WALDRON

Integration of Battery Technology to Optimize Microgrid Economics

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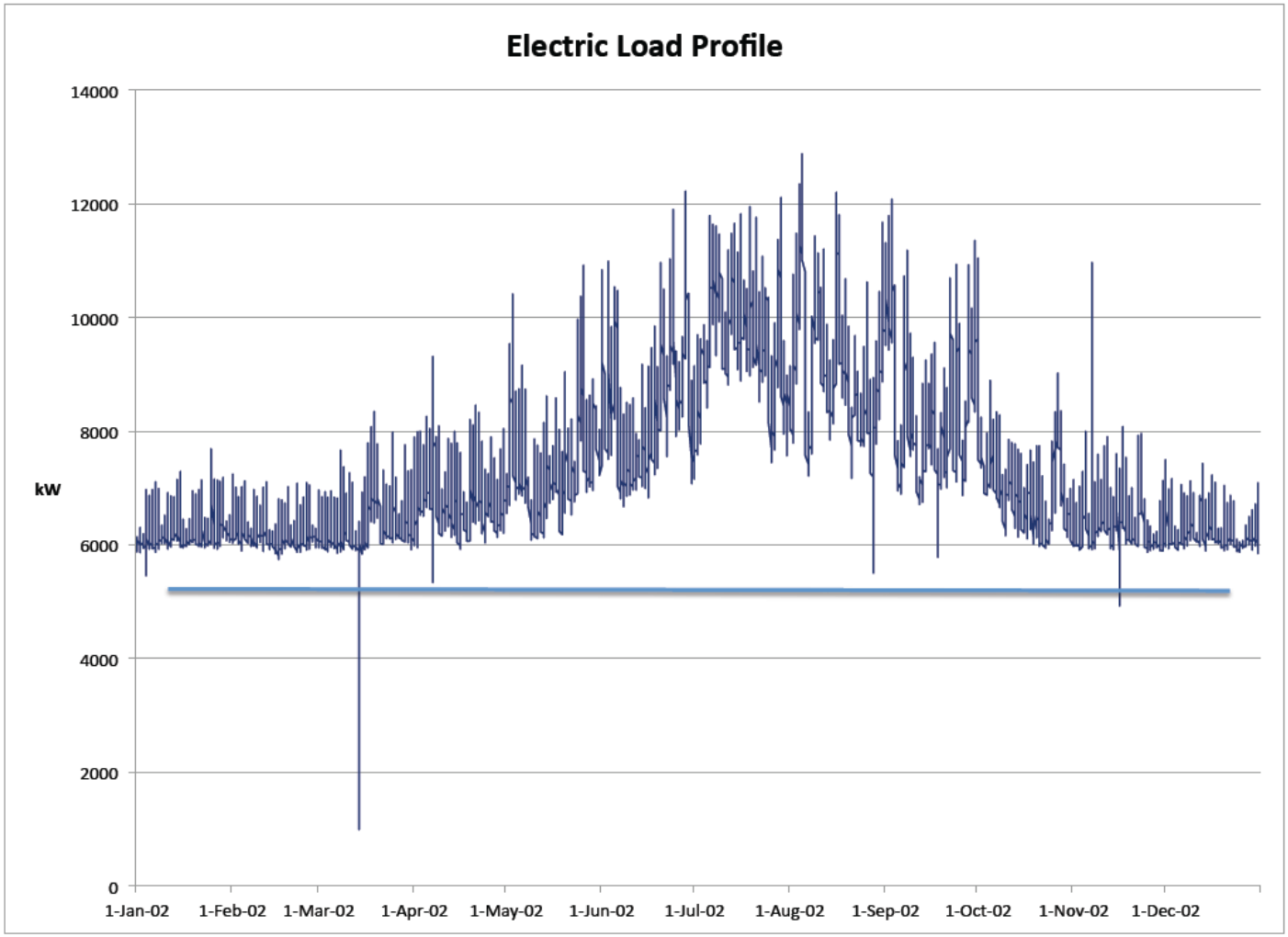
Things we Know About CHP

	Efficiency	Economics	Environmental
High Capacity Factor			
Low Capacity Factor			

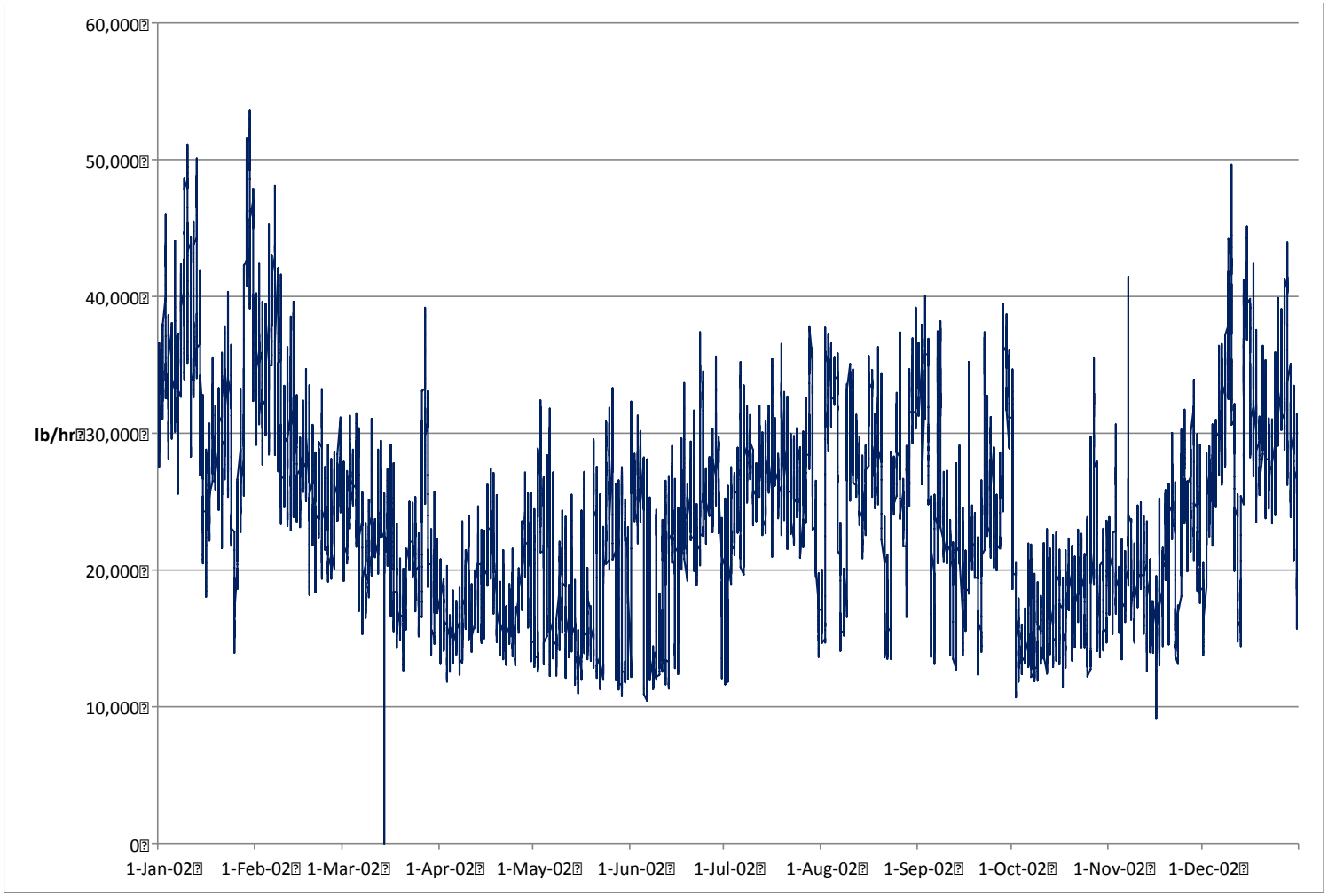
Capacity Factor is the number of units generated divided by the potential number generated.

High Capacity Factor Electric Profile



Shooting fish in a barrel

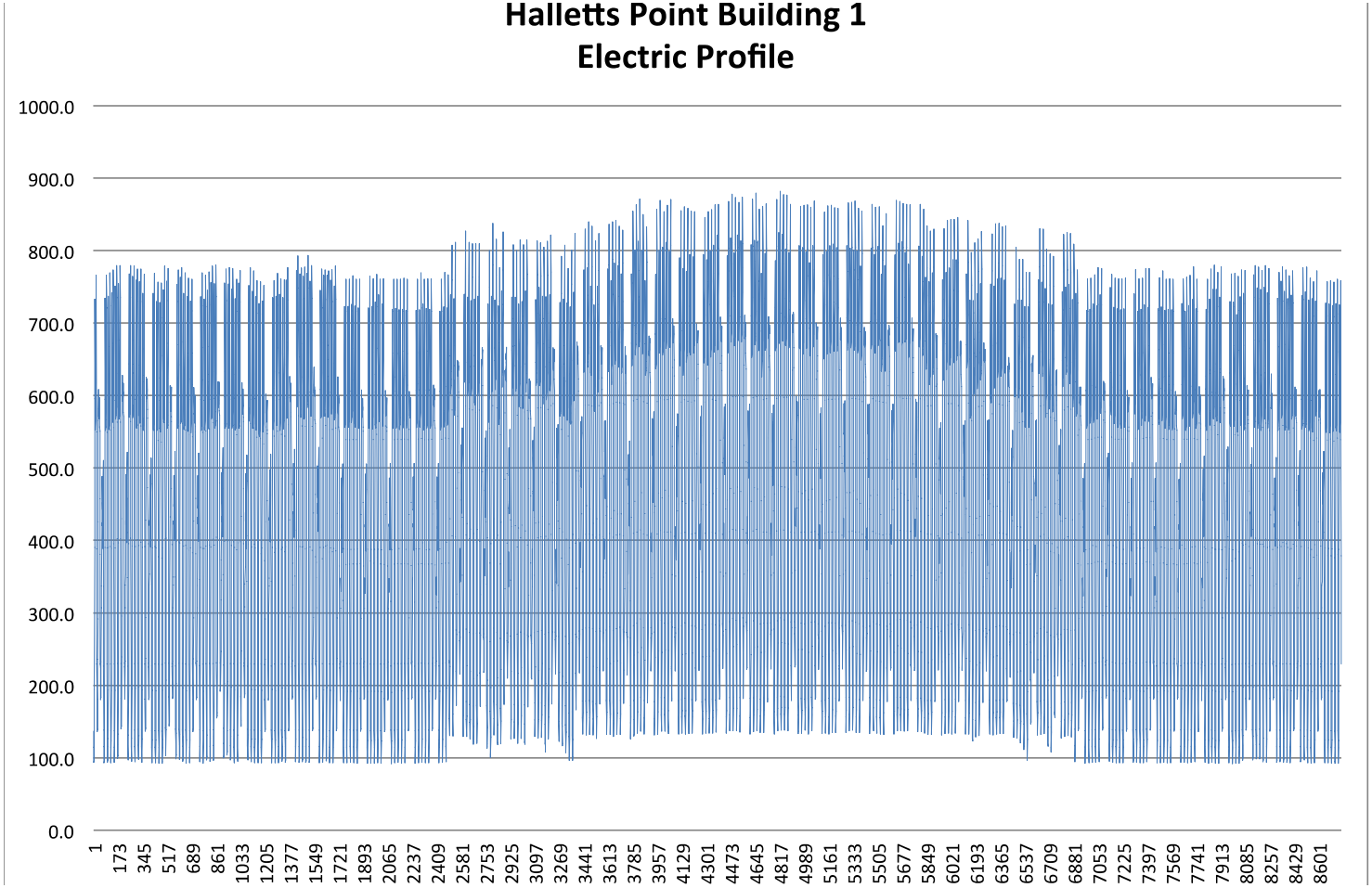
High Capacity Factor Thermal Profile



Then This Comes Along

Then This Comes Along

Low Capacity Factor Electric Profile

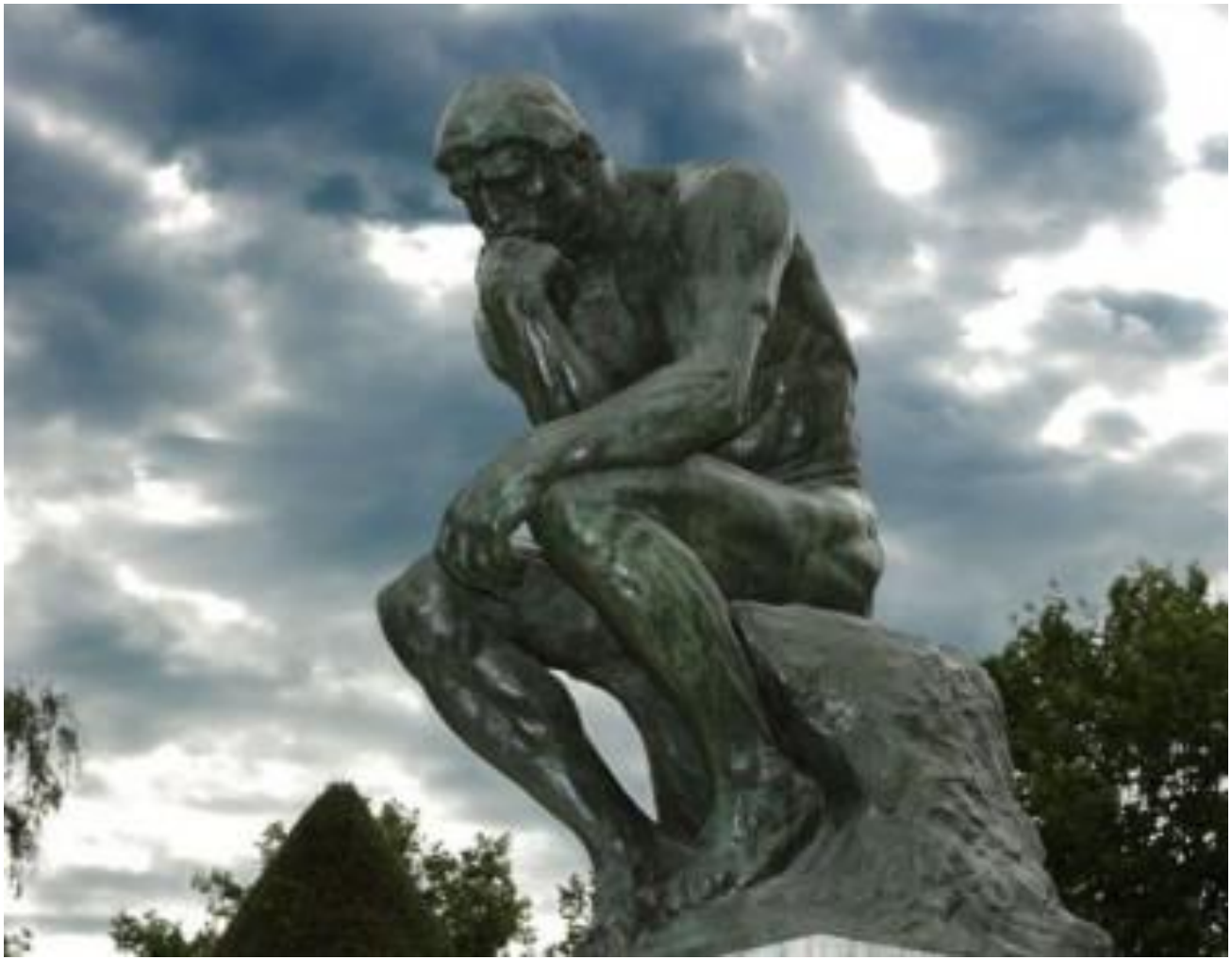


Shooting fish in the ocean with a paintball gun

Load Characteristics for CHP Success

- Nice to Have
  - Ratio of max to min <2.0
  - Nice area under the curve
- Our Problem
  - Ration of max to min >9.0
  - Almost no area under the curve

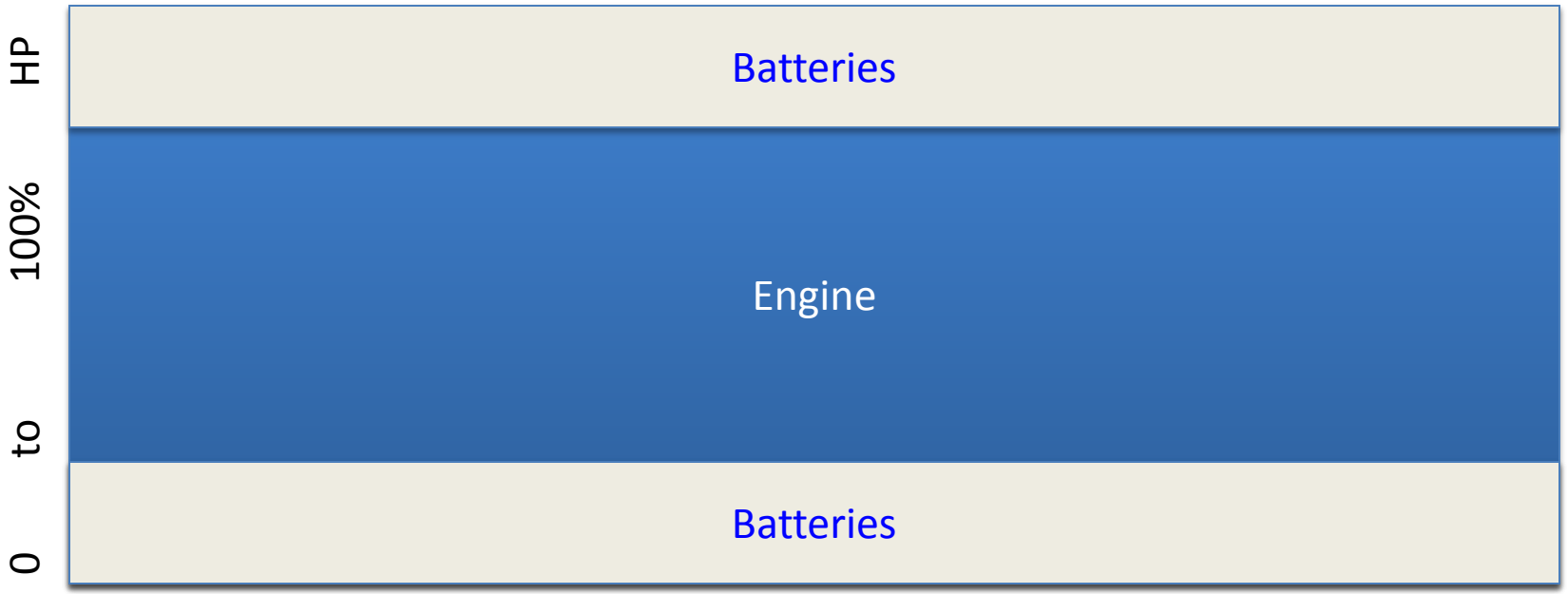
How to ……..



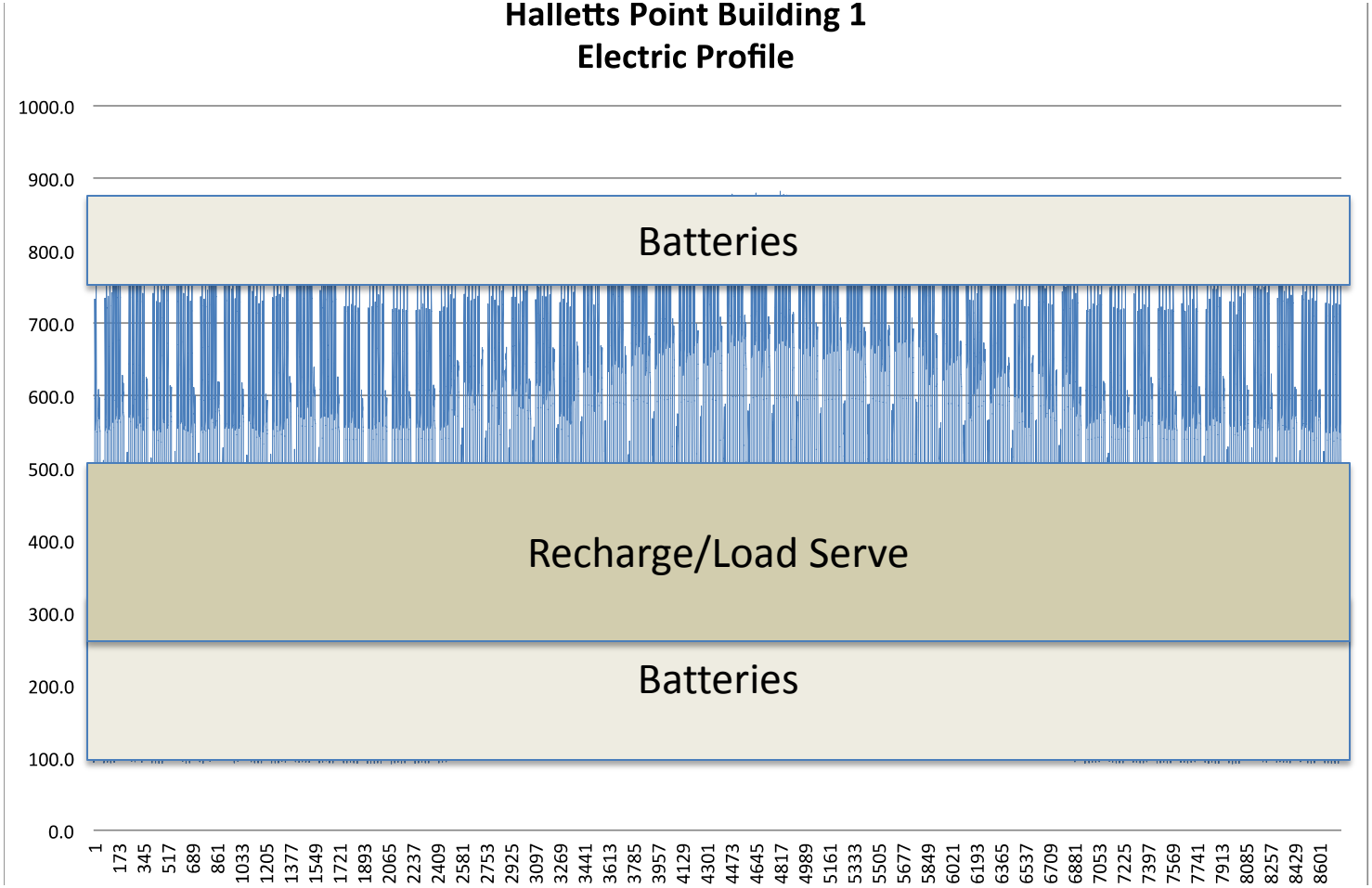
The Inspiration!!

What Does a Hybrid Car Do Well?

Improves the efficiency of operating against a variable load by utilizing batteries to shrink the operating envelope.



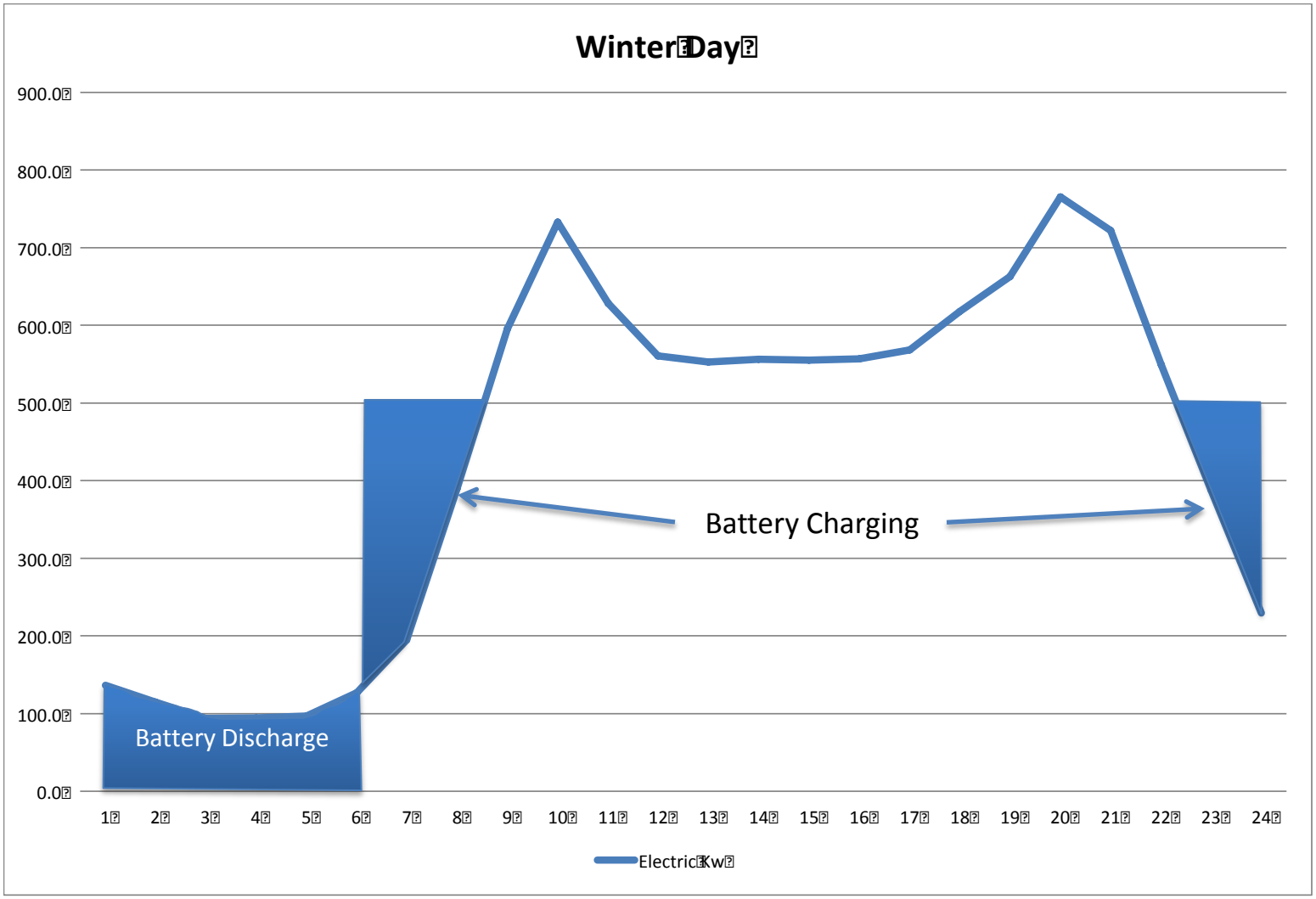
Low Capacity Factor Electric Profile



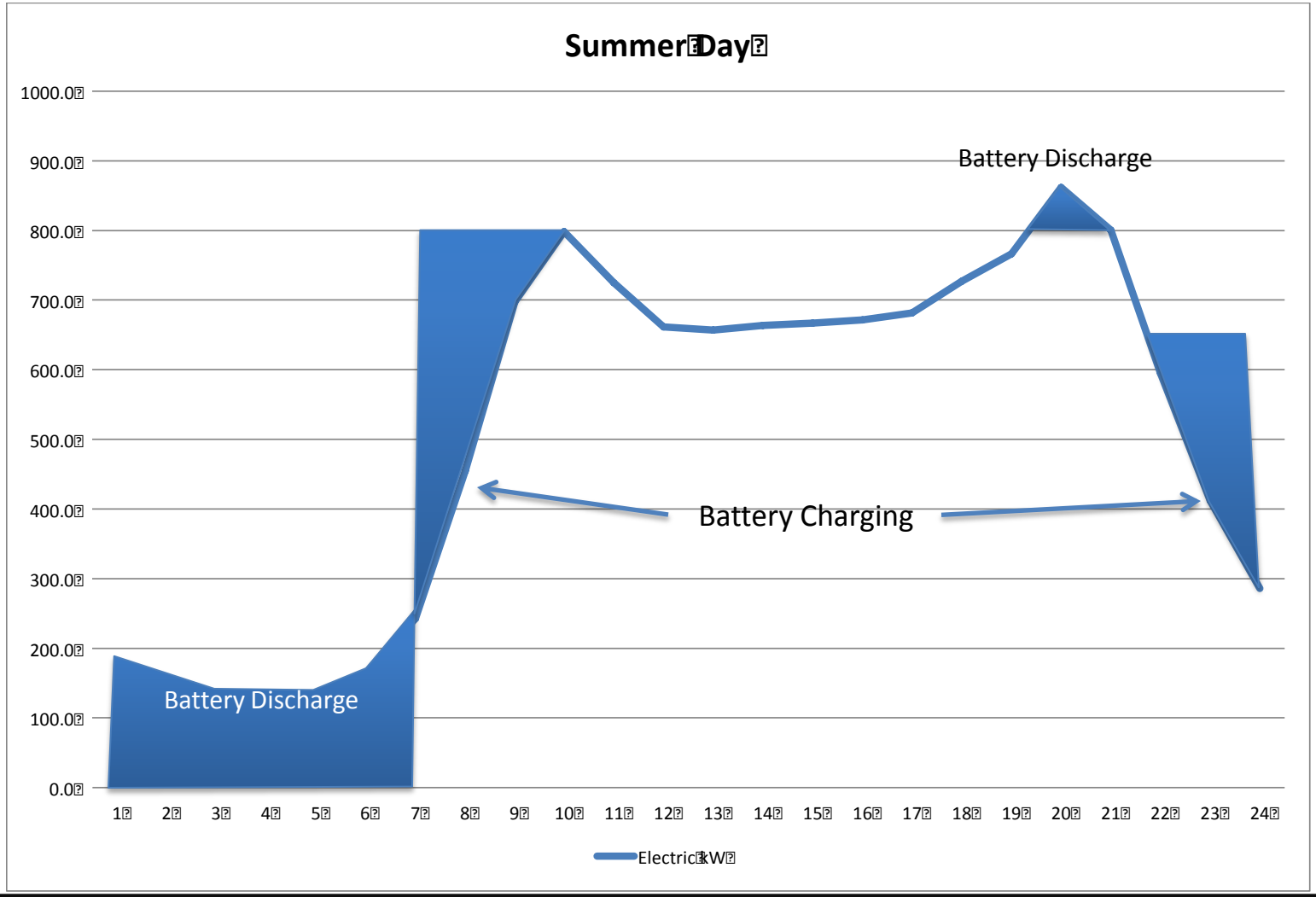
Prime Mover Equipment

Engine only CHP	Hybrid CHP
800 kw reciprocating engine	800 kw reciprocating engine
800 kw reciprocating engine	800 kw reciprocating engine
400 kw reciprocating engine	400 kw 1200 kwh battery system
200 kw reciprocating engine	

Typical Dispatch



Typical Dispatch



Economic Impact

- Reduced Capital Cost
  - Traded 400 kw and 200 kw for battery system
- Higher Efficiency
  - Battery system allows engines to run closer to optimal efficiency
- Reduced Maintenance
  - Reduced the total engine starts and stops
  - Reduced load swings
  - Planned down time for routine maintenance

Environmental Impact

- Less Engine Starts
- Keeps Engines at 50-100% output (emissions guarantees)
- Minimizes Greenhouse Gas Emissions

Implementation Challenges

- Each New Building Presents a new load profile
- Control System is a look ahead learning system
  - Utilizes past data with 24 hour weather predications to define the operations profile.
- Fire Protection Design
  - Lithium Ion Bad Reputation (hover boards to 787)

Questions…