

STORAGE POWER SOLUTIONS C-2-C™ ENERGY GATEWAY





INTRODUCING THE NEXT GENERATION OF ENERGY STORAGE: CELL-TO-CABINET C-2-C™

SPS' Cell-to-Cabinet™ (C-2-C™) technology represents the next generation of battery energy storage.

C-2-C™ surpasses the market, to bring a truly revolutionary Cell-to-Cabinet™ design that provides affordability & true revenue stacking, all with a 20-year performance guarantee. Providing superior safety & environmental performance, C-2-C™ also provides 100% system availability, ease of installation & built-in operational flexibility.

So What's the difference? SPS has used tried-and-true design principles of simplicity, integration and miniaturization from the IT and telecom sectors. The result is a system that significantly enhances revenue stacking and value capabilities.

Why SPS? Unlike most other energy storage companies, SPS is more than an integrator: SPS designs from the cell up and therefore maintains design control of the whole energy storage system, aggressively driving value for our customers. Our proprietary system architecture is based on over 100 years of proven experience, and deployment of over 1.5 GWh of lithium-based energy storage and over 4.5 GWh of Ni-Cd, Ni-MH and VRLA based critical infrastructure. SPS' management has deep experience in power electronics, battery energy storage, UPS and renewable energy.

SPS represents the next evolution in energy storage!

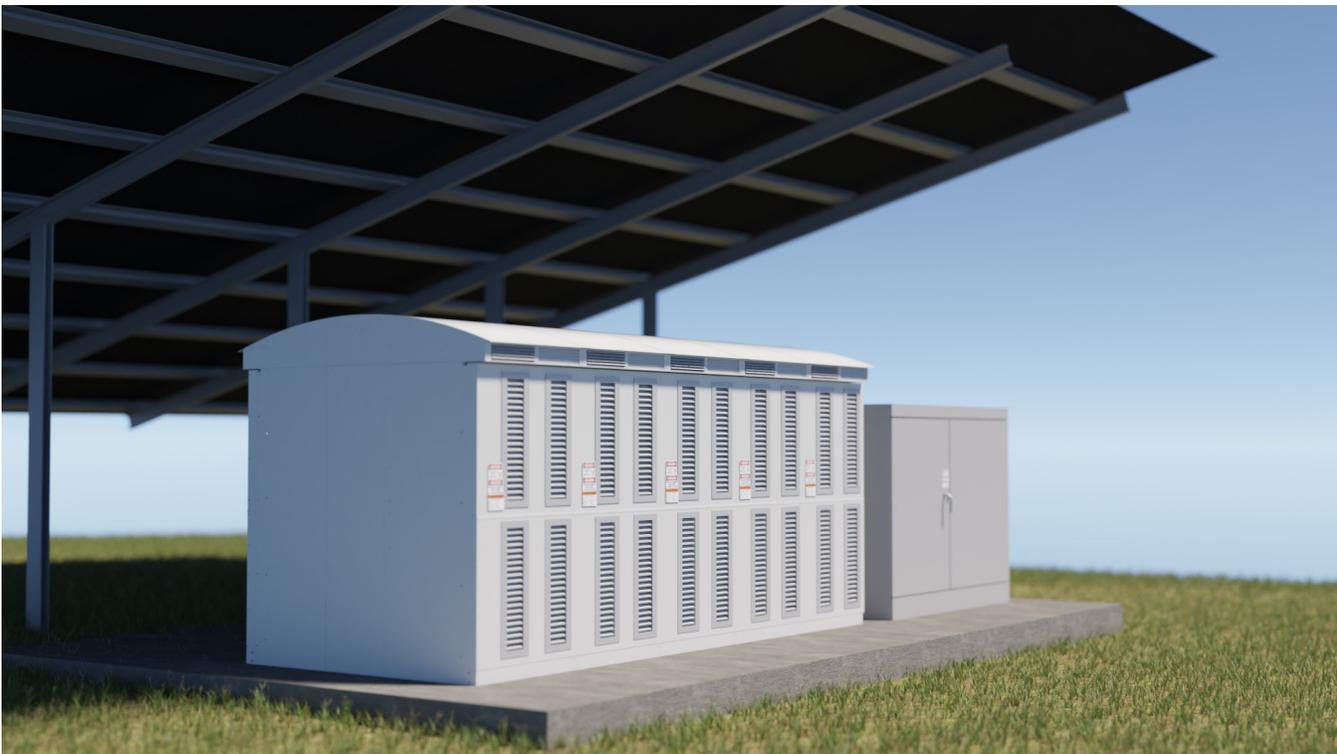
INTRODUCING THE NEXT GENERATION OF ENERGY STORAGE: CELL-TO-CABINET C-2-C™

So What is C-2-C™ SPS' Cell-to-Cabinet™ energy storage technology is a single string of large capacity prismatic LFP cells, housed in cartridges that are fully integrated with the PCS and packaged in a single cabinet. Each sub-system is simplified, miniaturized and integrated, with each cabinet including:

- Class A Lithium Iron Phosphate (LFP) cells.
- Power Conversion System (PCS).
- Cell monitoring & management system to optimize cell and string balancing & lifecycle.
- Thermal management.
- Fire prevention, containment & suppression.
- Safety circuits and security systems.
- Autonomous Energy Gateway Intelligence (AEGIS) software provides control, HMI and communications; manages system balancing, warranty, and performance as a distributed energy resource management (DERM) service pack.



C-2-C™ technology delivers a 50% cost reduction, while unlocking true revenue stacking capability.



Energy storage's value stream to the electric grid is the same as the Internet is to computers.

C-2-C™ DESIGNED FOR MAXIMUM CUSTOMER VALUE

CELL-TO-CABINET STORAGE DESIGNED FOR MAXIMUM CUSTOMER VALUE



SUPERIOR IRR

De-risked projects with 20-year performance guarantee. SPS drives value by eliminating costly balance-of-system components. Installation costs have been reduced through use of modular cartridge technology, perfected in the telcom world. C-2-C™ system arrives at site with all inter-cabinet connections included for quick and seamless installation.

OPTIMIZED REVENUE:

For the first time, enables true revenue stacking by segmenting storage into configurable units which can be dynamically reconfigured in real time to perform distinct revenue functions.

COMPACT DESIGN:

Balance of System Simplified, Miniaturized & Integrated With 143 kW/306 kWh Per m² Footprint.

HIGH EFFICIENCY:

Ultra-high efficiency power electronics & low auxillary power requirements and through intelligent thermal management.

100% AVAILABILITY:

Engineered using principles from telecom applications for enhanced availability, providing cost effective N+4 redundancy. UPS-backed controls for safety and operation.

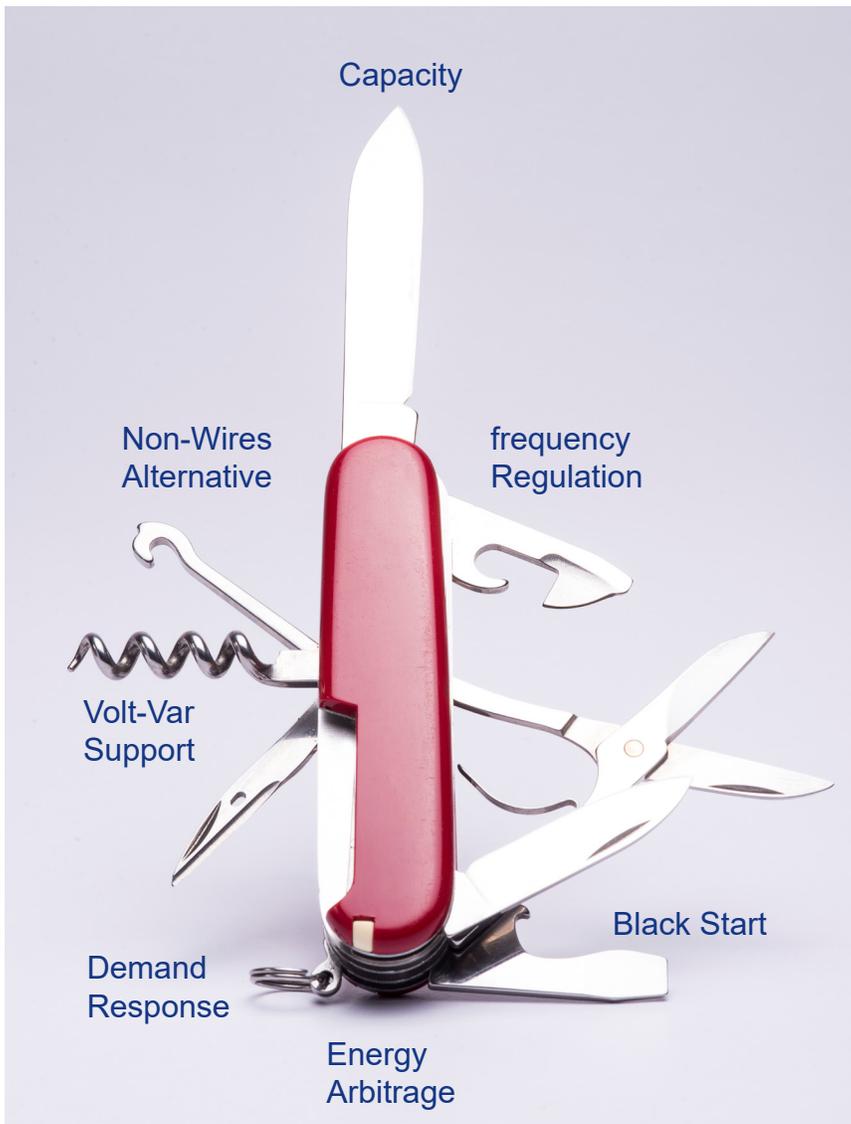
SUSTAINABILITY

SPS practices Circular Lifecycle Design Principles. LFP cells are 100% recyclable and meet all ROHS compliance requirements.

MAXIMUM SAFETY

7-Layers of safety built in for optimum protection against thermal runaway - 4 prevention layers and 3 containment layers. There are an additional 6 unique protection layers for public and worker safety.

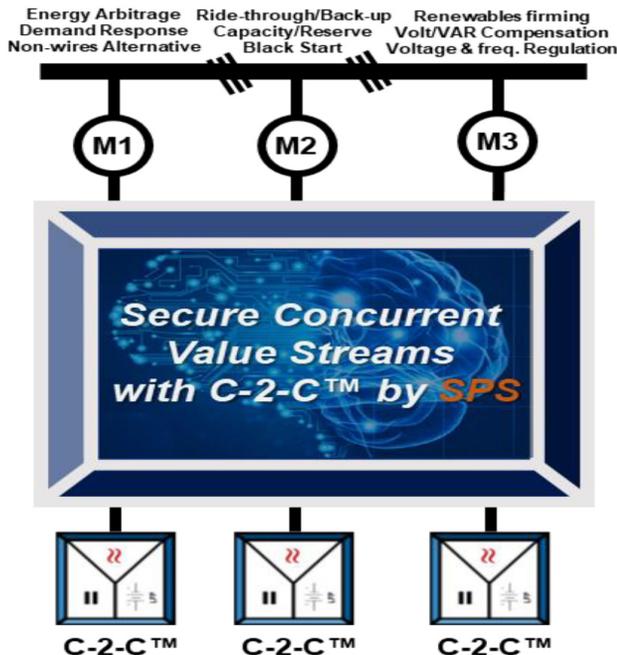
C-2-C™ ENABLES TRUE REVENUE STACKING



Until C-2-C™, energy storage was limited and could only perform one or two functions at a time, reducing the ability to respond to market signals, stack revenues and optimize energy storage return on investment.

Now, C-2-C™ provides the ability to truly revenue stack, with the capability to remotely segment the energy storage system in seconds into configurable blocks. These blocks run independent of each other, simultaneously performing different grid functions. This is made possible by distributed PCS at the cabinet level, along with proprietary AEGIS software which enables real time control of energy through revenue meters to the segmented storage units. Monitoring and balancing occurs at the cell level and state of charge (SOC) occurs at the cabinet level.

Not only can C-2-C™ now secure concurrent value streams, optimizing market opportunities to multiple grid functions, the system provides a superior roundtrip efficiency of 89%, further enhancing the financial performance of the system.



Energy storage is such a big deal that in the electric utility business we called it the holy grail. We knew that if we tried to get higher amounts of wind and solar on the grid, eventually it would break unless we had energy storage.

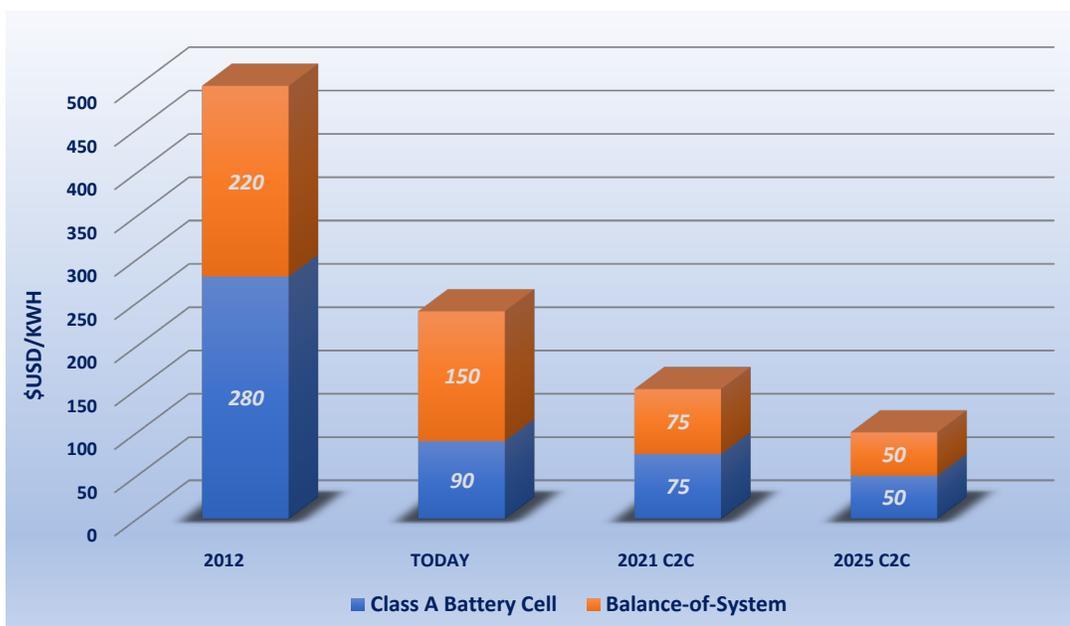
C-2-C™ DELIVERS A 30%+ COST REDUCTION INCREASING TO 60% BY 2025

When it comes to battery energy storage, cost comparisons are often confusing, with suppliers quoting costs for part of the system, such as for the battery cell, and excluding balance-of-system costs.

Overall battery energy storage has gone through a dramatic cost reduction, from an average cost of \$500 USD/kWh cost in 2012 to \$240 USD/kWh in 2020. However, this is only part of the story and it is important to break these costs down further into battery cells and balance-of-system costs. In 2012, LFP cells averaged \$280/kWh, approximately 56% of the entire system cost. Cell costs have declined to less than \$100/kWh and now are less than 41% of the system cost. Over the same time period, the balance-of-system costs have declined by a more modest 36% and now comprises \$140/kWh or 59% of system costs.

Reductions in the balance-of-system costs is key to making further gains in overall cost reductions. SPS' C-2-C™ technology, builds on highly competitive LFP cell pricing, to also focus on driving down the balance-of-system costs, and is on track to exceed total cost targets of \$100/kWh by 2025.

FURTHER SIGNIFICANT COST REDUCTIONS ARE INCREASINGLY DEPENDENT ON INNOVATION IN BALANCE OF SYSTEM COMPONENTS



To achieve these targets, SPS has ruthlessly examined each balance-of-system component in order to eliminate redundancies, simplifying and reducing system complexity, while enhancing system availability.

Whereas C-2-C™ uses one building block of a cell to cabinet, other energy storage companies are generations behind with cell-to-pack, cell-to-stack or cell-to-rack level configurations, each requiring more complex and costly balance-of-system components.

The key point is that by using a cell-to-cabinet design, C-2-C™ has eliminated costly power connections, switch gear, communications, controls and mechanical supports that less integrated systems require.

Balance-of-System includes costs for energy storage sub-systems, including battery monitoring, mechanical closures, thermal management, fire suppression system, safety systems and security. It also includes an integrated power converter system.

C-2-C™ PUTS SAFETY ABOVE ALL ELSE

Preventative Layers

Large capacity prismatic cells in a single string avoids parallel cell interaction and failure modes.

Cold plate structure. Redundant forced air cooling controlled by cell temperature.

Parallel digital and analog redundant monitoring & control of voltage, current and temperatures for safety subsystems.

Galvanic isolation to mitigate energy and / or voltage shoot-through during faults.
2-hr fire safety barrier to avoid propagation.
Elimination of fuel sources (like cables).

Containment Layers

Potassium Nitrate (KNO_2) canisters discharge to eliminate imminent thermal event.

Gas, smoke & fire sensing with sub-system controls. UPS backup for up to 96 hrs to avoid outages.

Dry pipe sprinkler system reduces thermal mass in the case of a thermal event.

In addition to full compliance with UL/CSA standards (UL/CSA 9540/9540A, UL1973, NFPA 855), C-2-C™ uses a safety-first design philosophy, going well beyond a software controlled battery management system.

Each C-2-C™ building block has 7 layers of defense built in to protect against thermal events, including 4 prevention layers and 3 containment layers.

SPS recognizes that safety starts at the cell level and uses Lithium-Iron-Phosphate (LFP) cells. Unlike systems using NMC cells, LFP cells have a significantly lower temperature rise, making them the safest battery of choice for stationary battery storage systems.

C-2-C™ CYBERSECURITY & PHYSICAL WORKER PROTECTIONS



- N+4 system design to maintain 100% availability.
- Analog-intelligence at the individual cell and C-2-C™ level.
- Cyber security with multi-layer intrusion prevention.



- 24/7 remote monitoring.
- Annual preventative maintenance.
- Off-site supervisory control, analytics, asset management, reporting and human interface.
- Annual training and certification for technicians.



- Lock-out, tag-out with customized security key.
- Optional site-biometric physical verification.
- Remote (10' spacing) central emergency STOP.
- Site closed off with perimeter fence.

C-2-C™ Builds in 100% Availability Into its Design



01

Large Capacity LFP Prismatic Cells - Lower Failure Probability

C-2-C™ technology uses large capacity prismatic LFP cells, reducing the number of cells that need to be paralleled together to meet energy requirements. In comparison to smaller cylindrical NMC/NCA cells, larger LFP cells decrease the probability of failure.

LFP chemistry also offers important advantages, including a larger external surface that provides for an ideal thermal exchange plane. LFP also has longer life & stability, constant voltage charge/discharge and low impedance (high efficiency).

02

Single Battery Cell String Coupled With DC:AC Converter

C-2-C™ technology uses a single string, large capacity prismatic cells, fully integrated in a cabinet with all balance-of-system components, along with a PCS. This modular building block is then paralleled to provide the required energy and power.

03

Cell to Cabinet Enclosure Eliminates Complexity

Many other system designs use multiple sub groups to aggregate cells into the enclosure, including packs, modules, stacks and racks, each requiring its own battery monitoring system, power connections, switch gear, controls and mechanical supports.

C-2-C™ has a single grouping, and designs right from the cell straight to the cabinet enclosure level. This eliminates all of the unnecessary balance-of-system and potential failure points, increasing overall availability.

Making Energy 100% Available



SPS

Evolving Energy Storage

THERMAL MANAGEMENT

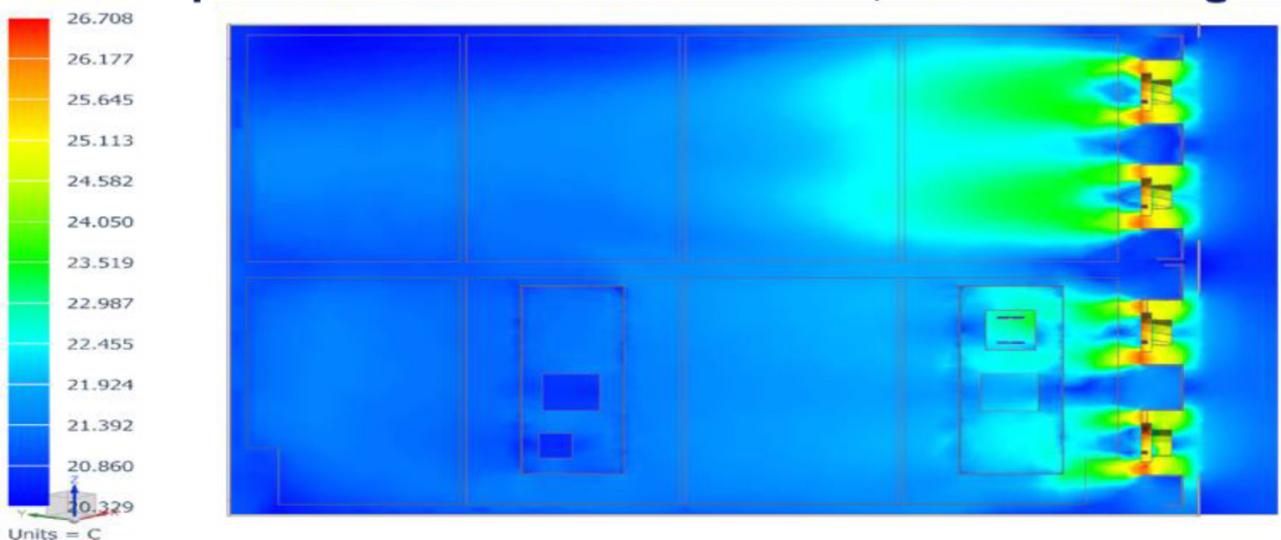
SPS' EXPERIENCE HAS SHOWN THAT FORCED AIR BASED COOLING OUTPERFORMS CENTRAL AIR CONDITIONING BY A 17X FACTOR FOR CAPITAL COSTS.

Thermal Management is an integral part of the energy storage design, impacting capital & operating costs, reliability and safety.

SPS takes a page out of data and telecom industry in selecting forced air cooling systems for thermal management - technology with millions of hours experience.

Very simply, forced air cooling outperforms other forms of thermal management, including liquid cooling and central air conditioning: it eliminates single points of failure, such as failed seals and leaks that are found with other systems. As well, unlike central systems, forced cooling provides an n+4 system availability and provides focused cooling to prevent hot spots in the battery block.

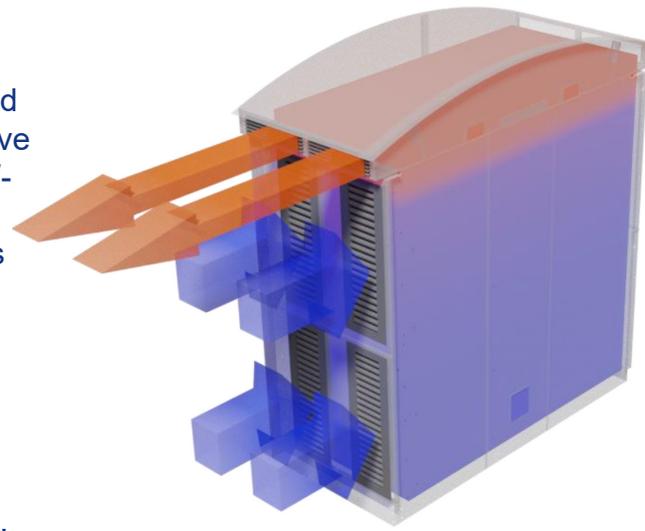
Cell temperature with ambient at 20°C, 100A discharge



C-2-C™ builds in proprietary advanced air flow design into its pluggable cell cartridge that features a cold plate mechanism and temperature sensors built at the cell level to move air and remove heat from the cell faster, maintaining cell temperature within a +/- 2 degrees celsius variance, enabling cell balancing & longevity. Coupled with lower temperature LFP cells, this design enhances safety and reliability by reducing the risk of thermal runaway.

Forced air cooling is ideal for a variety of rugged conditions, able to operate effectively in ambient temperatures up to 45 °C, before the control scheme de-rates performance and maintains equipment operating temperatures at a maximum 50°C. As well, C-2-C™ comes with built in heaters to keep the cells above 5 °C, in the event of ambient temperatures below freezing. Optional dehumidifiers are also available for high humidity climates.

All-in-all, forced air cooling provides a superior cost effective solution and is over 17 times more energy efficient than central air conditioning. In addition to maximizing use of existing ambient airflow, C-2-C™ uses R9 rated insulation to reduce solar heat gain inside to +2°C and to minimize winter heat loss.



THE AIRFLOW WITHIN EACH CABINET IS FROM FRONT OF THE CABINET, THROUGH THE C-2-C™ BLOCK AND TRANSFERRED UPWARDS IN THE “HOT” AISLE IN THE MIDDLE, TO BE EXHAUSTED THROUGH THE CANOPY AT THE TOP

C-2-C™ Includes an Industry-Leading, Proprietary Thermal Management System

COMPARISON OF FORCED AIR COOLING AND CENTRAL AIR CONDITIONING

	FORCED AIR COOLING	CENTRAL AIR CONDITIONING
REDUNDANCY	●	●
MEAN TIME BEFORE FAILURE	●	●
ENERGY EFFICIENCY	●	●
LOW CAPITAL COSTS	●	●
LOW OPERATING EXPENSES	●	●
LOW WEIGHT	●	●
LOW ACOUSTIC EMISSIONS	●	●

Environmental Performance



ENVIRONMENTAL PERFORMANCE

OUR CARBON FOOTPRINT IS OFFSET BY OUR CARBON HANDPRINT

Environmental stewardship and accountability is one of SPS' core values. We believe that our carbon footprint can be off-set by our carbon handprint (actions taken every day). Otherwise known as Circular Life Cycle Design, SPS looks at 4-stages of the product life – reduce (conserve usage), re-use, recycle and recover - in order to maximize our environmental performance.



REDUCE - C-2-C™ design philosophy is simplicity, reducing balance-of-system components, eliminating material, packaging and shipping footprint. Thermal management design also takes this philosophy further, reducing internal power and air conditioning requirements by a factor of 17, compared with central air conditioned battery storage system, leading to a highly energy efficient system.

RECYCLE - RECOVER - REUSE - As part of SPS' sustainability commitment and warranty, SPS recovers all used cartridges and recycles 95% of all material, including battery cells. As well, 5% non-recyclable electronics are recovered and re-used to build new energy storage systems.

SPS seeks to reduce the impact of our environmental footprint, while adopting the highest integrity and compliance standards.

C-2-C™ uses lithium-iron-phosphate (LFP) cells which are cobalt and nickel free. These heavy metals found in NMC and NCA battery chemistries are classified as category 1B carcinogens under the REACH Substances of Very High Concern (SVHC).

QUALITY ASSURANCE AND ADVANCED MANUFACTURING

SPS USES ADVANCED MANUFACTURING TO INCREASE QUALITY, RELIABILITY AND DRIVE DOWN COSTS.

SPS' Made-in-Canada proprietary design uses advanced materials manufacturing and automation to increase reliability and safety, while reducing component requirements, weight and costs. Advanced elements include use of Digital Augmented Reality Design tools and laser welding of key components in the hot pluggable cell cartridges. These cartridges feature locking mechanisms to ensure quick & correct insertion and removal of units, reducing maintenance costs and downtime.

SPS uses a rigorous Quality Assurance process, adopted from best practices in the automotive sector. Use of Prince2 Project Management methodology leads to repeatable processes, ensuring high and consistent quality in all components from day 1.

SPS believes that quality is only as good as your supply chain. We practice 100% factory testing of all battery cells at our Tier 1 battery cell suppliers' sites. Our QA processes also builds in rigorous data analytics, supplier audits, scorecards and continuous improvement plans, in addition to rigorous factory controls.

Installation is greatly simplified with assembly and testing completed in factory and the energy storage system shipped to site as a single assembly. Shock and vibration controls are built in to avoid stressing of bus bar and PCBA connections. These enhancements ensure that site installation and commissioning is reduced to hours instead of weeks.



**SPS IS PROUD TO BE COMPLIANT
WITH IATF 16949:2016 AND UN38.3
FOR SAFETY, MATERIAL HANDLING &
TRANSPORTATION.**

AUTONOMOUS ENERGY GATEWAY INTELLIGENCE (AEGIS)

**C-2-C™ BUILDS IN ITS AEGIS PLATFORM TO ENABLE A
TRANSACTIONAL GRID AND PEER-TO-PEER ENERGY EXCHANGE**



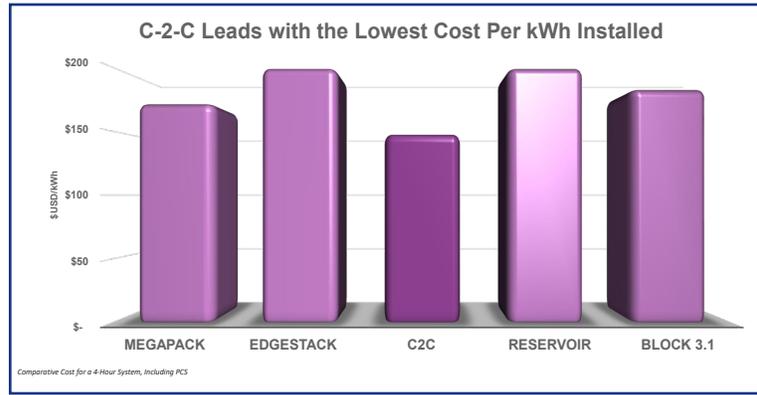
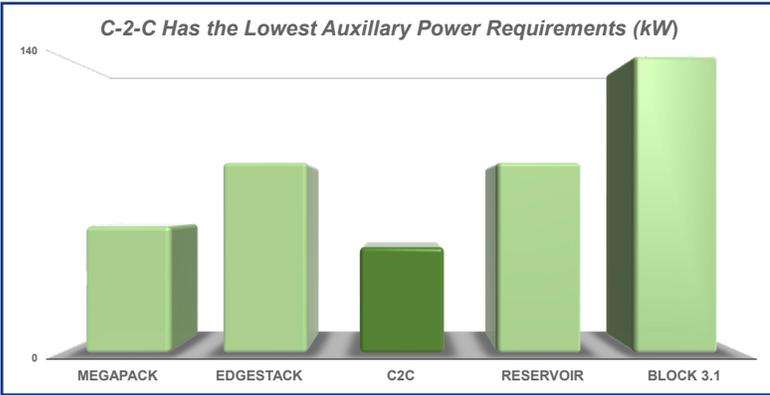
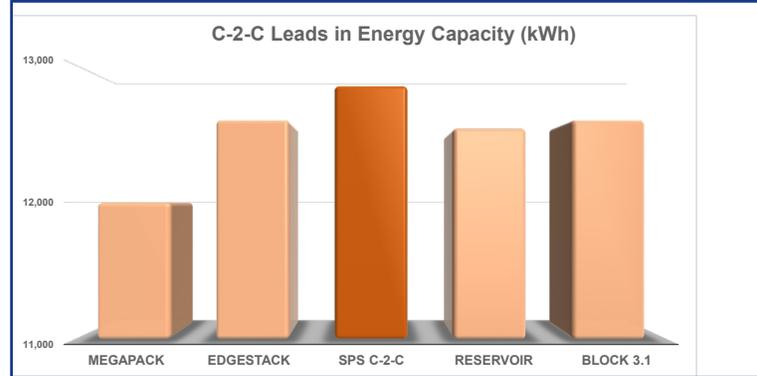
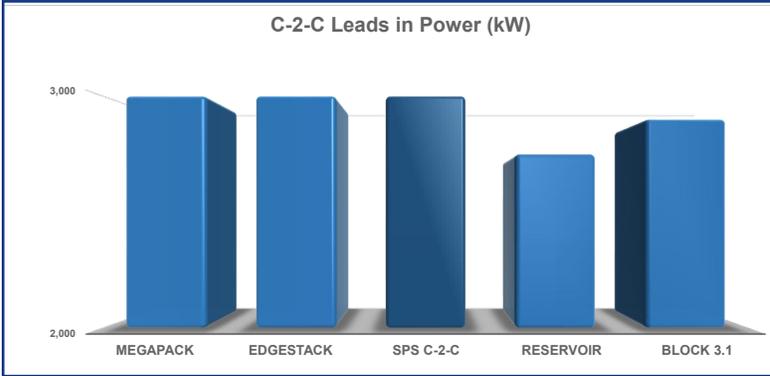
Imagine a world where every node of the electric grid is 100% available and paid for through peer-to-peer energy transactions. SPS' innovative Autonomous Energy Gateway (AEGIS) software and control system makes this a reality by unlocking revenue streams from underutilized load and generation electricity assets.

An energy gateway provides interoperability between both humans and various networks containing devices and applications. AEGIS is a 2, 3 or 4 port power electronics bi-directional device, fully enabled with 4G / 5G communications and distributed energy resource management (DERM) service pack, providing real time controls, μ grid & off-grid controls, VPP controls, ancillary services.

Ports are configurable to support a variety of applications and service types, including medium, high & low grid voltages, seasonal and long duration storage requirements, as well as application from renewable generation, EV's, front of the meter and behind the meter storage.

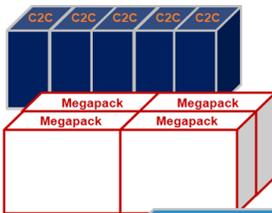
**An Energy Gateway is the equivalent
of a mobile phone for the electric grid,
directly connecting users and suppliers.**

STACKING UP THE COMPETITION

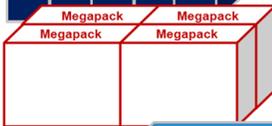


C-2-C™ Provides the Lowest Footprint (m²), While Packing an Industry-Leading Energy Density (kW/m³)

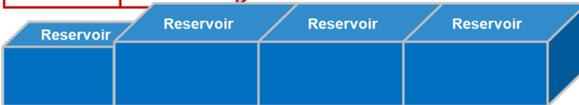
SPS: 3.00MVA, 12.85MWh
C-2-C™ LFP BESS



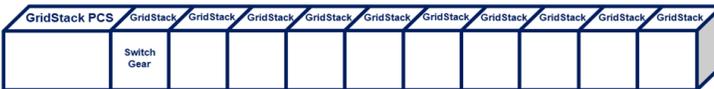
Tesla: 3.00MVA, 12.00MWh
MegaPack™ NCA BESS



GE: 2.75MVA, 12.54MWh
Reservoir™ NMC BESS



Fluence: 3.00MVA, 12.60MWh
EdgeStack™ NMC BESS



Powin: 2.90MVA, 12.60MWh
Block 3.1™ LFP BESS



SPS C-2-C™ LEADS THE WAY

C-2-C™ PROVIDES THE BREAK THROUGH IN ENERGY STORAGE TO PROVIDE GRID PARITY NOW



Footprint

With a 42 m² for a 3 MVA/12.85 MWh system, SPS leads the way in delivering the smallest footprint and one of the highest energy densities - a real advantage where land availability and costs are an issue.



System Availability

With 100% availability in its standard n+4 system, C-2-C™ guarantees performance.



Value Stacking

With one of the lowest costs/kWh, C-2-C™ makes a break through in energy storage to enable revenue stacking of different grid functions at the same time by segmenting the ESS.



Safety & Efficiency

With its proprietary thermal management system featuring forced air cooling, coupled with LFP technology, C-2-C™ protects against safety hazards, while lowering internal energy requirements.

ABOUT SPS



SPS

Evolving Energy Storage

Storage Power Solutions (SPS), founded in 2014 and headquartered near Toronto, Canada, designs, manufactures and distributes large-scale battery energy storage solutions that are infrastructure-hardened, resilient and affordable.

SPS is uniquely positioned in energy storage, leveraging its 100+ years of experience in AC & DC Power Electronics, Ni-Cd, VRLA, Ni-MH and LFP batteries, control & monitoring, IP65 N+1 systems with network & asset management tools as well as solar energy. SPS has designed, deployed and managed over 6 GW/4 GWh in a variety of critical applications.

SPS' DNA is critical infrastructure and employs a field-proven system architecture in its C-2-C™ technology. This includes a proprietary front-end with analog intelligent controls of the battery cabinet, enabling plug and play interface with a variety of inverters and UPS. With a focus on reliable and resilient (N+4) system design, SPS' cabinet approach can scale from 50 kWh to GWh+ and is suited to a variety of applications requiring infrastructure hardening and rugged environments.

OUR VALUES

INNOVATION AND CREATIVE DISRUPTION
SAFETY THROUGH SIMPLICITY & QUALITY
SUSTAINABILITY

STORAGE POWER SOLUTIONS C-2-C™ ENERGY GATEWAY

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