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**Doosan GridTech®**

About Us

***DOOSAN***

## About Doosan GridTech

Doosan GridTech provides comprehensive technical solutions to help customers take advantage of the evolving energy industry and maximize profits. Our services encompass the integration, management, and control of Battery Energy Storage Systems (BESS) and various distributed energy resources. We cover all aspects of BESS and Microgrid value chains, including system design, installation, testing, and maintenance.

Our parent company, Doosan Corp., is a \$15B multinational conglomerate that serves the infrastructure development needs of the power, industrial, and government markets. In 2016, Doosan Corp. launched Doosan GridTech by acquiring 1Energy Systems to expand into the clean energy, energy storage, and software business. Since then, Doosan GridTech's BESS control system technology has enabled the company to expand and accelerate the BESS business.

Our global team has successfully designed and deployed numerous energy storage installations using various battery technologies, including lithium-ion and vanadium redox flow batteries, across the Americas and Asia-Pacific regions. Between 2016 and 2019, industry leaders recognized our expertise, ranking us as one of the top energy storage solution providers, according to Navigant Research and Bloomberg New Energy Finance. Furthermore, we received the Grid Edge Innovation Awards from Greentech Media in both 2016 and 2018.

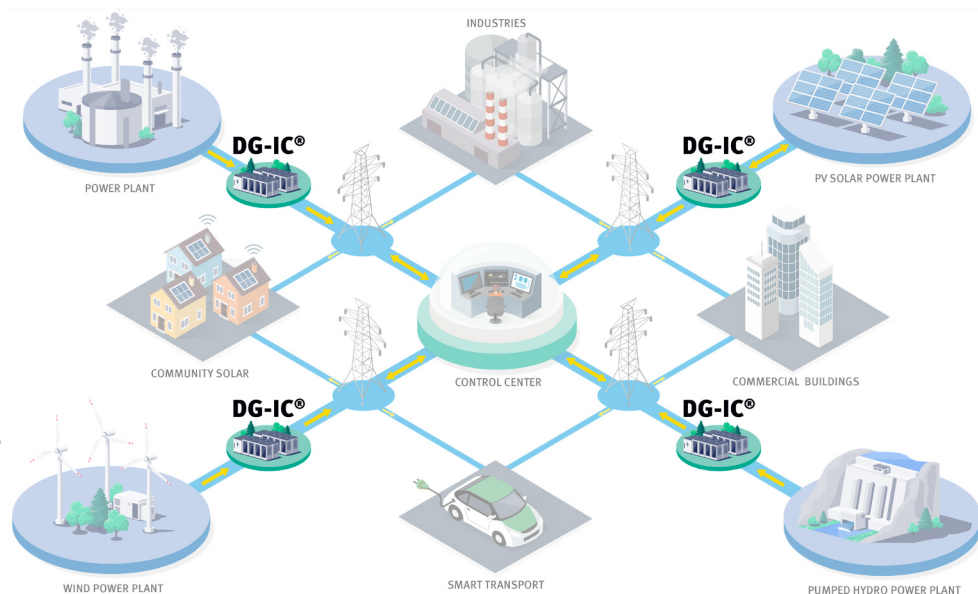
Based near Seattle with an additional office in Melbourne, Doosan GridTech comprises software engineers and power system engineers with extensive experience in control systems. Our mission is to deploy BESS solutions to address grid stability and renewable energy challenges.

## Software is our Difference

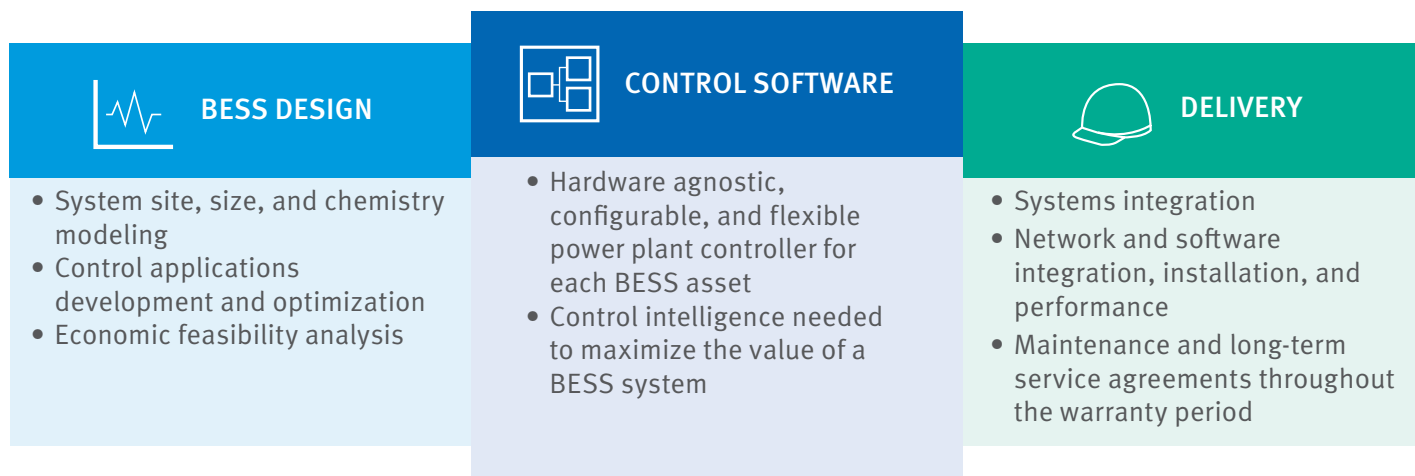
At the heart of Doosan GridTech's mission is our innovative two-tier software control platform engineered to operate seamlessly at both the individual site and fleet dispatch levels. This powerful platform equips you with the essential tools to effectively integrate distributed energy resources into your electricity system, ensuring you deliver reliable, high-quality service to your customers.

The control system software is crucial when installing an energy storage system, requiring effectiveness and adaptability due to evolving use cases. Avoiding proprietary vendor technology is important, as it can limit flexibility and introduce risks. Managing communication across different systems can be complex, especially with unique vendor configurations. The software must respond to grid conditions, integrate with SCADA, and adapt to scheduling, weather, and market signals to maximize battery value. Varied interfaces and security measures across systems can challenge scalability and maintainability.

Doosan GridTech has been a trailblazer in developing a control system tailored for energy storage, built on open standards to mitigate these communication and control challenges. Our adaptable platform ensures safe, reliable, and effective management and dispatch of energy storage and Distributed Energy Resources, no matter the use case or technology involved.



The heart of our business is our two-tier software control platform that can operate multiple generation sources as an individual Hybrid site. This platform provides you with the tools to integrate distributed energy resources (DER) into your electricity system while maintaining reliable, high-quality service to your customers.



## Energy Management Software

### Doosan GridTech Intelligent Controller® - (DG-IC®)

The DG-IC is an extensible energy management system for battery energy storage and hybrid power systems. It offers fully flexible, precision programming to deliver safe, reliable control and optimization with rapid response to changing conditions in real-time.

The DG-IC offers flexible and customized controls designed for optimal peace of mind, featuring rapid response times to variations in power metrics and configurable settings for both AC and DC applications. Its open standards design allows for tailored solutions, while built-in safety features, including maintenance mode and a three-tier alarm system, ensure the safety and reliability of personnel, the grid, and the system itself.

## BESS Design Services

Our design services focus on creating the optimal design and configuration for an energy storage system that aligns with your goals. We start by understanding the specific benefits you aim to achieve with the BESS. Then, we develop duty cycles that represent how the BESS will be utilized, incorporating optimization algorithms along with historical or simulated data. With this information, we can determine the appropriate system size while considering factors such as degradation, availability, and performance requirements. This process allows us to estimate the capital costs for the system, which can then be used to evaluate the project's economic feasibility.

## Deployment/Delivery Services

### System Integration

We customize your battery energy storage program to meet your specific needs by leveraging the extensive configurability of DG-IC. This process involves a thorough understanding of your operations, energy storage objectives, field practices, and equipment requirements. Our services include a detailed design that covers component descriptions, site electrical design and layout, control and communications design, and safety/system protection design.

Doosan GridTech offers flexible system integration and a variety of commissioning services, including BESS engineering, factory acceptance testing, pre-commissioning C-HIL (controller hardware-in-the-loop) testing, final commissioning and acceptance testing, training, and long-term field performance testing. We manage network and software integration, installation, and overall performance.

### Maintenance and Support

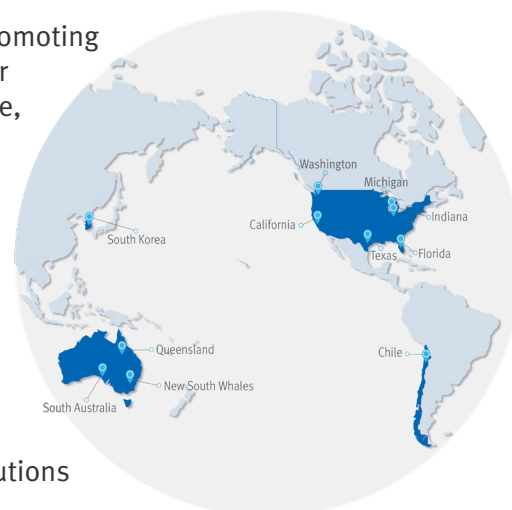
Once we integrate a system, we offer a range of services to ensure our utility customers have peace of mind regarding the system's long-term performance. Some customers prefer to handle system maintenance on their own and supply the necessary parts for scheduled maintenance. In this case, we can provide the required training for maintenance. Additionally, we can arrange for qualified personnel to be present and offer guidance during your first annual BESS maintenance cycle. Alternatively, if needed, we can provide full-service maintenance for the duration of the warranty.

## Representative Global Energy Storage Experience

At Doosan GridTech, we are committed to driving economic growth and promoting environmental sustainability by advocating for a robust, low-carbon power grid. We specialize in empowering large-scale power producers to evaluate, secure, integrate, manage, and optimize energy storage systems. Our Battery Energy Storage Systems are designed for maximum impact, whether they operate independently or paired with solar or wind power.

**With a team of seasoned battery storage experts based in Seattle and Melbourne, we have successfully designed, procured, and implemented a variety of systems across the Americas and Asia-Pacific, totaling nearly 1 GWh in capacity.**

We emphasize adaptability in every phase of a project, ensuring that we meet our clients' unique needs. Our commitment is to deliver tailored solutions that align seamlessly with your objectives.



Project	Client & Technology	Objectives	Use Cases
<b>Wave 1 Battery Supply</b> Tampa, Florida (100 MW / 200 MWh) <i>In Progress</i>	<b>Client:</b> Tampa Electric <b>Battery:</b> Gotion Li-ion <b>PCS:</b> SMA <b>EMS:</b> DG-IC®	Procure and deliver BESS equipment and coordinate the BESS design and data with 3rd party EPC to support the design and installation of a complete, functional system.	Peak shifting, voltage support, reactive power support, ramp rate control, fast frequency response.
<b>Tailem Bend II BESS</b> South Australia, AUS (41.5 MW / 45 MWh) <i>In Progress</i>	<b>Client:</b> Vena Energy <b>Battery:</b> CATL Li-ion <b>PCS:</b> Power Electronics <b>EMS:</b> DG-IC®	To counter the intermittent nature of solar generation and maximize the solar plant's profit while providing ancillary services to the National Electricity Market.	Fast frequency response, voltage support.
<b>Capital BESS</b> Australian Capital Territory, AUS (100 MW / 200 MWh) <i>In Progress</i>	<b>Client:</b> Neoen <b>Battery:</b> CATL Li-ion <b>PCS:</b> Power Electronics <b>EMS:</b> DG-IC®	Use ESS for market participation & respond to frequency changes to prevent voltage & frequency collapse, & add competition to the markets helping reduce consumer electricity prices.	Ancillary services, arbitrage, peak shaving, block/load shifting, renewable firming and smoothing, virtual inertia.
<b>Wandoan South ESS</b> Queensland, AUS (100 MW / 150 MWh)	<b>Client:</b> Vena Energy <b>Battery:</b> Samsung Li-ion <b>PCS:</b> Power Electronics <b>EMS:</b> DG-IC®	Market participation, standalone ESS, providing energy arbitrage and FCAS revenue.	Energy arbitrage, frequency control, ancillary services.
<b>Beacon Solar Plant ESS</b> Mojave Desert, CA (20 MW / 10 MWh)	<b>Client:</b> LADWP <b>Battery:</b> Samsung Li-ion <b>PCS:</b> SMA <b>EMS:</b> DG-IC®	Deploy large-scale energy storage system to provide greater resiliency and reliability to electrical system grid and allow for greater utilization of existing solar plant.	Solar integration, frequency response services, local voltage support.
<b>Micanopy ESS Microgrid</b> Micanopy, FL (8.3 MW / 11.7 MWh)	<b>Client:</b> Duke Energy <b>Battery:</b> Samsung Li-ion <b>PCS:</b> SMA	Deploy ESS with microgrid services to improve reliability for third-party energy user. Capture revenue from the southeast wholesale market to improve economics for investment.	Islanding, frequency regulation.
<b>Jennings ESS Microgrid</b> Jennings, FL (5.5 MW / 5.5 MWh)	<b>Client:</b> Duke Energy <b>Battery:</b> Samsung Li-ion <b>PCS:</b> SMA	Deploy ESS with microgrid services to improve reliability for third-party energy user. Capture revenue from the southeast wholesale market to improve economics for investment.	Islanding, frequency regulation.
<b>Atterbury PV + S Microgrid</b> Camp Atterbury, IN (5 MW / 5 MWh)	<b>Client:</b> Duke Energy <b>Battery:</b> Samsung Li-ion <b>PCS:</b> SMA <b>EMS:</b> DG-IC® <b>PV:</b> 2 MW array	Deploy mission-critical solar+storage system with microgrid services to improve reliability for Atterbury National Guard base. Capture revenue from the MISO Frequency Regulation market to improve economics for investment.	Islanding, frequency regulation.
<b>Nabb ESS Microgrid</b> Nabb, IN (5 MW / 5 MWh)	<b>Client:</b> Duke Energy <b>Battery:</b> Samsung Li-ion <b>PCS:</b> SMA <b>EMS:</b> DG-IC®	Use ESS to improve reliability to community. Capture revenue from the MISO Frequency Regulation market to improve economics for investment.	Islanding, frequency regulation.
<b>John Hopkins PV + S Microgrid</b> St. Petersburg, FL (2.5 MW / 18 MWh)	<b>Client:</b> Duke Energy <b>Battery:</b> CATL <b>PCS:</b> Dynapower <b>PV:</b> .8 MW array	Deploy ESS + PV with microgrid services to improve reliability for third party energy user. Capture revenue from the southeast wholesale market to improve economics for investment.	Islanding, frequency regulation.

Project	Client & Technology	Objectives	Use Cases
<b>Everett ESS</b> Everett, WA (2 MW / 7 MWh)	<b>Client:</b> Snohomish PUD <b>Battery:</b> Vanadium Redox Flow <b>PCS:</b> Siemens <b>EMS:</b> DG-IC®	Enable storage-based firming of renewable energy.	Energy arbitrage, peak shifting.
<b>Glacier ESS</b> Glacier, WA (2 MW / 4.4 MWh)	<b>Client:</b> Puget Sound Energy <b>EMS:</b> DG-IC®	Improve service to a remote community.	Peak shaving, islanding, and frequency response.
<b>Hardeson ESS</b> Everett, WA (2 MW / 1 MWh)	<b>Client:</b> Snohomish PUD <b>Batteries:</b> Mitsubishi & LG Li-ion <b>PCS:</b> Parker Hannifin <b>EMS:</b> DG-IC®	Enable storage-based firming of renewable energy as part of broader ESS fleet optimization.	Peak shaving, renewables smoothing, energy arbitrage/system flexibility.
<b>Mueller ESS</b> Austin, TX (1.8 MW / 3.2 MWh)	<b>Client:</b> Austin Energy <b>Battery:</b> Samsung Li-ion <b>PCS:</b> Younicos <b>EMS:</b> DG-IC®	Deploy utility-owned energy storage to integrate 3 MW of community and rooftop solar PV at lowest-cost of load served as part of DOE SHINES program.	Distributed-solar integration, bulk power market services, local power quality support.
<b>Kingsbery ESS</b> Austin, TX (1.5 MW / 3 MWh)	<b>Client:</b> Austin Energy <b>Battery:</b> LG Chem Li-ion <b>PCS:</b> Parker Hannifin <b>EMS:</b> DG-IC®	Deploy utility-owned energy storage to integrate community and rooftop solar PV at lowest-cost of load served as part of DOE SHINES program.	Distributed-solar integration, bulk power market services, local power quality support.
<b>Horn Rapids ESS</b> Richland, WA (1 MW / 4 MWh)	<b>Client:</b> Energy NW <b>Battery:</b> CATL <b>PCS:</b> Power Electronics <b>EMS:</b> DG-IC®	Smooth the solar output, shift off-peak solar energy generation to times when the energy is needed, and help reduce peak energy demand.	Solar smoothing, firming, and shifting.
<b>Parkview ESS</b> Kalamazoo, MI (1 MW / 1 MWh)	<b>Client:</b> Consumers Energy <b>Battery:</b> Samsung Li-ion <b>PCS:</b> Ingeteam <b>EMS:</b> DG-IC®	Deploy utility-owned energy storage system to support distribution circuit reliability and efficiency.	Peak shaving, voltage support.
<b>DHI Facility ESS</b> Changwon (12 MW / 70 MWh)	<b>Client:</b> SK E&S <b>Battery:</b> Samsung Li-ion <b>PCS:</b> Plaspo <b>Software:</b> DG-IC®	Increase utility of solar by shifting production to high demand hours.	Peak demand management, energy arbitrage, solar power shifting.
<b>BSS ESS Phase 1 &amp; 2</b> Gyeongsan-bukdo (3.8 MW / 12.2 MWh)	<b>Client:</b> BSS <b>Battery:</b> LG Chem Li-ion <b>PCS:</b> Plaspo <b>Software:</b> DG-IC®	Reduce energy costs by shifting solar energy production from four systems, using 5 <sup>th</sup> ESS for peak shaving.	Energy arbitrage, peak shaving.
<b>Uiryong PV + S</b> Gyeongsan-bukdo (3 MW / 8 MWh)	<b>Client:</b> BSS <b>Battery:</b> Samsung Li-ion <b>PCS:</b> Plaspo <b>Software:</b> DG-IC® <b>PV:</b> 3 MW array	Create REC Sales profit by charging and discharging of electricity from solar PV.	Energy arbitrage.
<b>Energy Storage System PV + S</b> Changwon (2.5 MW / 7.5 MWh)	<b>Client:</b> Future Energy <b>Battery:</b> LG Chem Li-ion <b>PCS:</b> Plaspo <b>Software:</b> DG-IC® <b>PV:</b> 1.2 MW array	Reduce energy costs by shifting solar energy production from local solar PV.	Energy arbitrage.
<b>Jeungpyeong ESS</b> Chungcheong-bukdo (2 MW / 10 MWh)	<b>Client:</b> SK E&S <b>Battery:</b> SK Innovation Li-ion <b>PCS:</b> SMA <b>Software:</b> DG-IC®	Reduce energy costs through peak shaving and energy arbitrage and create additional profit through demand response discharge.	Energy arbitrage, peak shaving.
<b>Naju PV + S</b> Jellanam-do (2 MW / 6 MWh)	<b>Client:</b> Ihan <b>Battery:</b> Samsung Li-ion <b>PCS:</b> Plaspo <b>Software:</b> DG-IC® <b>PV:</b> 2.6 MW array	Create REC Sales profit by charging and discharging of electricity from solar PV.	Energy arbitrage.
<b>Industrial PV + S Microgrid</b> Changwon (2 MW / 4.2 MWh)	<b>Client:</b> KOEN <b>Battery:</b> Samsung Li-ion <b>PCS:</b> Plaspo <b>Software:</b> DG-IC® <b>PV:</b> 0.1 MW array	Reduce energy costs by peak shaving and energy arbitrage in conjunction with solar PV.	Energy arbitrage, peak shaving.
<b>Changwon Learning Center PV + S</b> Changwon (.5 MW / 1 MWh)	<b>Client:</b> DHI <b>Battery:</b> Samsung Li-ion <b>PCS:</b> Plaspo <b>Software:</b> DG-IC® <b>PV:</b> 0.3 MW array	Reduce energy costs by shifting solar energy production from local solar PV.	Energy arbitrage.

## DOOSAN GRIDTECH® SOLUTIONS

## Intelligent Controller (DG-IC®)



Energy Storage Management System for  
Independent Power Producers | Project Developers | Utilities

Extensible energy management for battery energy storage and hybrid power systems. Fully flexible, precision programming delivers safe, reliable control and optimization with rapid response to changing conditions in real-time

## FLEXIBLE, CUSTOMIZED CONTROLS FOR YOUR PEACE OF MIND

### Responds Quickly

Prioritized operating modes with sub-second response to real or reactive power, voltage, and frequency variations mean a quick response to your most pressing needs.

### Adapts Readily

Configurable parameters, constraints, and settings and a commitment to open standards-based communications ensure the systems meet your specifications in AC and DC-coupled applications.

### Delivers Safely & Reliably

Built-in features - maintenance mode, three-tier alarm system, failsafe shutdown – ensure personnel, the grid, and the system are safe.

- Over thirty operating modes (prioritized by system owners) – targeting both real and reactive power use cases.
- Customized device configuration provides extensive monitoring capabilities of system components (e.g., PCS and battery banks), local power meters, relays, switches, etc.
- Seamless schedule setting reduces the need for operators to set operating modes constantly.
- Multiple means of control (local/remote/automatic) with configurable privileges ensure the right level of access for every stakeholder — hosted on-premise or in the cloud or through both as a hybrid solution.
- Communication between internal components using Modbus and external communication using DNP3 compliant with open standards specifications – MESA and SunSpec.
- Warranty tracking with history and charting of battery performance compared to the manufacturer's warranty limits. State of charge constraint engine maintains a constant dischargeable capacity and energy over system life, ensuring contract compliance.
- OneUI human-machine interface for improved ease of use and effectiveness of field operations.
- Configurable alarms for all system components.
- An embedded performance analysis module that allows system operators to create custom key performance indicators, benchmarks, and visualizations.

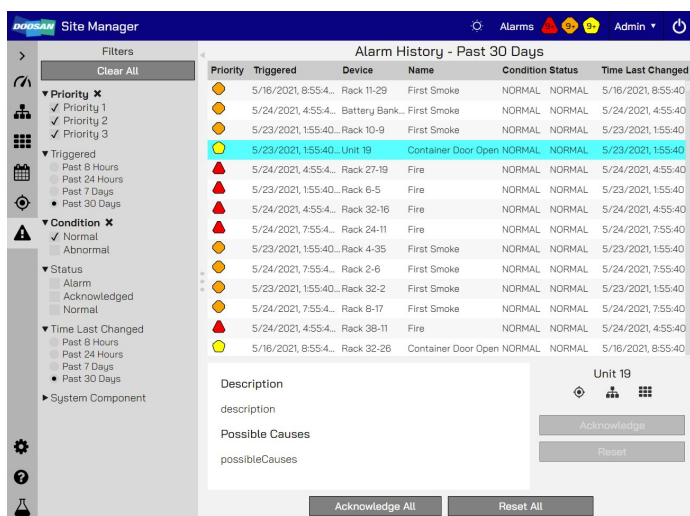
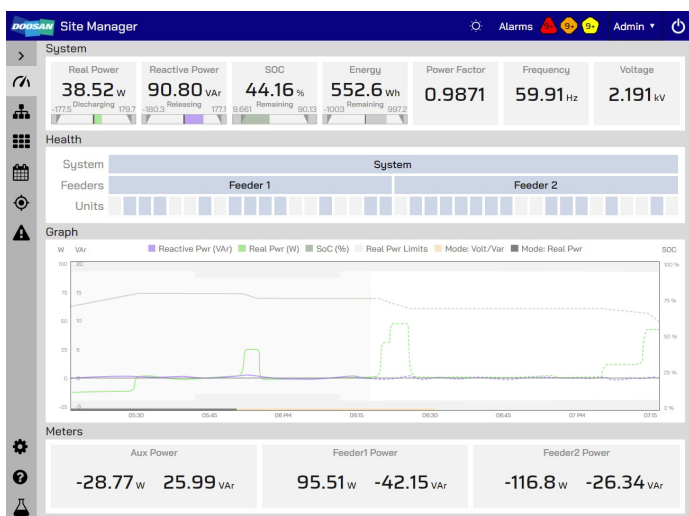
# OPTIMIZING VALUE ACROSS THE POWER AND ENERGY APPLICATION SPECTRUM

## NEW SYSTEMS AND RETROFITS

	APPLICATION	USE CASES	DG-IC OPERATING MODES
	Voltage Regulation	<ul style="list-style-type: none"> <li>Renewable Power Integration</li> <li>Remote community support</li> </ul>	<ul style="list-style-type: none"> <li>Voltage Smoothing</li> <li>Dynamic Volt/VAR</li> <li>Dynamic Volt/Watt</li> </ul>
	Frequency Regulation	<ul style="list-style-type: none"> <li>Ancillary services</li> <li>Contingency reserves</li> </ul>	<ul style="list-style-type: none"> <li>Automatic Generation Control (AGC)</li> <li>Frequency/Watt</li> <li>Spinning Reserves</li> </ul>
	Islanding	<ul style="list-style-type: none"> <li>Outage Management</li> <li>Non-wires Alternatives</li> </ul>	<ul style="list-style-type: none"> <li>SOC Management</li> </ul>
	Solar + Storage	<ul style="list-style-type: none"> <li>Power Firming</li> <li>Energy Shifting</li> </ul>	<ul style="list-style-type: none"> <li>Generation Following</li> <li>ESS Real Power</li> </ul>
	Peak Management	<ul style="list-style-type: none"> <li>Demand Charge Management</li> <li>Peak Shaving</li> </ul>	<ul style="list-style-type: none"> <li>Demand Charge Management</li> <li>Real Power Response</li> </ul>
	Energy Arbitrage	<ul style="list-style-type: none"> <li>Energy Market Participation</li> </ul>	<ul style="list-style-type: none"> <li>ESS Real Power</li> </ul>

## INTUITIVE, SIMPLE, COHERENT INTERFACES

### SEAMLESS ADOPTION & ERROR PREVENTION



## Office Locations

doosangridtech.com

### Seattle - Headquarters

3006 Northup Way, Suite 300  
Bellevue, WA 98004 USA

### Melbourne

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Wheelers Hill, VIC 3150 AUS



Customer satisfaction is achieved by adhering to performance, delivery period, and quality, offering a comprehensive solution through the provision of in-depth services from the initial stage to the completion of a project.