



Water Savings Clustering: Impact of Social Norms at Household Level

William Holleran, Head Data Scientist

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Background

- Masters Applied Econometrics
- Energy Efficiency Consulting
 - Evaluated Demand Response programs
 - Impact Evaluation of Social Norms based programs using regression modeling
- Transitioned from modeling with kWh to GPD and started at WaterSmart
- Head up research at WS

Outline

- Description of WaterSmart's Engagement program

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- Evaluation Methodology at Program Level

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- **Email Subject Line Analysis**

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- Application and Results of Synthetic Controls Model

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- Application and Results of Synthetic Controls Model
- Extensions and Conclusions

WaterSmart Program Summary

About WaterSmart[®]

WaterSmart empowers utility managers with actionable insights to increase customer satisfaction, reduce non-revenue water, and improve operational efficiency.

Our award winning software is designed, developed, and delivered in the United States.

HEADQUARTERS

San Francisco

FOUNDED

2009

AWARDS

Global CleanTech 100

Global Water Intelligence “Top 20”

BCorp Best for the Environment

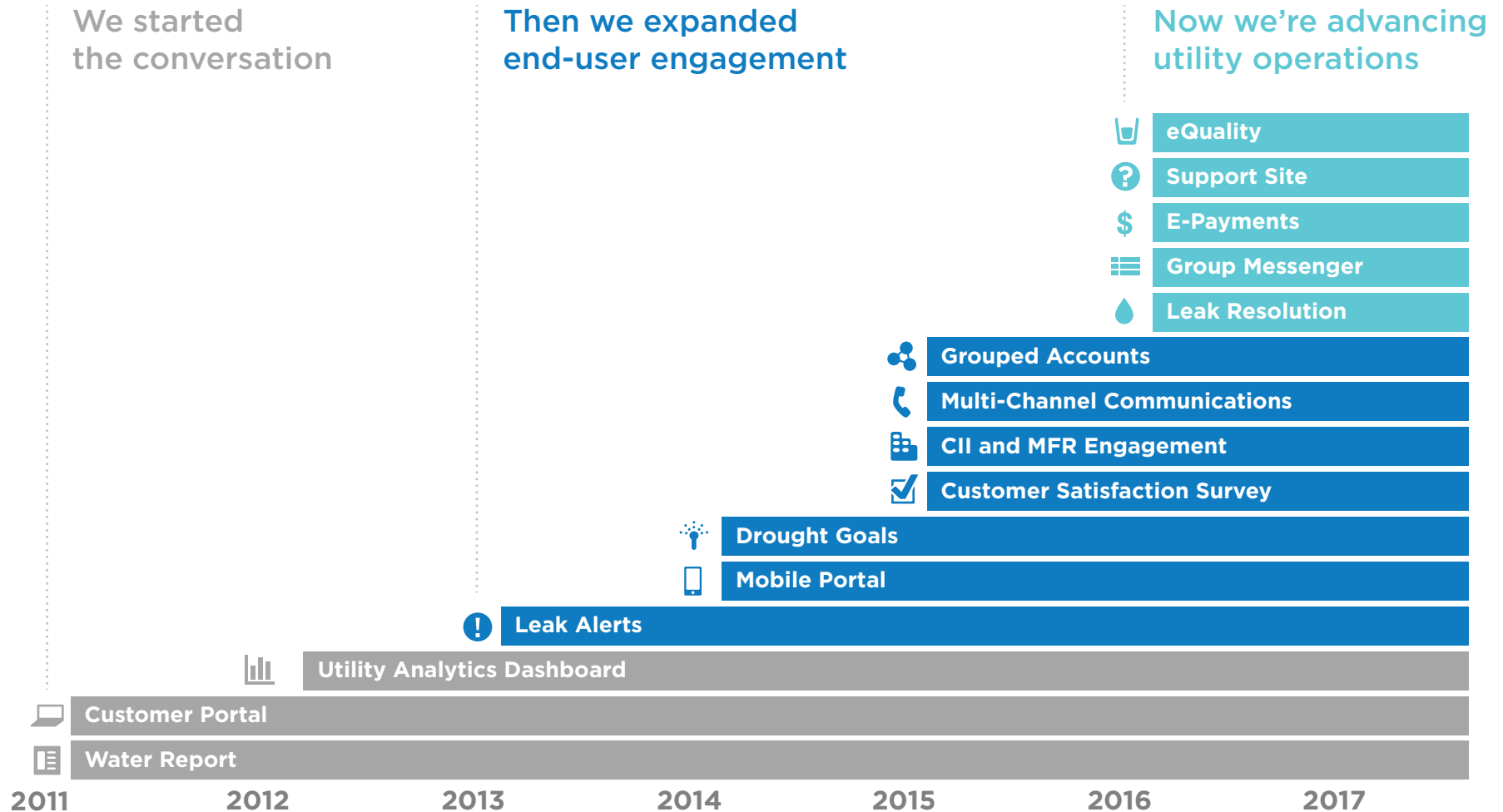
Sustainia 100

OUR PARTNERS INCLUDE
50+ UTILITIES IN 8 STATES
3M ACCOUNTS



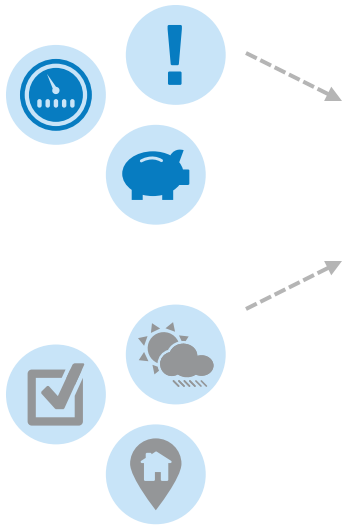
AMERICAN WATER

Increasing pace of innovation

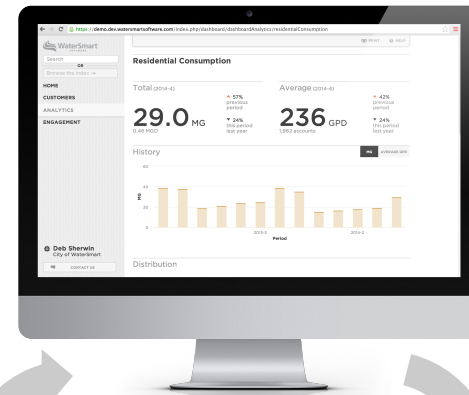


WaterSmart Platform

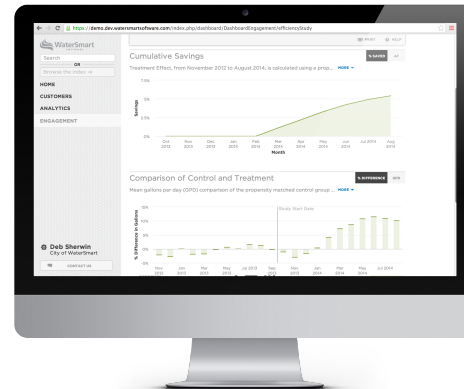
UTILITY DATA
Meters, Rebates &
Incentives, Violations



ANALYZE
Utility Dashboard



EXTERNAL DATA
Surveys, Property,
Climate



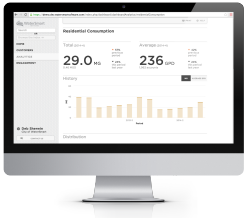
MEASURE
Report results,
outcomes, and trends



ENGAGE
Customer Portal,
Outbound Comm.

Targeted, timely messages

ANALYZE



Utility Analytics Dashboard

- Understand consumption trends & causes
- Leverage customer intelligence
- Support and engage with your customers

ENGAGE

Meter

Manual

AMR

AMI

Type



Attribute

Geography

Property characteristic

Income

Behavior

Program participation

Consumption level

Water end uses

Channel



MEASURE

Measurable outcomes

ANALYZE

ENGAGE

MEASURE



Engagement

- ↑ 36% Increase customer satisfaction
- 65%/10% Email open/click rate
- 70% Behavior change of recipients
- 15%-24% Profile updates
- 1.2x/2.5x Portal visits per year by customers with billing/interval data
- 10% AMI customers that are habitual Portal users: >5x/year
- 87% Continue Reports



Operating efficiencies

- 15-30% Email acquisition
- 2-6% Water savings rate
- 23% Decrease in leak duration
- Faster Call resolution
- Target and send group messages
- Track outreach and measure impact

Benefits of opt-out

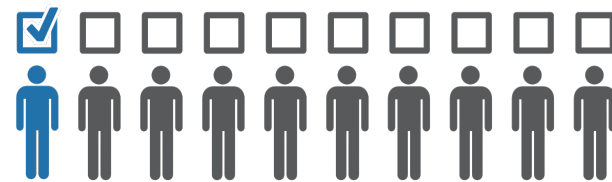
Opt-Out

- 82% retention rates
- ‘Push’ communications
- Maximum engagement
- Allows for randomized control trial & statistically significant M&V



Opt-In

- 14% opt-in rates
- ‘Pull’ communications
- Requires additional outreach and cost to drive adoption
- Self-selection bias excludes ability to measure results



Welcome Letter

- Utility branding
- Sets expectations for program, specific to meter class
- Drives SFR customers to complete profile



WaterSmart Program
123 Main St
Anytown, USA

SERVICE ADDRESS: 456 Washington St.
ACCOUNT NUMBER: 23873124-01



TAKE THE SURVEY

citywater.watersmart.com/survey

415.555.5555

info@citywater.com



WELCOME
TO THE WATERINSIGHT PROGRAM

Dear Blair,

The City of Anytown is excited to introduce you to the WaterInsight Program. This free service is part of our commitment to provide you with the best tools to manage your water use. I encourage you to get started today by completing the water-use survey.

Sincerely,
Pat Jones
Mayor of Anytown

TAKE THE SURVEY

citywater.watersmart.com/survey

We estimate that your household includes

4 people

Please complete the survey above to ensure your Home Water Report provides accurate comparisons and recommendations.

Finish by December 15 for a chance to win two \$50 gift cards—one for you and one for a friend.*

*Sponsored by our survey vendor.

WHAT YOU'LL GET

You'll receive bimonthly Home Water Reports and access to the WaterInsight Portal.

- How you compare** See how your water use compares to similar homes.
- Ways to save** Get personalized, step-by-step actions.
- News and events** Stay up to date.



Water Report

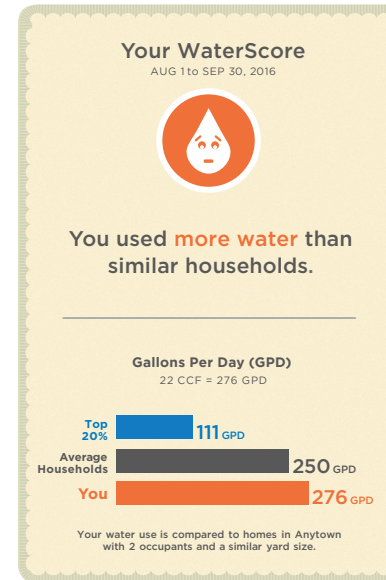
- Utility branding
- Personalized
- Water use in GPD
- Comparison: Social, Historical, or water budget
- Two targeted messages per report (one custom per cycle)
- Water-saving actions
- Periodic delivery

WATERSMART SOFTWARE

SOCIAL COMPARISON

 **City Water** | WaterSmart Program
123 Main Street
Anytown, USA

☎ 415.555.5555 ✉ info@citywater.com




YOUR HOME WATER REPORT


THIS IS AN INFORMATIONAL REPORT AND NOT A BILL.


SERVICE ADDRESS: 456 Washington St., Anytown
ACCOUNT NUMBER: 123873124-01

 GO PAPERLESS. SEE ALL INFO & PRODUCTS AT:
citywater.com

Blair Jones
456 Washington St.
Anytown, USA

 Surprised by your WaterScore?
Your WaterScore compares your use to others in City Water District who also have **2 occupants** and a **similar yard size**. Is your household different? Log on to update your profile and see adjusted comparisons.
citywater.com

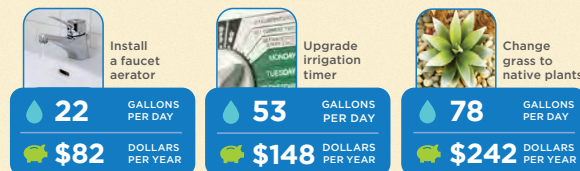
 Focus on your outdoor use
An estimated **65%** of your annual use is for irrigation.



Water-saving actions just for you

Selected based on your household characteristics, yard size, and historical water use.
[Log on to update your profile](#)

Potential savings if you:



Log On

Get your full list of recommended actions, and see:

- Where you're using the most
- Your progress over time
- Efficient products for purchase

citywater.com

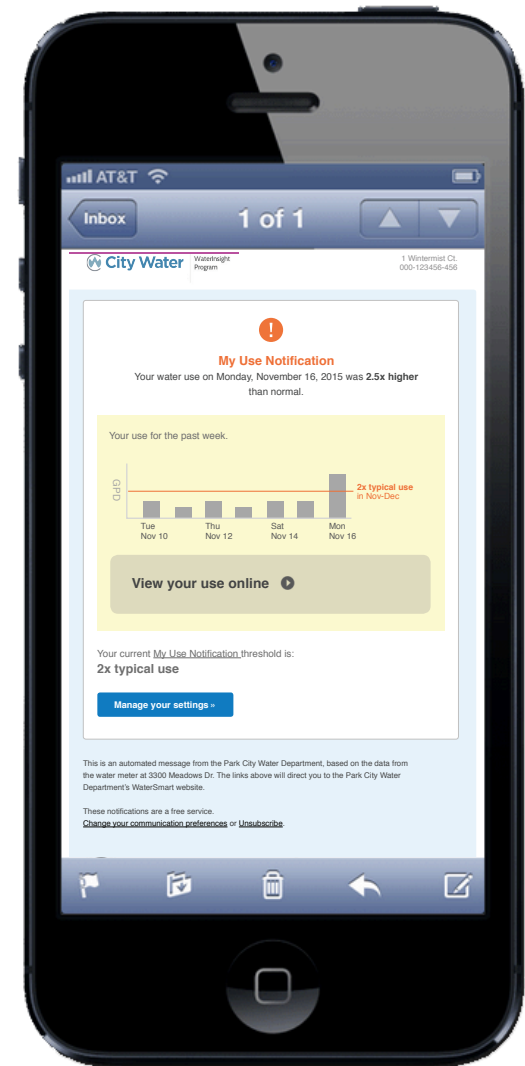
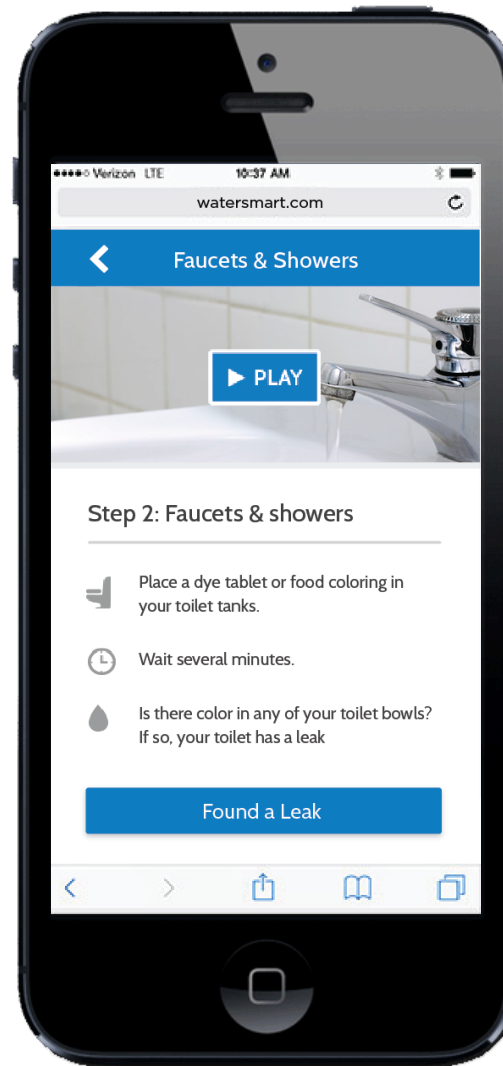
Account: 123873124-01
Zip Code: 98765

A free service offered by your water utility and powered by WaterSmart Software™

Alerts and notifications

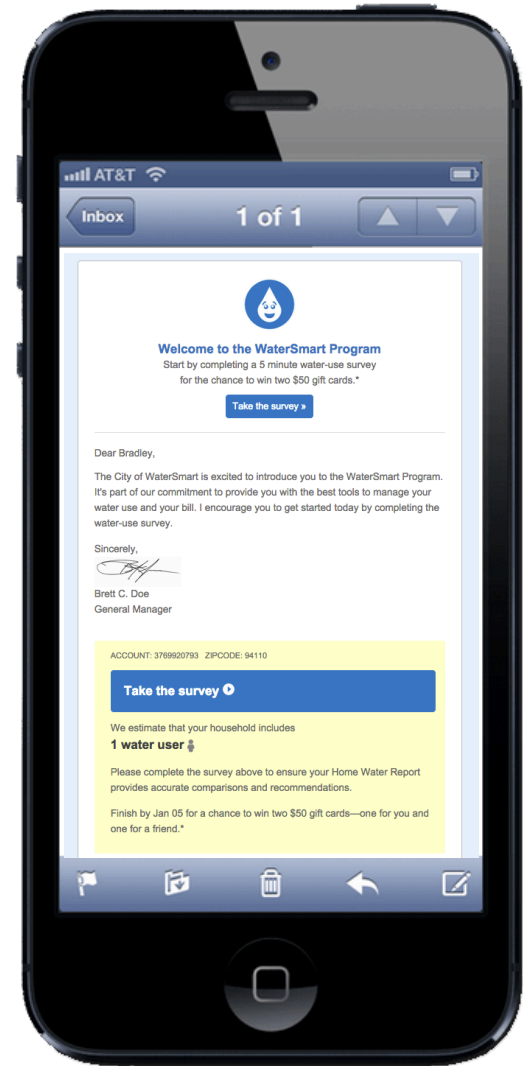
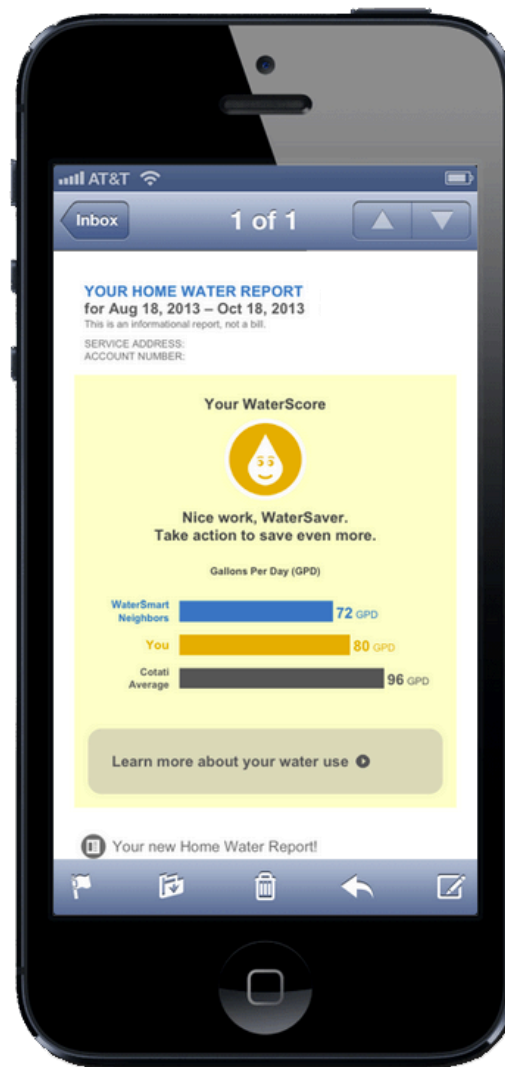
Email, text, or voice

- Leak alerts
 - Direct online for self-service in pinpointing time and source of leak
- My Use notifications
 - Customer can select to be notified if usage exceeds threshold
 - Daily or billing



Digital or print delivery

- All letters/reports can be delivered via email
- Convert customers as email addresses are obtained
- Personalize subject lines and links to Portal



Evaluation Methodology at Utility Level

Program Design (RCT)

- Randomized Control Trial Design for Each Implementation

1. Random Assignment



2. Implement
Treatment



3. Monitor
Participation/Usage

Panel Data Structure

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- Bi-Monthly billing utility will have 6 readings per customer per year.
- Time-invariant columns can also be included in the panel data-set

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$$\log(GPD_{i,t}) = \sum_{i=1}^N (\alpha_i * ID_i) + \sum_{t=1}^M (\beta_t * MonthYear_t) + \sum_{t=1}^M (\gamma_t * Treat_i * Post_t * MonthYear_t) + Treat_i + \varepsilon_{i,t}$$

Evaluation Methodology

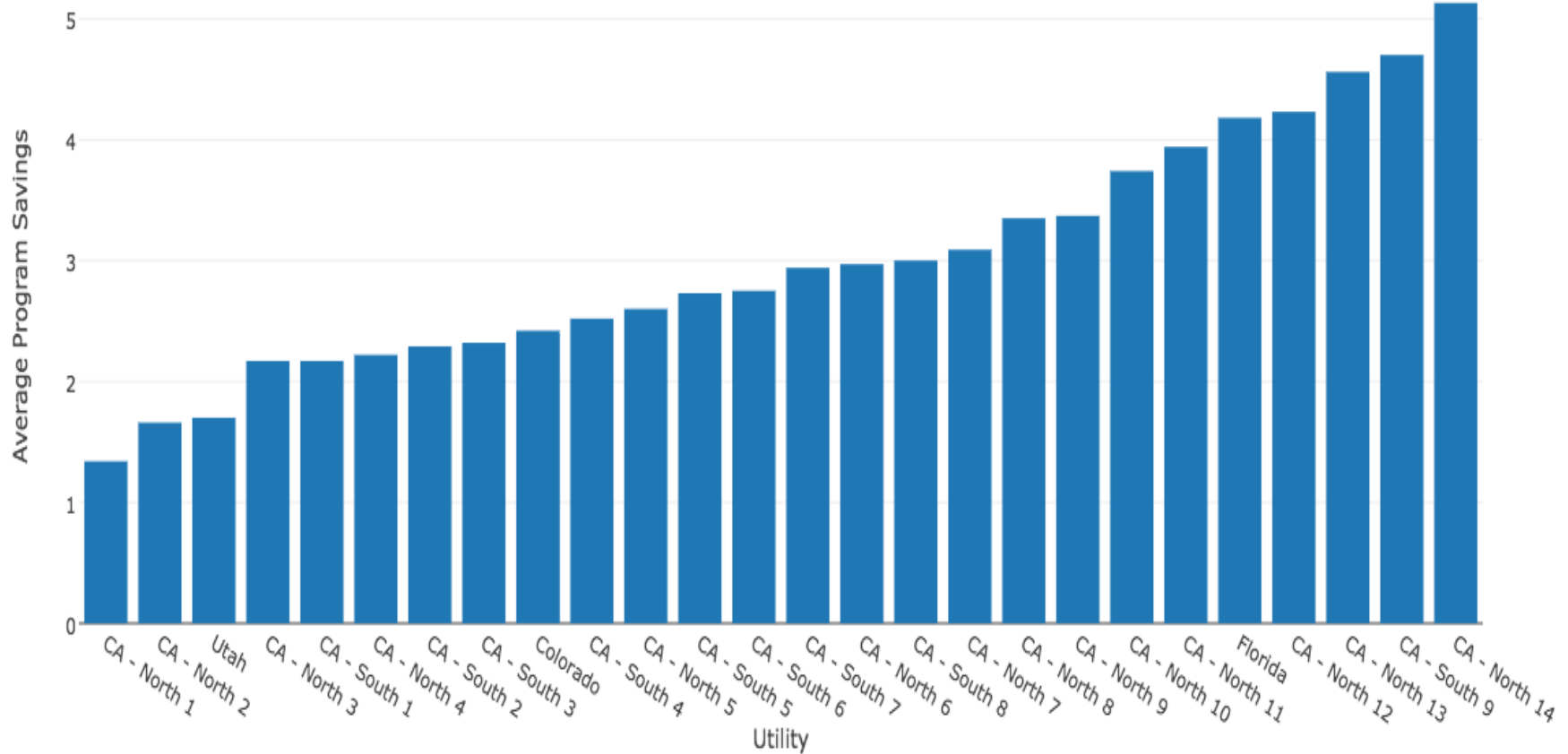
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- Check Standard Errors for statistical significance of each γ
- Only include significant γ 's in savings calculations

Aggregate Results

- 3.3% Average Program Savings (27 Utilities)



Email Subject Line Analysis

Top 5 WR Subject Lines 67% Open Rate

- Alert: {firstName}, 2 days per week watering restrictions are in effect
- Drought Update and your {currentMonth} Home Water Report, {firstname}
- Thanks for caring about your water use, {firstName}. You use {gpd}. Details inside.
- {firstName}, have you saved water this winter? Check here for your new WaterScore.
- Drought Update: We've reduced our water use by 25% and need to get to 28%. Your details inside, {firstName}.

Top 5 (Non Drought) 65% Open Rate

- Thanks for caring about your water use, {firstName}. You use {gpd}. Details inside.
- {firstName}, have you saved water this winter? Check here for your new WaterScore.
- {firstname}, in 2013, your water use was {gpdGoalBasisThisPeriod}. Last month, you used {gpd}. Details inside.
- {firstName}, over the course of the last 12 months, you've used {gpdchangeT12M} {interjectionT12M} water than the prior 12 months. Curious? Look inside.
- Hi, {firstName}. Did you know you used {overMedianPct} more water than average last period? Is your irrigation timer turned down to {wateringPercent}?

Bottom 5 Subject Lines 40% Open Rate

- How does your water use compare to that of other {occupants}-{personLabel} homes? Look inside your Home Water Report to find out.
- {firstName}, did you save water in {readMonth}? Check here for your new WaterScore.
- March is the EPA's fix-a-leak week. It's time to check your toilet for leaks. Here's how.
- {firstName}, do you use less water than similar homes? Find out now.
- {firstname}, 3 Ways For You To Save Money & Water

Top Subject Line Cluster - 'Dynamic And Personalized' Open Rate 62%

- {firstname}, in 2013, your water use was {gpdGoalBasisThisPeriod}. Last month, you used {gpd}. Details inside.
- {firstName}, over the course of the last 12 months, you've used {gpdchangeT12M} {interjectionT12M} water than the prior 12 months. Curious? Look inside.
- {firstname}, thanks for meeting your 20% reduction goal this past month!
- {firstName}, you're using {gpdchangeT12M} {interjectionT12M} water this year than last year. Curious? Look inside.

Worst Subject Line Cluster – ‘Spammy’ Open Rate 46%

- {firstName}: 3 Ways for You to Save Money & Water
- 3 Ways For You To Save Money & Water in {currentMonth}
- {firstname}, 3 Ways For You To Save Money & Water

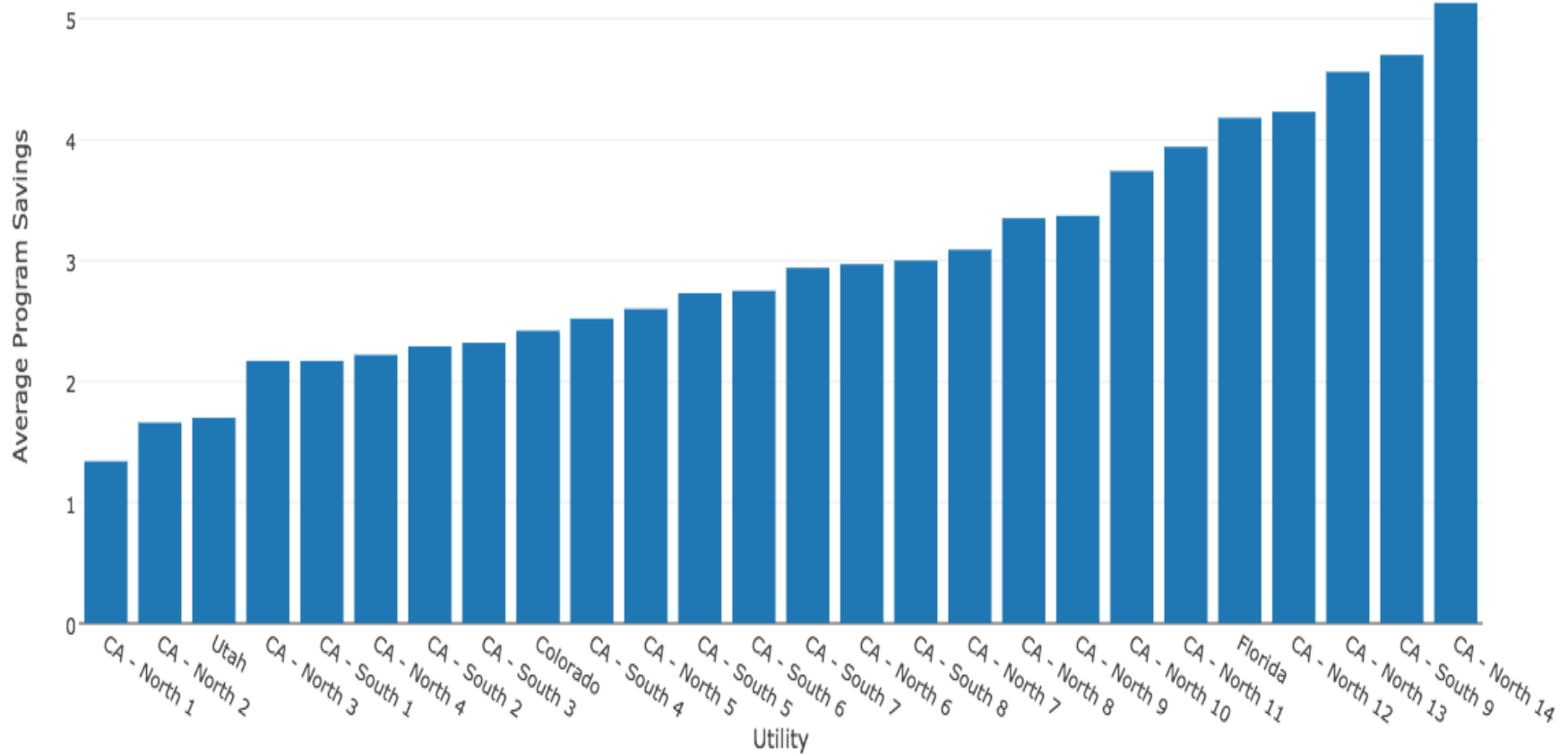
Email Best Practices

- Use unique and personalized subjects.
- Incorporate details about their GPD or GPD change
- Don't use subjects that have no personalized information

Program Level Results

Aggregate Results

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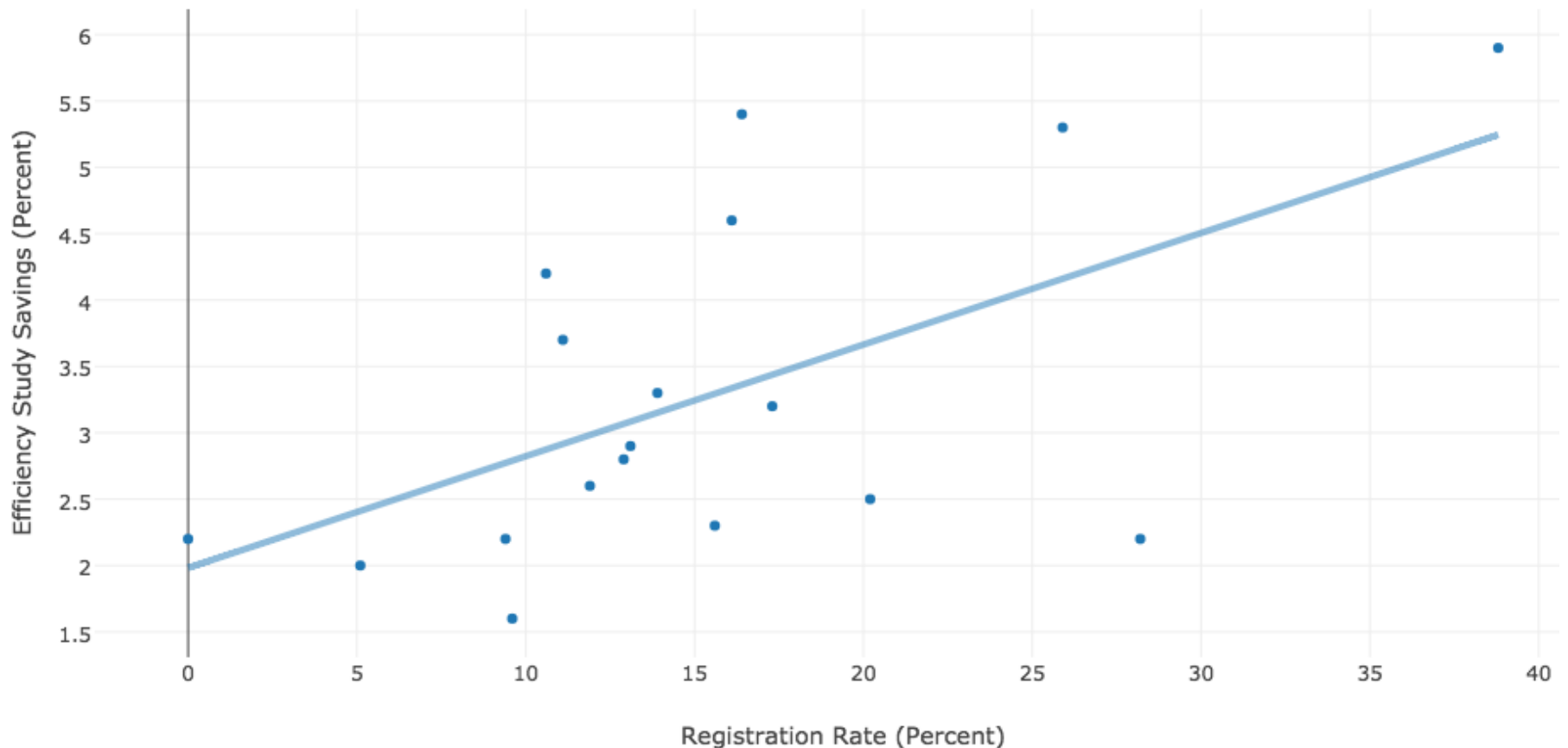


Program Level Factors

- Registration Rates
- Evapotranspiration (geography)
- Lot Sizes

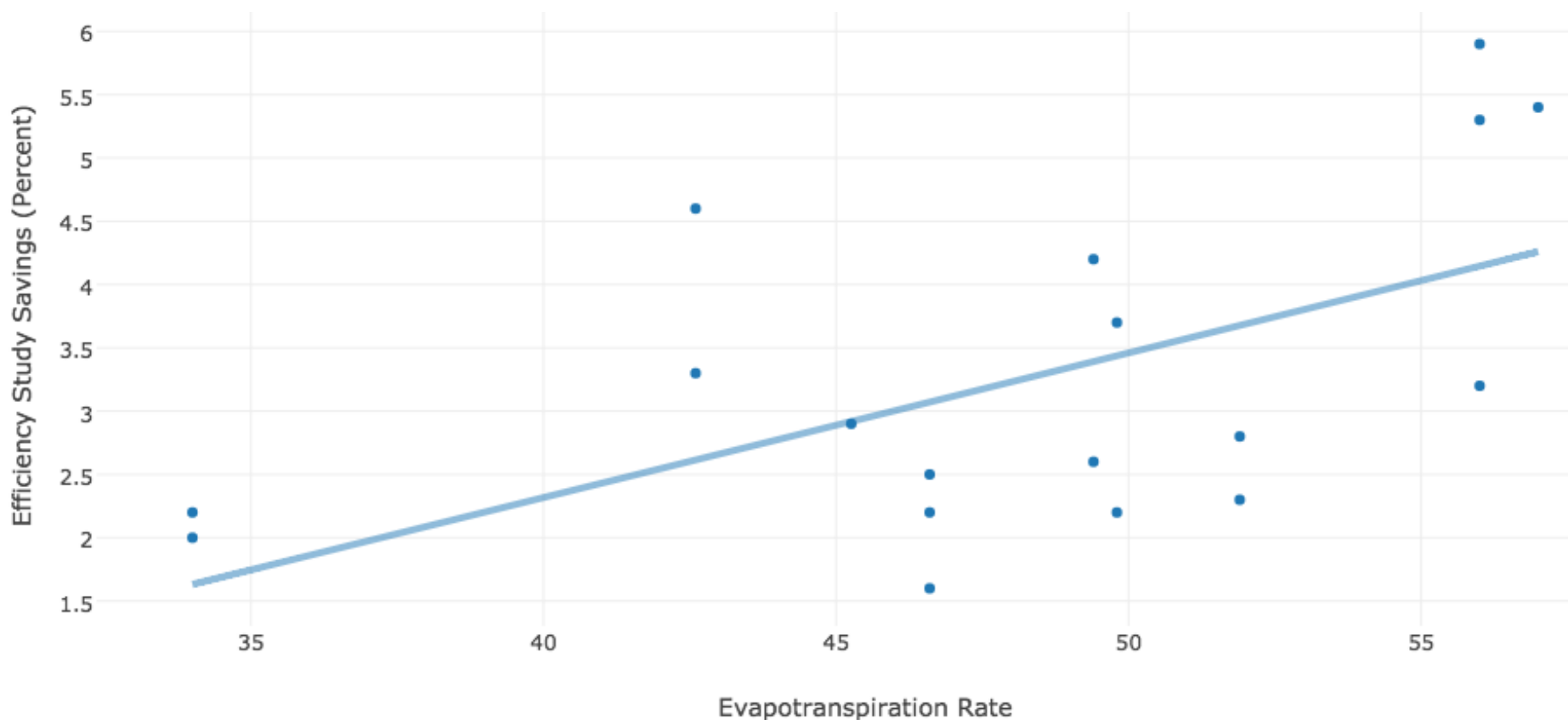
Registrations Drive Savings

- 10% higher registration rate correlates with an 0.84% higher program savings value. P-Value < 0.05



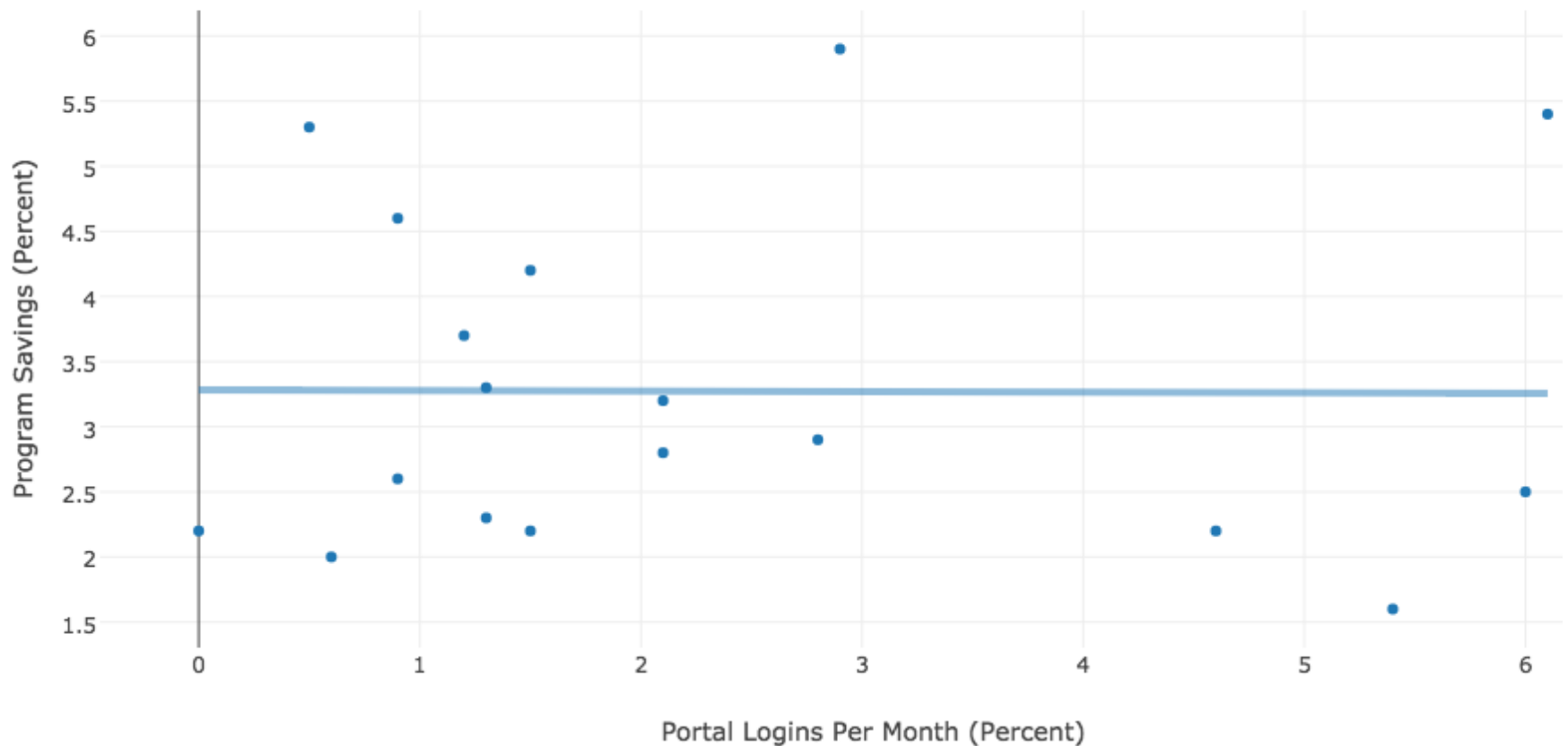
Positive Correlation between ET and Program Savings

- 10 point increase in ET correlates with an 1.14% higher program savings value. P-Value < 0.05



Portal Logins per Month

- No Relationship between portal logins per month and program savings



Expanding Analysis

- Limited number of implementations and variation in the data at utility level
- Cannot include all variables of interest in a single regression as a result
- Household level analysis would increase sample size by 5000X
- How can we combine data from many utilities?

What Drives the Savings

- Do all households save a similar amount?
- Are a small number of households driving the overall program savings?
- Looking to leverage the wealth of data in all the implementations WaterSmart has conducted.
- Typical fixed effects models do not allow for aggregation across implementations

Application and Results from Synthetic Controls Model

Synthetic Controls

- Synth package in R
- Applied to regional economic performance indicators in Spain at an annual level
- Weighted Average GDP Baseline from Controls

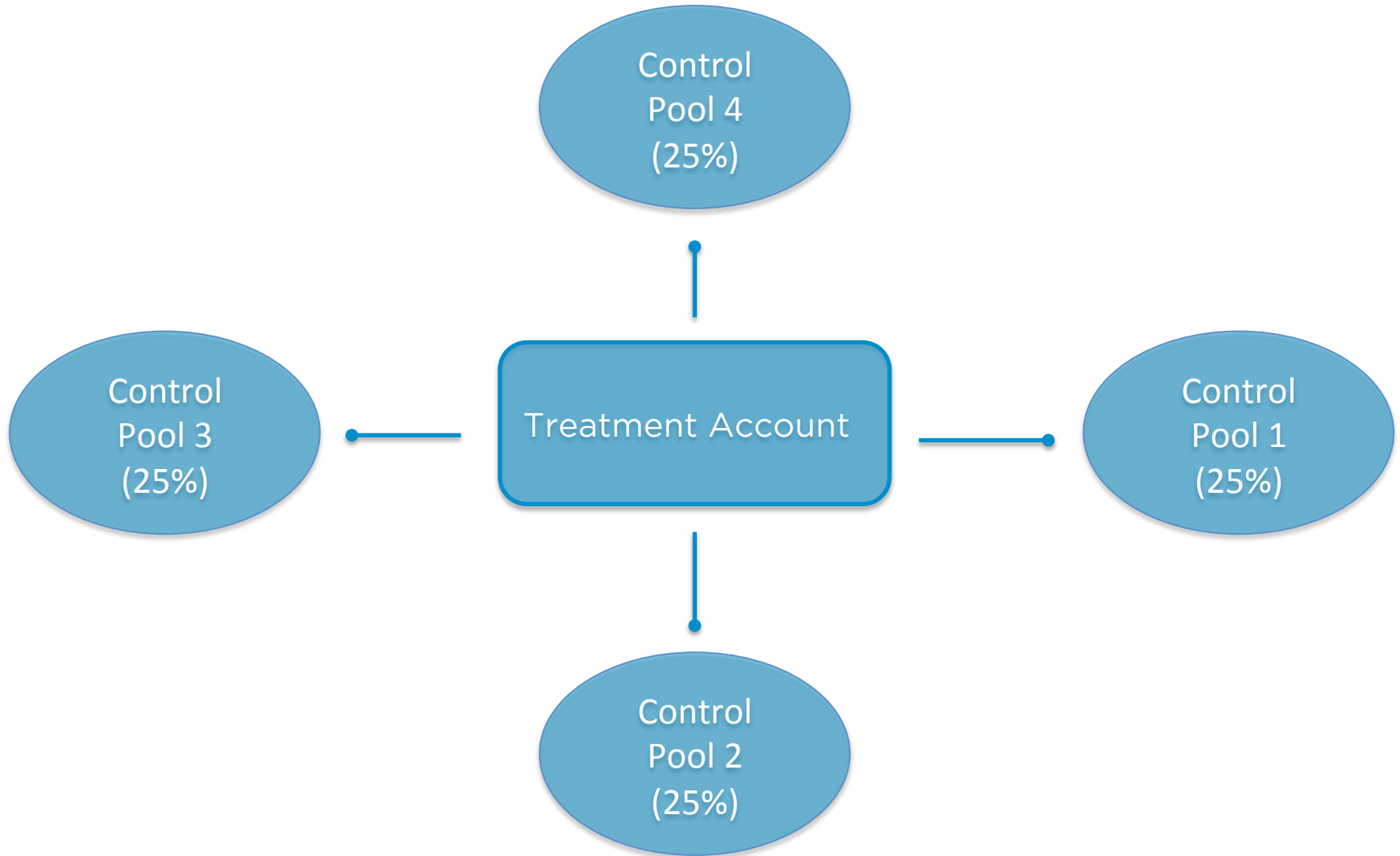
Synthetic Controls Chart

- Model functions by selecting a limited number of matches in a single run
- Year over year comparison for a household is influenced by too many factors, and we cannot isolate the WaterSmart program impact
- By selecting baseline households from the same utility who did not receive Treatment, we can ensure they were exposed to all other exogenous factors (utility-wide messaging, state-level messaging, weather, price changes, etc.)

Household Level Controls

- Run multiple times with distinct control pools and averaging the results to get a more robust baseline
- Determined after testing that 4 iterations gives a more diversified solution, at the cost of computation time

Diversifying the Baseline

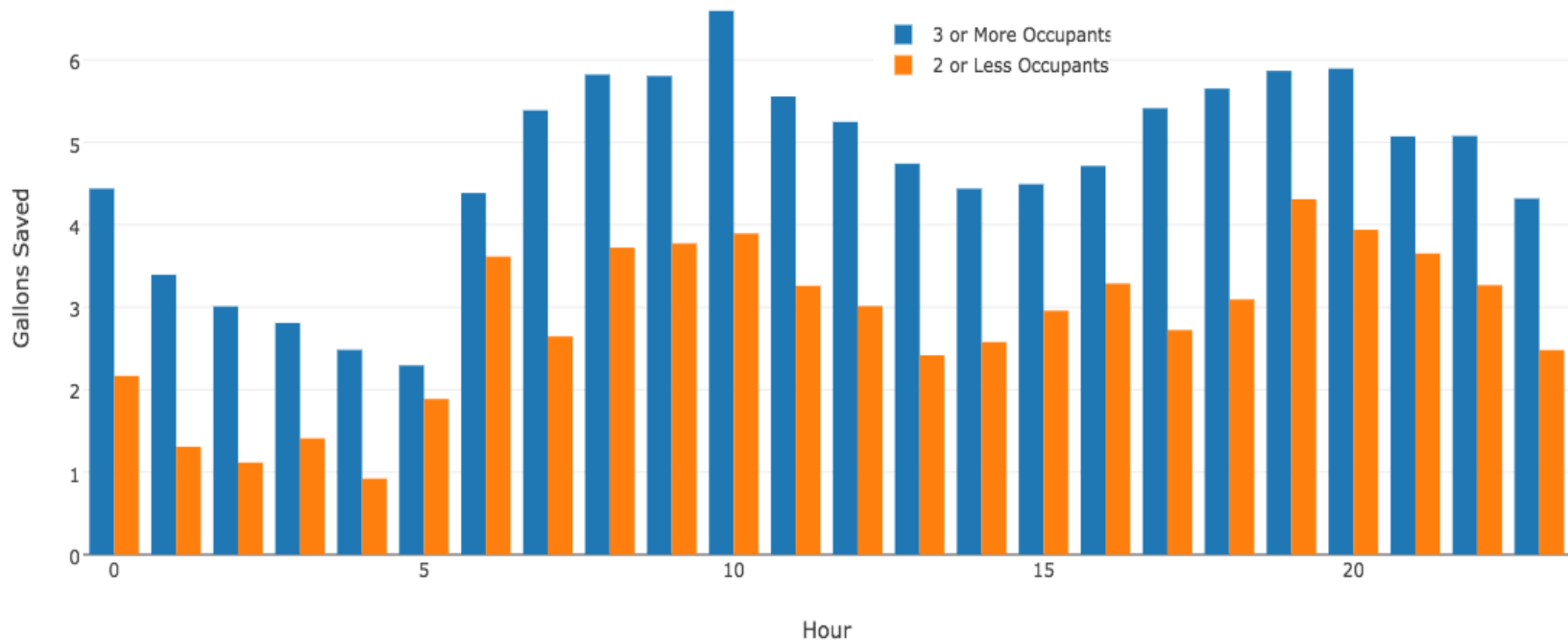


High Savers – Indoor Use

- Do homes with more occupants save more or less?

High Savers – Indoor Use

- Homes with 3 or more occupants save 113 GPD
- Homes with 2 or less occupants save 67 GPD



Savings Predictor Regression

- N = 63,310
- Dependent Variable = GPD saved versus baseline

Regression Summary

Variable	Coefficient (SE)
(Intercept)	8.55 *** (1.32)
avg_baseline	-0.01 *** (0)
registered_user	0.8 (0.79)
power_user	1.83 (1.46)
avg_waterscore	-9.41 *** (0.31)
program_count	0.72 * (0.32)
derived_irrigable_area	0 . (0)
email	-3.77 *** (0.82)
wr_count_print	0.76 *** (0.09)
wr_count_email	1.18 *** (0.13)
open_rate	7.11 *** (0.68)
home_age	0.06 *** (0.01)
own	3.87 *** (0.95)
has_pool	-0.95 * (0.42)
peak_ratio	0.49 *** (0.05)

Extensions and Conclusions

Extensions

- Evaluate Rebate Programs not structured as RCT
- Identify customers who are not saving after completing the efficiency measure.
- Survey those customers, investigate whether the measure was properly installed
- Brainstorm new covariates that might help explain difference in savings outcomes
- WaterSmart is always looking to help the field advance, frequently shares anonymized data with researchers