BIG DATA AND ITS BIG POTENTIAL:
Exploring Opportunity at the Intersection of the Smart Grid and Human Behavior

Behavior Energy and Climate Change Conference

November 19, 2013

Opinion **Dynamics**

What potential does big data hold?

Let's explore an example . . .

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Simple dating example:
Find # of acceptable candidates

Problem: How to find the perfect match?

Georgia Rossi at McKinsey Consulting put together a model to help her find suitable men in Sydney Australia where she lives.

Objectives:

- Capture deal breakers
- Show how many datable men in Sydney
- Provide a tool to filter men

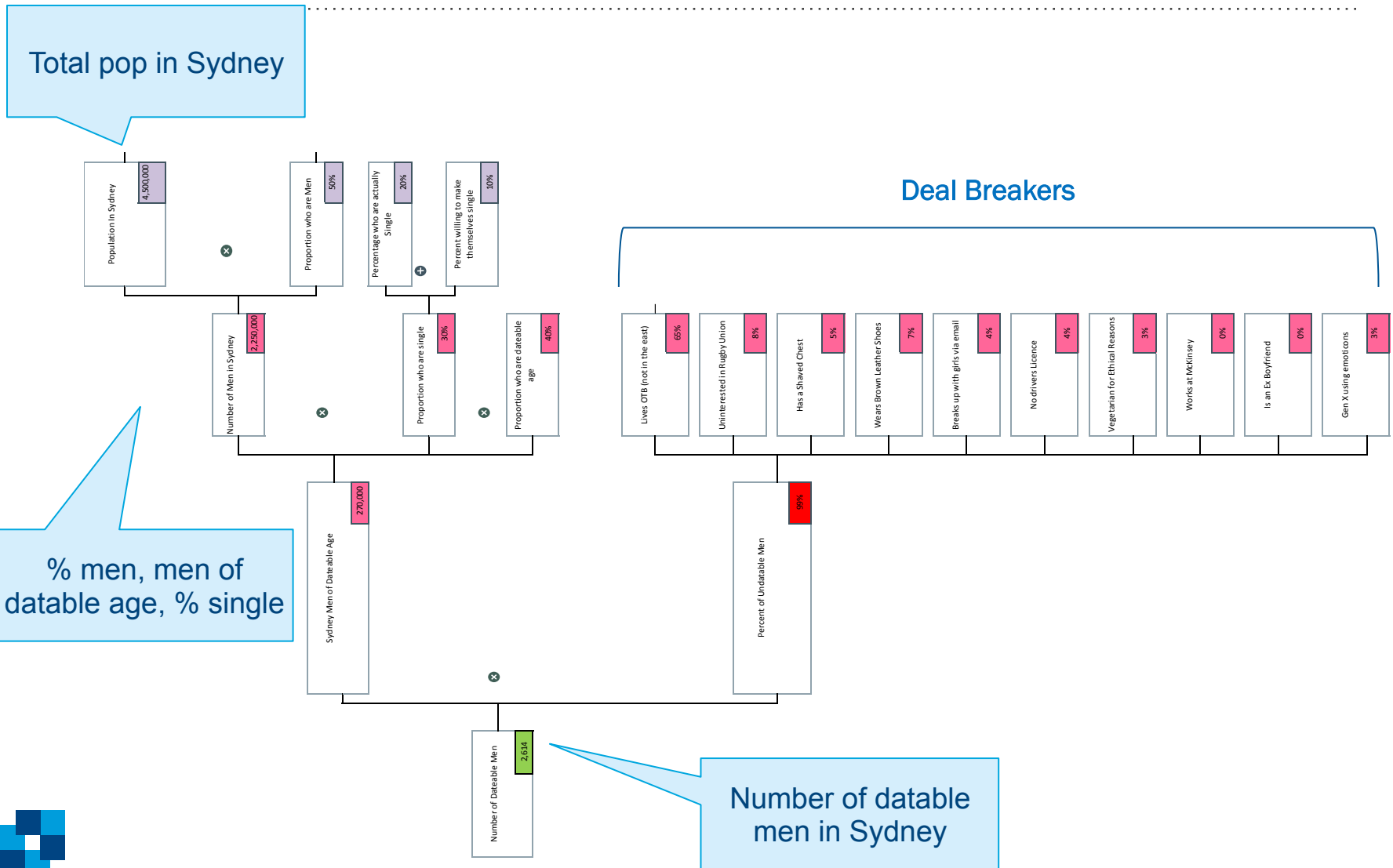| **Instructions for girls** |
| :--- |
| Decide list of deal breakers for your ideal soulmate and input on 'deal breakers and |
| - assumptions' tab - toggle assumptions |
| - View possible number of men available based on deal breakers in 'size of the pond' |
| Find man (this is the easy part - they don't have nearly as many deal breakers.. |
| - Although hopefully they don't mind girls who do) |
| - Get candidate to fill out survey |
| - View candidate prospects in 'confidential results' tab |
| - Fall in love, safe with the knowledge you haven't compromised … true love waits |

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Deal Breakers and Assumptions

Assumptions			
Population of Sydney	4,500,000	Married	30%
Proportion who are men	50%	De Facto	25%
Proportion who are dateable age	40%	Player in relationship	10%
		Devoted Boyfriend	15%
		Single	20%

Deal Breakers	Proportion of population		Sources
	%	Number	
Lives OTB (not in the east)	65%	175,500	Bridge traffic analysis
Uninterested in Rugby Union	8%	21,600	Pub chat
Has a Shaved Chest	5%	13,500	Beach perving
Wears Brown Leather Shoes	7%	18,900	CBD analysis
Breaks up with girls via email	4%	10,800	Teary female friends
No drivers Licence	4%	10,800	I've heard
Vegetarian for Ethical Reasons	3%	8,100	Tom Campey + mates
Works at McKinsey	0%	81	Know stalking
Is an Ex Boyfriend	0%	5	Hand tally
Gen X using emoticons	3%	8,100	Hand tally
	99%	267386.4	

Decision tree to narrow down the candidates

Total pop in Sydney

% men, men of datable age, % single

Number of datable men in Sydney

Deal Breakers

Population in Sydney	4,500,000
Proportion who are Men	50%
Percentage who are actually Single	20%
Percent willing to make themselves single	10%

Number of Men in Sydney	2,250,000
Proportion who are single	30%
Proportion who are dateable age	40%

Sydney Men of Dateable Age	270,000

Lives OTB (not in the east)	65%
Uninterested in Rugby Union	8%
Has a Shaved Chest	5%
Wears Brown Leather Shoes	7%
Breaks up with girls via email	4%
No drivers Licence	4%
Vegetarian for Ethical Reasons	3%
Works at McKinsey	0%
Is an Ex Boyfriend	0%
Gen X using emoticons	3%

Percent of Undatable Men	99%

Number of Dateable Men	2,614

Results – 2,613 datable men in Sydney

The Suitor

Candidate Results

Dateable if Desperate

Dateable

Undatable

There is a limited amount of dateable men in Sydney once one is strict about who one dates..

Sydney Men of Dateable Age	Lives OTB (not in the east)	Uninterested in Rugby Union	Has a Shaved Chest	Wears Brown Leather Shoes	Breaks up with girls via email	No drivers Licence	Vegetarian for Ethical Reasons	Works at McKinsey	Is an Ex Boyfriend	Gen X using emoticons	Dateable men
270000	-175500	-21600	-13500	-18900	-10800	-10800	-8100	-81	-5.4	-8100	2613.6
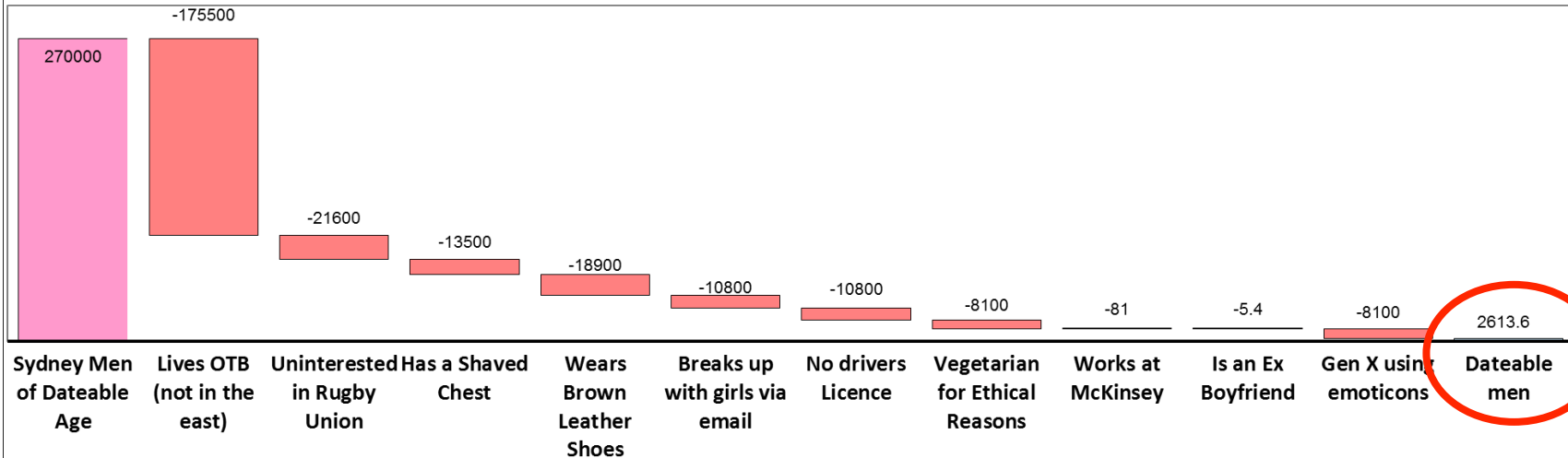
But how to find them?

The model doesn't help with this.

Effective use of data is about more than knowing the size of your population – or potential for energy savings.

Need to know *where* your target population spends their time and how to *reach* them.

Big data on the customer side can help!

This is where micro-targeting and segmentation are useful.

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Segmentation and microtargeting go hand-in-hand

SEGMENTATION

- Defines and divides population into identifiable groups based on <u>socio-demographics, attitudes, beliefs,</u> and other characteristics
- Segments useful for creating relevant <u>messaging and outreach</u>

Past Participation
- Highest
- Medium
- Lowest

High Ability

Complacent Consumers

Impact Seekers

Rebate Oppor-tunists

Not Motivated

Renters

Very Motivated

Resigned Retirees

Simple Savers

Low Ability
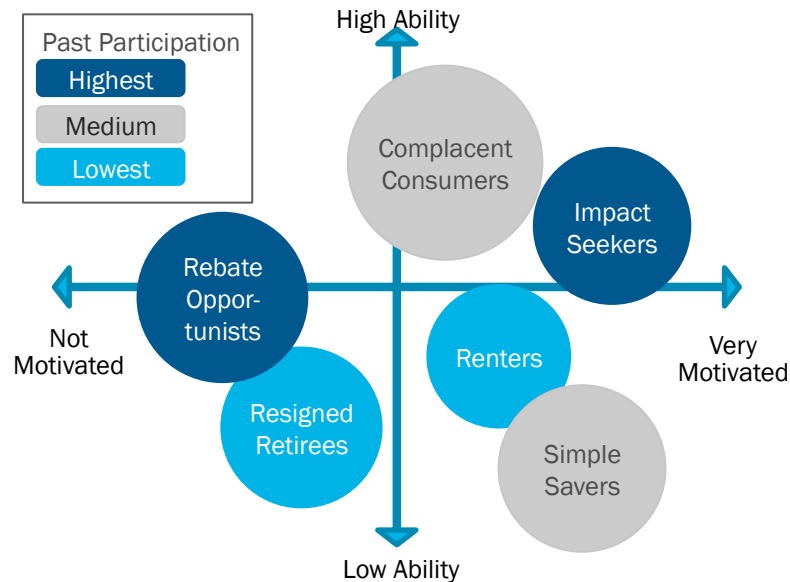
MICROTARGETING
(Propensity to Act)

- Microtargeting scores individual customers on their <u>likelihood to take a specific action</u> (e.g., participate)
- Uses data on <u>past participation, customer characteristics, perceived opportunity, ability to pay</u>
- The best "targets" from microtargeting may belong to different segments

High score: Best target for program

Use segment insights for positioning

Account	Demand Response	Home Energy Audit	Segment
20010203	2	99	B
11212322	66	41	A
29215134	20	16	A
44321278	31	50	C

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Identifying opportunities takes energy information and customer information

Consider three layers of engagement for each customer

Likely Adoption
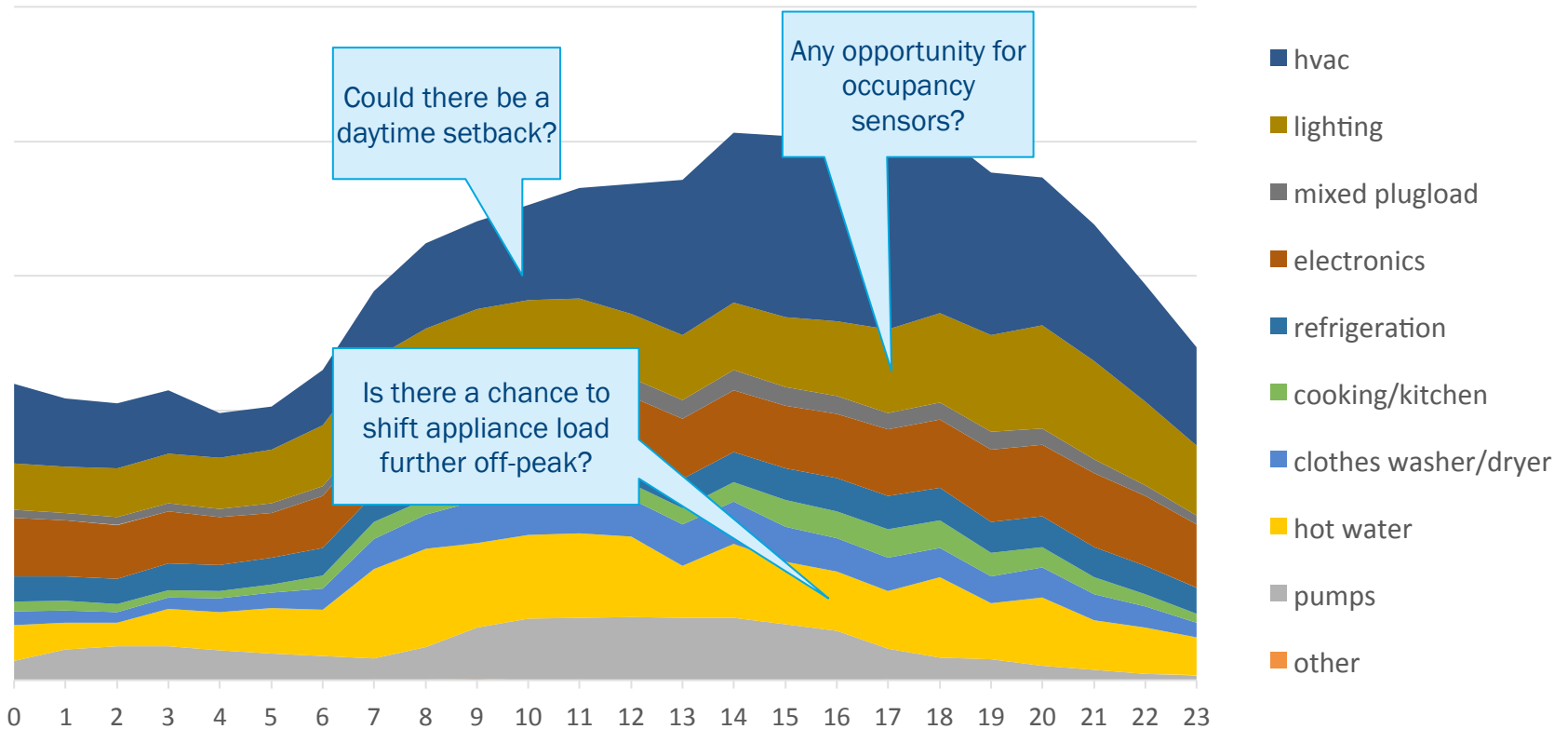*(function of attitudes/ beliefs, trust in utility, perceived opportunity, perceived ability to pay)*

Microtargeting (Propensity to Act)

*Propensity models based on **past participation** incorporate adoption decision (explicit) and perceived opportunity (implicit).*

Energy Opportunities
(function of home, equipment, load shapes)

Energy Potential

*"Mass customization" of building energy savings models frame **specific opportunities** for customers.*

Relevant Messaging
(function of barriers, motivations, attitudes/beliefs; related to sociodemographics)

Customer Segmentation

*Energy-oriented segmentation informs **positioning and messaging***

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Customer potential lies at intersection between likelihood to take action and "objective" savings opportunities

Participation / Uptake Potential

Portfolio target

Load Shape Opportunity

- *Motivations A*
- *Load shape C*

- *Motivations B*
- *Load shape B*

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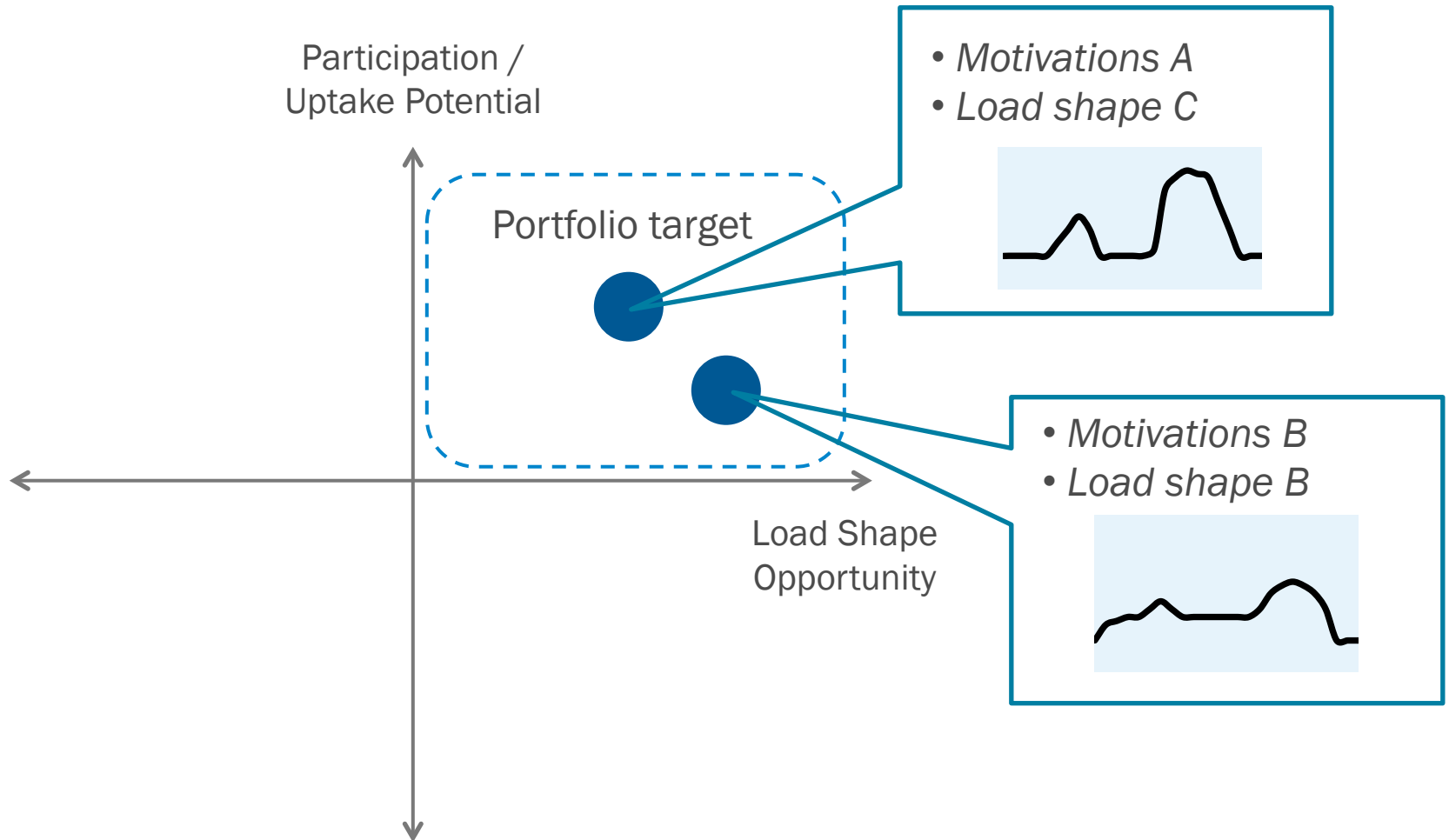
Examine end-use load shapes by segment to understand magnitude of energy waste

Segment 2 Hourly Usage by End-Use:
Average Summer Day

Could there be a daytime setback?

Any opportunity for occupancy sensors?

Is there a chance to shift appliance load further off-peak?

Legend:
- hvac
- lighting
- mixed plugload
- electronics
- refrigeration
- cooking/kitchen
- clothes washer/dryer
- hot water
- pumps
- other

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

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Residential load shapes can be disaggregated to show different types of usage behavior

1. Thermal
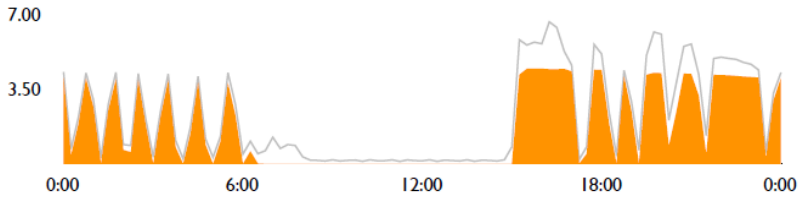
Figure 1. Thermal Load as Share of Whole Home

2. Always On
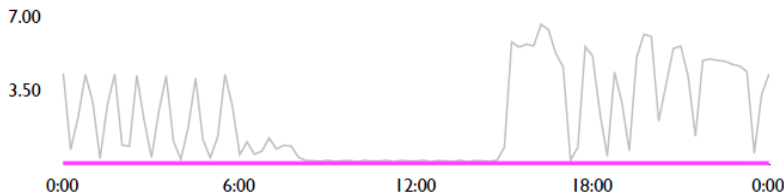
Figure 2. Always On Load as Share of Whole Home

3. Intentional/Plug In

Figure 3. Intentional Load as Share of Whole Home

4. Electric/Gas Substitutes
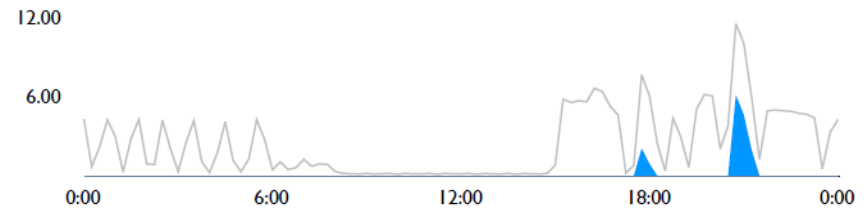
Figure 4. Electric - Gas Substitutes: Electric Clothes Dryer as Share of Whole Home

Total
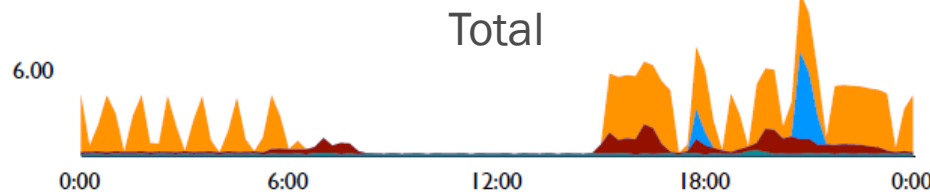
Figure 6. Whole Homes Use by Four Categories: Always On, Thermal Load, Intentional Load, Electric - Gas Substitutes

Source: Pecan Street publication, 2013. "Data Driven Insights from the Nation's Deepest Ever Research on Customer Energy Use."

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Segmentation: Load Shape Segmentation & Profiling

*Whole-house interval data can be used to **identify patterns in load shapes** that may represent opportunity; metered contextual and behavioral data can then enable us to **understand program and product opportunities.***

cluster similar patterns

Whole-House Load Shapes

Load Shape Segments
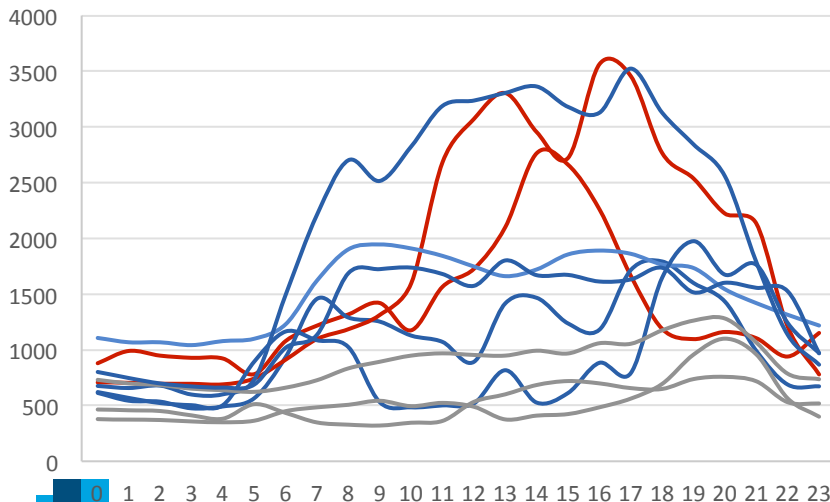
- Segment 1
- Segment 2
- Segment 3
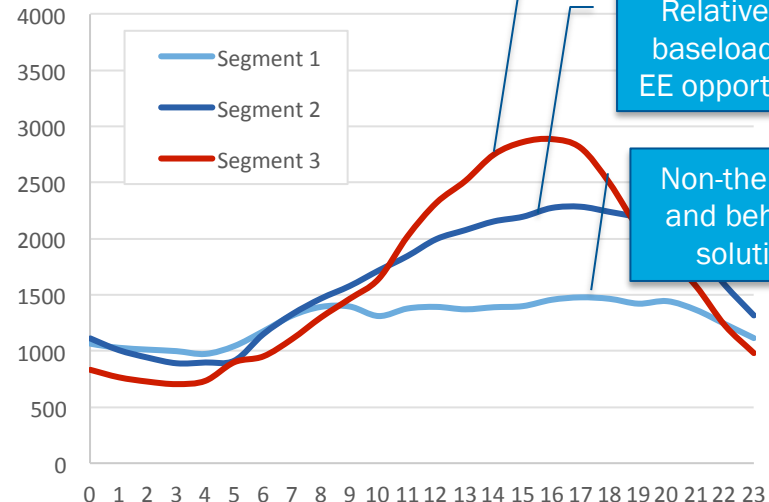
Potential for DR *or* CAC & envelope efficiency?

Relatively high baseload; many EE opportunities?

Non-thermal EE and behavioral solutions?

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Identify opportunities specific to each load shape segment

Seg-ment	Key Characteristics	End-Use Notes	Weather-ization	AC Rebate	Conserv-ation Behaviors	Demand Response	Dynamic Pricing
1	Consistently high baseload but limited peak	Steady HVAC use. Off-peak appliance use.	✓	✓			
2	High baseload and high, extended peak	On-peak HVAC, lighting; variable appliance use	✓	✓	✓	✓	✓
3	Lower baseload and high, compressed peak	On-peak HVAC, lighting, *and* appliance use			✓	✓	✓
4	Generally low load	Limited/no AC use	✓		✓		

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Whole-house and end-use metering data can identify specific program opportunities

Valuable for a single customer...   **...And valuable at scale**
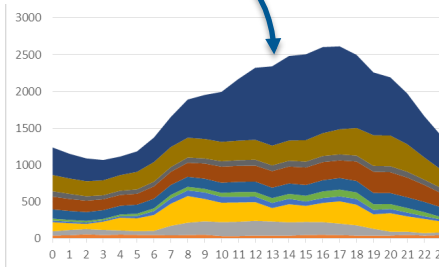
Recommendations:
- ☑ Duct sealing
- ☑ Lighting upgrades
- ☑ Direct load control
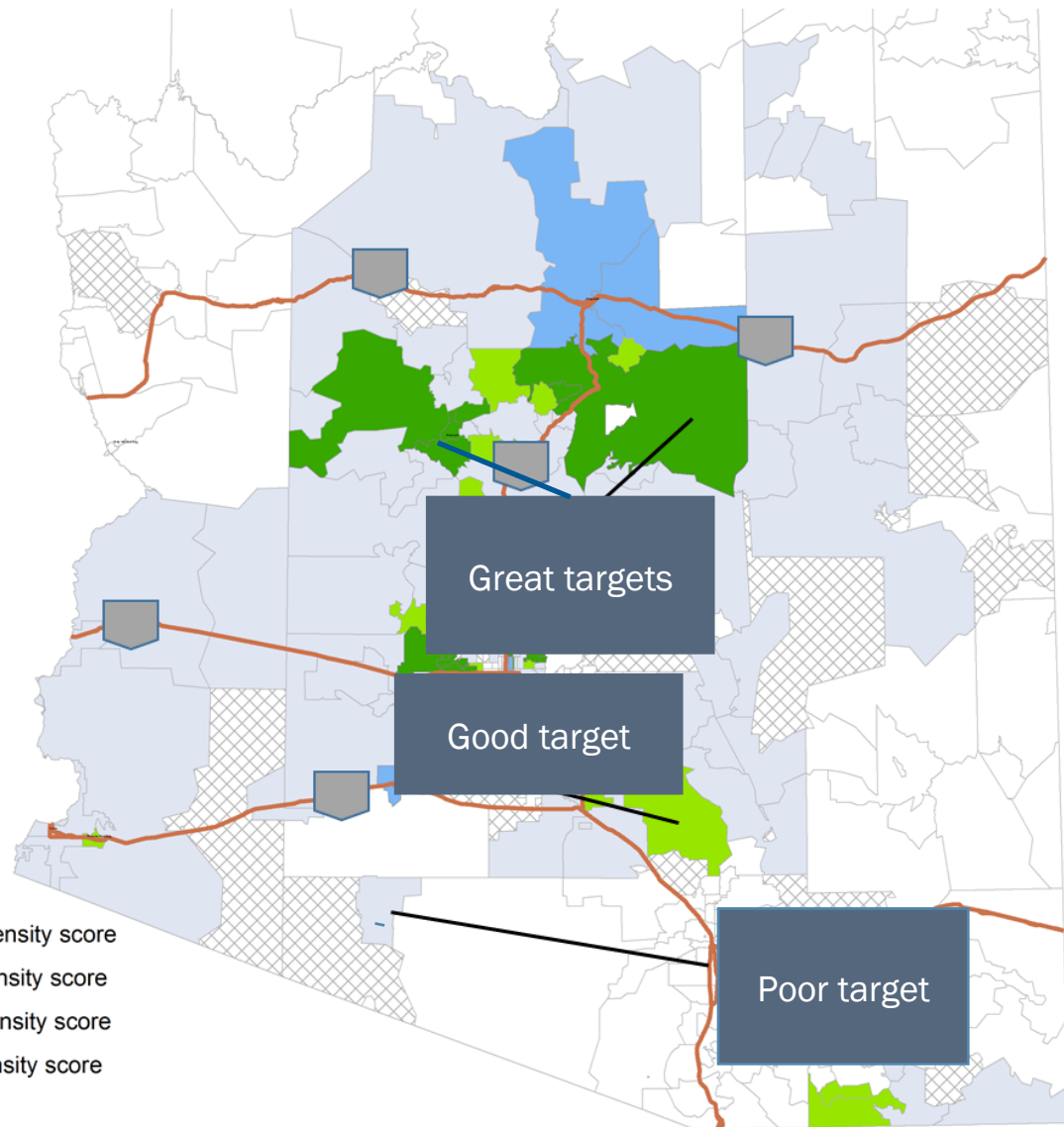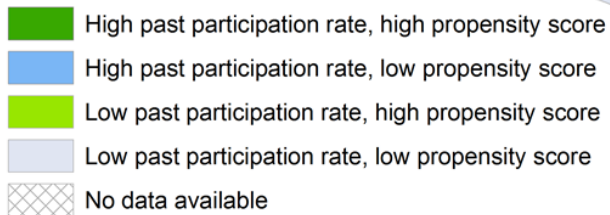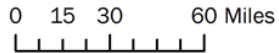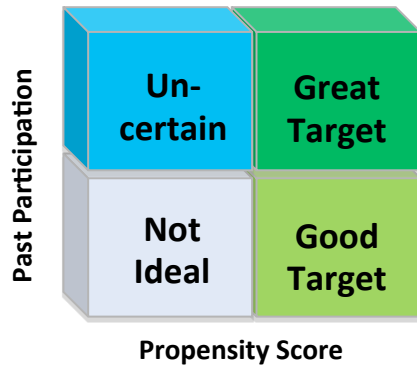
Good candidates for weatherization

High potential savings from DR
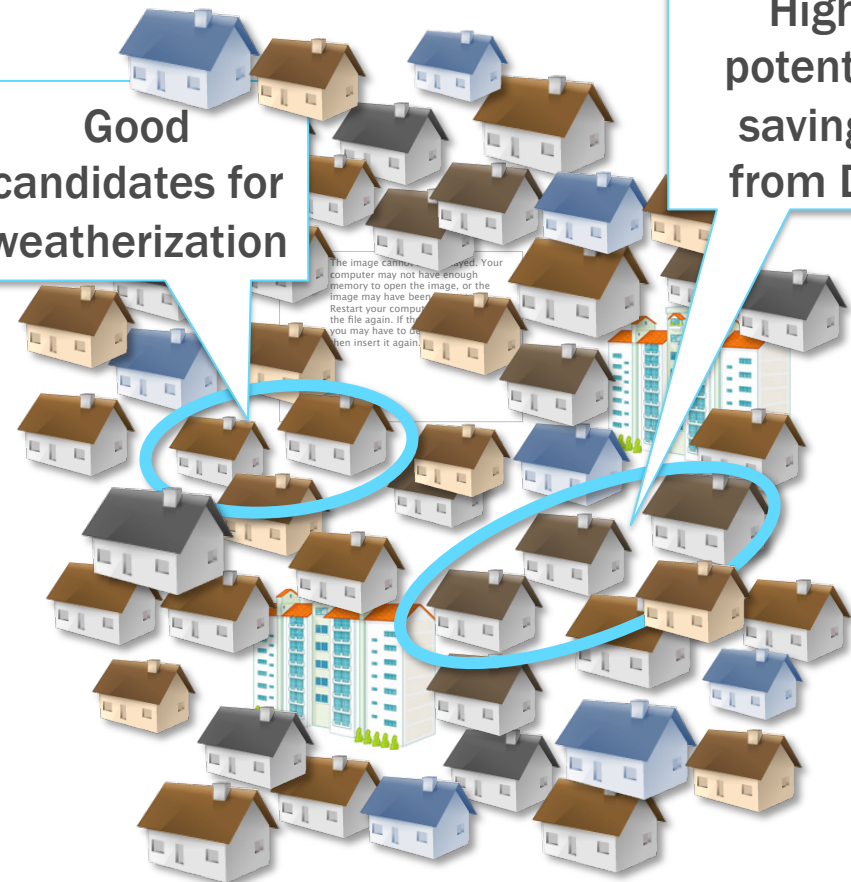
GIS mapping enables graphical representation of propensity, energy potential, and customer segmentation -- yielding immediate insight

GIS Mapping helpful for all three layers

Microtargeting (Propensity to Act)

Where are customers with high propensity scores located? Are they clustered in certain zip codes or towns?

Energy Potential

Where in the service territory are the customers with high energy saving potential?

Customer Segmentation

Where are the relevant customer segments located? Are they spread out but denser in some areas?

Map showing good targets for EE: areas with high past participation rate and high propensity to act

Past Participation / Propensity Score legend:
- Un-certain
- Great Target
- Not Ideal
- Good Target

Legend:
- High past participation rate, high propensity score
- High past participation rate, low propensity score
- Low past participation rate, high propensity score
- Low past participation rate, low propensity score
- No data available

0 15 30 60 Miles

Great targets

Good target

Poor target

Past participation rates, propensity scores, and demographics can be mapped to answer specific questions

- *Example question:* What areas have relatively high propensity scores, but relatively moderate or low income?

- Hot spot analysis can identify neighborhood-level opportunities

- Segmentation characteristics can help inform how to reach those individuals (type of messages, trusted authorities; direct mail v. email v. calling v. in-language, etc.)
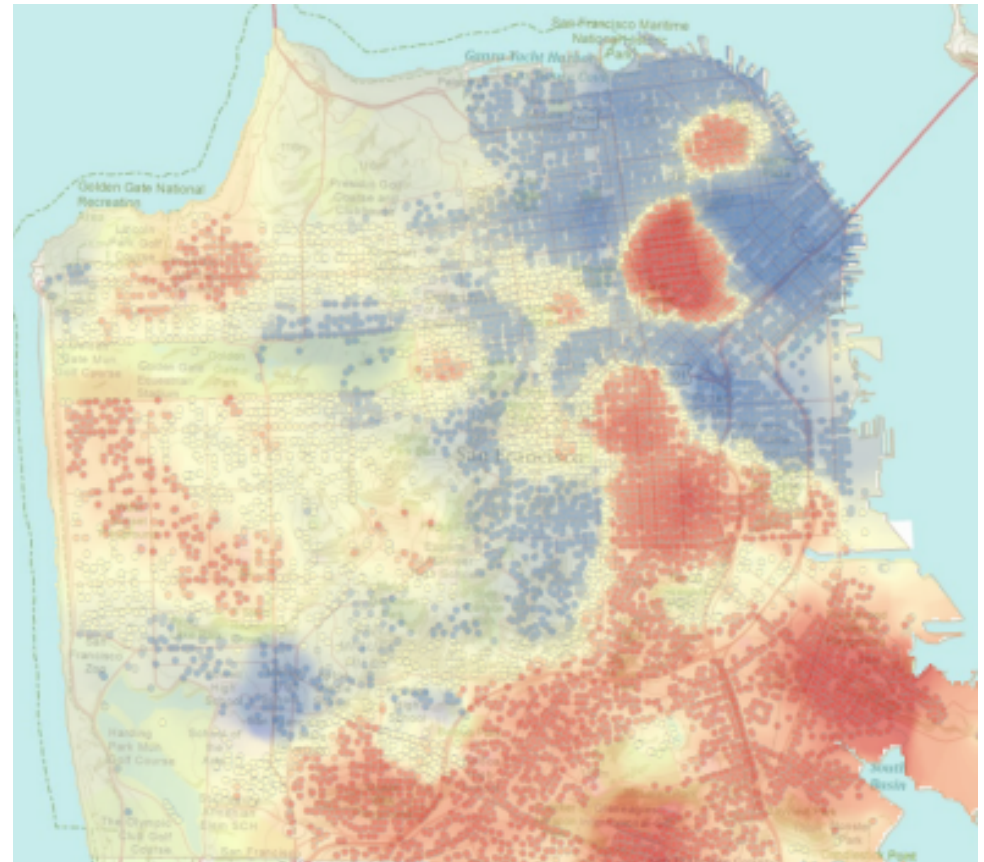
Source: ESRI (ArcGIS Resources)

Conclusions

- Harnessing big data is more than just calculating potential – it's about gleaning nuance to reach and to engage your audience

- Customers can be grouped based on individual characteristics visible in the data being collected now

- Finding ways to use the information that we have is the greatest challenge going forward

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Thank You

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Using all three layers can achieve increased engagement, relevance and adoption

Propensity to Act

Develop microtargeting models for specific programs/offerings based on past adoption/ participation data
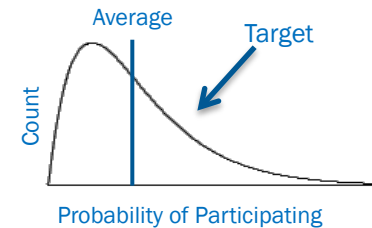
Energy Potential

Apply energy opportunities models (e.g., building simulation or load profile segments) to quantify specific opportunities aligned with each program

Segmentation

Develop (or leverage existing) segmentation around energy- and utility-specific barriers and levers

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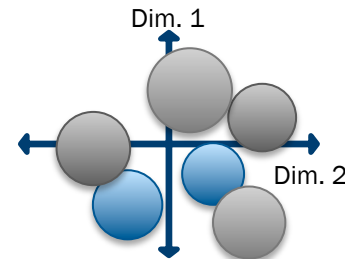
Combine energy potential research with ethnographic insights to understand how to develop tailored solutions

Survey findings and ethnographic insights can help explain why some households use much more energy than others (controlling for size, etc)

Key Findings: Pellentesque tempor magna eget purus accumsan, at pretium erat fringilla. Proin ultrices urna sit amet felis consequat, lobortis scelerisque eros egestas. Quisque vitae lectus sit amet mauris pretium bibendum.

Lobor sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.

Implications: Proin sollicitudin risus sed ligula ullamcorper consectetur. Praesent pretium placerat lorem et euismod.

Nam vulputate elit mi, sit amet sollicitudin lectus pellentesque vel. Etiam a tempus libero, sed tristique leo. Vivamus imperdiet, nulla id aliquet mollis, nunc

Fusce velit lacus, facilisis ac ullamcorper vitae, ullamcorper sodales justo. Nulla ut ultricies odio. Nunc non orci vehicula, pretium mauris quis, mattis .

Energy Intensity (annual btu per sq ft)
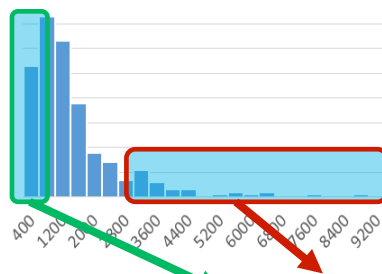
|	Low Intensiy	High Intensity
Avg. interior temp	77 deg	75 deg
Shift major appliance use to off-peak	14%	8%
Relative importance in energy decisions:		
Comfort	33%	40%
Convenience	40%	45%
Cost	27%	15%

"We try to keep the lights off more. The tv and lights provide us with enough lighting. I also have a infrared thermometer to look for hot or cold spots to find holes in the insulation."

"I lower the heater at night, and only raise it when I am in the house. Sometimes I just stuff dishtowels into the exhaust fan in the kitchen."

Nunc non orci vehicula, pretium mauris quis, mattis ipsum. Aliquam vel nisl id turpis imperdiet consequat vitae in nisi. Nam id aliquet urna. Ut fringilla purus metus, eget facilisis leo pretium eget. Cras consectetur faucibus elementum. Nulla vel vehicula augue.

Proin purus nibh, mattis nec venenatis vel, lobortis id mauris. Aenean nec lobortis nunc. Proin vitae scelerisque metus. Donec non tincidunt ligula. Nam eros odio, sodales id velit id, ultricies posuere ipsum.

Average Hourly kWh, Region 1
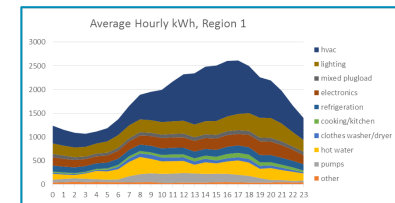
Donec non ultrices orci, non pharetra tellus. Morbi ac eleifend est. Suspendisse ultrices sed tortor vitae euismod. Nullam a orci eu massa faucibus eleifend gravida nec massa. Vivamus feugiat vitae nisl convallis blandit. Vivamus suscipit tristique gravida.
Morbi consequat leo elit, eu dapibus quam sollicitudin ac.
Nam id aliquet urna. Ut fringilla purus metus, eget facilisis leo pretium eget. Cras consectetur faucibus elementum. Nulla vel vehicula augue. Vivamus suscipit tristique gravida.

Utilities have a wealth of data on-hand to understand behavior and improve engagement

Past program participation – DSM and non-DSM

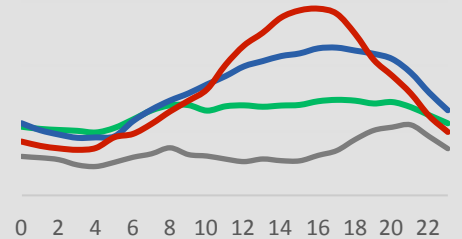| Account	TOU Rate	Energy Audit	Ref. Rebate
A	✓		
B		✓	
C			✓

Customer engagement – e.g., online activity, payment preferences

payment options

pay online

one-time payment

Energy indicators – e.g., seasonal usage, load shape

0 2 4 6 8 10 12 14 16 18 20 22

Customer characteristics from CIS data – e.g., rate class, time-as-customer

New   1-4 yrs 5-9 yrs 10-19 yrs 20+ yrs
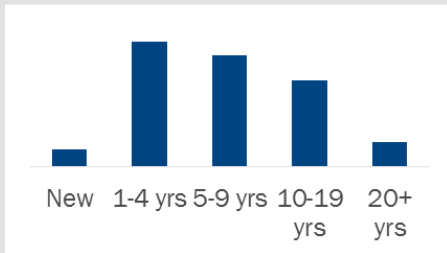
Secondary demographic/ housing data – e.g., age, income, home value