

VII. STANDING COMMITTEES

A. Academic and Student Affairs Committee

Faculty Presentation, “Sustainability Sensing”

Faculty presentation for information only.

**Shwetak N. Patel**

Computer Science & Engineering
Office: Paul Allen Center, 540

shwetak@cs.washington.edu

Shwetak N. Patel is a second year Assistant Professor in the departments of Computer Science and Engineering and Electrical Engineering at the University of Washington. His research interests are in the areas of Human-Computer Interaction, Ubiquitous Computing, and User Interface Software and Technology. He is particularly interested in developing easy-to-deploy sensing technologies and approaches for location and activity recognition applications. His work is currently being applied to addressing the nation's goal of reducing residential energy consumption. Dr. Patel was also the co-founder of Usenso, Inc., a demand side energy monitoring solutions provider that was acquired earlier this year. He received his Ph.D. in Computer Science from the Georgia Institute of Technology in 2008 and B.S. in Computer Science in 2003. Dr. Patel recently received the TR-35 award in 2009, which is awarded to 35 of the top young innovators worldwide.

His work has also been featured in a number of media outlets, including his past work being recognized by the New York Times as technology of the year.

Sustainability Sensing

Dr. Shwetak Patel

Assistant Professor

Computer Science & Engineering

Electrical Engineering

<http://www.shwetak.com>

<http://ubicomplab.cs.washington.edu>

dub
design:
use:
build:
univ. of washington

sustain

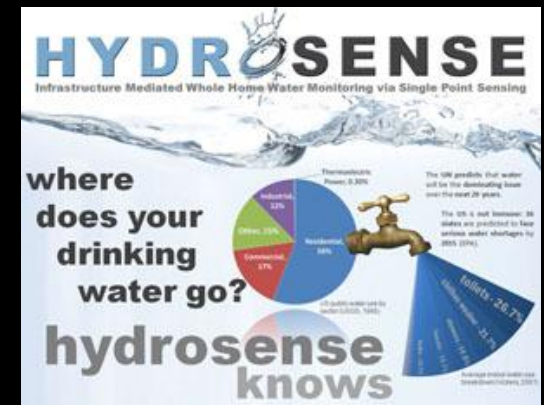
Electrical
Engineering

computer science
and engineering



Background

- Research Areas
 - Human-Computer Interaction
 - Ubiquitous Computing
 - Sensor-enabled Embedded Systems
 - User Interface Technologies
- Application areas
 - Health
 - Energy monitoring
- Strategy
 - Highly interdisciplinary
 - Students of all academic levels involved





**Making the grid in the home
smarter**

**Help consumers reduce their
residential consumption**

SAFeway

SAVE MORE AT SAFEWAY

GROCERY

SFWY PRIZLE STICK	1.50 B
ResPrice 1.79	CardSav .29
BLKBERY PRES	3.79 B
SFY CANOLA OIL	2.39 B
CEREAL PNT BUTTER	3.69 B
CHILI SAUCE SWT	3.29 B
CHF-B PIZZA	
LK GRCL SCE	

REFRIG/FROZ

LUC CHEESE	Car
ResPrice 6.79	
SPINACH ARTICHOKE	Ca
ResPrice 3.79	
3S CRWN VEG RSTD	C
ResPrice 3.79	
202.50 SFWY SEL M	
ResPrice 7.58	
MARGARINE	

GEN MERCHANDISE

#SFY BENEHIST TAB

7.99 T

BAKED GOODS

LD COSMIC BROWNIES	1.29 B
DROWEAT RYE	3.14 B
CUSTARD PIE 9IN	4.99 B
ResPrice 5.99	CardSav 1.00
CHOC CREAM PIE	4.99 B
ResPrice 5.99	CardSav 1.00

**** TAX	6.76	BAL	144.25
VF MC XXXXXXXXX			144.25

CHANGE .00

TOTAL SAVINGS 16.97

NUMBER OF ITEMS = 35

12/23/06 12:00 1877 02 0150 5145

SAFeway

SAVE MORE AT SAFEWAY

Month: April 2006

Total Food Units: 1527

Total Price:

\$527



Account number:
2-1084347-154771

JAMES LANDAY
5544 ASHWORTH AVE N
SEATTLE, WA 98103-5917

Property owner:
JAMES LANDAY
Service address:
5544 ASHWORTH AVE N

Seattle Public Utilities Bill

Questions? Call 206-684-3000 or 1-800-862-1181 (out of area calls only)
Write us? 700 5th Avenue, Suite 2777, PO Box 34027, Seattle, WA 98124-4027

C00034
LEAK
359
CD-0

Summary of charges as of August 18, 2009

Payments received after August 19, 2009 are not reflected.

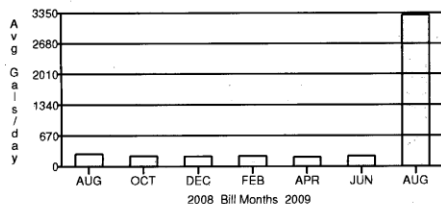
Previous balance:	317.91
Payments applied - THANK YOU!	317.91 CR
Balance:	0.00
Total adjustments:	0.00
Current billing:	2,994.83
TOTAL AMOUNT DUE ON September 08, 2009	\$2,994.83

SUMMER WATER RATES ARE IN EFFECT FROM MAY 16 THROUGH SEPTEMBER 15.
THIS BILL SHOWS HIGH CONSUMPTION. PLEASE READ ENCLOSED BROCHURE FOR INFORMATION.

Moving? Call us on the day you move if you are reading your own meter.
To have us read your meter for a fee, call us at least 3 days in advance of your move.

Remember: Account openings and account closings cannot be backdated to a day before you contact us.

Compare Your Water Usage



This Period	Same Period Last Year
No. of days: 64	No. of days: 62
Consumption in CCF: 283	Consumption in CCF: 23
Avg consumption/day: 4.42 CCF	Avg consumption/day: 0.37 CCF
Consumption in gals: 211684	Consumption in gals: 17204
Avg consumption/day: 3307.56 gals	Avg consumption/day: 277.48 gals

1 CCF = 748 gallons

Seattle Public Utilities Bill

Service address: 5544 ASHWORTH AVE N
Property owner: JAMES LANDAY
Account number: 2-1084347-154771

JAMES LANDAY
5544 ASHWORTH AVE N
SEATTLE, WA 98103-5917



DUE DATE: September 08, 2009
AUTOMATIC PAYMENT

Your account has Automatic Bank Payment. \$2,994.83 will be deducted from your bank account on the payment due date.

00000009080902001084347015477100000000000299483003

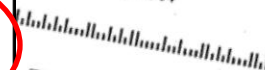
A-7/205-10
5/13/10

Florida Power & Light Company
PO Box 025576
Miami, FL 33102

Please request changes on the back.
Notes on the front will not be detected.

B 2,3,4,7,8 4118 6
NQ *** AUTO **CO 4501
38Q485818# 116049 Z

BEACH FL 33445-3504



The amount enclosed includes the following donation:
FPL Care To Share \$

Make check payable to FPL in U.S. funds
and mail along with this coupon to:

FPL
GENERAL MAIL FACILITY
MIAMI FL 33188-0001

Account number	Total amount you owe	New charges due by	Amount enclosed
	\$295.43	Jul 16 2008	\$

Statement date: Jun 25 2008				
Next meter reading: Jul 25 2008				
Account number:	Additional activity (+ or -)	Balance before new charges (=)	New charges (+)	Total amount you owe (=)
2489	0.00	0.00	295.43	\$295.43
0153				Jul 16 2008
9336				

Amount of your last bill	328.10
Payment received - Thank you	328.10 CR
Balance before new charges	\$0.00
New charges (Rate: RS-1 RESIDENTIAL SERVICE)	
Electric service amount	251.15**
Storm charge	2.59
Gross receipts tax	6.51
Franchise charge	15.75
Utility tax	1.01
Late payment charge	4.92
Total new charges	\$295.43
Total amount you owe	\$295.43

A late payment charge of 1.50% will apply if not paid by July 16, 2008, and your account may be subject to being billed an additional deposit.
Would you like one less bill to think about & help the environment? Enroll in FPL Automatic Bill Pay & your bill is always paid on time. Save time, postage, check writing & paper. Plus, cut fuel consumption of cars & trucks that transport checks. Enroll at FPL.com or see authorization form in this bill.

Please have your account number ready when contacting FPL.
Customer service: (561) 994-8227
Outside Florida: 1-800-994-8227
To report power outages: 1-800-40UTAGE (468-8246)
Hearing/speech impaired: 711 (Relay)
Online at: fpl.com

Consumption

50Wh Regenerated



Energy

Average

60.5 MPG

204 miles

6:22

H

M

OUTSIDE TEMP

Ford
Quality is Job 1.

VEHICLE DESCRIPTION

RANGER

1998 RANGER
XL 112" WHEEL
2.5L EFI I-4 EP
5-SPD MAN C

STANDARD EQUIPMENT INCLUDED AT NO EXTRA CHARGE

SAFETY/SECURITY

- DRIVER & PASS SRS AIR BAG
- REAR ANTI-LOCK BRAKES
- ADJ HEIGHT FRT SEAT BELTS
- SIDE DOOR GUARD BEAMS
- REAR HIGH MOUNT STOP LAMP
- 24 HR ROADSIDE ASSISTANCE

FUNCTIONAL

- POWER STEERING/BRAKES
- FRONT/REAR MUD FLAPS
- BATTERY SAVER
- GAS-FILLED SHOCKS
- 100K MILE TUNE-UP INTERVAL
- PREPPED FOR TOW HARNESS
- SLA SUSPENSION

EXTERIOR

- SOLAR TINT GLASS
- P205/75R14 BSW A/S TIRES
- ARGENT STYLED STEEL WHEELS
- W/BRIGHT HUB COVERS

- INTERMITTENT FRONT WIPERS
- BLACK SAIL MOUNT MIRRORS
- MED FLAT GRILLE/FRT BUMPER
- MED FLAT REAR STEP BUMPER
- EASILY REMOVABLE TAILGATE

INTERIOR

- 60/40 VIN
- 12V PWR POINT
- FLOOR CONSOLE/ETTE
- GAUGE PACKAGE
- CIGARETTE LIGHTER
- INSIDE HOOD RELEASE
- FULL DOOR TRIM PANELS
- DAY-NIGHT REAR VIEW MIRROR
- SUN VISORS

WARRANTY

- 3/36 BUMPER TO BUMPER

Compare this vehicle to others in the FREE FUEL ECONOMY GUIDE available at the dealer.

CITY MPG

22

Actual Mileage will vary with options, driving conditions, driving habits and vehicle's condition. Results reported to EPA indicate that the majority of vehicles with these estimates will achieve between 18 and 26 mpg in the city and between 22 and 32 mpg on the highway.



1998 RANGER PICKUP 4X2,
2.5 LITER ENGINE
(FEEDBACK FUEL SYSTEM),
4 CYLINDER, FUEL INJECTION
CATALYST, 5-SPEED MANUAL.

Estimated Annual Fuel Cost: \$781

HIGHWAY MPG

27

For Comparison Shopping
all vehicles classified as
STANDARD PICKUP
have been issued mileage ratings
ranging from 11 to 22 mpg city
and 15 to 27 mpg highway.

OLD TO

WESTLAND FORD
3301 WALL AVE
SGDEN

UT 84401

SHIP TO (IF OTHER THAN SOLD TO)





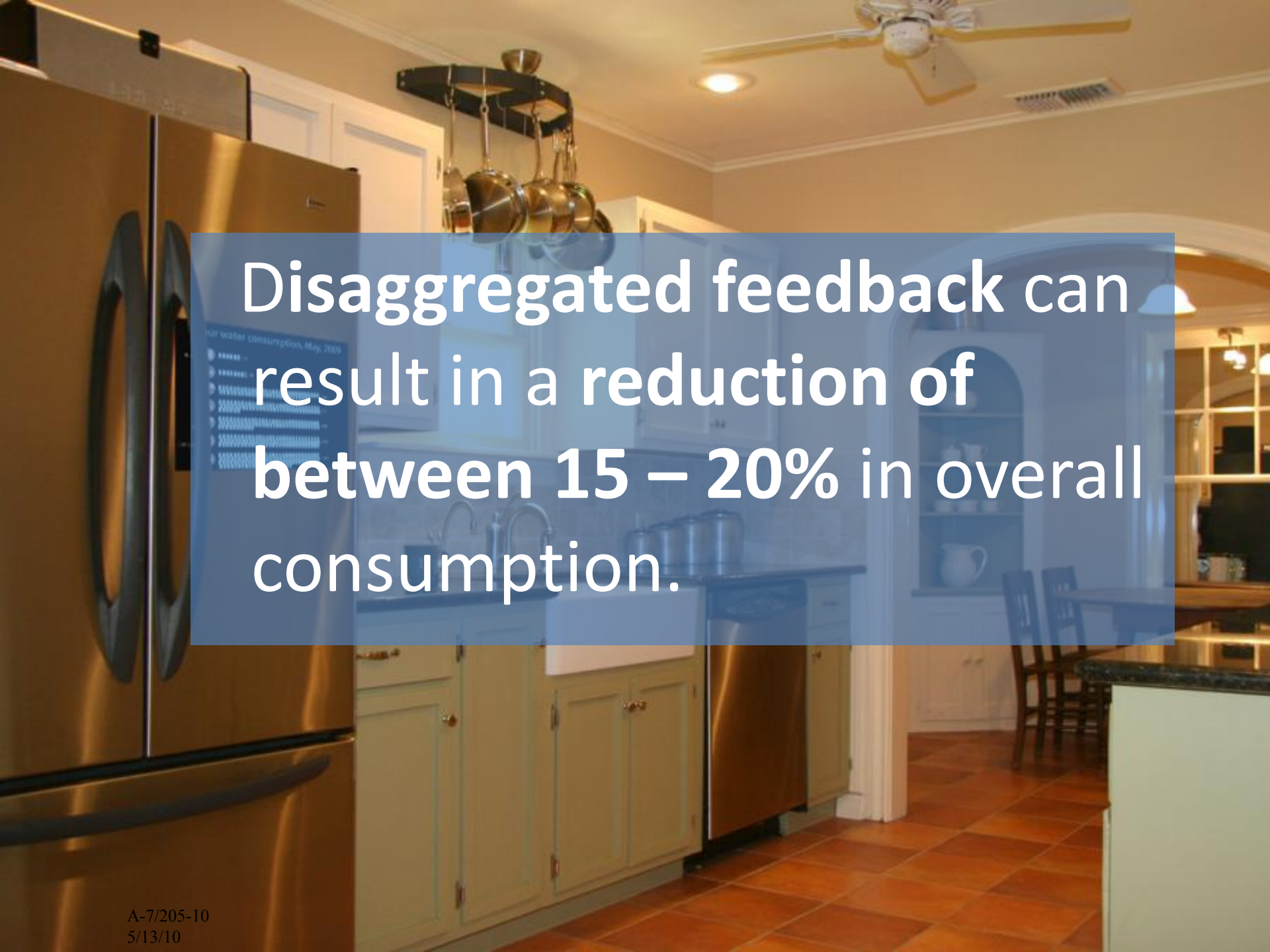
A-7205-10
5/13/10




KILOWATTHOURS

• 01200 240V 3W • TYPE J55 •

DE 4354628



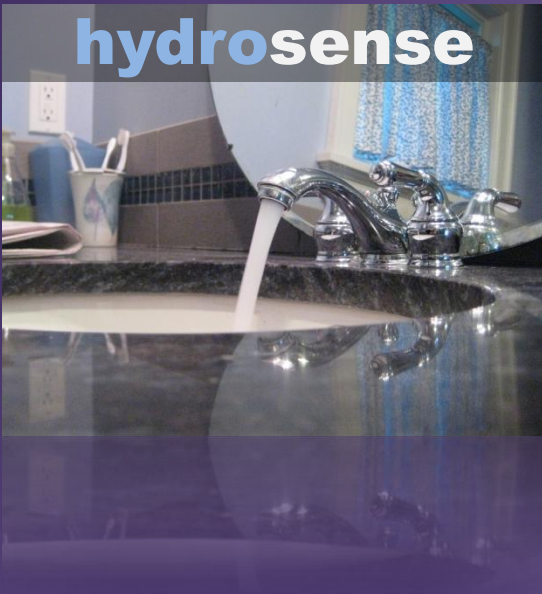
**Disaggregated feedback can
result in a reduction of
between 15 – 20% in overall
consumption.**

- 
- The background of the slide features a warm-toned photograph of a desk lamp with a black adjustable arm and a white lamp head. A bright blue, wavy, smoke-like line flows from the bottom left towards the center of the frame. A semi-transparent blue rectangle is positioned in the middle of the slide, containing two bullet points in white text.
- Create easy-to-deploy, low-cost, and highly granular sensing technology
 - Create novel, engaging, and persuasive feedback interfaces

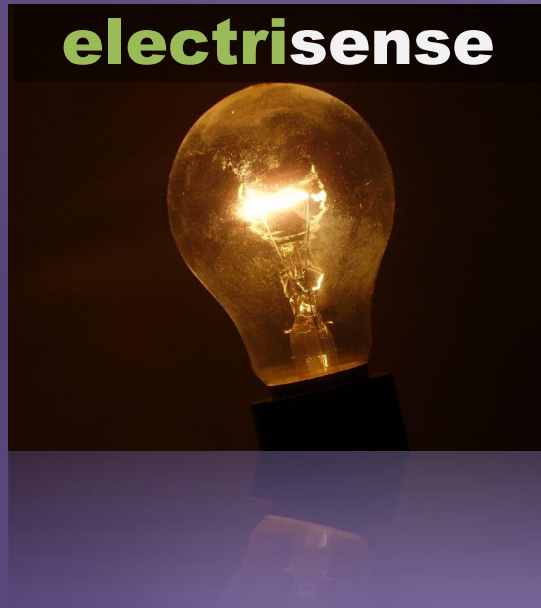


sensing feedback

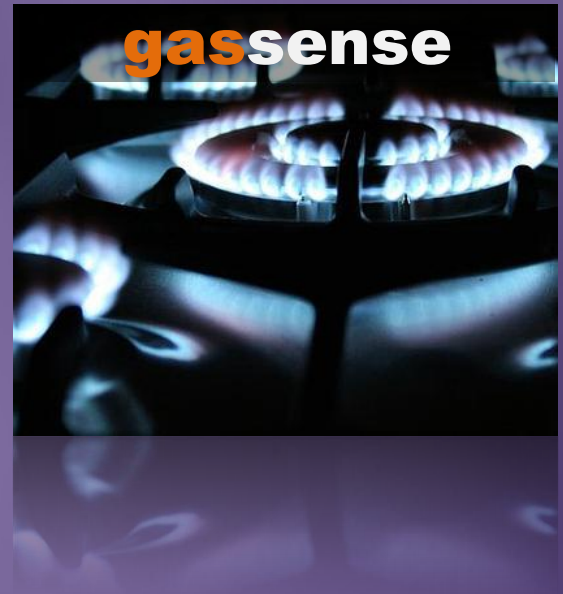
hydrosense




electrisense



gassense





coffee
bean grinder

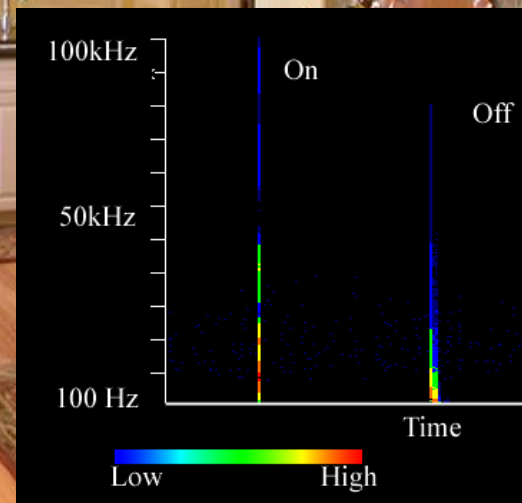
refrigerator

microwave

Distributed Direct Sensing

Infrastructure Mediated Sensing

Single plug-in device!

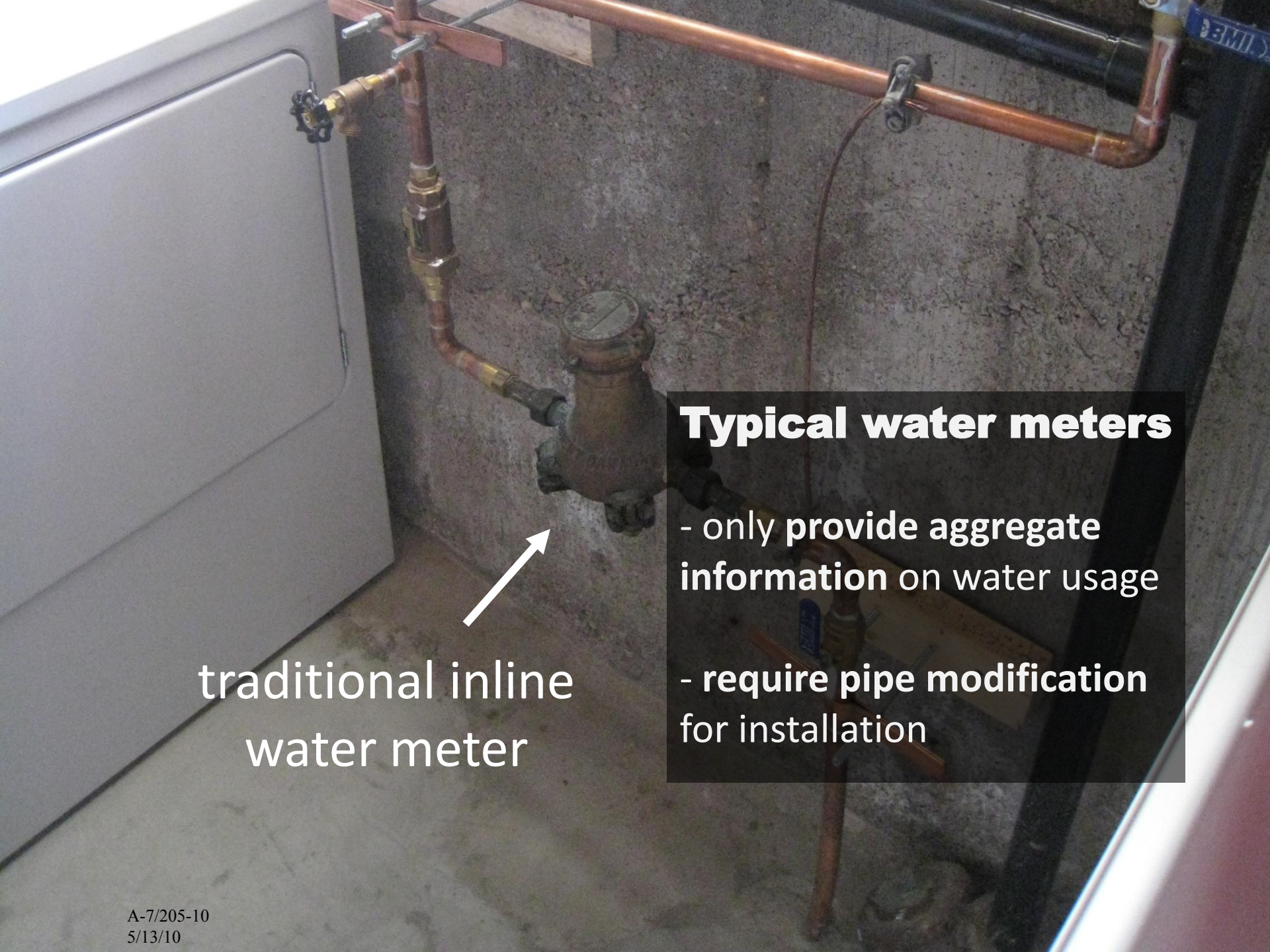


Water Sensing



- Single-point sensor of water usage
- Identifies water usage activity down to a fixture level (e.g., toilet)
- Provides estimates of flow at each fixture

hydrosense



traditional inline
water meter

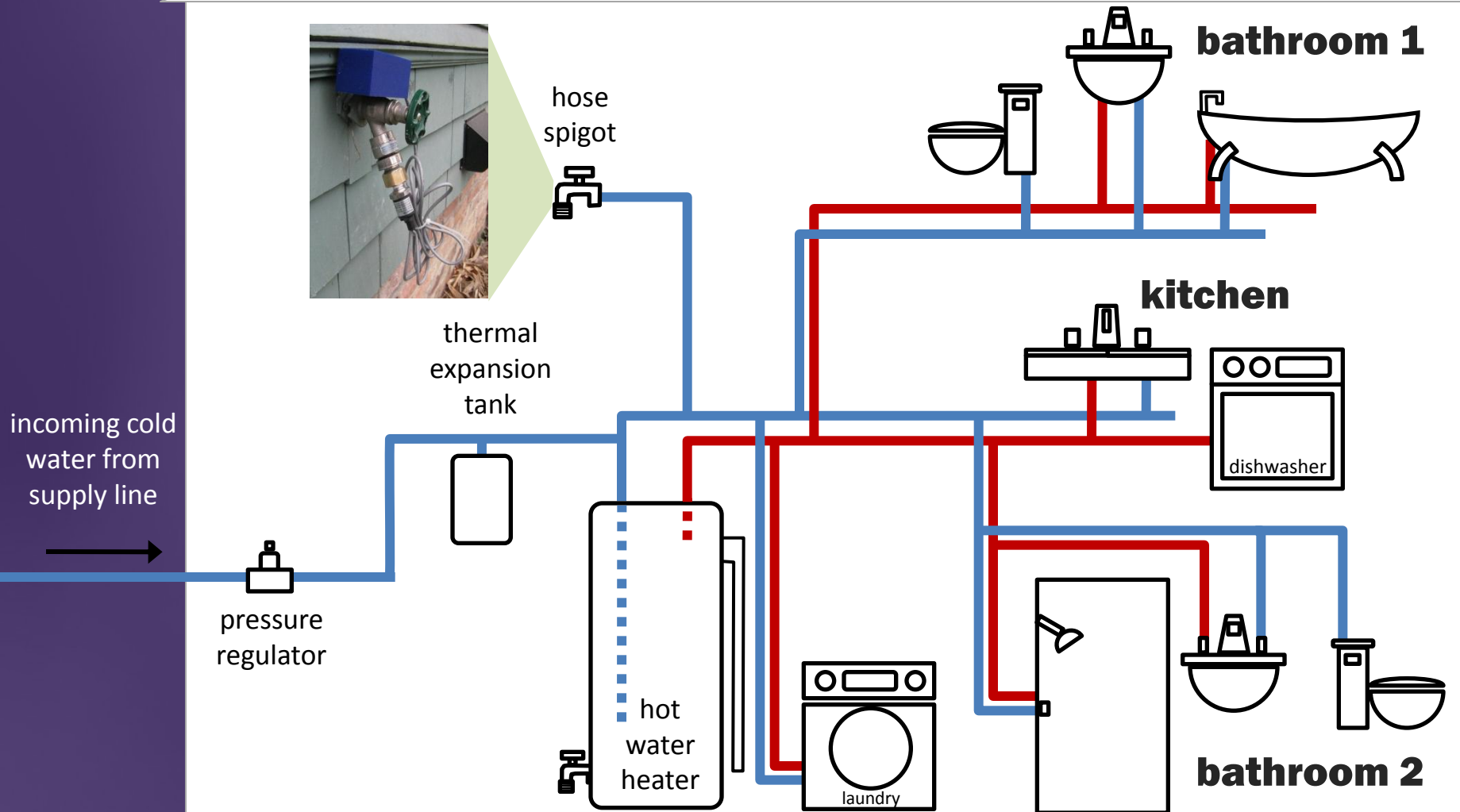
Typical water meters

- only provide aggregate information on water usage
- require pipe modification for installation

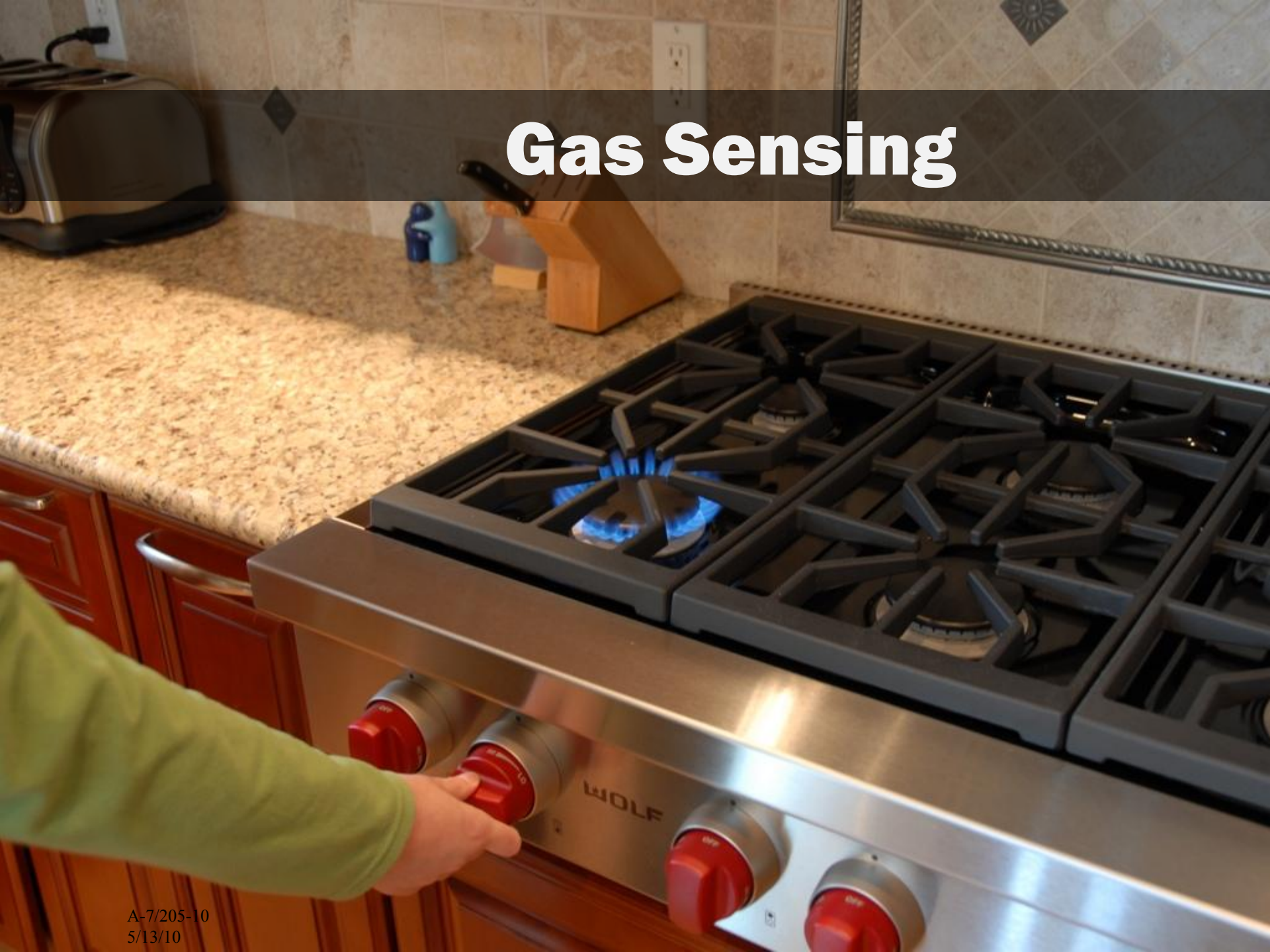


water tower

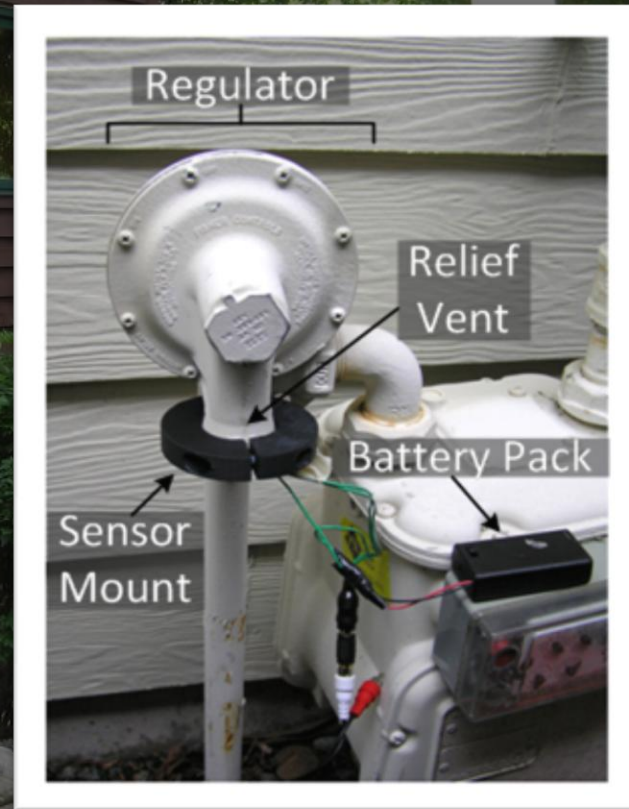
Closed Pressure System



Gas Sensing



GasSense

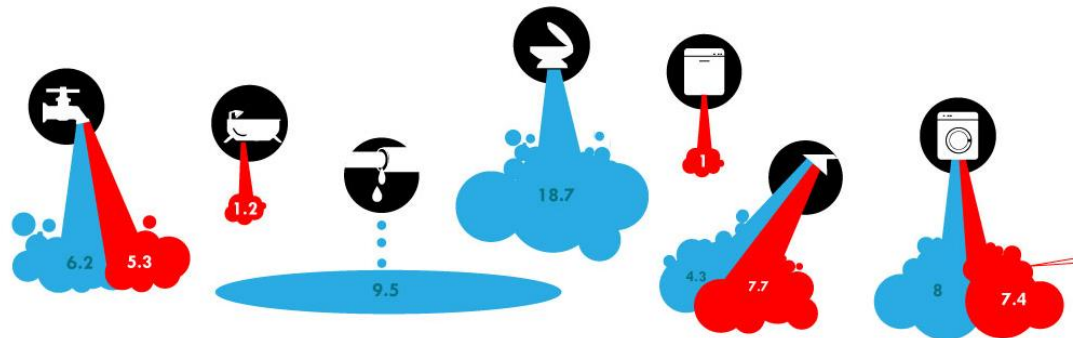
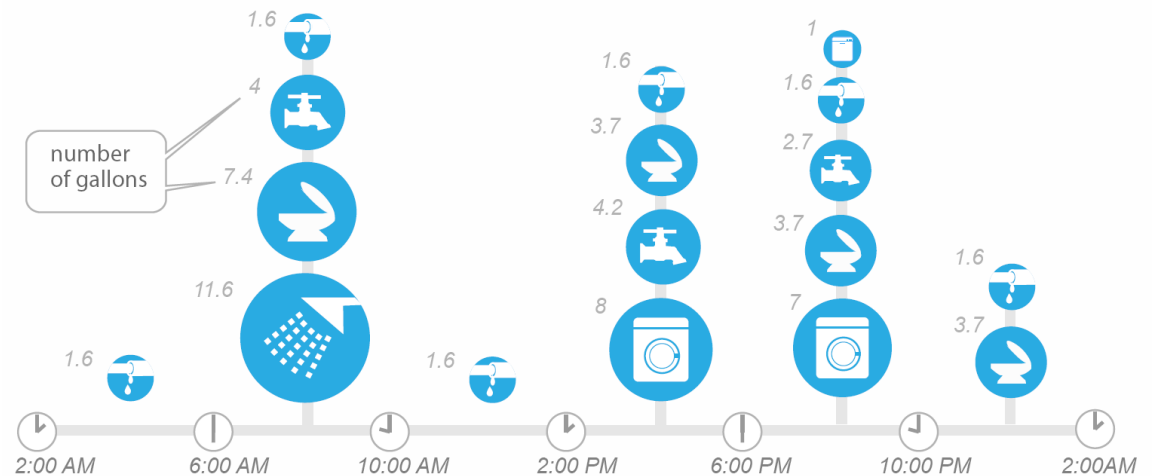


In-home Validation

- Performance benchmarks in real homes
- Non-expert deployments
 - Evaluated the installation procedure by homeowners and end-users
 - Mental models
 - Typical installation time is less than 35 minutes

Feedback Interfaces

TODAY's water usage (in gallons)



Home

Recommendations

Energy Data

my hohm center

home profile

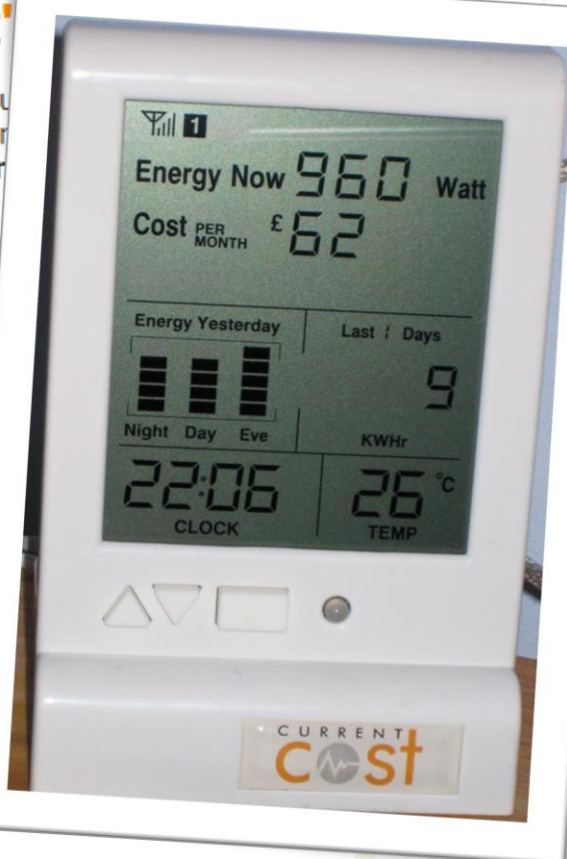
my news

My Hohm Center

How energy-efficient home? Let's

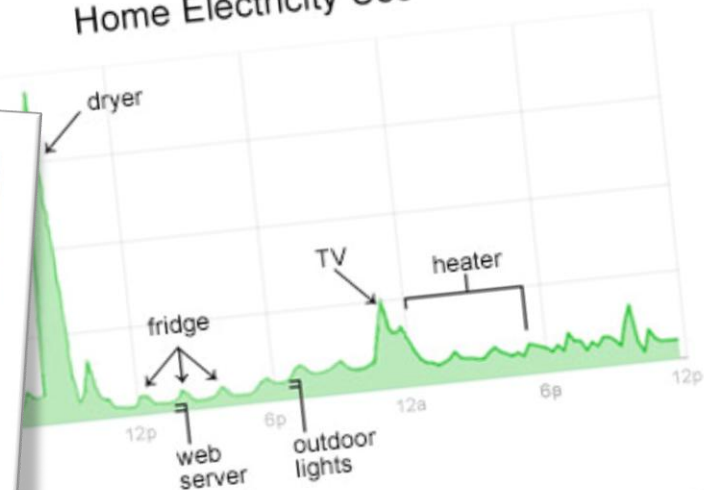
When you fill out your energy provider home energy report recommendations.

Complete Your



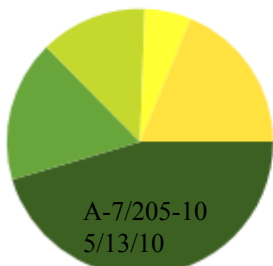
Google™ POWERMETER

Home Electricity Use



Available

Energy Cost Breakdown



Annual Energy Costs In Your Area

Average Home
\$1,891



Commercialization Success

Zensi, Shwetak Patel's Energy Monitoring Startup, Purchased by Belkin

Zensi, an energy monitoring company based on technology developed by UW CSE professor [Shwetak Patel](#) and collaborators, has been purchased by Belkin.

Zensi's technology was licensed from the University of Washington and from the Georgia Institute of Technology, Patel's Ph.D. institution. The technology includes single-point-of-attachment sensors for electrical power, water, and natural gas — a single sensor in a home or business uses signal processing and machine learning to identify sources and rates of consumption. This dramatically reduces the cost of instrumenting the home or business and providing occupants with the information they need to behave in more economical and environmentally responsible ways.



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[STARTUPS](#), [CLEANTECH](#), [DEALS](#)

UW Prof Shwetak Patel's Energy Startup, Zensi, Bought by Belkin

Gregory T. Huang 4/21/10

Zensi, an energy monitoring startup co-founded by University of Washington assistant professor Shwetak Patel, [has been acquired by Belkin](#), the computer hardware and wireless company based in the Los Angeles area. Financial terms of the cash deal weren't given. The news [was reported](#) earlier today by CNET.

Patel co-founded Zensi in 2008 while he was in graduate school at Georgia Tech in Atlanta, but he has continued to develop the technology at UW as a [faculty member](#) in computer science & engineering and electrical engineering. The company's technology includes sensors that you plug into a wall outlet to measure the amount of electricity used by each appliance or device in a home. Zensi's similar systems for water



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[Crave](#)

[Bus](#)

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Green Tech
Edited by Martin LaMonica



April 21, 2010 5:35 AM PDT

Belkin buys crafty power-tracking start-up

by Martin LaMonica



Font size



Print



E-mail



Share

109

[retweet](#)



Share

10

1



digg

Electronics and wireless equipment maker Belkin is getting deeper into energy management as it partners with a company with technology that detects how electricity is used within a home.



The company, called Zensi, was founded by academics—

Value for the Utilities

- Conservation
- New model for demand response
- Validation and verification of conservation activities
- No truck roll or costly rollouts
- No need to go into the home



Jon Froehlich



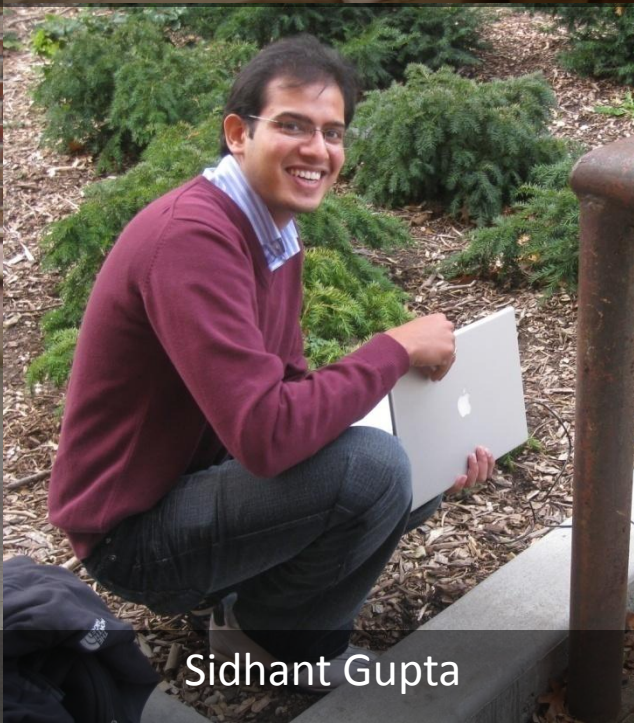
Eric Larson



Tim Campbell



Conor Haggerty
5/13/10



Sidhant Gupta



Gabe Cohn

A photograph of a kitchen interior. On the left is a large stainless steel refrigerator. To its right are white kitchen cabinets and a countertop with a sink and faucet. Several pots hang from a rack above the counter. In the background, an arched doorway leads to a dining area with a wooden table and chairs. A ceiling fan is visible at the top.

Thanks!

- Questions?

- shwetak@cs.washington.edu

- <http://www.shwetak.com>