Sociotechnical Systems to Enable Smart & Connected Energy-Aware Residential Communities #1737591 (IRG – 1, FY2017)

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Community-identified Problem

ihcda *Launches **Moving Forward program***

BWI *Builds innovative **housing communities***

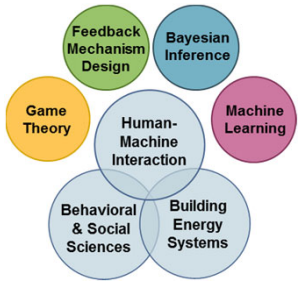
PURDUE UNIVERSITY *Conducts **sociotechnical** research and develops new **S&C resident engagement** technology*

Vision

Develop new S&C technology to engage community residents in understanding and reducing their home energy use while increasing their environmental awareness and improving their quality of life.

Intellectual Merit

Use-Inspired Research



Fundamental Contributions

Physics-informed machine learning for energy model identification

Energy-feedback mechanism design

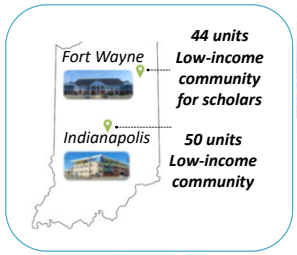
Social game design

Outcomes

- 2017 *Baseline data/energy analytics*
- 2018 *Eco-feedback mechanism*
- 2019 ***MySmartE app development***
- 2020 ***Deployment of MySmartE app in 94 Indiana households***
- 2021 *Mechanism design*
- 2022 *Scale-up, transition to practice*

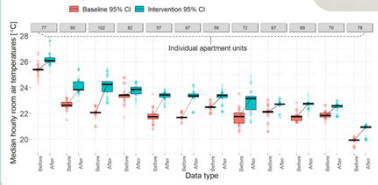
Project Activities

Pilot Deployment of MySmartE



44 units Low-income community for scholars

50 units Low-income community



Positive effect of the intervention for all units for which baseline and intervention data were available.
>20-30% community energy savings

Resident interviews

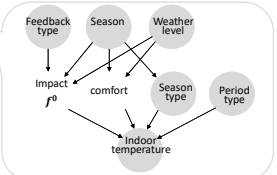
The results from post-experiment interviews revealed that:

- Residents became more energy-aware after using MySmartE. (e.g., *"I think it's great…It is definitely helping me to be more conscientious of my energy usage…"*). Also, residents said that they were thermally comfortable in their home while they were saving energy.
- The social game elements such as avatars or social proof information excited residents during the game (e.g. "It encouraged me…oh ok, we are doing this, and we have this to achieve, it was a really fun thing for me".

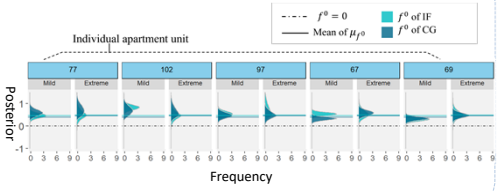
Scalability research

Human decision-making

Causal structure → Resident utility model → Bayesian calibration

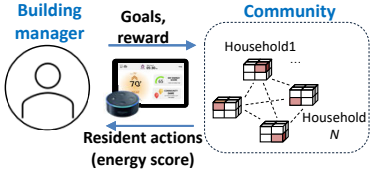


Positive impact of eco-feedback ($f^0 > 0$)



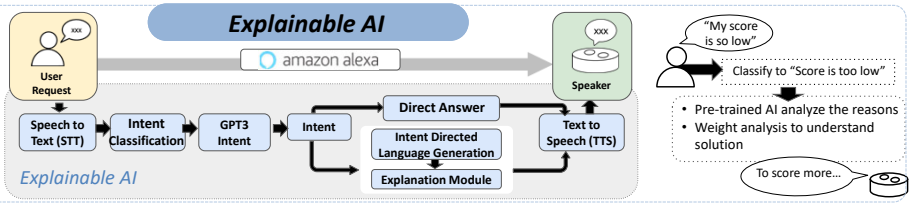
Mechanism Design

Conceptual framework



Community decision trend

Explainable AI

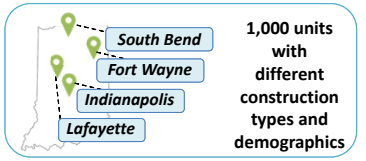


Broader Impact

- Develop new smart home energy management system that works with a tablet and Amazon Alexa.
- Empower affordable housing residents reduce their energy bills.
- Enable government (cities/states, housing authorities) and industry stakeholders (community developers, utility companies, energy aggregators) to design and deploy new energy efficiency programs.

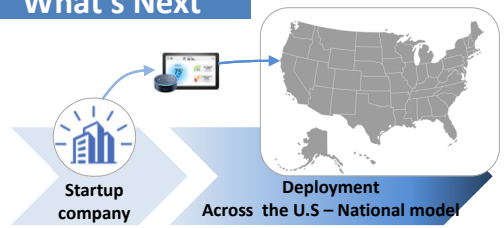
Sustainability

PATENT REGISTERATION	SCALE-UP DEPLOYMENT	TRANSITION TO PRACTICE



1,000 units with different construction types and demographics

What's Next



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