



VANADIS POWER

2015 Global
Energy Storage Competitive Strategy
Innovation and Leadership Award



FROST & SULLIVAN



50 Years of Growth, Innovation & Leadership

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Background and Company Performance

Industry Challenges

Frost & Sullivan independent analysis suggest that the key challenges for medium and large-scale energy storage technologies include the cost of technology, its economic viability, physical dimensions for installation, and proven performance. These challenges dampen the adoption of battery energy storage solutions (BESSs) in the medium and large-scale storage solutions.

Technology Cost & Economic Viability

Medium and large-scale storage technologies involve high capacity storage in terms of hundreds of kilowatts (KWs) and megawatts (MWs). Battery technology for such a high capacity storage is expensive, which limits the adoption of battery energy storage. If the battery chemistry used for medium and large-scale storage is affordable with a less expensive total cost of ownership, this will clearly promote market growth to a large extent.

Physical Dimensions

Physical dimensions of energy storage technology are important for any installation. BESS for medium and large-scale installations needs to be compact, because this makes it simpler for on-site installation. This challenge requires BESS to be modular, with the flexibility to add additional storage capacity. When physical dimensions meet the practical expectations of medium and large-scale storage, it promotes the usage of BESS.

Proven Performance

Installation of BESS is often challenged by the lack of proven battery chemistry. Although different chemistries are available for energy storage, Frost & Sullivan points out that few technologies are considered to be safe for usage at medium and large, high-capacity storage applications. Proven performance from different installations globally will drive the best suitable battery chemistries.

Strategy Innovation and Customer Impact

Effective Strategy that has Increased Global Installations

Vanadis Power (Vanadis) is a European company offering medium and large-scale energy storage through vanadium redox flow battery (VRB). The company, established in 2013, has implemented an effective strategy in the past couple of years that is proven by the number of installations. The company, through its strategic partnership with Rongke Power, from the Asia-Pacific region, and UniEnergy Technologies (UET), from the United States, has both technical expertise and marketing advantages for the European and global markets. Frost & Sullivan notes that the strategic partnership with Rongke Power and UET has given a strong advantage to Vanadis to offer superior medium and large energy storage through VRB.

Rongke Power has more than 6 years of field, design, and production experience in the Asia-Pacific region, with a stack capacity up to 30MW/year in 2013. Similarly, UET, from the United States, has technological expertise, offering an efficient electrolyte that has twice the energy and power density and the ability to efficiently operate in the temperature range of -5°C to $+60^{\circ}\text{C}$. Partnership with these two companies truly highlights the effective strategy that Vanadis has in place for gaining the experience and expertise for both short-term and long-term expansion in the energy storage space.

Excellent Strategic Execution Positions Vanadis as the Key Company for VRB

Vanadis has adopted best-in-class processes to support efficient and consistent implementation of its business strategy. Rongke Power, a key player in the VRB market in the Asia-Pacific region, is sharing its expertise with Vanadis to add value to both companies. This expertise made Vanadis the BESS supplier to the Bosch project, offering 250KW, 1MWh VRB energy storage solutions within a year of its existence in Europe. The best-in-class manufacturing process of U.S based UET has given a strong advantage to Vanadis in offering high-quality VRB solutions. UET, established in 2012, has expanded significantly in two years; it is the first manufacturer to offer a grid-scale, fully integrated, containerized flow battery for rapid and flexible development.

These partnerships with two key strong companies has made Vanadis a successful participant in the understanding and successful implementation of VRB solutions, which ultimately reflects upon the company's excellence in strategic execution.

Competitive Differentiation Makes Vanadis Unique among VRB Manufacturers

Major challenges with VRB chemistry include the limited stability of electrolyte chemistry, where the vanadium element precipitates at temperatures above 35°C and below 10°C . This results in low energy density and low power densities. This challenge was effectively addressed by Vanadis with the technological expertise of UET. The company has come up with a new type of vanadium electrolyte chemistry, which has doubled its energy and power density, with a wide operating temperature of -10°C to $+60^{\circ}\text{C}$. This has simplified both the system operation and cost. The expertise of UET makes the companies well distinguished from other VRB manufacturers, offering flow batteries with less energy and power density. This differentiation enables Vanadis to progress quite remarkably, offering VRB technology for medium and large-scale storage.

Most Convincing Price/Performance Value

Containerized VRB solutions from Vanadis offer the most convincing price/performance value. VRB solutions available are normally at lesser energy density and temperature range, while the product solution from Vanadis is clearly superior, with electrolytes offering energy (KWh) and electrodes in cell stack offering power (KW). This enables passive heat management, where the flowing electrolytes carry the heat generated, thus acting as heat sinks with an increased operating temperature range.

The ability of Vanadis to support multiple applications, such as renewable integration, T&D support, microgrids, and ancillary services, makes it truly unique among the existing manufacturers. These features position Vanadis as a unique, distinguished participant in

the flow battery market, offering safe, cost-effective batteries with great price performance value for medium and large-scale storage.

Well Proven Customer Purchase Experience

The proven technical expertise from Rongke Power has allowed Vanadis to offer an excellent customer purchase experience, such as when it supplied a 320KW peak power and 1MWh capacity storage for a wind farm in Germany. This installation is the largest flow battery storage in Europe, addressing all of its customers' relevant needs and challenges. This installation offers grid stabilization, frequency control, and energy trading. A smooth customer purchase experience has also allowed Vanadis to be a part of the prestigious project for Bosch in Germany.

Satisfied Customer Ownership Experience Paves Way for Strong Growth

VRB is a safe and relatively affordable battery chemistry. VRB offered by Vanadis is containerized and has the flexibility to scale up storage capacity, which is a major advantage that offers a superior customer experience. A 90KW/120KWh system is offered in a 20' shipping container, as a plug-and-play system. This eliminates the hassles of designing and integrating for the developer, thus making it a smooth process for storage application. These features also provide customers with a commendable ownership experience, paving the way for the company's impressive long-term growth.

Conclusion

Vanadis Power is a distinguished and unique contributor which launched the improved, technically advanced vanadium redox flow batteries in the energy storage market. The company has achieved significant milestones through its strategic partnerships with Rongke Power and UniEnergy Technologies, both of which have technical expertise and manufacturing capabilities. Using the experience and expertise from its strategic partners, Vanadis Power is quick to respond to market expectations, which indicates that it is a clear leader in this space with efficient strategies, innovations to overcome the competition, and a superior product offering.

With its strong overall performance, Vanadis Power has earned the 2015 Frost & Sullivan Competitive Strategy Innovation and Leadership Award.

Significance of Competitive Strategy Innovation and Leadership

Any successful approach to achieving top-line growth must (1) take into account what competitors are, and are not, doing; (2) meet customer demand with a comprehensive, value-driven product or service portfolio; and (3) establish a brand that resonates deeply with customers and stands apart from other providers. Companies must succeed at these three things—brand, demand, and positioning—to achieve best-practice levels in competitive strategy.



Understanding Competitive Strategy Innovation and Leadership

Demand, brand strength, and competitive differentiation all play a critical role in delivering unique value to customers. This three-fold focus, however, must ideally be complemented by an equally rigorous focus on strategy innovation and customer impact.

Key Benchmarking Criteria

For the Competitive Strategy Innovation and Leadership Award, Frost & Sullivan analysts independently evaluated two key factors — Strategy Innovation and Customer Impact — according to the criteria identified below.

Strategy Innovation

- Criterion 1: Strategy Effectiveness
- Criterion 2: Strategy Execution
- Criterion 3: Competitive Differentiation
- Criterion 4: Executive Team Alignment
- Criterion 5: Stakeholder Integration

Customer Impact

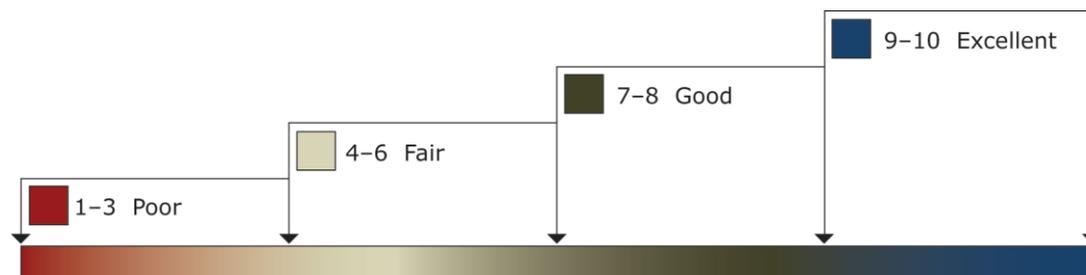
- Criterion 1: Price/Performance Value
- Criterion 2: Customer Purchase Experience
- Criterion 3: Customer Ownership Experience
- Criterion 4: Customer Service Experience
- Criterion 5: Brand Equity

Best Practice Award Analysis for Vanadis Power

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 our 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 is organized by Strategy Innovation and Customer Impact (i.e., the overarching categories for all 10 benchmarking criteria; the definitions for each criteria 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, we have chosen to refer to the other key players in as Company 2 and Company 3.

DECISION SUPPORT SCORECARD FOR COMPETITIVE STRATEGY INNOVATION AND LEADERSHIP AWARD

<i>Measurement of 1-10 (1 = poor; 10 = excellent)</i>			
Competitive Strategy Innovation and Leadership	Strategy Innovation	Customer Impact	Average Rating
Vanadis Power	9	9	9.0
Competitor 2	8	7	7.5
Competitor 3	7	6	6.5

Strategy Innovation

Criterion 1: Strategy Effectiveness

Requirement: Strategy effectively balances short term performance needs with long-term aspirations and vision for the company

Criterion 2: Strategy Execution

Requirement: Adoption of best-in-class processes to support the efficient and consistent implementation of business strategy

Criterion 3: Competitive Differentiation

Requirement: Unique competitive advantages with regard to solution or product are clearly articulated and well accepted within the industry

Criterion 4: Executive Team Alignment

Requirement: The executive team is aligned on the organization’s mission, vision, strategy and execution

Criterion 5: Stakeholder Integration

Requirement: Strategy reflects the needs or circumstances of all industry stakeholders, including competitors, customers, investors, and employees

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 like they are buying the most 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

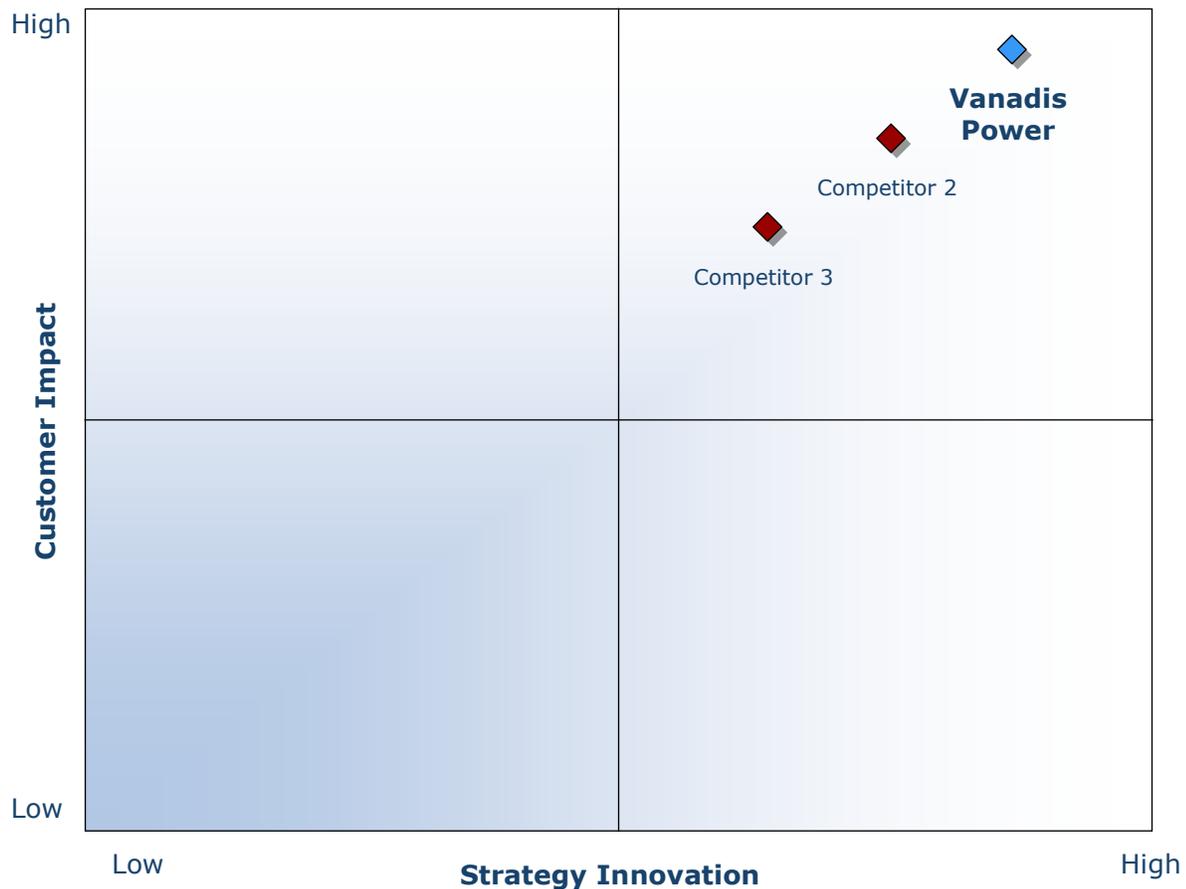
Criterion 5: Brand Equity

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 can 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.

DECISION SUPPORT MATRIX FOR COMPETITIVE STRATEGY INNOVATION AND LEADERSHIP AWARD



The Intersection between 360-Degree Research and Best Practices Awards

Research Methodology

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of our 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, leading to 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 players and for identifying those performing at best-in-class levels.

360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS



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

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

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

About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, enables clients to 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 practice models to drive the generation, evaluation and implementation of powerful growth strategies. Frost & Sullivan leverages almost 50 years of experience in partnering with Global 1000 companies, emerging businesses and the investment community from 31 offices on six continents. To join our Growth Partnership, please visit <http://www.frost.com>.

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