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Household energy-saving behavior and smart grid communication between utilities and customers

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Introduction

- Smart grids & their technologies are under pilot testing worldwide (Mah, 2015; Reinprecht, 2016)
- Smart grid technologies are assumed to :
  - Lead to behavior change
  - Reduce demand side energy consumption (Khan, 2016)
- Research gap: ***Do smart grids and smart technologies actually change behavior and promote more sustainable energy use?*** Yet to be answered—notably at scale of a city.

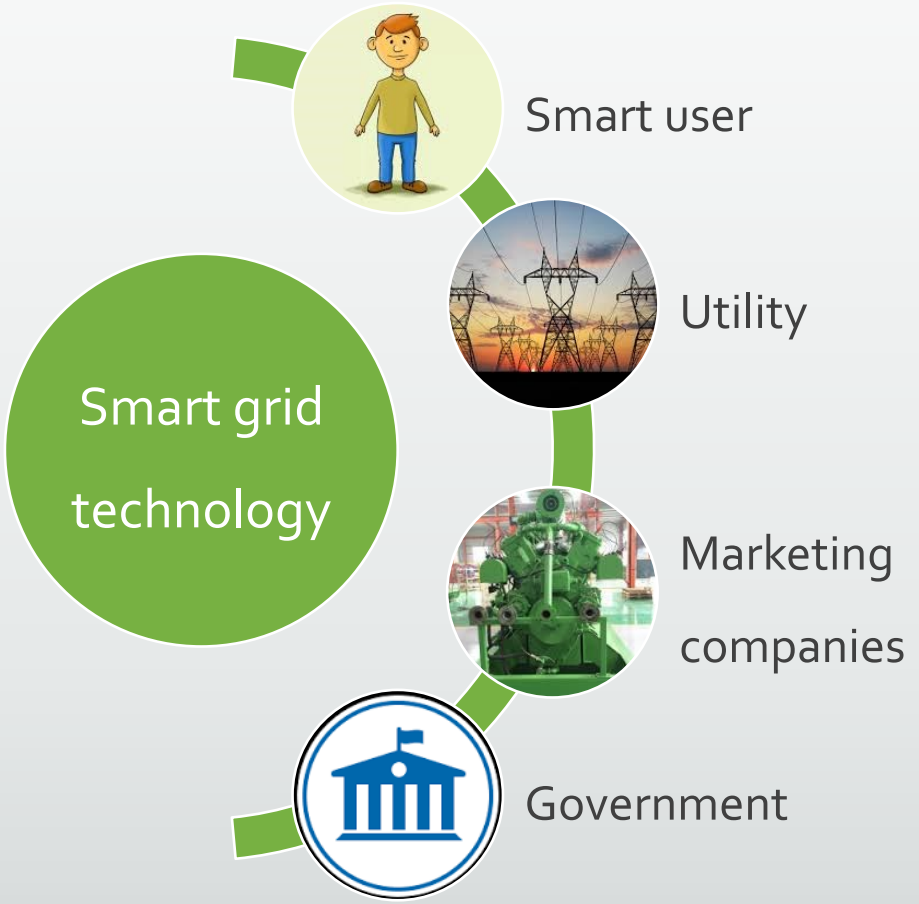
Background

Socialization as per sociology and psychology:

..the process by which individuals identify their position and become entrenched parts of collectives..

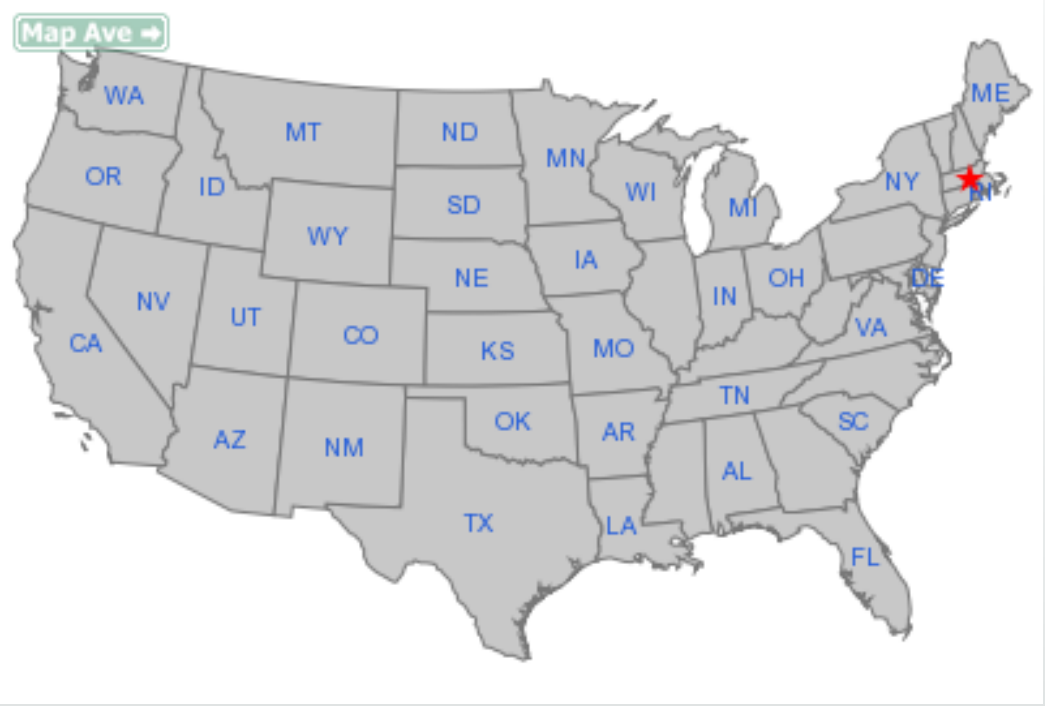
(Skjølsvold, 2015)

"Socialization agents"



Our study area

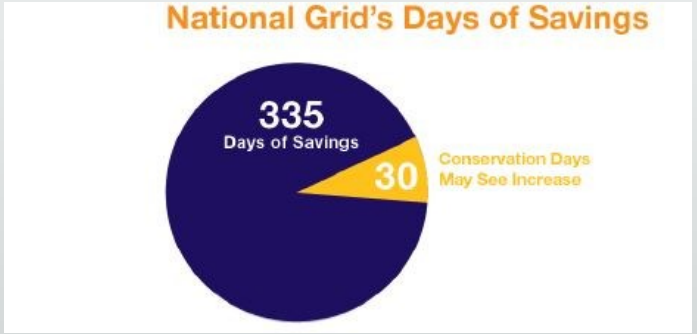
- Worcester, MA (USA) with a population of 181,045
- National Grid (the utility) is implementing a 2yr pilot – Smart Energy Solutions (SES) Program
- Homes flagged across 11 electric power supply feeders
- 15,000 smart meters installed



http://www.eachtown.com/Massachusetts/City/Worcester;17416/

SES Program – Triple strategy

Smart in-home technology	Energy consumption feedback technologies	Real-time Pricing Plans
• Smart plug control devices • Smart thermostats	• Digital picture frame • WorcesterSmart web Portal	• Smart rewards pricing • Conservation Day rebate plan



Technology packages

Level/Technology package	Types of technology	Requirements*	Share of population
Level 1	Smart meter + WorcesterSmart web portal	None	92%
Level 2	Level 1 + digital picture frame + mobile app	High-speed broadband Internet connection	5%
Level 3	Level 1 + smart thermostat	Central air conditioning	1%
Level 4	Level 1 + Level 2 + Level 3+ load control devices	Central air conditioning and a broadband high-speed Internet connection	2%

Our research

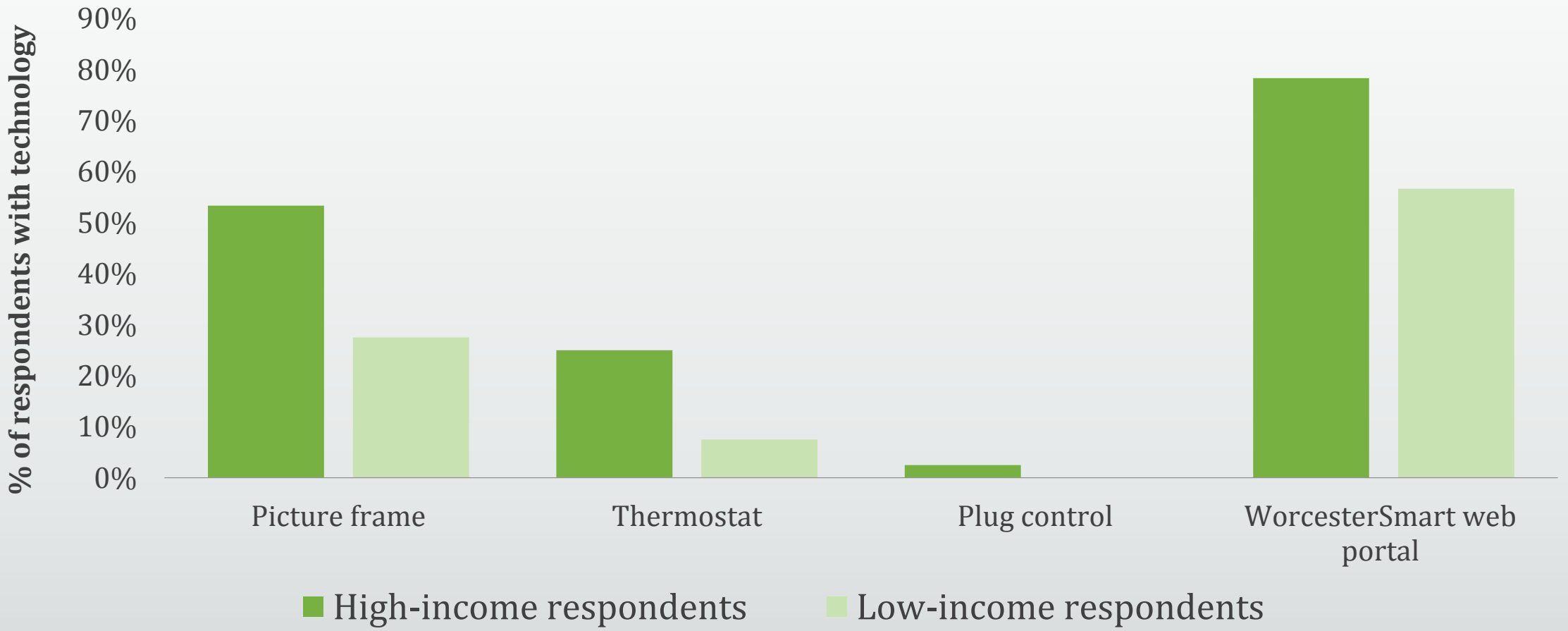
Objectives:

- Determine how residential customers adopted and engaged with smart grid technologies
- Study resulting changes in behavior from engagement with technology and pricing incentives from the utility

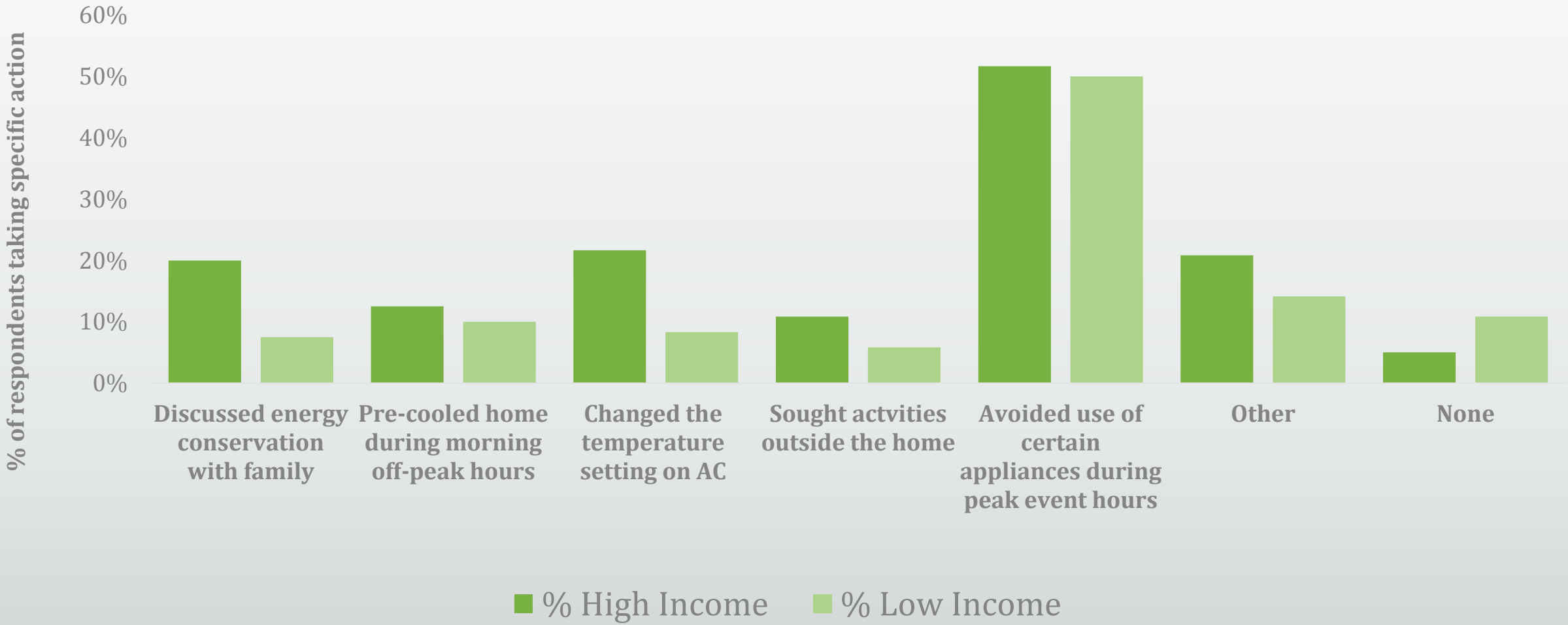
Data

- Analyzed data collected directly from NG customers
- 3 surveys
- N=1301, Random sample = 240

Finding 1: Integration of different technology



Finding 2: Actions taken by SES customers on Conservation Days



Finding 3:Energy savings achieved

- Customers in SES program conserved energy
- 2,300 MWh reduction - or 17 kWh a month per customer
- Most effective pricing structure was the Smart Rewards Pricing - combines Time of Use and Critical Peak Pricing (bill saving of $109)
- Customers in the Conservation Day Rebate plan - modeled in Peak Time Rebate structure (financial savings averaging $20)

Other findings

- Smart grid customers willingly adopted and engaged with in-home technology
- The provision of real time feedback contributed to the socialization of technology
- High-income households took more action to conserve energy because of better access to technology than low-income households

Implications

- Collaboration of “Socialization agents” – for affordable access of smart grid in-home technology to all households. Thus increase socialization.
- Utilities - focus on early adopters, learn from, and involve them as advocates for technology adoption and socialization to other customers.
- Real time pricing influenced behavior - off peak rates, conversely, expensive peak event rates.
- Possibility of rebound effects i.e. Jevons paradox (Sorrell, 2009) - consider environmentally meaningful behaviors to accompany technological influence

Any Questions?

Thank you!!

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