

### BACKGROUND

It is well-established that customer engagement - regardless of industry - is a critical element that separates great companies from the rest. In the residential energy sector, one proven way to engage customers is through energy disaggregation: taking the customer's total energy consumption and attributing it to different appliances in the home.

Yet as energy disaggregation continues to become more mainstream in its applications, there remain instances where data limitations can cause the end user to have disaggregation for only a portion of their consumption. Unfortunately, in these scenarios the opportunity to educate customers on appliances that are not disaggregated is lost.

### THE BIDGELY SOLUTION

To address this limitation, Bidgely has developed a hybrid approach that combines its industry-leading disaggregation algorithms with a localized rule-based model, the combination of which provides 100% itemization of energy consumption. There are a number of benefits to this type of approach:

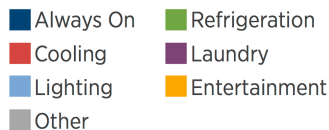
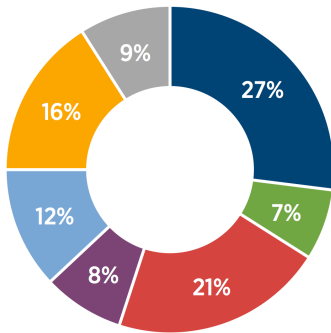
**Data Flexibility** | Works with all types of energy data:

- **HAN** (better than 1 minute sampling rate);
- **AMI** (15/30/60 minute sampling rate);
- **Monthly** (1 sample per month).
- It also works for **gas consumption**

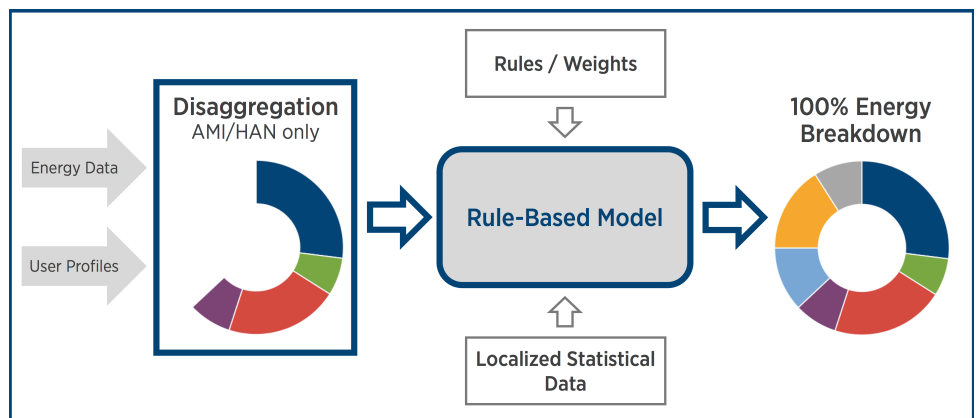
**Localization** | Minimal development required to localize for a given state, region, or country

**Self-Improving** | As the end user engages more, the accuracy of the results continues to improve

**THE GOAL:**  
100% Energy Breakdown



### Bidgely "Hybrid" Model



#### HOW DOES IT WORK?

To create 100% appliance itemization, Bidgely utilizes a rule-based hybrid model with 3 main inputs:

1. Disaggregated customer energy data;
2. An established set of rules, weights, and conditions; and
3. Available localized energy consumption information

**100% APPLIANCE ITEMIZATION PIPELINE**

1. Import geography-specific public appliance usage data into the model
2. Get home energy usage for the month
3. Fetch all available attributes for the user/home
4. Run our standard disaggregation algorithms. This will typically disaggregate 50-70% of the energy usage depending on the home.
5. Pass the results from (3) and (4) into the rule-based model.
6. Get the complete appliance breakdown of energy usage.

**Creating the Rule-Based Model**

Creating the rule-based model is an offline information-gathering exercise that needs to occur before the solution is deployed. The information sought for creating the model centers around recent reports on residential energy consumption in the local geography, typically covering the following information/categories:

Electricity	Gas	Consumption Variables
Refrigeration	Space Heating	Property Type
Heating	Water Heating	Property Size
Cooling	Cooking	Property Age
Water Heating		Own vs Rent
Cooking		# Occupants
Lighting		Occupant Life Stage
Entertainment		Space Heating Type
Laundry		Water Heating Type
Other		Month of Year
		Weather

**BIDGELY 100% ITEMIZATION RESULTS**

Bidgely has evaluated 100% itemization in the UK. Below is a comparison of the profiles<sup>1</sup> and results from two home types.

**Home A**

Home A is a newer 2-bedroom, all-electric flat (apartment), with 2 adult occupants.

<b>Property Type:</b> Flat (apartment)
<b>Size:</b> 2 Bedroom
<b>Built:</b> Post-2000
<b>Occupants:</b> 2 Adults
<b>Gas Appliances:</b> None
<b>Main Electric Appliances:</b> Heating, Water Heating, Refrigeration, Oven, Hob (stove), Kettle, Dishwasher, Washing Machine, Dryer

**Home B**

Home B is an older 4-bedroom, gas and electric semi-detached home, with 2 retired occupants.

<b>Property Type:</b> Semi-Detached
<b>Size:</b> 4 Bedroom
<b>Built:</b> 1925-1976
<b>Occupants:</b> 2 Retired Adults
<b>Gas Appliances:</b> Heating, Water Heating, HOB
<b>Main Electric Appliances:</b> Refrigeration, Oven, Kettle, Dishwasher, Washing Machine, Dryer

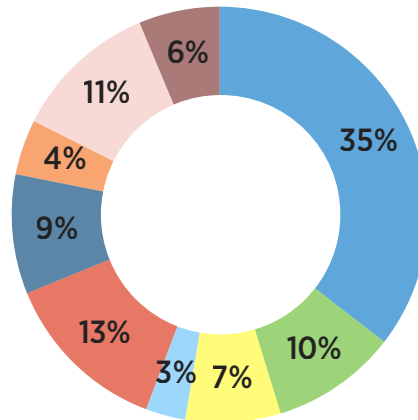
<sup>1</sup> - detailed profile information for the example homes can be found in the Appendix



*"I was amazed at how the chart represented my own view of how my energy is broken down for June."*

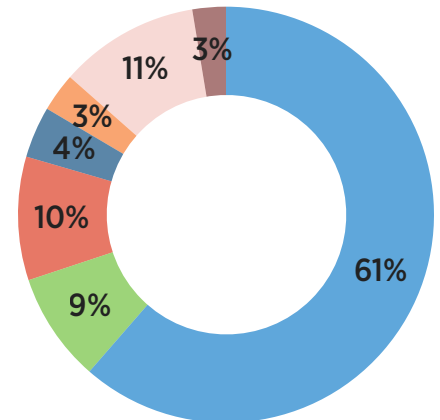
- Home B Occupant

**Home A**  
June Energy Usage



- Always On
- Space Heating
- Cooking
- Lighting
- Other
- Refrigeration
- Water Heating
- Laundry
- Entertainment

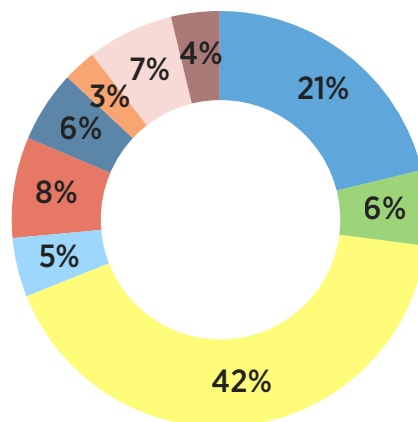
**Home B**  
June Energy Usage



- Always On
- Cooking
- Lighting
- Other
- Refrigeration
- Laundry
- Entertainment

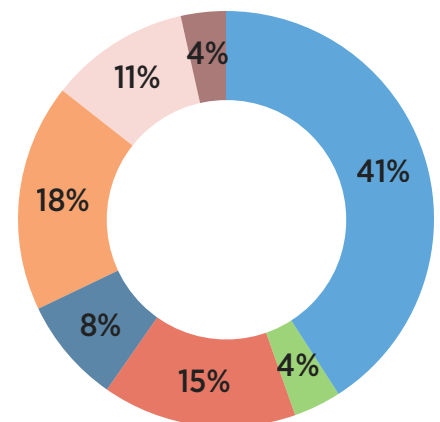
In comparing the June energy usage for the two homes, a few differences become apparent. Although Home B is larger, Home A is an all-electric flat. As such, Home A has more appliances making up the pie, as well as a much higher energy use. Because Home B has some significant gas appliances, it has a higher percentage of electricity usage coming from Always On (61% vs 35%). But in terms of total Always On consumption, Home A (173 kWh) and Home B (171 kWh) are quite similar. This can be justified by the fact that the additional electric appliances in Home A - Heater, Water Heater, HOB - do not contribute much (if anything) to Always On usage.

**Home A**  
January Energy Usage



- Always On
- Space Heating
- Cooking
- Lighting
- Other
- Refrigeration
- Water Heating
- Laundry
- Entertainment

**Home B**  
January Energy Usage



- Always On
- Cooking
- Lighting
- Other
- Refrigeration
- Laundry
- Entertainment

*"This looks like...the real picture."*

- Home A Occupant



In comparing the June/January energy usage for the two homes, the first notable difference is the increase in overall energy usage in winter. For Home A, much of that higher usage is due to the increase in Electric Heating. For Home B, there is a significant increase in Lighting, as well as a notable increase in Cooking. As the winter months are darker and colder in the UK, it makes sense that the retiree occupants would be using more lighting and electric cooking.

## CONCLUSION

In the residential energy sector, one proven way to engage customers is through energy disaggregation: taking the customer's total energy consumption and attributing it to different appliances in the home. However, with current disaggregation algorithms, end users typically only see a portion of their total energy consumption. To address this shortcoming, Bidgely has developed a hybrid disaggregation approach that combines its industry-leading disaggregation algorithms with a localized rule-based model. The combination of these two elements provides 100% itemization of energy consumption, creating a more engaging experience for our end users throughout the globe.



## APPENDIX

### Profile Information

Parameter	Home A	Home B
Property Type	Flat	Semi-Detached
Size	2 Bedroom	2 Bedroom
Age	Post-2000	1925-1976
# Occupants	2	2
Occupant Type	Working Adults	Retirees
Heating	Electric	Gas Boiler
Water Heating	Electric Immersion	Gas Boiler
Refrigeration	Yes	Yes
Oven	Electric	Electric
Grill	Electric	Electric
HOB	Electric	Gas
Microwave	Yes	Yes
Toaster	Yes	Yes
Kettle	Yes	Yes
Dishwasher	Yes	Yes
Washing Machine	Yes	Yes
Dryer	Yes	Yes
Iron	Yes	Yes
TV	Yes	Yes
DVD/BluRay	Yes	Yes
Digital TV Box	Yes	Yes
Game Console	No	No
Computer	Yes	Yes
Tablet	Yes	Yes
Electric Shower	No	No
Pool	No	No
Sauna	No	No
Electric Vehicle	No	No