LBNL Building 90 Monitoring:
Status Update and New EIS Features

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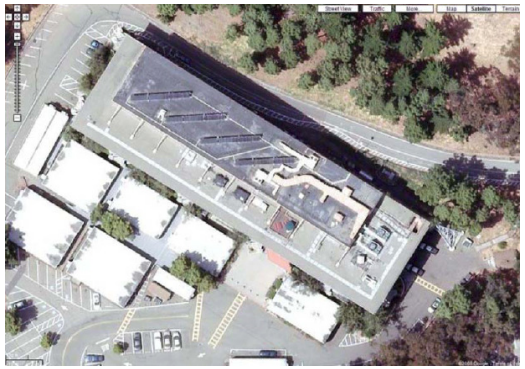
BERKELEY LAB
LAWRENCE BERKELEY NATIONAL LABORATORY

Presentation Agenda

1. B-90 Monitoring Project Goals, Description, and Status.
2. B-90 Systems and Data Communication.
3. B-90 EIS Introduction and Demonstration
4. New EIS and Analytical Features
5. Discussion

Goals for the Building 90 Project

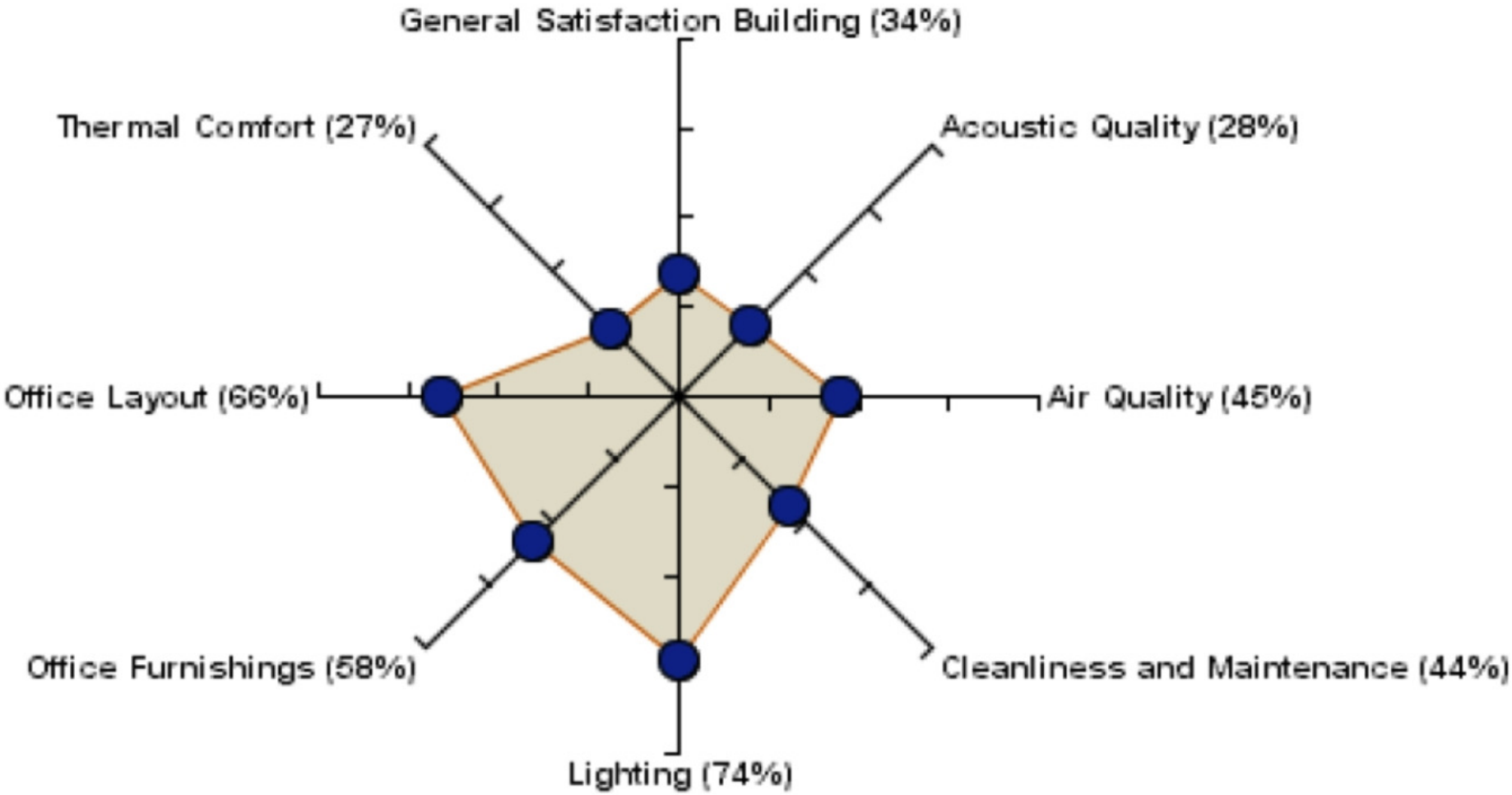
- Characterize energy and environmental conditions in B-90--monitoring and modeling
- Develop plan for “deep energy retrofits”
- Develop model space planning guidelines for research divisions
- Conduct R&D on energy feedback--dashboards--to building users and operators



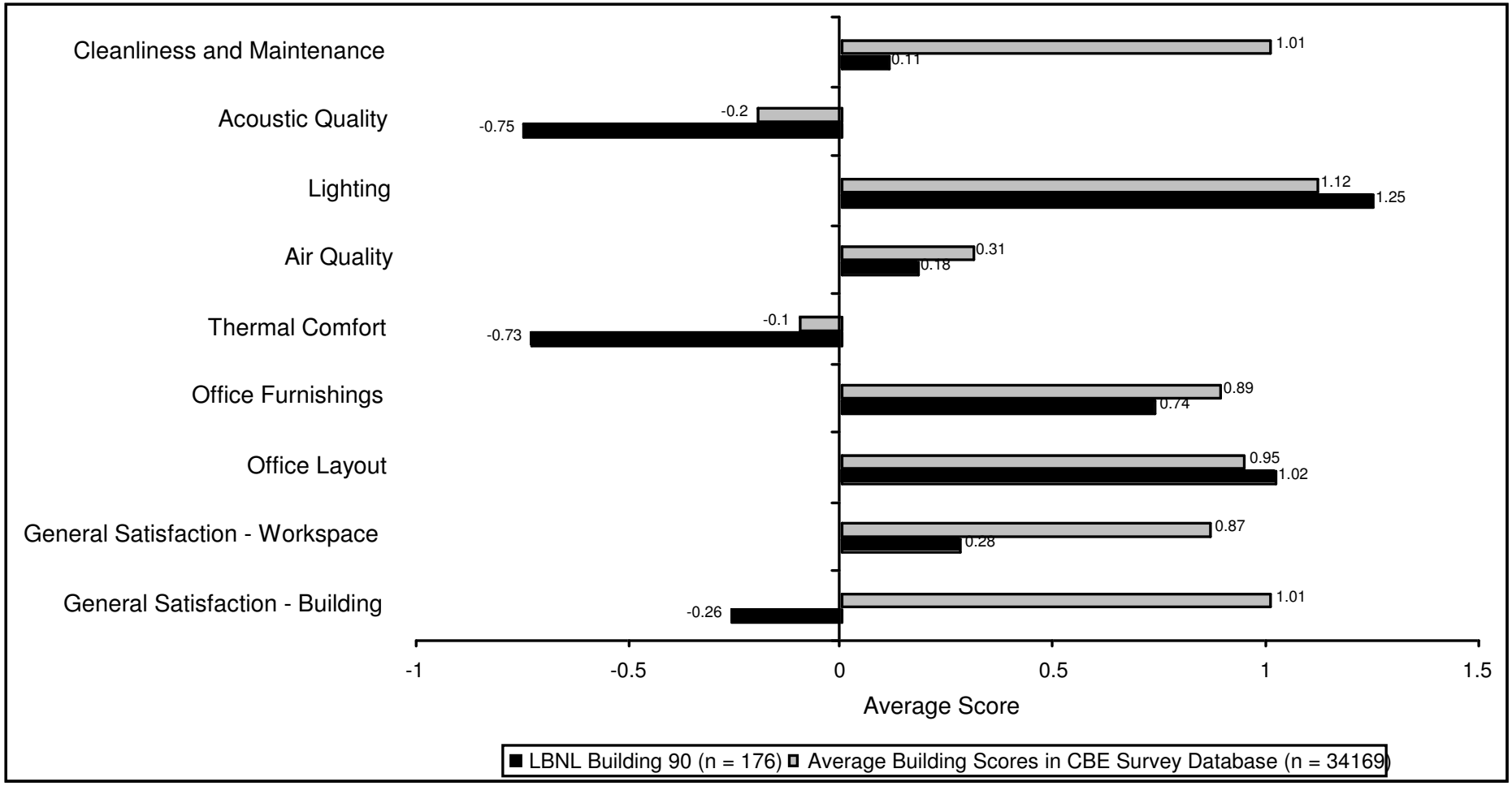
Building 90 Floor Area by Division

Division	Net square feet	percentage	Estimated people*
EETD	28,393	46	178
EH&S	2,221	4	15
Earth Science	17,284	28	108
Facilities	3,402	5	19
HR	3,547	6	23
IC	1,147	2	8
Lab Directorate	5,854	9	35
Total B90	61,848	100	386
Trailers	12,260		77
Total B90 Complex	74,108		463

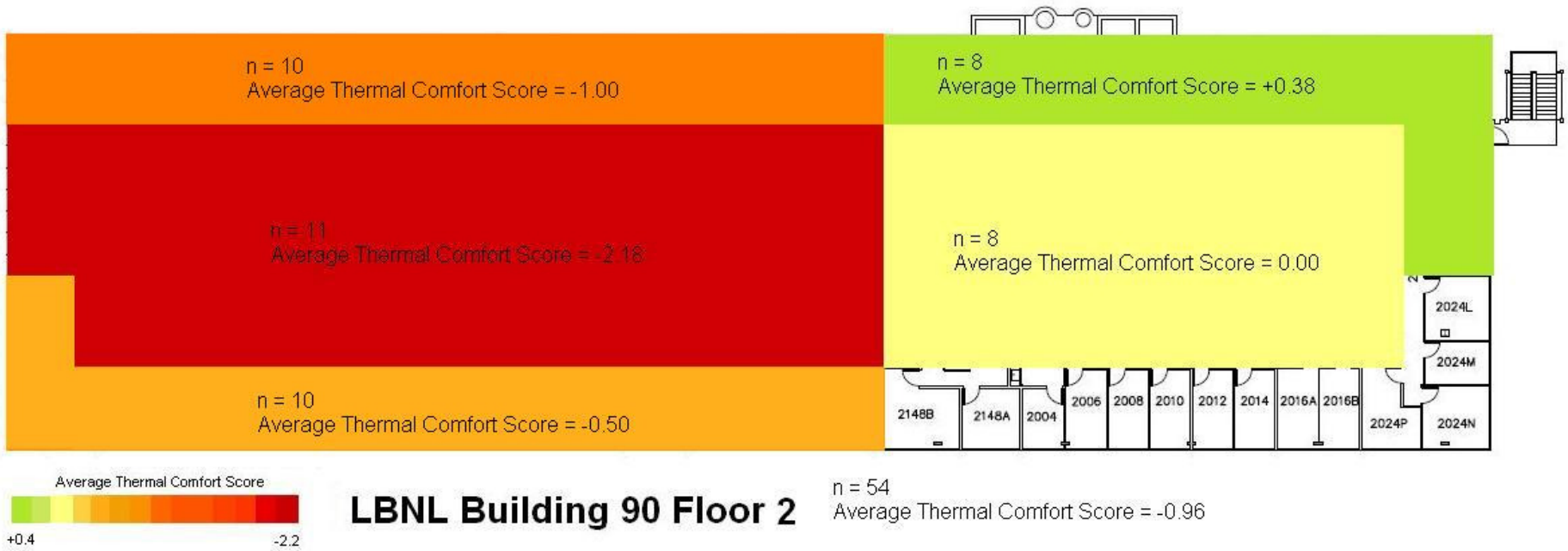
Satisfaction in Core Survey Categories

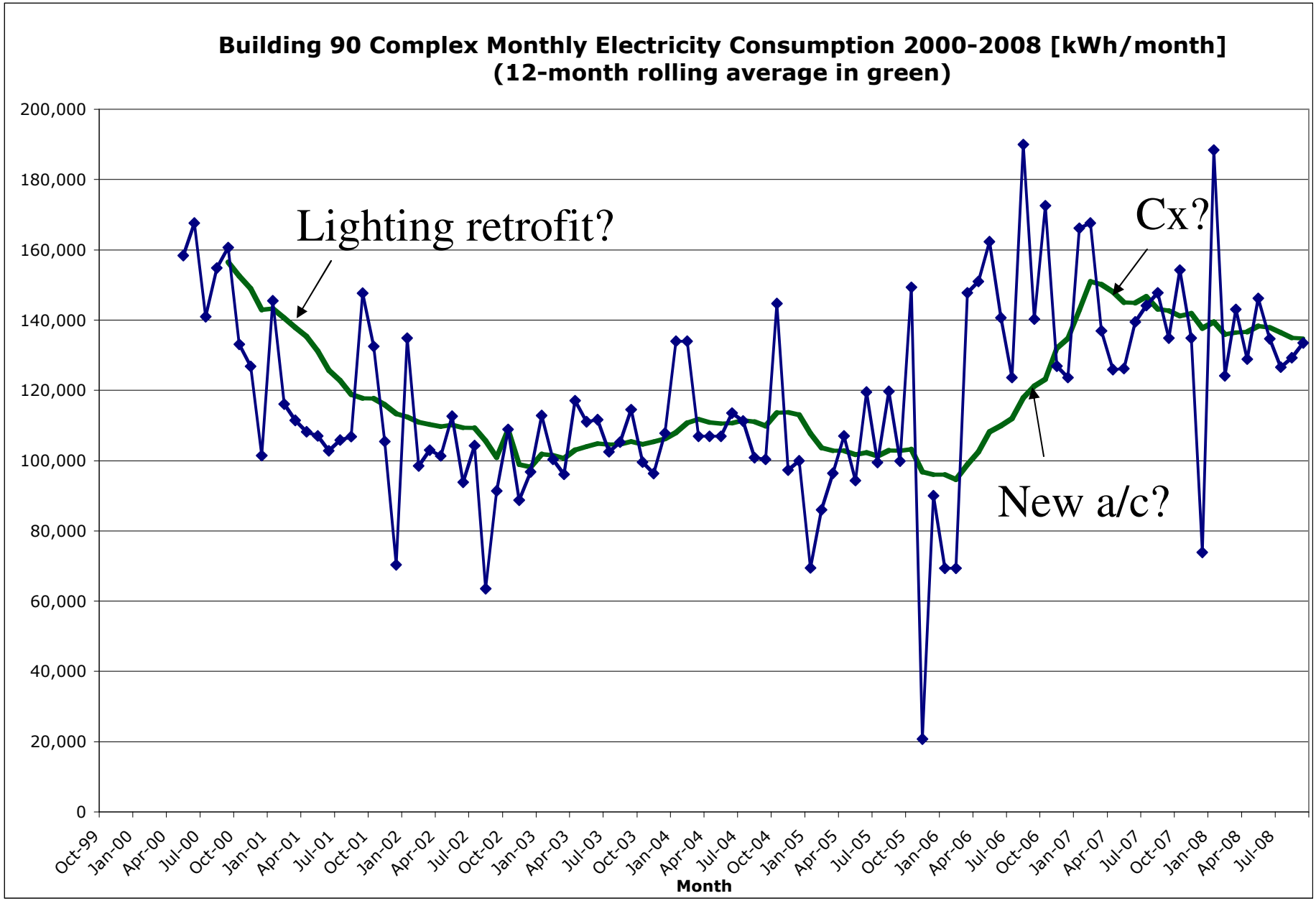


Building 90 Average User Satisfaction



Average Thermal Comfort Building 90 2nd Floor




Building 90 Complex Monthly Electricity Consumption 2000-2008 [kWh/month]
(12-month rolling average in green)
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Lighting retrofit?
Cx?
New a/c?
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
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Oct-06
Jan-07
Apr-07
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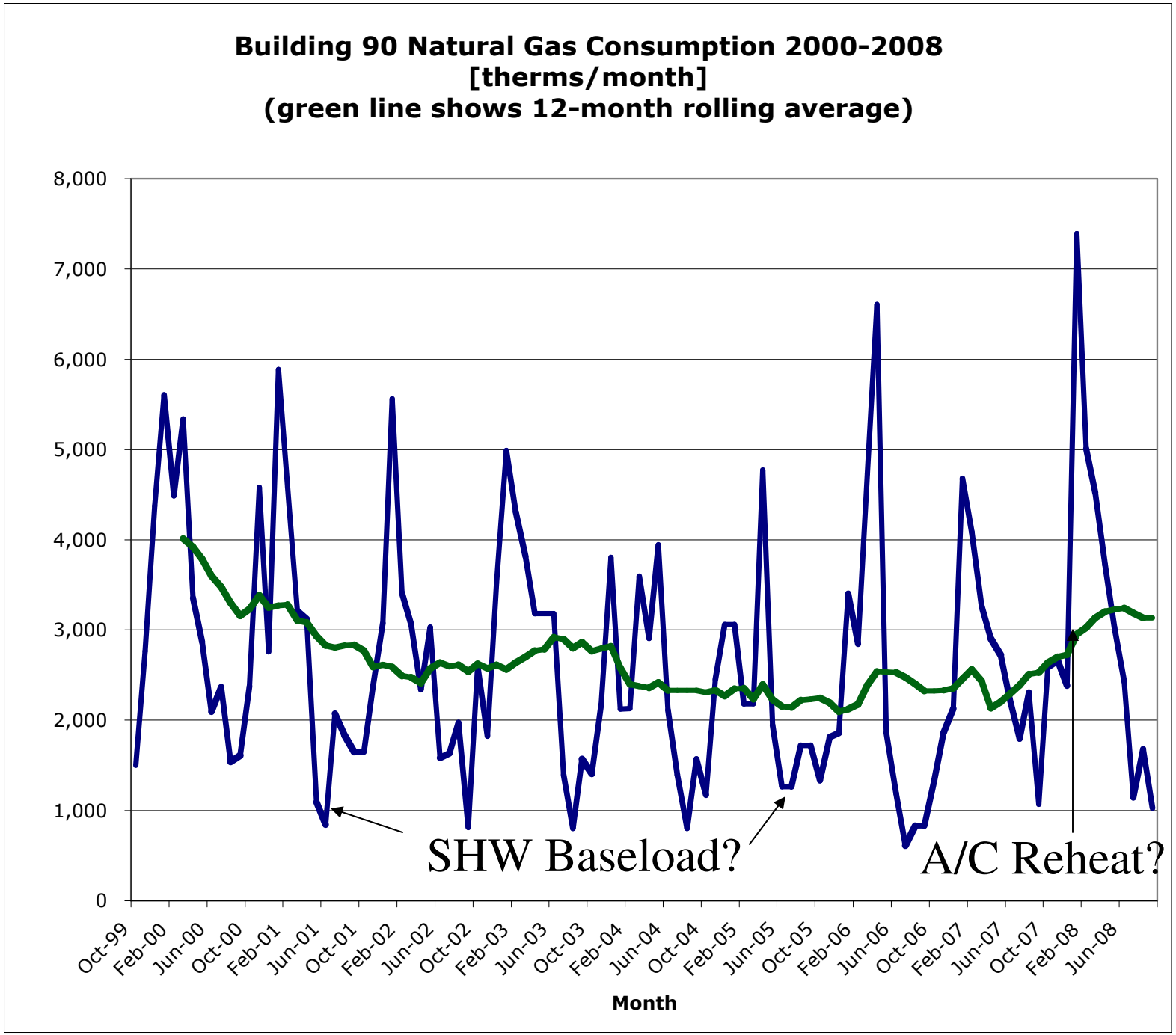
Oct-07
Jan-08
Apr-08
Jul-08
Month


Building 90 Natural Gas Consumption 2000-2008
[therms/month]
(green line shows 12-month rolling average)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
SHW Baseload?
A/C Reheat?
Oct-99
Feb-00
Jun-00
Oct-00
Feb-01
Jun-01
Oct-01
Feb-02
Jun-02
Oct-02
Feb-03
Jun-03
Oct-03
Feb-04
Jun-04
Oct-04
Feb-05
Jun-05
Oct-05
Feb-06
Jun-06
Oct-06
Feb-07
Jun-07
Oct-07
Feb-08
Jun-08
Month

B90 Electricity End Use Estimates

Building 90 Complex Electricity End Use Estimates

	Power density	Operating schedule	Gross Floor Area	Total Electricity	Percent Total Electricity
	w/ft2	hrs/yr	ft2	kWh/yr	%
Lighting	0.8	3000	106,128	254,707	16%
Plug Loads	1.5	3000	106,128	477,576	30%
Cooling & fans				885,542	55%
Total Electricity				1,617,825	100%

Energy Star Target Finder Rating

Energy	2008 Actual	Target	Top 10%
Energy Performance Rating (1-100)	71	75	90
Energy Reduction (%)	23	26	45
Source Energy Use Intensity (kBtu/Sq. Ft./yr)	211	202	151
Site Energy Use Intensity (kBtu/Sq. Ft./yr)	87	84	63
Total Annual Source Energy (kBtu)	22,372,536	21,421,160	16,049,616
Total Annual Site Energy (kBtu)	9,279,019	8,884,435	6,656,585
Total Annual Energy Cost ($)	$ 132,780	$ 127,134	$ 95,254
CO2 Emissions (tons/year)	932	892	669

Total Gross Floor Area: 106,128 (Sq. Ft.)

Electricity (2008) 1,617,825 kWh /yr @ $ 0.060/kWh
Natural Gas (2008) 3,759 MBtu/yr @$ 9.500/MBtu

Current Status of Work

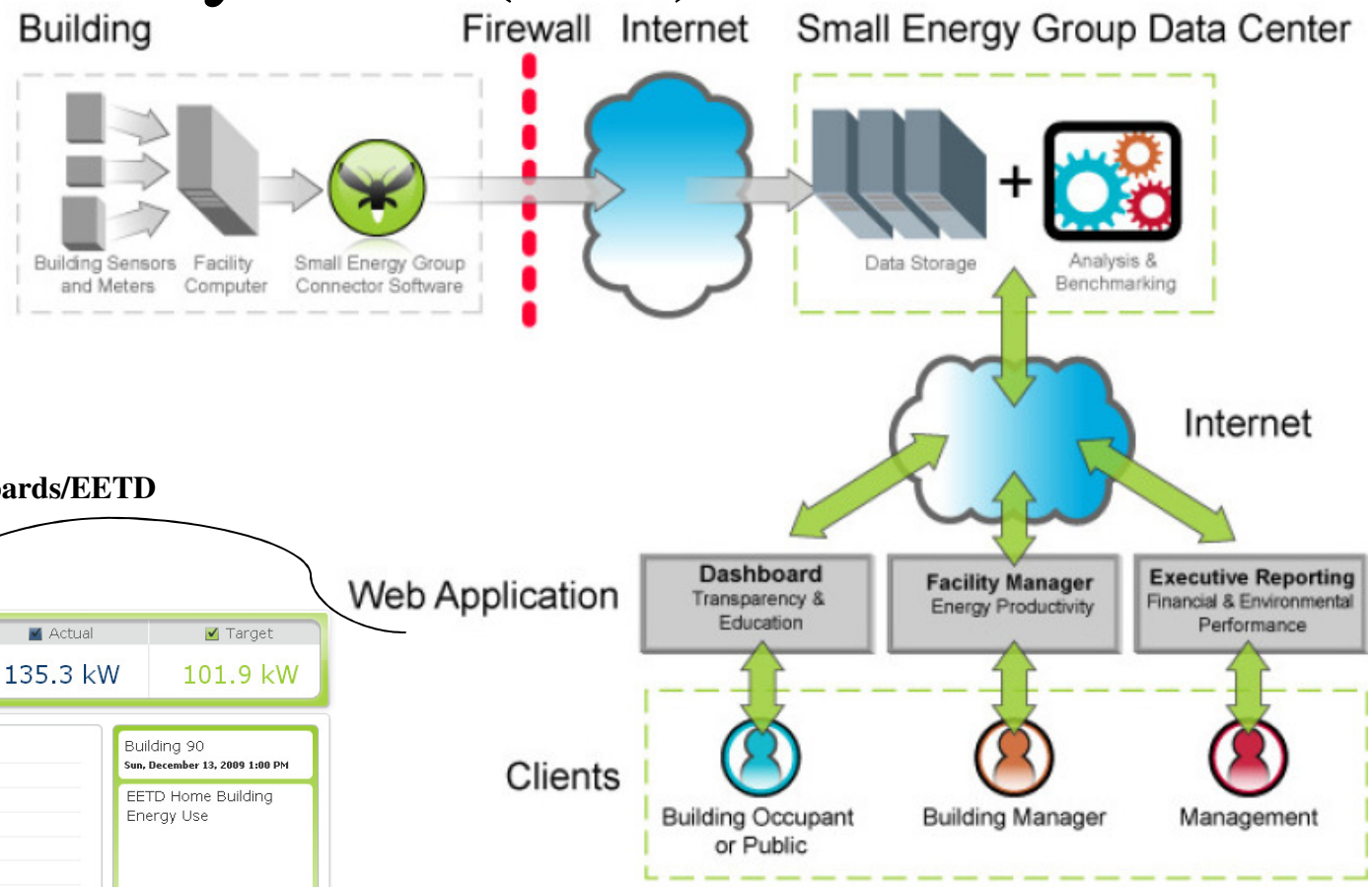
- *Deep Energy Retrofit* report complete
- Awarded *NZE User Facility*
- Draft Guidelines for space planning
- Phase 1 monitoring and dashboard complete.
- Data integration troubleshooting <u>in progress</u>.

B-90 Systems and Data Communication

B-90 Existing Systems

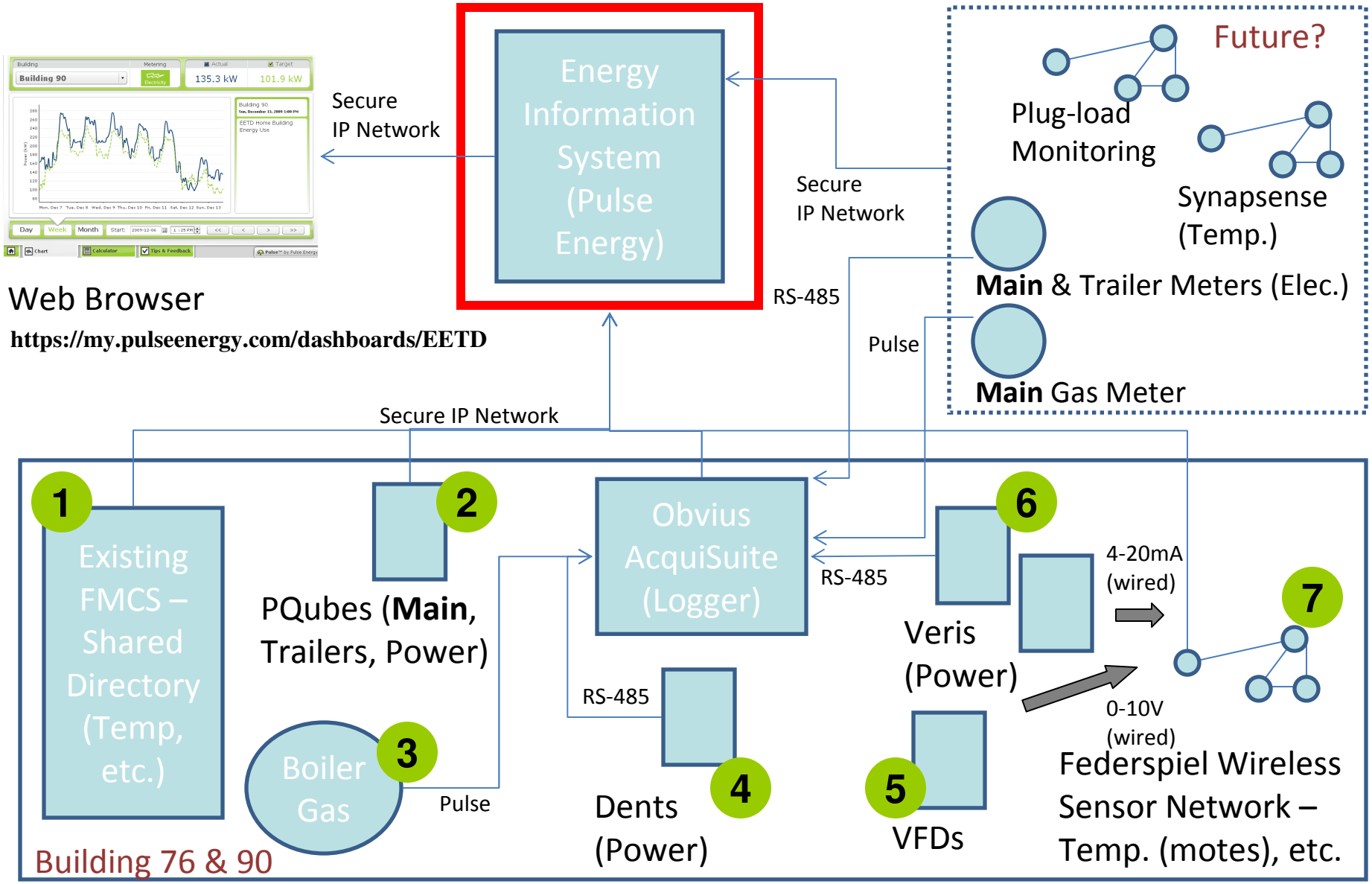
- Ad-hoc designed air handling and Direct eXpansion (DX) systems
- Perceived poor energy performance.
  - Lack of data for monitoring and analysis.
- Documented poor occupant comfort
  - Cold dumping
  - Hot spots
- Functional, but archaic Facility Management Control Systems (FMCS)
- B-90 Main meter recently upgraded.

Generic Pulse Energy's Energy Information System (EIS) Architecture

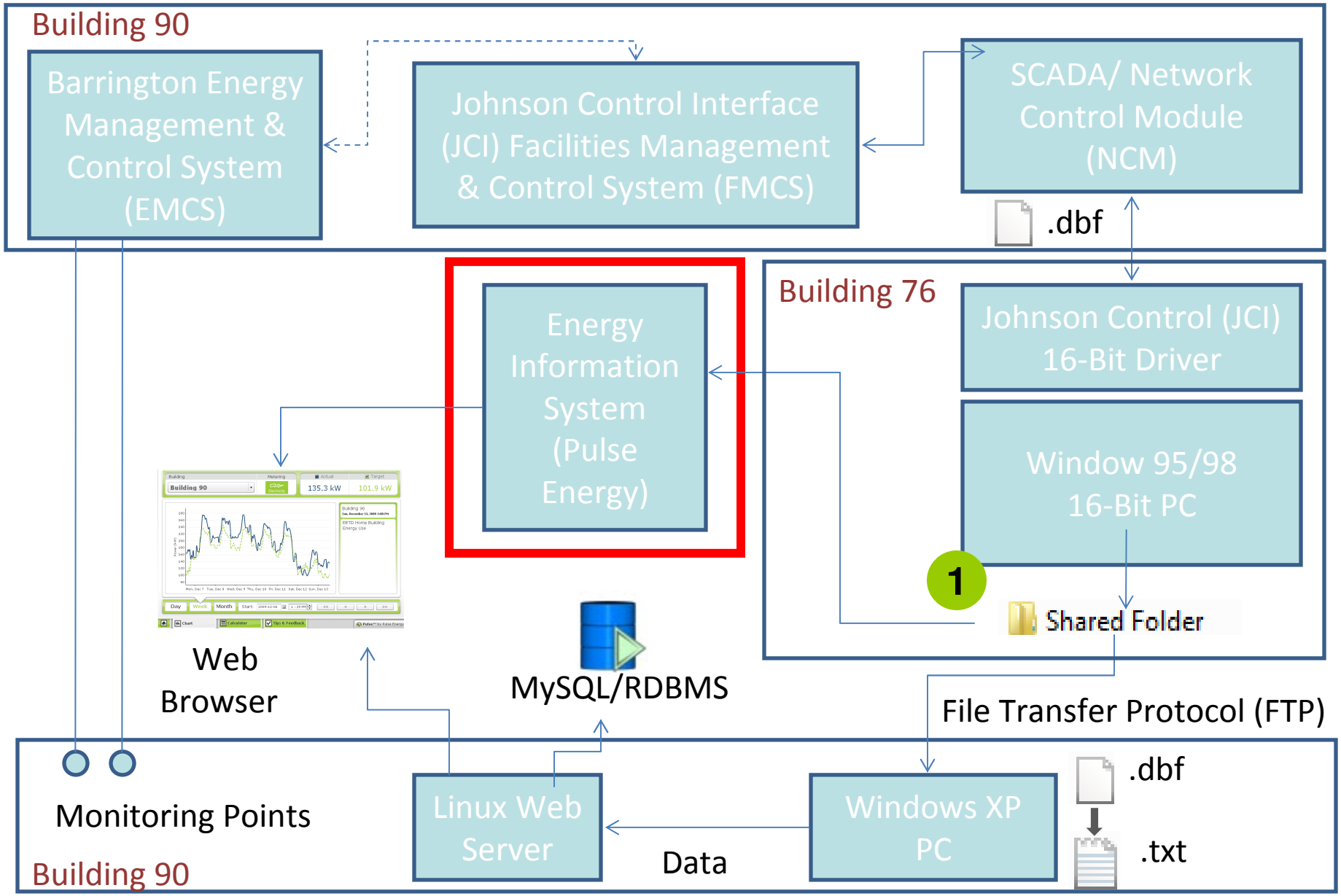


https://my.pulseenergy.com/dashboards/EETD

B-90 EIS Data Communication Architecture



FMCS Data Architecture to EIS



B-90 EIS Introduction and Demonstration

- EIS Status
- Visualization and Dashboards
  - Dust
  - Federspiel
  - Pulse
- Contractual Closeout
- Preliminary Analysis

B-90 Monitoring Status

- Delivered:
- Wireless motes
  - Federspiel (Dust)
  - Synapsense
- Veris power meters
- PQube power meters
- Dent power meters
- Boiler gas pulser
- Computer
- Gateways

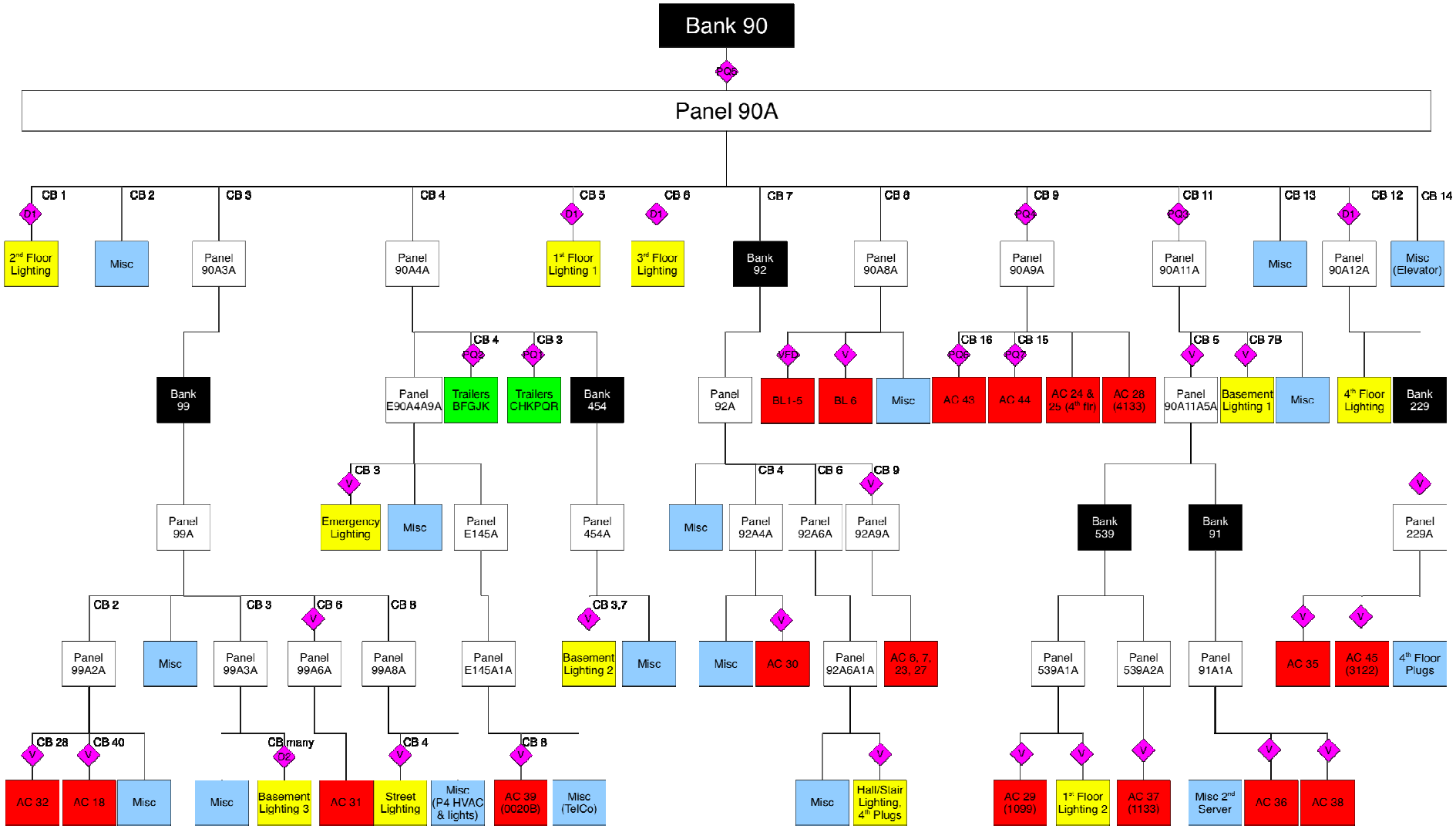
B-90 Monitoring Status: Hardware Components

- Wireless motes
  - Federspiel (Dust) (connectivity only 90%)
  - Synapsense (not commissioned)
- Veris power meters
  - 2 meters yet to be installed by LBNL
  - 2 RS-485 meters not communicating
- PQube power meters (some firmware tweaks)
- Dent power meters (CT issue F/W or H/W)

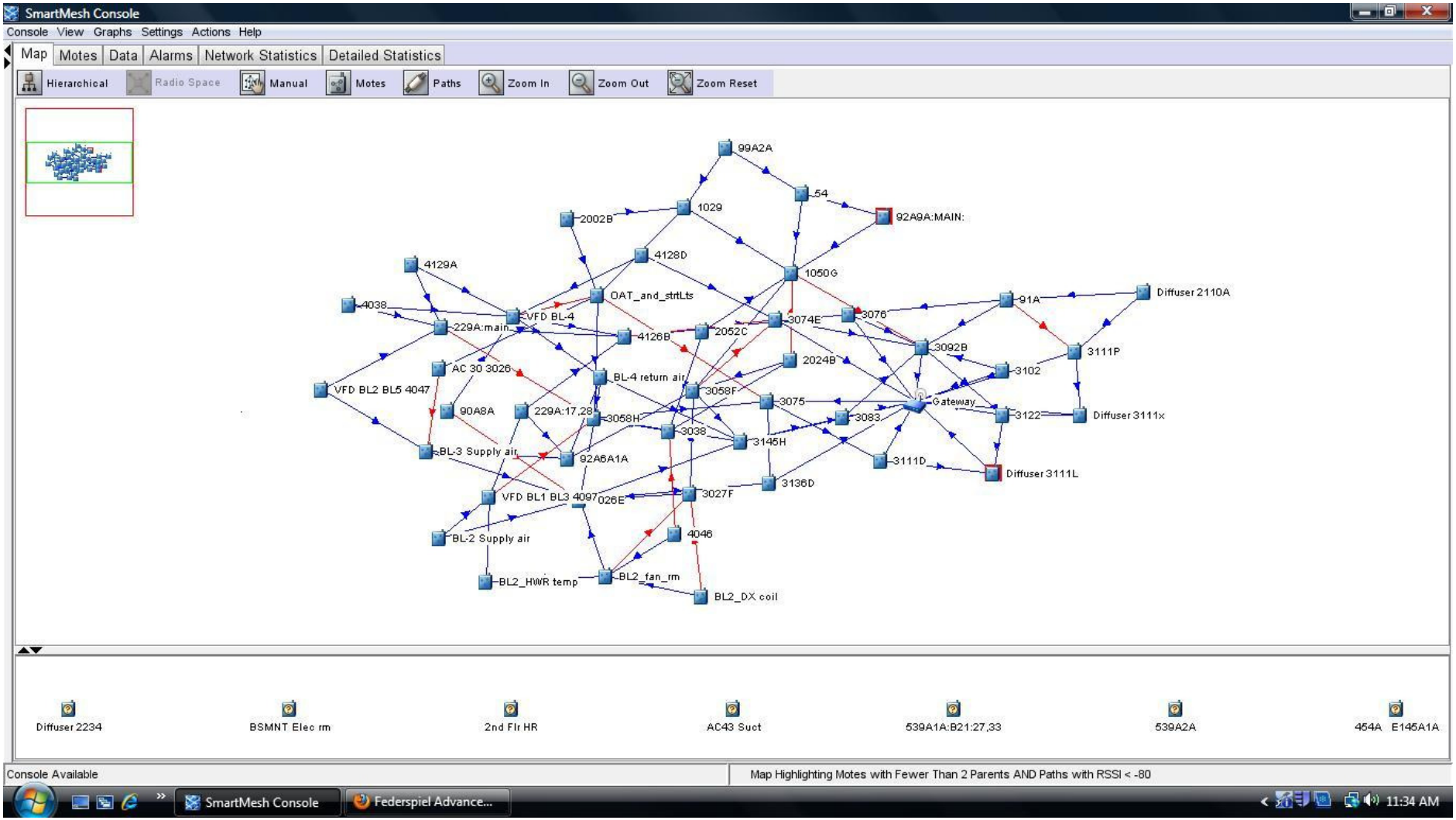
B-90 Monitoring Status: Software and Commissioning

- Validation, calibration of measured values
- Incorporate math calculations
- Configure meaningful screens
- System energy analysis

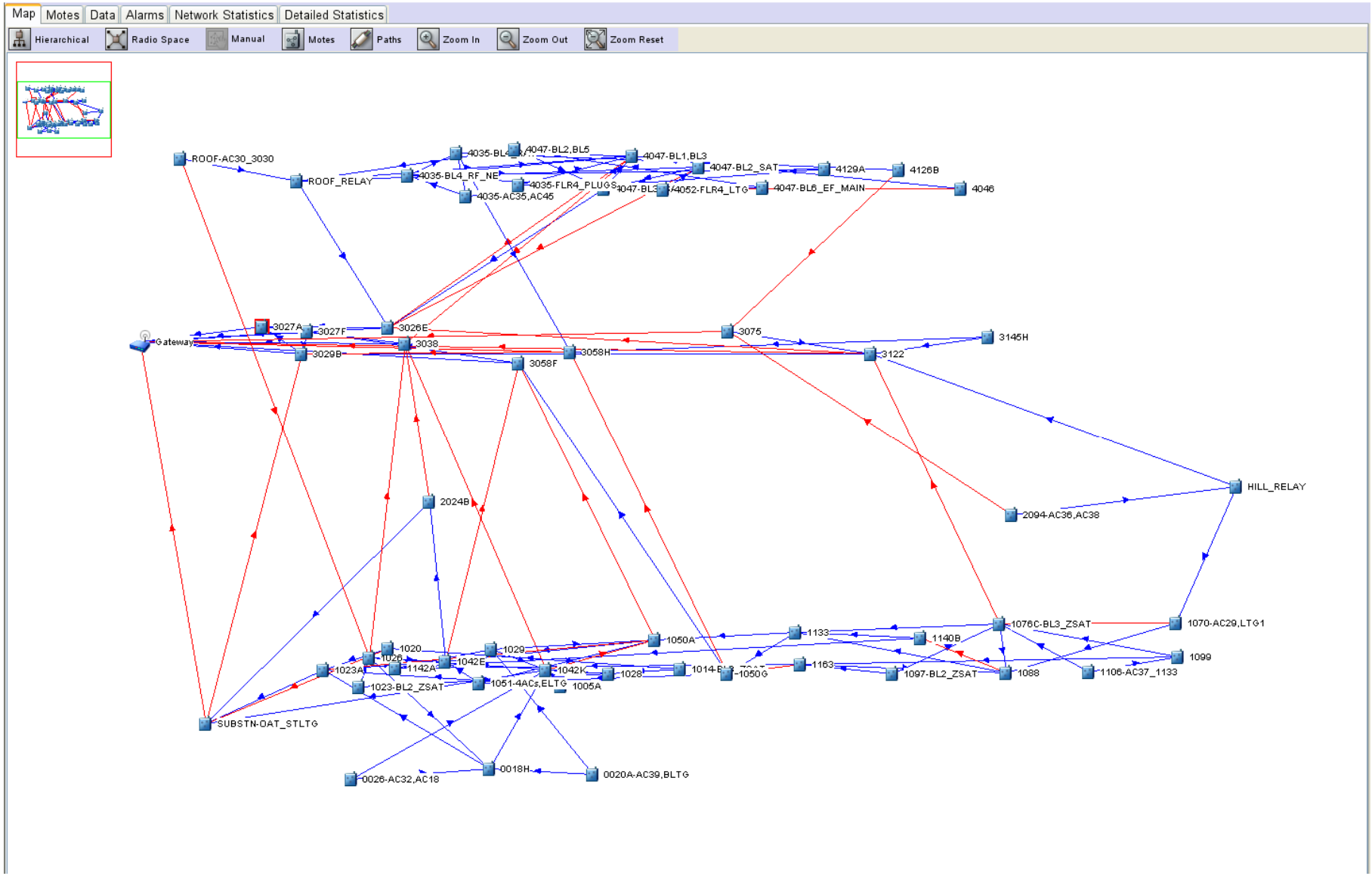
Electricity Tree and Meter Locations



Federspiel Advanced Control System (FACS)



Federspiel Advanced Control System (FACS) – Spatial View



Federspiel Advanced Control System (FACS)

Federspiel Advanced Control System - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://128.3.20.208:8080/user/index.php?menu=showunit&unit=LBNL

Most Visited | Getting Started | Latest Headlines | Federspiel Web Login

Federspiel Advanced Control System

Configuration
Floor Plan

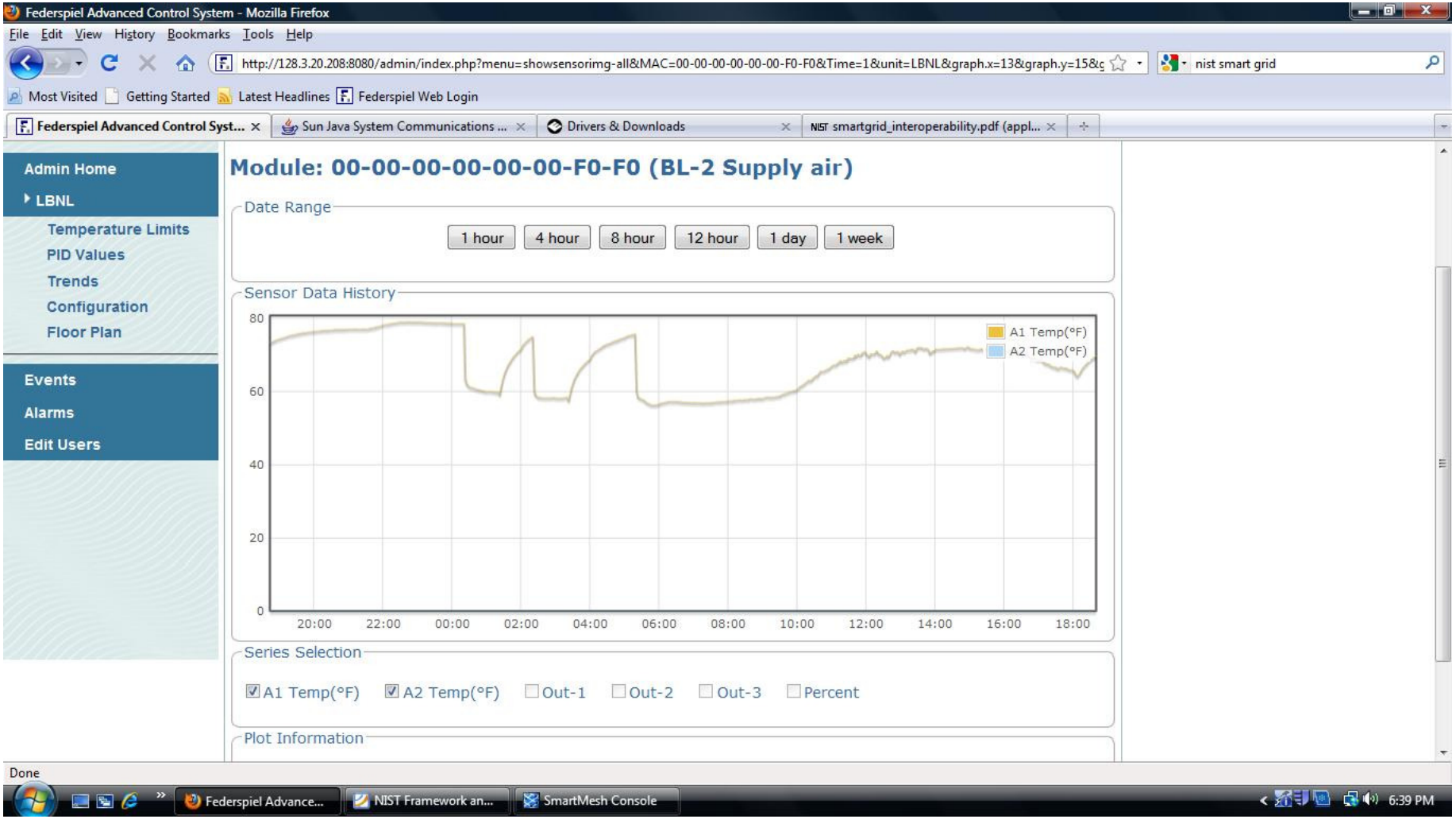
Events
Alarms

Location	AHU	State	Months	A1	A2	Limit-Low	Limit-Hi	MAC Addr
1029	*	Live		81.66	–	60.00	80.00	00-F2-3B
1050G	*	Live	14	81.14	–	60.00	80.00	00-EE-D9
1050H	*	Unreachable		---	---	60.00	80.00	00-F1-39
19	*	Unreachable		---	---	60.00	80.00	00-FA-19
20	*	Unreachable		---	---	60.00	80.00	00-F9-8B
2002B	*	Live		83.74	–	60.00	80.00	00-FA-17
2024B	*	Live		83.35	–	60.00	80.00	00-EF-AC
2024C	*	Unreachable		---	---	60.00	80.00	00-F1-6D
2052C	*	Live	33	78.07	–	60.00	80.00	00-FA-2E
21	*	Live	29	84.65	–	60.00	80.00	00-F9-80
22	*	Live	64	83.48	–	60.00	80.00	01-05-8E
24	*	Live	73	78.45	–	60.00	80.00	00-F1-24
25	*	Live	51	82.96	–	60.00	80.00	00-F9-5F
30	*	Live	36	86.23	–	60.00	80.00	00-EF-0F
3026E	*	Live	26	83.22	–	60.00	80.00	00-F9-F7
3027F	*	Live	177	83.48	–	60.00	80.00	00-F0-7D
3038	*	Live	74	80.76	–	60.00	80.00	00-F9-B6
3058F	*	Live	24	80.63	–	60.00	80.00	00-F1-3C
3058H	*	Live	25	80.50	–	60.00	80.00	00-F9-F2
3074E	*	Live	21	78.58	–	60.00	80.00	00-EE-FE

Done

Federspiel Advance... | Federspiel Advance... | Java Automatic Upd... | SmartMesh Console | Untitled - Paint | 4:40 PM

Federspiel Advanced Control System (FACS)



New B-90 EIS and Analytical Features

- Pulse Energy

Back-Up Slides

Data Communication and Security Requirements (Low-Priority)

- **Data Collection, Access, Cleaning, Storage, & Analysis**
  - LBNL has access to data all times and is stored as per defined metrics.
  - Data is accessible in portable formats such as .CSVs, .TAB, .XML, etc.
- **Communication Protocols**
  - Local and Wide Area Network (LAN – WAN) communication shall use non-proprietary communication technology (e.g., Internet Protocol)
  - Communication infrastructure accessible to third-party integrators.
- **Network and Data Security**
  - Maintain privacy, data integrity, and secure access (e.g., 128-bit).
  - Use of Secure hypertext transfer protocol (HTTPS) for the Internet.
  - Meet LBNL network security requirements and policies