

#### NORTH AMERICA



## ENABLING MASS PRODUCTION OF EV BATTERIES OPTIMIZED FOR EXTENDED RANGE AND EXTREME FAST CHARGING



Battery Show, Novi 2022 September 13, 2022

## CHARGING THE EV LIFESTYLE



# ELECTRIC VEHICLES ARE AT AN INFLECTION POINT...

 Growing variety of models, performance, design and range offerings

Drivers expect cars to match their **fast lifestyle** and be eco-friendly, accessible, efficient and in time

• **Charging speed** is a crucial decision-point





## ...but available EV models are yet to deliver a worryfree fast charging experience that is similar to that of fueling a conventional car.

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### **FAST CHARGING RAPIDLY DEGRADES THE BATTERY**

#### The challenge of fast charging

- Drivers sacrifice battery life for fast charging
- Actual user's feedback and manufacturer data confirms rapid battery degradation even if only occasionally fast charged



#### EV-OEMs specifically warn users to limit the use of fast charging

#### **I**NOTICE

Fast charging with direct current (DC) uses a very high charging power. Frequent fast charging can permanently reduce the battery capacity of the high-voltage battery.

\* Use case cycle life extrapolated from article data and models' official range  Minimize the use of DC chargers (such as Superchargers) for optimal Battery health.

The peak charging rate of the Battery may decrease slightly after a large number of DC Fast Charging sessions, such as those at Superchargers. To ensure It is normal for estimated range to decrease slightly over the first few months before leveling off. Over time, you may see a gradual, but natural, decrease in range at full charge - this depends on factors such as Supercharging regularly or the mileage and age of the Battery. Your Model 3 will inform you in the unlikely event a hardware issue is causing excessive Battery or range degradation.

## **StoreD**ot's extreme fast charging battery cells are different





• Charged in 10min

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- No degradation due to fast charging
- Extreme fast charging regardless of battery's state of charge



# **STOREDOT AT A GLANCE**



### **LEADERSHIP IN EXTREME FAST CHARGING AND HIGH ENERGY DENSITY**

Founded 2012 Israel



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World's first Silicondominant Extreme Fast Charging (XFC) EV battery

toreDot





\$200M invested \_\_\_\_\_\_\_\_ 100+ patents (granted and pending)



Strategic investors covering EV ecosystem





## **STOREDOT'S UNIQUE TECHNOLOGY** KEY DIFFERENTIATORS AND VALUE PROPOSITION



## STOREDOT'S XFC – A HIGHLY DIFFRENTIATED BATTERY FOR ANY ELECTRIC VEHICLE

- Silicon-dominant anode
- Proprietary additives and cell design
- Manufactured in standard production facilities



Same **ENERGY** Density and **price** trajectory

100+ miles charged in 5 min

### WITH STOREDOT'S XFC NO BATTERY DEGRADATION DUE TO EXTREME FAST CHARGING EVEN WHEN EXTREME FAST CHARGED CONSECUTIVELY

#### Currently available fast charging

- OEMs sacrifice battery cycle-life for fast charging
- Actual user data confirms rapid battery degradation even if only occasionally fast charged

#### OEM1



#### OEM2



Sources:

Insideevs.com: https://insideevs.com/news/548404/volkswagen-confirms-8percent-degradation-id3/

2) YouTube: https://www.youtube.com/watch?v=p9R8HXSnD5Y

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#### StoreDot's extreme fast charging

- Game changer: drivers can fast charge every time
- 1250 consecutive XFC extreme fast charges
- No degradation due to XFC



\* Use case cycle life extrapolated from article data and models' official range

#### Actual OEM use cases vs. StoreDot's XFC

#### WITH STOREDOT'S XFC CONSISTENT, RELIABLE CHARGING RATE AT ANY STATE OF CHARGE 100in5: 100 MILES CHARGED IN 5 MINUTES

#### **Currently** available fast charging

• Charge rate significantly slows down as battery's state-of-charge increases

#### StoreDot's extreme fast charging

- 100 miles charged in 5 minutes at any stateof-charge, no matter how full or drained your battery is
- Consistent 350kW charging for packs >75kWh



ources:

1) P3 group website: https://www.p3-group.com/en/p3-charging-index-comparison-of-the-fast-charging-capability-of-various-electric-vehicles-from-a-use

2) Insideevs.com: https://insideevs.com/news/512344/porsche-taycan-fast-charging-analysis/



#### **STOREDOT'S XFC – THE WINNING SOLUTION:** >50% REDUCTION IN CHARGING TIMES WE UTILIZE THE HIGHEST POWER AT ANY STATE OF CHARGE

#### **Currently** available fast charging

• Unable to utilize full power of chargers

#### StoreDot's extreme fast charging

- >X2 faster than premium fast charging models
- 100 miles charged in 5 minutes



\*StoreDot 100in5 simulated pack assumes 74kWh using 350kWh-500A charging station Sources:

L) P3 group website: https://www.p3-group.com/en/p3-charging-index-comparison-of-the-fast-charging-capability-of-various-electric-vehicles-from-a-users-perspective-update-2021/

2) Insideevs.com: https://insideevs.com/news/512344/porsche-taycan-fast-charging-analysis/

3) https://insideevs.com/news/550025/lucid-air-fast-charging-review/



Lucid Air (118kWh)	Porsche Taycan Turbo S (94kWł
<ul> <li>Mercedes EQS 580 (120kWh)</li> </ul>	Audi e-tron 55 (95kWh)
—— Tesla Model 3 LR (82kWh)	<ul> <li>Hyundai Ioniq 5 (72.6kWh)</li> </ul>
StoreDot 100in5 (≥74kWh)	

# PROVEN TECHNOLOGY



## **TECHNOLOGY VALIDATION: SHORTEST TIME FROM LAB TO EV FF** PROVEN SCALE-UP CAPABILITIES



\*Dimensions, typical numbers

## **30Ah EV FORM FACTOR PROVEN SOLUTION**

>1000 CONSECUTIVE XFC CYCLES (0%-80% IN 15 MINUTES)

• 30Ah @C/3

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- Energy density of 300Wh/kg
- 0-80% in 15 minutes (1C discharge)
- SoH measured every 15 cycles
- An improved formulation already validated on a 3Ah cell

#### 100 SOH . Cycled capacity Still running • 90 80 70 Retention % 60 50 Cell type 30Ah pouch Anode >40%Si 40 Cathode NMC811 Energy Density 680 Wh/L eq 30 Specific energy 310 Wh/kg ea Charge Time 0-80% <15 min Ambient Temperature 25 °C 20 10 0 200 400 600 800 1000 1200 0 Cycle #

% Retention - consecutive XFC cycles

#### **30Ah EV FORM FACTOR PROVEN SOLUTION**

>1000 CONSECUTIVE XFC CYCLES (10%-80% IN 10 MINUTES)

- 30Ah @C/3
- Energy density of 300Wh/kg
- 10-80% in 10 minutes (1C discharge)
- SoH measured every 15 cycles
- Based on past scale-up experience and extrapolation, projected retention >80% after 1000+ cycles
- An improved formulation already validated on a 3Ah cell



#### % Retention - consecutive XFC cycles

### **STOREDOT OUTSTANDING LOW TEMPERATURE PERFORMANCE (-20°C)** 3Ah POUCH

• 75% discharge capacity @ -20°C

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• Similar to high-end graphite based solutions

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**Discharge capacity Vs Temperature** 

# STOREDOT OUTSTANDING HIGH POWER (3C) DISCHARGE PERFORMANCE

• 89% discharge capacity @ 3C discharge rate

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• Similar to high end graphite-based solutions

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#### **Discharge capacity vs C-rate**

# TECHNOLOGY HIGHLIGHTS



## EXTREME FAST CHARGING IS POSSIBLE ONLY WITH NEW, INNOVATIVE BATTERY TECHNOLOGY









#### **CLEAR ADVANTAGES FOR NANO-SILICON OVER GRAPHITE AS ANODE** ACTIVE MATERIAL

for Li-ion Batteries 1.6 TiO<sub>2</sub> MO. Potential V vs Li/Li+ 1.2 0.8 Ge Sn 0.4 Graphite 0.0 500 1000 1500 3000 3500 4000 0 Specific Capacity mAh/g

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**Common Anode Materials** 

In a conventional graphite anode, it takes SIX carbon atoms to hold ONE lithium atom In a silicon anode, ONE silicon atom can hold ~FOUR lithium atoms





### **ADDRESSING SILICON CHALLENGES**



## The battery must be **holistically designed** and developed with all related elements in mind, in order to be successfully commercialized.

### **STOREDOT HOLISTIC APPROACH TO BATTERY DEVELOPMENT**



StoreDot's patent portfolio



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- Anodes
- Cathodes
- Electrolytes
- Binders
- Separators
- Production processes
- Systems

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### RANGE ON DEMAND<sup>™</sup> STOREDOT'S 100inX BATTERY TECHNOLOGY ROADMAP



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## **SCALE-UP & MANUFACTURING** STOREDOT'S KEY DIFFERENTIATORS AND STRENGTHS



## **IN-HOUSE PILOT PRODUCTION LINE**

#### FROM MOLECULE DESIGN TO SAMPLE PRODUCTION, UNDER ONE ROOF



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#### STANDARD PRODUCTION PROCESS



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### **XFC SOLUTION WITH ESTABLISHED EV BATTERY MANUFACTURING**

#### High volume manufacturing JV

#### StoreDot manufacturing partnership with EVE Energy



Production of EV form-factor A-Sample cells



Framework to achieve mass-production



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Utilizing existing Li-ion manufacturing lines

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Leading OEM validation

#### Strategic partnership with leading EV OEMs



A-Samples supply by StoreDot



Evaluation of StoreDot technology



EV OEM proof of concept

#### **FLEXIBILITY OF FORM FACTORS**

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#### DEVELOPING CELLS FOR ALL FORM FACTORS, ALLOWING OEM DESIGN FLEXIBILITY

#### Pouch



Prismatic



StoreDot's main focus in recent years has been on pouch cells. Our pilot line and EV samples (A & B) are based on a typical form factor of 300X100mm. We offer flexibility in dimensions according to customer requirements.

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StoreDot technology is suitable for scaling up production of prismatic cells based on OEM requirements. We have developed prototypes of 46XX cell based on our innovative chemistry, and are exploring the cooling requirements while scaling up the technology

46XX cylindrical

#### 21700 cylindrical



We have developed prototypes of 21700 cells based on our innovative chemistry, and are exploring scaling up the technology

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## **STOREDOT IS DISRUPTING THE EV BATTERY SPACE KEY TAKEAWAYS**

- $\mathbf{1}$ Pioneer in an enormous TAM and serviceable available market 2 Disruptive technology based on proprietary compounds and cell design >50% reduction in charging time with same energy density and price trajectory Mass-production of 100in5 XFC by 2024 Roadmap to **100in3** fast charging and extreme energy density in 2028 Established OEM and manufacturing partnerships
  - Five EV-OEM partners and shareholders underpinning our positioning
  - Strong management with experienced professional R&D team

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(8)

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\$118bn / \$76bn 100+ Patents 100in5 >1250 cycles at 300 Wh/kg 400 Wh/kg Polestar DAIMLER VOLVO EVE. OLA

**35** PhDs, 120 professionals

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