CEG Catalyst Energy Group

Fast-Charging Super Capacitor Energy Storage Systems

CEG Super Capacitor Energy Storage Systems (CEGSC Energy Storage Systems) now include revolutionary Hybrid Graphene+ Super Capacitors offering unmatched performance and durability.

CEGSC Energy Storage Systems feature:

- Breakthrough fast-charging / slow-discharging super capacitors that limit generator runtime, dramatically reducing fuel consumption, pollution and generator maintenance
- Super capacitors that last for 1 million charge / discharge cycles
- 100% depth of discharge
- Separate ports output AC and DC simultaneously
- Functionality in extremely cold and extremely hot conditions
- No end of life toxic waste - free of hazardous materials
- No transportation restrictions versus batteries with risk of fire
- Custom solutions including disparate voltages, single or three phase, optional integration with wind, solar or the grid, user defined duration of backup

Contact info@CatalystEnergyGroup.com for further information
or to schedule your project modeling

CEG Catalyst Energy Group

CEGSC Energy Storage Systems Minimize Generator Runtime

Reducing Pollution, Slashing Fuel Cost, Decreasing Generator Maintenance

Where the grid is unavailable or unreliable, *CEG Super Capacitor Energy Storage Systems* automatically summon generators only as needed, quickly charge super capacitors and turn generators OFF, dramatically reducing generator runtime.

These benefits are achieved by integrating proprietary Hybrid Graphene+ Super Capacitors into CEG's broad range of energy generation and storage products creating an entirely new performance standard. The new CEGSC Power Systems combine the durability and functionality of previous systems with substantively enhanced performance achieved by the addition of superior energy storage technology.

PERFORMANCE COMPARISON	***HYBRID GRAPHENE+ SUPER CAPACITORS*** VS CONVENTIONAL ENERGY STORAGE			
Function	***HYBRID GRAPHENE+ SUPER CAPACITORS***	Standard Super Capacitors	Lithium-ion (general)	Lead Acid Batteries
Charge Time	3 to 6 Mins	2-3 hrs	1 to 2 Hrs	4 to 8 Hrs
Charge/Recharge Life Cycles	1,000,000	1,000,000	3,000 to 5,000	200 to 300
Energy Discharge	Programmable!	FAST	SLOW	SLOW
Voltage	2.7 V or 4.2 V	2.7 or 3.0V	3.6 - 3.7V	Many
Energy Density (Wh/kg)	350 to 500	NA (Fast Discharge)	150 - 250	40 to 50
Power Density (W/kg)	> 20,000	18,000	150 to 250	< 100
Farrads / Capacitor	100,000	3,000	NA	NA
Efficiency	99%	99%	85% - 95%	60% - 75%
Charge Temperature	-40˚ to 60˚C (-40˚ to 140˚F)	-40˚to 65˚C (-40˚to 149˚F)	0˚ to 45˚C (32˚ to 113˚F)	–20° to 50°C (–4° to 122°F)
Discharge Temperature	-40˚ to 60˚C (-40˚ to 140˚F)	-40˚to 65˚C (-40˚to 149˚F)	-20˚ to 60˚C (-4˚ to 140˚F)	–20° to 50°C (–4° to 122°F)
Risk of Fire	NO	NO	YES	NO
Shipping Restrictions	NO	NO	YES	NO
Hazardous Components	NO	NO	YES	YES
Performance Fade	NO	NO	YES	YES
Depth of Discharge	100%	100%	80%	50% - 75%
Cost/kWh	To Specifications	$1,400	$200	$100

I èõNXŘ Graphene+ {dzLJŜN / I·LJI·ŎλűƨNs feature:

- Recharge in as little as <u>three minutes versus hours for lithium-ion and lead acid batteries</u>
- Up to 1 million charge / discharge cycles (typical of capacitors) versus 3,000 to 5,000
- Virtually no fade in performance for 1 million cycles (typical of capacitors)
- Programmable rate of discharge - as slow as conventional batteries, as fast as capacitors or anywhere in between
- 33 times more farads per capacitor than standard super capacitors
- Operation in extremely cold and extremely hot conditions
- No end of life toxic waste - no hazardous materials
- No transportation restrictions versus batteries with risk of fire
- 100% depth of discharge (lithium-ion can require twice as many batteries)

CEGSC Power Systems provide more hours of stored, pure sine wave energy because they feature a number of proprietary, seamlessly integrated components:

HYBRID GRAPHENE+ SUPER CAPACITORS - Proprietary Hybrid Graphene+ Super Capacitors featured in CEGSC Power Systems charge in as little as three minutes versus one to six hours for Lithium-ion or Lead Acid batteries. In addition to this very fast charging feature, what makes HGSC energy storage unique is their ability to discharge at a controlled and programmable rate rather than the very fast discharge that has historically limited the use of Super Capacitors. This combination of fast recharge and slow discharge dramatically reduces generator run time, creating dramatic fuel savings.

PROPRIETARY CHARGE CONTROLLER - CEGSC Power System's charge controller optimizes battery efficiency via a unique algorithm that monitors and controls the entire system and receives automatic software upgrades via Wi-Fi.

INTEGRATED PROPRIETARY POWER FACTOR UNITS - CEGSC Power Systems incorporate proprietary Power Factor Capacitors which supply power to meet demand surges, thereby enhancing efficiency and preserving stored energy.

CUSTOM INVERTERS - CEGSC Power System's custom, high quality inverters contain fail-safe redundant printed circuit boards. This addresses the weak link in many energy storage systems as inverters produce heat which can cause electronics to fail. Further enhancements to CEG inverters include over-sized wiring and copper clad connectors.

CEG
Catalyst Energy Group

GRID CONNECTED MODULAR ENERGY STORAGE SYSTEM

Grid Connected (ON-GRID) Modular Energy Storage System

- ✓ 500kWh Battery System (Scalable)
- ✓ 8 Inverter Modules
- ✓ 3 Inverter Frame
- ✓ Data logger, lighting, plug sockets, air conditioning system, hydrolic lifter for technical service, portable work table

GRID CONNECTED MODULAR ESS

- 3 Phase battery inverter modules
- 200 kW compact frame with switchgear
- High Height (10ft tall modular structure)
- Operating with different battery types:
  Super Capacitors, Lead Acid or LiFePO4
- Bidirectional energy flow (charge/discharge)
- Active/Reactive power control (optional)
- CAN Bus control
- Short troubleshooting time
- Horizontal efficiency curve

200 kW Inverter Frame

GRID CONNECTED MODULAR ESS

- Direct grid connection (no special transformer needed)
- High DC voltage (> 680 V)
- Power Shifting
- Overvoltage, overcurrent, overload & overtemp. protection
- Anti-islanding Protection (IEC 62116 & IEC 61727)

200 kW Inverter Frame

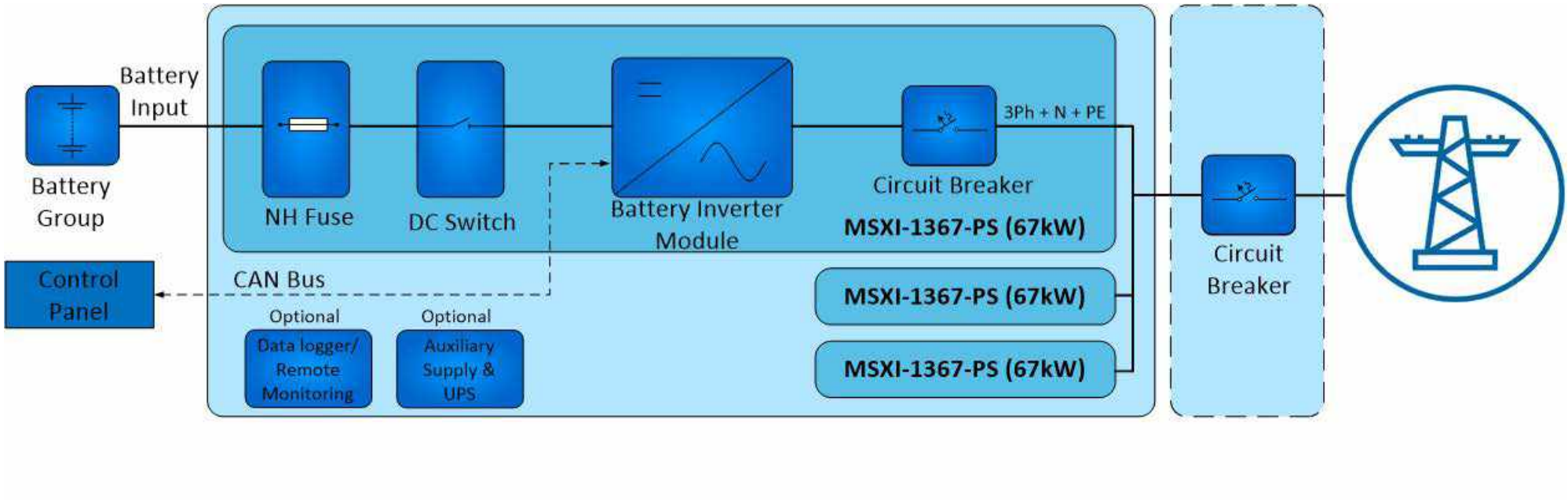
COMPARING CEGSC SYSTEM COST TO DIESEL GENERATOR SPARE PARTS, OIL, FUEL AND MAINTENANCE COSTS

GENERATOR PRIME POWER KVA	OIL FILTER FUEL FILTER FUEL PRE FILTER ELEMENT; AIR FILTER V BELT; ALTERNATOR V BELT; FAN BREATHER VALVE THERMOSTAT	OIL	SERVICE	TOTAL USD		DIESEL LT
45 KVA	$6,100	$918	$3,600	$10,618	+	72,000
60 KVA	$6,200	$1,188	$3,600	$10,988	+	100,800
80 KVA	$6,300	$1,404	$3,600	$11,304	+	165,600
100 KVA	$6,400	$1,836	$3,600	$11,836	+	201,600
142 KVA	$6,500	$1,944	$3,600	$12,044	+	237,600
200 KVA	$6,600	$2,376	$3,600	$12,576	+	331,200
250 KVA	$6,800	$3,348	$3,600	$13,748	+	403,200
350 KVA	$7,000	$3,888	$3,600	$14,488	+	504,000

CALCULATION PARAMETERS:
Generators running 7/24, 100% power, 20 days in mount, 360 days / Year.
Filter change every 200 hours
Diesel price check http://www.globalpetrolprices.com/diesel_prices/

SYSTEM BLOCK DIAGRAM

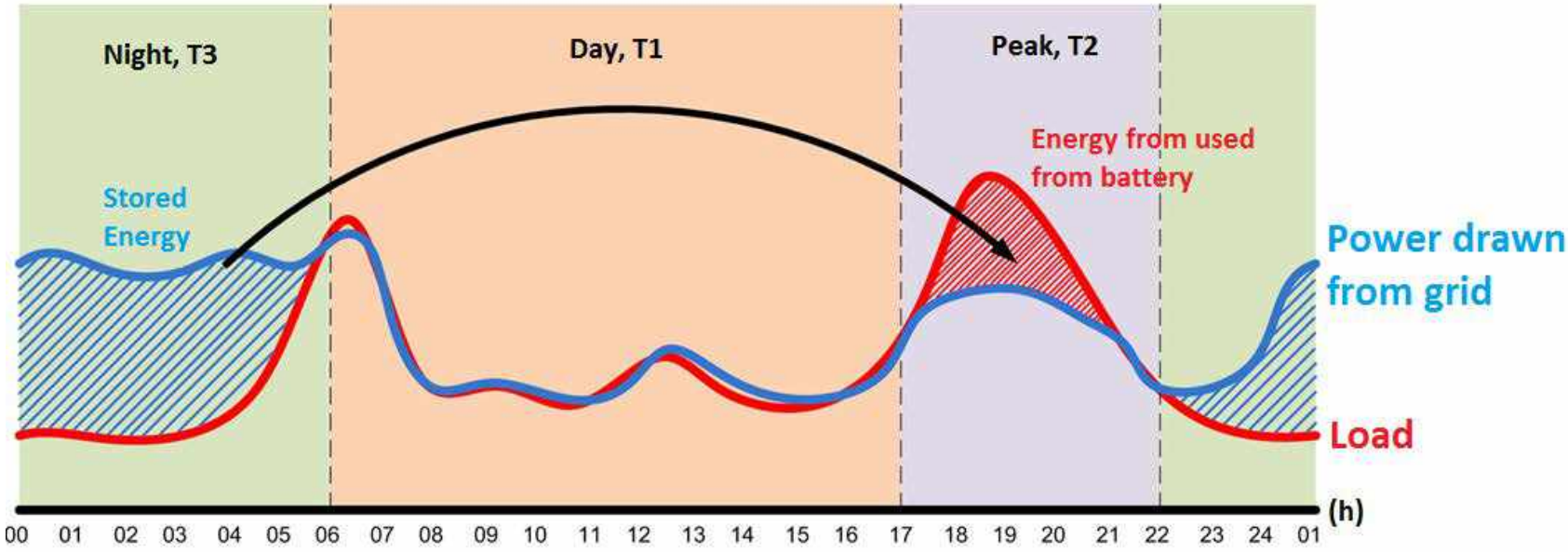
- 200 kW Inverter block diagram:



GRID CONNECTED MODULAR ESS

ESS Operating Modes

- Off peak energy can be stored for use during peak demand.

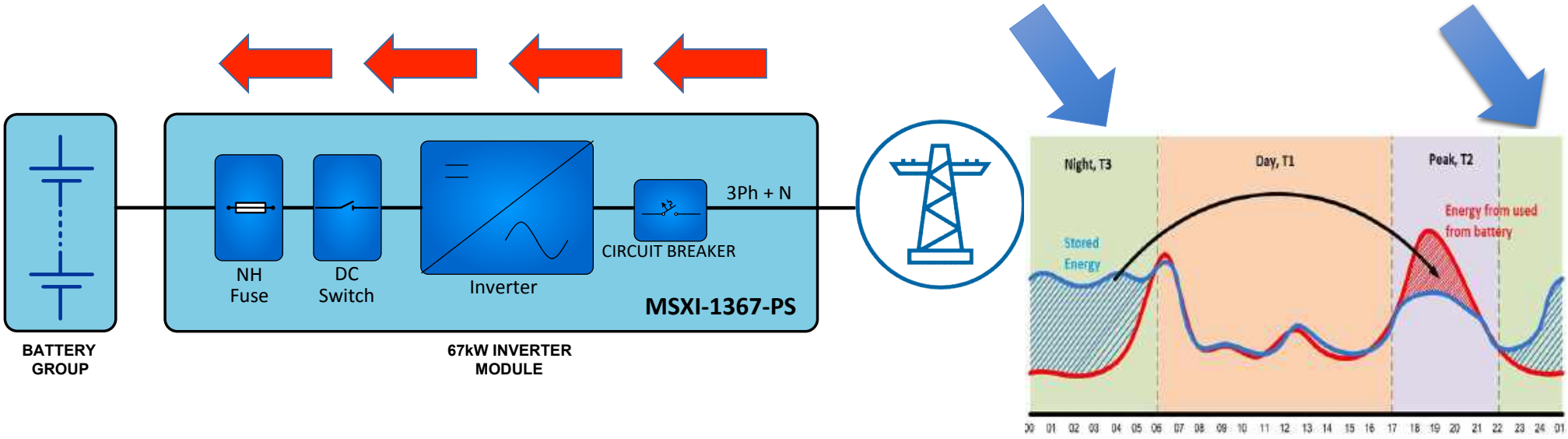


POWER SHIFTING CONCEPT

ESS Operating Modes

1. T3 (Low Price)

In this mode of operation, power drawn from the grid is used to charge energy storage.

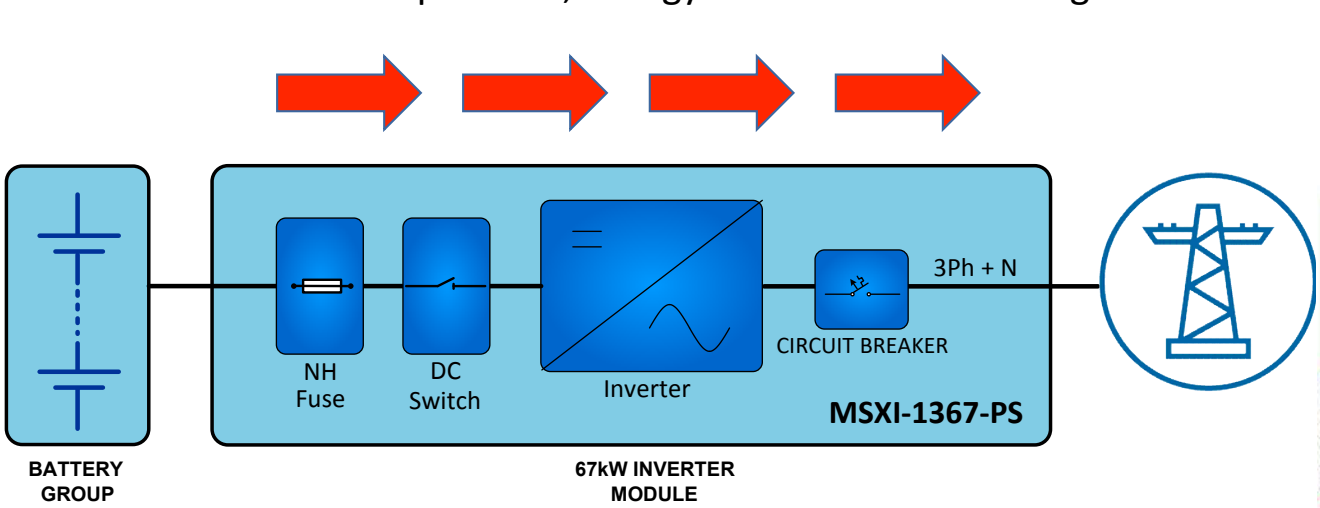


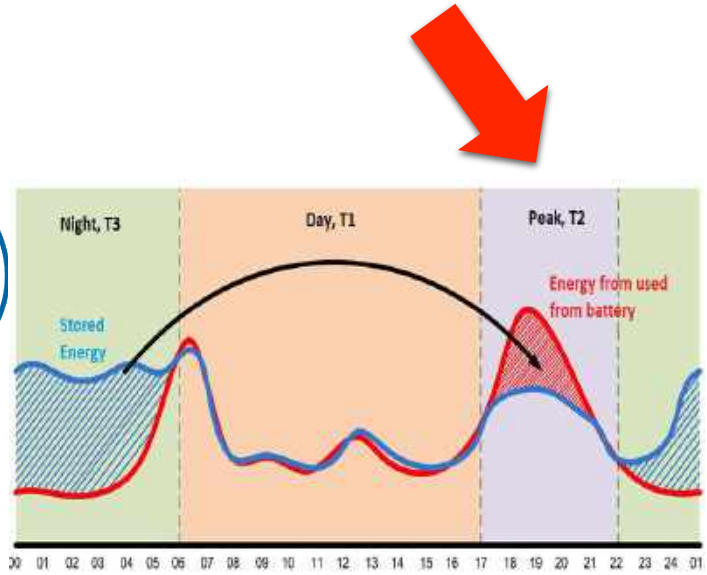
POWER SHIFTING CONCEPT

ESS Operating Modes

2. T2 (High Price)

In this mode of operation, energy is transmitted to the grid via stored energy.





Project Modeling

Extraordinary flexibility achieved by customizing CEGSC Power Systems assures effective operation in any environment:

- At sites not serviced by the grid, CEGSC Power Systems can be configured to generate both primary power and backup power
- Where grid outages occur with some regularity, an optional internal generator assures backup capability for an extended duration
- Where the grid is dependable, several hours of HGSC energy backup address infrequent and shorter outages
- When evaluating new sites in areas not served by the grid, combining CEGSC Power Systems with solar arrays, wind or internal generators provides primary and backup power 24/7 avoiding the need to extend power lines to these remote locations. Fuel savings combined with dramatically reduced battery maintenance provide significantly more robust returns on investment using this strategy

CEGSC Power Systems are designed to be customized. Proprietary plug and play components and the unique characteristics of the batteries themselves encourage addressing each customer's precise requirements.

Energy sources, generating capacity and storage capability can be adjusted to reflect the constraints and opportunities of the customer's specific operating environment.

Control algorithms in CEGSC Power Systems interact seamlessly with solar, wind and the grid while being monitored remotely via the web or the CEG app with a custom username and password:

- Receive data in real time that is that is both predictive of issues and facilitates addressing those issues
- Monitor individual super capacitor modules, each solar panel, each inverter, the charge controller, fuel tank level and generator performance
- Track incoming power and outgoing power as well as diagnose issues with alerts for loose connections, grounding faults, short circuits and over circuit faults

CEG provides sophisticated yet durable systems, turnkey solutions, robust technical support, project modeling, site evaluations, systems engineering, product commissioning, parts, warranties and service agreements. This process starts with CEG's *Power Consumption Questionnaire.*

Catalyst Energy Group
One Lincoln Centre, 5400 LBJ Freeway, Dallas, Texas 75240
(214) 210-0085 info@CatalystEnergyGroup.com CatalystEnergyGroup.com