



# ***IPERC***

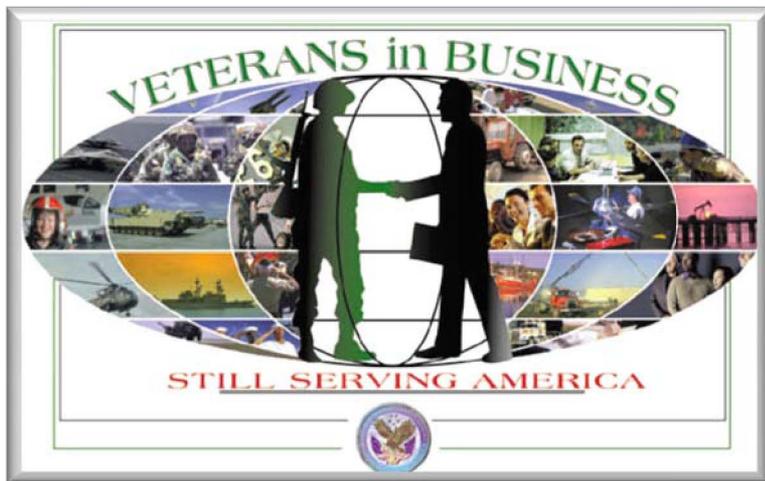
INTELLIGENT POWER & ENERGY RESEARCH CORPORATION

## **Thoughts on Supervisory Control for Hybrid Electric Storage Modules**

**Hybrid Energy Storage Module Workshop  
19 May 2011**

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**Founded in 2004**  
**Industry leader in distributed “intelligent” supervisory controls for energy systems.**



A Serviced-Disabled Veteran-  
Owned Small Business  
incorporated in New York State

ARRA award  
recipient – creating  
more American jobs  
in 2010 & 2011

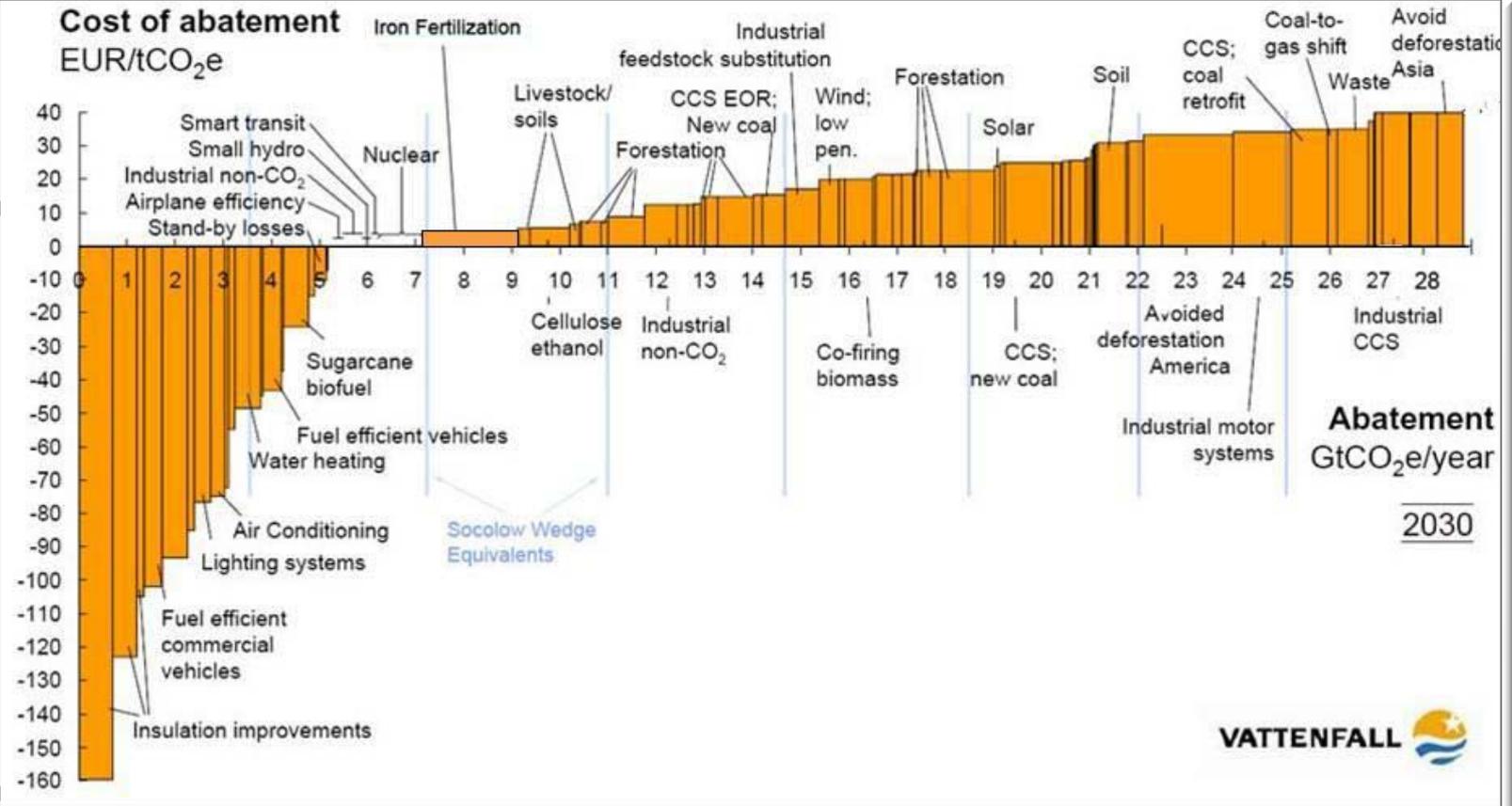


Tibbetts' Nominated  
for Small Business  
Innovative Research  
Project of the year  
in 2010

- Able to control an electric grid of different
  - Design
  - Vintage
  - Fuel sources
  - Physical condition
- Reliable uninterrupted power for changing, battlefield priorities
- Significant reduction in logistics fuels
- Automatic reconfiguration if equipment is damaged or moved
- Near-real-time priority load shedding

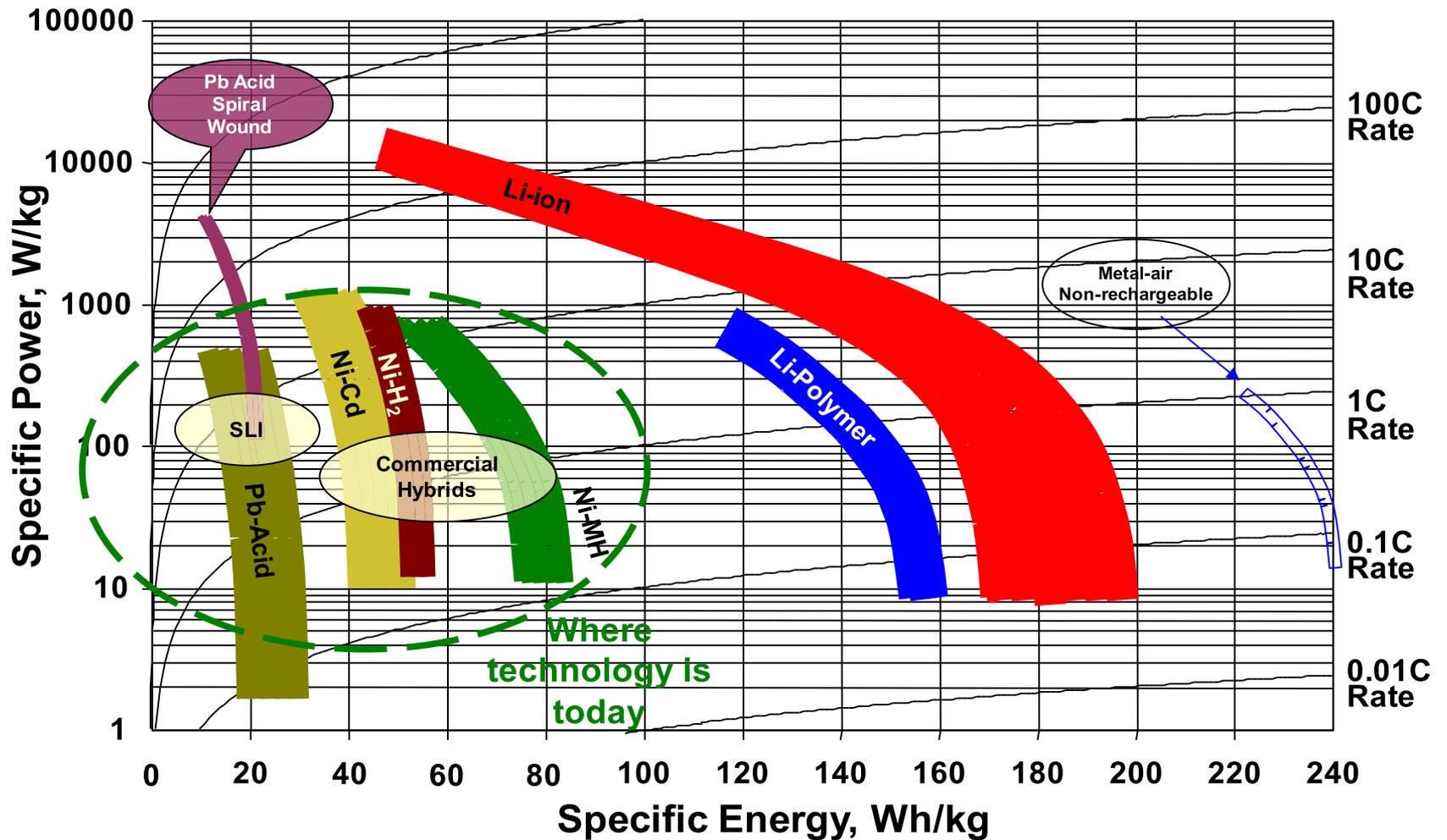
# The IPERC IPC: The right technology at the right time

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**Significant emission abatement and energy reduction can best be achieved through improved efficiencies. Intelligent power controls fit into this category.**

# Battery Characteristics



## **Non-negotiable issues**

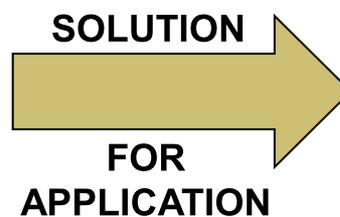
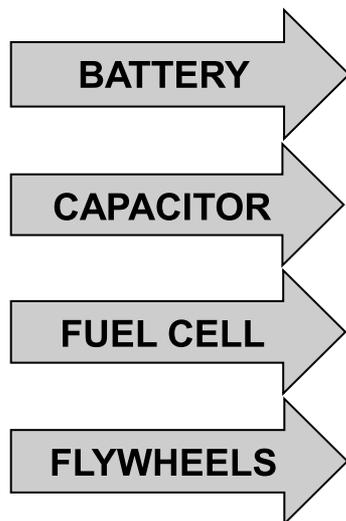
- Safety
- Reliability
- Maintainability
- Portability
- Frequency and voltage stability

## **Design choices**

- Electrical architecture i.e. bus voltage
- DC - AC conversion
- UPS vs. large scale storage and its architecture

# Hybrids For High Energy And High Power Needs

# *I*PERC



## **Know your problem**

- Power security and reliability
- Penetration of renewables and ramping
- Peak shaving / demand shifting
- Platform or stationary application

## **Know your demand profile**

- Peak power – fast response
- Average energy – slow response
- Mission duration

## **What if you don't know your demand profile?**

- What prevents premature energy depletion?
- How to avoid shortages during peaks?

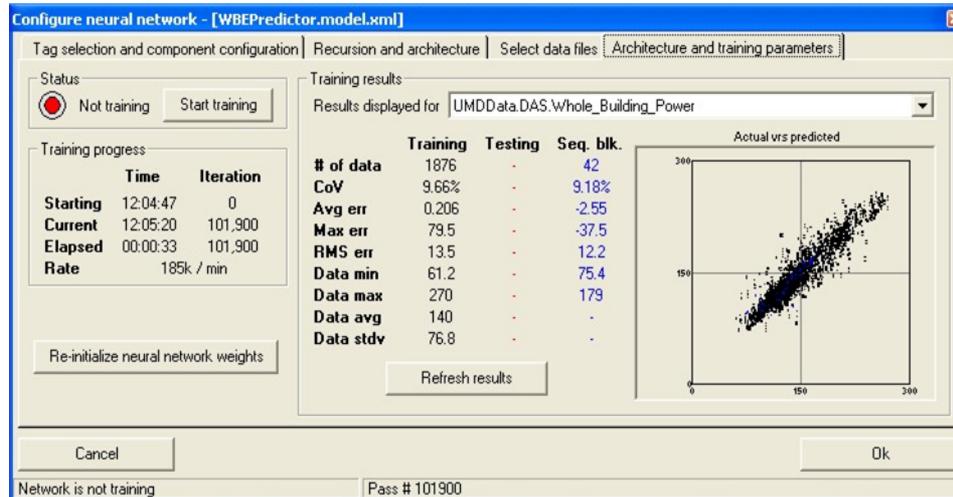
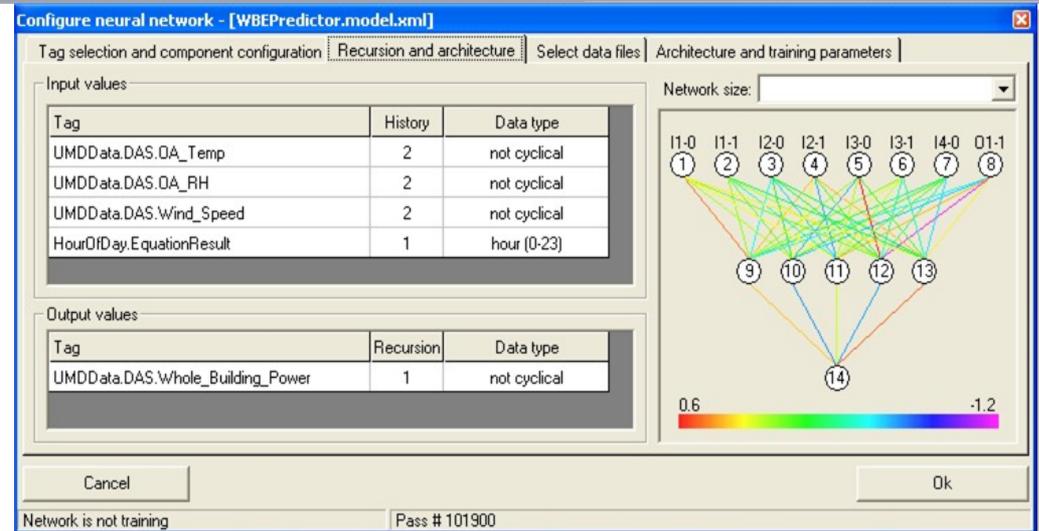
# Energy management

## Preventing Premature Depletion

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### Many Options

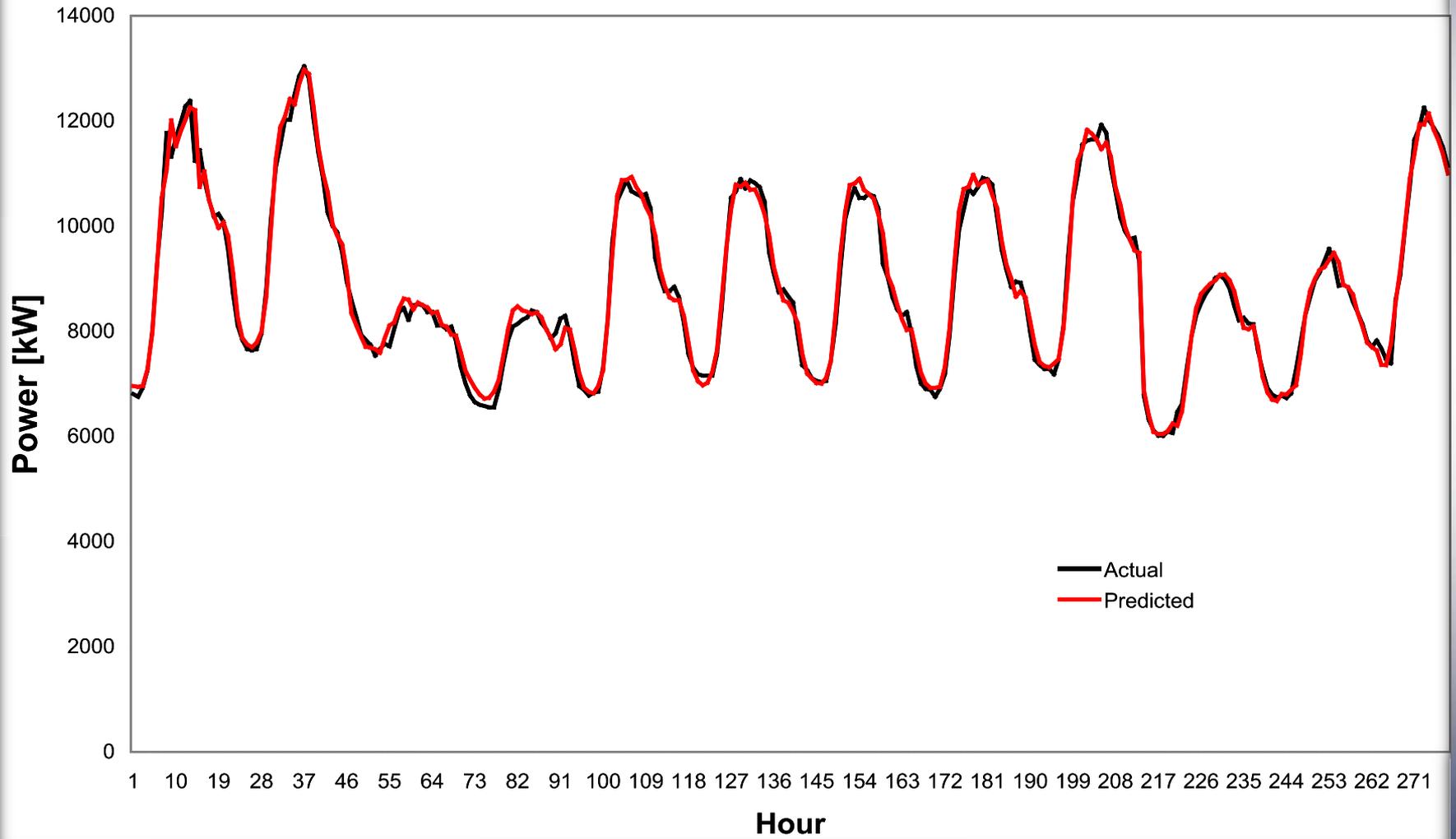
- First principles
- Stochastic modeling
- Regression
- Artificial intelligence



Pick the right tool for the job!

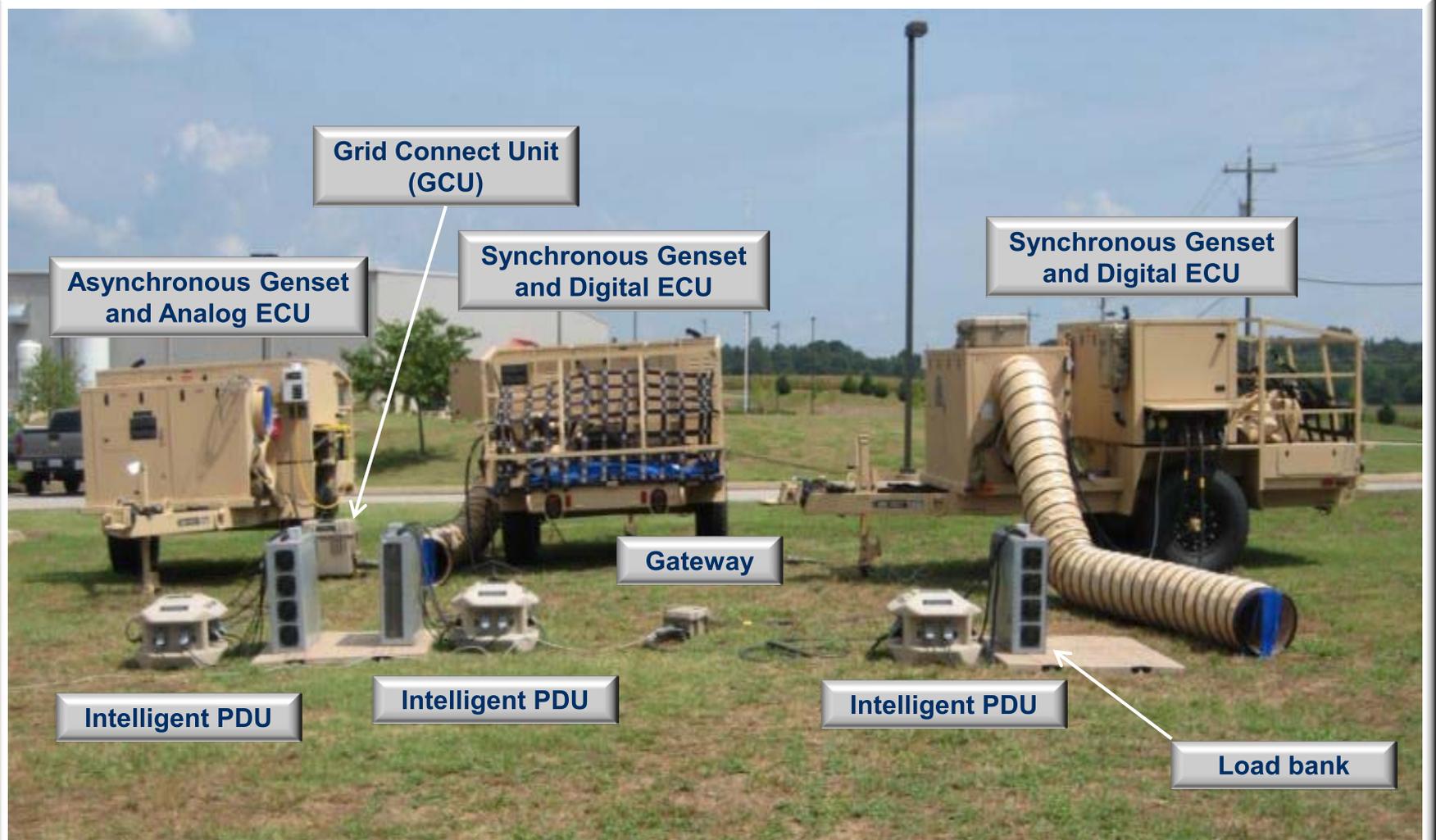
# Long-Term Energy Prediction

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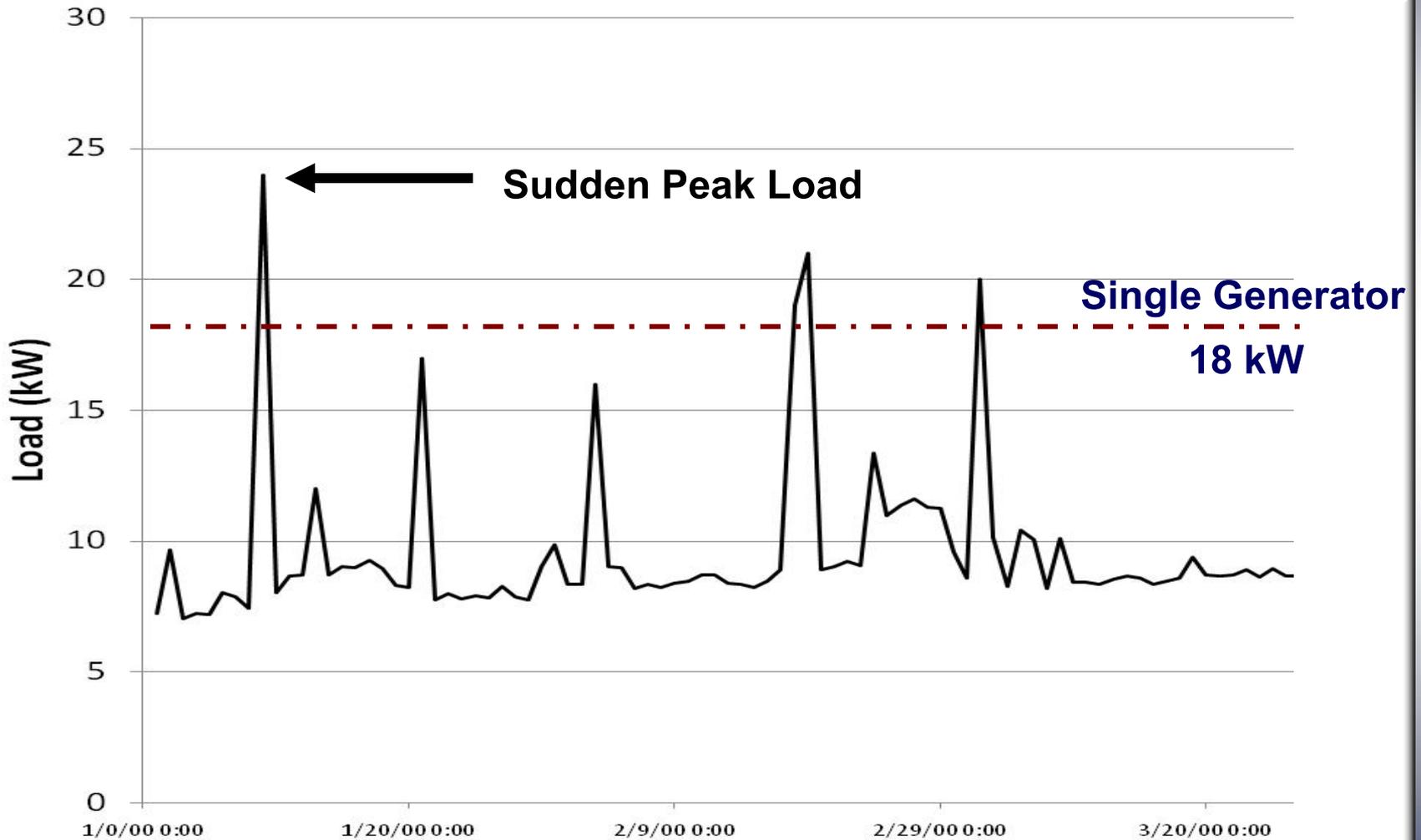


# Short-Term Power Profile Case Study

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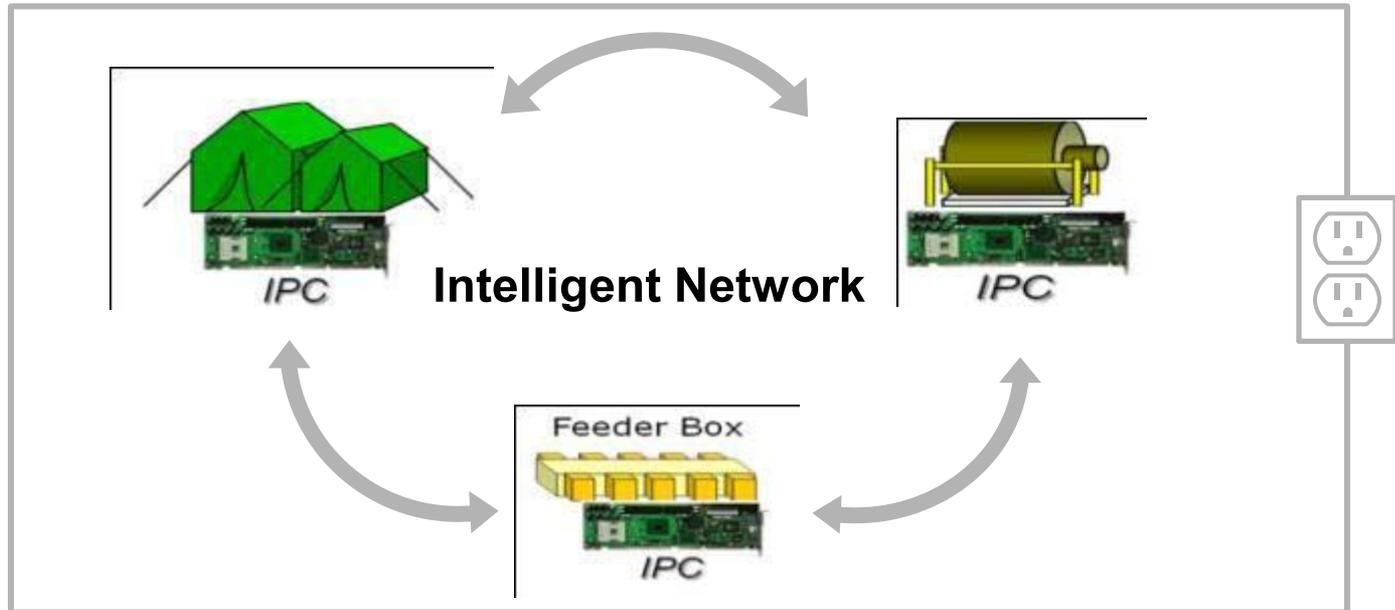


# Short-Term Power Profile



# Intelligent Grid Network

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**Optional Remote Monitoring**



**Router to Internet/  
Secure DOD Network**



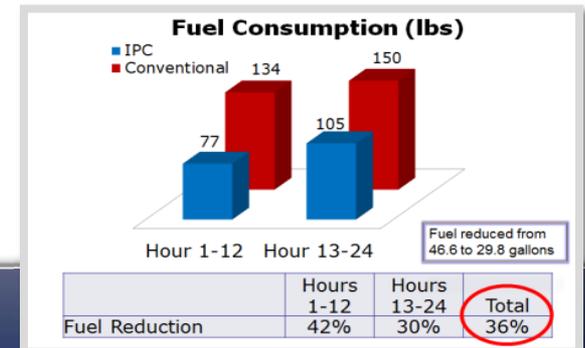
**Laptop**

# Tactical Microgrid Application **IPERC**



*IPERC Technology Demonstration, Huntsville, AL 15 July 2010*

- Developed full scale prototype for a tactical operations center
- Embedded "*intelligence*" into standard equipment – making it smart
- Delivered reliable power, prioritized decision-making
- Demonstrated 36% fuel reduction in tactical generators



# Software and Hardware

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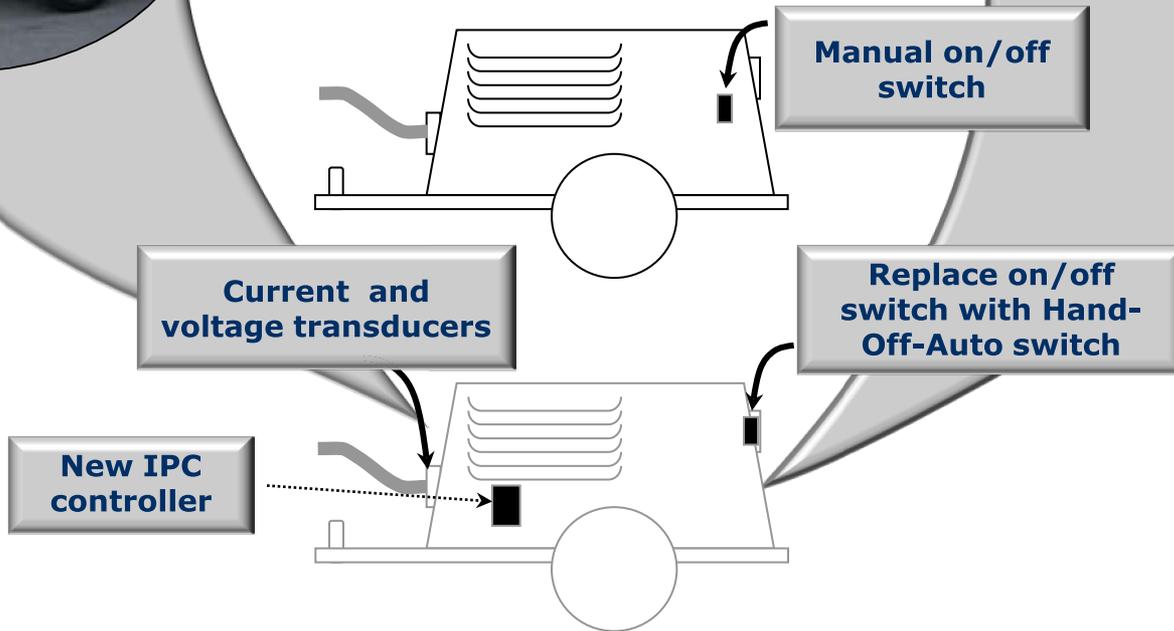
## Hardware

Generators, PDUs, loads



## IPERC IPC

IPC, Power Management Software



# Embedding Intelligence

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***Intelligent power distribution unit (PDU)***



***Embedded intelligence on generators***



***Mounting intelligent controls onto ECUs***

- Energy storage is an enabler for:
  - Security and reliability
  - High penetration of renewables
  - Power management
  
- Supervisory controls
  - Optimizes performance
  - Critical for contingency conditions
  - Ensures storage is not prematurely depleted
  - Needs to be an integral part of system design and operation

**Questions**

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**Thank You!**



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