



UPS Efficiency and Dual Purpose Applications

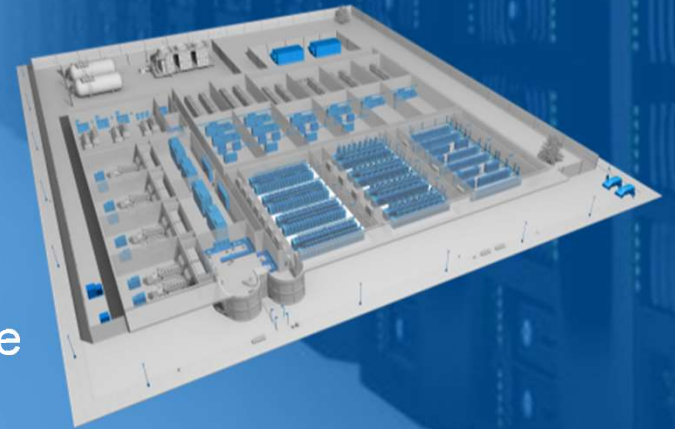
Billy Stapleton, Partner Development Manager
May 2019



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Addressing data centers trends

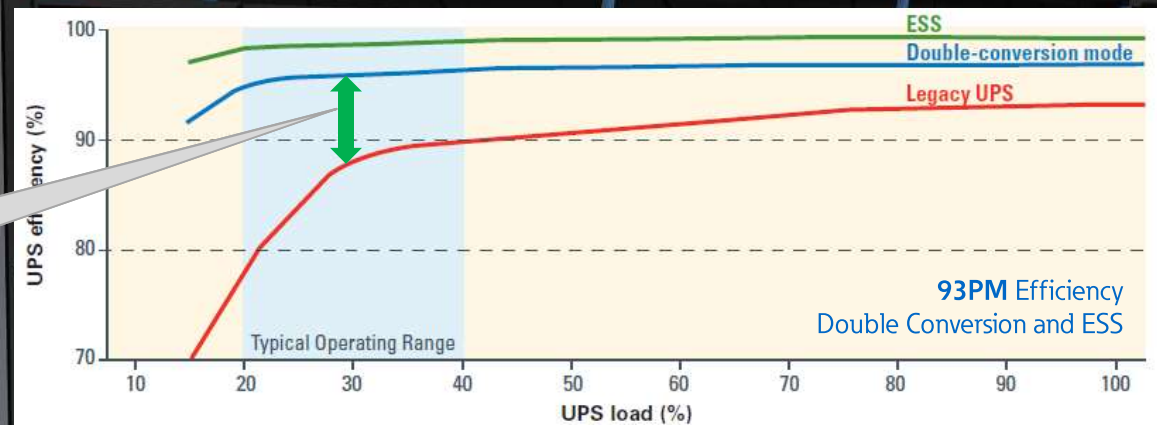
- “Pay as you grow”
- Higher availability
- Higher efficiency
- Distributed redundancy
- Alternative energy storage
- Grid-aware systems



2-Level vs 3-Level Efficiency

Hot Air

Redeploy **energy savings** to other **revenue** generating equipment



Cold Air

Step up efficiency with ECO mode

- ✓ **Efficient**

99% efficiency across entire operating range

- ✓ **Intelligent**

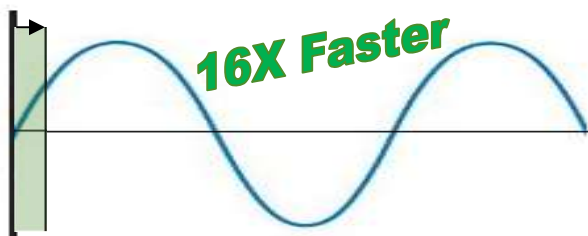
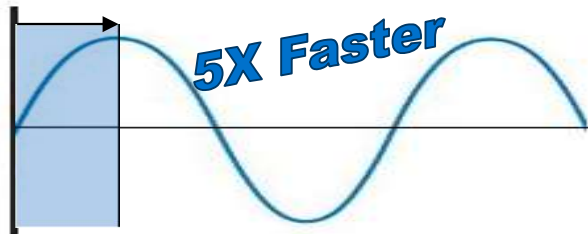
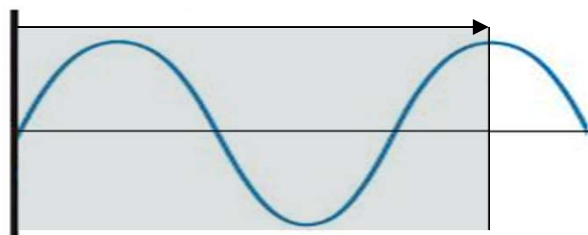
Detects incoming power quality and engages modules as needed (<2ms transfer)

- ✓ **Reliable**

Proven double conversion topology ensures continuous load availability

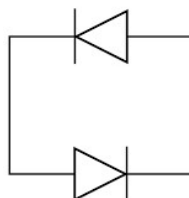


ESS is Fast!



Computer system tolerance:

20ms ... 1/50th of a second



Digital Static Transfer Switch (STS):

4ms ... 1/250th of a second



Energy Saver System:

*1.2ms total ... 1/830th of a second
(inverter is engaged in 620μs !)*

Why should you consider using ESS?

Cost
savings!



CRITICAL LOAD	250 kW
<i>(energy + demand) per kW hr</i> ELECTRIC COSTS	\$0.11
LEGACY UPS EFFICIENCY	93%
EATON ESS UPS EFFICIENCY	99%
ANNUAL ENERGY SAVINGS	223 MW hr
ANNUAL CO ₂ SAVINGS	160 METRIC TONS
CARS OFF THE ROAD	29 CARS
ANNUAL ELECTRIC COST SAVINGS	\$24,572

Using ECO mode or ESS typically recovers
100% of the UPS cost over 2-3 year period

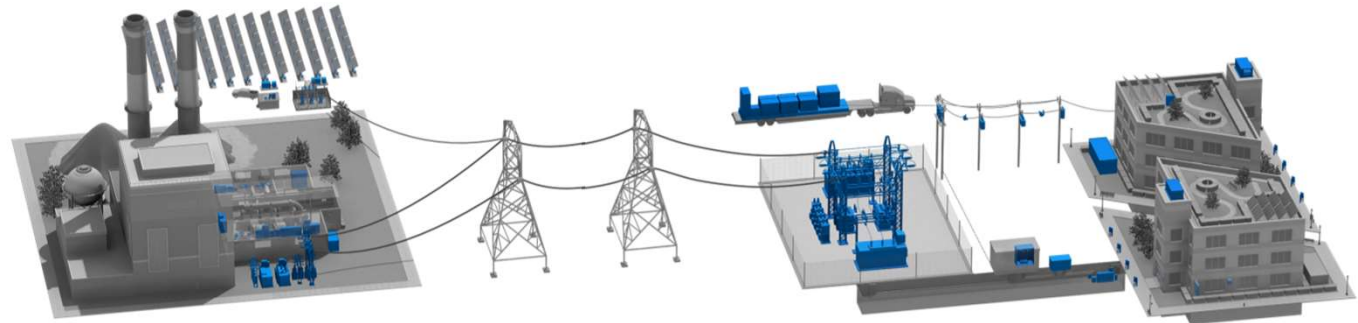


Grid-aware UPS systems

Providing true energy management technology that is reliable and efficient.

Dual purpose UPS

1. Continues to provides power quality management for critical load
2. Adds energy management options
 - Demand charge management
 - Time-of-use energy management



Terminology:

Dual Purpose System:

A UPS capable of supporting both a traditional UPS function while also supporting an energy storage system

Energy Arbitrage:

The practice of purchasing and storing electricity during off-peak times, and then utilizing that stored power during periods when electricity prices are the highest.

Frequency Regulation:

Either supplying power or lowering load in response to utility request. This function supports stabilizing grid frequency during high and low load demands

Demand Response:

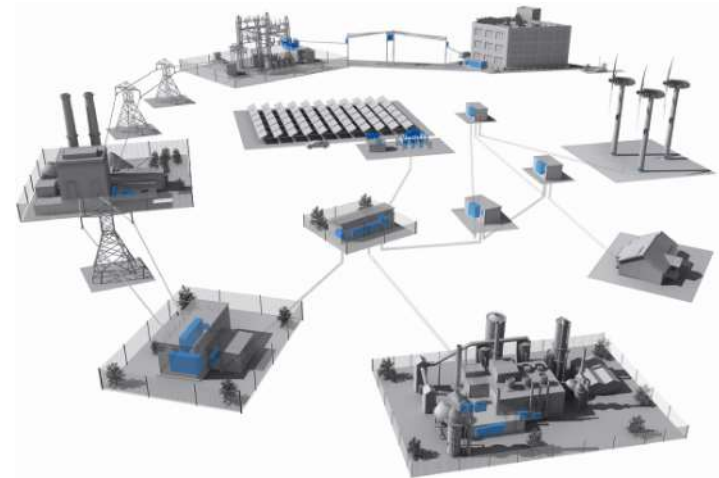
Using stored energy to lower customer's peak power demand from grid.

Utility Pricing:

Usage: Rate for each kWh used

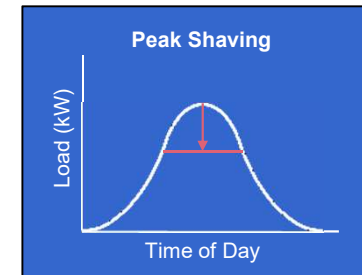
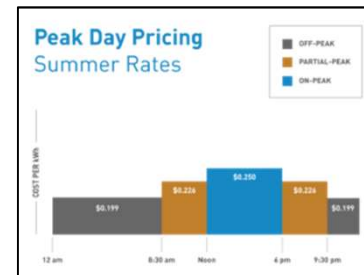
Demand Charge: Charge for the maximum kW **you may** utilize.

Facilities Charge: Additional demand charge to re-coup infrastructure cost

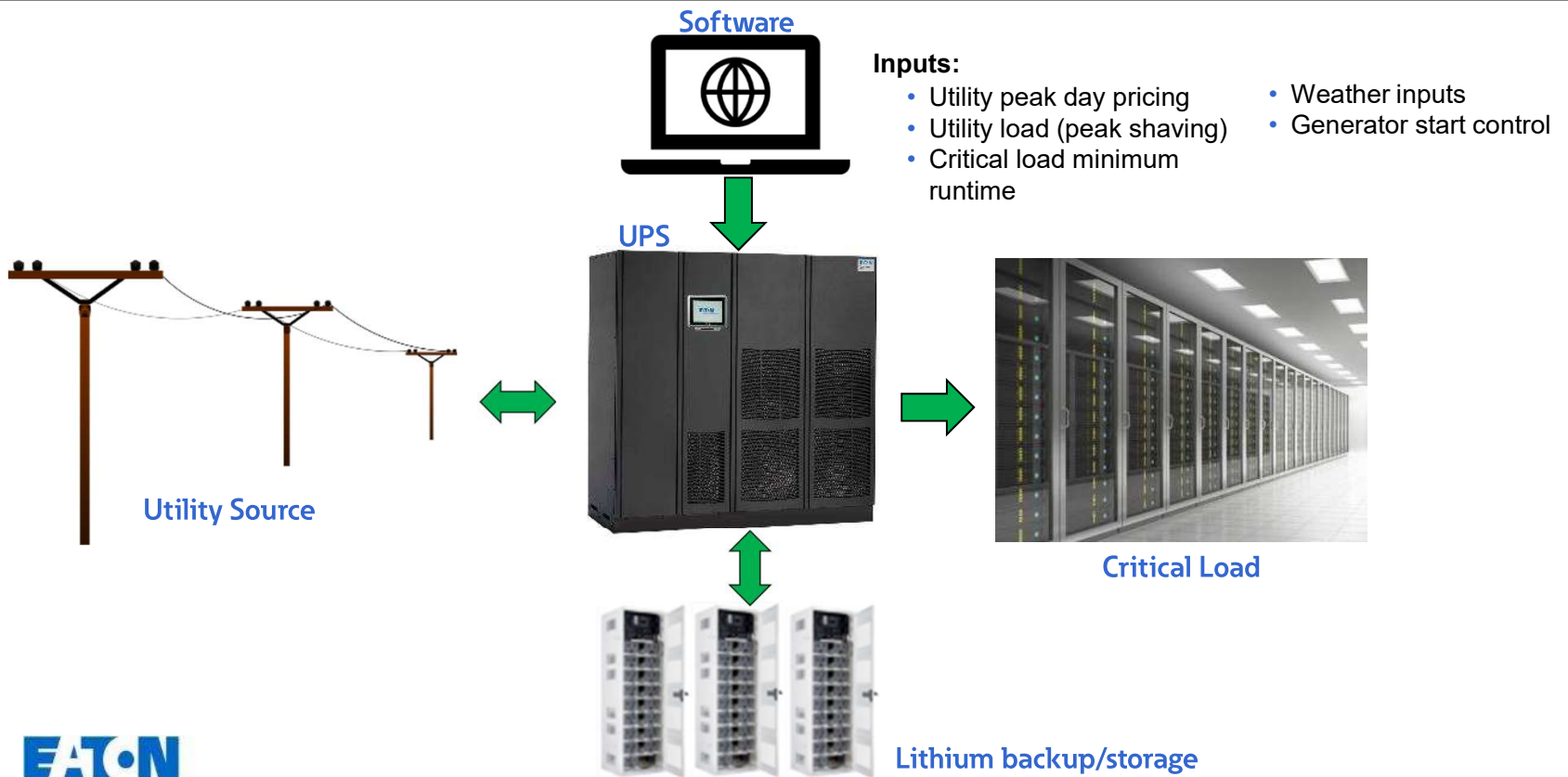


Customer considerations

- UPS operates normally to support customer's critical load.
- Additionally, customer maintains full control of energy services:
 - Enable/disable
 - Desired peak limits
 - Peak pricing model
 - Minimum UPS backup time

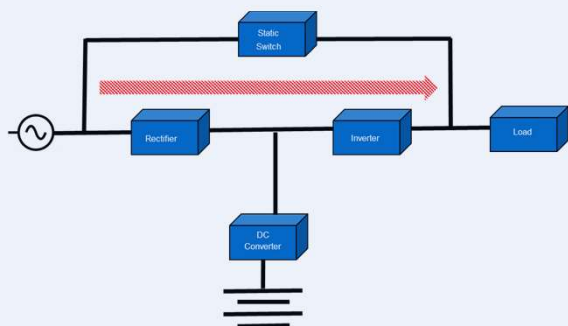


System components



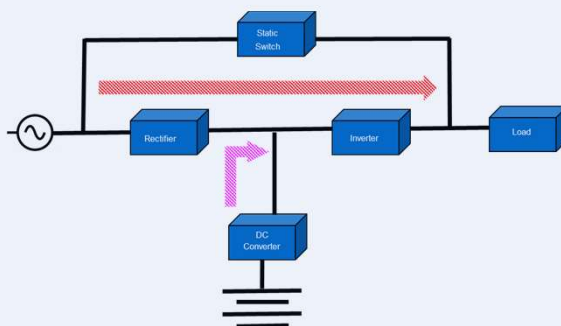
Operating modes:

Normal double conversion operation (UPS mode only)



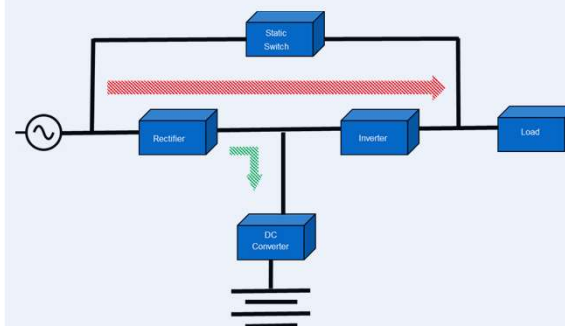
- ✓ Battery fully charged
- ✓ Static switch off

Dual Purpose – double conversion + grid demand reduction operation



- ✓ UPS still supporting load
- ✓ Battery discharged to provide partial power to load to reduce utility demand

Dual Purpose – double conversion + adding demand to grid



- ✓ UPS still supporting load
- ✓ Battery charging
- ✓ Static switch off

Why is this possible now? Lithium.

- Lithium is viable alternative to traditional VRLA offerings
- Lithium provides longer life (and warranties), higher operating temperatures, higher cycle rates and smaller footprints. These benefits, in turn, provide the lowest total cost of ownership!

VRLA

Lithium

- 58% smaller
- 75% less weight
- BMS included
- >8x # of cycles
- >2.4x life and warranty
- Higher operating temp (0 - 40°C)

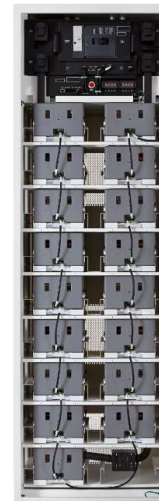


N54 VRLA



kWh: 33
Weight (lbs): 4855
In²: 1436

Samsung



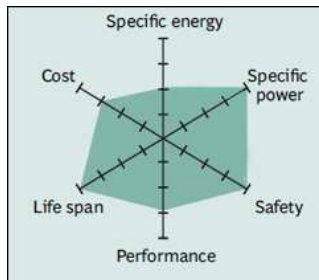
kW: 200
kWh: 33
Weight (lbs): 1213
In²: 624

LG Chem

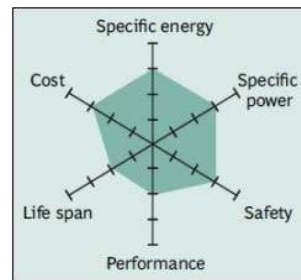


kW: 250
kWh: 28
Weight (lbs): 1100
In²: 432

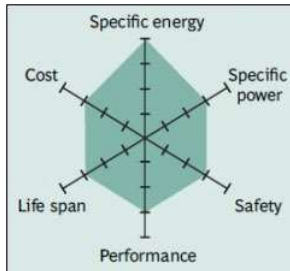
Lithium chemistry types



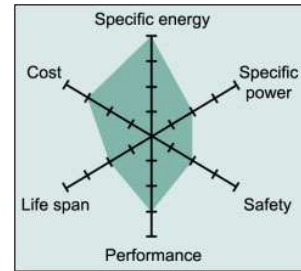
Lithium Iron Phosphate (LFP)



Lithium Manganese Oxide (LMO) +



Lithium Nickel Manganese Cobalt Oxide (NMC)



Lithium Cobalt Oxide (LCO)



Samsung



**Lithium Manganese Oxide (LMO) +
Lithium Nickel Manganese Cobalt Oxide (NMC)**

LG Chem



Lithium Nickel Manganese Cobalt Oxide (NMC)

Specific energy
Capacity that relates to runtime

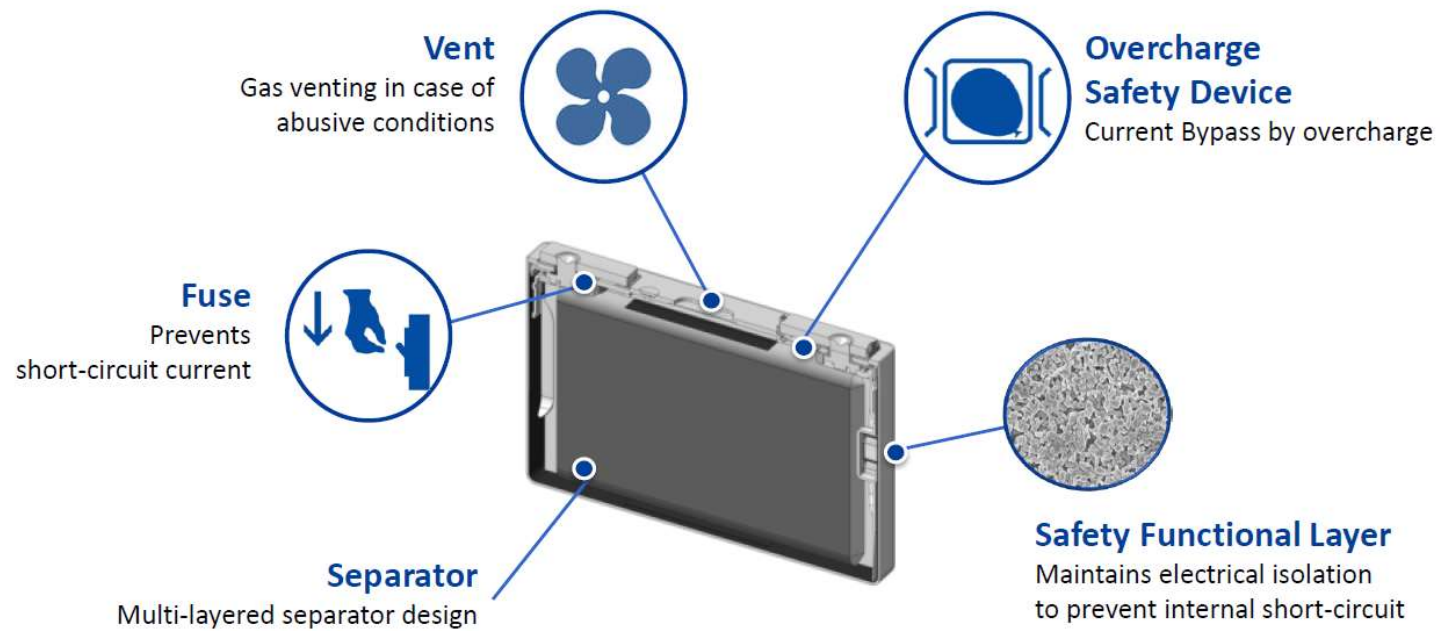
Specific power
The ability to deliver high current

Performance
at hot and cold temperatures

Life span
Reflecting cycle life and longevity

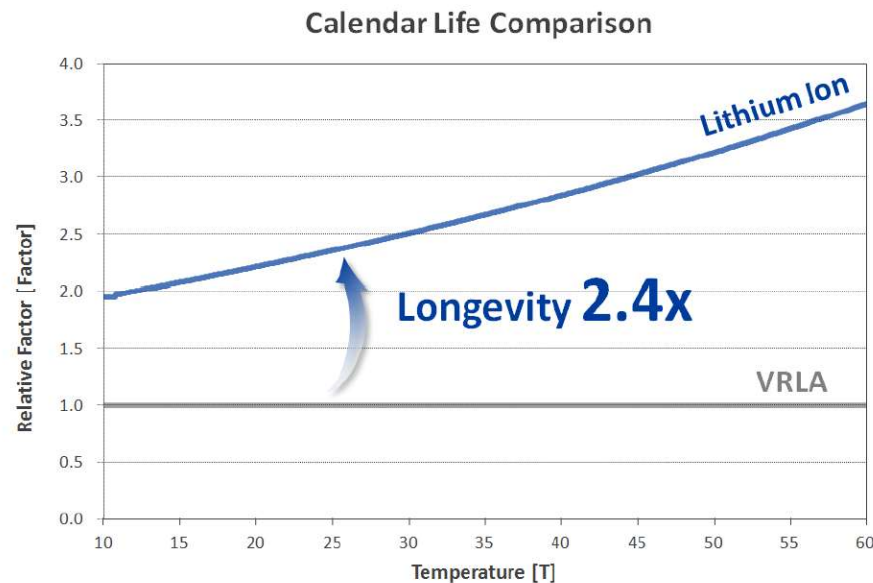
Lithium safety

Safety Cell Design



Lithium life expectancy

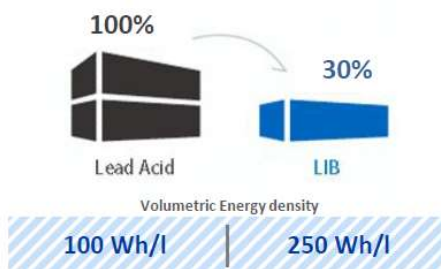
- Lithium provides 2.4x longer life at 25°C (vs VRLA) and even longer “x life” at higher temps
- At 25°C, lithium provides 15 years of life with a 10 year warranty on the performance of the lithium



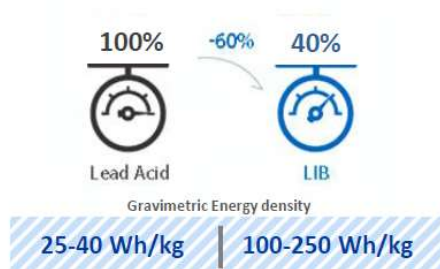
Ambient Temp [°C]	Calendar Life [years]		Ratio
	VRLA (Premium)	LIB	
10	20	33	1.65
15	14	25	1.8
25	7	15	2.15
60	0.6	2	3.8

Lithium Summary

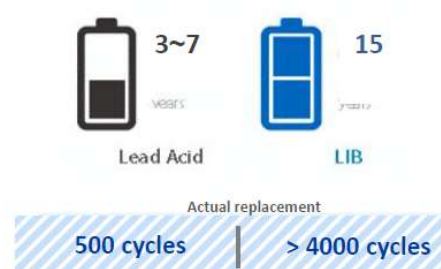
System Space



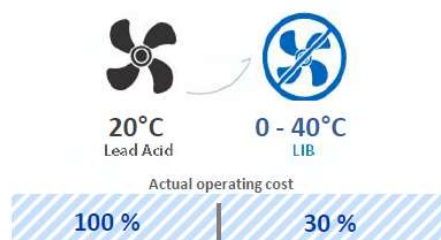
System Weight



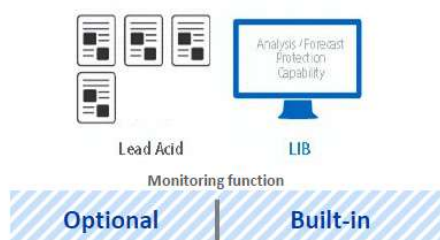
Design Life



Operating Temperature



Battery Management System



Environmental Friendly





TechBench Product Overview

Ziv Zantkovsky, Territory Development Manager

May 2019



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What we do in the lab space



Work Force Integration

- Adequate and efficient space to leverage and maximize human capital investment
- Ergonomic solutions to decrease lost hours



Technology Integration

- Technology can over run workspace – competes with personal workspace
- Often computer based - requires wire management



- **Work Space Integration**

- Square footage is expensive
- Managing Cubic Space creates better space utilization and faster ROI



- **Work Flow Integration**

- Understanding Input – Process – Output characteristics enhances organizational performance

Value Proposition



Eaton provides laboratory platforms that increase the performance and value of laboratory space through the integration of people and technology, maximizing work space, which enables Laboratory Managers to achieve highly effective and efficient work flow

Tech Bench Superior



Tech Bench Best

TechBench Workbench System



Tech Bench Good

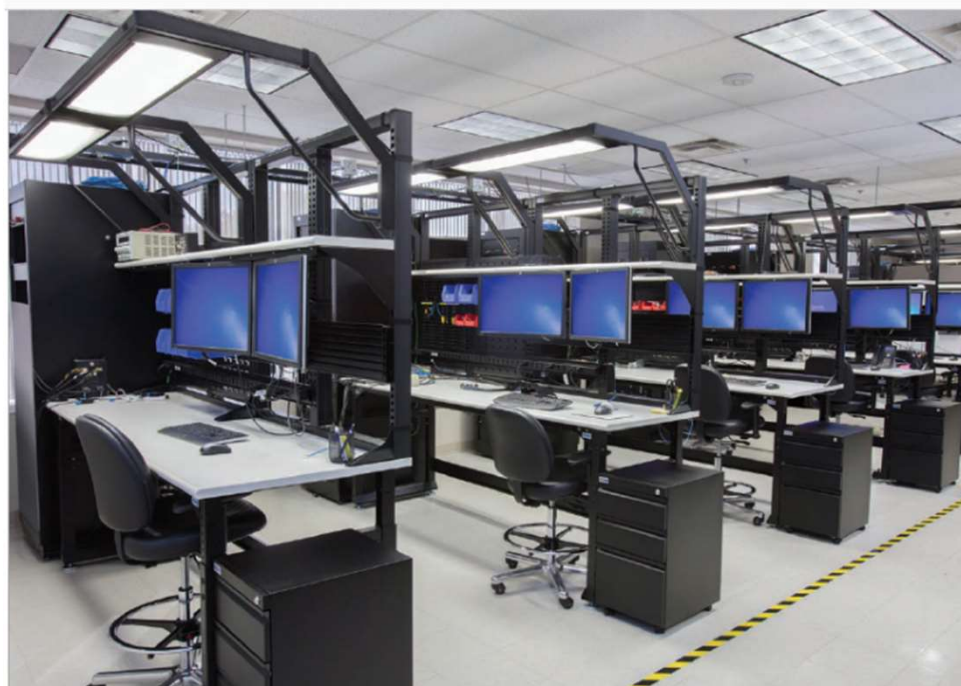


Image examples

Bench tops

Heavy-duty bench tops are available in six widths and two depths. Choose the type that best meets your requirements.



ESD control laminate



Maple hardwood



Phenolic resin

Panels

Three panel options are available in multiple heights and widths. Mix and match to meet application requirements.



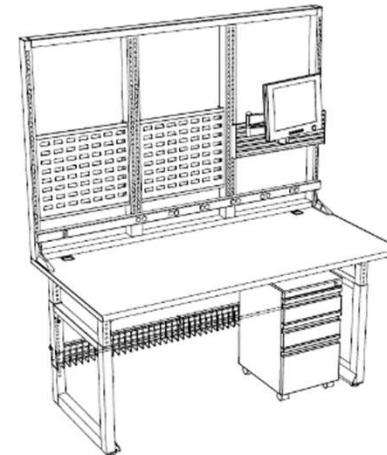
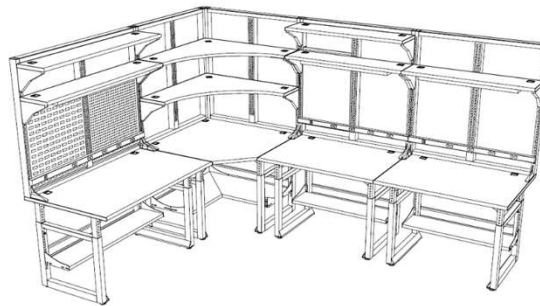
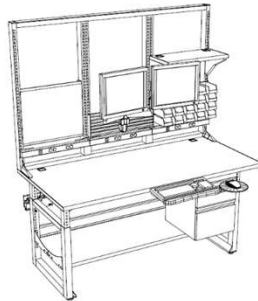
Bin board



Peg board panel



White board panel





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