TROES
The Revolution of Energy Storage

TROES Corp – Introduction

TROES Corp. is a Canadian, Advanced Battery Energy Storage company, specializing in Smart Distributed Energy Storage solutions.

TROES, established in May 2018, develops, designs, manufactures, and delivers smart, high-performance, rigorously tested, innovative, cloud based LiFePO4 energy storage systems that integrate TROES' proprietary Battery Modules, Batteries.

We focus on commercial, industrial, institutional, and microgrid segments with stationary applications with major benefits including bill reduction, self-supply, backup, decrease of capital expenditure, power grid congestion alleviation, peak shifting, voltage adjustment.

TROES is set apart from the rest of energy storage providers by:

- offering "Customized-Off-The-Shelf", flexible and scalable designs - covering a wide range of applications (56kWh–100+MWh), better performance, safer, IP-supported tech, very competitive financing/leasing terms and shorter delivery times.
- offering industry leading safety tested batteries, modular and customizable designs to match client needs to avoid over-sizing and over-payment, and a full-solution energy storage system integrating both the hardware and software aspects to provide maximum value.
- enabling mid-size energy project developers and engineering firms to achieve a safer, more economical, and easy-to-integrate battery energy storage solutions for their clients by leveraging TROES proprietary Energy Storage technologies. Our Co-balt free chemistry passes 3800C in head spread test vs 2200C of NMC, and our highly modular design and integrated microgrid controller system save at least 30% cost specially in less than 5MWh system

TROES product has already passed CSA/UL certification and TROES already has deployed systems in Ontario, Canada.

TROES is scaling up very quickly since establishment and right now with the pipeline for projects from China, US, and Canada.

TROES' systems and solutions have been adopted by customers from Canada, U.K., and U.S.A. As of today, have installed and ready to install: 2.34MWh

Success Stories

TROES has already built a pipeline of over USD50million (approximately 100+MWh) with potential projects in nine countries and regions including USA, Mexico, UK, Europe, Israel, Asia, and Australia. Recent projects range from the design-win for an innovative system for a cooling company to use at a Canadian airport (77kWh transportable diesel generator offsetting), the installation of a "virtual power plant" application (1.6MWh community micro-grid in Canada and UK) and bid-won projects like the R&D demonstration related project for a US University (222kWh Micro-grid application) and in NB's Shediac Smart Energy Community Project; specifically, the component where two commercial buildings will be converted to net-zero (Government of Canada Pension Centre and the Town of Shediac's Multipurpose Centre) 200kW/400kWh and 30/100 (peak shaving – integrating with renewables PV's).

On generic business basis, we have 2 provisional IP's.

1. Dual- Equilibrium™ balancing technology (to significantly extend the life cycle of the BESS)
2. Multitasking tool to analyze, control and remotely monitor the system.

We also were very proud and honoured to:

- Win the 1st prize in the "Made in York Region" investors pitching competition after competing with 40 participating companies
- Be selected as one of the top "5 supported companies by VentureLAB (York Region's Innovation hub) to watch in 2020"
- Be listed as top energy storage Startup on Welp Magazine's article for the "46 Start-ups Working on Energy Storage to Follow in 2021"
- Welcome the Mayor of the City of Markham, Honourable Frank Scarpitti, at our offices
- Be awarded an advanced application of wireless communication technology involving 5G antennas in our BESS.

TROES Corp – Technical Information

1. What is the self-discharge rate of the battery?	**A:** 2%-3% / month
2. BESS / Power Conversion System: **2.1** Is the power conversion system included? **2.2** Is the same power conversion system for every system? **2.3** Are you the Manufacturer? **2.4** Specifications?	**2.1.** Yes. **2.2.** The power conversion system is project specific. We can provide different brand and size of PCS as according to the system size including output voltage and output power. **2.3.** We are the manufacturer. We own the Intellectual Property of system design, certificate, patent etc. and we arrange the sourcing and procurement. We outsource manufacturing and manage the manufacturing process, control the quality, and provide O&M by ourselves. **2.4.** Power conversion system: We provide specs brochure or specs sheet. **BESS:** We have indicative BESS specs brochures. To design a BESS, we use a "Specs Form" to collect the info needed for the project/application and then we create the specs sheet for the specific design.
3. Round-trip efficiency of system?	**A:** The calculation is based on how much energy can be used from the batteries divided per energy delivered. BESS eff=98%, PCS eff=96.5%, System eff=98%*96.5%=94.6% Round trip efficiency is calculated by PCS eff * BESS eff * PCS eff * DoD = approximately 88%
4. Recommended depth of discharge (DOD)?	**A:** DoD stands for Depth of Discharge, which measures how deeply discharged a battery is, since over-discharge can dramatically damage a rechargeable battery. The high DoD set, the shorter battery life cycle. Normally the DOD is set up from 90%-95% from manufacturer.
5. What are the tests and protection systems available for your battery pack?	**A:** Our products pass the Certificate of UL 9540 / UL 9540A (BESS) UL1973(battery pack), UL1741(PCS) and UL50 (enclosure), UN38.3, Our existing proprietary battery pack design passed more than 30 safety experiments including the North American safety certification and UL 9540 extreme high temperature thermal runaway test, under which it did not ignite in high temperature environment and has a high safety index.
6. Do you have any fire protection design?	**A:** Yes, we have standard fire protection design. We use Honeywell's off-gas detection technology as the optional predynastic measure, and we have standard Novec or Aerosol fire suppression system installed as option, normally mandate for outdoor system. Meanwhile, we have our proprietary technology environmental control system MiControl and remote monitoring system MiGrid-Operator to diagnose early risks which might catch on fire. Meanwhile, we have UL9540A certified system, UL 9540A included a series of progressively larger fire tests. Each test generated specific data used to evaluate thermal runaway characteristics and fire propagation without specific pass/fail test criteria.
7. Charge / Discharge **7.1** What is the charge and discharge rate – Definition?	**7.1.** We call charge/discharge rate as 'C rates'. The calculation of 'C rate' is 'charge & discharge power/capacity'.

7.2 What's TROES' BESS charge and discharge rates?	For example, a 100kWh battery discharge at a power of 100kW, the battery discharge rate is 1C and the battery will be fully discharged after one hour. **7.2.** Our BESS can reach up to 2C charge and discharge rate. C rate depends on project requirement.
8. Lifecycle description?	**A:** The battery cell TROES chose will be with no less than 6500 cycle at 80% EOL capacity, with 0.5C charge/discharge rate under 25 ℃ based on lab testing. While system operation cycle life is more practical. System operation cycle will be less than battery cell cycle, each project is different, it is upon the application, cycles per day, operation temperature, charging rate etc.
9. What's the definition of SOC?	**A:** State of Charge (SOC) is the available percentage of energy of battery. Take our cellphones for example, the percentage of available power is the SOC.
10. Is this a UL listed product?	**A:** As far as we know, UL certification is one of the highest levels of safety certificate for Battery Energy Storage product in the world. Our products pass the test and have the Certificates of: UL 9540 / UL 9540A (BESS) UL1973(battery pack), UL1741(PCS), UL50 (enclosure), UN38.3 (for the transportation). All the battery packs/modules (with BMS) and PCS are UL listed (CSA approved). Since each client has different system requirements, we do the UL certification for the overall system on each site. If the client needs system certification, we help to get UL9540 certification for site inspection from either QPS or CSA or UL or ETL etc, and we will be responsible help the client gets the UL9540 (UL 9540A) for the system, as we have done for past projects.
11. Does your BESS come with a built in BMS system?	**A:** Yes, BMS is built in and certified together with Battery Packs/Modules.
12. What is the waterproof level of the outdoor and indoor cabinet?	**EA:** The outdoor cabinet meets the requirement of NEMA 3R, which includes IP14 protection from being sprayed by water from all directions waterproof testing, and anti-corrosion testing,etc.
13. What EMS system do you recommend?	**A:** It depends on the application; we collaborate with different EPS partners. Please let us know the application of your project/site. TROES has our own microgrid orientated EMS. But we also work with other EMS companies on different use cases, such as SNC Lavalin, Siemens or other small brands. Some of them focus on Building automation, some of them focus on forecast based peak shaving etc.
14. Does your BESS emit any GHG?	**A:** No. BESS by itself doesn't emit any carbon emission, even in case of a fire situation we could choose NOVEC 1230 type of fire extinguisher, which uses environmentally friendly extinguishing fluid. Beyond, it will reduce GHG emission if used with other renewable sources.
15. How long have these batteries been operating in production duty cycles?	**A:** During the production, the battery mostly is charged and discharged 3 – 5 cycles based on the battery quality and system consistency.

16. What is their lab tested vs real anticipated number of charge cycles to a degraded capacity of 80%?	**A:** If the operation conditions are the same, the real anticipated cycles are in line with the lab tested ones.
17.1 Is the system compliant with NFPA855? **17.2 What kind of suppression agent is used?** **17.3 How is the system monitored for fire?** **17.4 What kind of venting is used (if any)?**	**17.1.** Considering the cell level, the prismatic cells manufacturers we selected are equipped with safety disks to prevent the cell explosion. For pouch, the seal will open by themselves if thermal event happens. **17.2.** We provide UL certified FM200/Novec 1230/Aerosol fire suppression systems with smoke sensor and alarm system through Modbus communication. The Emission free (FirePro One) is also available - with much higher price. **17.3.** There will smoke sensor within the container and temperature sensors within the battery packs and container to check on fire issue. Remote monitoring system will let the owner receive info about whether system's caught fire remotely through the fire suppression sensor and temperature sensor. System alarm will also record them. On local control side it will mostly rely on the fire suppression system itself, which will be turned on if anything is detected. We can also add the control logic on if the temperature within battery is too high, then turn on the fire suppression system - the issue will be that the communication won't be faster than the communication within the fire suppression system itself. Only the temperature sensor is not really a reliable way to define whether there is fire. TROES offers off-gas detection technology with single cell off-gas event detection. Working in parallel with TROES' Remote Monitoring, the off-gas detection technology provides alerts at the earliest sign of failure, enabling the option to prevent thermal runaway. Most battery energy storage systems available in the market have smoke detectors but when the smoke is detected, it might be too late. **17.4.** Considering the cell level, the prismatic cells manufacturers we selected are equipped with safety disks to prevent the cell explosion. For pouch, the seal will open by themselves if thermal event happens.
18. What do you use for thermal management? HVAC or liquid cooling?	We use HVAC system and Fan for thermal management for outdoor system. Fans are installed on the battery pack, BESS cabinet and the PCS cabinet. In cell level, the LFP chem/material is more stable and produces low heat. Its ceramic coating fits the structure design to avoid short circuit. In addition, the enclosure of the cell is of high strength and comes with the explosion-proof value. The cells have passed the puncture test and the 380C thermal spread test.
19. Are the power conversion system certified to UL1741 and can be either grid forming or grid following?	Yes, they come with UL1741. It can work both on-grid/off-grid mode.
20. Do you have a reference for a utility connection?	We've designed BESS's connected with 480V/400V 3phase 4 wire, optional to integrate transformer following latest ESA standard. One of our projects is serve higher mid-voltage requirement such as 27.6KVA.

21. Installations can be both 1ph and 3ph?	All our PCS options have 3 phases connection in the AC side. Only one phase can be used if necessary, however the power per phase is 1/3 of the maximum power that the PCS can supply. If the PCS is connected to an unbalanced 3 phase system, it can delivery power in its 3 phases, and when it is in a charging cycle, only one of the phases can be used to charge it, however this configuration is not quite recommended, even less usual.
22. What statistics do you have on long-term reliability of your cells and failure cases?	We have real data and lab data to support cell life cycle, meanwhile, we have years of system operation data as well.
23. What is the Amp of the system?	It depends on the voltage and power of the system. For a 3 phase system the calculation is: Total Power of the PCS (kW)*1.732/Voltage (V)
24. What PCS manufacturers do you work with?	We choose the PCS depending on the project and requirements of our clients but typically some of our PCS partners include Sinexcel, EPC Power, GoElecric, etc.
25. Why do we need remote monitoring for our project?	The RMS ensures the safety of the system measuring the battery voltage, battery current, State of Charge (SOC) , Max cell voltage, min cell voltage, max temp, min temp, etc. It also provides alarms and alerts for module comms lost, cell overtemperature, cell under temperature, cell over/under voltage, DC storage limiting charge/discharge
26. How many systems have you sold?	We have sold 14 systems and 70% of them are successfully deployed. The rest are still in the process of delivering.
27. Can you satisfy TAA compliance?	Yes, we could satisfy. Our TAA solution to a US military project was approved by customer. Normally our systems are manufactured in China, however since we are based in Canada, we can source just the cells from China while sourcing all other components from US or TAA compliant countries and do the manufacturing in Canada allowing for us to reach 50%+ domestic or TAA compliant country manufacturing cost
28. Do you carry cells that have higher Crates than 2C and what is the approximate $/kWh comparison?	We do have some LTO options that can serve above 2C options, but the overall price may double compare to 2C. (4C cost = 2x 2C cost). We could also use 2C cell to satisfy higher C rate project need, we just need to oversize the 2C system

TROES Corp – Sales & Operations

1. What is the price of this unit?	The price of each System depends on the Application, kWh, the system specs, the financing/leasing/payment terms, and many other technical and commercial variables.
2. What's the ROI?	It depends on the application and the cost/benefit analysis, we see a lot of cases with unlevered IRR more than 10%-12% especially with high electricity price, good solar or wind condition or high diesel cost etc.
3. Do you manufacture your own cells, or do you package up third party cells?	TROES has our own software technology to make cell chemistry and PCS ignostic. Right now, we recommend LFP chemistry, and we collaborate closely with multiple top manufacturers like CATL/ATL, EVE etc. We are onboarding more cell manufacturers to release the supply chain challenges. Also, different cell with different C rate could satisfy different project requirement. For example, some need 1C or 2C charge and discharge rate, some require super low temperature cells. We are also developing product lines with LTO chemistry, supercapacitor and flow battery and we are promoting to the market.
4. Where is your manufacturing location?	We have multiple locations, modules and packs are manufactured in China, enclosure could be from China, Canada or US and our systems are assembled either in China, Canada or close to where the project is located. TROES is also extending our manufacturing location to North America
5. Are you able to share your sales pipeline, and how do you price?	Info like sales pipeline and pricing is confidential, we could possibly share partial information post-NDA.
6. What are the Leasing solutions?	We offer leasing solutions through our financial partners. The eligibility and cost depend on the profile of the handling (the lease) company for the leasing partner to do its due diligence. Basic info to start off with company's name, industry in, business description, years in business, financial standing, the annual project(s) volume of leasing, if it's a one-off sale or multiple sales.
7. What can we expect for overall price $/kWh?	Depends on the scope of supply and size of the battery system as the price per kWh decreases as the system size increases. For our small system the price/kWh (less than 500kWh) will range over $500/kWh compared to our largest systems the price may arrange between $300-$400/kWh

TROES Corp – Service & Maintenance

1. Do you offer a battery warranty?	**A:** 2-year free warranty. Optional 5- or 10-year extended warranty.
2. Do you offer Service and Maintenance?	**A:** We offer maintenance and on-site technical and monitoring service. That includes the technical inspection, charge and discharge test, and consumables inspections. We also provide optional 5- and 10-year extension service on good price. We also provide augmentation plans to keep the System's capacity to the originally designed levels.

TROES Corp – Intellectual Property

1. IP Type?	**A:** We applied US IP, they have two types, Utility Ip and design IP. Our IP is Utility IP
2. IP's, for what?	**A:** TROES has 2 provisional IPs: 1) the "Dual-Equilibrium" ™ balancing technology (a hardware and software device to significantly extend the life cycle of the BESS) and 2) Multitasking tool to analyze, control and remotely monitor the system.
3. What is Dual Equilibrium™	This technology is for the battery cell equilibrium (balancing). The State of Charge (SOC) unbalance in a battery pack could significantly influence the battery pack lifetime. Therefore, the balancing is required to ensure the battery lifetime. Currently the equilibrium technology widely used is the passive equilibrium method, which is stable but offers low efficiency. Our technology combines both active and passive equilibrium methods which can bring us a higher efficiency battery equilibrium method and a longer battery life.