

UNIVERSITY OF CALIFORNIA

* Presenting Omar I. Asensio ^b

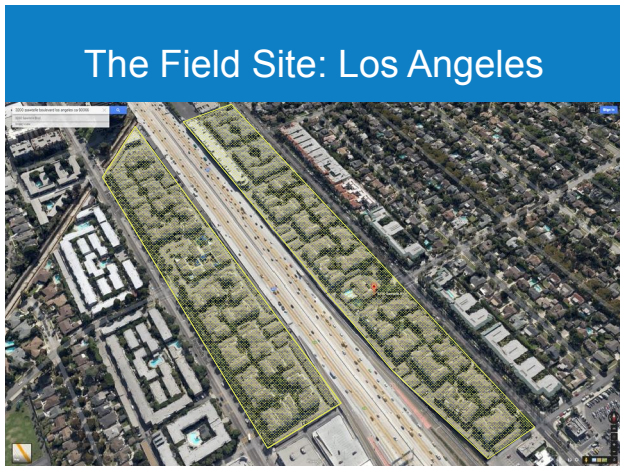
What can we learn from high-frequency appliance-level energy metering? Results from a field experiment

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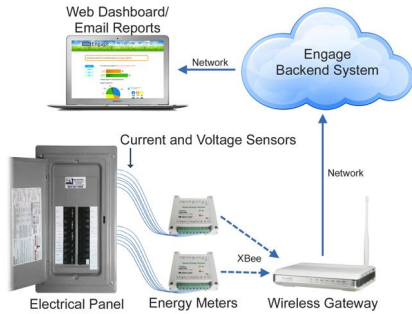
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Highlights

- We monitored appliance-level electricity usage at a CA field site for 124 similar apartments for 24 months.
- Behavior accounts for a significant source of appliance usage variation
- Households overestimate lighting and HVAC use by 75% and underestimate plug load usage by 29%.
- Plug load accounts for the largest share of electricity use at all hours of the day.
- Savings of 11% were achieved by replacing old refrigerators.

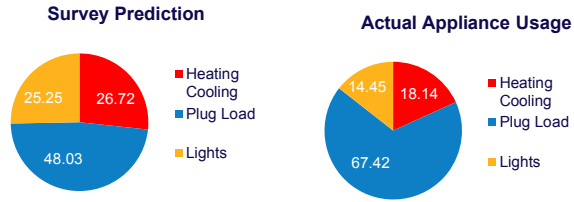


ENGAGE System Design and Dashboard



Predicted versus actual share of appliance usage

N= 132 households out of 137 households



Correct Guesses = 0 out of 137 households !
 6 out of 132 correctly guessed Heating and Cooling share
 2 out of 132 correctly guessed Plug Load
 6 out of 132 correctly guessed Lighting

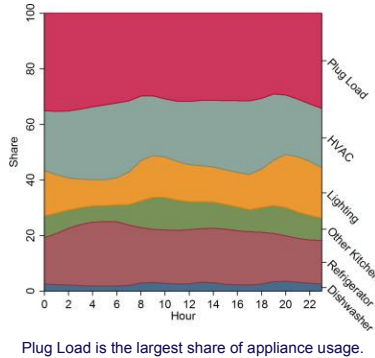
Appliance Shares of Total Electricity Usage versus National Data

Variable	ENGAGE Field Site California		Residential Energy Consumption Survey 2009 (RECS)		p-Value	
	Mean	S.D	Mean	S.D		
Heating/cooling	18.14	10.9	18.83	16.08	0.61	
Refrigerator	24.93	10.5	18.25	7.26	0	
Lighting	14.45	9.43	All others	62.91	14.92	0
Plug load	30.9	12.9				
Dishwasher	2.72	2.28				
Other kitchen	8.86	6.76				

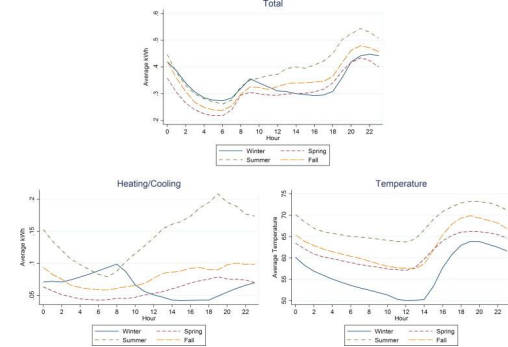
CALIFORNIA FIELD SITE

NATIONAL DATA

Appliance Shares by Time of Day

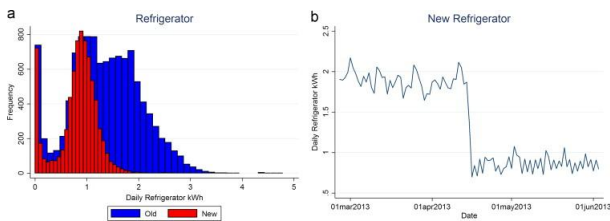


Average Hourly Electricity Use by Season



Savings from new Refrigerators

Refrigerators were replaced if more than 10 years old



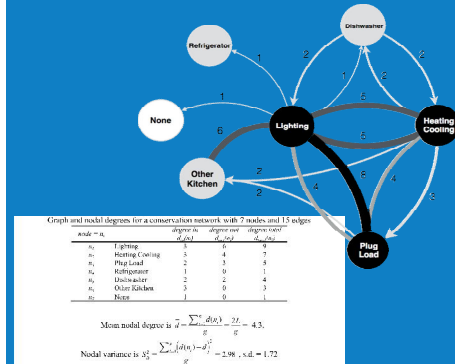
Appliance	N	Mean (kWh)	Predicted USAGE (kWh)a	Std. Dev.	Min	Max
New refrigerator	7452	0.82	1.05	0.39	0	2.72
Old refrigerator	11,155	1.35	1.91	0.69	0	4.79

Conclusions

- Household's estimations of their appliance usage are inaccurate (Consistent with Attari et.al. 2010, Armel et.al. 2013)
- Lighting and HVAC are over-estimated and Plug Load is under-estimated
- Behavior accounts for 25–58% of variation
- Replacing refrigerators with more energy efficient models led to overall energy savings of 11%

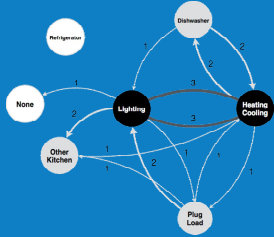
Appliance Networks

Conservation Networks and Behavioral Ties

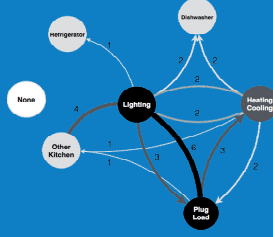


Understanding Appliance Networks

Cost Savings Frame



Health Frame



Thank you for listening !

For more information visit www.environment.ucla.edu/ccep

Backup slides

Distribution of Daily kWh usage

