The Future of Energy

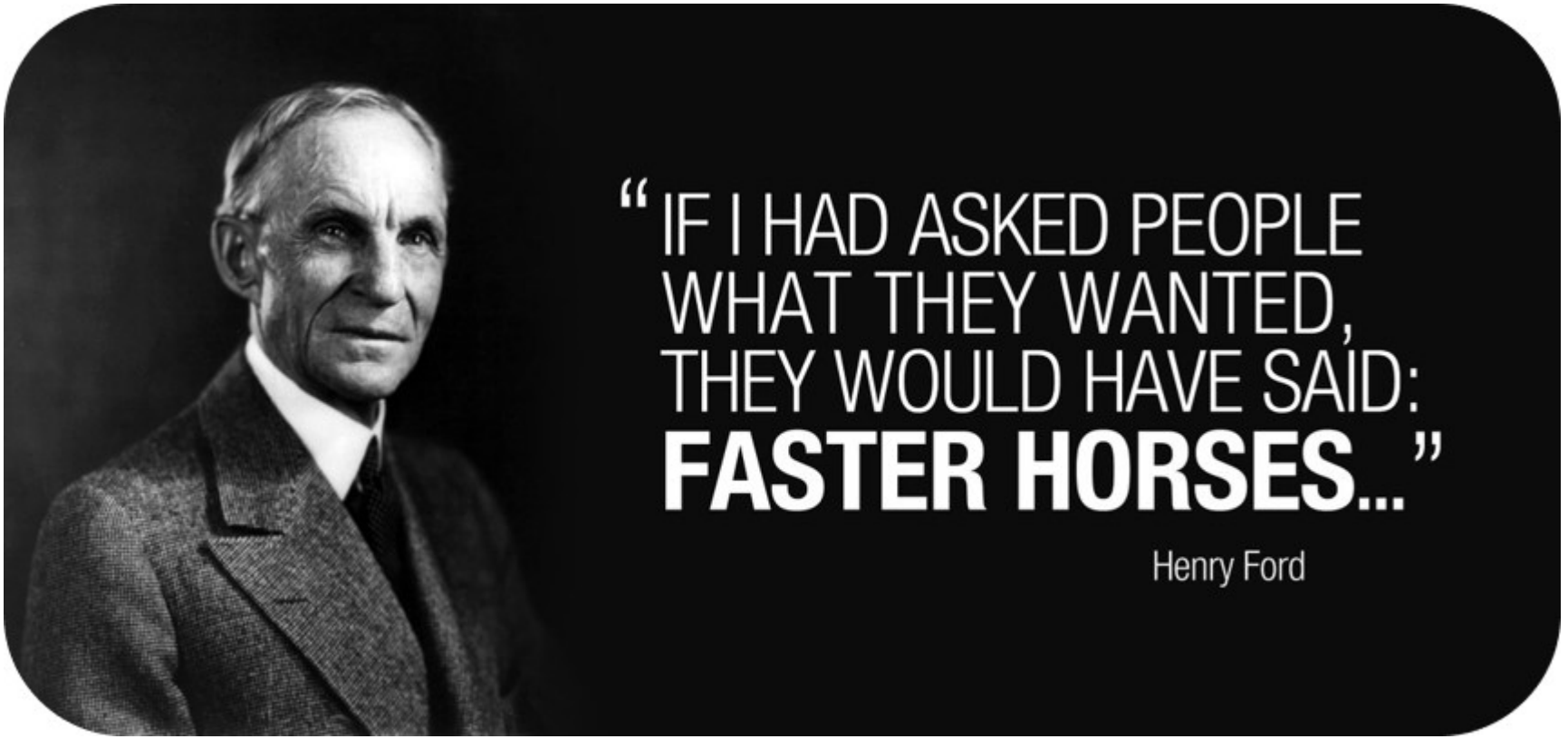
A view from the finance world

Gerard Reid

Co-Founder & Partner, Alexa Capital

January 2021

A REVOLUTION IN HOW WE CONSUME AND PRODUCE ENERGY IS UNDERWAY



CONTENTS

FIVE FACTORS WILL DRIVE US TO A MORE SUSTAINABLE FUTURE

DRIVERS OF THE ENERGY REVOLUTION

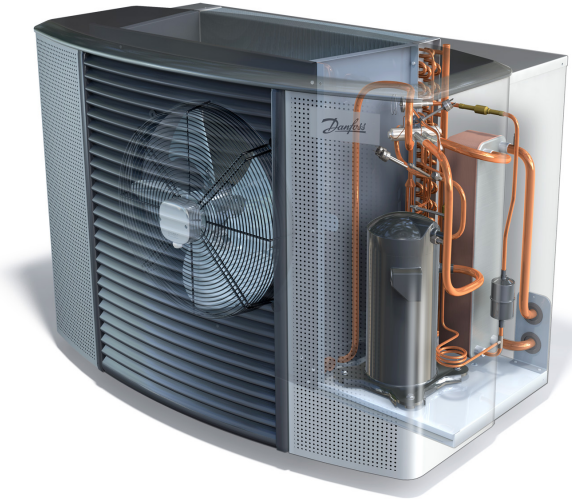
- The need to electrify
- Rise of renewables
- Digitalisation 2.0
- Electrification of transport
- Emergence of Storage

A ZERO-CARBON, SUSTAINABLE PLANET

ELECTRICITY IS BECOMING THE WORLD'S MOST IMPORTANT ENERGY SOURCE

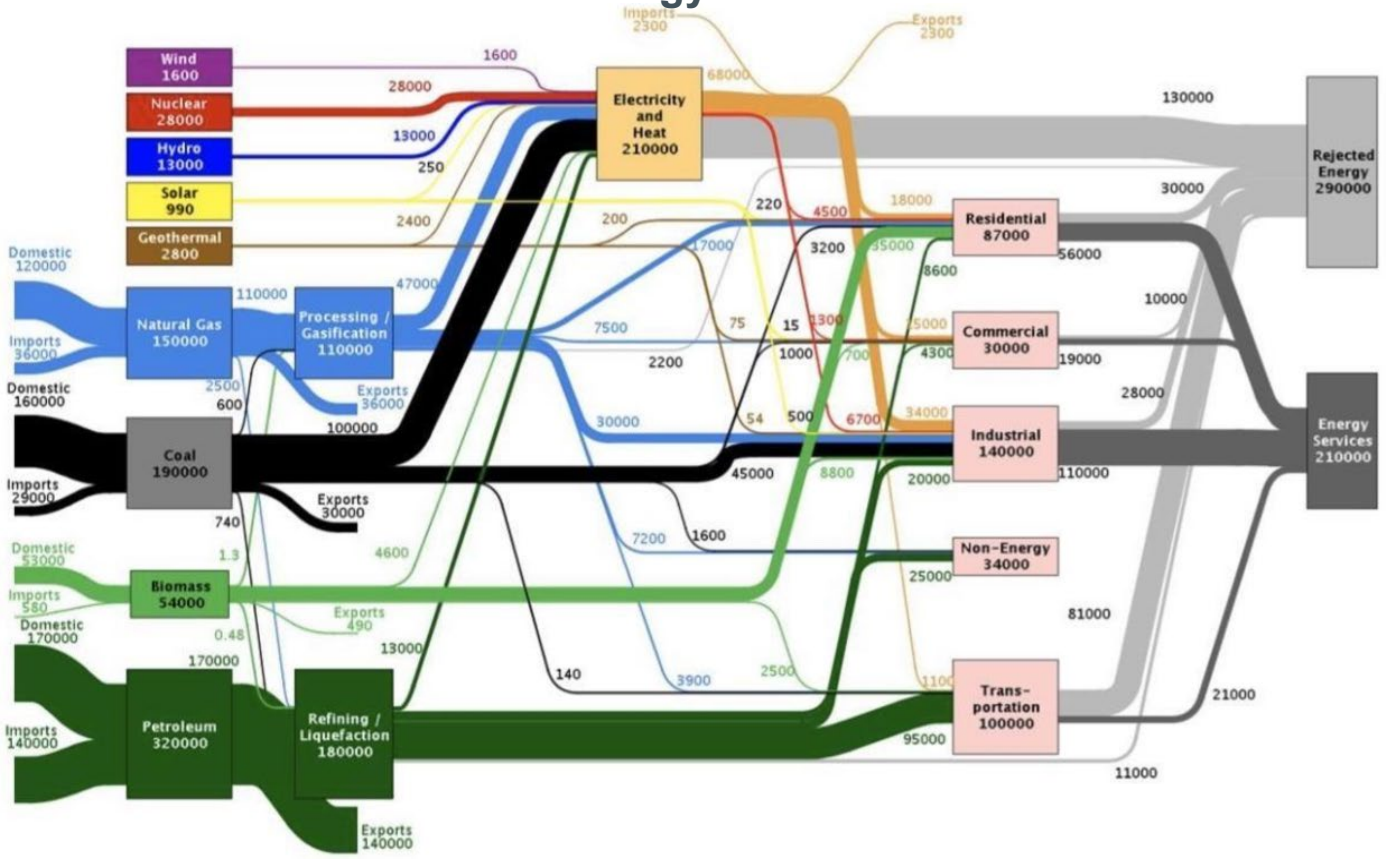
DRIVER #1: IT ALREADY IS AS OUR DIGITAL WORLD CAN NOT SURVIVE WITHOUT ELECTRICITY!

DRIVER #2: TECHNOLOGY CHANGE AND ECONOMICS WILL PUSH US TO ELECTRIFY TRANSPORT, HEAT AND HEAVY INDUSTRY



DRIVER #3: ONE OF THE BEST WAYS TO LOWER CO_2 EMISSIONS IS TO REDUCE ENERGY CONSUMPTION THROUGH ELECTRIFICATION

Our Energy System is highly inefficient, wasting 60% of the energy extracted



Diesel

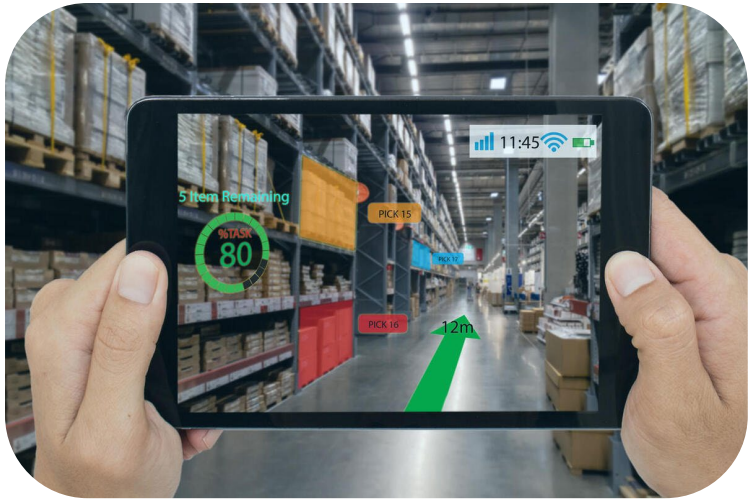
45 kWh / 100 km

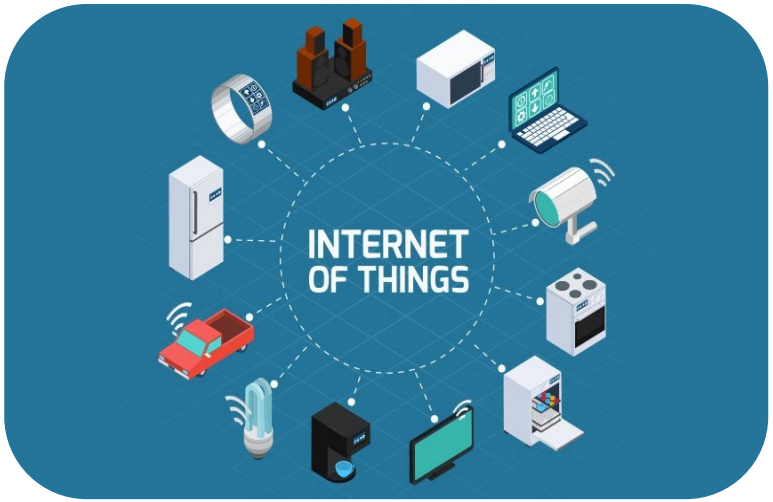
EV

15 kWh / 100 km

Source: IFU Hamburg

DRIVER #4: OUR FUTURE DIGITAL WORLD NEEDS MORE ELECTRICITY!

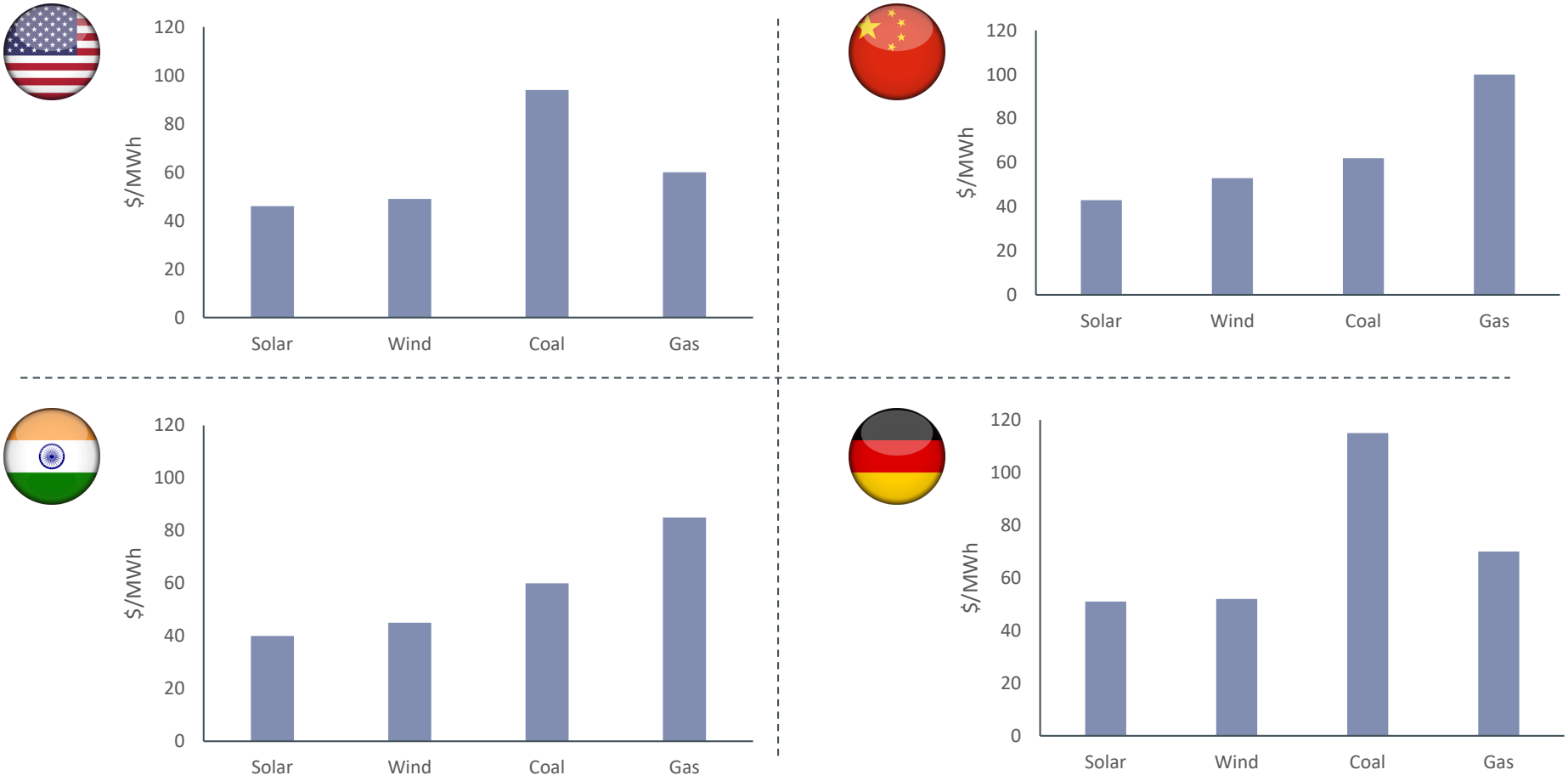




RENEWABLES TECHNOLOGY WILL DOMINATE THE GLOBAL CAPACITY MIX OVER THE COMING DECADES

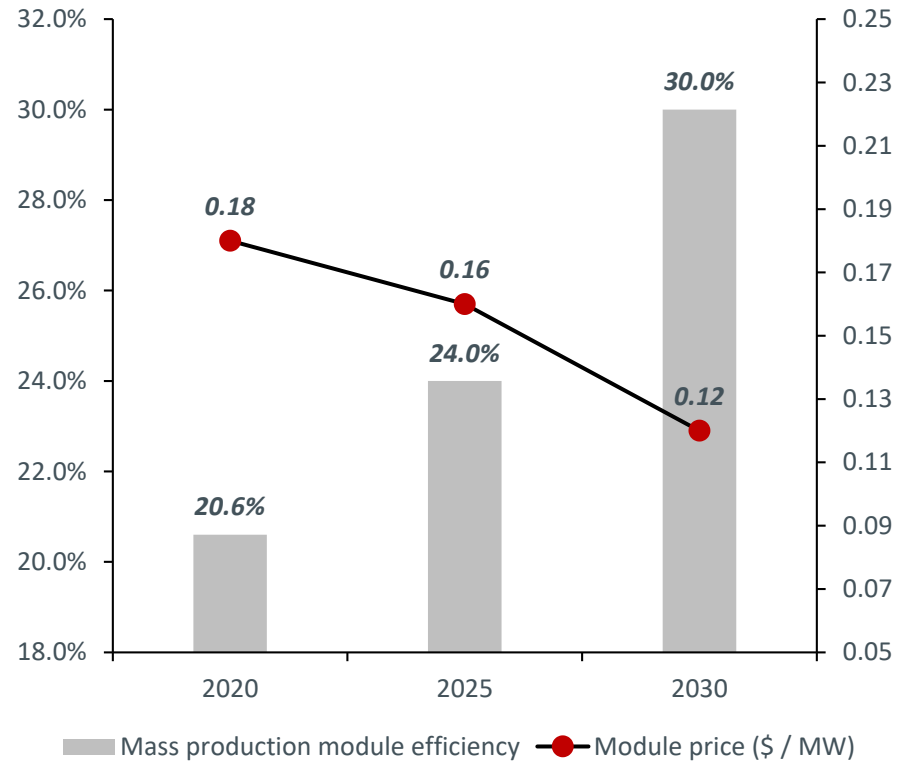
DRIVER #1: LOW COST RENEWABLES...

LCOE by technology in different markets



Source: Alexa Capital

DRIVER #2: WE WILL SEE FURTHER COST REDUCTIONS IN RENEWABLES AND IN PARTICULAR SOLAR WE WELL AS PERFORMANCE INCREASES



Sources: Bloomberg, International journal of science

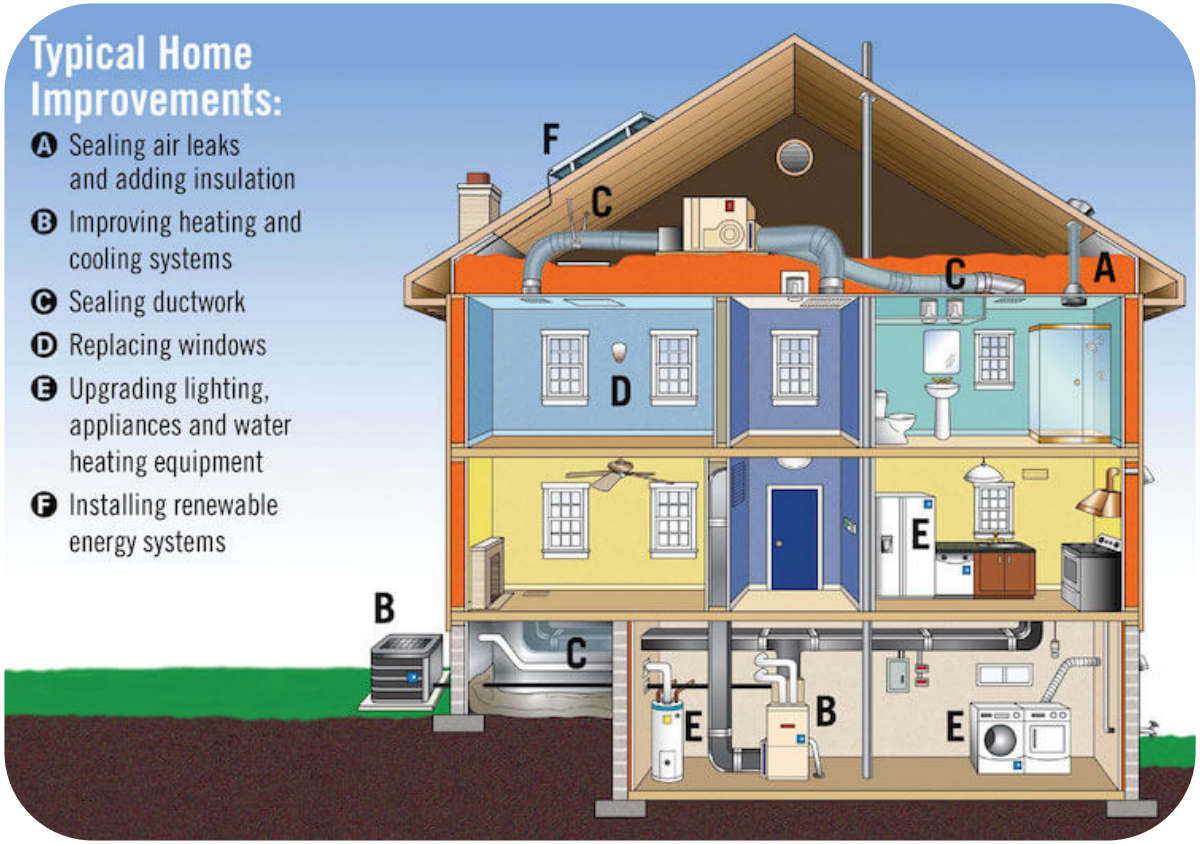
DRIVER #3: IT IS MUCH EASIER AND CHEAPER TO DECARBONISE ELECTRICITY THAN HYDROCARBON FUELS…

Decarbonising heat is:

Expensive

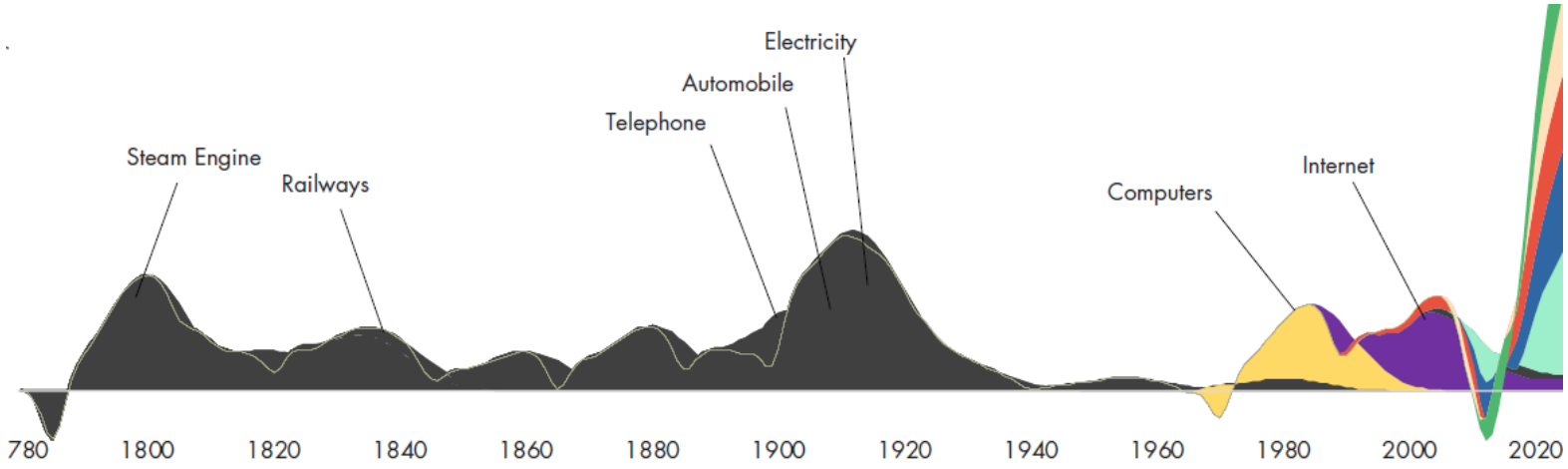
&

Disruptive



DIGITALISATION 2.0 IS THE KEY TECHNOLOGY DISRUPTOR OF THE NEXT DECADE, AND WILL TRANSFORM THE WAY WE THINK ABOUT ENERGY & MOBILITY

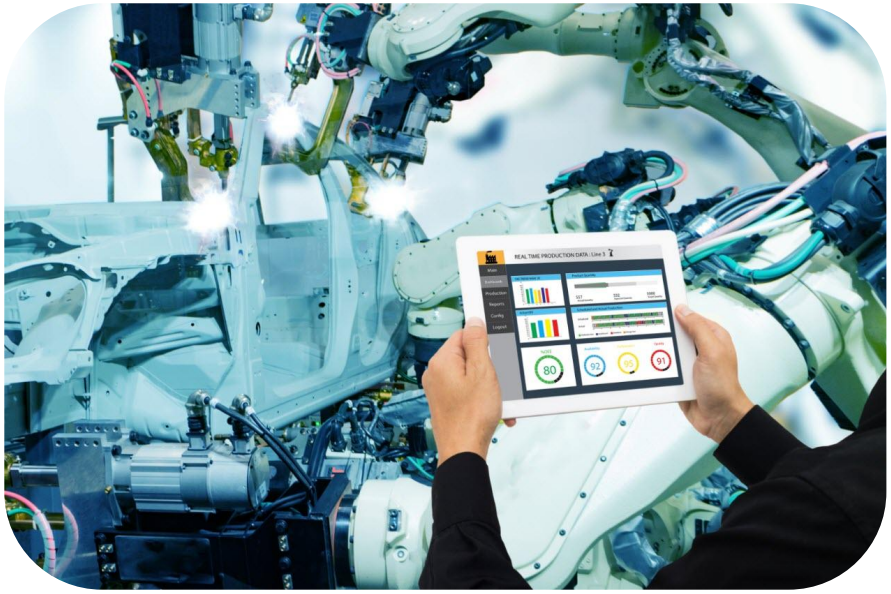
Impact of Big Technology Shifts on Economic Development



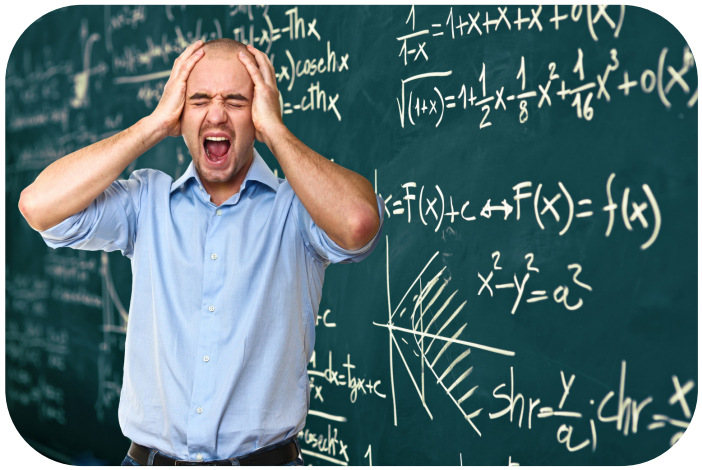
Digitalisation 2.0

- Cloud computing
- IoT
- Big Data
- AI
- 5G

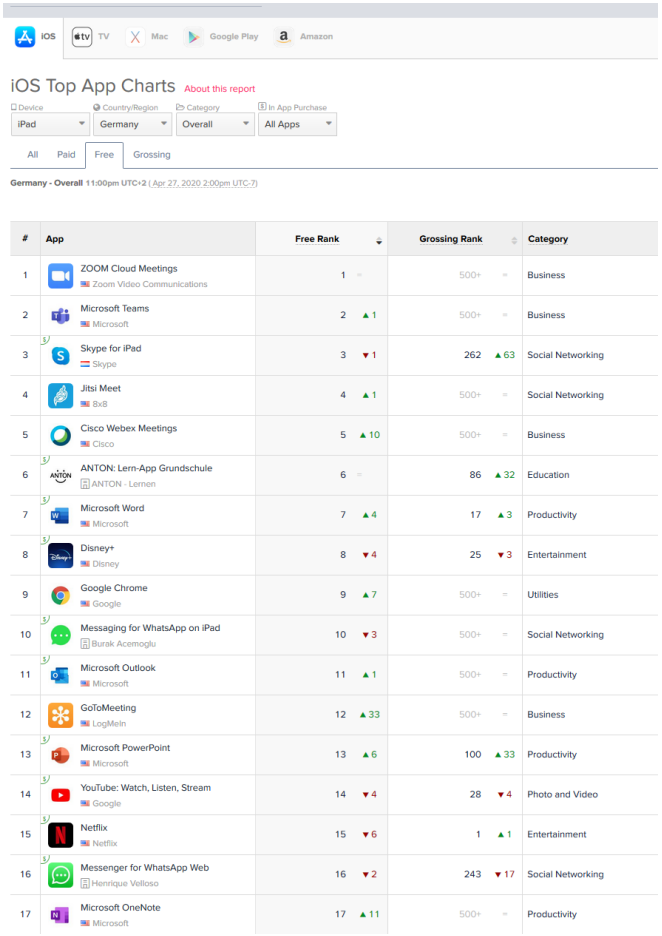
DRIVER #1: ECONOMICS



DRIVER #2: EASE OF USE



DRIVER #3: COVID-19 IS ACCELERATING THE DIGITAL TRANSITION



iOS | TV | Mac | Google Play | Amazon

iOS Top App Charts

About this report

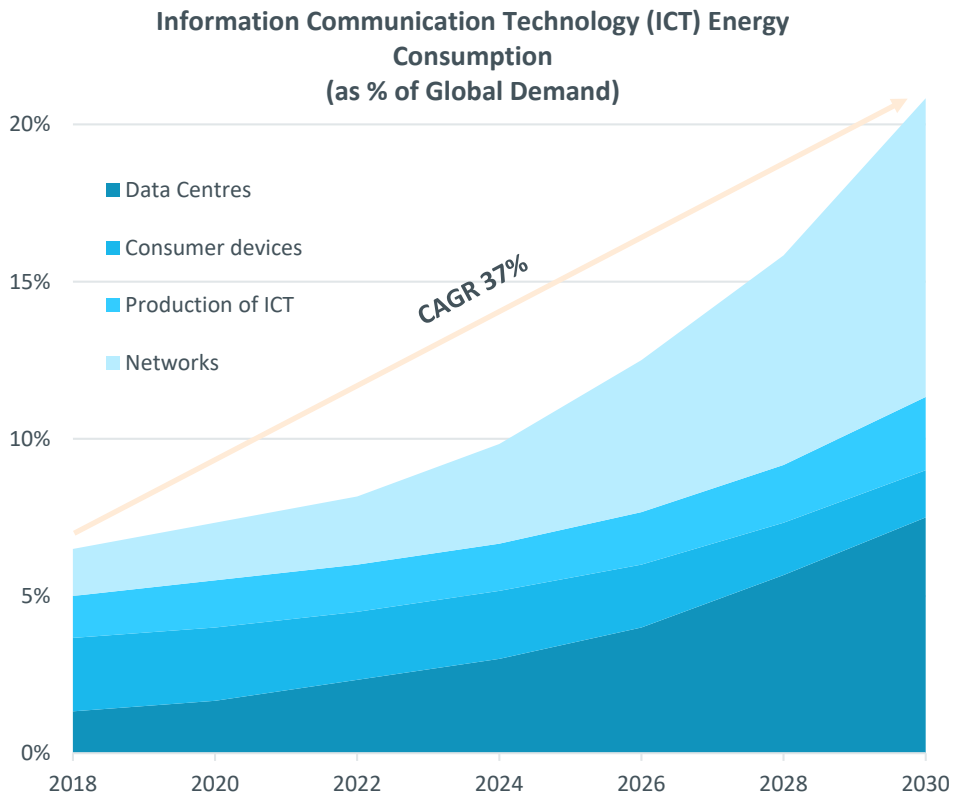
Device: iPad | Country/Region: Germany | Category: Overall | In App Purchase: All Apps

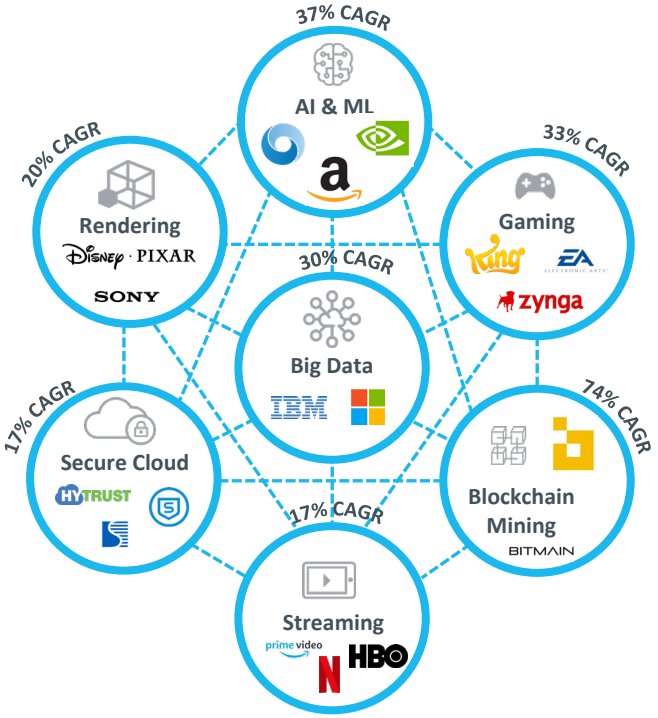
All | Paid | Free | Grossing

Germany - Overall 11:00pm UTC+2 (Apr 27, 2020 2:00pm UTC-7)

#	App	Free Rank	Grossing Rank	Category
1	ZOOM Cloud Meetings Zoom Video Communications	1 =	500+ =	Business
2	Microsoft Teams Microsoft	2 ▲1	500+ =	Business
3	Skype for iPad Skype	3 ▼1	262 ▲63	Social Networking
4	Jitsi Meet 8x8	4 ▲1	500+ =	Social Networking
5	Cisco Webex Meetings Cisco	5 ▲10	500+ =	Business
6	ANTON: Lern-App Grundschule ANTON - Lernen	6 =	86 ▲32	Education
7	Microsoft Word Microsoft	7 ▲4	17 ▲3	Productivity
8	Disney+ Disney	8 ▼4	25 ▼3	Entertainment
9	Google Chrome Google	9 ▲7	500+ =	Utilities
10	Messaging for WhatsApp on iPad Burak Acemoglu	10 ▼3	500+ =	Social Networking
11	Microsoft Outlook Microsoft	11 ▲1	500+ =	Productivity
12	GoToMeeting LogMeIn	12 ▲33	500+ =	Business
13	Microsoft PowerPoint Microsoft	13 ▲6	100 ▲33	Productivity
14	YouTube: Watch, Listen, Stream Google	14 ▼4	28 ▼4	Photo and Video
15	Netflix Netflix	15 ▼6	1 ▲1	Entertainment
16	Messenger for WhatsApp Web Henrique Velloso	16 ▼2	243 ▼17	Social Networking
17	Microsoft OneNote Microsoft	17 ▲11	500+ =	Productivity

DRIVER #4: BIG TECH POWER DEMAND WILL CONSUME 21% OF TOTAL ENERGY BY 2030





Global data center market size projections appear conservative, since forecast growth rates for Big Data applications are significantly higher.

Sources: Bloomberg, International journal of science

THE TRANSPORTATION SECTOR IS ELECTRIFYING

EVs

DRIVER #1: PHYSICS AND ECONOMICS ARE DRIVING AUTOMOBILES TOWARDS AN ELECTRIC FUTURE

ICE

25% efficiency

Oil | Plant to tank | Thermodynamic losses | Engine & transmission

6 litres per 100km

€6.50

Hybrid

28% efficiency

Oil | Plant to tank | Thermodynamic losses | Engine & transmission

4.5 litres per 100km

€4.50

EV

77% efficiency

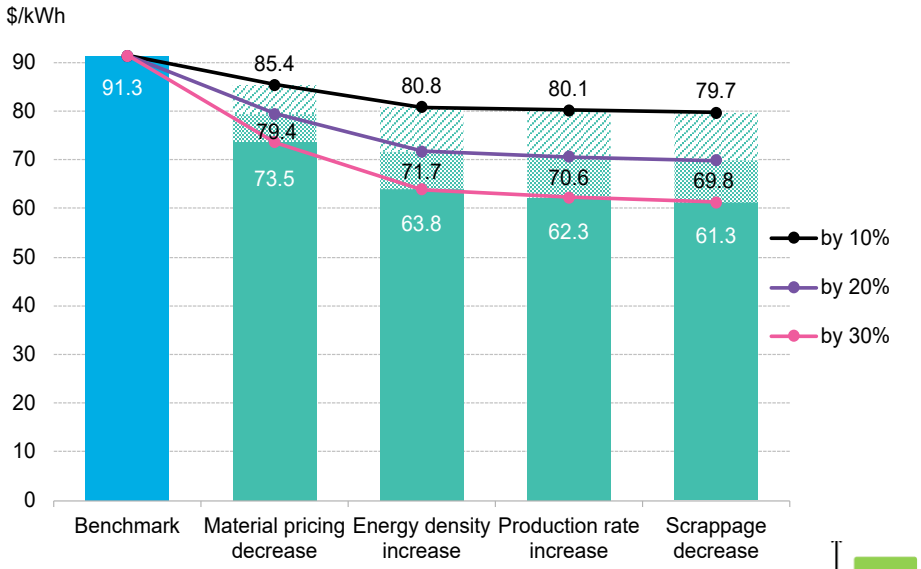
Renewables | Grid losses | Battery charger | Li-ion batteries

15.5kWh per 100km

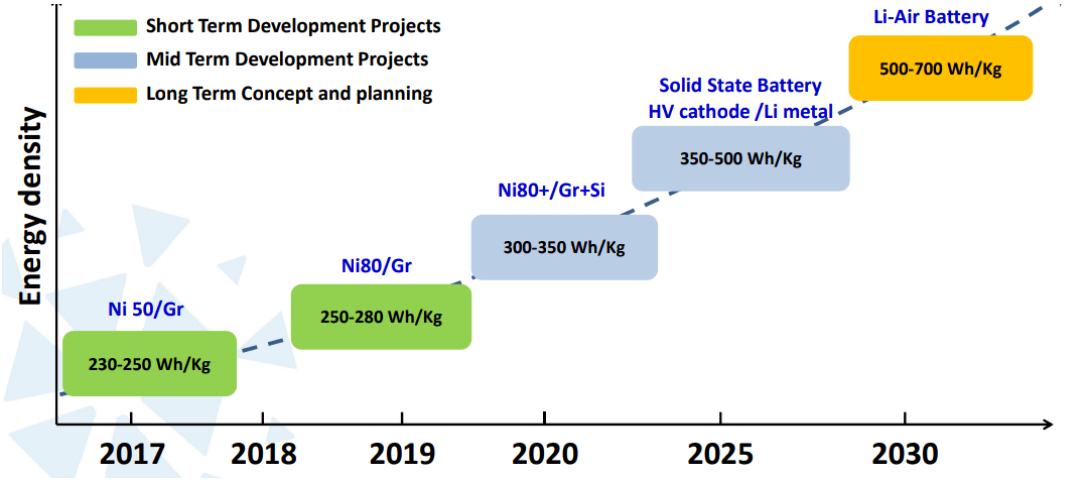
€1.08

Source: Alexa Capital

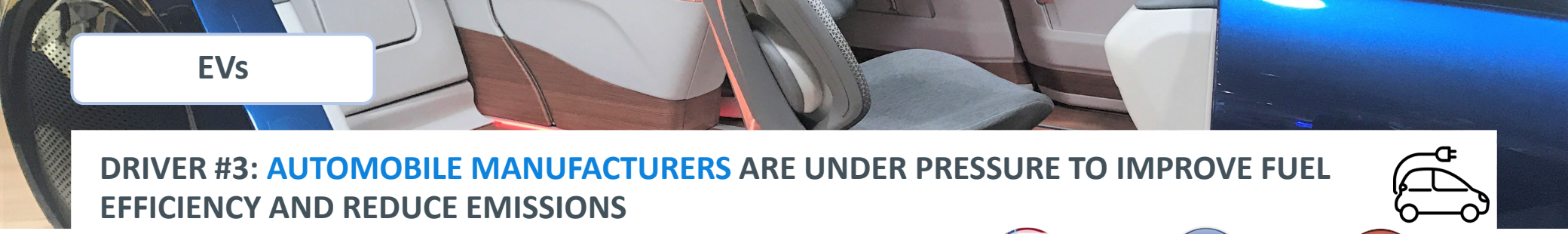
DRIVER #2: BATTERY CELL COSTS ARE GOING TO FALL FURTHER IN THE NEXT YEARS AND PERFORMANCE AND LIFETIME IS GOING TO IMPROVE



1000+km range EVs are in sight!



Source: BNEF & CATL



DRIVER #3: AUTOMOBILE MANUFACTURERS ARE UNDER PRESSURE TO IMPROVE FUEL EFFICIENCY AND REDUCE EMISSIONS

TCO advantage to drive widespread adoption	✓	✓	✓
Depends on the evolution of fuel & battery prices, taxes, incentives	✓	✗	✗
Increasing offer of desirable EVs in premium segments	✓	✗	✗
Tightening regulations & CO2 fleet emissions targets	✓	✓	✓
City level emissions regulations & restrictions	✓	✓	✓
ICE registration bans	✗	✓	✗
Incentives and tax advantages are present but declining	✗	✓	✓
xEV adoption will follow announced targets for NEV and FH/MH	✗	✗	✓

Source: Alexa Capital

DRIVER #4: EVS ARE EXCITING TO DRIVE!

Tesla Model 3 S

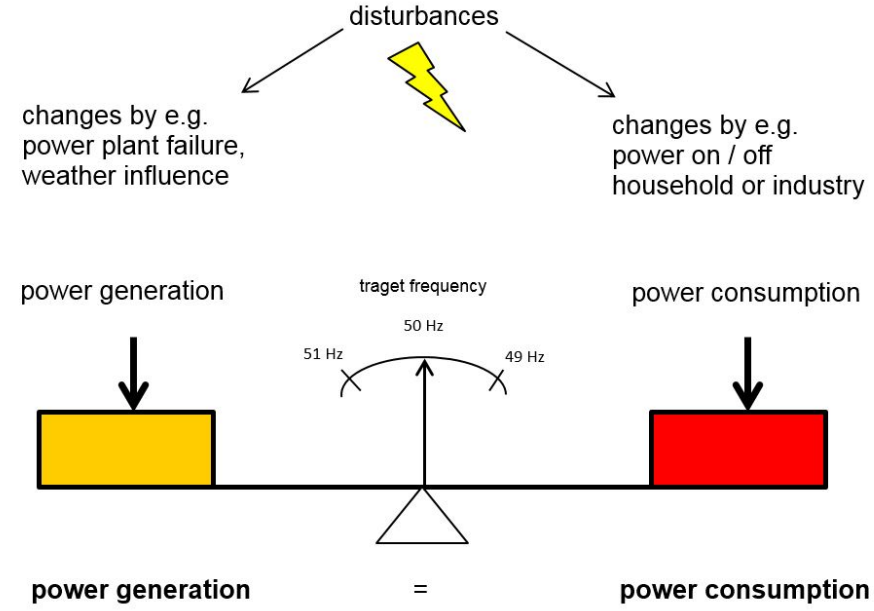
0-100kmh = 3.2sec!

VW ID3

0-100kmh = 7sec!

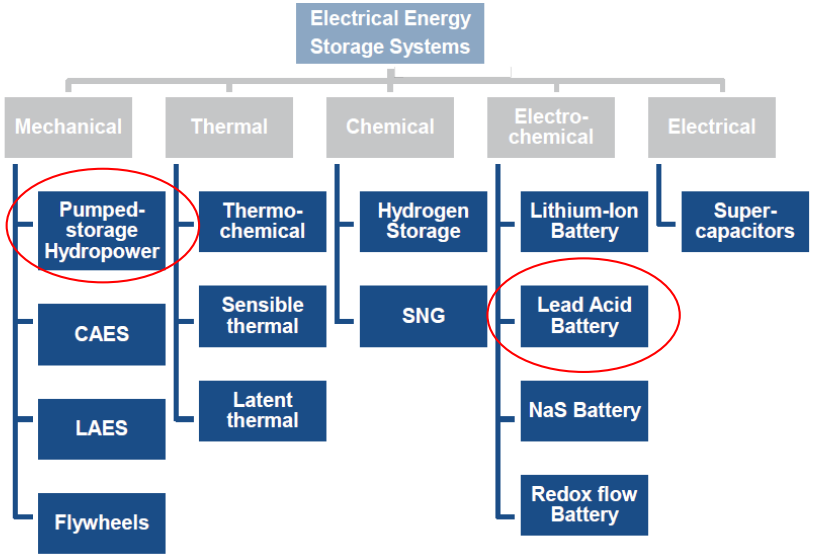
WE ARE GOING TO SEE ENERGY STORAGE EVERYWHERE

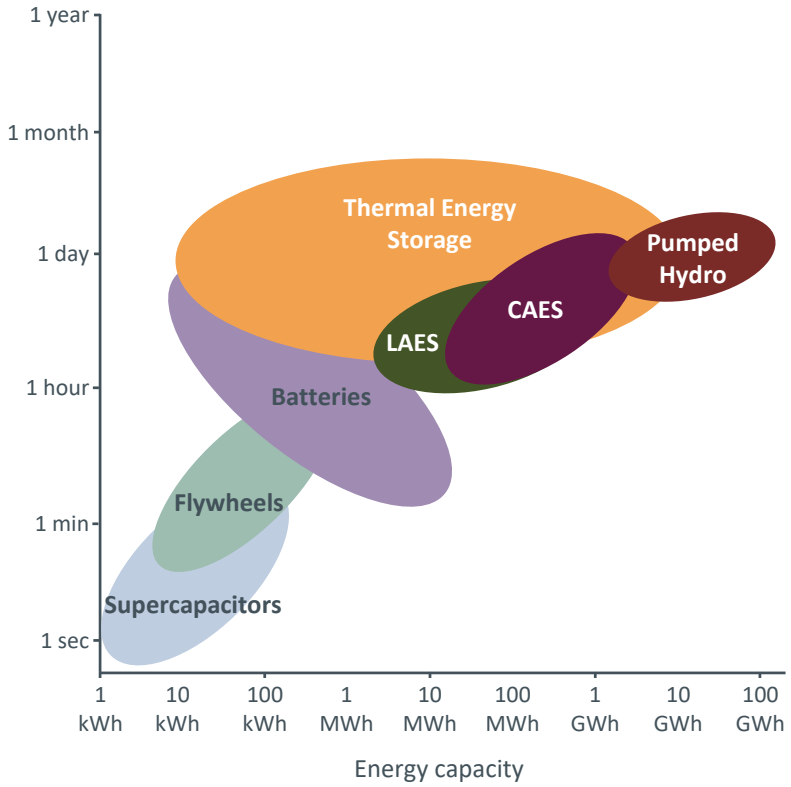
FOSSIL FUELS ARE EASY TO STORE WHILE ELECTRICITY IS NOT…



DRIVER #1: THERE ARE LOTS OF ELECTRICAL STORAGE TECHNOLOGIES ALREADY, AND THESE NEED TO BE USED DIFFERENTLY

TWO TECHNOLOGIES HAVE DOMINATED THE LAST 100 YEARS: PUMPED HYDRO & LEAD ACID

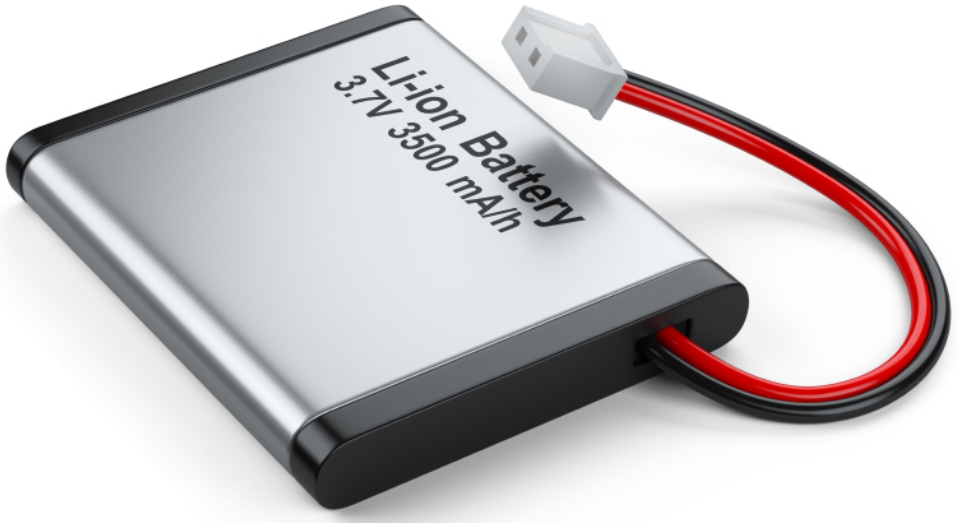




Source: BNEF

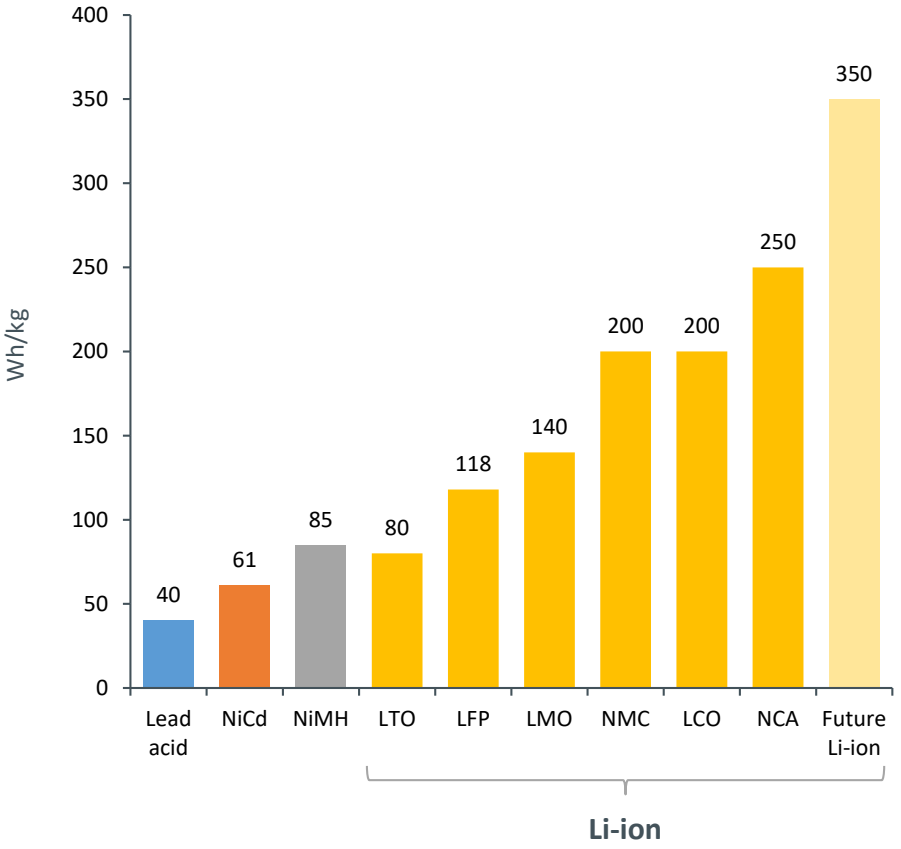
DRIVER #2: LITHIUM ION BATTERIES ARE ALREADY EVERYWHERE!

I COUNTED 150 IN MY HOME…

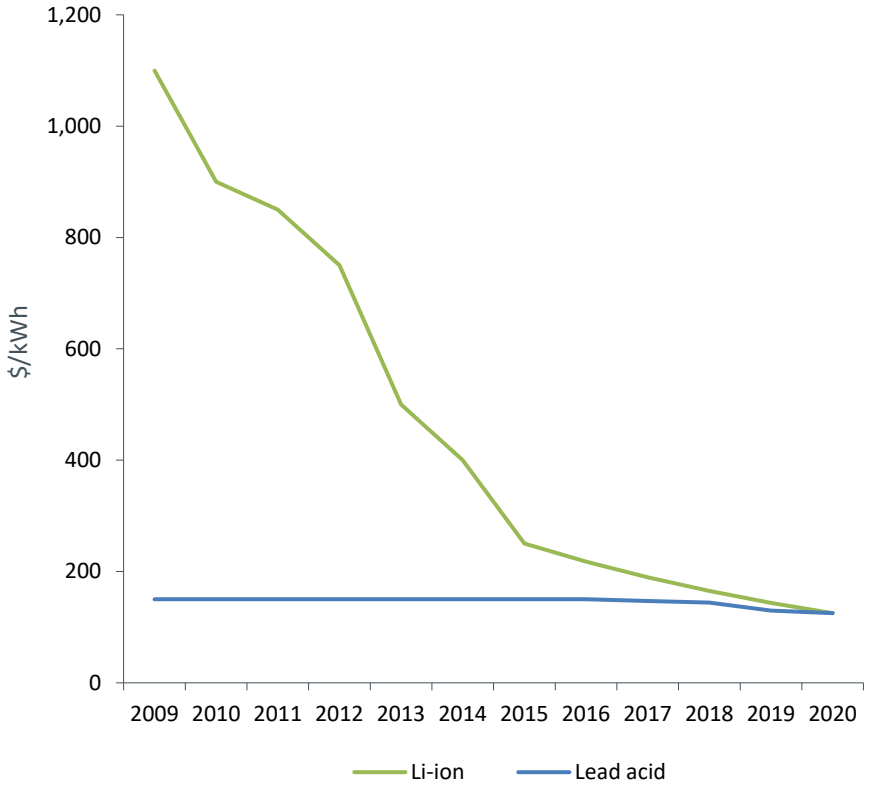


DRIVER #3: LITHIUM-ION BATTERIES IS TAKING OVER FROM LEAD ACID BATTERIES

Energy Density of Different Batteries

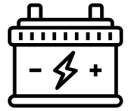


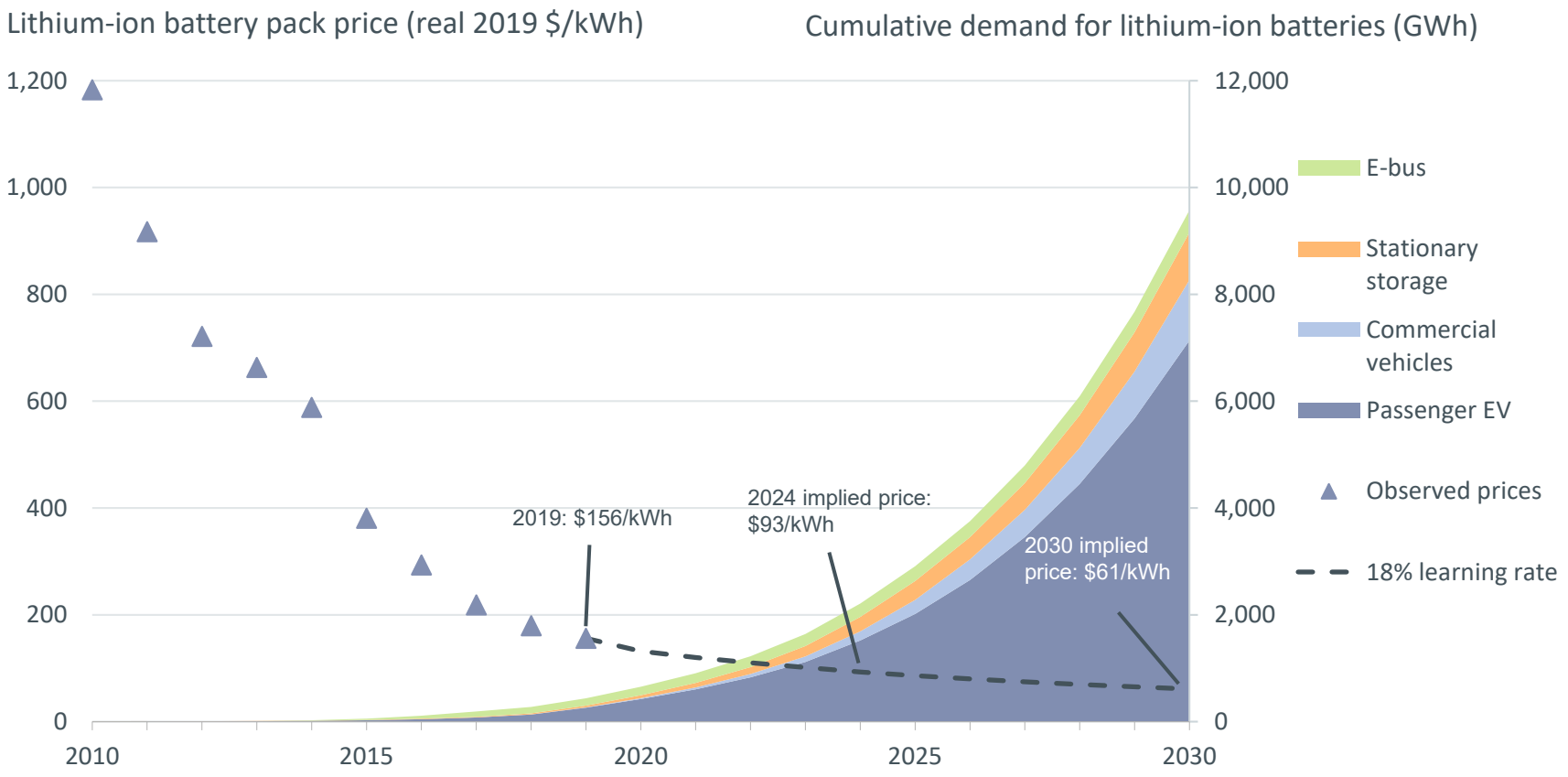
Li-ion are now at the same price as lead acid



Source: BNEF

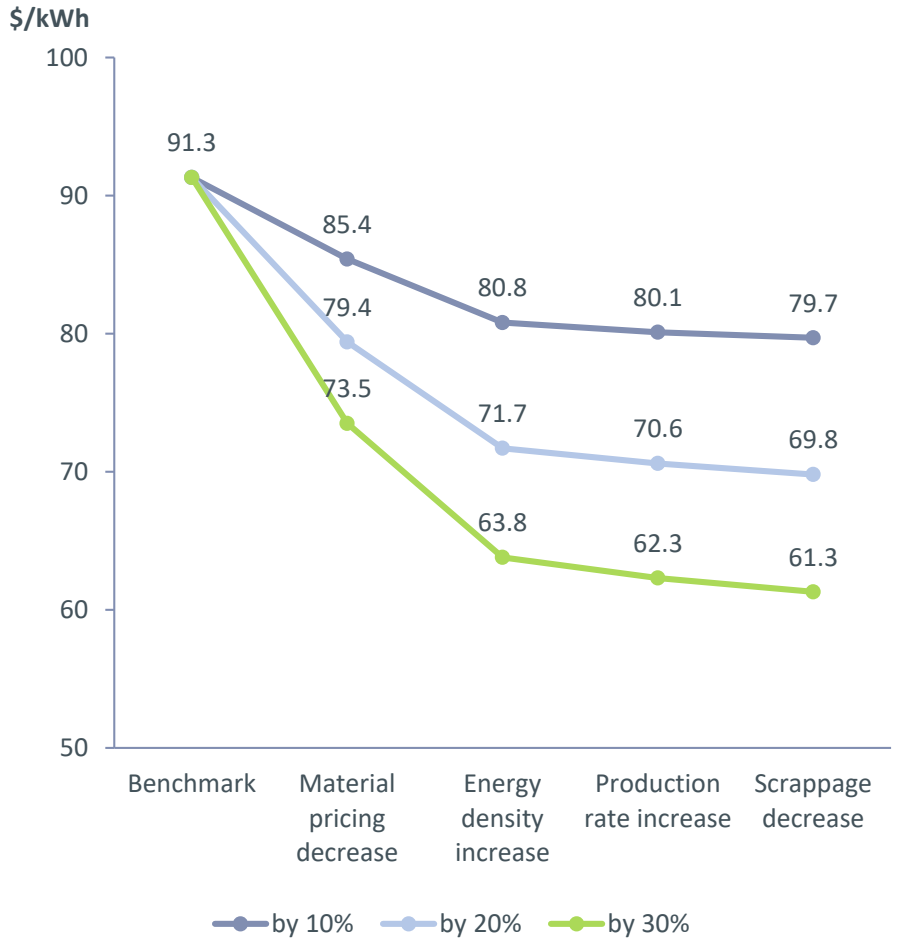
DRIVER #4: LITHIUM-ION PRICING IS GOING TO GET LOWER AND VOLUMES ARE INCREASING - MOSTLY GOING INTO TRANSPORT

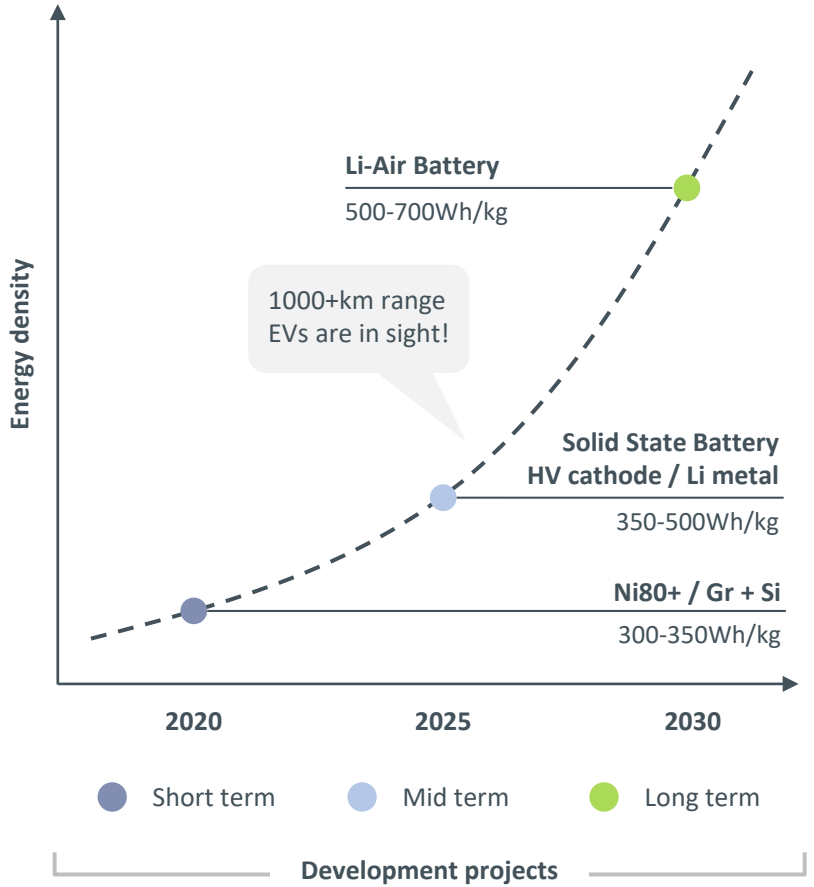




Source: BNEF

DRIVER #5: BATTERY CELL COSTS ARE GOING TO FALL FURTHER IN THE NEXT YEARS AND PERFORMANCE AND LIFETIME IS GOING TO IMPROVE

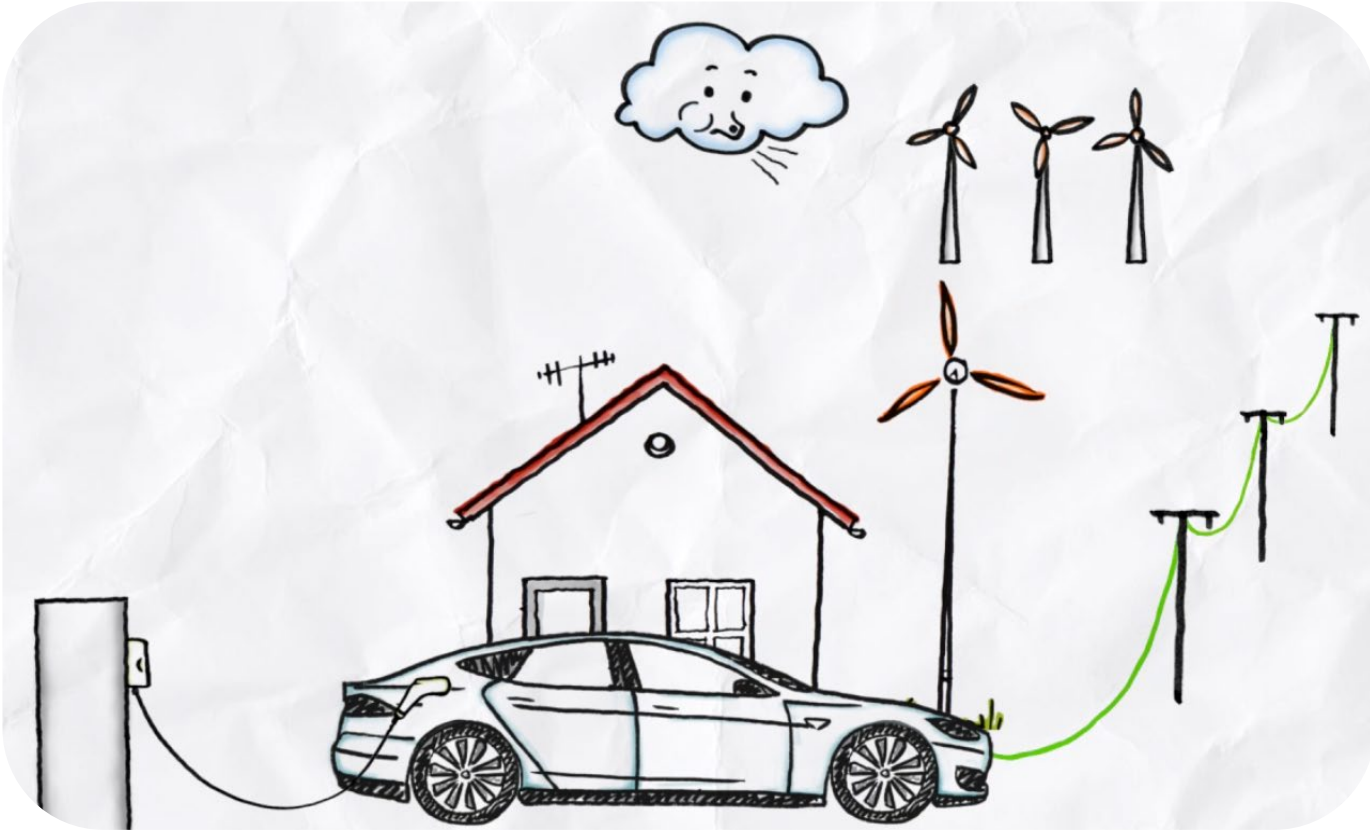




Source: BNEF & CATL

DRIVER #6: LITHIUM-ION BATTERIES WILL BRING TOGETHER THE UTILITY AND AUTOMOBILE VALUE CHAINS

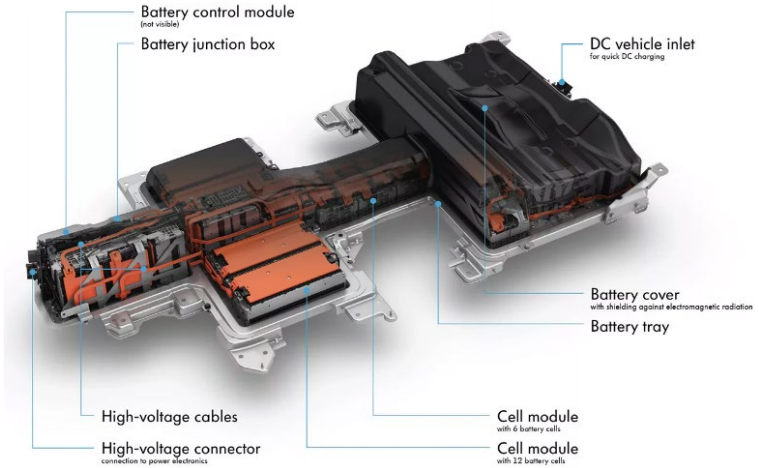
AND CARS ARE ONLY USED 5% OF THE TIME...

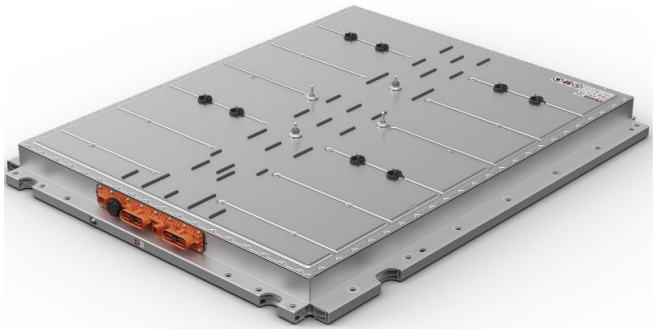


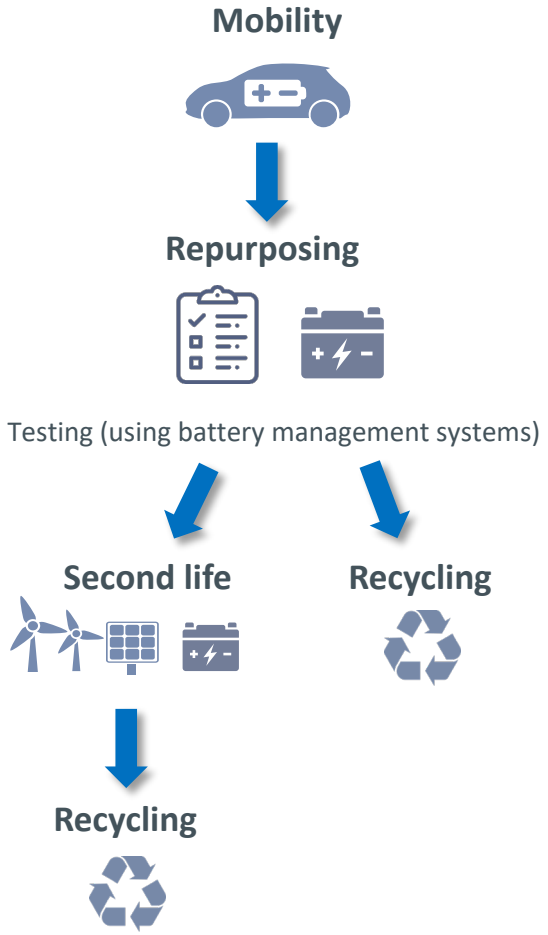
1m Tesla = 100GWh of power = Peak power needs of Germany and Netherlands

Source: Alexa Capital

DRIVER #7: THERE WILL LOTS OF LOW COST BATTERIES OUT THERE…SECOND LIFE BATTERIES ARE COMING

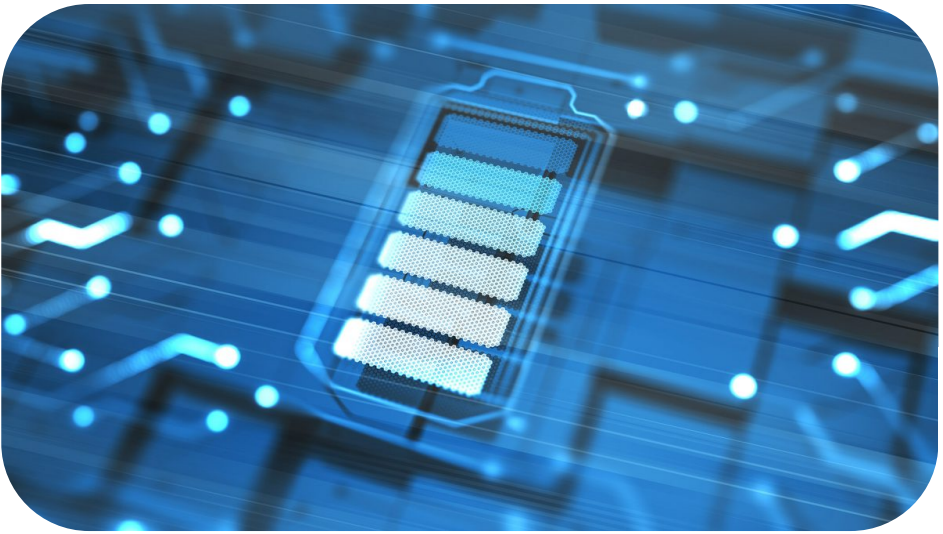


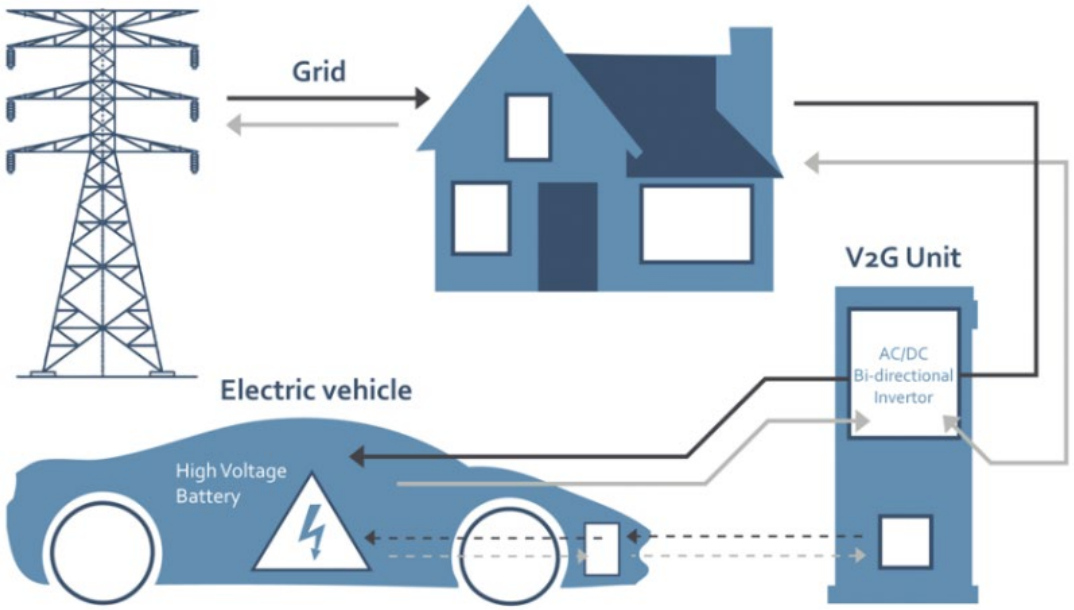




Source: Alexa Capital

DRIVER #8: DIGITALISATION ENABLES STORAGE BY ALLOWING DEVICES TO BE CONNECTED TOGETHER





CONTENTS

THE FINANCE WORLD IS PUSHING CAPITAL INTO LOW CARBON TECHNOLOGIES AND ELECTRICITY!

BlackRock. About Us Newsroom Insights Investor Relations Sustainability Careers

A Fundamental Reshaping of Finance

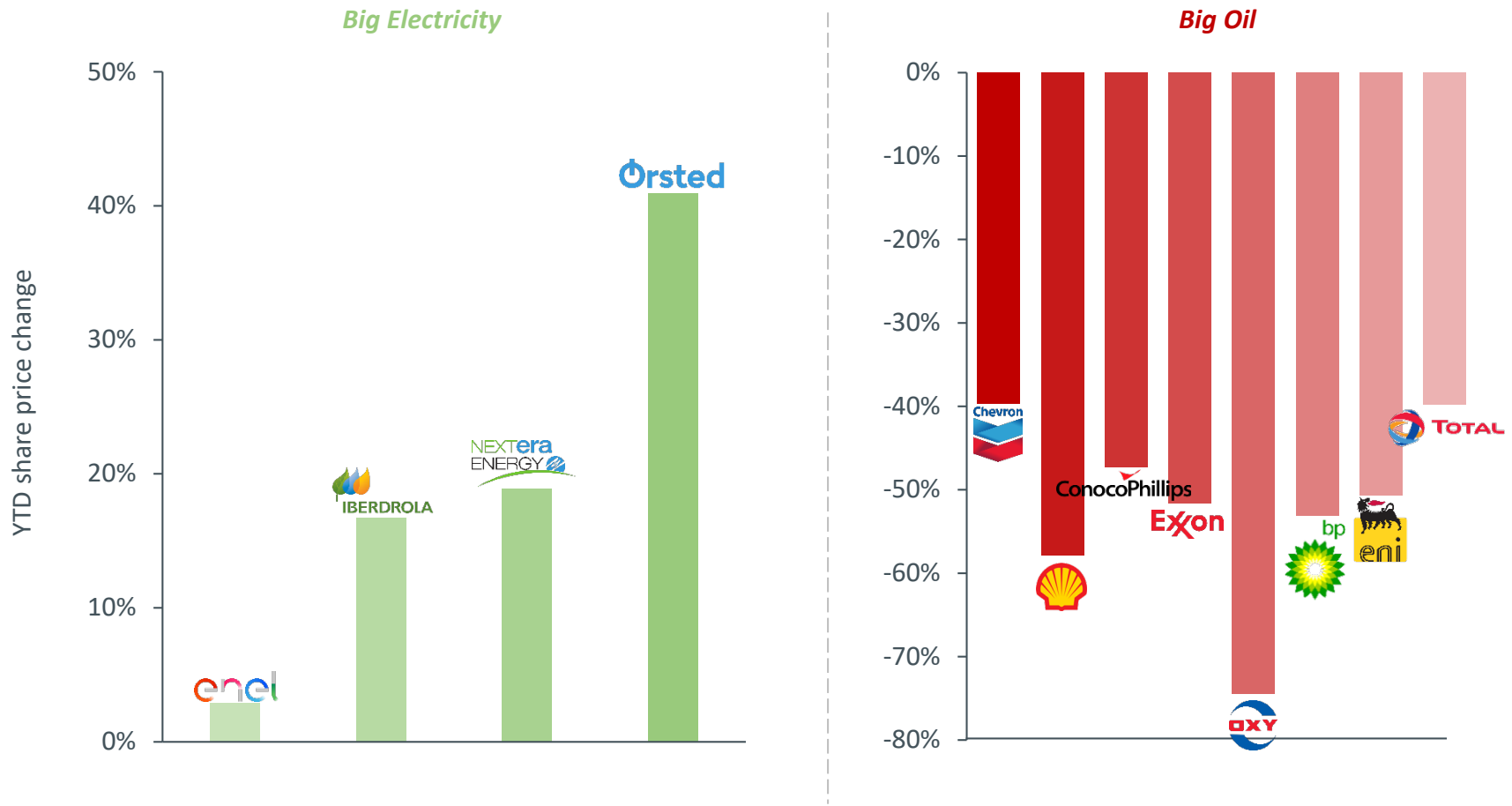
1. The evidence on climate risk is compelling investors to reassess core assumptions about modern finance

2. Investors are increasingly reckoning with these questions and recognizing that climate risk is investment risk.

3. Because capital markets pull future risk forward, we will see changes in capital allocation more quickly than we see changes to the climate itself'

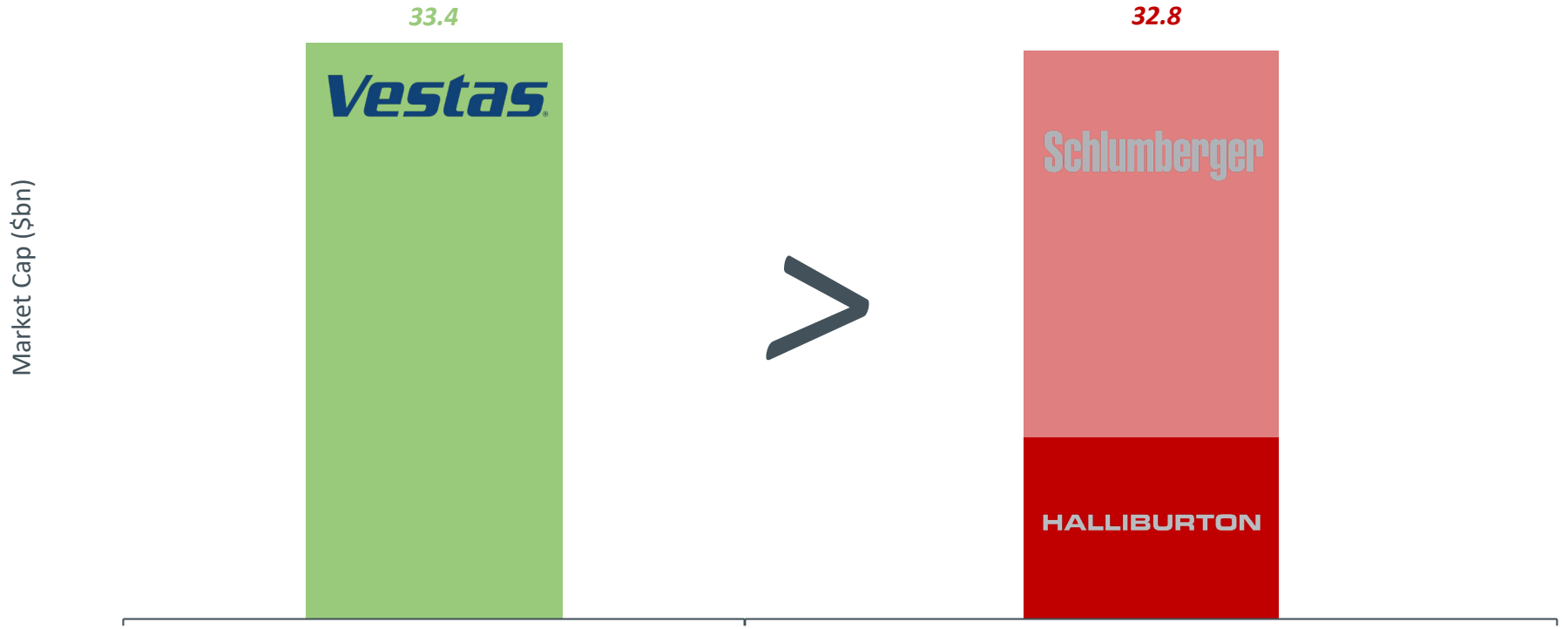
Larry Fink, CEO Blackrock

CAPITAL IS FLOWING OUT OF OIL AND INTO ELECTRICITY AND IN PARTICULAR CLEAN ENERGY PRODUCERS



Source: Bloomberg

THE LARGEST RENEWABLE SUPPLIER VESTAS IN THE WORLD IS WORTH MORE THAN THE TWO BIGGEST OIL AND GAS SERVICES BUSINESSES TOGETHER



Source: Bloomberg

ENERGY AND MOBILITY STOCKS PERFORMED EXCEPTIONALLY WELL IN 2020

EVs

TESLA +700%

Solar

SUNRUN +300%

JinKO Solar +140%

SUNPOWER +330%

Wind

Vestas +90%

PNE pure new energy +90%

SIEMENS Gamesa +80%

Source: Bloomberg

WE ARE SEEING A BIG COMMITMENT TO CLEAN ENERGY FROM FINANCIAL INSTITUTIONS

World's biggest sovereign wealth fund to ditch fossil fuels

Norway's Government Pension Fund Global gets go ahead to divest $13bn of investments

▲ North Sea oil companies such as Premier and Tullow will lose investment. Photograph: Alamy

Source: The Guardian

MASSIVE AMOUNTS OF INFRASTRUCTURE CAPITAL IS FLOWING TO THE ENERGY SECTOR

Environment

	2020
Greenfield	USD 5.90bn
Brownfield	USD 5.98bn
Refinancing	USD 5.09bn
Greenfield PPP activity	8 deals

Social

	2020
Greenfield	USD 5.32bn
Brownfield	USD 11.38bn
Refinancing	USD 5.55bn
Greenfield PPP activity	41 deals

Transport

	2020
Greenfield	USD 34.63bn
Brownfield	USD 39.00bn
Refinancing	USD 42.67bn
Greenfield PPP activity	49 deals

Energy

	2020
Greenfield	USD 53.61bn
Brownfield	USD 86.60bn
Refinancing	USD 41.69bn
Greenfield PPP activity	2 deals

Power

	2020
Greenfield	USD 23.52bn
Brownfield	USD 42.90bn
Refinancing	USD 18.31bn
Greenfield PPP activity	7 deals

Renewables

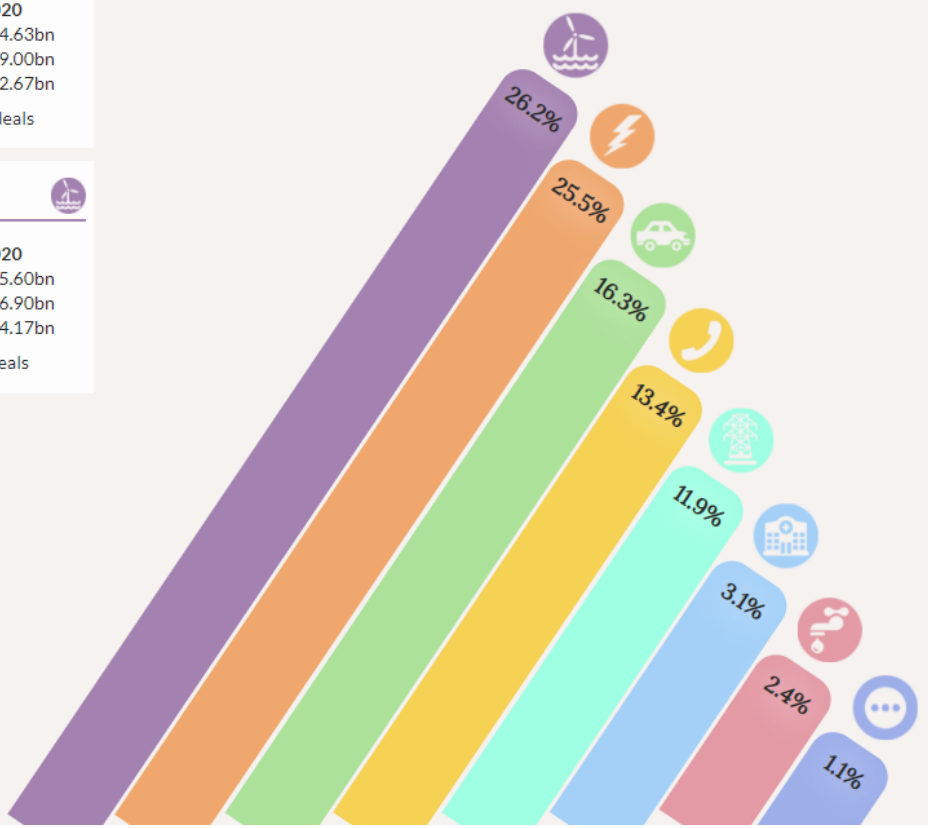
	2020
Greenfield	USD 75.60bn
Brownfield	USD 66.90bn
Refinancing	USD 44.17bn
Greenfield PPP activity	4 deals

Telecommunications

	2020
Greenfield	USD 10.98bn
Brownfield	USD 70.81bn
Refinancing	USD 13.85bn
Greenfield PPP activity	5 deals

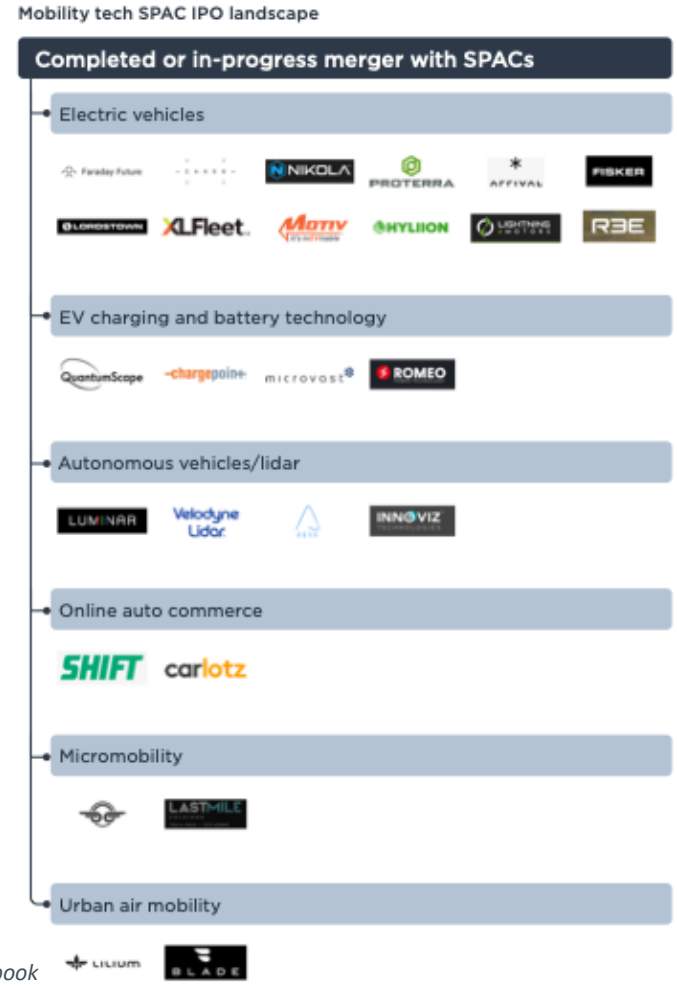
Other

	2020
Greenfield	USD 0.09bn
Brownfield	USD 6.65bn
Refinancing	USD 0.96bn
Greenfield PPP activity	1 deal



Source: Inframation

HUGE AMOUNTS OF PUBLIC MARKET CAPITAL ARE FLOWING INTO MOBILITY TECH – $100BN IN VALUATIONS



Source: Pitchbook

Company	Ticker	SPAC	SPAC ticker	Announcement date	Segment	Market cap/last valuation ($M)*	Return since announcement date
Nikola Motor Company	NKLA	VectoIQ Acquisition	VTIQ	March 3, 2020	Electric vehicles (hydrogen/B2B)	$6,560.2	54.3%
Hylion	HYLN	Tortoise Acquisition	SNPR	June 19, 2020	Electric vehicles (hydrogen/B2B)	$2,641.0	23.0%
Shift Technologies	SFT	Insurance Acquisition	INSU	June 29, 2020	Auto commerce (digital marketplaces)	$703.1	-29.7%
Velodyne Lidar	VLDR	Graf Industrial	GRAF	July 2, 2020	Autonomous vehicles (lidar)	$3,907.4	28.1%
Fisker	FSR	Spartan Energy Acquisition	SPAQ	July 10, 2020	Electric vehicles (B2C)	$4,134.0	-8.7%
Lordstown Motors	RIDE	DiamondPeak Holdings	DPHC	August 3, 2020	Electric vehicles (B2C/B2B)	$4,471.8	77.4%
Canoo	GOEV	Hennessy Capital Acquisition	HCAC	August 18, 2020	Electric vehicles (B2C/B2B)	$4,017.9	43.0%
Luminar	LAZR	Gores Metropoulos	GMHI	August 24, 2020	Autonomous vehicles (lidar)	$10,191.0	189.4%
QuantumScape	QS	Kensington Capital Acquisition	KCAC	September 3, 2020	Electric vehicles (batteries)	$19,340.9	203.0%
XL Fleet	XL	Pivotal Investment II	PIC	September 18, 2020	Electric vehicles (B2B)	$2,696.1	75.5%
ChargePoint	CHPT	Switchback Energy Acquisition	SBE	September 24, 2020	Electric vehicles (charging)	$2,400.0	240.1%
Romeo Power	RMO	Riverside Management Group	RMG	October 5, 2020	Electric vehicles (batteries)	$2,453.3	92.9%
Faraday Future	PSAC	Property Solutions Acquisition	N/A	October 6, 2020	Electric vehicles (B2C)	$3,000.0	N/A
Microvast	N/A	Tuscan Holdings	THCB	October 12, 2020	Electric vehicles (batteries)	$2,000.0	57.2%

Source: PitchBook | Geography: Global
*As of January 11, 2021

CAPITAL NEEDS TO FLOW TO THE MINING SECTOR DUE TO THE INCREASING NEED FOR NATURAL MATERIALS TO SUPPORT NEXT GENERATION BATTERIES

The Telegraph

Electric car boom fuels global scramble for nickel and cobalt

A surge in demand for crucial metals could lead to sourcing problems for the growing electric car industry

FINANCIAL TIMES

The Big Read Cornwall

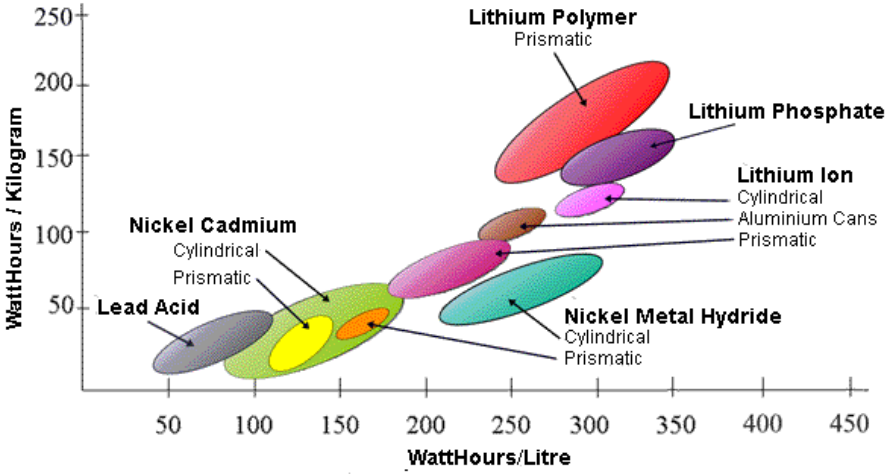
The electric vehicle revolution: Cornwall tries to revive its lithium mines

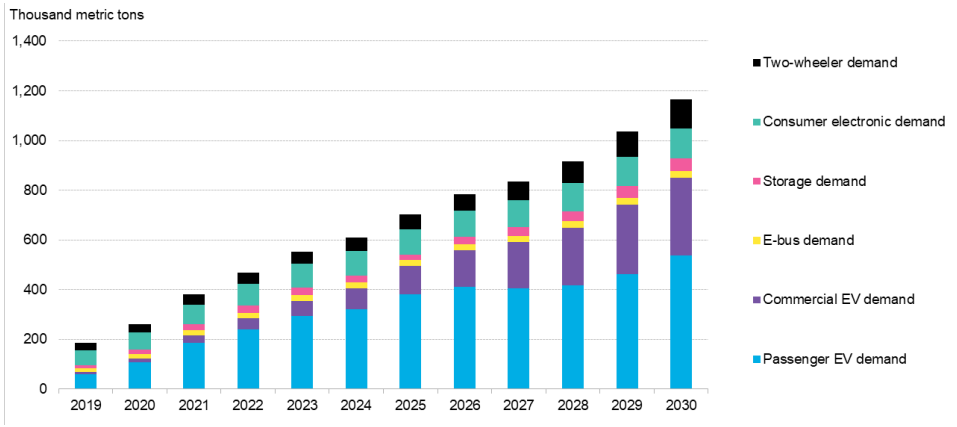
The English region wants to produce the metal used in car batteries but has to prove it can do so at scale

Source: Telegraph; FT

FROM 2.5M TO 25M EVS IN A DECADE

1. LITHIUM IS THE LONG TERM WINNER AS IS VERY LIGHT, HAS EXCEPTIONAL NEGATIVE ELECTRODE POTENTIAL AND IS ABUNDANT





Demand up 9x to over 1.2m tonnes p.a by 2030 (25m new EVs) – noting that 50% of lithium demand is already from batteries

Source: BNEF

FROM 2.5M TO 25M EVS IN A DECADE

2. COPPER WILL BE A BIG WINNER AS EVERY EV NEEDS AN EXTRA 60KG OF COPPER

25KG

- **85kg (car)-200kg (bus)**

- **1-10kg**

10x increase - 1.5m tonnes p.a. (from 24m tonnes p.a.) – could have big impact on market

Source: Alexa Capital

FROM 2.5M TO 25M EVS IN A DECADE

3. NICKEL WILL SEE AT LEAST A 10X INCREASE IN DEMAND FROM BATTERIES BY 2030 TO 1.3M TONNES P.A.

BNEF refined class 1 nickel supply curve

Segment	2018	2019	2020	2021	2022	2023	2024	2025
Passenger EV demand	54	51	88	153	201	252	298	395
Commercial EV demand	4	4	9	15	23	32	43	56
E-bus demand	1	1	1	2	2	2	2	2
Two-wheeler demand	19	16	17	24	26	29	34	37
Storage demand	4	8	10	17	26	32	34	27
CE demand	14	14	18	20	23	24	27	29
TOTAL battery demand	96	93	143	231	301	372	438	546
Non-battery demand	760	768	749	759	764	768	768	768
Flexible non-battery demand	313	337	311	324	331	337	337	337
Total demand	1,169	1,199	1,203	1,314	1,395	1,478	1,544	1,652
De-risked supply (2019)	1,078	1,175	1,248	1,330	1,365	1,386	1,391	1,407
Nameplate capacity (2019)	1,078	1,216	1,273	1,380	1,422	1,422	1,422	1,476

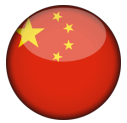
By 2030 over 50% of global demand will go to batteries

Source: BNEF

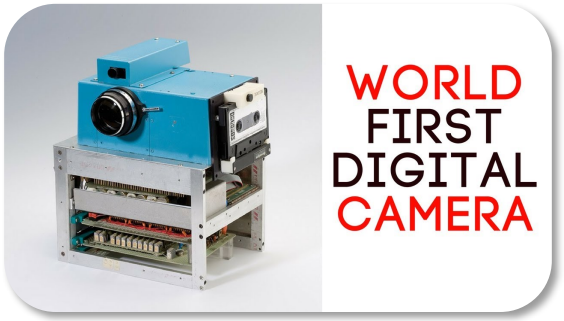
CONTENTS

1. THERE IS AN OPPORTUNITY TO CREATE GLOBAL CHAMPIONS AS AT THE START OF THE 20TH CENTURY

2. THIS REVOLUTION WILL CAUSE A MAJOR SHIFT IN THE WEALTH OF REGIONS AND NATIONS



3. MANY INCUMBENTS WILL NOT SURVIVE AS THEY WILL BE TOO SLOW TO CHANGE



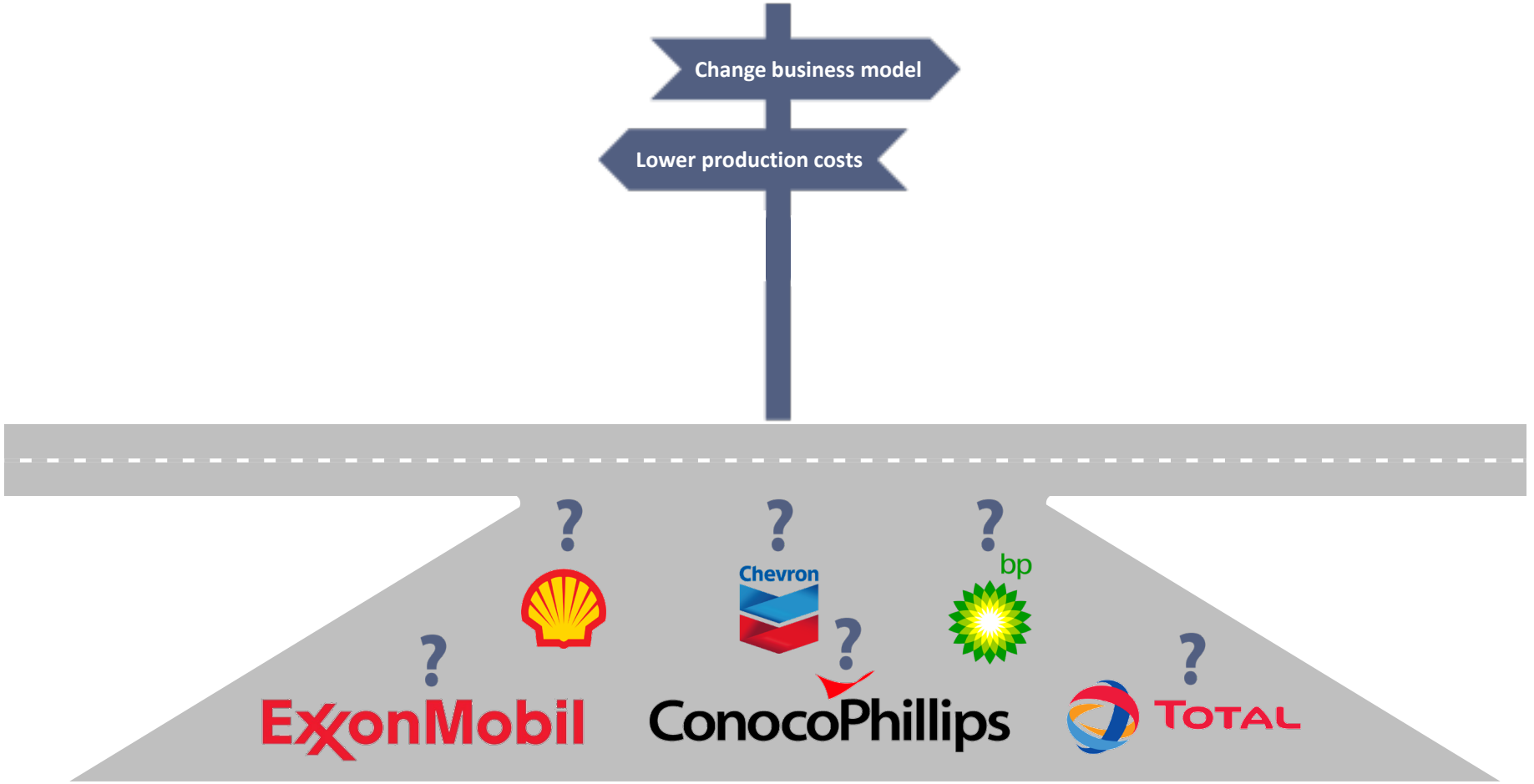
Share price ($)

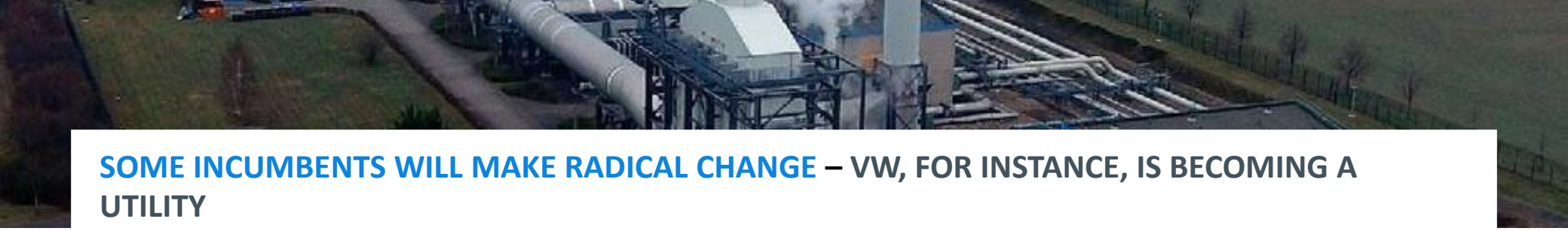
40
35
30
25
20
15
10
5
0

Jan-2014 Jan-2015 Jan-2016 Jan-2017 Jan-2018 Jan-2019

Source: Bloomberg

THE ONLY OIL & GAS COMPANIES THAT SURVIVE WILL HAVE VERY LOW COSTS OF PRODUCTION, OR WILL CHANGE THEIR BUSINESS MODELS





SOME INCUMBENTS WILL MAKE RADICAL CHANGE – VW, FOR INSTANCE, IS BECOMING A UTILITY

MOTORING RESEARCH

Volkswagen is entering the energy industry with 'Elli'

January 9, 2019 / by Ethan Jupp