



National Renewable Energy Laboratory
Innovation for Our Energy Future

Automated Home Energy Management System Expert Meeting
October 1-2, 2009

AGENDA – Day 1

8:30 – 8:45	Welcome and Debriefing of Building America and Home Energy Management Research- Lew Pratsch, DOE
8:45 – 9:15	Utilities Trends– Smart Grid Projects and Integration With Home Controls - Mike Keese, SMUD
9:15 – 9:45	Thoughts on Controls System Performance Requirements – Rich Brown, LBL
9:45 – 10:15	Efficiency Trends in Consumer Electronics – Kurtis McKenney, TIAX
10:15 - 10:30	Session Break
10:30 – 11:00	Cloud Computing (Web Data Computing, Data Storage) Trends – Troy Batterberry, Microsoft
11:00- 11:30	Cloud Computing (Web Data Computing, Data Storage) Trends – Tom Sly via Net Conference
11:30 – 12:00	Smart Appliance Trends / Home Area Network Trends – David Najewicz, GE
12:00 – 1:00	Lunch Break
1:00 – 1:30	Utilities Trends– Smart Grid Projects and Integration With Home Controls – Kathleen Hoxworth, Jennifer Wozniak, XCEL
1:30 – 2:00	Home Automation Product Development Trends- Jay McLellan, HAI
2:00 - 2:30	Facilitated Discussion – “Why DOE?” Ren Anderson, NREL
2:30 – 2:45	Session Break
2:45 -3:15	“Automated Monitoring, Control, Diagnostics, Optimization and Soft-Repair For Smart Homes” – Haorong Li, University of Nebraska
3:15 – 3:45	Lighting Controls Trends – Dianne Pisarek, Verve
3:45 – 4:15	Home Automation Product Development Trends – Harold Sullivan, Control 4
4:15 – 4:30	Session Break
4:30 – 5:30	<u>Facilitated discussion:</u> Building America program plans, and whole house controls research program for new and existing homes; standardized approaches for implementing automated home energy management. Xia Fang, Ren Anderson, DOE/NREL



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MEETING MINUTES

The expert meeting/workshop was organized in a presentation with facilitated discussion style. The objective of the meeting was to officially launch the NREL research in the automated home energy management research, review the Building America program research plan, and review the latest market trends in the automated home energy management research area.

Following is a listing of discussion and presentations from the meeting.

Introduction and Welcome – Ren Anderson, NREL

- Stated three main challenges to focus on:
 - Standardize approaches for success
 - Establish guidelines for efficient systems
 - Develop default mode that at least doubles savings on annual basis

Overview of Building America Research on Home Energy Management - Lew Pratsch, DOE

- Addressed the need to look at home automation in the context of both new and existing homes.
- HEM also has potential for shaving peak loads and improving air quality.
- Utility companies may be the key for financing retrofits with home automation because demand-reduction can increase profitability.

Smart Grid Activities of the Sacramento Municipal Utilities District (SMUD) - Mike Keesee, SMUD

- Presented demand response and the fact that customers do not want to be told how to behave; therefore anything we ask must be a business proposition.
- We are at the beginning stages of figuring out what the potential return on investment in HEM is.
- Current strategy is to try everything and experiment. Examples include pre-cooling schedule at Home of the Future, the Greenbuilt retrofit with Control4, and Mascot house with Greenbox & web-based interface.

Controls System Performance Requirements – Rich Brown, LBL

- "Other" energy uses (including lighting, appliances) dominate, and occupant behavior matters (both in purchase decisions and behaviors). Problems include large number of small loads, diverse usage patterns, legacy devices, hard to retrofit, people don't want to spend time managing their home's energy, off-state load (control problem).
- Distributed control paradigm, good user interface, device interoperability (via standards) necessary.
- Control systems should not use too much energy (e.g. Verve has energy-harvesting).
- Long-term focus should be data-networks rather than controls, interface with smart grid.
- An aggressive goal would be universal interoperability by 2015 (for individual building).

Efficiency Trends in Consumer Electronics – Kurtis McKenney, TIAX

- Consumer electronics are 50% of MELs.
- 70% of CE energy is consumed in active mode, 23% in off mode. "Other" loads are fractionally huge in low-energy homes. Installed base and usage are up. Occupancy sensors to turn home entertainment systems off/idle/active?



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- AC to DC conversion is wasteful; if your house generates DC, use it in DC.

Cloud Computing (Web Data Computing, Data Storage) Trends – Troy Batterberry, Microsoft

- Introduced beta version of Microsoft Hohm. Anyone can log in (maybe opt in to download utility data for yourself). Level of detail depends on capabilities of utility meters. Models currently take ~10s to run, but will be down to ~1s.
- Goal is demand elasticity, since zero-carbon energy sources are variable in output.
- The beta audience is single-family households, 40-something females, 'light-greens.'
- Goal is demand elasticity, since zero-carbon energy sources are variable in output.

Cloud Computing (Web Data Computing, Data Storage) Trends – Tom Sly via Net Conference

- Introduced Google Power Meter, a google.org project. Want to take advantage of the fact that people reduce their energy use by 5-15% just by having real-time feedback.
- No other industry (other than energy) has the kind of price opacity.
- Device partnership (for people who will not receive smartmeters in the next 5 years) vs. utility partnership (currently 9 signed). Power Meter will show 15-minute interval whole-home data in google gadget.
- There's also a budget-tracker. Co-branding. Third-party applications can run on top of Power Meter.

Smart Appliance Trends/Home Area Network Trends – David Najewicz, GE

- Introduced demand-response enabled appliances / HEM systems with direct tie to smartmeter via zigbee.
- Bottoms-up approach: getting appliances to talk to meter, then add a monitoring interface.
- Reiterated the importance of establishing standards and protocols.

SmartGridCity™ Integration with Home Controls – Kathleen Hoxworth, Jennifer Wozniak, XCEL Energy

Xcel Energy is actively working on modernizing their grid because outages cost \$1 billion a year, the current utility workforce will retire en masse soon.

- Need to incorporate new technology into existing infrastructure. For example, Smartgrid in Boulder: IT infrastructure, communication network, current and voltage sensors, 2-way meters, customer web portal, in-home devices.
- There will be more meter installments from now until end of year (currently 16k, will be 24k). Data collected in 15-minute intervals.
- Doing in-home tests with 24 homes with Control4.
- BPL has high bandwidth, better for latency issue.
- Demonstrated Xcel's pilot project web portal.

Automated Home/Energy Management- Jay McLellan, HAI

- HAI is focusing on remotely controllable home automation, with activity detection if you can't get people to push a button.
- The need of efficiency without reducing comfort.



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- Climate Energy "freewatt" has results from early study with programmable thermostats.
- Pilot research partnering with CARB/SWA on fault diagnostic detection on air conditioning unit refrigeration circuits.

Facilitated Discussion – “Why DOE?” Ren Anderson, NREL

- Why should DOE be involved in the HEM research?
 - Energy saving
 - what's next - risk assessment
 - presence sensor technology
 - create national market via national policy
 - accelerate customer participation
 - more renewables possible if appliances are smart
 - forum for sharing
 - good statistical data
 - CAFE standard for houses & devices

Automated Monitoring, Control, Diagnostics, Optimization and Soft-Repair for Smart Homes – Haorong Li, University of Nebraska

- For many appliances, 90% of effort is in design phase, though 75% energy use is in occupancy phase. But design effort has impact on 90% of systems: e.g. RTU - most have not been charged properly, most are not maintained properly. Also many units are oversized (that's a purchase decision). Automated fault-detecton and diagnostics (FDD) would be a better way to go. Problem is lack of real-time interaction between occupants and energy systems.
- Need low-cost, non-invasive plug & play to enable automated calibration in a non-traditional manner.

Lighting Controls Trends – Dianne Pisarek, Verve Living Systems

- Verve residential lighting control system has EnOcean protocol (RF), each component has energy-harvesting.
- Features wireless switches without batteries, sensors.
- Dimmability and the ability to control groups of lights together are important.
- Cost is approximately \$2500-\$3000 into a ~2500 sq ft house but you save \$500-\$1000 in wiring. Standby power on single controller is of order 2W.

Home Automation Product Development Trends – Harold Sullivan, Control 4

- Control4 system can be easily installed in both new and existing homes.
- System works on the Home Area Network (inside the home, links devices together, may or may not be connected to utility).
- Interested in comprehensive home automation, not just energy saving.

Wrap-up: NREL Home Energy Management Research Facilitated Discussion – Xia Fang, Ren Anderson, NREL

- Explanation of difference between source energy and energy at home
- Articulated goals and challenges for HEM systems from Building America perspective



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- Key enabling actions:
 - aggregate data to verify automated control benefits
 - AHEM working group, CEA, PV, PHEV
 - fault-free presence detection
 - non-volatile memory in CE
 - energy-labeling in CE (Federal Trade Commission)
 - EnergyStar plus = DR-enabled energy star?
 - default mode of operation (CEA)
 - BEOpt modeling help
 - DC bus capabilities
 - common terms & definitions (e.g. how to express percent of dimming)
- Needs:
 - Device "ESP"
 - cost / flexibility (custom programs are more expensive)
 - minimum requirements & full flexibility
 - baseline for house before change
 - "Best in Class" recommendations (FTE)

ATTENDEE LIST

<u>Name</u>	<u>Organization</u>
Aaron Grin	BSC
Kurtis McKenney	TIAX
Amber Wood	NAHB Research Center
Matt Wiggins	TIAX
Haorong Li	University of Nebraska-Lincoln
Vicky Pang	Consol/BIRA
Andrew Au	Consol/BIRA
Jen Wozniak	Xcel Energy
Kathleen Hoxworth	Xcel Energy
David Hoak	Florida Solar
Harold Sullivan	Control4
Tom McGuinn	Verve
Jeff Iott	Masco Corp
Dianne Pisarek	Verve
Steve Vang	Consol/BIRA
Subrato Chandra	FSEC
Keith Temple	FDSI



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Jay McLellan	HAI
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Tom Sly	Google
Troy Batterberry	Microsoft
Lew Pratsch	DOE
David Springer	CARB/DEG
Srikanth Puttagunta	CARB/SWA
Dianne Griffith	CARB/SWA
Amanda Magee	CARB/SWA
Ren Anderson	NREL
Lieko Earle	NREL
Lee Magnusson	NREL
Cheryn Engebrecht	NREL
Stacey Rothgeb	NREL
Xia Fang	NREL