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# *Fraunhofer Center for Sustainable Energy Systems*

## **Home Energy Displays (HEDs):**

## **Consumer Adoption and Response**

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# Project Scope

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## *The Opportunity:*

HEDs make energy visible and encourage energy savings through feedback and behavioral change by inhabitants

## *The Challenge:*

Current HEDs fail to engage consumers and maintain their interest in the longer term, compromising their energy savings

## *Questions to Address:*

What do users want out of home energy management (HEM)?

How does HED feedback design influence user engagement?

Can more engaging HEDs achieve persistent energy savings?

# Background

- Current Market:
  - Digital displays of energy consumption
  - Current consumer barriers:
    - Confusing specifications
    - Range of prices (\$99-up to \$5k)
    - Vaporware
    - Different types of information design
- While some researchers have classified elements of feedback design, none have deployed models contrasting these dimensions and media in-field.



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# Relevant Work

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- Darby (2006): Mentions that while 'simple' displays could save up to 10%, 'complex' displays could save up to 18%
- Many HED tests of a limited duration (< 6 months)
- Dam et al. (2010): 15 month study of HEDs in Netherlands
  - N = 304
  - Initial overall energy savings of 7.8% after 4 months
  - **Savings NOT sustained in second wave measurements (@15 months)**
  - Concluded that longitudinal research on HEDs with a focus on interaction design needed.
- **Research needed on HED medium, aesthetics, and feedback design to effectively sustain engagement and energy savings**

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# Study Approach – User Testing Phase

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- Uncover the barriers to HEM technology adoption
  - 1. Online survey of early adopters (n=50)
    - User preferences & usability ratings of products
  - 2. Focus Groups (n=25)
    - 1 group already uses HEM, 3 groups separated by age
      - What is the consumer's current understanding of the product?
      - Which device functions and specifications are most effective?
      - Does age play a role in technology adoption?
      - Which products and applications have the best consumer response?



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# Study Approach – Field Deployment Phase

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- Create display testing groups (n=100)
  - 50 get a market digital in-home display (low interactive group)
  - 50 get an additional web/phone based application (high interactive group)
- Collect energy consumption (electricity) data over long-term testing phase
  - Initial 4 month testing period, follow up testing period of another 4 months after a 6 month break, with survey data in between.
  - Compare groups to see if they differ overall and/or are maintained over a longer period of time

# Initial Results

- We surveyed early adopters on HED preferences
  - Desired characteristics
  - Hypothetical usage ratings
    - 'Length of use' as a metric of adoption
  - Three presentation media (home, web, phone)

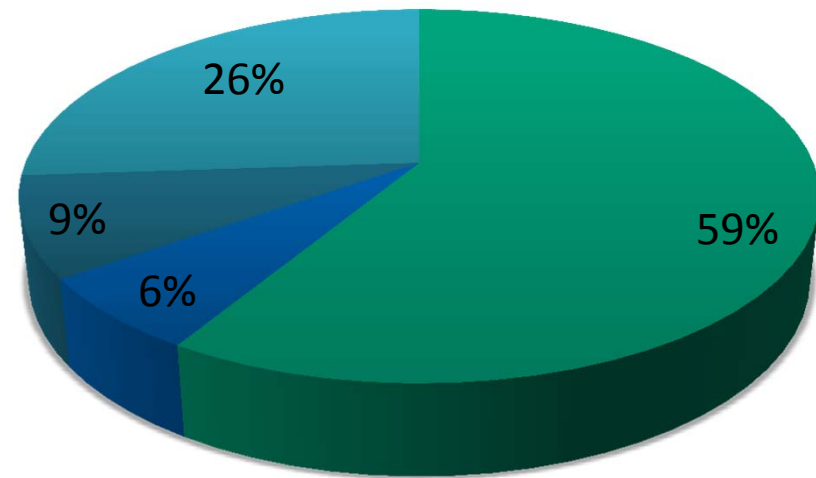


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# Initial Results – Features

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Q: Which feature of home energy management would you be most interested in? (check one)



- Real-time electricity consumption monitoring
- Cost and bill information or prediction
- Carbon footprint
- Energy-reducing tips and education

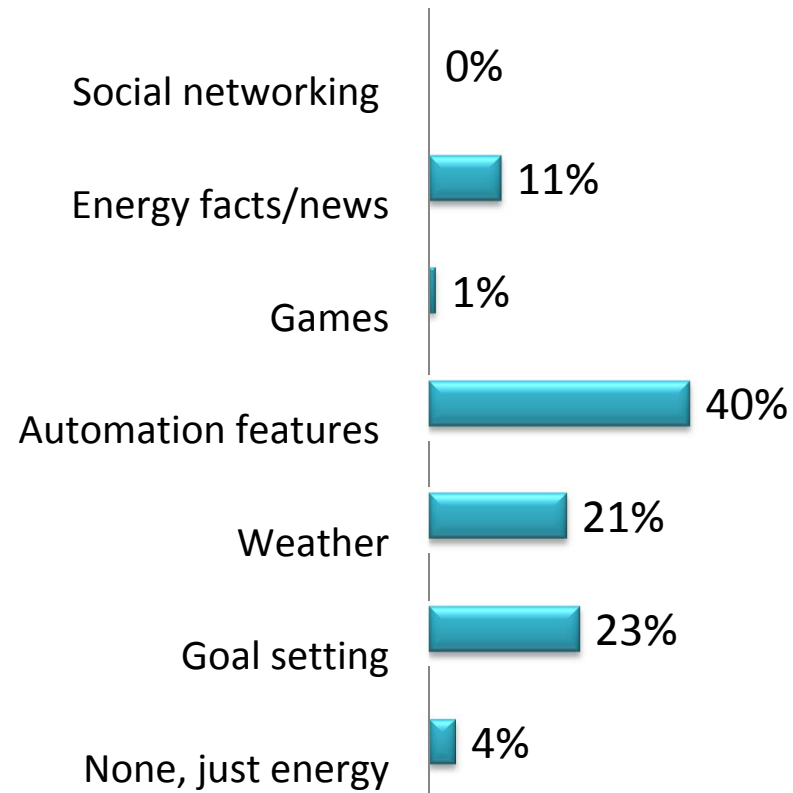


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# Initial Results - Wants

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**Q: What other things  
would you want your  
home energy  
management system to  
have, if any?  
(Check all that apply)**

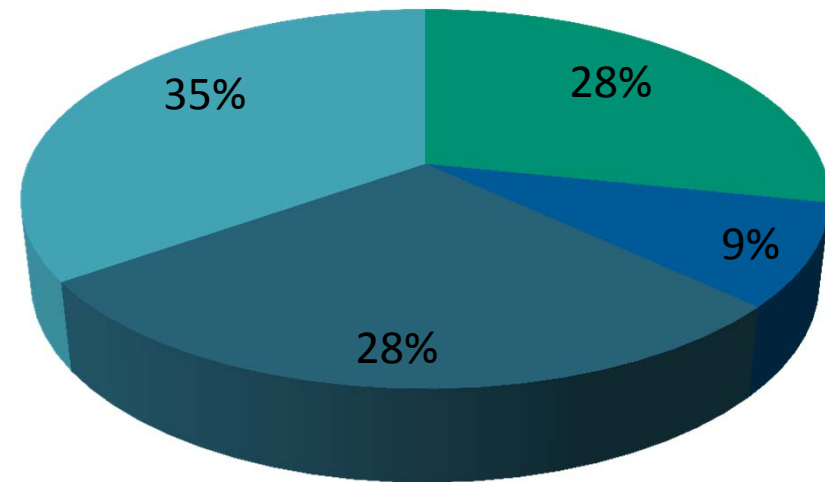


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## Initial Results – Medium

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Q: Which medium of home energy management do you think you'd most prefer?



- A display that sat on your counter or wall
- A web portal you could log into
- A smart phone application
- I'd like them all

■ Time spent means by medium:

	HED	WEB	PHONE
None	14%	8%	<b>30%</b>
1-5min	<b>65%</b>	53%	56%
10-15min	19%	<b>35%</b>	13%
Over 15 min	2%	4%	2%

Mean of four exemplars for each medium

■ Time spent by overall usability rating:

	GOOD	BAD
None	6%	<b>28%</b>
1-5min	63%	57%
10-15min	27%	14%
Over 15 min	4%	1%

Mean of top or bottom rated for each of the three mediums

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# Preliminary Conclusions

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- Most people likely to spend very little time using HEM
- Usability ratings are good predictor of length of use
- Approaches to residential energy management providing multimedia options are the most likely to be successful
  - Phone apps still can't rival web portals, even though they are highly desired
  - HEDs need to be more engaging overall to compete with web and phone based media
- Current results stress the need for more work in the energy domain on user interface design, as well as what elements of visual energy feedback lead to the most energy savings.

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# Next Steps

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- Recruit participants and run focus groups
- Based on user testing, finalize the HEDmodels and supplemental energy applications for deployment
- Establish property management partner for the field deployment
- Perform field testing
- Develop guidelines for HEDs to optimize their sale, user adoption, and effective use:
  - What barriers are the most critical to address for HED deployment on a larger scale?
  - What media are most effective in the long-term?