



Increasing Energy Saving Behaviors *via* Social Networks

Jennifer Mankoff, Tawanna Dillahunt, H. Scott
Matthews ... and the rest of the StepGreen team



Encouraging Green Behavior

Lots of literature on the HCI/Environmental Psychology side to draw from

(Froehlich *et al.*, CHI '10; DiSalvo *et al.*, CHI '10)

Many approaches to motivation

(e.g. Abrahamse *et al.*, 2006)

- Information
- Goal-setting
- Comparison
- Commitment
- Incentive/Disincentive

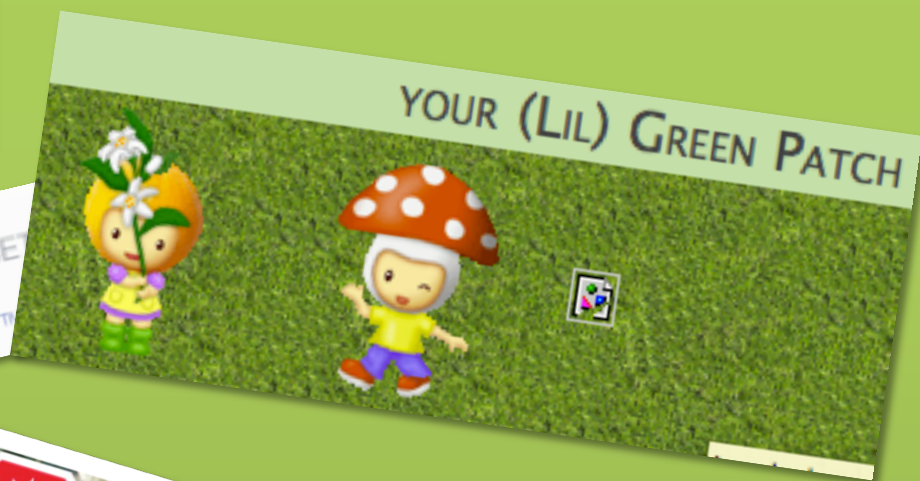
Many models of behavior (Norm-Activation, Rational Choice, Trans-Theoretic)

(He *et al.*, CHI' 10)



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Small actions. Big impact.

 GoodGuide



YAHOO! GREEN



 treehugger
A Discovery Company

 energyrace
make a difference. measure it here.
Where green minded people meet

GreenNexus

Our Research

Past work suggests approaches for creating green behavior

How to bring successfully into design of social sites?

- What types of motivation will be most effective?
- How does this change as group size, deployment length, and participation grow?
- What role does social capital play in motivation?
- Will online social networks have a structural impact on green behavior (e.g. socializing people to the issue, distributing information)

Our Research

Explored through two deployments:

- **StepGreen.org** (large scale; technology first)
- **Community Monitor** (small scale; user research first)



StepGreen.org Process

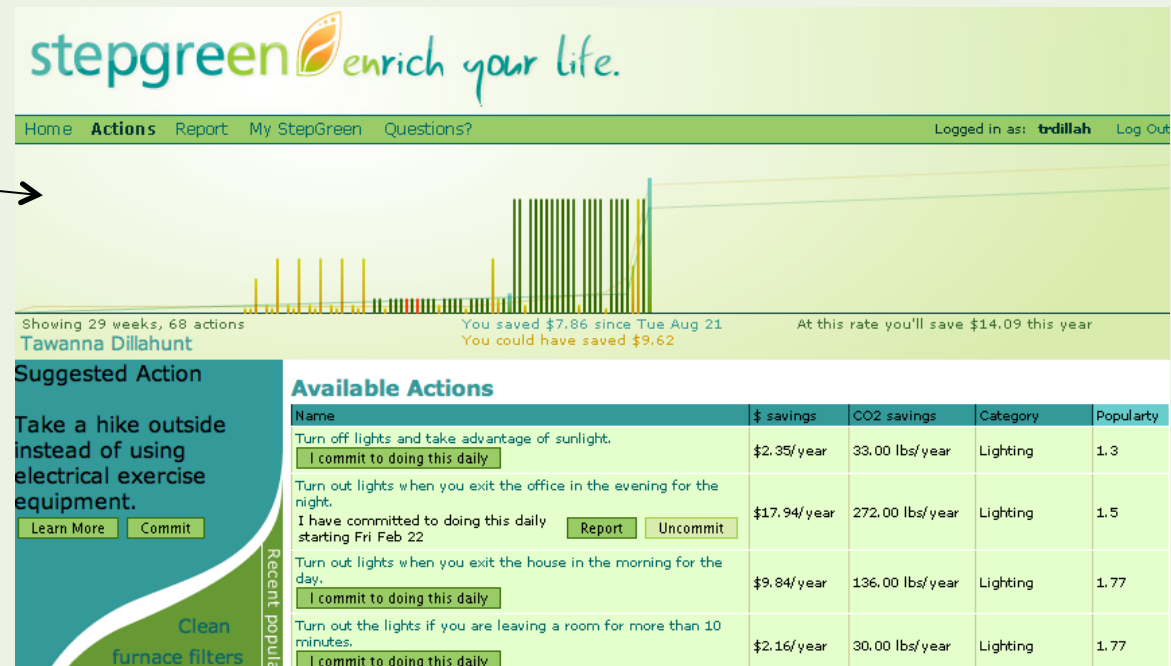
Literature studies, surveys and interviews, many discussions (multidisciplinary)

Focused on:

- Overall Site
- Actions
- Visualization
- How motivational techniques worked within StepGreen.org ...

StepGreen Server:

- User history
- External user accounts
- External API



Clients

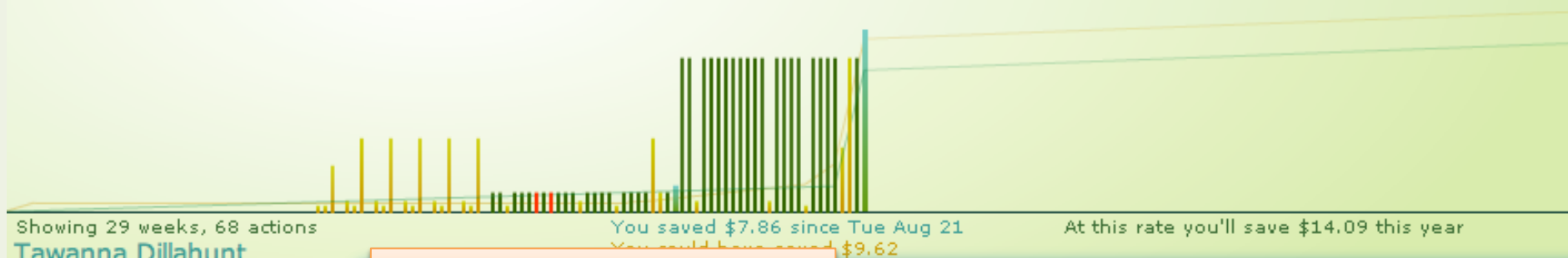
Twitter

Phone (Android)

Facebook (Game)

Planning app;

J. Mankoff, S. R. Fussell, T. Dillahunt, R. Graves, C. Grevet, M. Johnson, D. Matthews, H. S. Matthews, R. McGuire, R. Thompson, A. Shick and L. Setlock, ICWSM 2010.



Tawanna Dillahunt

Suggested Action

Take a hike outside instead of using electrical exercise equipment.

[Learn More](#)

[Commit](#)

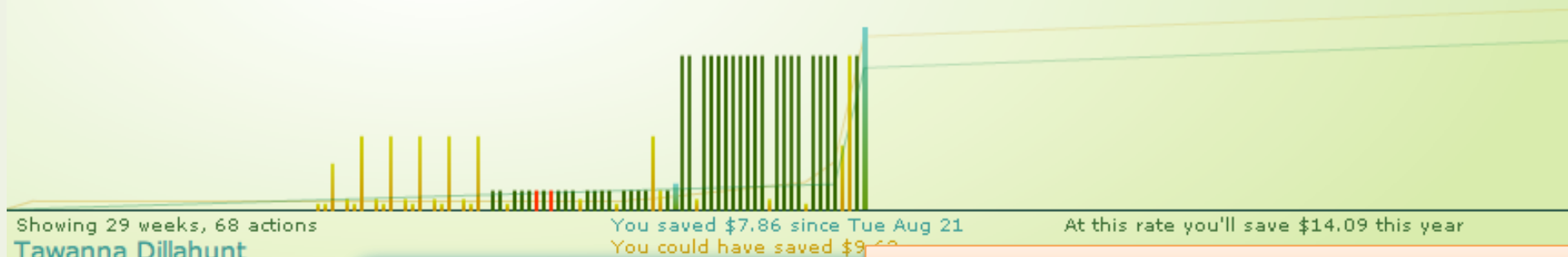
Clean
furnace filters

1. Commit to actions

Available Actions

Name	\$ savings	CO2 savings	Category	Popularity
Turn off lights and take advantage of sunlight. I commit to doing this daily	\$2.35/year	33.00 lbs/year	Lighting	1.3
Turn out lights when you exit the office in the evening for the night. I have committed to doing this daily starting Fri Feb 22 Report Uncommit	\$17.94/year	272.00 lbs/year	Lighting	1.5
Turn out lights when you exit the house in the morning for the day. I commit to doing this daily	\$9.84/year	136.00 lbs/year	Lighting	1.77
Turn out the lights if you are leaving a room for more than 10 minutes. I commit to doing this daily	\$2.16/year	30.00 lbs/year	Lighting	1.77





Tawanna Dillahunt

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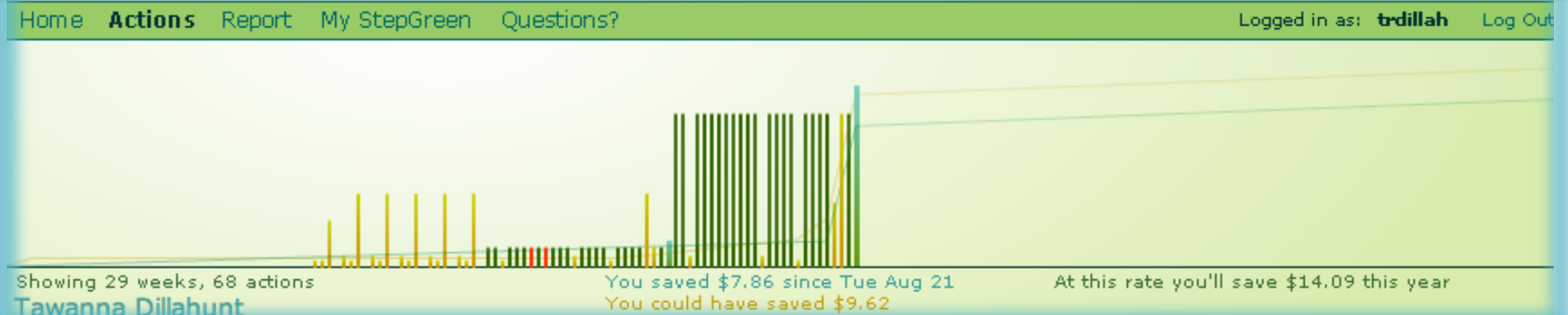
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2. Report on actions



3. Visualize savings



Suggested Action

Take a hike outside instead of using electrical exercise equipment.

[Learn More](#)

[Commit](#)

Clean
furnace filters

Recent popular

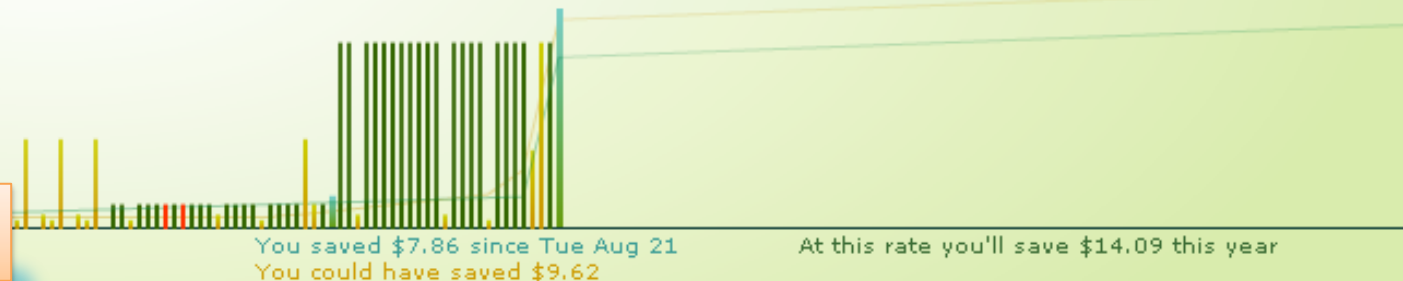
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Carnegie Mellon

4. See Suggestions



Suggested Action

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[Learn More](#)

[Commit](#)

Clean
furnace filters

Recent popular

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Actions

Drawn from many sources

Designed to appeal

Confirmed with survey (122 people)



Developing actionable suggestions

Surveyed 122 people through CraigsList

Each rated actions in terms of how likely they were to do them (1 .. 5)

Results

Action	Mean (sd)
Turn off lights when leaving the room	4.23 (1.16)
Wash full loads of dishes	4.14 (1.24)
Combine trips in personal auto	4.11 (1.14)
Adjust thermostat to below 70 in winter	3.84 (1.27)
Unplug electronics when not in use	3.78 (1.27)
Wash laundry in cold water	3.72 (1.26)
Turn down water heater temperature	3.60 (1.23)
Take shorter showers	3.52 (1.37)
Reduce amount of meat in diet	3.29 (1.45)
Air dry your clothes	3.13 (1.42)
Carpool	2.94 (1.32)
Use public transportation	2.95 (1.40)

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Initial Visualization Design

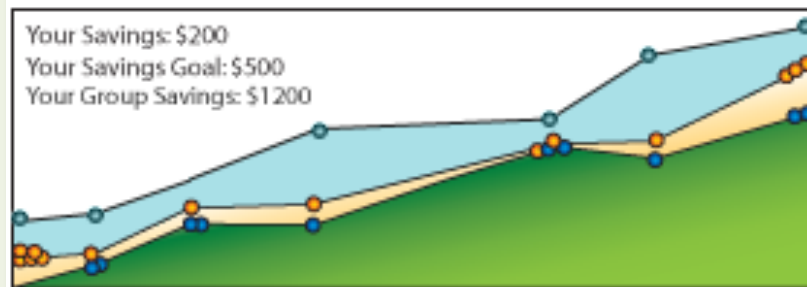
StepGreen.org Suggested Action: Shorter Showers

Number of Votes/Pledges (20 people have taken this action)
Reduce your shower from 20 minutes to 15 minutes - save \$200 annually.

Not Now

Commit

Your Savings: \$200
Your Savings Goal: \$500
Your Group Savings: \$1200

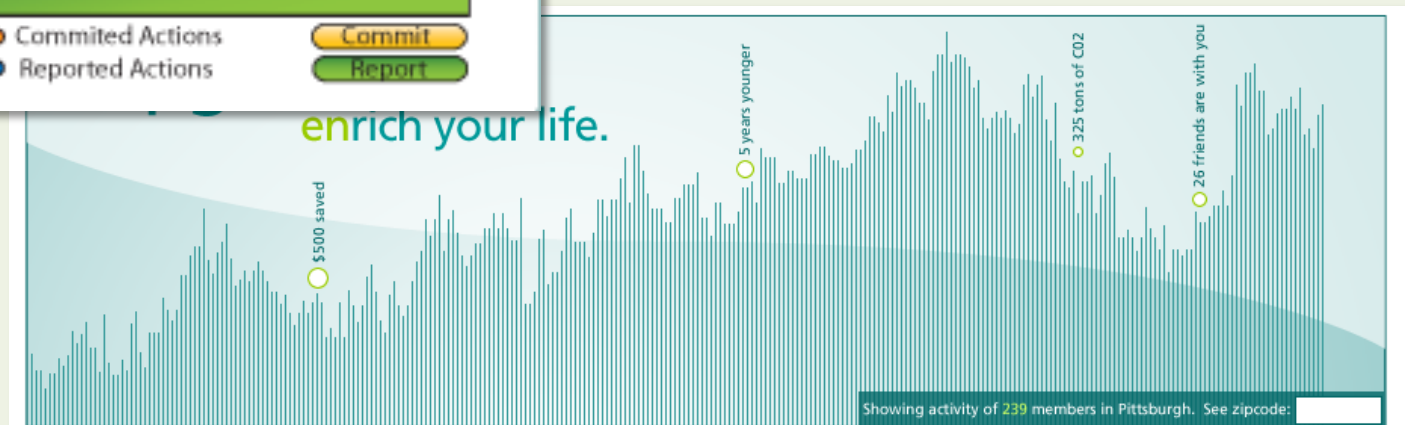
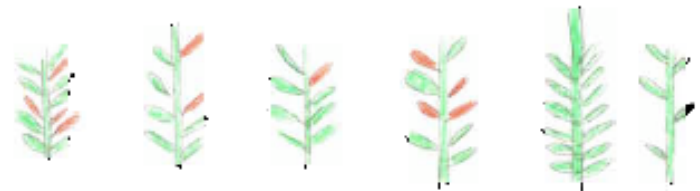


Potential Savings
Actual Savings

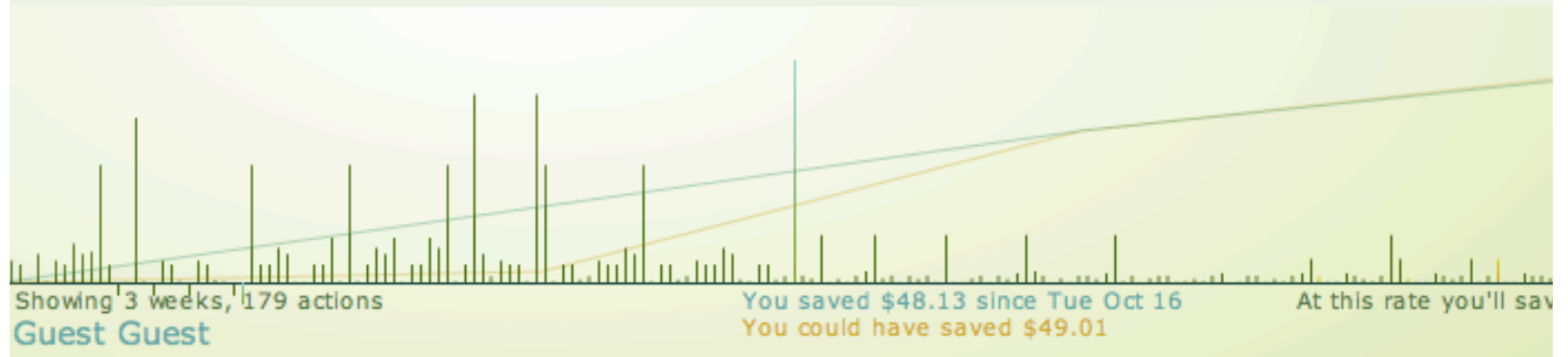
Committed Actions
Reported Actions

Commit

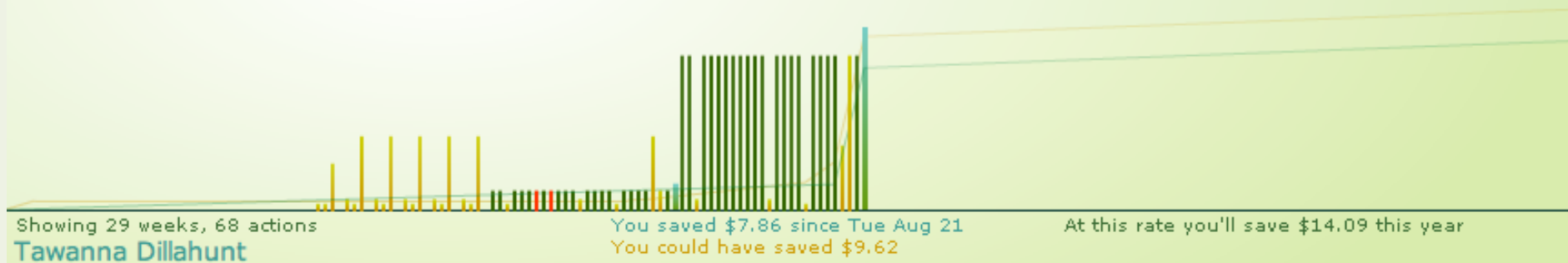
Report



Visualization



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Suggested Action

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[Learn More](#)

[Commit](#)

Clean
furnace filters

Recent popular

Available Actions

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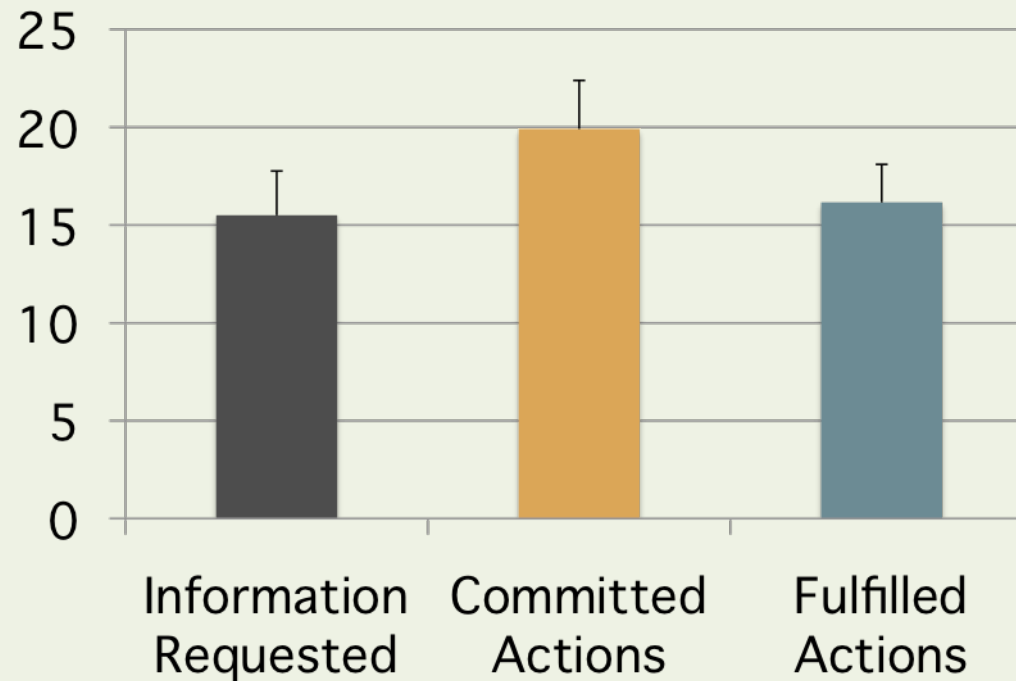
Field Deployment

Three week field study (Fall 2007)

- 32 participants with active MySpace accounts
- Pre and post surveys; Interviews: on their environmental attitudes, decision-making styles, demographics

Tracked actions on the site, friend views,
signups: saw 57 different actions over a 3 week period

Results: Actions



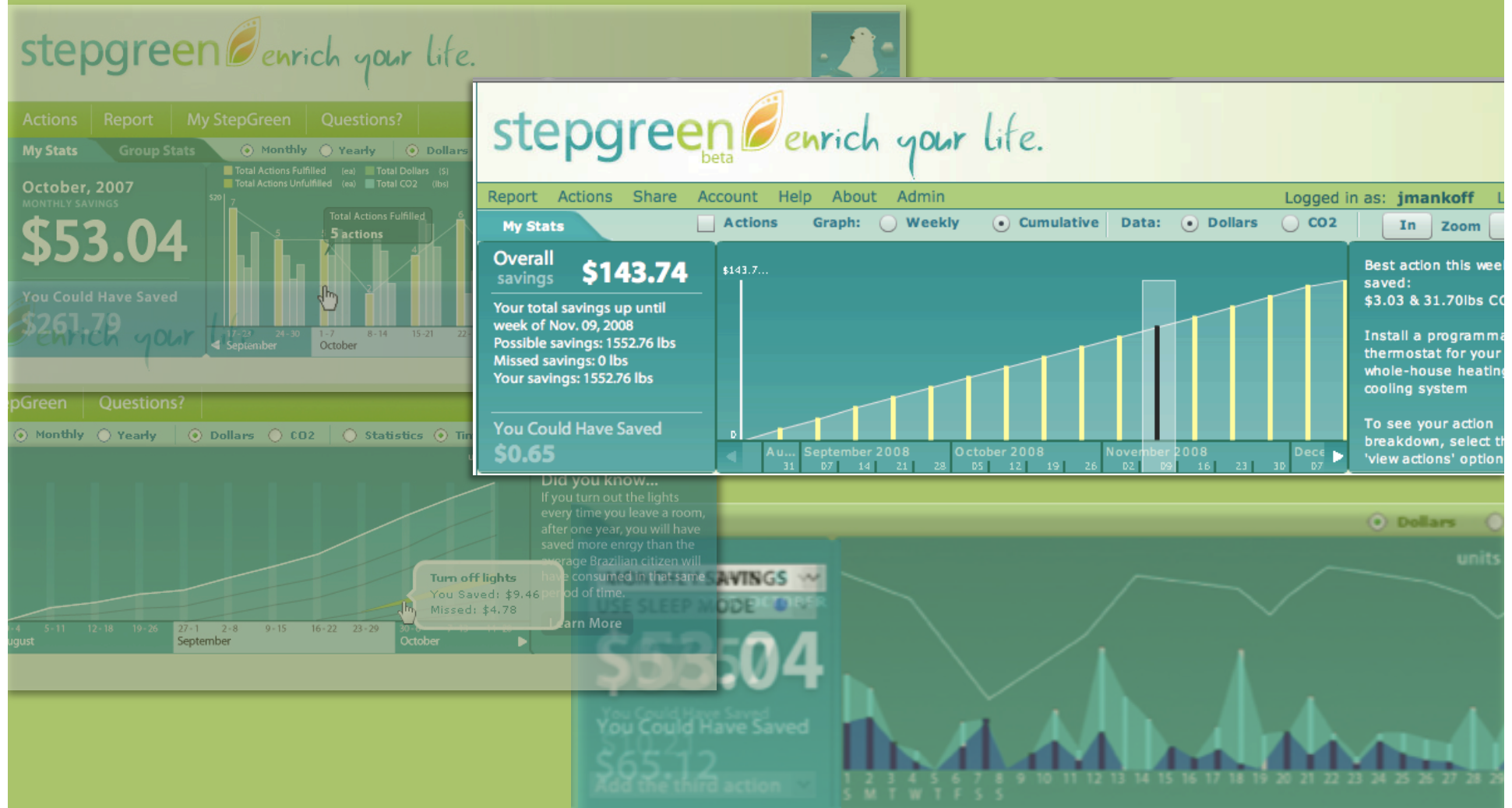
Actions that don't change

Rank	Already Do	Unappealing
1	Turn out lights when leaving home (16%)	Install motion sensors for some lights (5%)
2	Use a manual toothbrush (12%)	Turn off and unplug devices at work (5%)
3	Turn out lights when leaving a room (12%)	Volunteer time (5%)

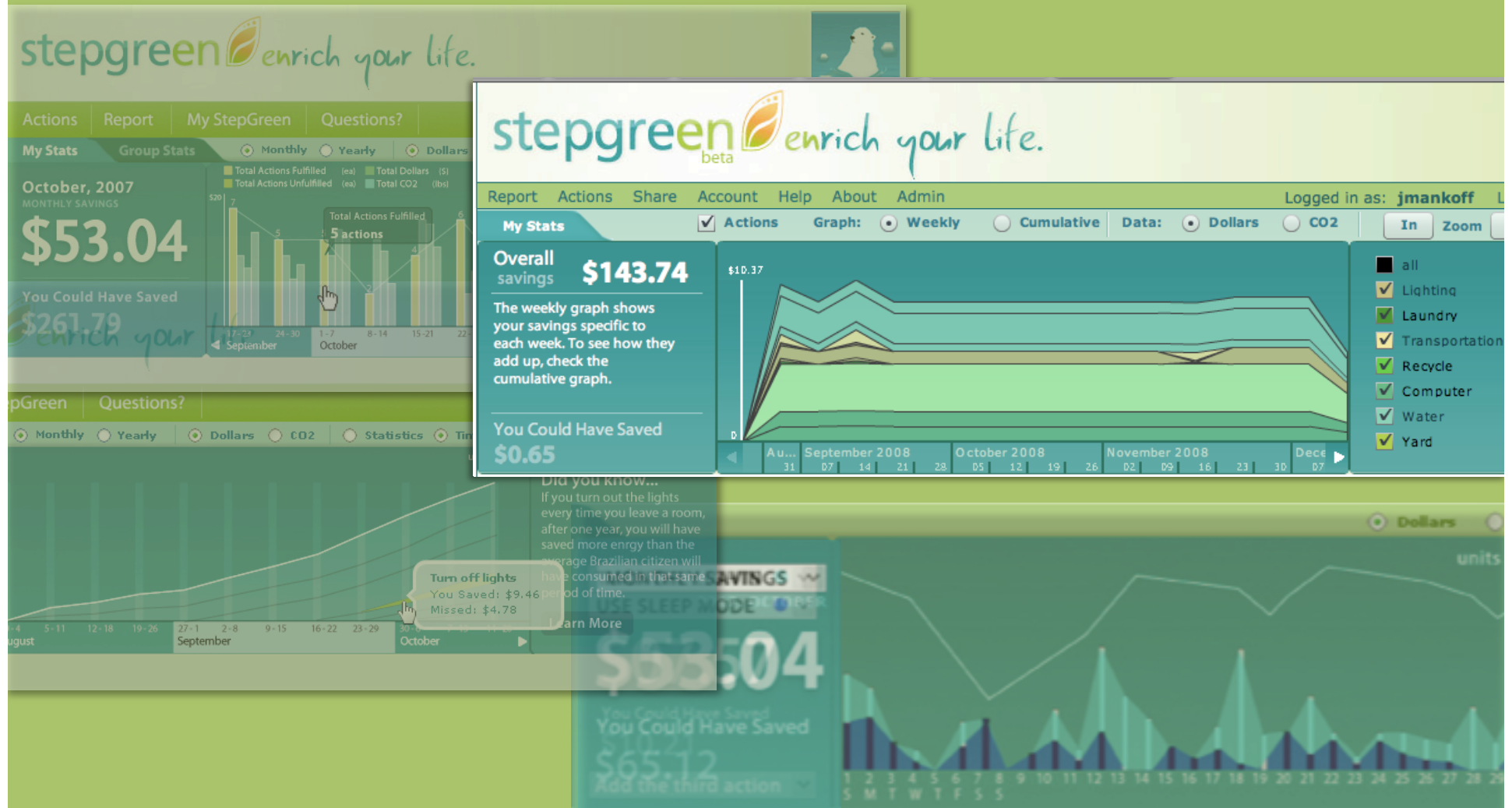
Popular, High Impact New Actions

Name	Impact
Set your home computer to sleep	617 lbs CO ₂ /yr
Recycle aluminum	116 lbs CO ₂ /yr
Adjust your water heater thermostat to 120F	1242 lbs CO ₂ /yr

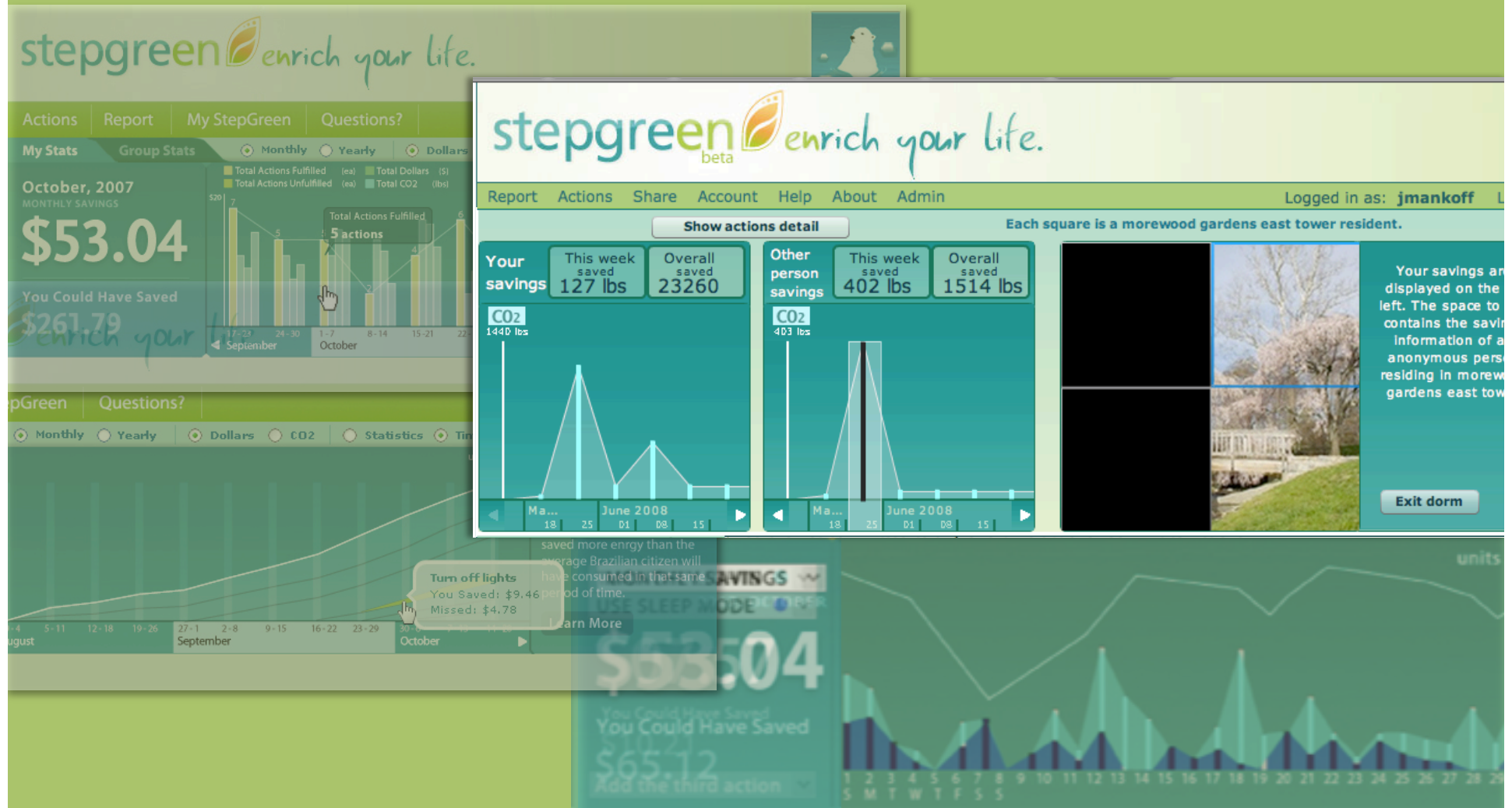
Results: Visualization



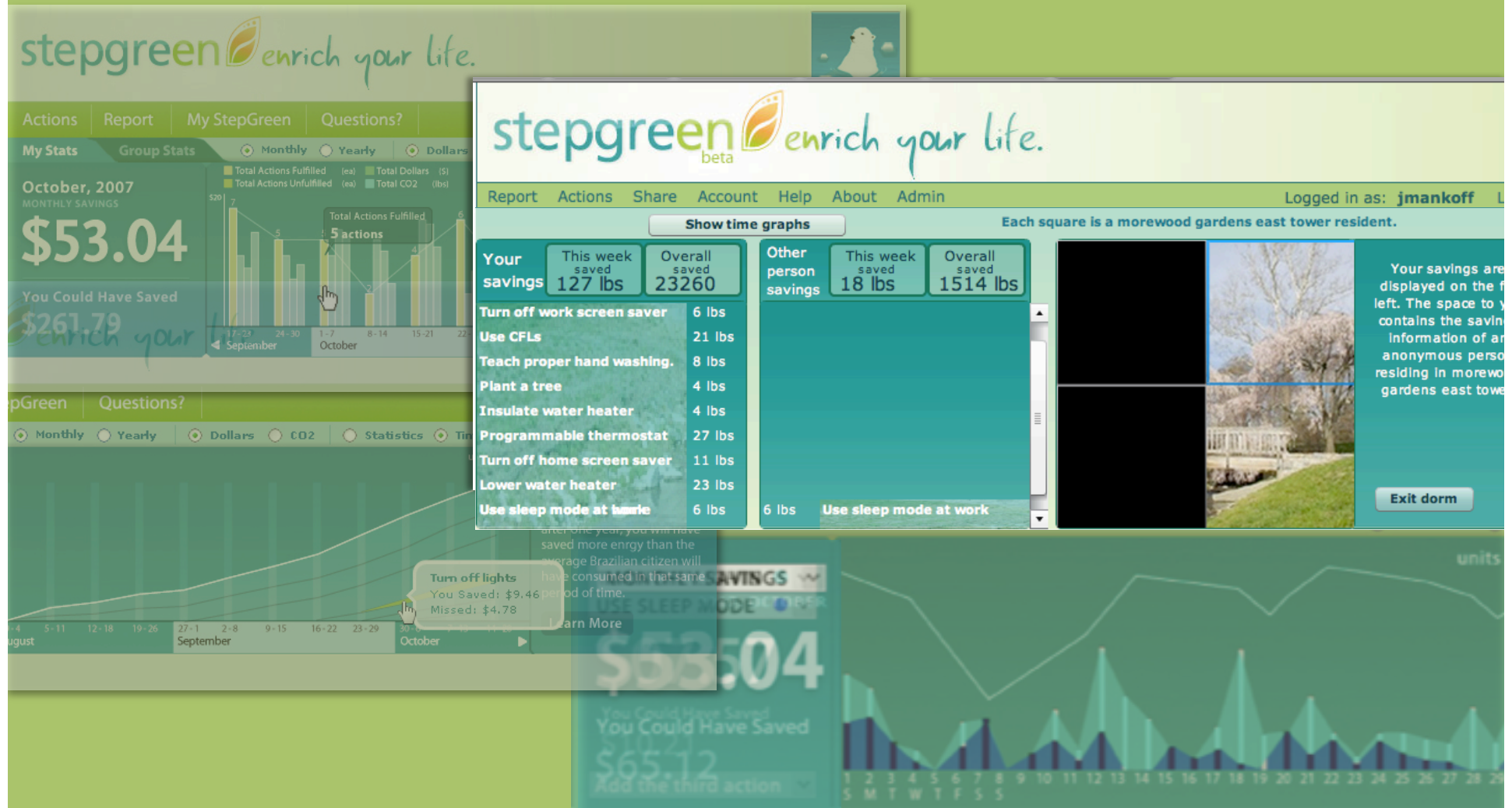
Results: Visualization



Results: Visualization



Results: Visualization



Results: Interaction

4 stayed on for 50-90 more days

3 visited other participants' pages frequently (every day to 3 days) -> wanted to see each other in same visualization

10 reported showing the site to others

2 reported answering queries about the site

6 friends of participants visited the sign up link

Design issues

Users wanted the main site to be more social

Users wanted to create their own actions

More integration with social web (e.g. twitter integration)

More customization & flexibility



A New Emphasis



stepgreen_{beta}  enrich your life.

[Home](#) [Actions](#) [FAQ](#)

[Sign up](#) or [Login](#)

Password

[Login](#)

You have been logged out.

Save Energy. Save Money. StepGreen 

1. Create or commit to green actions

1 Create and take green actions

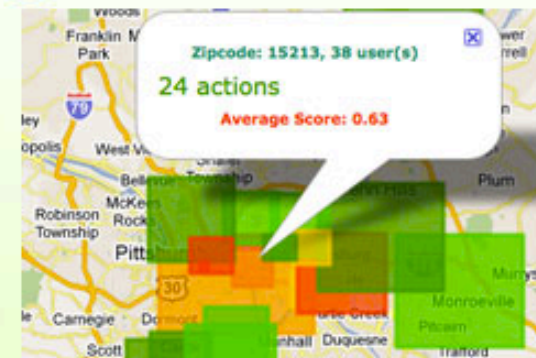
Can't find the action you are after? [Create a new action!](#)

<< Previous: 1 2 3 4 5 6 7 8 9 10 11 Next >>

Name *	Comments / Updated *
 Turn off the lights when you exit the house in the morning for the day.	 13 Aug 2 comments
 Brush teeth the old-fashioned way.	
 Turn off the lights if you are leaving a room for more than 10 minutes.	


Your History
These are the actions you have told us that you have done.
Today
You have not told us of any actions today.
Last 30 Days
May 09 testAction x 1
May 06 Turn off, and unplug, printers connected to home computers when not in use. x 1
Previous 12 Months
May 2011 Turn off, and unplug, printers connected to home computers when not in use. x 1
March 2011 Volunteer time to do work in a green space. x 1
testAction x 1
Biked to and from work last week x 1

2 Compare your community



3 Share your experiences

From: near_mountain on 20 Mar 2009 (see all comments from this user)

Subject: Walk to destinations less than one mile away. 

I bike if distances are longer than 10 miles away. Walking takes too long, but I am fortunate to live in an area that supports cycling.

[Reply](#)

[Report](#)
[Spam](#)

[Sign up](#)

My Stats

☐ Actions

Graph:

☐ Weekly

☒ Cumulative

Data:

☒ Dollars

☐ CO₂

In

Zoom

Out

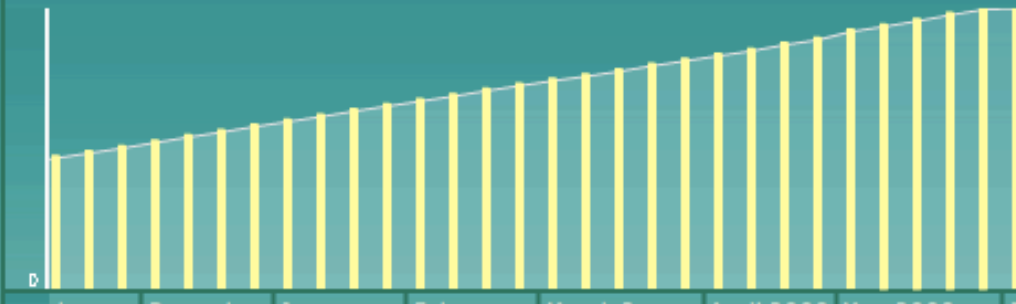
Overall savings

\$511.47

This graph shows your total savings since you joined the site. The savings for each week are added to the total of the previous period.

You Could Have Saved
\$0.84

\$511.4...



Nov... Decemb... January ... February... March 2... April 2009 May 2009 June :
06 23 30 07 14 21 28 04 11 18 25 01 08 15 22 01 08 15 22 29 05 12 19 26 03 10 17 24 31 07

Roll over the different weeks to see what action saved you the most that week.

To see your action breakdown, select the 'view actions' option.

Welcome

Turn off the TV Turn off room lights Use a manual toothbrush Combine trips Fill clothes magazines Use sleep home lights Use sunlight Use a manual razor Fill dishwasher Turn off office lights

Your (jmankoff) recent activity

Savings

Last Week

CO₂: 135.92lbs

So Far This Week

CO₂: 33.98lbs



3. Share and Discuss

[Report on Your Actions](#)

[Commit to New Actions](#)

Your Recent Comments

From: jmankoff on 25 May 2009

Subject: Install a programmable thermostat for your whole-house heating and cooling system

Interesting. I know that many

Recent Discussions on Your Actions

From: mankoff on 31 May 2009

Subject: Set your home computer to automatically hibernate/sleep after a short period of inactivity.

On OS X you can use cron

Email reminders

no-reply@stepgreen.org
to: jmanhoff@cs.cmu.edu
date: Fri, Dec 12, 2008 at 9:00 AM
subject: [StepGreen.org] Weekly Status Update

Hi jmanhoff,

Would you like to compare your actions to those of similar StepGreen users?

We are testing a new feature. [Try it out!](#)

Last week you saved:

- 1.98 lbs CO2 less than a [similar user](#). (See how they did it [here](#).)
- \$9.28
- 136.92 lbs CO2

Remember to report your green actions this week at [StepGreen.org/report](#)

What's New?

We have a new improved graph which should make it easier to see how you have been saving. Log into your [StepGreen.org](#) account and take a look!

Have Twitter?

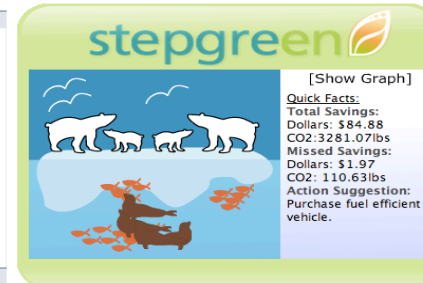
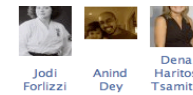
You can now have StepGreen publish updates to your personal Twitter feed. To turn this feature on, go to [StepGreen.org/users/newshare?id=jmanhoff](#)

Right now, we can send your [weekly](#) savings to your Twitter feed. To turn this feature on, go to [StepGreen.org/users/newshare?id=jmanhoff](#)

Twitter feed

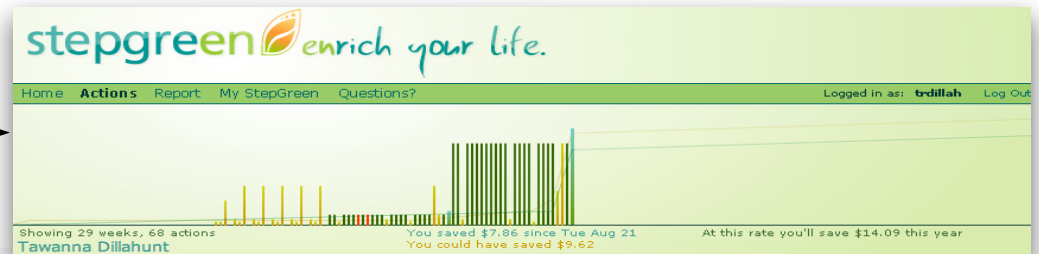
June 29
Tawanna's StepGreen Update.
Tawanna Dillahunt's polar bear family is very happy! This is because Tawanna Dillahunt has saved 391.70 lbs of CO2 in the last month

Facebook applet



StepGreen Server:

- Contains user commitment and reporting history
- Keeps track of external user accounts
- Serves data needed by visualization



Myspace applet



Female
33 years old
PITTSBURGH,
PENNSYLVANIA
United States

Online Now!

Last Login:
10/31/2007

View My: Pics | Videos

Contacting Jennifer

Send Message Forward to Friend
Add to Friends Add to Favorites
Instant Message Block User
Add to Group Rank User

MySpace URL:
<http://www.myspace.com/jmanhoff>

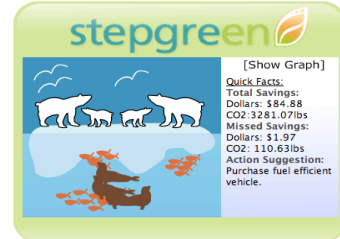
Jennifer's Interests

General
Music

Jennifer is in your extended network

Jennifer's Latest Blog Entry [Subscribe to this Blog]
[View All Blog Entries]

Jennifer's Blurbs
About me:



Suggestion

Tag cloud

Suggested Action

Volunteer time to clean up a green space.
[Learn More](#) [Commit](#)

Zoom [+ - X]

Recent popular actions

Turn off the TV Turn off room lights Use a manual toothbrush Avoid using oven. Combine trips Fill clothes washer Recycle glass Take stairs at work Recycle newspapers Walk Use CFLs Recycle aluminum Recycle magazines Use sleep mode at home Turn off home lights Use sunlight Use a manual razor Fill dishwasher Turn off home screen saver Turn off office lights

Content (tabbed) Action browser:

Available Actions

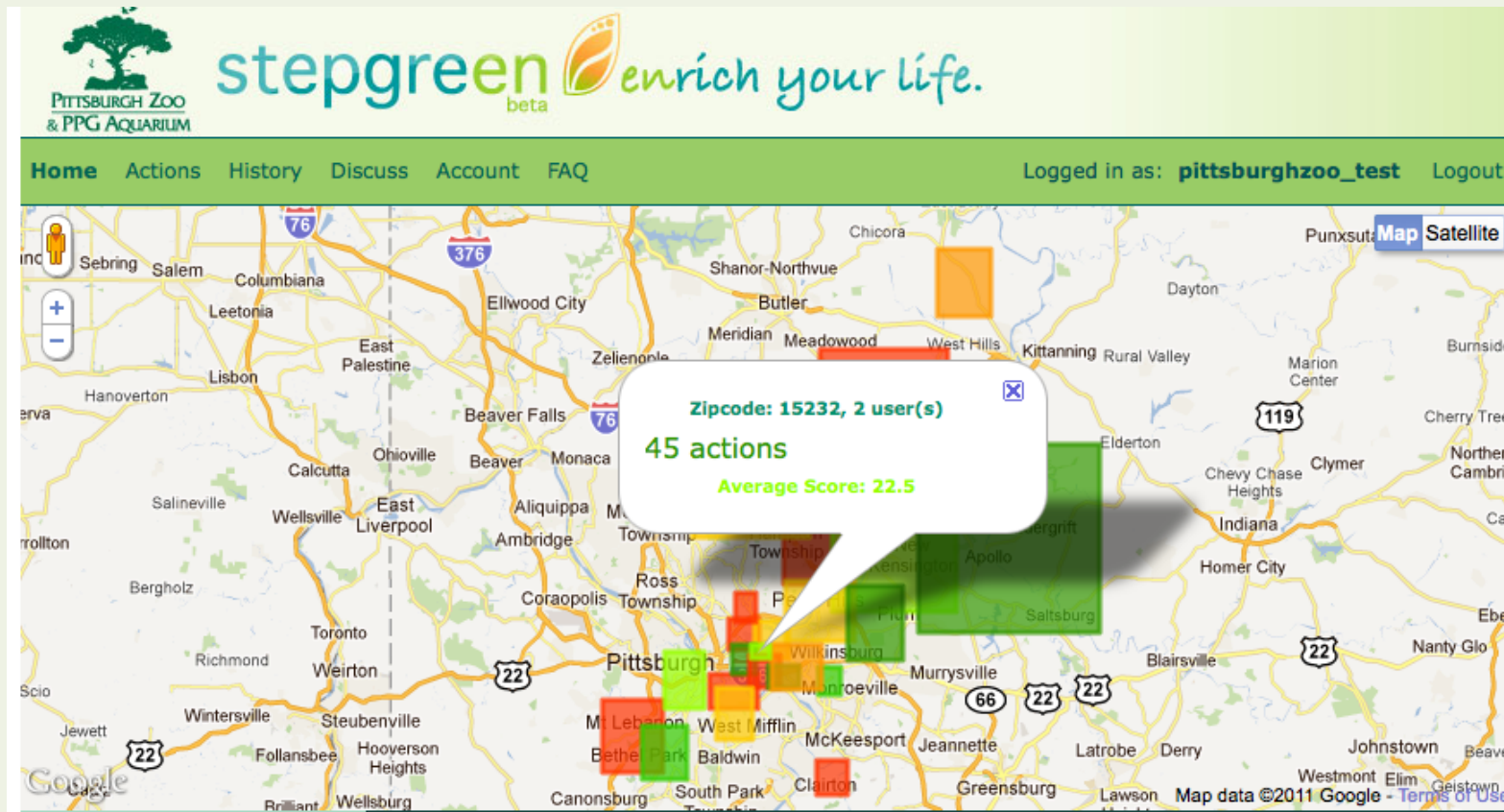
Name	Frequency	Dollar / CO2 savings	Category	Popularity
Turn off the lights when you exit the house in the morning for the day. I have committed to doing this	Recurring	\$14.23/year 198.56 lbs/year	Lighting	156
Set your home computer to automatically hibernate/sleep after a short period of inactivity. Done Mon May 19 I will do this again	One Time	\$44.65/year 617.08 lbs/year	Computer	152
Brush teeth the old-fashioned way. I commit to doing this	Recurring	\$1.82/year 24.09 lbs/year	Grooming	135

Or reporting page:

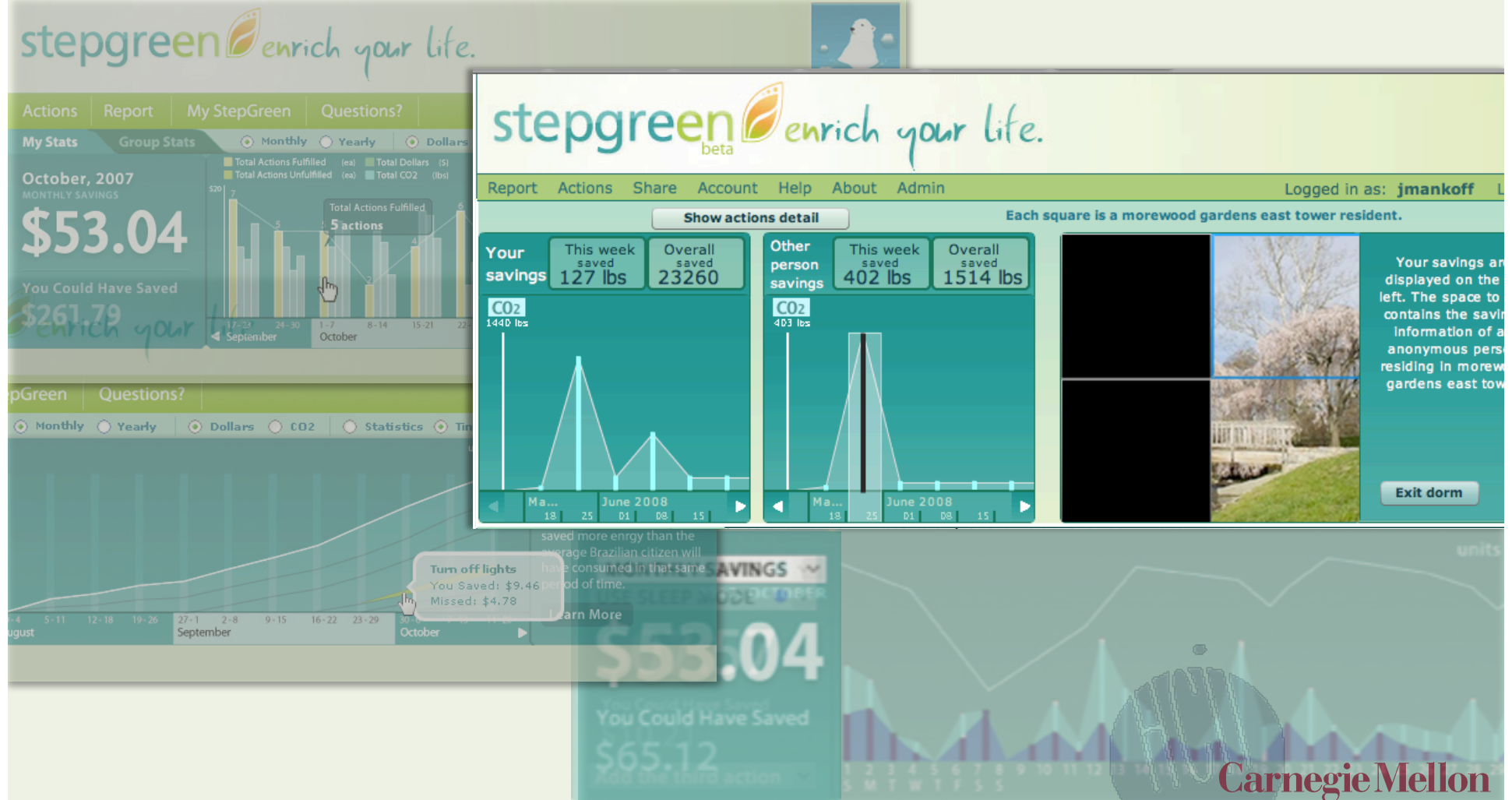
Recurring Commitments: 16

Name	Last report	Dollar/CO2 savings
Replace one incandescent light bulb with a compact fluorescent light bulb. I have done this <input type="text"/> times since Sunday	4 weeks ago Uncommit	\$-48.00/year 1049.69 lbs/year
Turn off the lights when you exit the house in the morning for the day. I have done this <input type="text"/> times since Sunday	4 weeks ago Uncommit	\$14.23/year 198.56 lbs/year
Wash only full loads of dishes. I have done this <input type="text"/> times since Sunday	Never Uncommit	\$39.05/year 538.74 lbs/year
Use public transit to commute this week. I have done this <input type="text"/> times since earlier today	Today Uncommit	\$-182.00/year 1716.00 lbs/year

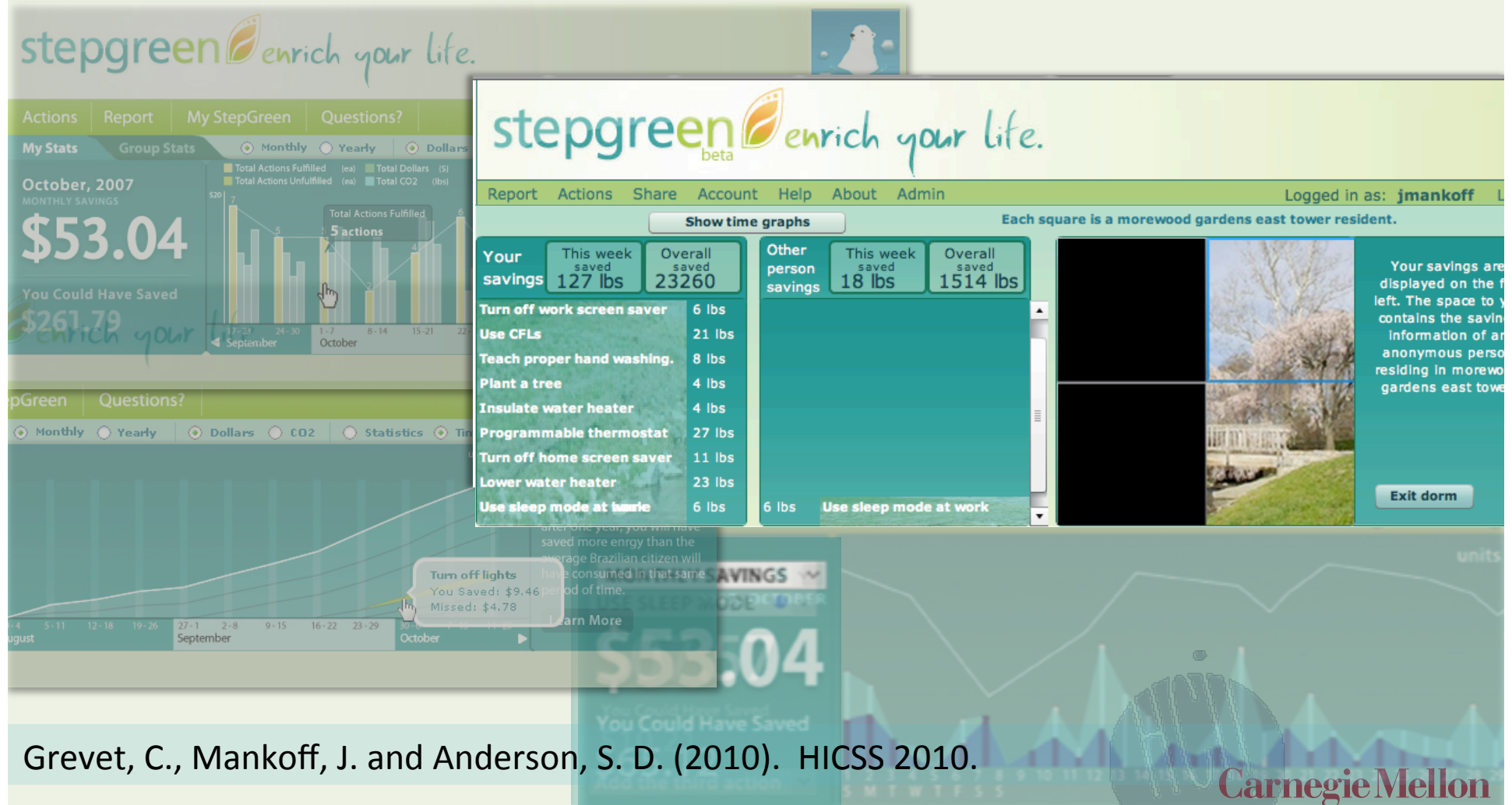
New Visualizations



New Visualizations



New Visualizations



Grevet, C., Mankoff, J. and Anderson, S. D. (2010). HICSS 2010.

Multiple open deployments

Competitions:

- First ever CMU dorm study
- Cornell inter-building competition (work oriented)
- Zoo Pittsburgh neighborhood competition
- Wellesley (study described above)
- Pittsburgh Green Business competition

Open Use:

- API for client development
- Website (separate from specific competitions)

Next Steps

“Full” Twitter and Desktop interfaces

Working Facebook game

Energy use over time [e.g. Google
PowerMeter support]



Our Research

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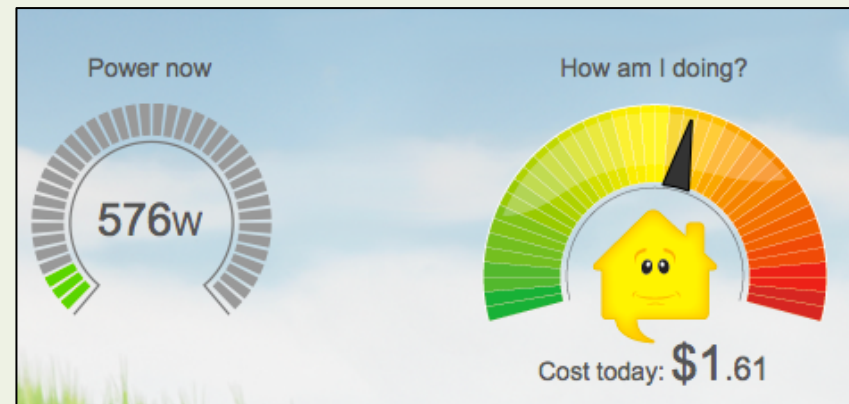


Existing Home Feedback Technology

Positive	Limitations
Produce 10-15% savings [Parker et al., 2006; Darby, 2006; Fischer, 2008]	Targets limited audience [Thørgersen & Crompton, 2009]
Displays real-time information (e.g., CO ₂ , \$, kWh consumed)	Displaying certain information could de-motivate individuals [Thørgersen & Crompton, 2009]
	Don't engage multiple stakeholders



The Energy Detective

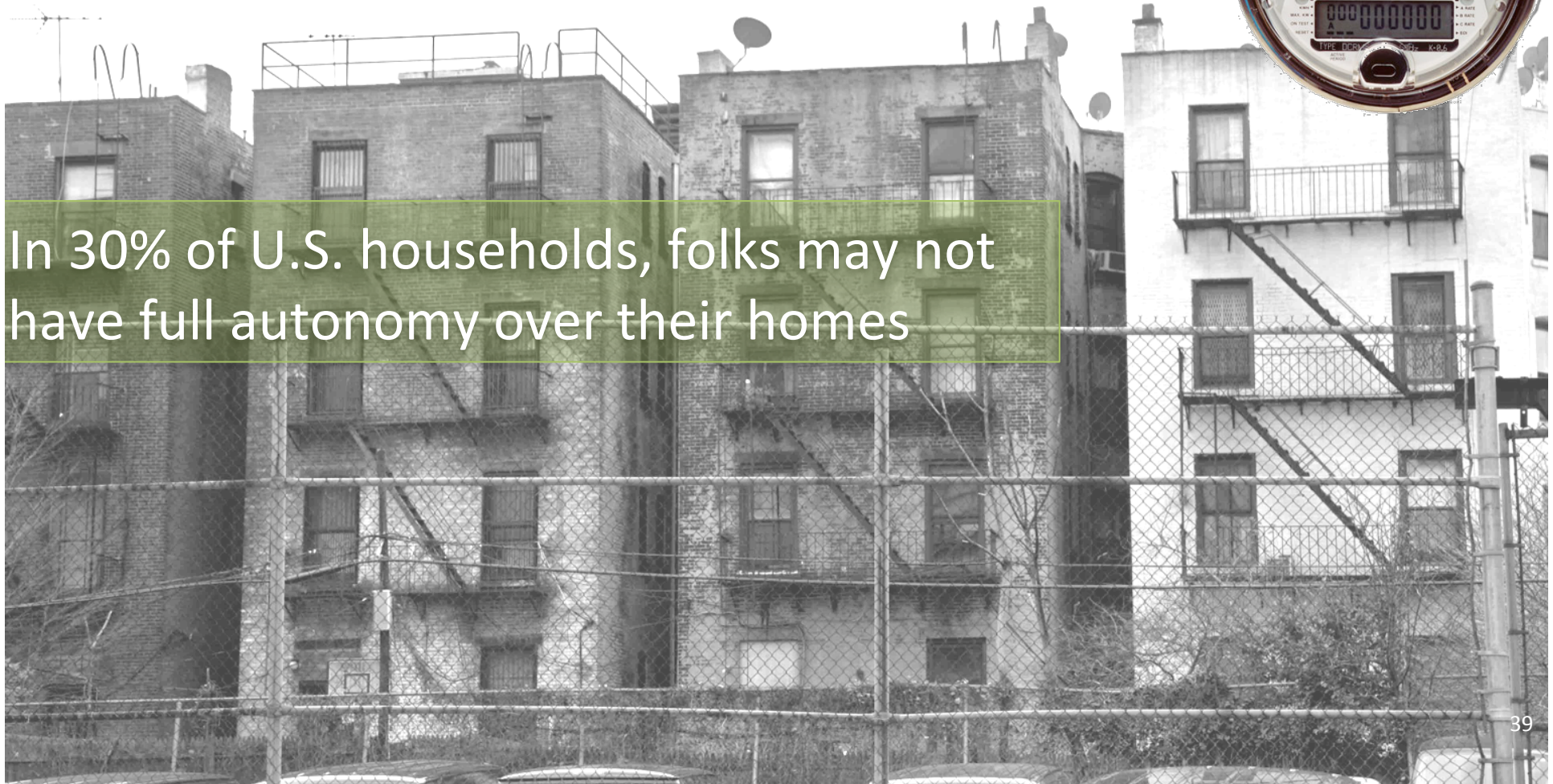


AlertMe Meter

Putting Things in Context



In 30% of U.S. households, folks may not have full autonomy over their homes

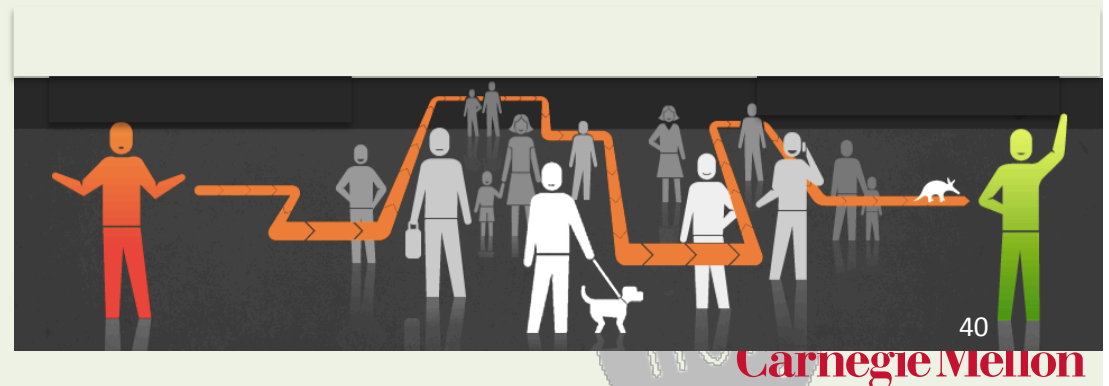


Where does technology fit?

Sensing technologies produce new information

Social technologies facilitate sharing and negotiation

Both technologies influence action



Landlord/Tenant Relationships



Landlords hold the upper hand in landlord/tenant relationships [Keller, 1988]

Study Details

	TENANTS 1	LANDLORDS	TENANTS 2
Method	Photos + Interviews	Interviews	Role-Playing
Race	African American	Caucasian	African American + Caucasian
Income	~\$10K/year	\$30K - \$70K +	< \$20K/year

Sources of Conflict

	STUDY 1 TENANTS PHOTO-ELICITATION	STUDY 2 LANDLORDS INTERVIEW	STUDY 2 TENANTS ROLE-PLAY
Expectations	✓		
Money	✓	✓	✓
Power Imbalance	✓		

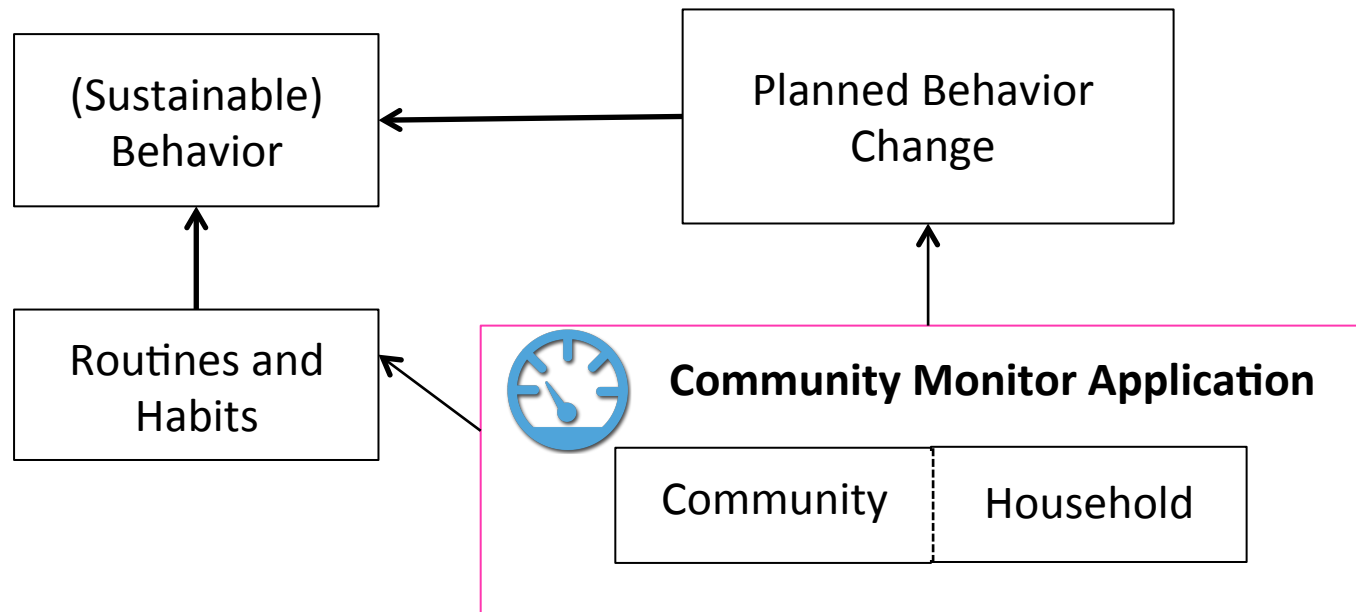


Conflict Resolution

	STUDY 1 TENANTS PHOTO-ELICITATION	STUDY 2 LANDLORDS INTERVIEW	STUDY 2 TENANTS ROLE-PLAY
Knowledge	✓	✓	
Communication & Negotiation	✓	✓	✓
Community Action	✓		



Factors Influencing Behavior



Iterative Design

9 householders (1 homeowner); 2 landlords

3 high income (1 landlord)

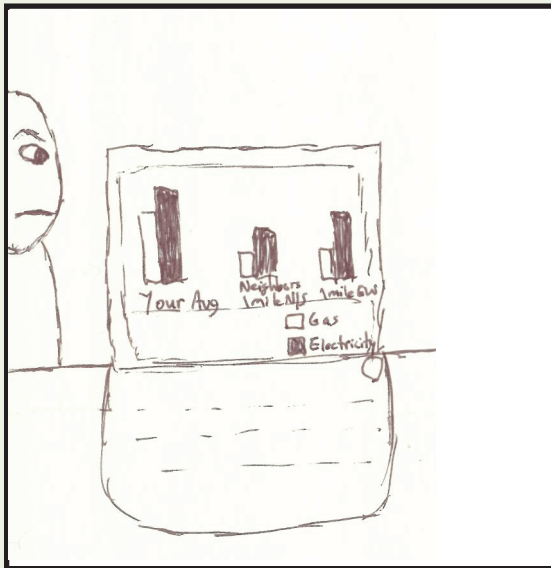
Presented scenarios Davidoff *et al*, Ubicomp 2007

Modified scenarios over study to focus on most popular designs

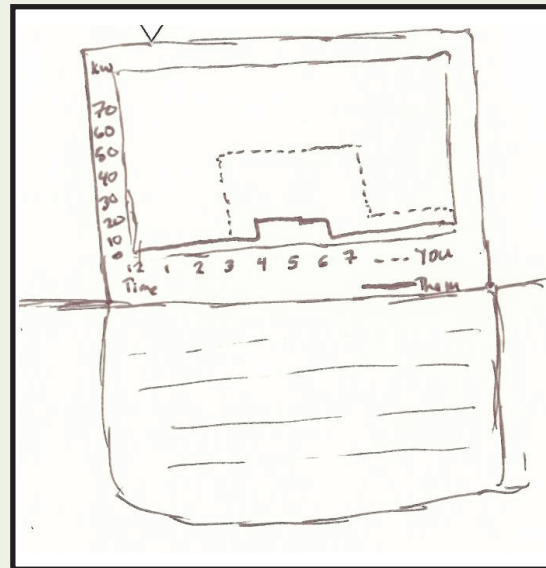


Online Discussion Preferred over Interaction with Neighbors

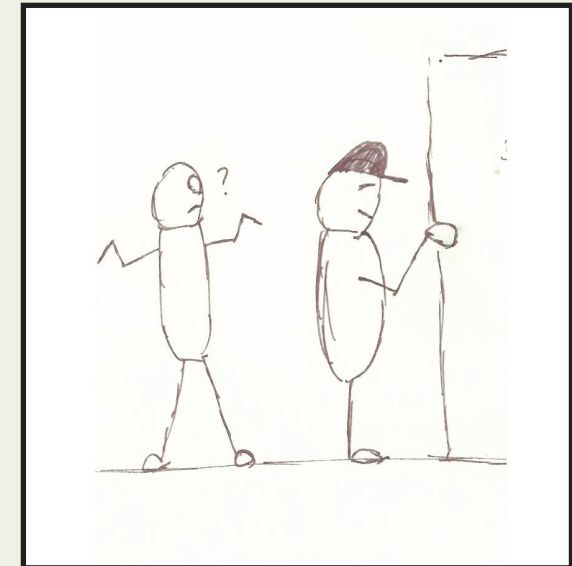
SCENARIO 3b: Sam's excess consumption



Sam, another resident of the community takes a look at this week's comparison chart from his computer.



The website shows that he has higher consumption than his neighbor in the early evening on average.



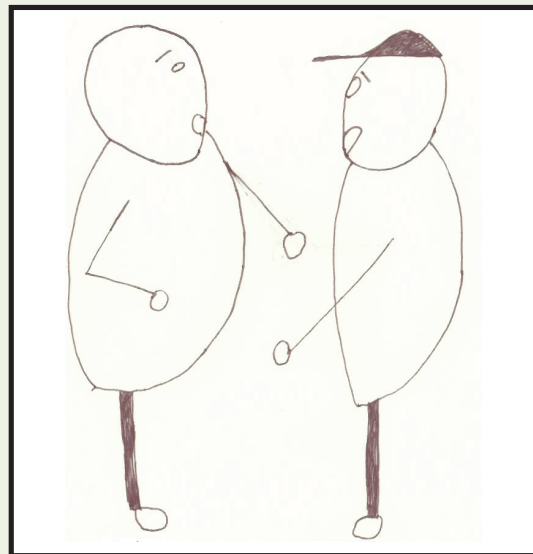
He knocks on his neighbor's door. He discovers that his payments are much higher than his neighbors and he tries to find out why.

Design Carefully for Including All Stakeholders

SCENARIO 3c: Pedro's inspection



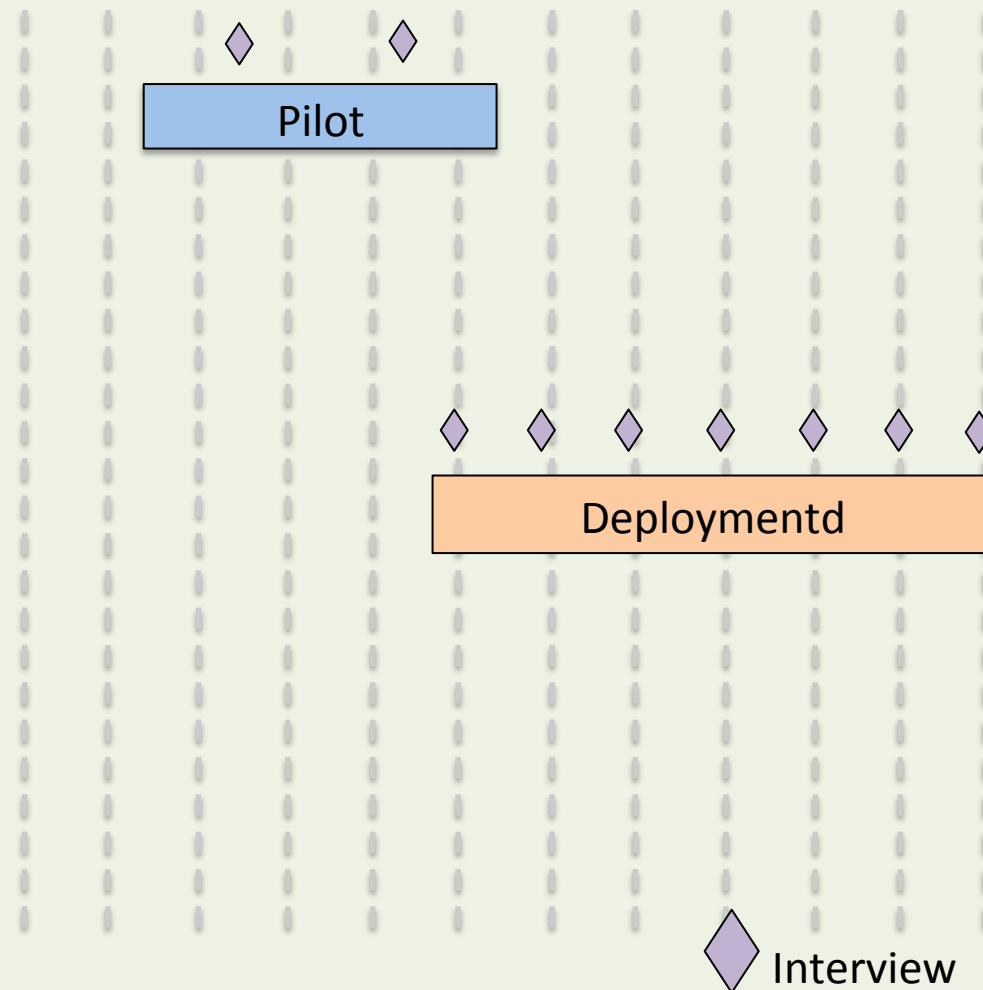
Pedro has been a landlord for many years, and at times has felt as if his tenants try to take advantage of him. For example, he has seen tenants' guests become permanent tenants of his complex. He has also seen tenants leave their windows open in the winter without turning off the heat; Pedro is responsible for paying his tenants' utility bills. He also notices that one of his tenants living in a 1-bedroom apartment consumes twice as much as his tenants living in a 2-bedroom apartment.



Pedro asks his tenant if he can take a look at his apartment for potential energy related issues. His tenant questions his request but allows the landlord to take a look the next day.

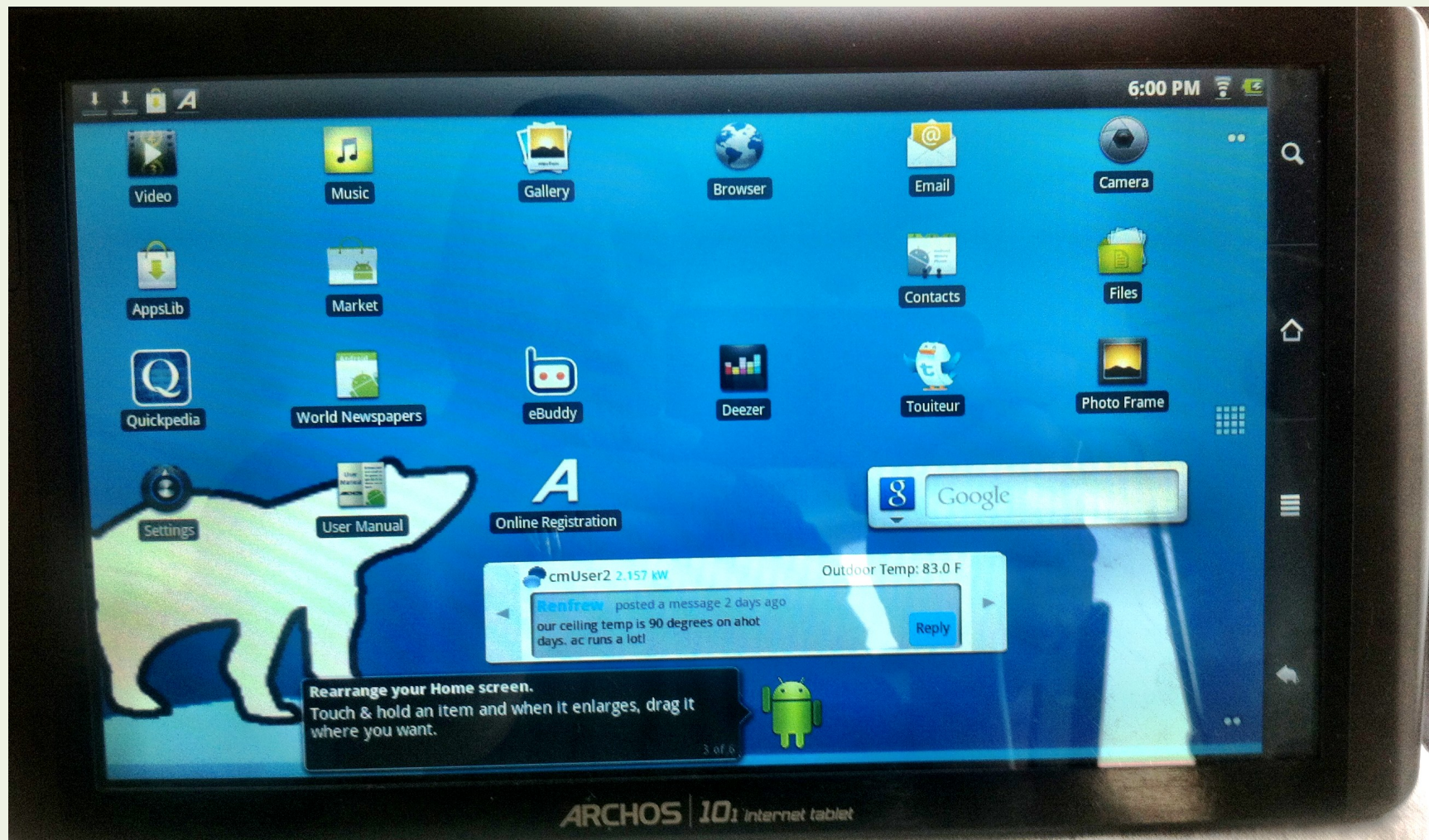
I5 Home Deployment

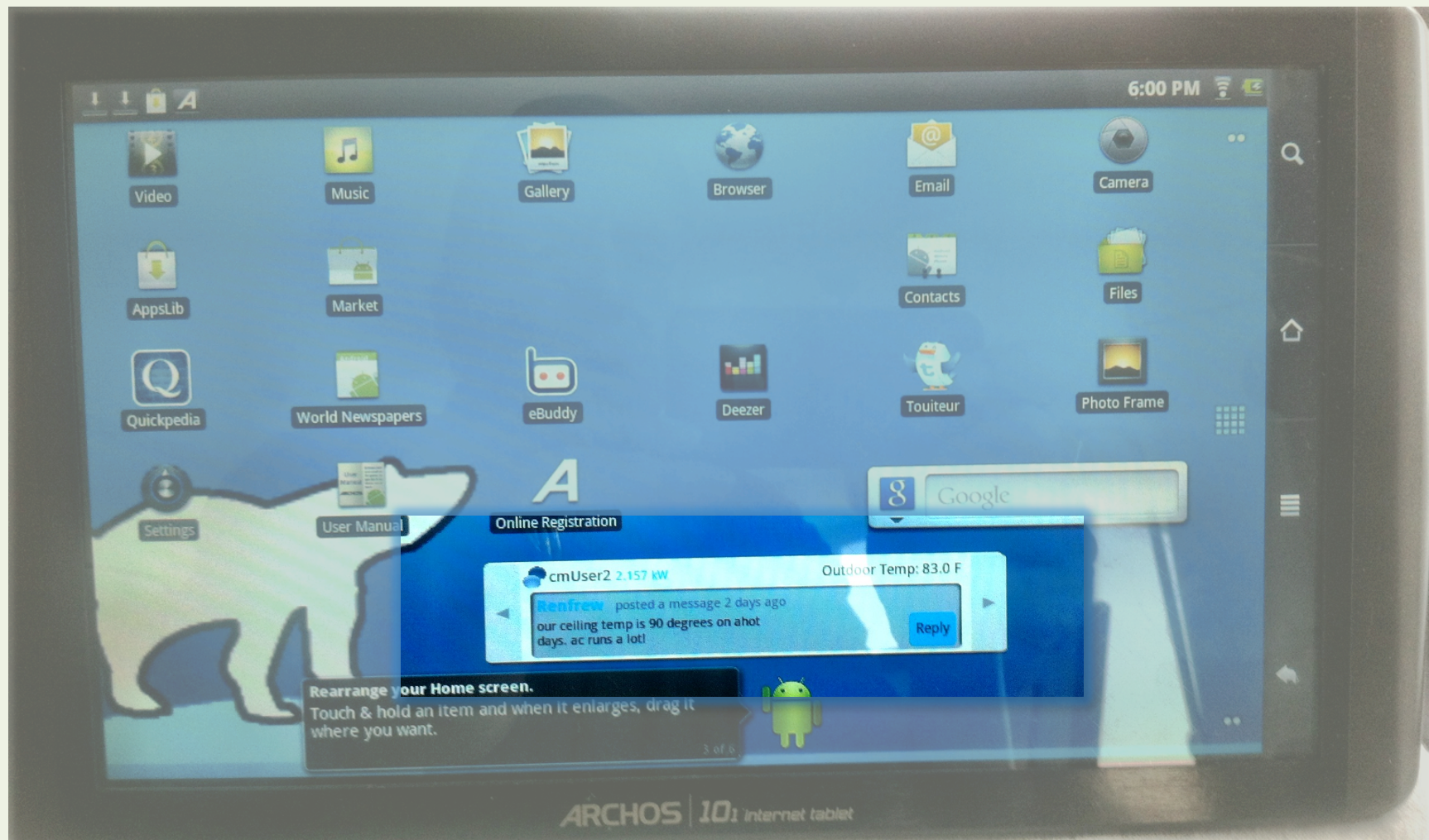
Jun 2011 Aug 2011 Oct 2011 Dec 2011 Feb 2012 Apr 2012

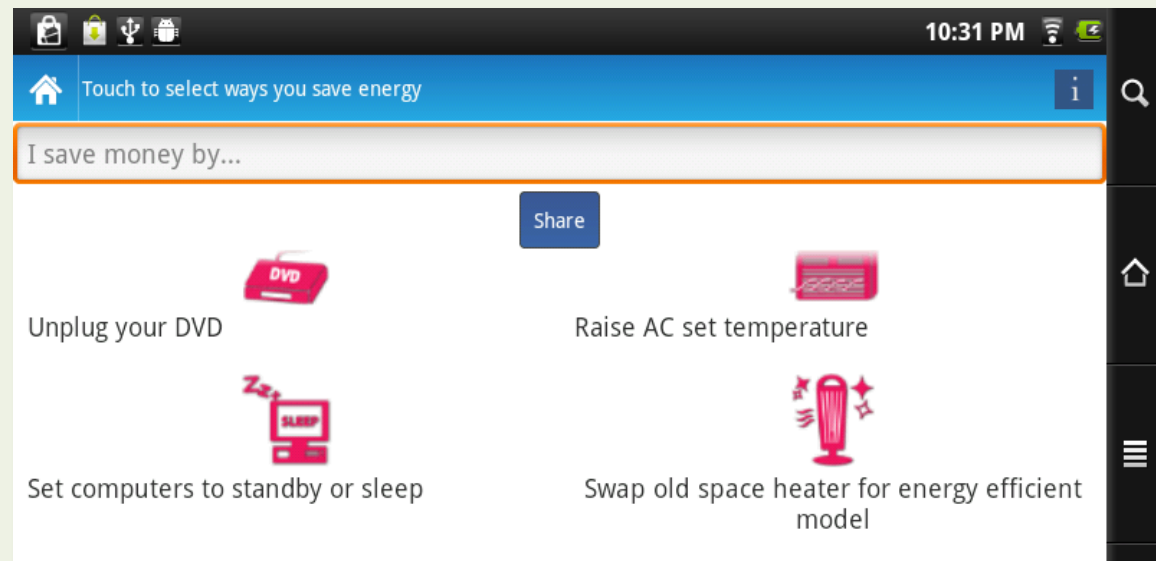
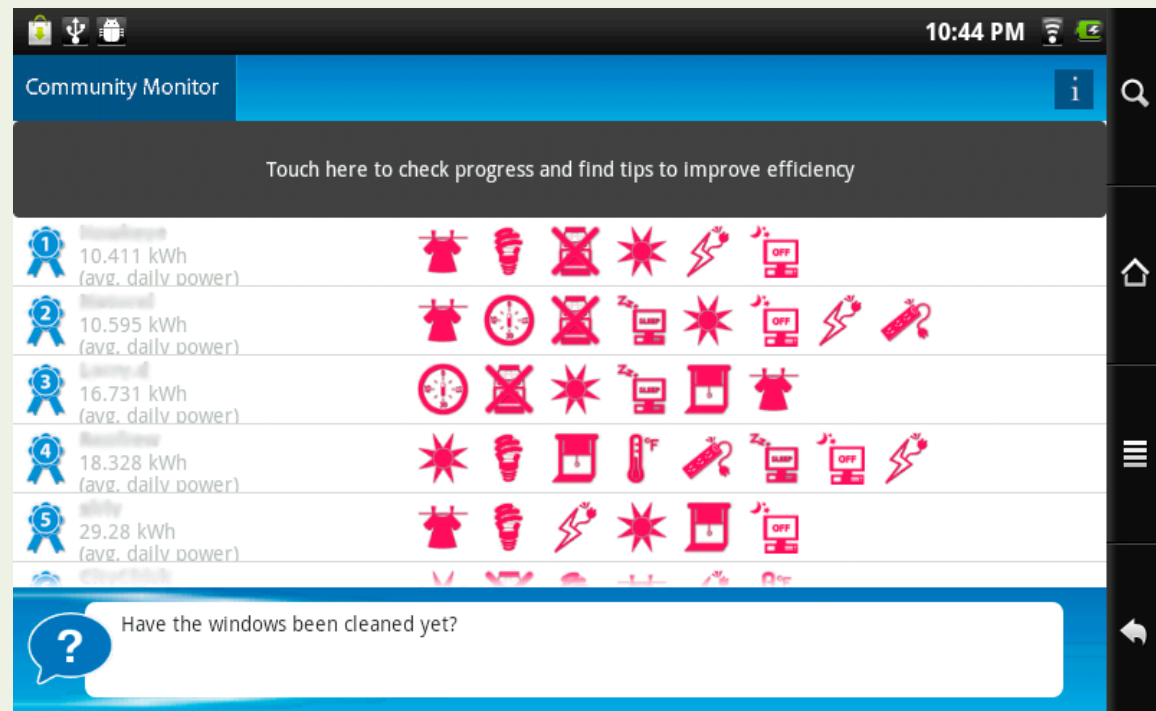


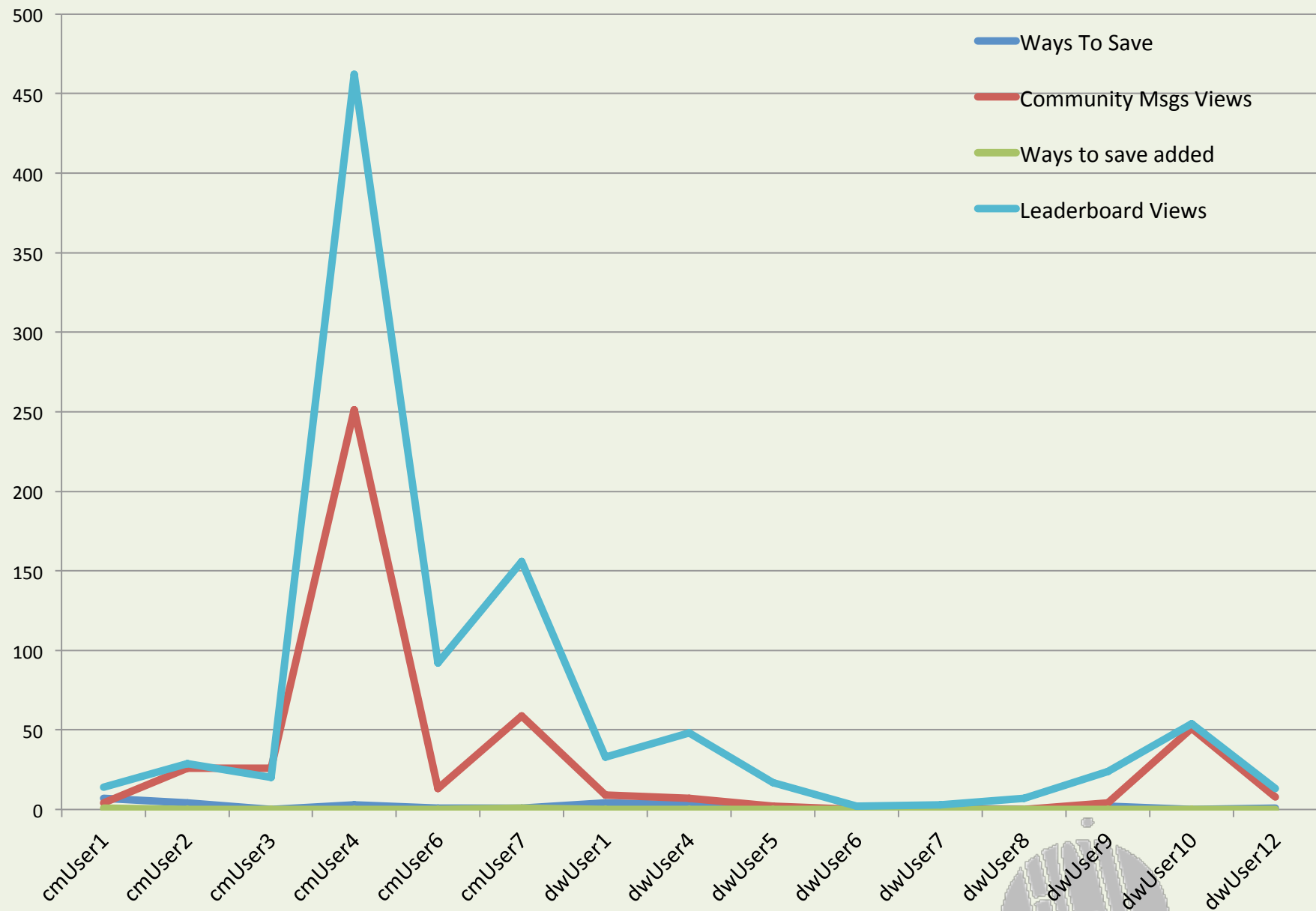
- Mixed-Income
- Low-income don't pay, all others pay
- All electric
- Built in 1907 / 2010

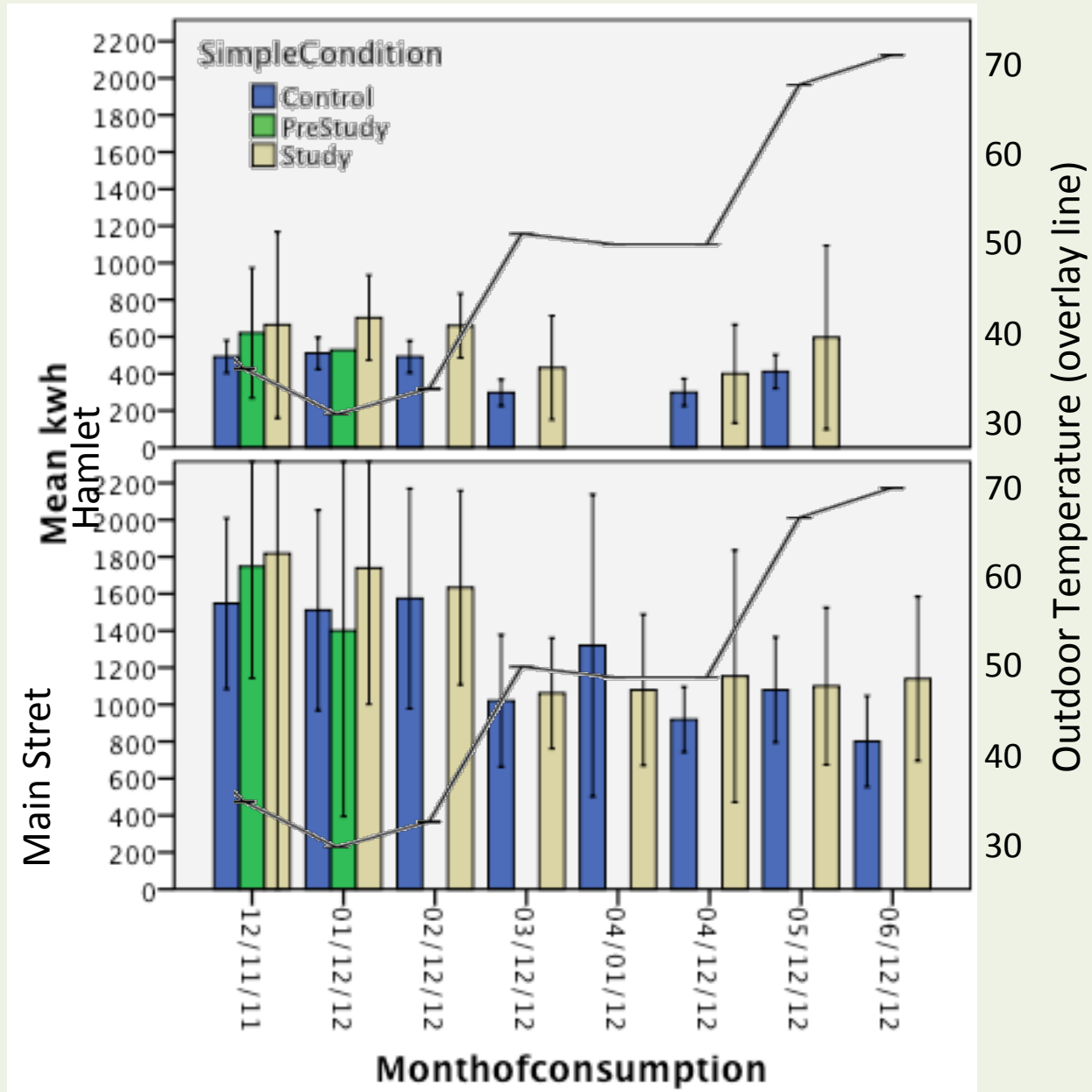












Conclusions

Carefully designed, targeted, small deployment more engaging than general system in our case

Social connections worked best when online and offline complemented each other

Privacy and power a special concern in multi-stakeholder settings (*e.g.*, landlord/tenant)

Households naturally took on many different roles with respect to the second deployment

Personal Informatics for energy?

- Impact hard to quantify
- Comprehensive data unavailable



For the future

Automated techniques under explored

Beyond the individual?

Crossing cultures?



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Thanks to the many
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