



# Advancing Technologies in Energy Storage

Sharon Bonesteel AiA, CBO



# Batteries are like your basic brownie .....>

## **Lead Acid Batteries**

We understand  
the advantages  
the risks

We know how to deal  
with the hazards

Like your grandmother's  
brownie recipe, they are  
tried and true; a pantry staple.





## Brownies with NUTS – Energy Density

Energy per unit volume = Capacity  
How many pounds does it take  
to store so many watt-hours  
(vs Power Density)

**Change:**

Cathode/Electrode/Electrolyte

New materials for higher ED

Li-ion Batteries – High ED

Disadvantage of deflagration



## Brownies with Caramel and Coconut



New issues revealed  
Thermal runaway  
Re-ignition & Stranded Energy  
Performance issues

Battery Management Systems  
Insulated Pack Materials  
Fire Retardant Electrolytes

## Brownies with Beets and Crème Cheese

Cells connected together  
in an insulated  
pack that dissipates heat

Additives that decrease  
dendrites and reduce  
the flammability of the  
electrolyte



# **Brownies with Frosting – YUCK!**

Used – (good? damaged?)

Off Specification (means what?)

Second Life – (appropriate?)

Recycled

Repurposing – UL 1974

IFC 2018 – Section 1206

NFPA 855 Standard (draft)

UN3481 & UN3091



# Blondie Brownie & white chocolate?

Redox Flow Batteries  
(transfer of electrons)

- Rechargeable
- More energy dense than Li-ion
- Potentially more safe
- Modification to membrane  
and Electrolytes in future





## UET flow battery - 2012

UniEnergy Technologies

Developed at PNNL

Uses Vanadium

Sulfuric acid electrolyte

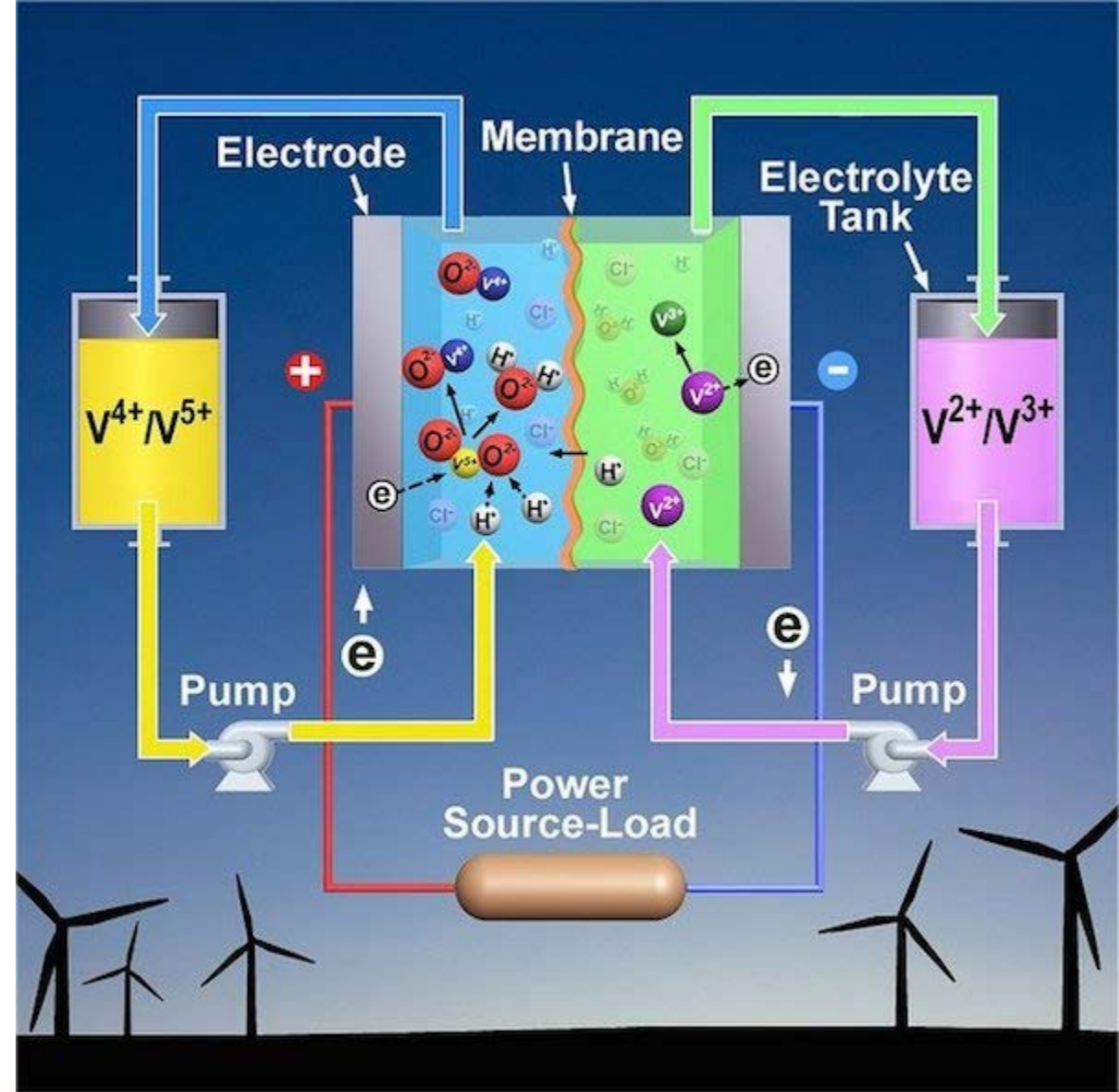
Now now + hydrochloric acid

**2015 – 1 MW-4 hr battery**

Supporting WSU's smart campus

Constant charging and discharging

**2018 – Cobalt Crunch?**



Clean Technica ezine illustration





## And now for something completely different...

Smaller?

Can we recycle the Carbon?

What new Membranes could be developed?

More Energy Dense?

What about Nanobots to deliver the electrons  
along organic veins instead of conductors?

Plug & Play Solar + Storage?

## Great Resources:

[Battery University](#) – a Free Educational Website sponsored by Cadex Electronics Inc.

[U.S.Department of Energy Energy Storage Systems Program](#) hosted by Sandia National Labs, PNNL & Oak Ridge NL

[SRP Battery Incentive Program](#)







Salt River Project, Arizona

**Sharon.Bonesteel @ SRPnet.com**