairs, golf carts, and how about the e-rickshaws in Pakistan and India?

What is behind all the development? Our world is focused on cleaner air, improving fuel efficiency and savings. We also have higher living standards across many economies, and longer living populations, where more and better batteries are helping people travel, play or live more conveniently.



SILICON JOULE™ TECHNOLOGY

04

Let's start with an overview of today's $105 billion global market.

Transportation, even without plug in, all-electric cars, or "pure EVs", plus Consumer Electronics split about 80% of the total market with at least $40 billion in demand in each sector.

In the consumer segment, rechargeable batteries are now taking all the growth. Lithium batteries' attributes in small energy packs have made many devices like Bluetooth speakers, earphones/AirPods, even toothbrushes and many other devices easier to use with rechargeable batteries economically.

Well known primary battery brands like Duracell and Energizer have to broaden their product portfolios to grow. Both of these companies have recently gone through revitalizing corporate shifts with Duracell moved into Berkshire Hathaway, and Energizer recently spun out from its sister businesses.

Transportation remains our largest sector with about $42 billion in sales which continues to grow aided by better advanced lead-based batteries which are saving fuel and emissions in cars with the stop/start feature and helping in big trucks with their idle-off systems.

Also, we continue to see expansion of vehicle sales across Asia.
China's new vehicle sales of an estimated 23m+ this year are now about one-quarter larger than the sales in each North America and Europe.

The $15 billion Industrial and Defense sector includes the major application of battery powered material handling equipment whose sales are up double digits worldwide this year, powered by the dynamic growth of e-commerce, which means more warehouses.

The other two large industrial sectors are Telecom and UPS. We see greater dependency and requirements for uninterrupted networks which have expanded use of higher integrity backup power. Cloud computing networks want the continuous safe power across the 3+ minute transition to gen sets, fuel cells or alternate power supplies. Even before 5G networks further develop, more micro network sites are being added to supplement today's networks with both lead and lithium batteries.

The two highest profile markets which are pure EVs and for Electricity are estimated at $4 billion in 2017, and both are poised for high growth across the next five years. We know the drivers for pure EV sales are China, California, Tesla, Germany and others, obviously with big forecasts for sales ahead.

Across our existing Electricity networks, or the developing distributed networks, renewable solar and wind generation now have energy storage being deployed in more than just demonstration applications. Energy storage is integrated most frequently today with solar or wind in Australia, Germany, California, and many islands where integration of batteries is motivated by incentives and/or high electricity costs.

GROWTH TO 2022

$ IN BILLIONS (B)		EST 2017	CAG % ENERGY (Wh)	CAG % Value	EST 2022
CONSUMER ELECTRONICS	PRIMARY	$22B	1%	0%	$20B
	RECHARGE	18	7	5	23
TRANSPORT	PURE EV	4	42	40	22[1]
	ALL OTHER	42	4	6	56
ELECTRICITY	ON & OFF GRIDS	4	22	20	10
INDUSTRIAL/DEFENSE/AIR		15	4	5	19
	TOTAL	$105B	≈7%	≈7%	$150B

(1) 1.5 million pure EVs by 2020

SILICON JOULE® TECHNOLOGY

05

This table shows my forecast for growth. You can see the energy content in kilowatt hours and the market value growth, which offers a view of the relative trends in energy content delivered vs their cost.

Let's start with the overall market where I estimate the market to increase an average of 7% to $150 Billion by 2022.

The forecast growth averages 7% for both energy content and value, even though some sectors are more likely than others to collect an increasing amount per kWh.

For pure EVs, included is a 2% annual cost reduction, in spite of material cost increases. In some applications, the better advanced lead batteries will offer much improved functionality, allowing higher cost recovery from their low starting cost position.

Sales forecasts vary a lot for pure EV vehicles for the next five years, reflecting different assumptions for regulations and incentives worldwide. Rather than debate the range of forecasts out there, I will just highlight that I have included an estimate of 1.5 million pure EV cars and light trucks being sold annually by 2022. This is below many forecasts, yet even at this level, the value of batteries with their safety systems will grow to $22 billion, which is about $15,000 per car and a growth rate of 40%.

This growth is being pursued aggressively by Samsung, LG Chem, Panasonic/Tesla and many Chinese producers. They are making huge capacity investments along with parallel commitments to mitigate the risks to the cost and supply of lithium and cobalt.

For clarity, the expanding range of low speed electric vehicles from bikes, to golf carts, delivery vehicles and others are spread across the rest of the transportation and industrial markets in these numbers.

The Electricity market integrating batteries on or off grid is the other prospect for high growth with solar and wind generation. We all know renewable generation costs have come down dramatically, and it is terrific for society, which can support a huge reduction in harmful emissions, at least when it is sunny or windy.

It is now obvious to many that to realize the highest potential of intermittent renewable generation you need to integrate batteries. That is unless you ignore the impact on grid reliability, other base load and transmission changes and costs, or limit the renewable generation to a small share of the systems.

For batteries, I believe this translates into possibly 20% annual growth. This is a synthesis of forecasts that differ by billions. Some of the higher forecasts include even more aggressive assumptions for capacity, materials and incentives.

For the consumer sector, the terrific growth rates for mobile phones, tablets, and other devices over the last decade has moderated. This is being complemented by so many new robots, medical items, toys and other devices. This includes the really interesting wearables market, where small batteries in clothes, smart watches, glasses, hats and boots

05
(continued)

may help or influence us in untold ways.

Energy storage continues to be an enabling technology, even if our users always say give us more energy, faster, smaller, lighter and cheaper. And yes, help me when I forget to recharge, as if a perpetual motion machine might yet be devised.

However, for many companies in this room, the opportunities may be greatest in the rest of the transportation sector, where the further evolution of stop/start is combined with a wide range of hybrid vehicle solutions which are being planned by car makers.

Reducing fuel consumption and emissions, the larger, harder working batteries I estimate will lead to market growth of 6% annually to $56 Billion.

The Industrial sector will grow at least 5% per year, first from the large material handling applications being driven by e-commerce and the related warehouse growth required for more and ever faster deliveries of your new shoes or dinner. In spite of the growth, the existing lead battery makers see added challenges in this large market. Beyond the preference for higher energy and less maintenance, some trucks now have lithium batteries enabling fast opportunity charges. And in the largest of Amazon and Walmart warehouses with large truck fleets we are also seeing more fuel cells where the high costs of the fuel cell packs and the hydrogen refueling infrastructure can be better amortized against other savings.

Our reliance on networks of all kinds in our personal lives and businesses from the cashless cash register to the factory floor is sure to call for continued growth in backup power batteries to keep us connected, and in business.

Lastly, beyond the growth in battery use for defense, aerospace and aircraft, there is the growth for civil use of battery powered drones in aiding emergencies like we faced with storms and flooding in Texas and Florida in the US this month. There is also growing surveillance applications for farms, forests and pipelines.

TRANSPORTATION OPPORTUNITIES

	ENERGY kWh	2022 NEW CARS	BATTERY VALUE
EV	20 – 100	< 2M	$8k – $25k
PHEV (High Voltage)	2 – 15	> 5M	$1k – $6k
48V Hybrids	1 – 5	> 10M	**$200 – $2k**
"Better" STANDARD	0.7 – 1.5	> 85M	$50 – $200
		105M *new cars sold*	

Where to focus?

SILICON JOULE® TECHNOLOGY

06

Many of us can remember the OE battery value at under $25 per car or less than one-quarter of 1% of a $15,000 car. Let's contrast that to the profile progressing with the very high value opportunities which I have segmented into four buckets in this slide.

In the left column you can see the energy content in ranges of kilowatt hours for the four segments, which starts with EVs, which may go from 20 to 100 kWhs per vehicle. From short range urban EVs where the value of the batteries may start under $8,000, or up to the longer range Teslas, delivery vans, etc. the battery value may exceed $20,000 per vehicle.
In this analysis, I am estimating for the EVs in Los Angeles, Frankfurt, Manchester or Tokyo, rather than the very practical, simple and slower EVs growing quickly in China, India and other markets.

In the second segment of high voltage hybrids, we may see a range of 2 to 15 kWhs of capacity, with battery value per vehicle of $1,000 to $6,000.

The emerging 48V hybrid or dual voltage systems represent a big opportunity with $200 to $2,000 per vehicle with an energy content range of 1 to 5 kWhs. This segment may have the greatest impact on changing our car fleet, due to its practicality and real net energy savings for society by halving the size of engines with smarter batteries, and really optimizing the use of much less fuel, with far lower emissions as a result.

07

The highest growth for a large market remains China. Their growth in new vehicles is now complemented with the maturing replacement market. And policies continue to push for more EVs and hybrids.

On the Industrial side, the scale of the mobile telecom and rail networks and power industry is supporting continued growth. This is also more electric material handling equipment and many low speed EVs scrambling across China's large and busy cities keeping them clean, or moving families and goods.

With the tightening regulations and aggressive local producers, the competition can be challenging, yet all the battery market leaders are committed to participate where the world's largest growth has occurred, and will continue.

India represents a large battery market, possibly as large as Europe already, because of the consumer use of batteries with inverters, plus hybrid radio base stations, and batteries within India's solar industry. However, it takes patience, low costs and innovative products and strategies to compete profitably in India given today's distribution channels and two strong local producers.

In a moment I will explain why Europe may be the second most interesting market for profitable growth.

REGIONAL GROWTH TO 2022

	KEY DRIVERS	CAG%
CHINA	EV, Hybrids & Solar & LS EV	10%
INDIA	EV, Hybrids & Solar	> 8%
REST OF ASIA/AUSTRALIA	Japan + Korea Transport Australia Solar	> 5%
EUROPE	Solar, EV & Hybrids vs Diesel	> 6%
AMERICAS (N+S)	Hybrids, EV & Industrial/Defense	> 5%
AFRICA	Solar	> 6%

After China, which markets for valuable growth?

08

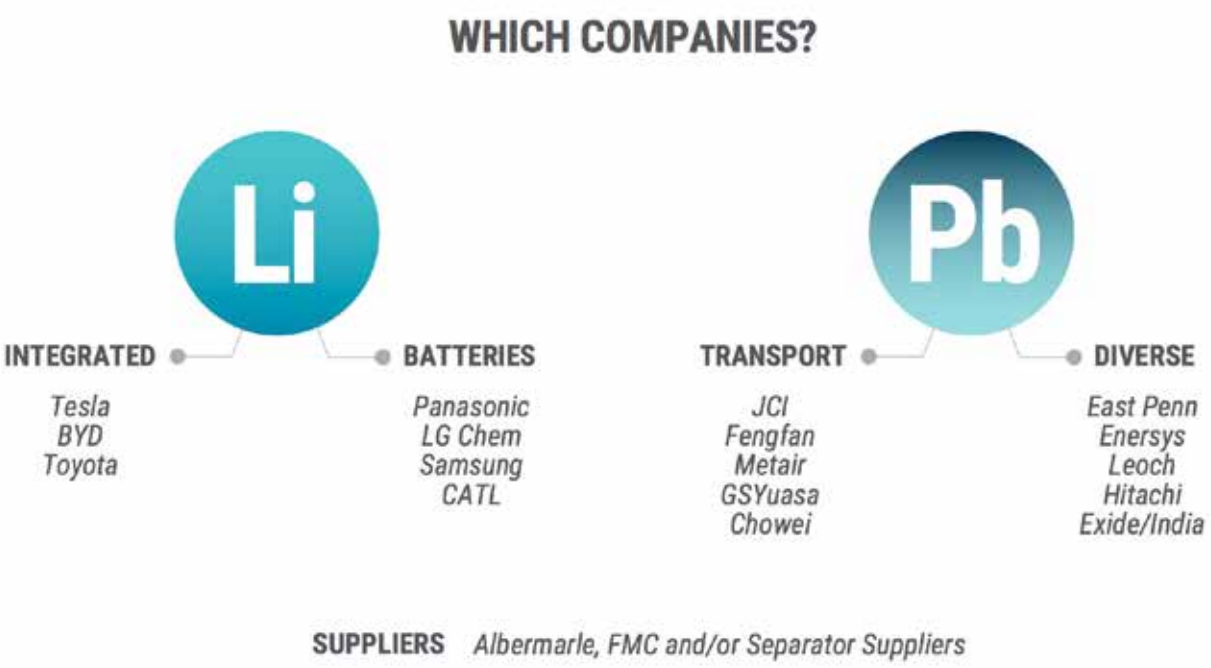
The good news is all regions are expected to share in attractive growth for energy storage based on the many factors explained.

Yet, I offered to share my opinion on the best opportunities, so let me explain the three reasons why Europe may rank second to China.

First, the response to the diesel emission issues has been dramatic in Europe where over half the new cars still have diesel engines. Car makers and regulators have committed to shift away from diesels and plans are accelerating to launch more hybrids and EVs.

Second, the early build out of solar capacity without storage in the EU is being complemented now by policies to support the integration of energy storage. This makes great sense for their grid, consumers and our industry.

Lastly, Europe's producers have seen some of the highest growth in material handling equipment sales. The e-commerce sales and the evolution to more efficient direct distribution channels may have started faster in North America and China, yet in Europe the savings' prize in distribution is potentially high, and this may support more investment in warehouses and the related lift trucks and batteries.



SILICON JOULE™ TECHNOLOGY

09

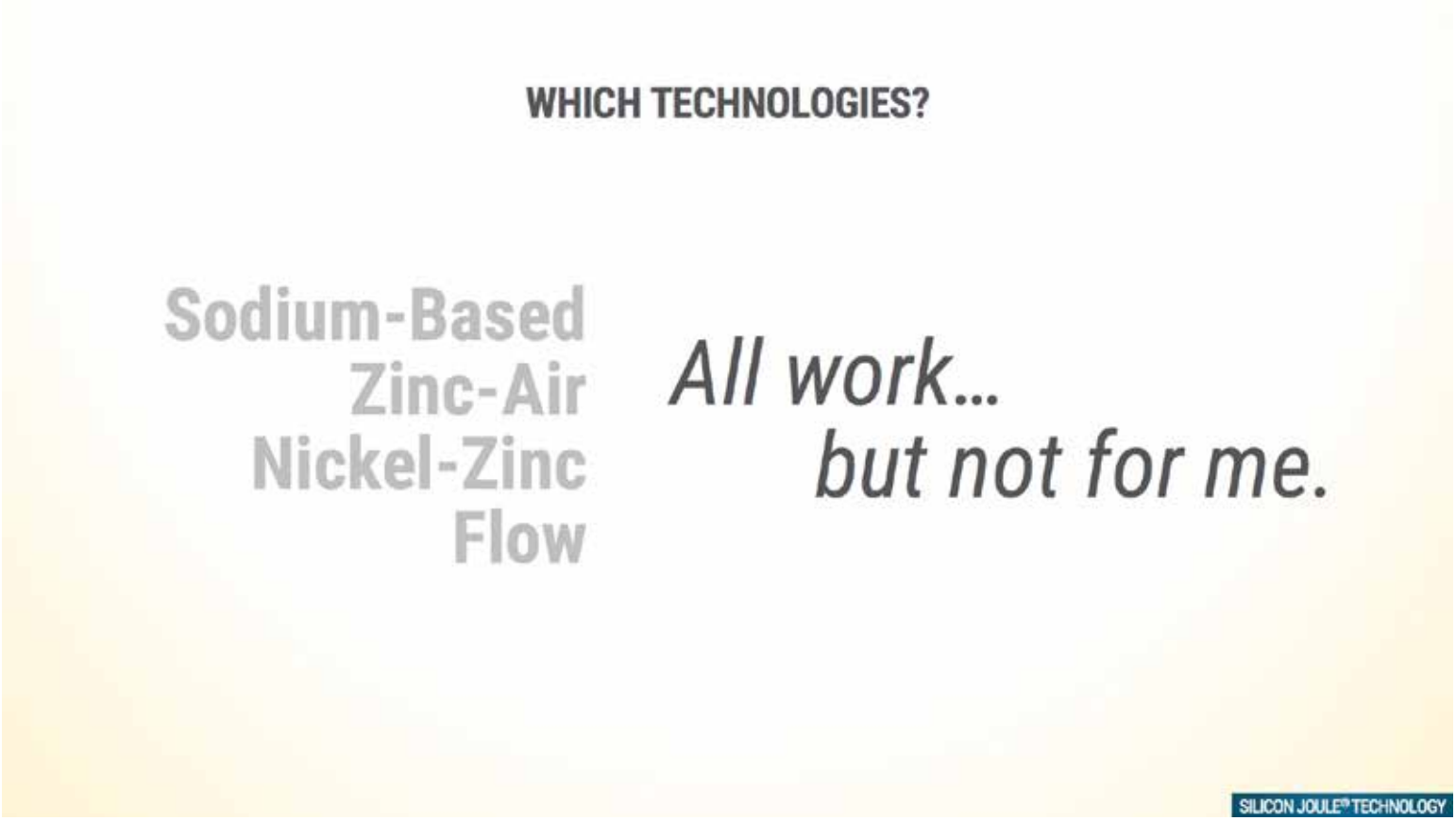
Shown here are companies grouped by their participation and influence within the lithium and lead-based battery sectors.

On the lithium side, I segment the companies who have their large energy storage business integrated with their applications - like Tesla, BYD and Toyota, because it may position them better for success.

For lithium batteries, it is ambitious to devise a strategy to compete with the leading Asian cell producers of Panasonic, LG Chem, Samsung and CATL. These producers, along with the three integrated vehicle companies mentioned have very high scale. Some have billions in positive cash flows and are making plans for much more capacity and research for lithium batteries. This may limit others striving for a profitable business producing lithium cells and batteries. Government incentives to help Germany establish a cell production platform may progress to protect their huge auto industry.

For lead batteries, I have segregated the larger companies into those who focus on transportation or the others from East Penn through to Exide India who supply a range of applications.

In addition, I have listed Albermarle and FMC as large lithium material suppliers, and the separator sector which is essential to both lead and lithium battery makers.



10

Before narrowing choices further on companies, let me share my bias on the prospect for battery technologies.

There is a lot of continuing R&D and start-up funding beyond lithium and lead battery technologies from sodium-based, to multiple others using many of the metals in the periodic table. Some of these may survive, even thrive in the environment where we have such attractive growth. My guess is that outside of safer lithium, and advanced lead, the other technologies are fighting at best, for niches in the market, unless some really unique breakthrough.

This bias reflects the huge scale and respective market strengths of the existing advanced lithium and leading advanced lead based battery companies, and also because both of these technologies, in my opinion, have a lot of further product development potential.

For lithium, the companies directly integrating the safer versions of lithium already commercialized, or being developed, are attractive as candidates for investment. In addition, those reducing costs with cobalt reductions or elimination without yielding too much performance are attractive.

Advanced lead batteries, I believe, are likely to get much better in performance while retaining their unique strengths of low costs and world-leading sustainability. Yes, I really believe advanced lead batteries will soon be achieving 2-3x performance improvements to rival lithium batteries in many applications, aside from extended range pure EVs.

And there are two parts of the story for lead batteries' potential improvements:

1. Much better active material recipes for charge acceptance, higher active material utilization and longer cycle life at various states of charge, and

2. True bipolar architecture platforms that can really stretch power and energy ranges and voltage options.

Many companies are achieving higher charging rates and cycle life, and research is well underway from Japan to the US, also at national labs. Much better analytics and tools to determine what additives and materials should be in or out to achieve the crystal structures necessary for breakthrough performance in active materials is closer than two years ago.

And for bipolar advanced lead solutions, there is real progress by different companies which are diligently pushing for commercialization as early as 2019. And the architecture improvement provided by bipolar batteries will, I believe, further amplify the improvements underway in paste recipes.

One other appealing investment theme comes from comparing the opportunities in energy storage today to the California Gold Rush in the 1800s. Thousands of people worked feverishly to find gold. Yet, some of the best investments proved to be those supplying the materials, shovels and services to the people searching for gold.

Using this analogy today in our attractive markets, investments in the companies supplying lithium materials or separators or related services might prove great opportunities. Many of these companies like Albermarle and others are already flourishing.

For the sake of transparency, I would explain my personal battery investments, all of which are long term, and they simply follow the themes I have explained.

I have two significant personal investments, one in the advanced lead area being Gridtential for its Silicon Joule bipolar technology, and the second is an integrated lithium battery and vehicle company, BYD of China. And I have smaller investment in a miner, Lithium Americas.

BYD made sense to me based on their strategy around EV buses and forklift trucks targeted worldwide with their defined operating ranges. And of course BYD has a large local China position including EV car sales and lithium battery production, backed by good governance.

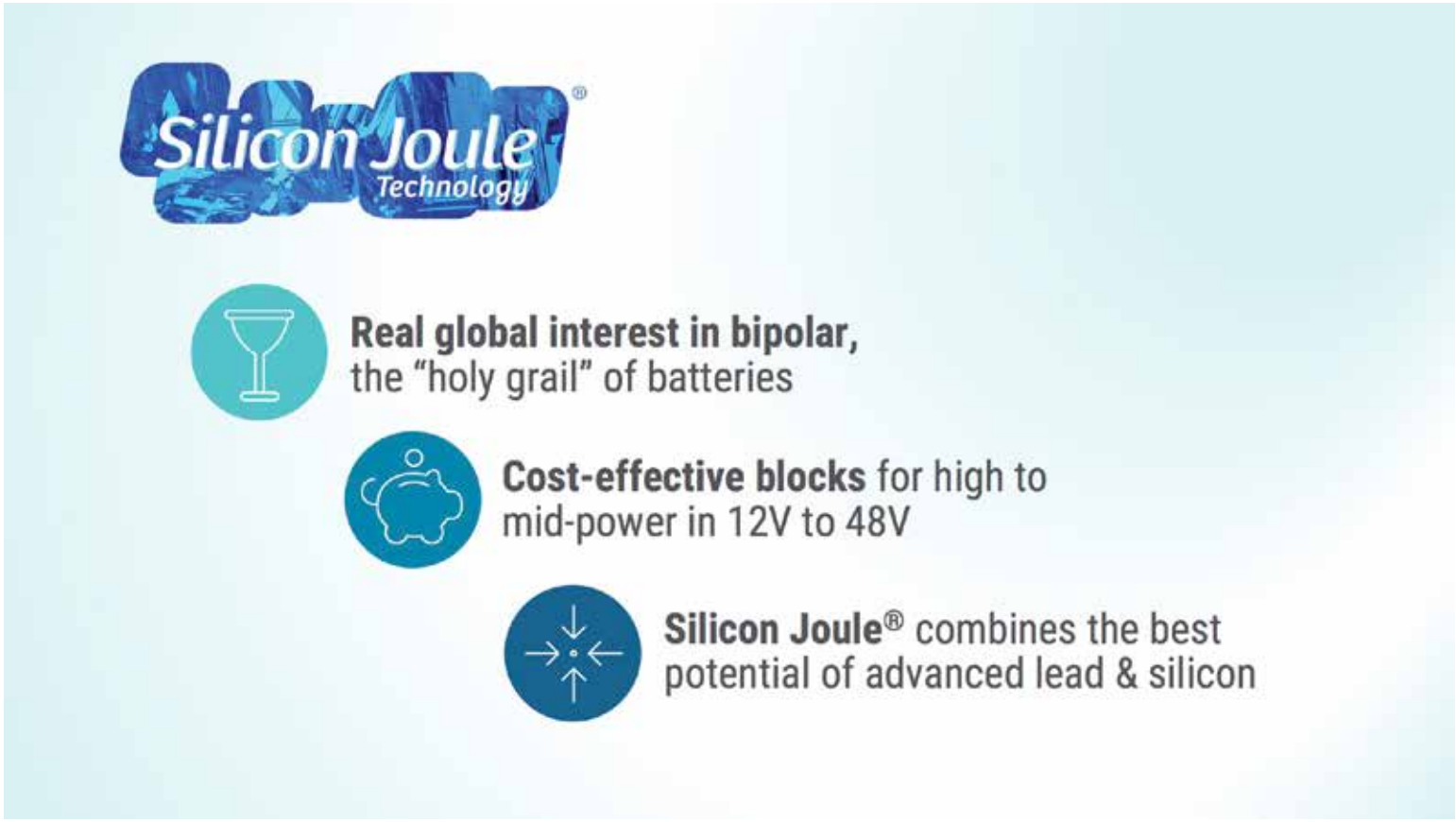
Before I close with comments on Gridtential, I would like to highlight a view on regulations.

The EU regulation for vehicles at end of life (or ELV) was well intentioned striving to promote a sustainable economy and protect the environment in the EU and abroad, where often third world countries catch the terrible burden of unsafe recycling practices of many materials within a car. As many of you know, there is a Lead ban in the ELV Directive, even though so far the EU has made short exemptions to this ban.

However, the 99%+ successful returning, recycling of lead batteries in the EU and worldwide, and their effective perpetual complete reusability in future batteries is an perfect example of a sustainable material for productive use in our society. The use of lead in legacy applications like gas, paint, pipes and others was a mistake, now acknowledged and corrected, or in process. However for batteries, lead used is a brilliant example of sustainability.

The ELV Directive is practically supporting the substitution of lithium for lead batteries, and . It is having is the absolute reverse impact to the intended objective of the ELV Directive, in my opinion. For now, most lithium batteries are ending up in landfills or third world countries, and they are dangerous at end of life for many reasons. There is no common sense being applied in this situation, which I hope will be reversed in the coming years.

I remain a big fan and investor for advanced energy storage including lithium batteries well designed and controlled, along with a return scheme. Yet the regulations to control them are far behind. The fires and injuries we are already seeing and risking daily around the world will only increase, and they will multiply especially in Europe if the ELV ban is not logically reversed.



13

I will close commenting on Gridtential's Silicon Joule bipolar technology.

Many battery scientists accept bipolar as the Holy Grail in battery development due to its unique potential in power and energy contrasted to familiar battery construction. However, there have been a lot of failed attempts to get the theoretically possible designs out of the lab to commercial use.

Complementing the inherent efficiency gains of a bipolar battery is the ability to build blocks flexibly from 12v to 48v to match up more efficiently with so many system needs across our industry, especially in automotive and backup power applications.

The Silicon Joule is being developed with strong battery partners as a unique combination of low cost treated silicon wafers combined with the ever improving lead active material designs to deliver breakthrough performance. It obsolete's grids and cast on straps, also allowing a much lighter battery.

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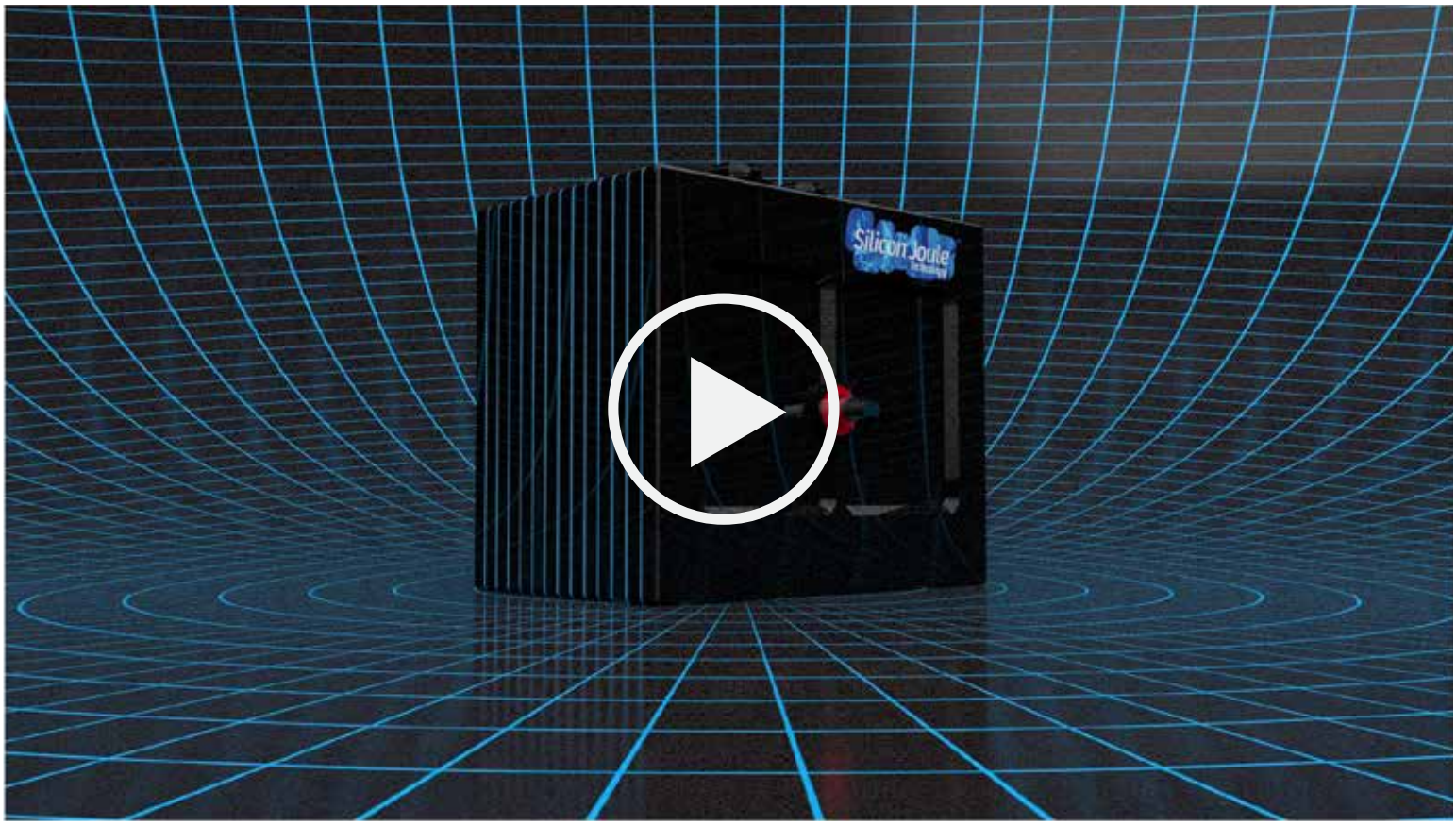
The Silicon Joule technology enables manufactures to convert incrementally their large existing factories to adapt the technology without spending billions for new plants. There is more work left to be done by Gridtential and our battery partners, yet the progress is real, and the potential is huge.



15 Before closing with a video, you have heard my preferences for investments by applications, regions, technologies and companies through the remarks already. There are a lot of really good battery and supplier companies investing smartly for the future. All the best to you with your choices.

Thank you.

RAY KUBIS
CHAIRMAN

GRIDTENTIAL

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