FROST & SULLIVAN

BEST PRACTICES

AWARDS

FROST & SULLIVAN

2019 BEST PRACTICES AWARD

SGTech

Sustainable Green Technologies

2019 EUROPEAN
LIVESTOCK WASTE MANAGEMENT
TECHNOLOGY INNOVATION AWARD

Contents

Background and Company Performance

Industry Challenges

The Food and Agricultural Organization (FAO) of the United Nations has identified that growing populations, rising affluence, and urbanization are translating into increased demand for livestock products, particularly in developing countries. The FAO estimates that global demand for livestock is projected to increase by 70% to feed a population expected to reach 9.6 billion by 2050.

Globally, there has been an increase in the formation and adoption of policies and frameworks particular to providing responsibly for a rising population, such as the Kyoto Agreement and United Nation's Sustainability Development Goals (SDGs) that have established the importance of addressing the threat to human and animal health and food safety. In this context, livestock farming practices play a vital role in enabling a safe environment for humans and animals, owing to the amount and the nature of livestock waste generated within such facilities. Though a large share of the growing demand for livestock products is met by fast-growing modern forms of intensive livestock production, traditional livestock farming systems are still in operation, with or without limited technological advancements that reduce the environmental impact of such farms.

Animal manure and slurry from livestock farms often pose a threat to the environment owing to nutrient leaching, ammonia (NH_3) evaporation, and emission of greenhouse gases (GHG) such as methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2). Curbing the release of GHG into the environment is one of the key priorities of developed and developing nations to mitigate the effects of global warming and climate change. The emission of ammonia and nitrogen oxides from the livestock sector contributes to the formation of secondary particulate matter (PM) and tropospheric ozone, both of which have a serious impact on air quality. Also, the leaching of nutrients such as phosphorous and organic matter present in manure will deteriorate the quality of both freshwater and coastal water. Thus, a sharp increase in the adoption of novel technologies is being witnessed, mainly for the handling and recycling of livestock waste. Anaerobic digestion (AD) is one of the most widely used technologies for livestock waste management because it facilitates biogas generation and fertilizer production as additional revenue streams, along with treating the livestock waste.

Existing livestock waste management systems using AD face the challenge of biogas generation with low methane concentration, affecting the feasibility of reusing the generated biogas within the livestock facilities. Also, most waste management techniques adopted by livestock farms often fail to offer any nutrient concentration or are characterized by ineffective recovery of valuable organic matter. This is the main cause of poorly treated water being reused for various operations inside the farm, which negatively impacts the health of livestock as well as contaminates groundwater. The digestate produced from ADs is high in nitrogen and phosphorous and conventionally used as fertilizers spread across farmland. Yet large amounts of nutrients end up polluting the water bodies and causing eutrophication in lakes, reservoirs, and oceans.

Hence, the application of digestate as landspreading is continuously subjected to strict regulations to curb the amount of nitrogen that can be distributed on land over a year by a farmer. The nitrogen load on European farmland is strictly regulated by the European Union's (EU) nitrate-directive (91/676/EEC nitrate). This regulation warrants the need for developing nutrient-recovery systems to mitigate water and air pollution arising from livestock farms. Additionally, the capital investment required for such livestock waste management systems, especially for small and medium-sized farms, is considerably high, and conventional processes tend to reduce nutrient recovery potential, resulting in the delay of farmers realizing their return on investment (ROI).

Frost & Sullivan recognizes that the livestock sector demands a shift in status quo; it is necessary to increase the overall performance of waste management systems to realize economic and environmental benefits, and ensure policy and regulatory compliance.

Technology Attributes and Future Business Value

Industry Impact

Israel-based Sustainable Green Technologies (SGTech) is a cleantech startup that specializes in providing a complete and sustainable livestock waste management solution. SGTech has developed the Integrated Ecosystem Solution (IES), an innovative biological process combining enhanced biogas production with simultaneous removal of nutrients from livestock manure and slurry. The end products are clean energy, high quality treated water[1], and a safe, solid fertilizer. Figure 1 shows the key difference between a dairy farm using conventional AD and SGTech's IES technology.

Figure 1: Comparison between Conventional AD System and SGTech's IES Technology
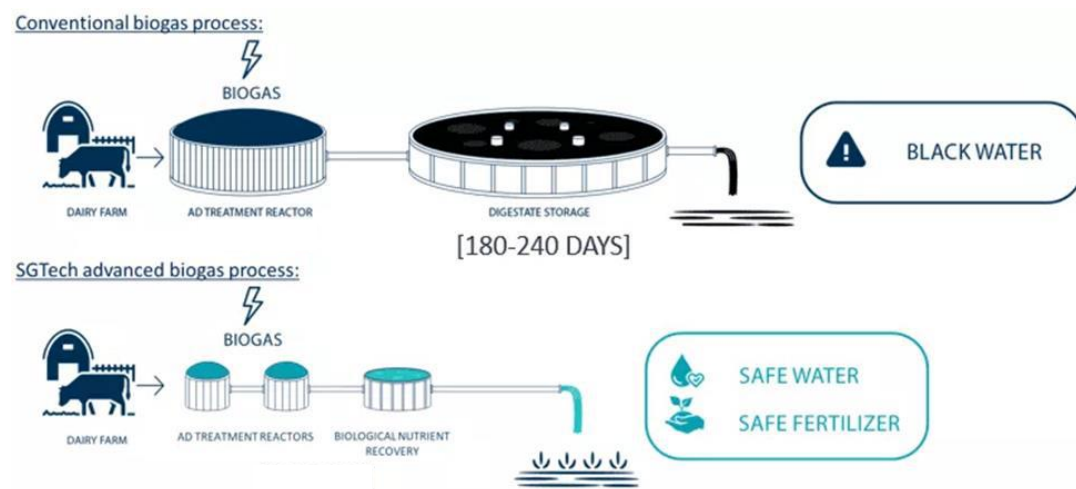
Image Source: SGTech

---

[1] Meets the Israeli's sewage discharge limits.

With the IES process, SGTech devised a sophisticated and complex algorithm-based approach to effectively treat livestock waste and shorten the time required to produce high quality by-products. SGTech's IES improves the process performance over conventional AD systems by enhancing the biokinetics of each stage, while taking for account DNA analysis of the reactor's microbiome with traditional chemical measurements. The biogas generated using SGTech's innovative solution has methane content in the range of 62-65%, which is 20% higher than the methane content in biogas generated from conventional AD solutions. As such, SGTech's biogas extend the potential of producing biomethane. Hence SGTech's IES process enhances the value proposition of biogas generation in livestock farms, and allow small and medium-sized farms to enter the market, by providing an opportunity for onsite consumption of generated biogas and the ability to sell excess electricity to the grid.

Frost & Sullivan lauds SGTech's groundbreaking ideas that facilitate the onsite utilization of generated biogas, introducing a circular approach that will reduce the CAPEX and OPEX of livestock waste management solutions, resulting in wide adoption and improved environmental performance of livestock farming.

Product Impact and Application Diversity

Digestate produced from anaerobic digesters contain high loads of nitrogen, and phosphorous. The common practice is annual spreading of the digestate in fields and open land, under strict regulation for the nitrogen loads, when this liquid cannot be applied in the wet season and requires 180-240 days of storage. SGTech's IES process effectively removes up to 90% nitrogen and 70 % phosphorus from liquid digestate which offer the possibility for direct irrigation. Also, using the water directly following nutrient removal, mitigates the cost of constructing storage tanks and transporting it long distances for spreading. The solids from the process could be used as a fertilizer to be applied. In the view of sustainable development, SGTech is assessing the technology life cycle to target process development for reduction of green-house gases (GHG) and environmental footprint.

Thus, SGTech's IES stands out from competing livestock waste management systems by providing a complete solution for livestock farms that can produce clean energy, high quality treated water, and safe fertilizer without the need for additional chemicals, processing or treatment equipment. Frost & Sullivan believes that SGTech outperforms its competitors through its application diversity capabilities and the high quality of the products produced.

Visionary Innovation

Frost & Sullivan's Visionary Innovation team has identified more than a dozen Mega Trends, which are the transformative, global forces that will define the future world with their far-reaching effects on businesses, societies, economies, cultures, and personal lives. Visionary companies are leveraging these concepts to establish unique market niches. Frost & Sullivan believes effective livestock waste management will drastically reduce the environmental impact of livestock farms and ensure additional revenue streams for the farmers. As such, SGTech's IES technology for livestock waste management aligns with

the Innovating to Zero; Health, Wellness, and Well Being; and Future of Energy Mega Trends. Frost & Sullivan applauds the transformative potential of IES and SGTech's long-term sustainable growth.

Similarly, a major target area of UN sustainable development goals is ensuring good health and well-being, affordable and clean energy production, and climate action. Stakeholders throughout the food supply chain have aligned their sustainability ambitions with these goals, recognizing an immediate need to mitigate environmental impacts of livestock farming and searching for the right technology partner that address the need while enhancing the quality of by-products such as biogas and fertilizers that can act as additional revenue streams. SGTech's IES exemplifies this type of solution for livestock farming to reduce environmental footprint tin comparison to conventional AD solutions.

Frost & Sullivan believes that SGTech's IES demonstrates a future-ready approach to the sustainable and safe management of livestock farming waste that will help clients save money and resources while protecting people and the planet.

Scalability

In 2016, SGTech successfully tested its technology on an Israeli dairy farm by treating approximately 2 m^3/d and 530 gal/d of influent waste containing 1 to 2% dry matter. Post building a successful nutrient removal prototype, SGTech successfully built a commercial pilot scale-up (15 m^3/d and 4,000 gal/d) in 2017 to treat the organic waste stream (raw manure and milking parlor slurry) of a dairy farm. With successful verification of economic profitability in the commercial pilot plant, SGTech is currently in the process of building its first full-scale projects (500-2000 cows) in selected regions and aims to deploy its IES in 3 Israeli farms and 3 farms abroad by early 2020.

Frost & Sullivan appreciates that the innovative algorithm behind SGTech's IES process enables the company to cater to a wide range of clients in the livestock sector. With changes and tweaks of the algorithm, IES has the potential to handle diverse loads and meet a variety of regulatory requirements. Enhanced process design and performance demonstrated in pilot scale and will enable the company to move forward to the commercialization phase and set up its IES in a range of livestock facilities across Israel and Europe by 2020.

Frost & Sullivan believes SGTech's ability to provide customized livestock waste management solutions based on end users' requirements position the company to realize its customer acquisition and commercialization goals.

Technology Licensing

SGTech's IES is patented under the Patent Cooperation Treaty (PCT), an international agreement administered by the International Bureau (IB) of the World Intellectual Property Organisation (WIPO) and covers most of the major countries of the world including China, the United States, Canada, the United Kingdom, Israel, and Australia, among others, with three more patents pending in various jurisdictions.

SGTech aims to license the know-how of its IES process to biogas developers in order to execute projects at farms. The biogas developers will build and operate (BOT/BOO) facilities based on SGTech's IES, and provide long-term operation and maintenance services for the dairy farms. Through this business model, the dairy farms, mainly small and medium-sized, can benefit from the low cost required to set up a waste management facility from day-one, without any capital required. Moreover, the company has created an in-house laboratory with lab-scale reactors, which enables continued research and development (R&D) activities to further improve the IES process. Additionally, SGTech partners with Israeli universities to perform R&D activities related to its IES technology, yet ownership of IP generated through such collaborations remains with SGTech.

Frost & Sullivan believes that SGTech's focus on strengthening its patent portfolio will help its clients gain a competitive advantage by leveraging the diverse patent landscape.

Conclusion

Sustainable Green Technologies (SGTech), an Israeli cleantech and renewable energy company, has developed Integrated Ecosystem Solution (IES), a patented algorithmic waste management approach to enable nutrient recovery, biogas generation, and water recycling for livestock farms. The game-changing chemical-free waste management process enables the generation of biogas with methane content in the range of 62 to 65%, which is 20% higher than the biogas generated using conventional AD solutions. The innovative process facilitates nutrient reduction of nitrogen (up to 90%) and phosphorus (up to 70%) that can offer the use for irrigation by the liquid byproduct without the risk of regulatory incompliance of nitrogen/phosphorus loading in arable lands. The high quality water generated at the end of the process can be used for various operations within the livestock facility. Thus, SGTech's IES enables livestock farming to benefit from cleaner energy, cleaner water, and cleaner soil.

For its strong overall performance and persistent dedication towards environmental sustainability, SGTech has earned Frost & Sullivan's 2019 Technology Innovation Award.

Significance of Technology Innovation

Ultimately, growth in any organization depends on finding new ways to excite the market and maintaining a long-term commitment to innovation. At its core, technology innovation, or any other type of innovation, can only be sustained with leadership in 3 key areas: understanding demand, nurturing the brand, and differentiating from the competition.

- Acquire competitors' customers
- Generate awareness and interest
- Increase market share
- Grow the overall size of the market
- Balance price with profitability

- Increase brand equity
- Establish a strong brand identity
- Inspire customers
- Build a reputation for innovation
- Push the envelope

DEMAND

BRAND

Technology Innovation Leadership

COMPETITIVE POSITIONING

- Deliver superior value to customers
- Be a leader in innovation
- Implement innovation strategy
- Carve out a unique market niche

Understanding Technology Innovation

Technology innovation begins with a spark of creativity that is systematically pursued, developed, and commercialized. That spark can result from a successful partnership, a productive in-house innovation group, or a bright-minded individual. Regardless of the source, the success of any new technology is ultimately determined by its innovativeness and its impact on the business as a whole.

Key Benchmarking Criteria

For the Technology Innovation Award, Frost & Sullivan analysts independently evaluated 2 key factors—Technology Attributes and Future Business Value—according to the criteria identified below.

Technology Attributes

      Criterion 1: Industry Impact
      Criterion 2: Product Impact
      Criterion 3: Scalability
      Criterion 4: Visionary Innovation
      Criterion 5: Application Diversity

Future Business Value

      Criterion 1: Financial Performance
      Criterion 2: Customer Acquisition
      Criterion 3: Technology Licensing
      Criterion 4: Brand Loyalty
      Criterion 5: Human Capital

Best Practices Award Analysis for SGTech

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

- 9–10 Excellent
- 7–8 Good
- 4–6 Fair
- 1–3 Poor
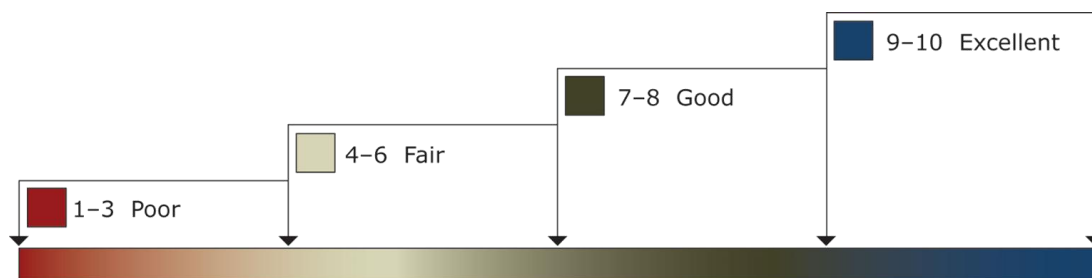
The Decision Support Scorecard considers Technology Attributes and Future Business Value (i.e., the overarching categories for all 10 benchmarking criteria; the definitions for each criterion are provided beneath the scorecard). The research team confirms the veracity of this weighted scorecard through 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.

Measurement of 1–10 (1 = poor; 10 = excellent)			
Technology Innovation	Technology Attributes	Future Business Value	**Average Rating**
SGTech	**9.5**	**9.5**	**9.5**
Competitor 1	8	8	8
Competitor 2	8	7	7.5

Technology Attributes

Criterion 1: Industry Impact
Requirement: Technology enables the pursuit of groundbreaking ideas, contributing to the betterment of the entire industry.

Criterion 2: Product Impact
Requirement: Specific technology helps enhance features and functionalities of the entire product line for the company.

Criterion 3: Scalability
Requirement: Technology is scalable, enabling new generations of products over time, with increasing levels of quality and functionality.

Criterion 4: Visionary Innovation
Requirement: Specific new technology represents true innovation based on a deep understanding of future needs and applications.

Criterion 5: Application Diversity
Requirement: New technology serves multiple products, multiple applications, and multiple user environments.

Future Business Value

Criterion 1: Financial Performance
Requirement: Potential is high for strong financial performance in terms of revenue, operating margins, and other relevant financial metrics.

Criterion 2: Customer Acquisition
Requirement: Specific technology enables acquisition of new customers, even as it enhances value to current customers.

Criterion 3: Technology Licensing
Requirement: New technology displays great potential to be licensed across many verticals and applications, thereby driving incremental revenue streams.

Criterion 4: Brand Loyalty

Requirement: New technology enhances the company's brand, creating and/or nurturing brand loyalty.

Criterion 5: Human Capital

Requirement: Customer impact is enhanced through the leverage of specific technology, translating into positive impact on employee morale and retention.

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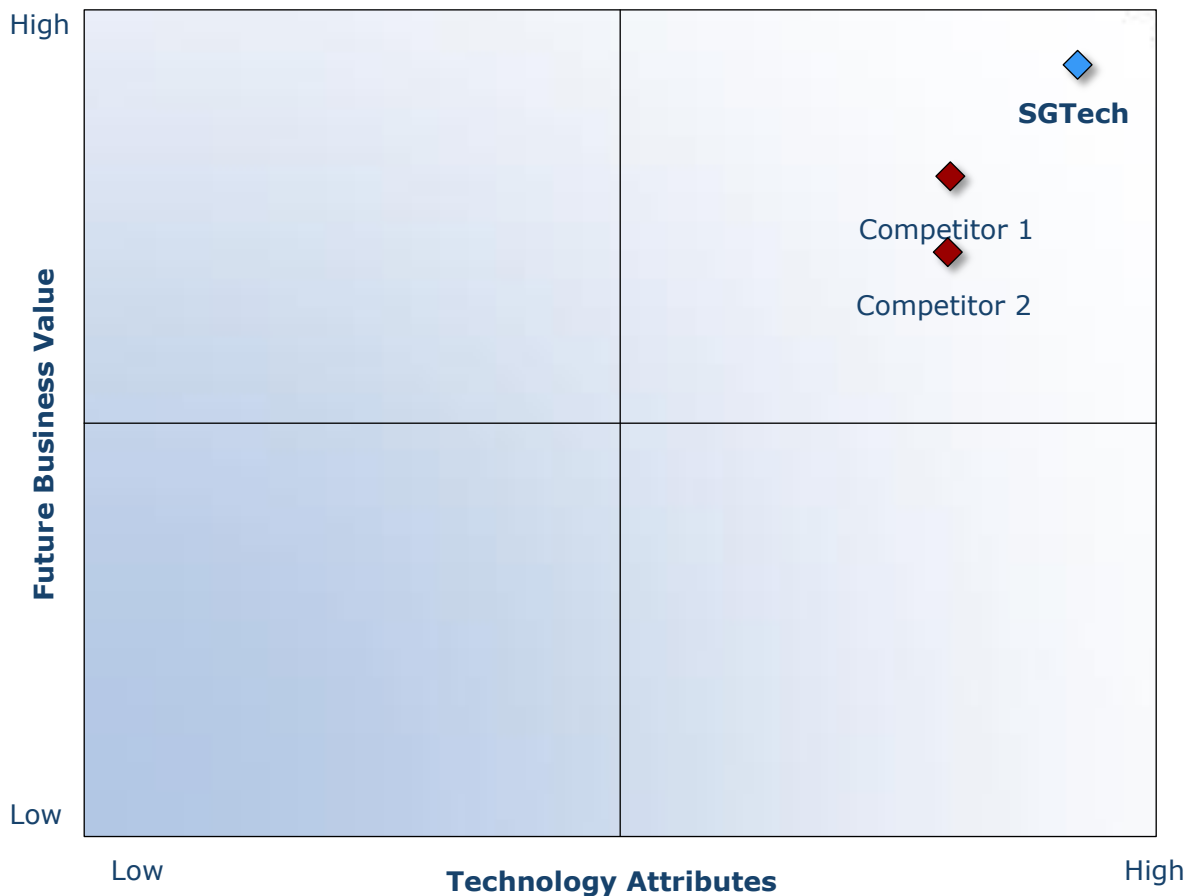
Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

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	**Monitor, target, and screen**	Identify award recipient candidates from around the world	• Conduct in-depth industry research • Identify emerging industries • Scan multiple regions	Pipeline of candidates that potentially meet all best practices criteria
2	**Perform 360-degree research**	Perform comprehensive, 360-degree research on all candidates in the pipeline	• Interview thought leaders and industry practitioners • Assess candidates' fit with best practices criteria • Rank all candidates	Matrix positioning of all candidates' performance relative to one another
3	**Invite thought leadership in best practices**	Perform in-depth examination of all candidates	• Confirm best practices 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	• Brainstorm ranking options • Invite multiple perspectives on candidates' performance • Update candidate profiles	Final prioritization of all eligible candidates and companion best practices positioning paper
5	**Assemble panel of industry experts**	Present findings to an expert panel of industry thought leaders	• 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	• 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	• 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 practices award recipient	• Review analysis with panel • Build consensus • Select recipient	Decision on which company performs best against all best practices criteria
9	**Communicate recognition**	Inform award recipient of recognition	• 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 is able to share award news with stakeholders and customers	• Coordinate media outreach • Design a marketing plan • Assess award's role in strategic planning	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.