



PROMAT®

2015

McCormick Place South | Chicago

March 23-26, 2015

promatshow.com

Not Batteries, But Energy Systems

Sponsored by:

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Presented by:

**Arlan Purdy, Product Manager, Energy
Storage Systems & Emerging
Technologies**

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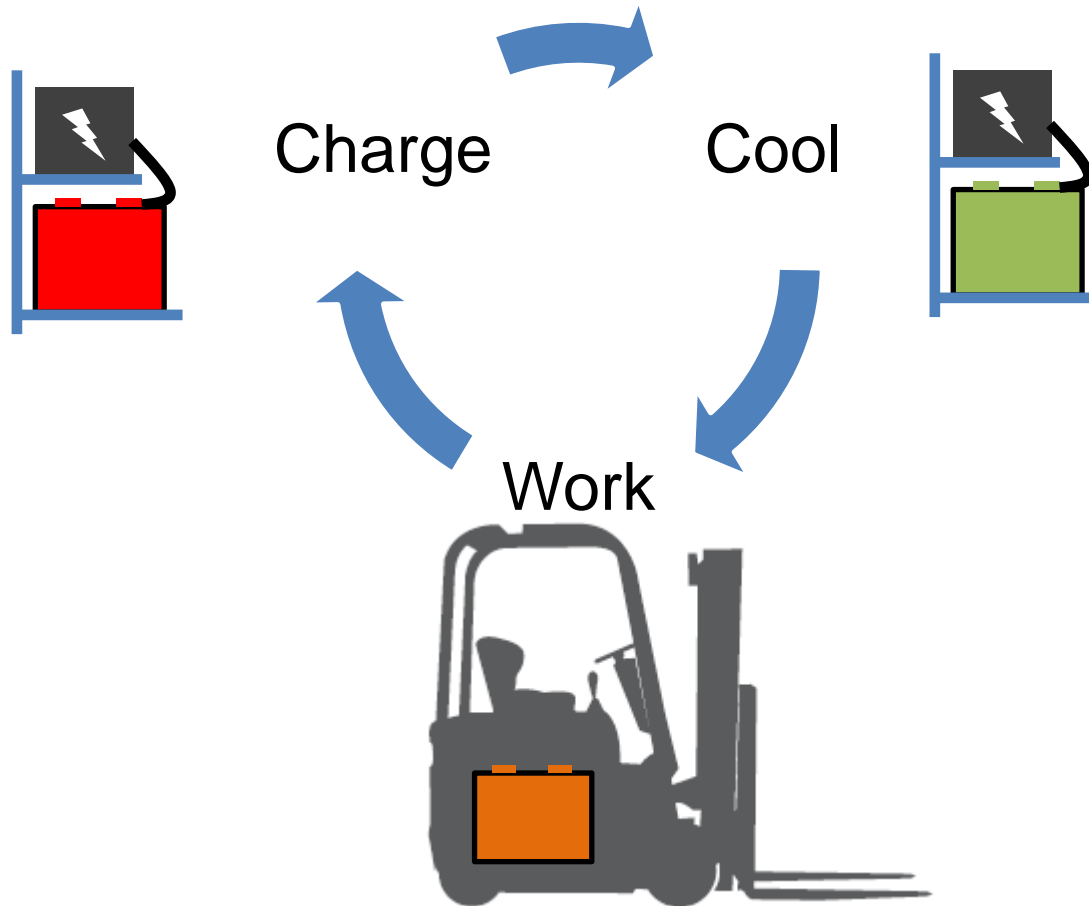
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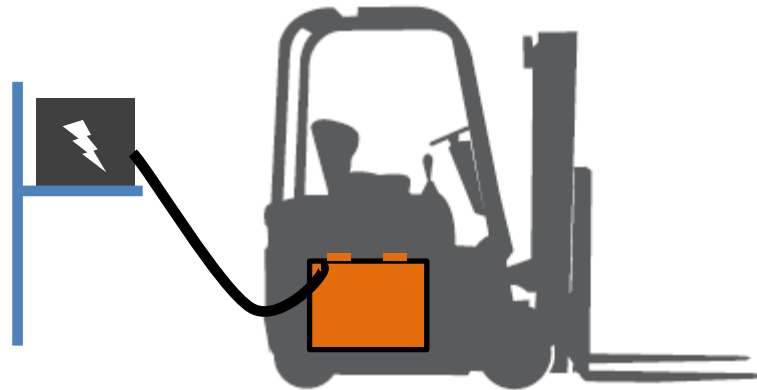
8/8/8 battery cycle





Opportunity charging

- Advantage:
 - Fewer batteries to buy, store and move
- Disadvantage:
 - Battery may become too hot



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Touchpoints

40%

of forklifts operate on more than one battery.

There are nearly 44 steps to exchange a battery.

Source: Internal data



Toyota Production System

When I was a boy of 14,
my father was so **ignorant**
I could hardly stand to have the old man around.

But when I got to be 21,
I was astonished at how much
he had **learned** in seven years.

— attributed to **Mark Twain**

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Temperature

26%

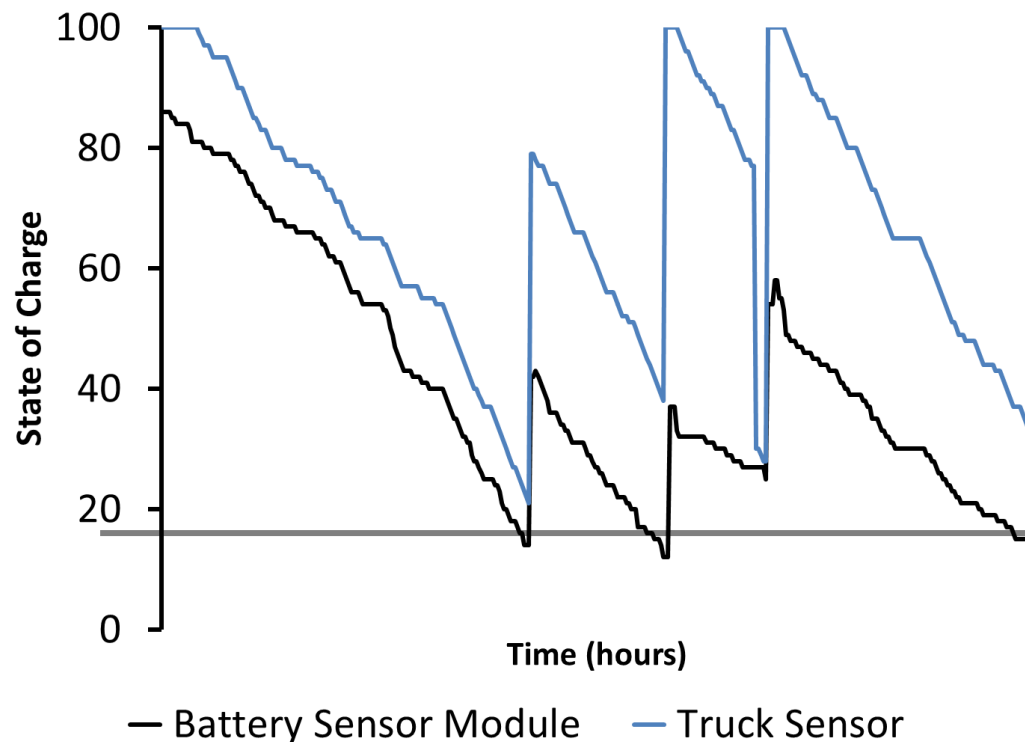
of batteries exceed the manufacturer's
recommended temperature limit (around 122 F),
which may affect warranty eligibility.

Source: Internal data



Battery state of charge (BSOC)

- Voltage-only monitoring may be distorted by opportunity charging
- More accurate if also monitoring ampere hours (AH) flowing in and out

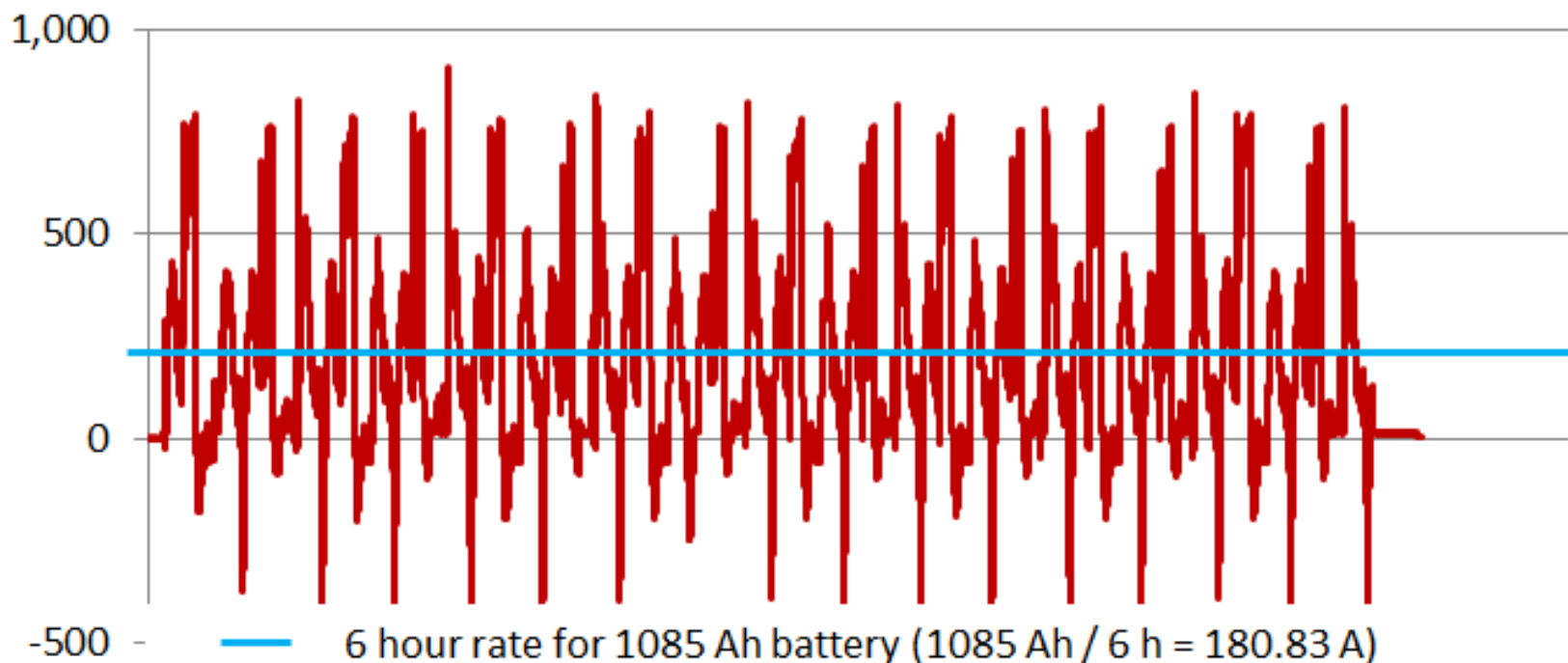


Source: Internal measurements



Capacity at 6 hours constant rate discharge

Current over time (~ 10 min)



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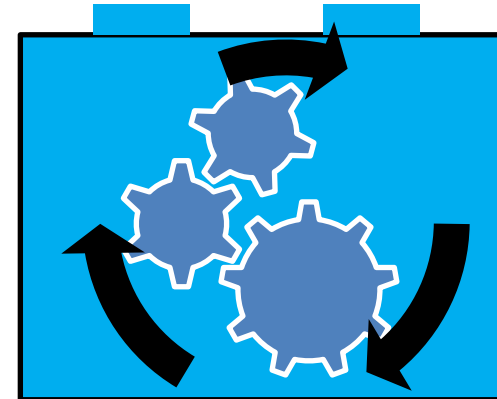
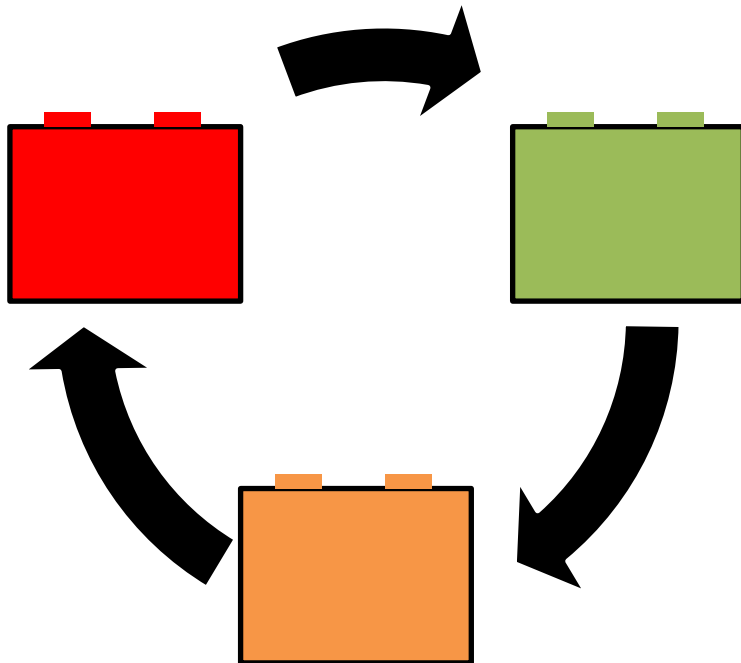
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Complexity in new systems



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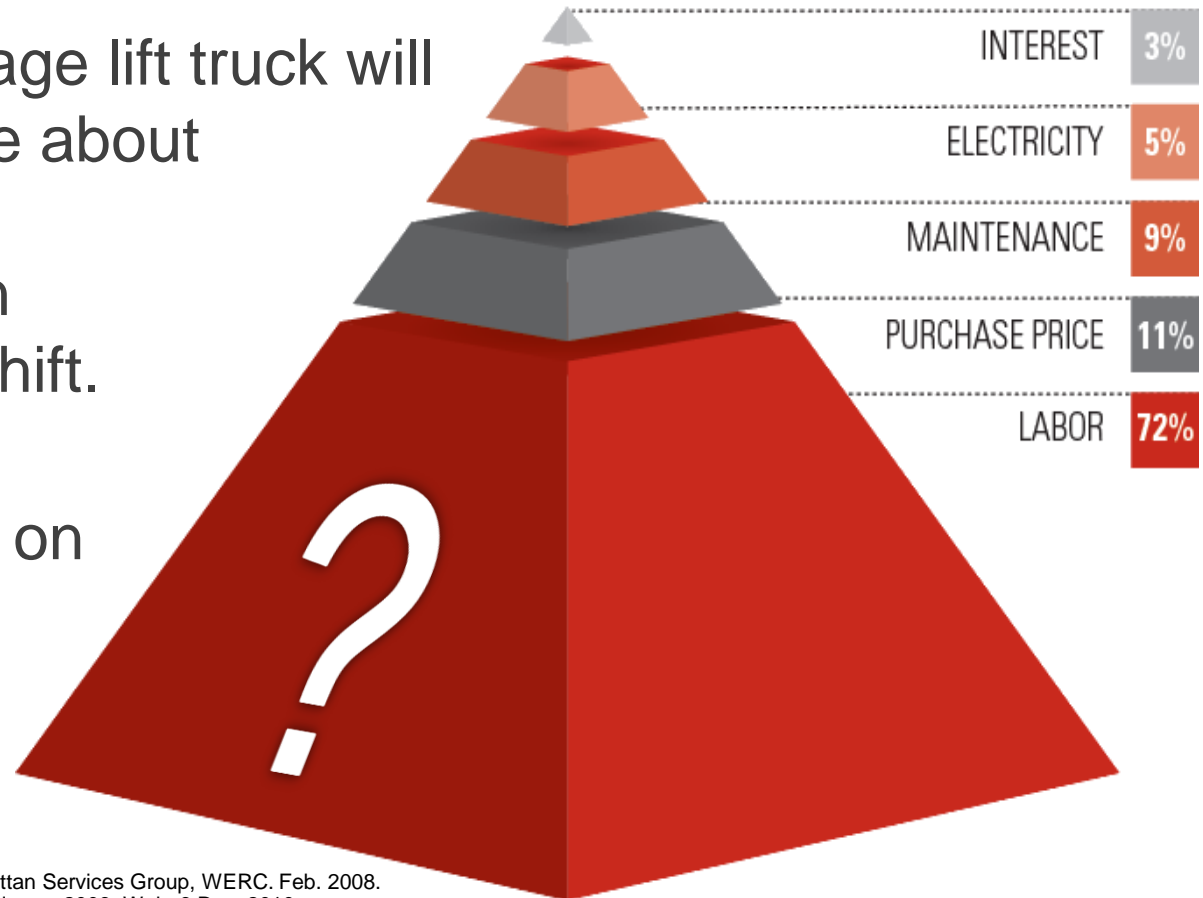
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If only it were that easy ...

An average lift truck will be in use about 4 hours out of an 8-hour shift.

What else is going on inside your warehouse?



Sources: Tanel, Tom. "Achieving Warehouse Success." Cattan Services Group, WERC, Feb. 2008. Seminar; and "Buy, Sell, or Hold?" AllBusiness.com. AllBusiness, 2006. Web. 6 Dec. 2010

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Timing

91%

of batteries have missed a watering appointment;

8%

of batteries have missed an equalizing charge.

Both conditions will shorten battery life.

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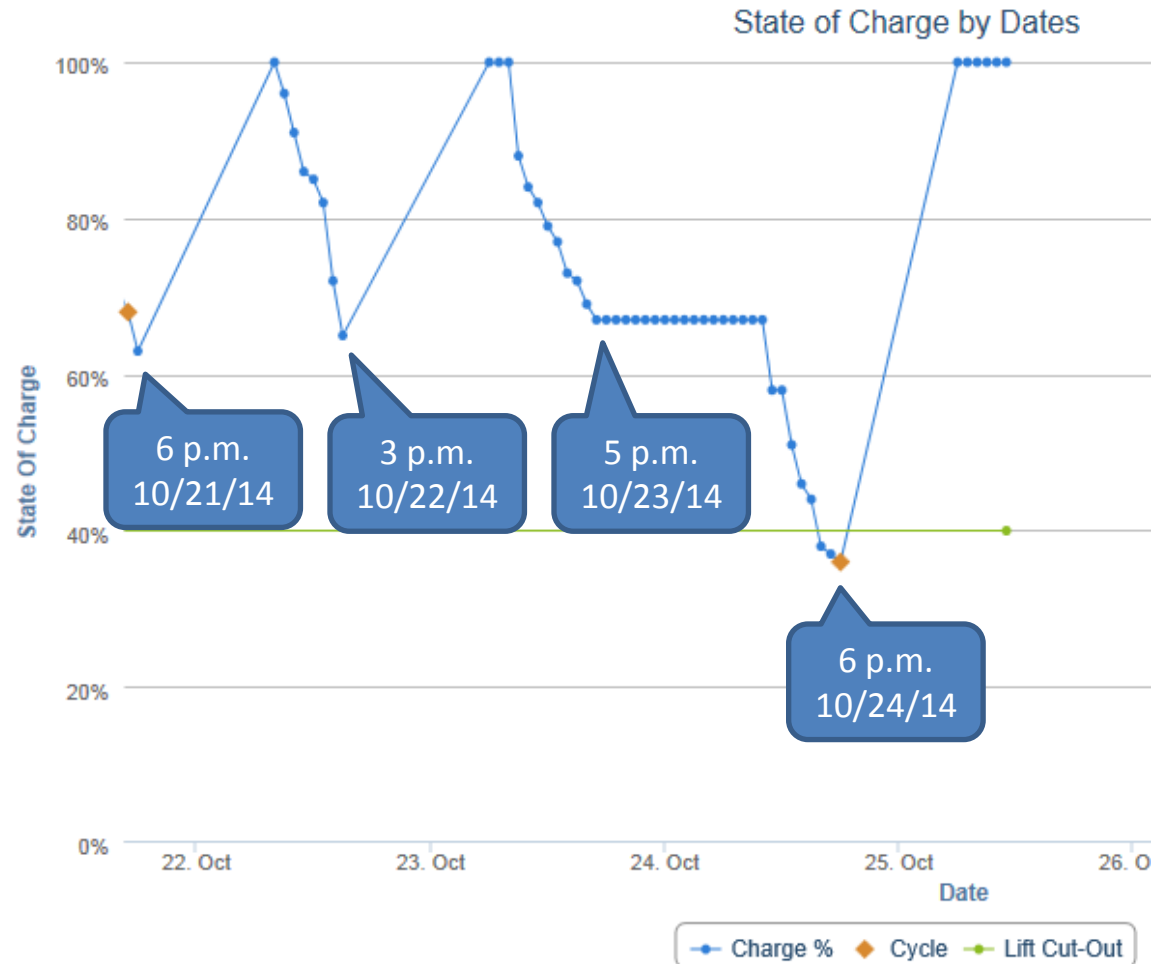
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Be real

Opportunity
charging doesn't
work ...

if you don't do it.



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3 T's

Touchpoints

Temperature

Timing

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What can I do?

- **Measure** energy use.
- **Consider** what changes.
- **Plan** for when it doesn't work.
- **Choose** for your application.
- **Monitor** your performance.



What can I do?

- **Measure** energy use.
- **Consider** what changes.
- **Plan** for when it doesn't work.
- **Choose** for your application.
- **Monitor** your performance.

- Several operators
- Several trucks
- Several weeks



What can I do?

- **Measure** energy use.
 - **Consider** what changes.
-
- **Plan** for when it doesn't work.
 - **Choose** for your application.
 - **Monitor** your performance.

- Seasonal
- Off-shift
- Business growth



What can I do?

- **Measure** energy use.
 - **Consider** what changes.
 - **Plan** for when it doesn't work.
 - **Choose** for your application.
 - **Monitor** your performance.
- How often?
 - How long will you be down?
 - What will you do in the meantime?
 - Will it affect your costs?



What can I do?

- **Measure** energy use.
- **Consider** what changes.
- **Plan** for when it doesn't work.
- **Choose** for your application.
- **Monitor** your performance.

They are **not** all the same!

- Shift hours
- Break times
- Pallets moved
- Aisle length
- Rack height
- Load weight



What can I do?

- **Measure** energy use.
 - **Consider** what changes.
 - **Plan** for when it doesn't work.
 - **Choose** for your application.
 - **Monitor** your performance.
-
- Truck, operator and battery combined
 - Truck and battery talking
 - Watch:
 - Water
 - Equalization
 - Temperature

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