

Demand Insights from AMI data

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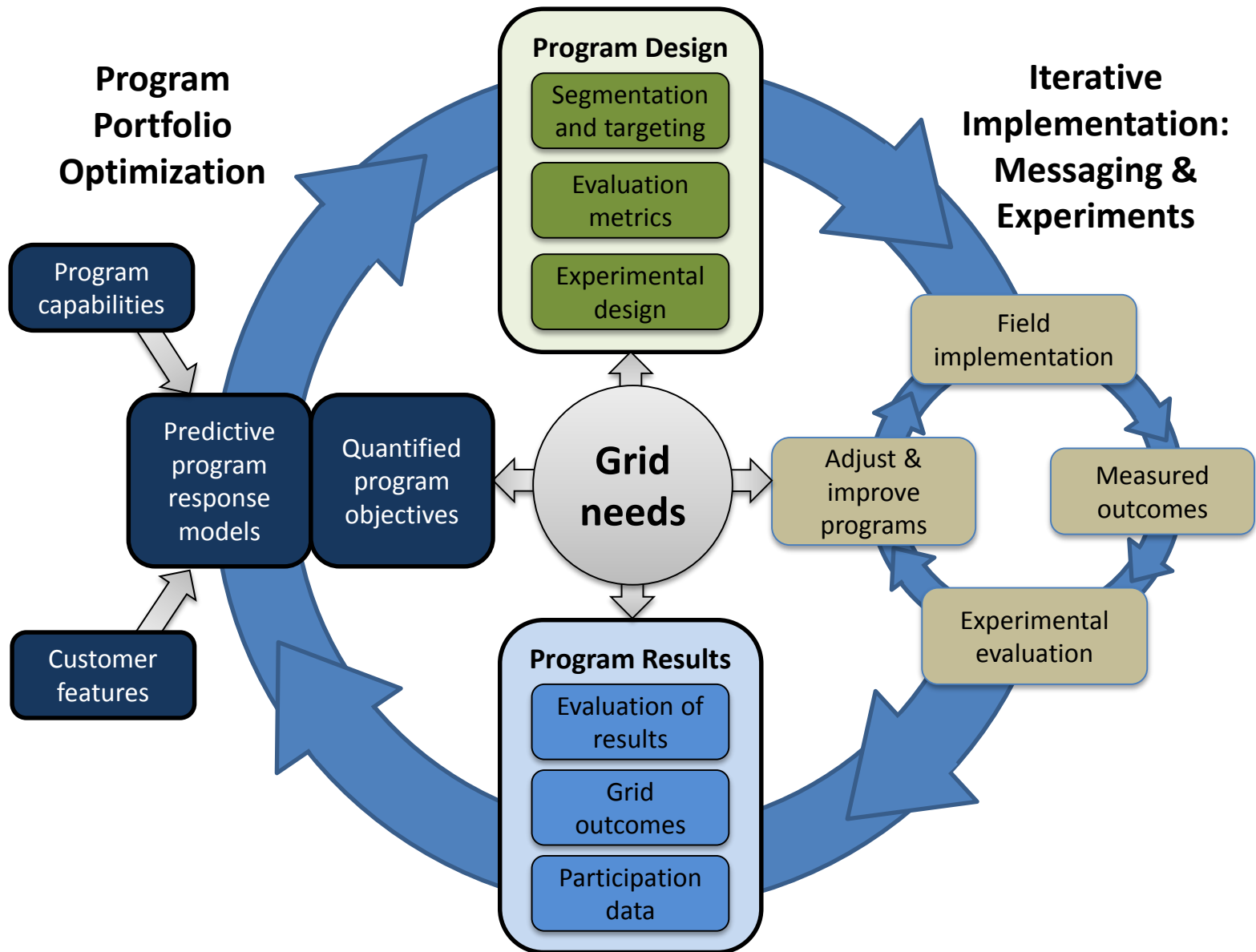
Problem statement

- The grid has evolved without the benefit of a detailed understanding of **patterns or determinants** of customer consumption
 - Demand is **taken as a given** and infrastructure is planned and operated accordingly
- In the 21st century, the grid will need to **integrate and manage** unprecedented levels of renewable and distributed generation
 - This will require fundamental changes to planning and operations supported by flexible demand

Our work

- Convergence Data Analytics builds tools that use **machine learning** and statistical models to uncover **patterns and determinants of demand** and realize opportunities for **demand flexibility**.
 - Flexible Demand: Smart Efficiency and Demand Response
 - Learn customer characteristics from demand data
 - Customer segmentation and targeting **based on consumption**
 - Data driven evaluation, **response modeling**, and iterative **learning**
 - Distribution planning and operations
 - Understanding **customer diversity** and aggregate behavior
 - Matching intermittent generation with **flexible loads** and **storage**
 - Aligning flexible demand with **grid needs**

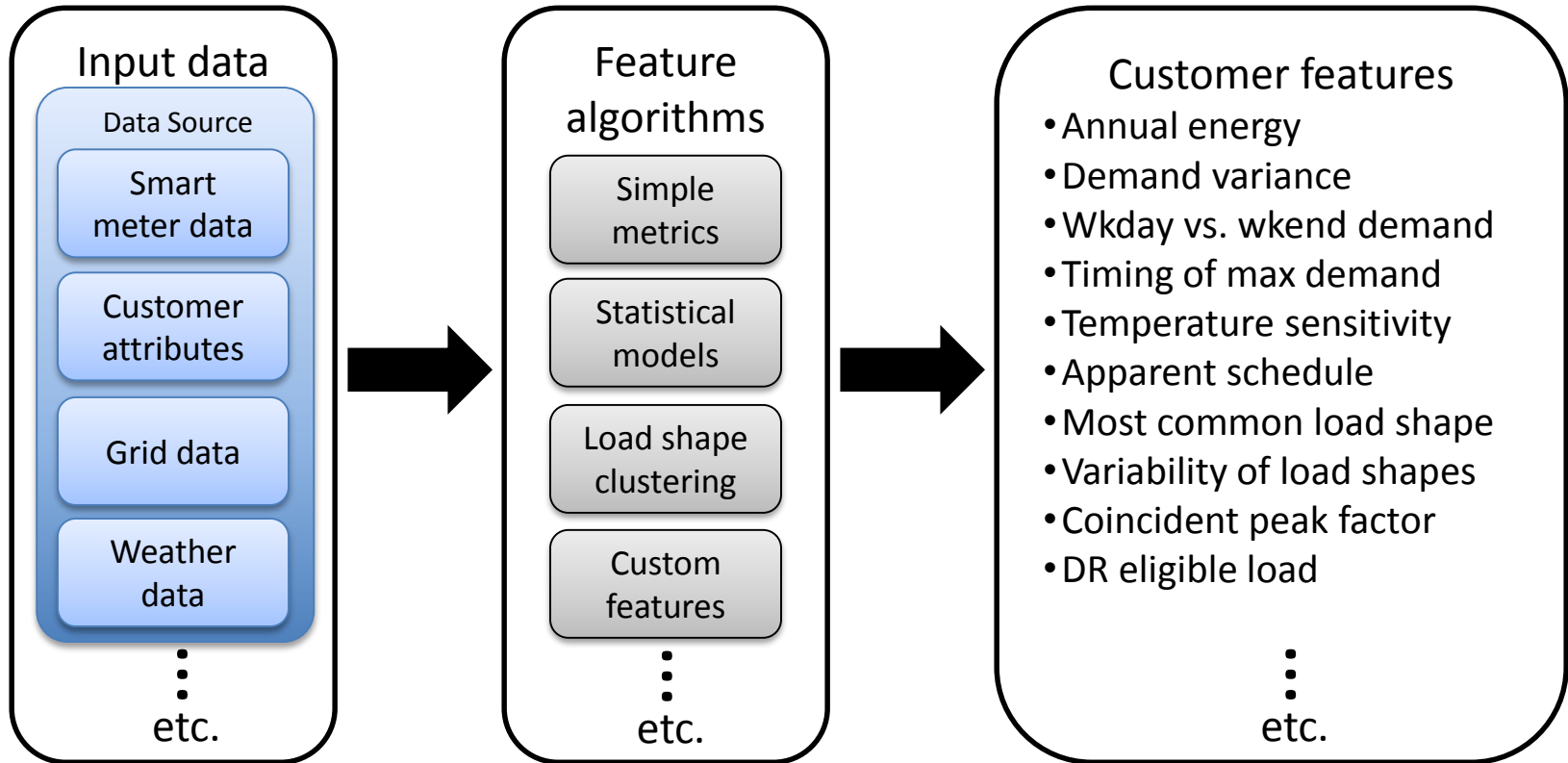
Flexible Demand: Big Picture



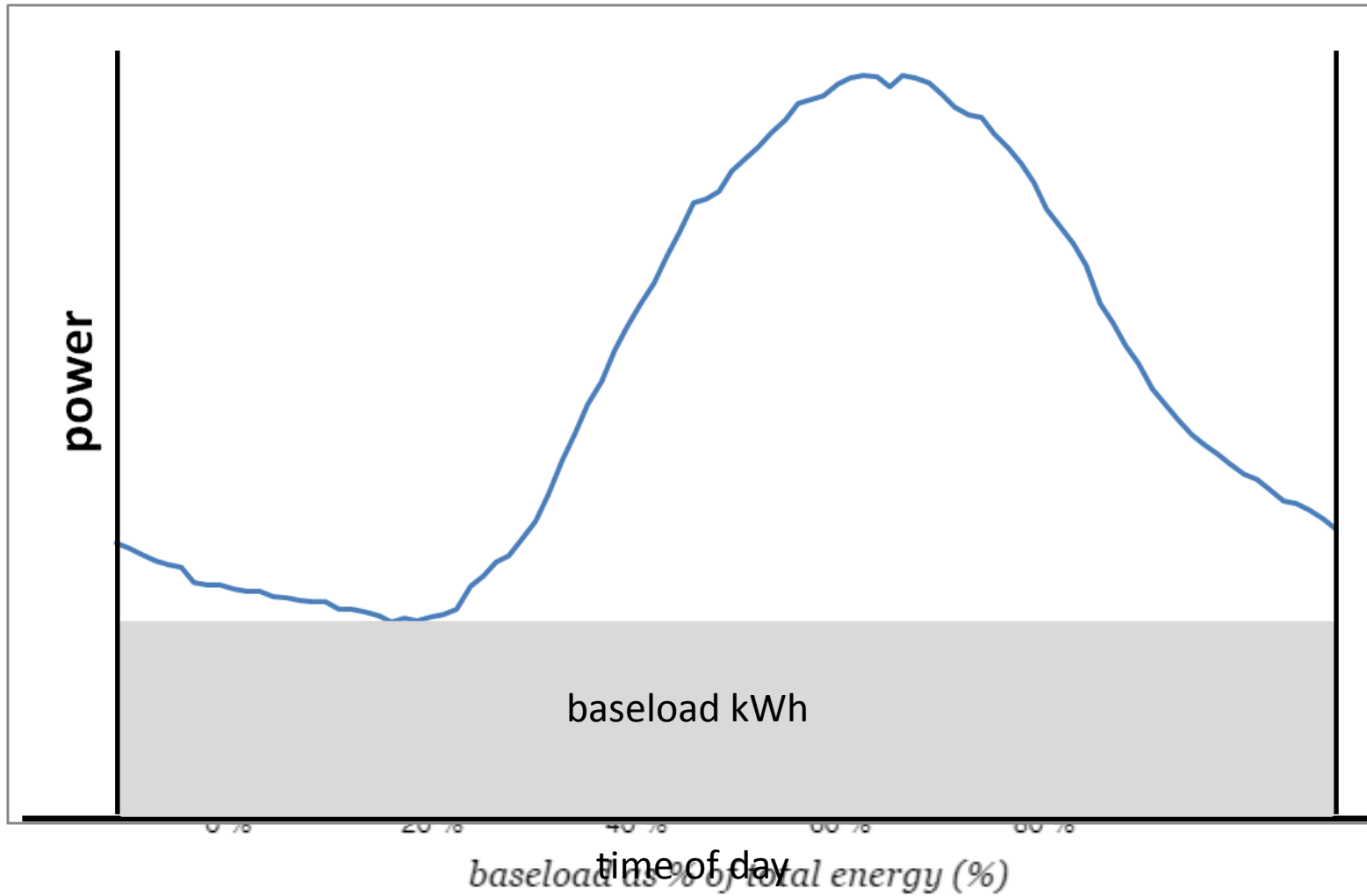
Open platforms

- Algorithmic supremacy is **not the right goal**
 - All approaches have strengths and weaknesses
 - In practice, there is not much difference in power/fit between well implemented methods
- To thrive, the intelligent efficiency industry needs to **earn the trust** of regulators and customers
 - We cannot learn or innovate without trying things that do not work
 - Better separate fact & fiction on what can be learned using meter data
- We are **open sourcing all of our tools** (VISDOM for R and the Python-based Demand Insight Engine) and subjecting our algorithms to peer review
 - Building community & best practices on efficient, scalable, and repeatable analyses
 - We focus on adoption: enabling utilities and EE/DR pros to learn from data; lifting the veil of mystery from the analysis

Demand feature engine



Ex: Baseload



Customer demand feature matrix

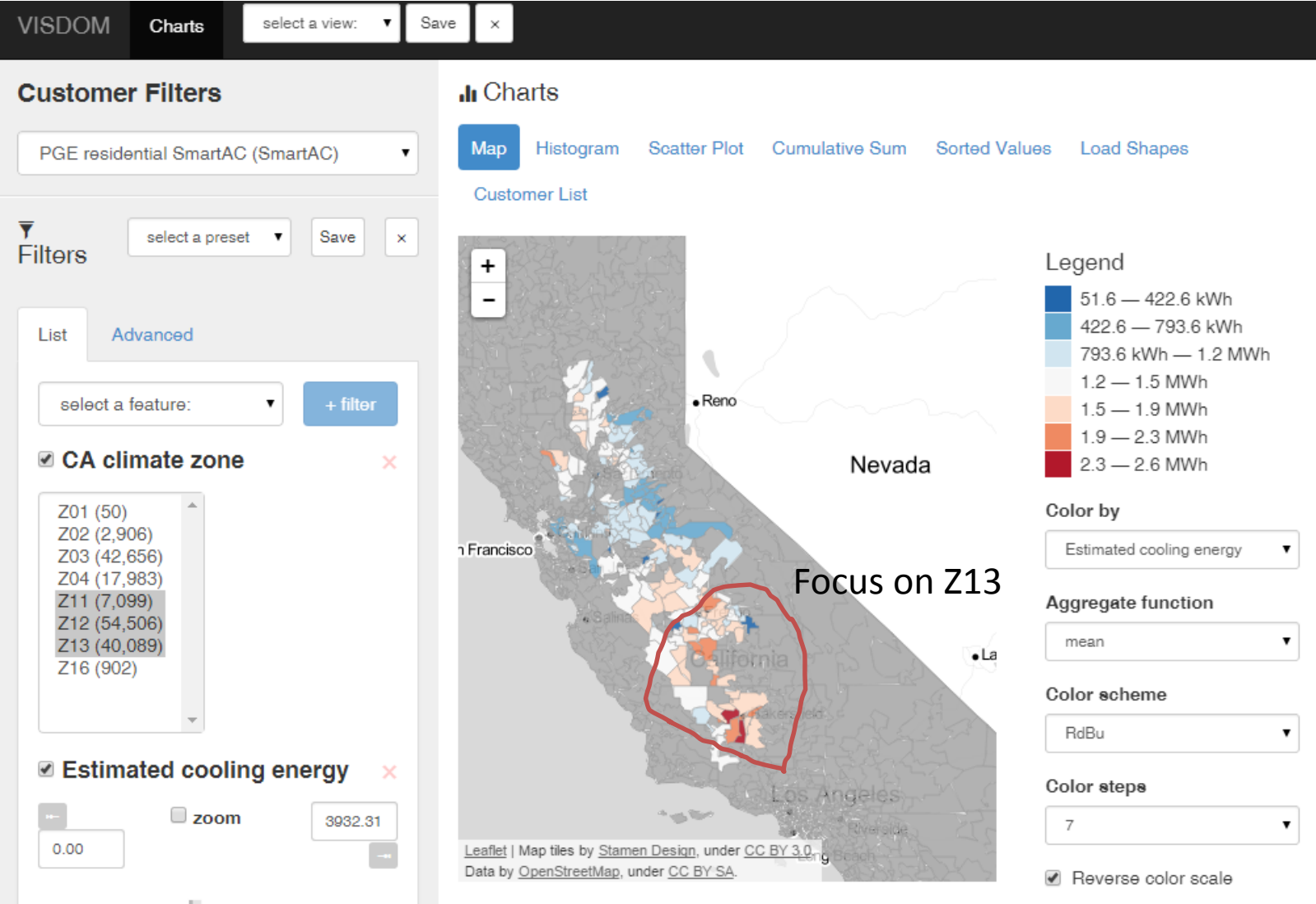
Cust id	Location code	Coincident peak factor	DR eligible load	Coincident peak load	...	Temp sensitivity	Load shape variability
1	J-02-03	1.2	100 kW	400 kW	...	1.1 kW/°F	2.1
2	J-02-03	1.1	5 kW	200 kW	...	0.01kW/°F	5.6
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
250000	S-01-04	1.3	10 kW	50 kW	...	0.5 kW/°F	3.2

- Uses data features to provide search engine for customer behaviors.
 - Filter
 - Visualize
 - Interact
 - Export

Ex: Segmentation and targeting

- Define desired program **participant profiles** in terms of feature values
- Example: HVAC DR Control Program
 - Target **geography**
 - High **cooling** consumption
 - **Load shape** peak during grid stress
 - Low load shape **variability**

HVAC: Find cooling loads

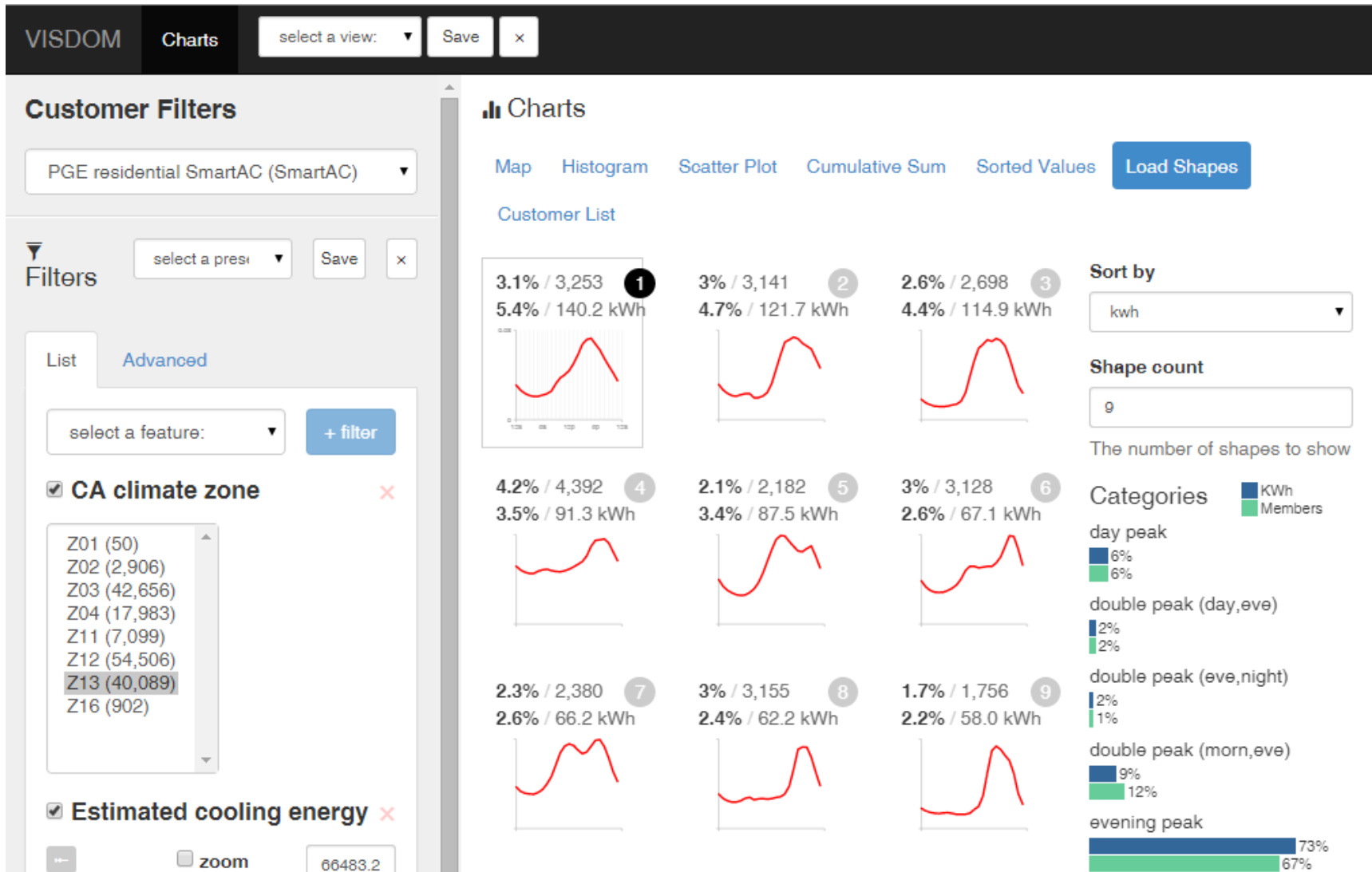


Z13: cooling

- Quite a bit of diversity across households



Z13: evening peaking customers



Z13: Export targeted customer data

VISDOM Charts select a view: Save x

Customer Filters

PGE residential SmartAC (SmartAC)

Filters select a pres Save x

List **Advanced**

select a feature: + filter

CA climate zone x

- Z01 (50)
- Z02 (2,906)
- Z03 (42,656)
- Z04 (17,983)
- Z11 (7,099)
- Z12 (54,506)
- Z13 (40,089)**
- Z16 (902)

Charts

Map Histogram Scatter Plot Cumulative Sum Sorted Values Load Shapes

Customer List

Download CSV

index	id	zip5	cooling_energy
127111	7617114478	93306	26329.0696013057
61433	4015959140	93306	21919.4481361054
129305	7723230105	93263	21289.3594088718
108972	7073874605	93312	20875.0921950739
97718	6717917605	93306	19354.9314223031
96705	6691515905	93311	17404.101966676
97759	6719322905	93308	16623.813530485
97841	6723541105	93309	16297.2294800161
95784	6662037505	93313	16266.7745893401
95106	6639382505	93309	15756.5722925792
94156	6608102305	93309	15516.88360955
112321	7178912405	93304	14960.0756223367
91883	6537949405	93313	14786.8639016858
88078	6400624505	93309	14705.7883764545

Display Column: Estimated cooling energy

first n rows: 100

Ascending?

Thank You

Convergence Data Analytics, LLC



Actionable insights from customer meter data.

www.convergenceda.com

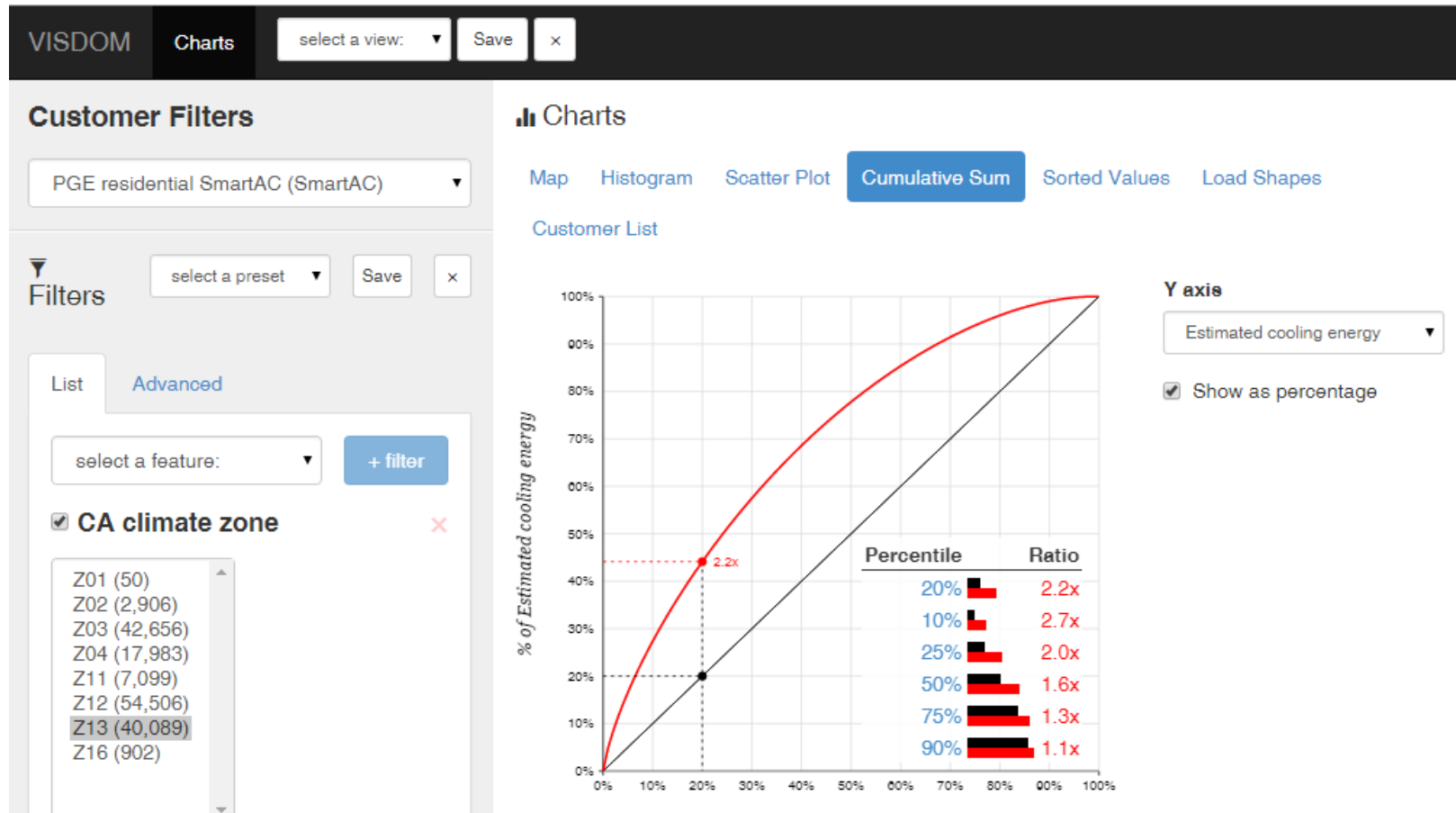
How can we help put your data to work?

Sam Borgeson

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Z13: top users

- Top 20% of customers use >45% of cooling



The payoff

Final output is a **ranked list of customers** ordered by priority based on **customized targeting criteria**:

1. Geography (hot climate zone)
2. Timing of peak demand (early evening peaks)
3. Household cooling loads (biggest AC users)
4. Other program-relevant customer attributes
 - Income and equity impacts of program
 - Past program participation and outcomes
 - Special inclusion or exclusion categories
 - etc.

Program benefits

Energy programs should be designed and implemented using energy data!

- Identify and **eliminate free riders** from the beginning
- Improved program **cost effectiveness**
 - **4x expected** program response compared to untargeted customers (2x compared to best practice geographic targeting) for the **same total customer acquisition costs**
- More **focused messaging** to recruit each customer
 - Personalized information based on energy usage attributes
 - Greater likelihood of enrollment
- Use customer metrics to **evaluate program outcomes**

VISDOM Structure

