

# Battery Informatics, Inc.

## Value Proposition

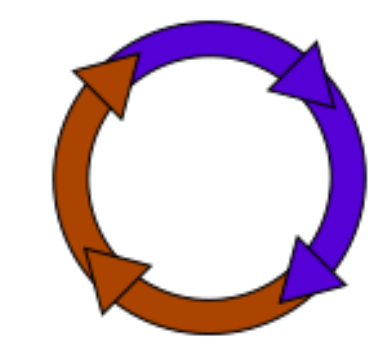
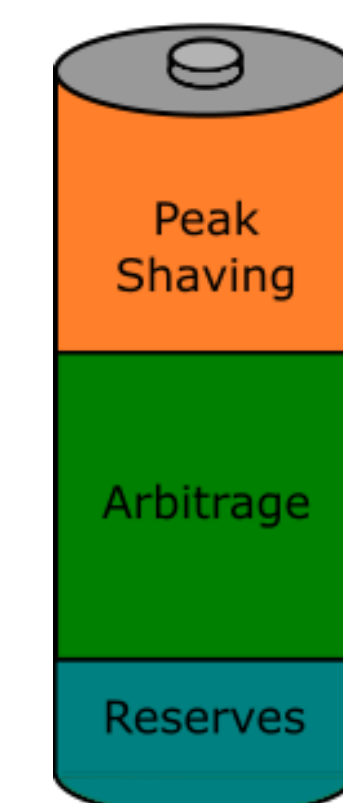
Our software tools provide energy storage applications a significantly better ROI

- Easier to estimate benefits prior to deployment
- Multiple services provided by same battery for improved battery utilization
- Enhanced smoothing of renewable generation
- Easier to turn grid-scale batteries into profitable investments

## Value Streams

- **Grid economics:** Extract better benefits from the grid by state-of-the-art algorithms from UW.
  - ✓ Peak shaving, renewable generation smoothing, frequency control, ...
- **Battery performance:**
  - ✓ One battery can provide multiple services by automatic “virtual” allocation of available resources; may more than double the value of the battery.
  - ✓ More value from the battery for same number of cycles by relaxing conservative operating rules and monitoring the health of the battery.

Allocate energy for maximum economic value...



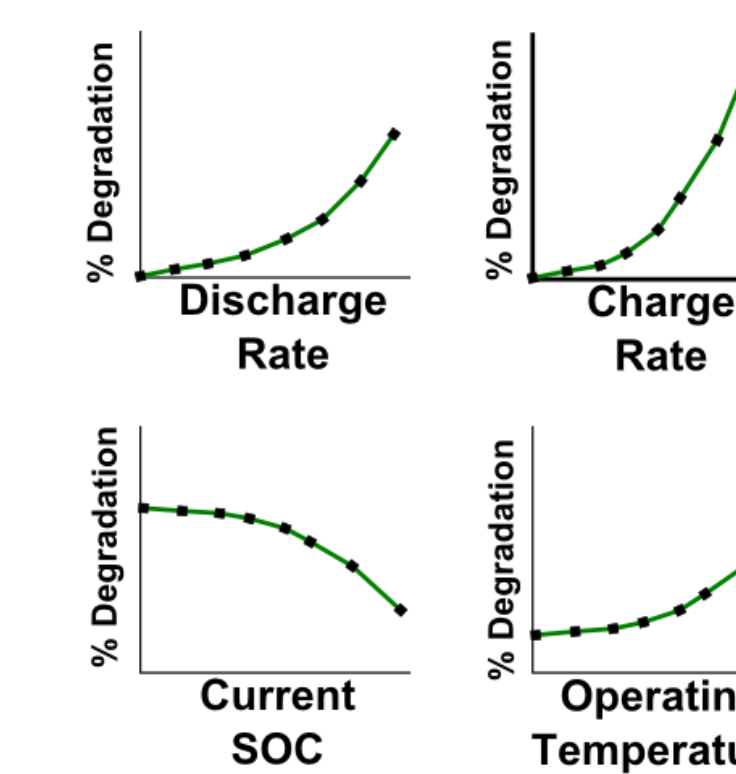
considering variable energy pricing  
and  
cost of operating battery storage

## Management of Batteries Considering Battery Health and Power Systems Optimization

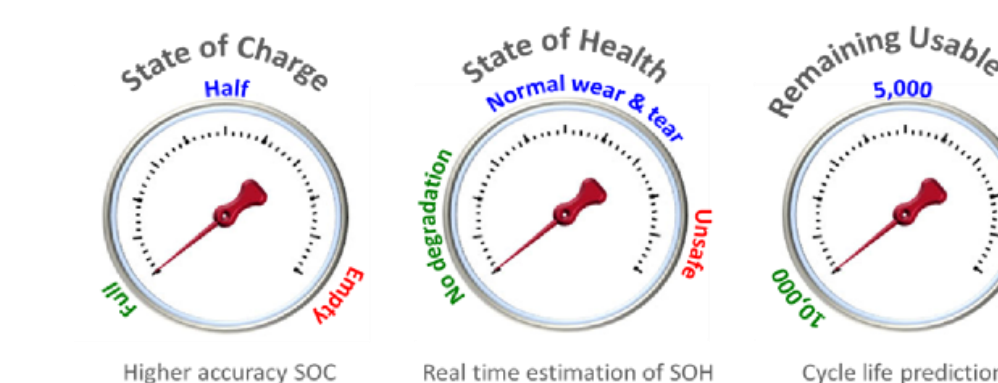
- Battery Informatics software tools manage the charging/discharging of batteries based on:
  - ✓ Price of electricity
  - ✓ Renewable energy penetration
  - ✓ Relaxed battery operating constraints
- Provides increased benefits compared to state-of-the-art.
- Can be used by electric utilities as well as commercial entities.
- Can aggregate and coordinate distributed batteries.

### Battery Health Characterization

#### a) Degradation Prediction

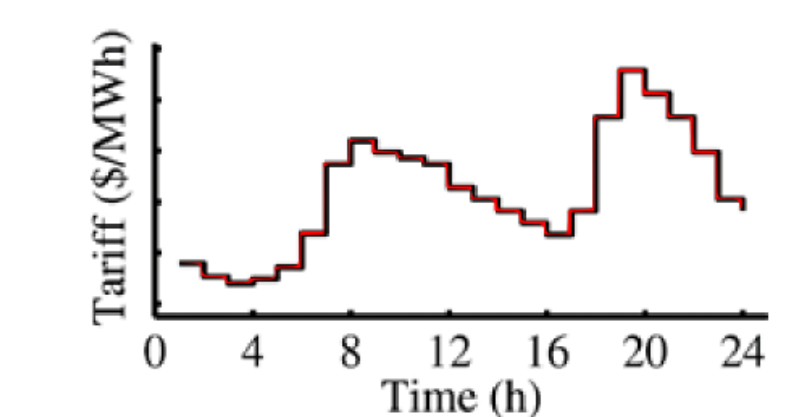


#### d) Estimation of Current State



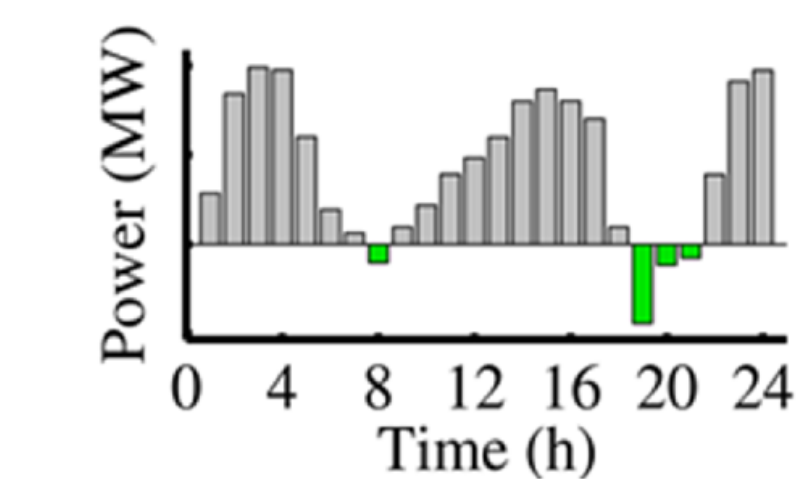
### Power Systems Optimization

#### b) Economic Decision-Making



Grid to Battery (G2B)  
Battery to Grid (B2G)  
Battery to Building (B2B)

#### c) Optimal Day-ahead Strategy



## Advisors



**Daniel Schwartz**  
Director of UW Clean Energy Institute, Prof. of Chem. Eng.



**Bjorn Frogner**  
Entrepreneur-in-Residence at UW CoMotion

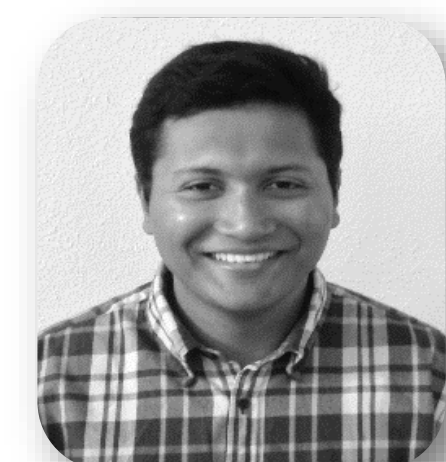


**Miguel Ortega-Vazquez**  
Prof. of Electrical Engineering

## Technical Team



**Andrei Afanasiev**  
UW CoMotion Fellow



**Mushfiqur Sarker**  
PhD Student in Electrical Engineering



**Matt Murbach**  
PhD Student in Chemical Engineering



**Hrvoje Pandžić**  
Prof. at Univ. of Zagreb

## Company Timeline

- ◆ Summer 2015 to Spring 2016 – Continued development of technology, demos and validation
- ◆ October 2015 to Spring 2016 – Raise Funding

## Grid Management Patents

- Mushfiqur R. Sarker, Hrvoje Pandzic, Miguel A. Ortega-Vazquez. "Optimal Operation and Services Scheduling for an Electric Vehicle Battery Swapping Station" U.S. 2014. Provisional Patent No. 62/086,411.
- Mushfiqur R. Sarker, Yury Dvorkin, and Miguel A. Ortega-Vazquez, "Optimal Participation Strategy for Energy Storage in the Energy and Reserve Markets".

## Battery Health Patents

- Murbach, M., Gilbert, D., Whitten, A., Erickson, B., Schwartz, D.T. Nonlinear Harmonic Response As Signature for Battery Diagnostics. Application Number: 62131698. Filed March 11, 2015