

F R O S T & S U L L I V A N

# BEST PRACTICES

## AWARDS

F R O S T & S U L L I V A N

2020 BEST PRACTICES AWARD



StoreDot

Inspired by Nature

**2020 EUROPEAN  
RAPID CHARGING BATTERY MANUFACTURING  
NEW PRODUCT INNOVATION AWARD**

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## Background and Company Performance

### *Industry Challenges*

Lithium-ion (Li-ion) batteries have evolved in recent years as a promising source of energy. These batteries are rechargeable and primarily used to power electric vehicles (EVs), hybrid EVs, and portable devices. Li-ion batteries are ideal for EVs because of their higher power-to-weight ratio, effective high-temperature performance, low self-discharge, 90% decline in cost over the past decade, and competitive energy efficiency compared to traditional battery solutions.

Fast charging for EVs is a decisive parameter to augment their global adoption because it serves as a solution to consumers' concerns associated with EV range and reliability. Although fast charging is among the primary requirements for supporting EV adoption, the following factors are restraining the development and integration of fast charging technologies:

- **Lithium plating and battery technology gap:** Fast charging for EVs causes lithium plating because of cold temperatures, leading to lithium deposits around the battery anode during charging. This lithium deposition further results in the deterioration of the battery lifecycle and compromises battery safety, thus causing fire or an explosion.
- **Thermal instability:** Humidity and temperature levels affect the safety, performance, and lifecycle of batteries. In addition, an excessive temperature increase induced by fast charging may cause battery cells to swell, cause increased pressure within the cells, and create gaseous emissions, leading to battery explosion.
- **Optimizing battery designs to sustain fast charging:** Batteries are mostly designed to optimize energy for higher energy capacity but have limited power density. These batteries have a different cell design, which is the most sensitive element for fast charging; therefore, designing batteries to sustain fast charging without deteriorating their specific energy or lifecycle is the primary constraint for battery manufacturers.

Frost & Sullivan has identified that fast-charging Li-ion batteries that can be sustainably integrated with both existing and new charging infrastructure will be a key factor in augmenting EV adoption. In addition, concerns associated with lithium plating, battery lifecycle, thermal influence, and battery design must be addressed when commercially deploying these charging systems.

### *New Product Attributes and Customer Impact*

#### **Match to Needs and Reliability**

Founded in 2012, StoreDot is an Israel-based innovator in the field of materials, such as nanomaterials, along with designing, tuning, and synthesizing new organic compounds.

StoreDot's organic compounds significantly enhance the performance of devices, including batteries, sensors, digital memory, and displays.

StoreDot's FlashBattery is an extreme-fast-charging, multi-function electrode (MFE) Li-ion battery technology based on novel nanomaterials combined with proprietary enhanced electrolytes and organic binders. The assimilation of active nanomaterials and the company's organic compounds enable about five minutes of full cell charging capacity (a 10 Coulomb (C) charging rate). StoreDot's FlashBattery demonstrates lower resistance than conventional battery systems, coupled with controlled inherent shrinkage and cell expansion during the discharge/charge cycles, which in turn solidify the battery's operational reliability. For the long term StoreDot in parallel is also working on extreme-energy density solution based on solid state battery technology.

The company has about 102 patents, with 57 granted and 45 pending applications. FlashBattery is a comprehensive solution for fast charging that includes the following key components:

- **Cathode:** proprietary organic polymer-based compound for enhanced safety and stability
- **Anode:** layered nanoparticles based on metalloids, including tin, silicon, and germanium, that are embedded within an organic conductive matrix
- **Electrolyte:** high-voltage capability and enhanced safety by preventing dendrite through an ionic organic liquid-based electrolyte
- **Data science:** machine learning and artificial intelligence, along with the automated optimization of material compounds
- **Cell structure:** optimized thin layer coating for thermal management during fast charging
- **Electronics:** dynamic charging with real-time voltage management

StoreDot's FlashBattery is the combination of both battery and supercapacitor technologies and demonstrates unique advantages over its counterparts, in terms of higher energy density of about 240 watt-hours per kilogram (Wh/kg) in the current Si rich prototype and targets 300Wh/Kg after EV packaging optimization, flat output voltage, low self-discharge, and long-term energy storage with up to 1,000 cycles.

Frost & Sullivan lauds StoreDot for developing a fast-charging battery technology that can transform the way Li-ion batteries are produced and integrated worldwide. Moreover, the technology can enhance the development of novel, fast-charging battery systems, with the aim to integrate a competitive business scenario while augmenting EV adoption.

## Quality and Positioning

Leveraging its ability to develop novel materials and compounds for Li-ion cell design, StoreDot has developed its EV battery solution to include a pack of hundreds of flash battery cells. The FlashBattery technology can store energy for a range of about 300 miles on a five-minute charge, translating into about a 60-mile range on a one-minute charge. In contrast, other commercial fast-charge Li-ion battery systems deliver about 50 to 70% of the charge capacity within 20 to 30 minutes. The company's core technology is based on chemically synthesized organic molecules that can be electrochemically and optically tuned to allow for enhanced performance, compared to conventional Li-ion battery systems.

StoreDot has a dedicated research and development (R&D) team that develops and enhances fast-charging batteries. The company has been developing and enhancing its fast charging technology capabilities through its in-house testing and validation facilities, providing it with a significant advantage over competitors, in terms of technological efficacy and aftersales support. While other solution providers within the battery industry develop application-specific systems, StoreDot's comprehensive FlashBattery addresses both fast-charging and battery reliability characteristics, making it a go-to solution for utilities and system operators. StoreDot's FlashBattery solution, therefore, meets customers' expectation for consistent performance during the battery's entire lifecycle.

StoreDot has been working with various industry participants to integrate its fast-charging batteries commercially. The company's partners include BP, Nissan, Eve Energy, TDK Corporation, Daimler, and Samsung. Moreover, StoreDot provides a comprehensive, sustainable, smart, and extreme-fast-charging battery, compared to its conventional fast-charging Li-ion counterparts, for EV applications, thus demonstrating its technological quality.

The company has positioned its products to address the aforementioned critical issues associated with the safety, range, and lifecycle of Li-ion batteries, compared to their conventional counterparts. The company's manufacturing process for FlashBattery utilizes the same traditional capital equipment as conventional Li-ion batteries. The cost of its EV FlashBattery, therefore, is aligned with the cost reduction curve for both current and future conventional Li-ion batteries.

Frost & Sullivan commends StoreDot for being a key innovator in the battery industry that has significantly established a competitive business environment by introducing its FlashBattery technology. StoreDot is expected to flourish commercially in the near future because of its strong industry relationships and ability to address the critical issues that are restraining large-scale EV adoption worldwide.

## Design and Brand Equity

The primary demarcation between StoreDot's FlashBattery and various auxiliary battery systems is that the company's comprehensive offering enables machine learning and artificial intelligence platforms to optimize material compounds automatically while ensuring battery durability and reliability. Furthermore, the MFE design and the use of self-healing 3D organic polymers provide enhanced mechanical strength, ultra-fast lithium in diffusion, and high electrical conductivity.

The following are a few additional features that provide FlashBattery with a competitive edge over other commercially available battery technologies:

- **Efficient charge rate:** FlashBattery's efficient and rapid charge rate is about 20 times faster than conventional Li-ion batteries, ensuring enhanced energy density and low internal resistance (ESR).
- **Minimal charging downtime:** FlashBattery enables uninterrupted EV use with negligible charge downtime, which in turn eliminates the need to find an electrical outlet to connect for a long duration. Moreover, FlashBattery enhances the user experience and can change end users' perspective about EVs.
- **Safe fast charging:** FlashBattery uses multi-layer safety protection through proprietary nonflammable compounds that are specifically designed to sustain high-current charging.

StoreDot has developed a one-stop solution for utilities and industry participants seeking fast charging, durable battery configurations; smart interoperability; low resistance; safe operations; and higher energy and power density. Frost & Sullivan research indicates that StoreDot's FlashBattery is a benchmark compared to competitive battery and super-capacitor technologies because of the company's unique ability to provide a comprehensive solution that supports the transition between conventional and advanced data-driven, fast-charging battery storage technologies.

## Conclusion

Batteries are among the primary technologies that enable industry participants to augment the integration of sustainable and efficient EVs worldwide. Challenges associated with battery safety, longevity, and durability, however, have been restricting large-scale EV adoption. Although Li-ion batteries have significantly transformed the EV industry, these systems require a longer charging time and are prone to losing the charge quickly.

StoreDot's fast-charging FlashBattery technology, therefore, is a significant enhancement in terms of upgrading the performance characteristics of EV batteries. The ability of StoreDot's solution to achieve a full charge within five minutes with a range of 300 miles augments the overall consumer and utility perspective of EVs.

With its strong overall performance, StoreDot has earned Frost & Sullivan's 2020 New Product Innovation Award in the European rapid charging battery manufacturing industry.



## Significance of New Product Innovation

Ultimately, growth in any organization depends on continually introducing new products to the market and successfully commercializing those products. For these dual goals to occur, a company must be best in class in three key areas: understanding demand, nurturing the brand, and differentiating from the competition.



## Understanding New Product Innovation

Innovation is about finding a productive outlet for creativity, for consistently translating ideas into high-quality products that have a profound impact on the customer.

## Key Benchmarking Criteria

For the New Product Innovation Award, Frost & Sullivan analysts independently evaluated 2 key factors (New Product Attributes and Customer Impact) according to the criteria identified below.

### New Product Attributes

- Criterion 1: Match to Needs
- Criterion 2: Reliability
- Criterion 3: Quality
- Criterion 4: Positioning
- Criterion 5: Design

### Customer Impact

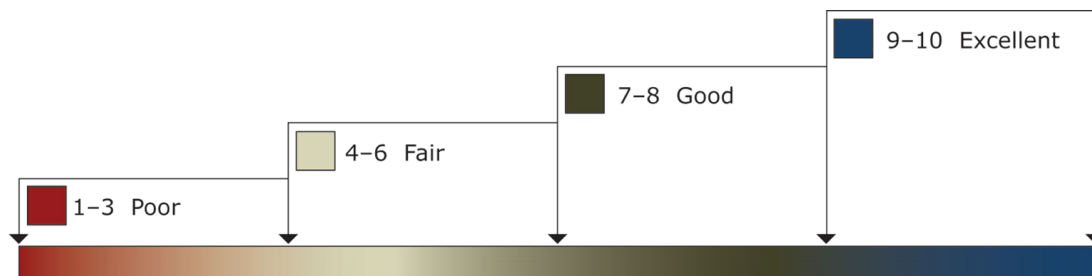
- Criterion 1: Price/Performance Value
- Criterion 2: Customer Purchase Experience
- Criterion 3: Customer Ownership Experience
- Criterion 4: Customer Service Experience
- Criterion 5: Brand Equity

## Best Practices Award Analysis for StoreDot

### Decision Support Scorecard

To support its evaluation of best practices across multiple business performance categories, Frost & Sullivan employs a customized Decision Support Scorecard. This tool allows research and consulting teams to objectively analyze performance according to the key benchmarking criteria listed in the previous section, and to assign ratings on that basis. The tool follows a 10-point scale that allows for nuances in performance evaluation. Ratings guidelines are illustrated below.

#### RATINGS GUIDELINES



The Decision Support Scorecard considers New Product Attributes and Customer Impact (i.e., the overarching categories for all 10 benchmarking criteria; the definitions for each criterion are provided beneath the scorecard). The research team confirms the veracity of this weighted scorecard through sensitivity analysis, which confirms that small changes to the ratings for a specific criterion do not lead to a significant change in the overall relative rankings of the companies.



The results of this analysis are shown below. To remain unbiased and to protect the interests of all organizations reviewed, Frost & Sullivan has chosen to refer to the other key participants as Competitor 1 and Competitor 2.

<i>Measurement of 1–10 (1 = poor; 10 = excellent)</i>			
<b>New Product Innovation</b>	New Product Attributes	Customer Impact	Average Rating
<b>StoreDot</b>	<b>9.5</b>	<b>9</b>	<b>9.25</b>
Competitor 1	8.5	8	8.25
Competitor 2	8	7	7.5

### *New Product Attributes*

#### **Criterion 1: Match to Needs**

Requirement: Customer needs directly influence and inspire the product's design and positioning.

#### **Criterion 2: Reliability**

Requirement: The product consistently meets or exceeds customer expectations for consistent performance during its entire life cycle.

#### **Criterion 3: Quality**

Requirement: Product offers best-in-class quality, with a full complement of features and functionalities.

#### **Criterion 4: Positioning**

Requirement: The product serves a unique, unmet need that competitors cannot easily replicate.

#### **Criterion 5: Design**

Requirement: The product features an innovative design, enhancing both visual appeal and ease of use.

### *Customer Impact*

#### **Criterion 1: Price/Performance Value**

Requirement: Products or services offer the best value for the price, compared to similar offerings in the market.

#### **Criterion 2: Customer Purchase Experience**

Requirement: Customers feel they are buying the optimal solution that addresses both their unique needs and their unique constraints.

#### **Criterion 3: Customer Ownership Experience**

Requirement: Customers are proud to own the company's product or service and have a positive experience throughout the life of the product or service.

**Criterion 4: Customer Service Experience**

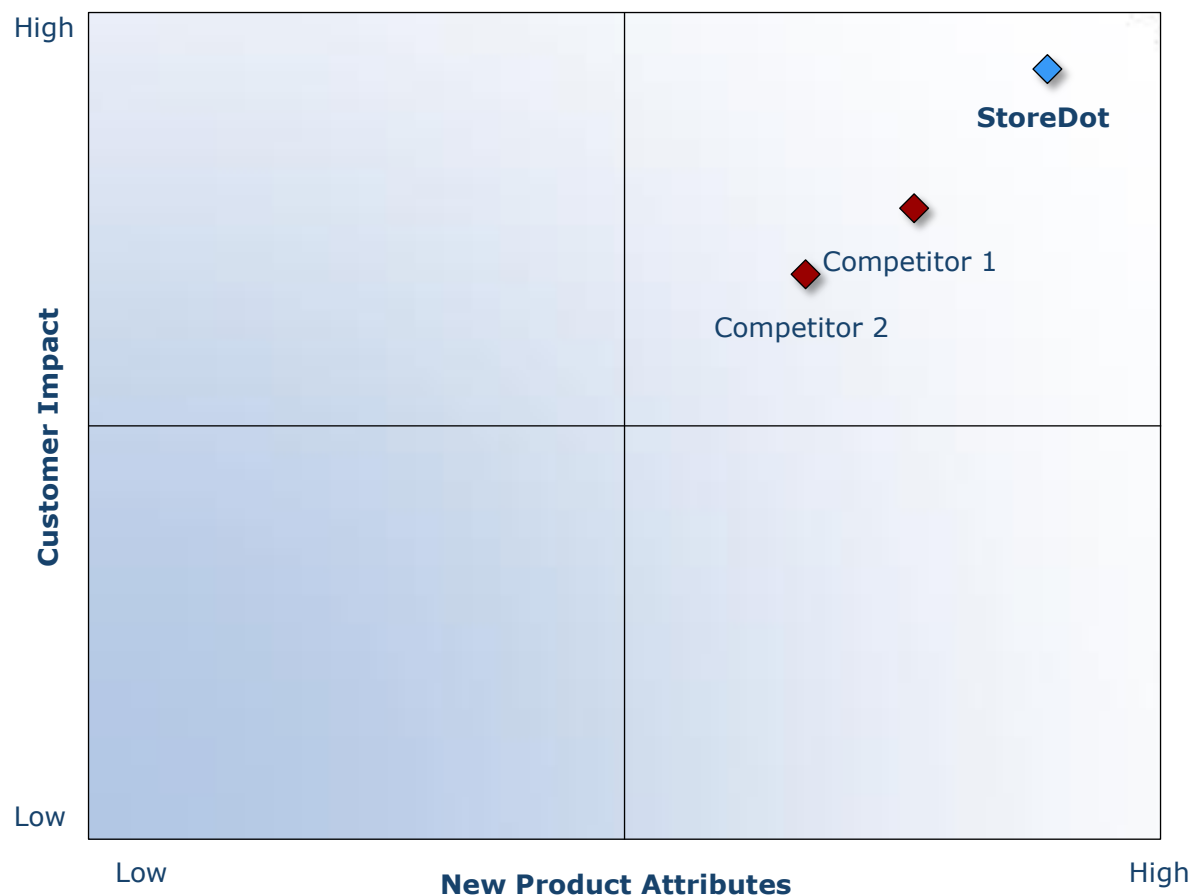
Requirement: Customer service is accessible, fast, stress-free, and of high quality.

**Criterion 5: Brand Equity**

Requirement: Customers have a positive view of the brand and exhibit high brand loyalty.

***Decision Support Matrix***

Once all companies have been evaluated according to the Decision Support Scorecard, analysts then position the candidates on the matrix shown below, enabling them to visualize which companies are truly breakthrough and which ones are not yet operating at best-in-class levels.



## Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan analysts follow a 10-step process to evaluate award candidates and assess their fit with select best practices criteria. The reputation and integrity of the awards are based on close adherence to this process.

STEP	OBJECTIVE	KEY ACTIVITIES	OUTPUT
1 <b>Monitor, target, and screen</b>	Identify award recipient candidates from around the world	<ul style="list-style-type: none"> <li>Conduct in-depth industry research</li> <li>Identify emerging industries</li> <li>Scan multiple regions</li> </ul>	Pipeline of candidates that potentially meet all best practices criteria
2 <b>Perform 360-degree research</b>	Perform comprehensive, 360-degree research on all candidates in the pipeline	<ul style="list-style-type: none"> <li>Interview thought leaders and industry practitioners</li> <li>Assess candidates' fit with best practices criteria</li> <li>Rank all candidates</li> </ul>	Matrix positioning of all candidates' performance relative to one another
3 <b>Invite thought leadership in best practices</b>	Perform in-depth examination of all candidates	<ul style="list-style-type: none"> <li>Confirm best practices criteria</li> <li>Examine eligibility of all candidates</li> <li>Identify any information gaps</li> </ul>	Detailed profiles of all ranked candidates
4 <b>Initiate research director review</b>	Conduct an unbiased evaluation of all candidate profiles	<ul style="list-style-type: none"> <li>Brainstorm ranking options</li> <li>Invite multiple perspectives on candidates' performance</li> <li>Update candidate profiles</li> </ul>	Final prioritization of all eligible candidates and companion best practices positioning paper
5 <b>Assemble panel of industry experts</b>	Present findings to an expert panel of industry thought leaders	<ul style="list-style-type: none"> <li>Share findings</li> <li>Strengthen cases for candidate eligibility</li> <li>Prioritize candidates</li> </ul>	Refined list of prioritized award candidates
6 <b>Conduct global industry review</b>	Build consensus on award candidates' eligibility	<ul style="list-style-type: none"> <li>Hold global team meeting to review all candidates</li> <li>Pressure-test fit with criteria</li> <li>Confirm inclusion of all eligible candidates</li> </ul>	Final list of eligible award candidates, representing success stories worldwide
7 <b>Perform quality check</b>	Develop official award consideration materials	<ul style="list-style-type: none"> <li>Perform final performance benchmarking activities</li> <li>Write nominations</li> <li>Perform quality review</li> </ul>	High-quality, accurate, and creative presentation of nominees' successes
8 <b>Reconnect with panel of industry experts</b>	Finalize the selection of the best practices award recipient	<ul style="list-style-type: none"> <li>Review analysis with panel</li> <li>Build consensus</li> <li>Select recipient</li> </ul>	Decision on which company performs best against all best practices criteria
9 <b>Communicate recognition</b>	Inform award recipient of recognition	<ul style="list-style-type: none"> <li>Announce award to the CEO</li> <li>Inspire the organization for continued success</li> <li>Celebrate the recipient's performance</li> </ul>	Announcement of award and plan for how recipient can use the award to enhance the brand
10 <b>Take strategic action</b>	Upon licensing, company is able to share award news with stakeholders and customers	<ul style="list-style-type: none"> <li>Coordinate media outreach</li> <li>Design a marketing plan</li> <li>Assess award's role in strategic planning</li> </ul>	Widespread awareness of recipient's award status among investors, media personnel, and employees

## The Intersection between 360-Degree Research and Best Practices Awards

### *Research Methodology*

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of the research process. It offers a 360-degree view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan's research methodologies. Too often companies make important growth decisions based on a narrow understanding of their environment, resulting in errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry participants and for identifying those performing at best-in-class levels.

### 360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS



## About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, helps clients accelerate growth and achieve best-in-class positions in growth, innovation, and leadership. The company's Growth Partnership Service provides the CEO and the CEO's growth team with disciplined research and best practices models to drive the generation, evaluation, and implementation of powerful growth strategies. Frost & Sullivan leverages nearly 60 years of experience in partnering with Global 1000 companies, emerging businesses, and the investment community from 45 offices on 6 continents. To join Frost & Sullivan's Growth Partnership, visit <http://www.frost.com>.