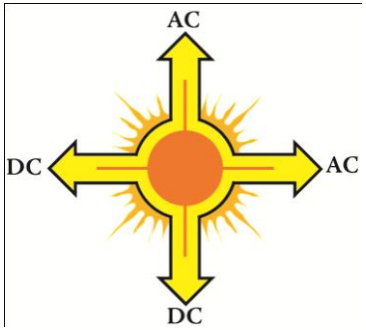
EPRI ELECTRIC POWER RESEARCH INSTITUTE

Hydro Québec

HEART TRANSVERTER

Heart Transverter

Implementing the Smartest Grid for the Least Amount of Time and Money



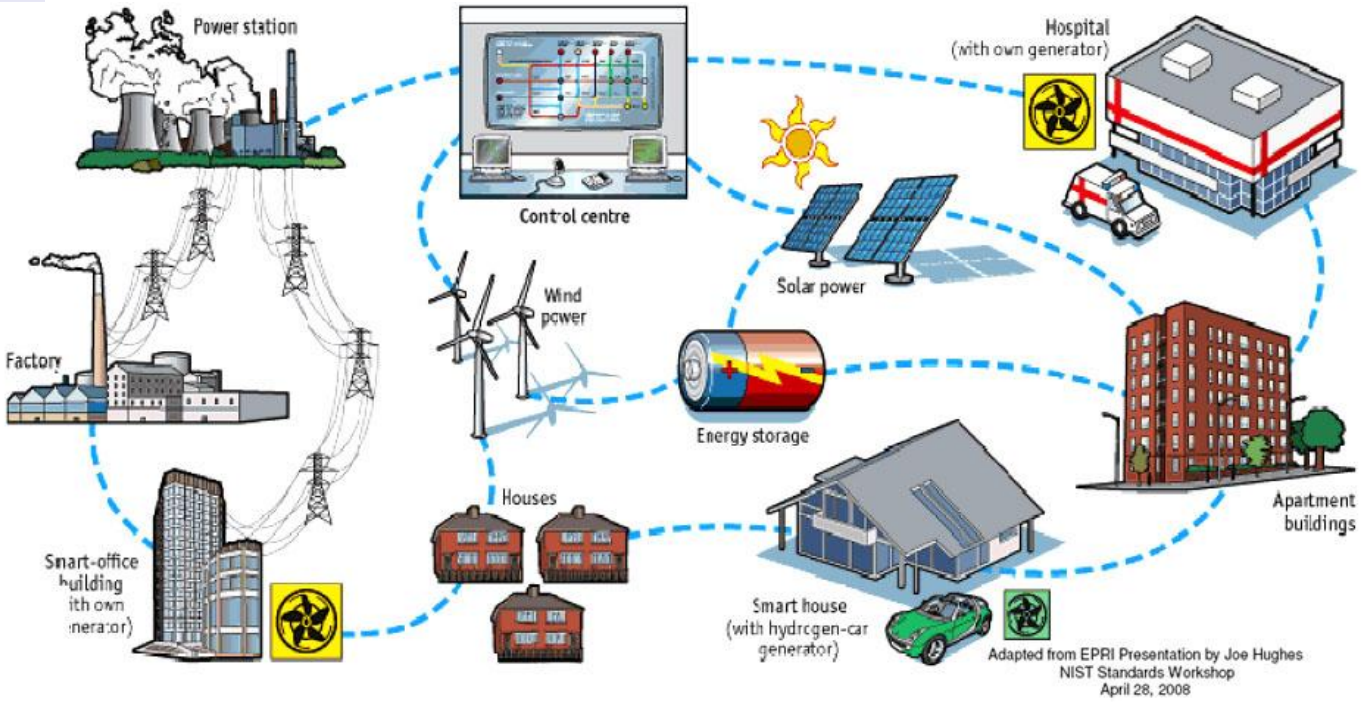
Heart Akerson
CEO Heart Transverter S.A.

EPRI PQ and Smart Distribution 2010 Conference and Exhibition

Transporting You into the 21st Century Distribution System

June 14–17, 2010

The Popular Smart Grid Idea: Data Intensive Monster



EPRI estimates this will cost $165 Billion and take 20 years to install.

Real time decisions involve detailed data being sent all the way to the central control center and then back to each device.

This idea depends on an extremely complicated high speed communications network that is a combination of HAN, FAN/AMI, WAN & LAN (the blue dotted lines). The software to manage this amount of data processing will be cumbersome and introduce major new security risks.

The Grid could be inundated with calls about why someone's washing machine doesn't work.

There is no autonomous energy security for the office or home.

The Problem: Dynamics of the Typical Home or Office

1.7 kW average load ⟷ 100 amp service 24 kW peak load

100 houses need 170 kW average with possible peak of 2.4 MW

Typical load varies between 100 kW and 270 kW

Electricity is mostly billed by the kwh but the dynamics heavily influence the true cost.

Peaker plants deal with the dynamics but use hydrocarbons, are expensive and pollute.

This brings up ideas of complex rate structures for peak and off-peak.

The hidden cost of Renewable Energy is more dynamics which means more peaker plants.

There is a driving need for energy security.

Imagine a world where the houses used a flat 1.7 kW with no dynamics. Imagine a world where RE was integrated into every home driving the grid load to a flat 1.2 kW, still with no dynamics.

This is the REAL SMART GRID.

The Real Smart Grid (One House at a Time)

Local Data - Local Decisions

Global Summaries - Global Guidelines

100 amp service → 50 amp service

PHEV

Heater

Frig.

Hot Water

HVAC

Well Pump

6 Relays with Current Sensing (30 amp)

T13X AMI & Load Management

4 Line Voltage & Current Sensing (100 amp)

AC GRID

AC Generator

4 kW Power Modules

AC in

AC out Data

920 watts solar expands to 4 kW

6 kWh Battery Bank Lead Gel or Li-ion

4 kW critical loads, lights, electronics, frig., UPS

Remote Panel

LAN to GRID, Neighbors, Smart Appliances

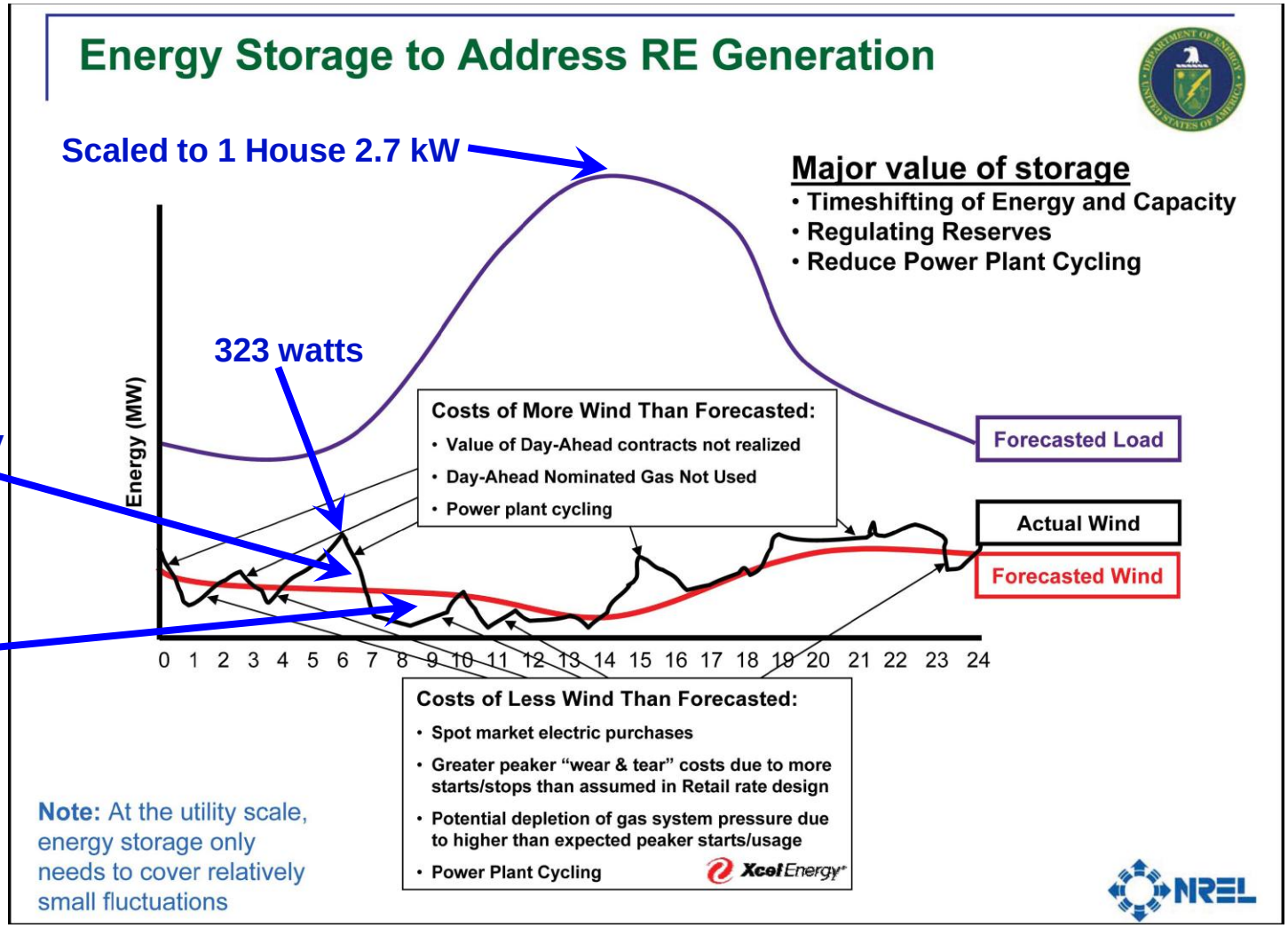
Typical House or Office System (One House at a Time)

Boulder 4 kW UPS, 920 w Solar, 138 kWh solar per month	QUANTITY	COST	EXTENDED
SOLARWORLD SW230-mono MODULE 230W 24V MC4-Blue	4	$ 928	$ 3,712
TRANSVERTER POWER MODULE 2000W	2	$ 2,000	$ 4,000
TRANSVERTER REMOTE PANEL	1	$ 200	$ 200
TRANSVERTER T13X (Smart Grid in a Box)	1	$ 600	$ 600
MK S31-SLD-G 12 V 108AH BATTERIES GEL	6	$ 262	$ 1,572
Hardware, wires and other B.O.S.			$ 782
		TOTAL	$ 10,866

IMPACT OF 100 HOUSE PROJECT

- END USER COST $1,087K, RAW MATERIALS $746K, LOCAL INSTALLERS $341K
- REDUCED ENERGY CONSUMPTION BY 20% SAVING OVER 23 MWH / MONTH
- PRODUCING 13.8 MWH SOLAR / MONTH AND REDUCING GRID BY 37 MWH/MONTH
- SOLAR CAN BE EXPANDED UP TO 60 MWH / MONTH AT CUSTOMERS OPTION
- AUTOMATIC SURGE ASSIST TO GRID OF 400 KW
- AUTOMATIC POWER FACTOR CORRECTION TO GRID OF 400 KW
- DEEP DATALOGGING, REAL TIME INFORMATION & DOCUMENTATION
- 100 AMP SERVICE → 50 AMP SERVICE BY AUTOMATIC LOAD SEQUENCING ABSOLUTELY CUTS THE COST OF THE ELECTRICAL INFRASTRUCTURE IN HALF
- COMMUNITY ENERGY STORAGE CAPABILITY IN PLACE (JUST SET THE RULES)
- INDIVIDUAL HOME ENERGY SECURITY, 6 KWH OF BATTERY BACKUP + SOLAR
- FEEDS THE R&D EFFORTS OF EVERYTHING IN ENERGY & SMART GRID SECTORS

Making Renewable Energy Real (One House at a Time)



Charging .485 kWh
8% battery capacity
@ C/19

Discharging .474 kWh
8% battery
capacity @ C/28

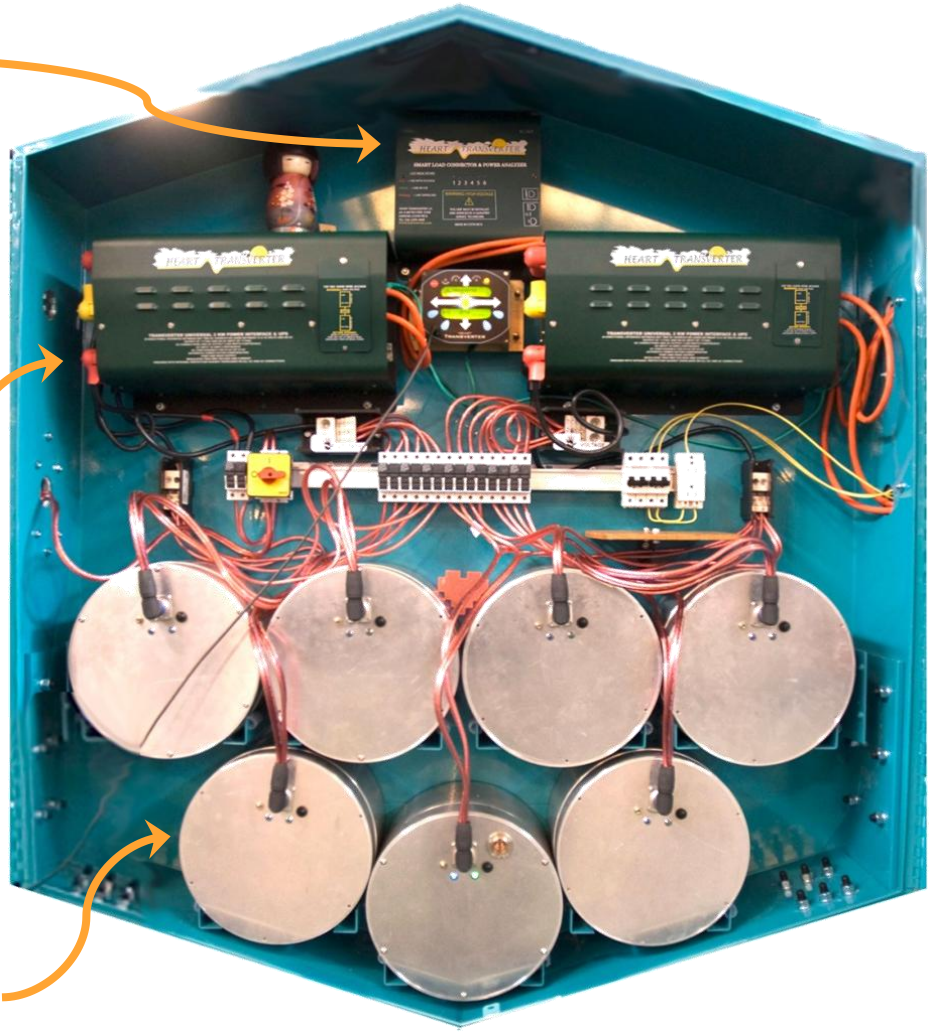
Community Energy Storage (One House at a Time)

T13X SMART GRID

4 kW OF POWER MODULES

Growing Energy Labs CES installation in San Francisco

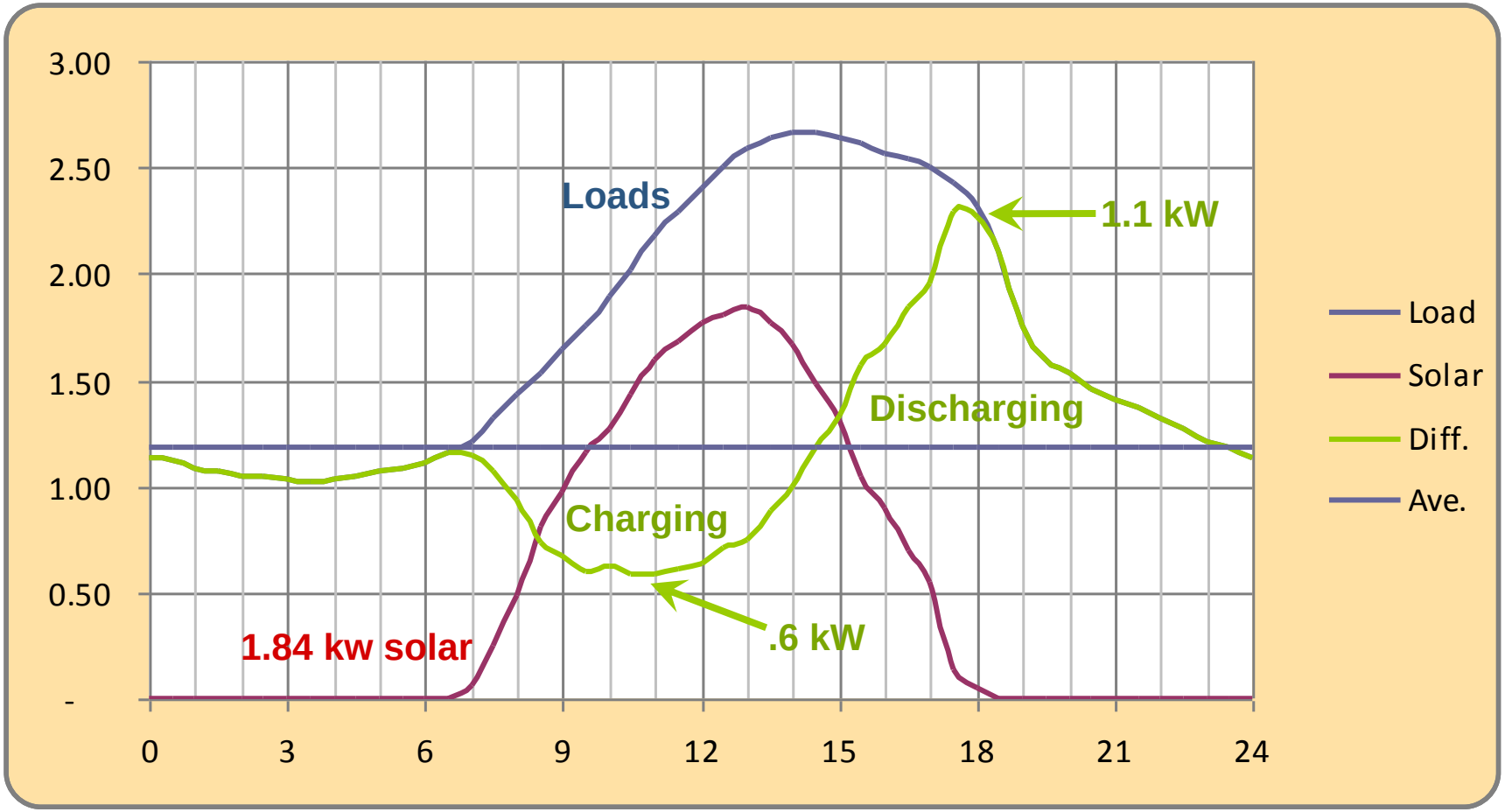
14 kWh LI-ION BATTERIES
Cycle Life > 10,000



Balancing Loads with Solar, One House at a Time

Daily Charge-Discharge 3.9 kWh = 65% of 6 kWh battery
Charge @ C/10 Discharge @ C/5

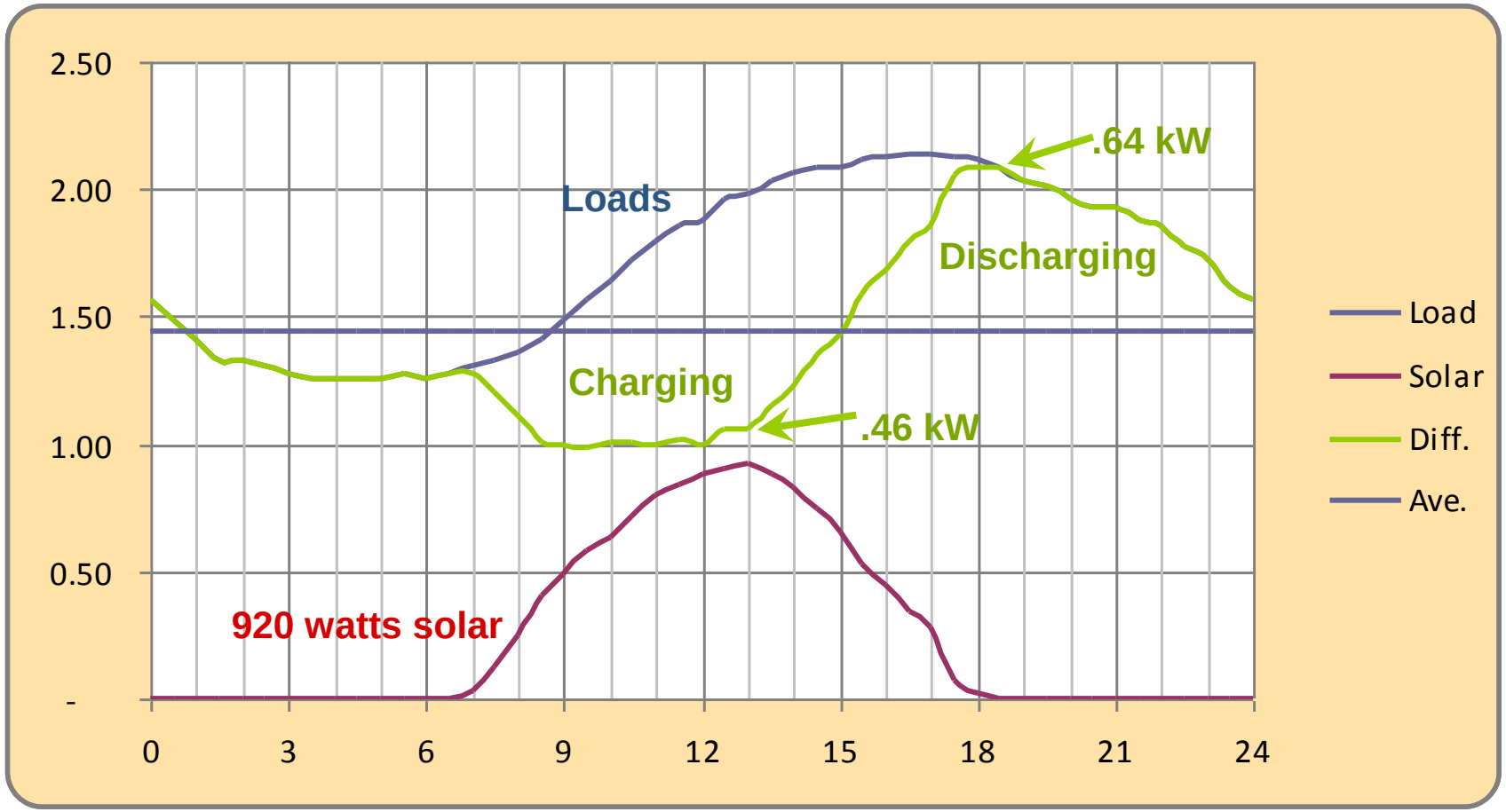
NREL Model



Balancing Loads with Solar, One House at a Time

Daily Charge-Discharge 3.7 kWh = 62% of 6 kWh battery
Charge @ C/14 Discharge @ C/9

CA July 8th



Two of Today's Real CES Options

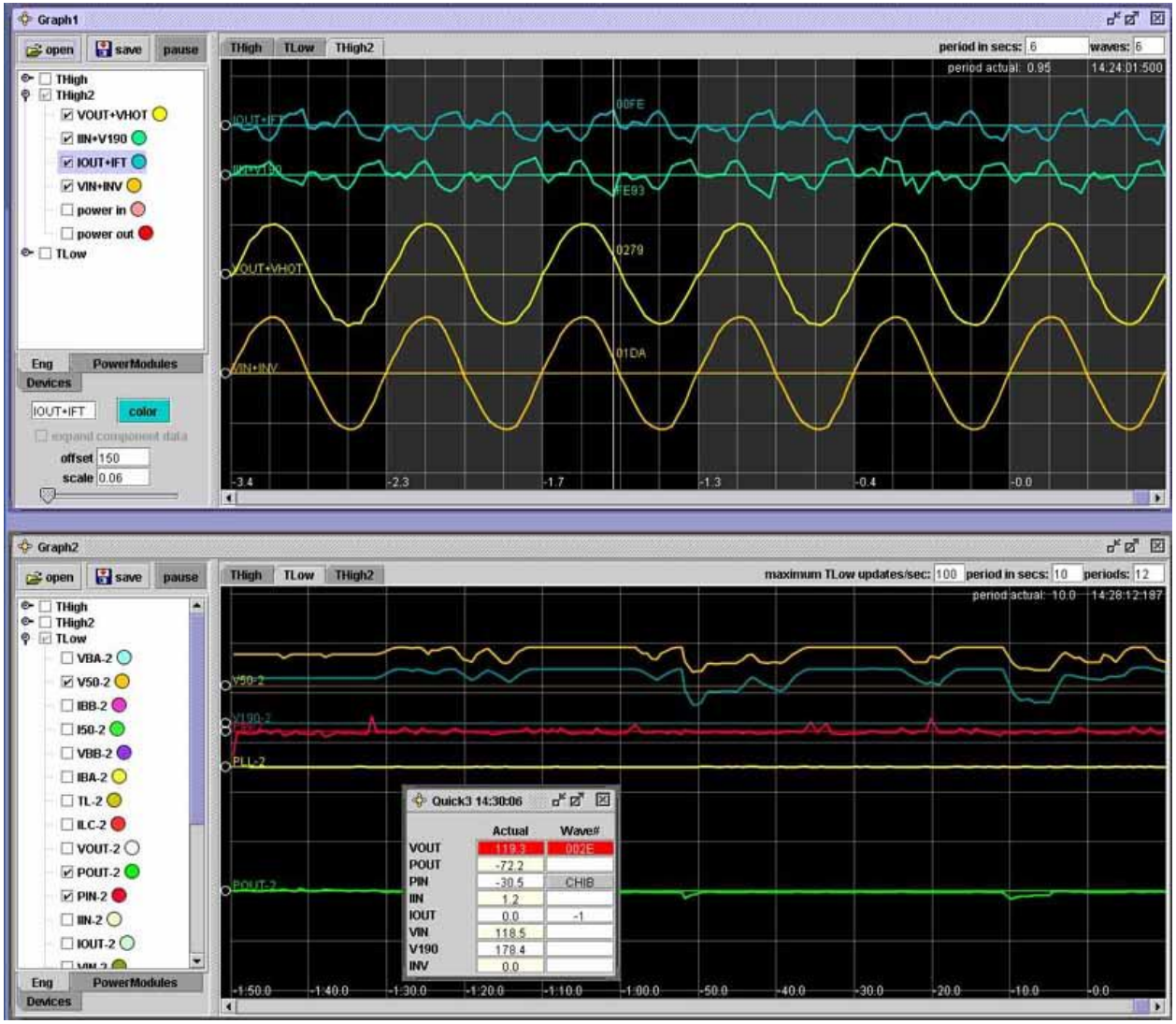
1 MW CES Price $1 M

You need to pay the people who operate and maintain it. Real estate also extra. Installation costly and complicated.

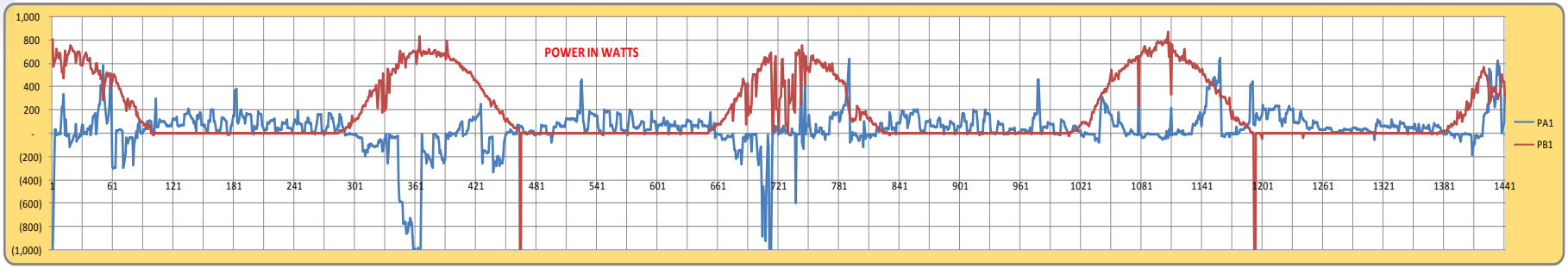
400 kW CES Price already paid for by the owners. The people who operate and maintain it work for free. Real estate included. No installation.

Advanced Waveshape Analysis & Mathematical Models

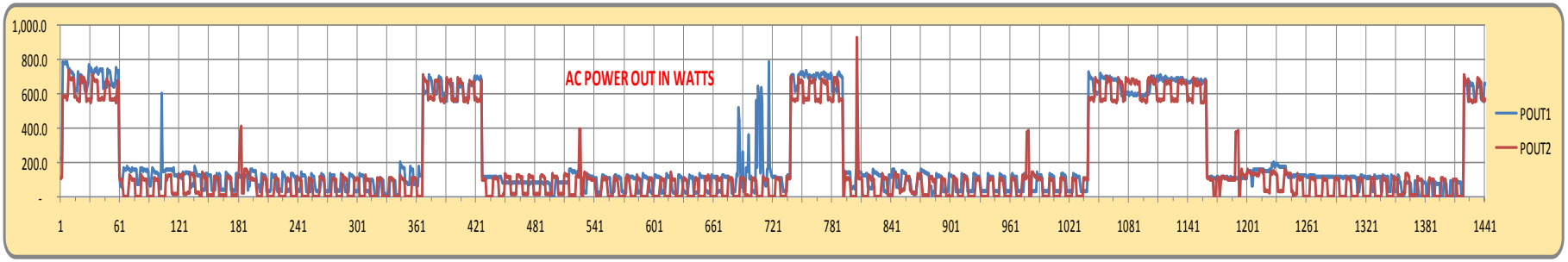
- **Dense FPGA logic enables new levels of performance.**
- **Immune from system lockups that plague microcontrollers**
- **Emulates all test equipment via USB to PC.**
- **Creates both the most detailed live data plus the most compressed math models.**
- **Detailed real time power factor and harmonic analysis.**
- **Seamless updates of all logic via internet**



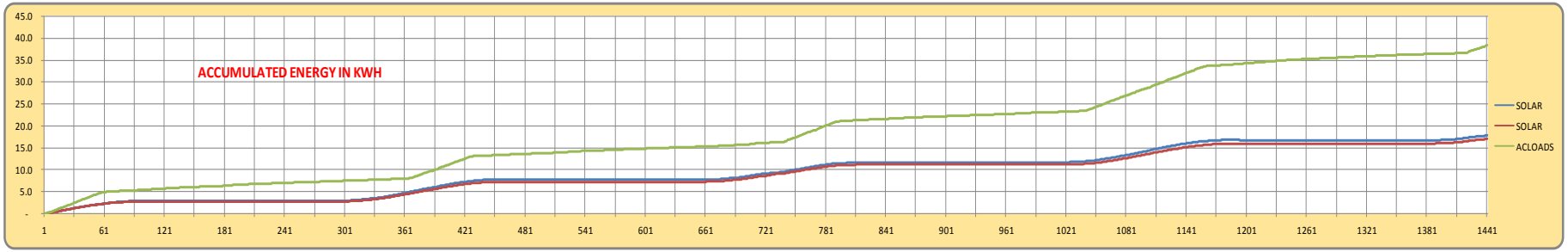
Advanced Data Logging (One House at a Time)



AUTOMATIC ADVANCED DATA ANALYSIS & MODELING STORED IN FLASH



PRODUCT IMPROVEMENT & FAULT PREDICTION

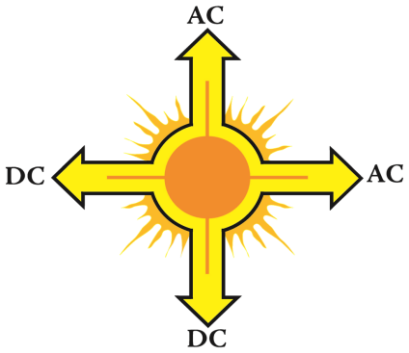


SERVICE LEVEL AGREEMENTS

Where do we go from here?

HEART TRANSVERTER

Implement 100 house test projects in every state and province. This will:



- **Engage the individual home owners.**
- **Reduce the grids actual cost to provide each kWh.**
- **Lower the cost of the electrical infrastructure.**
- **Integrate RE for the lowest possible cost with the highest stability.**
- **Provide individual house and office autonomous energy security.**
- **Provide Smart Grid benefits to the grid companies while minimizing the data processing burden.**
- **Create a real test bed environment for Smart Grid software developers.**
- **Provide a state of the art energy lab for every "2 guys in a garage".**