OVERCOMING DEREGULATED ELECTRICITY MARKETS: EVALUATING THE POTENTIAL FOR A PLATFORM FOR RETAIL PLAN EVALUATION

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by

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ABSTRACT

Overcoming Deregulated Electricity Markets: Evaluating The Potential For A Platform For Retail Plan Evaluation

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Energy is one of the most hotly discussed topics of the modern age. One segment of these discussions is devoted to the environmental impact of energy production and consumption. The second segment of this discussion pertains to the markets for energy. These markets are highly varied between different areas of energy and power: oil and gas is sophisticated and driven by a variety of market pressures, while power generation and distribution are less so.

This research will focus specifically on the power distribution space. In Texas, homeowners and other buyers of power from the grid are able to choose from many retailers. These retailers have policies and pricing structures that are nuanced and varied, and while all this information is made publicly available, it is hardly accessible to the average buyer. The following pages will discuss the nature of these markets and provide motivation for a platform that allows consumers to easily select optimum retail power plans based on their location and consumption habits.

ACKNOWLEDGEMENTS

I would like to thank my undergraduate research professor, Dr. Le Xie, for the immense amount of guidance in conducting this research. I also wish to thank Dr. Srinivas Shakkottai and Hao Ming, as well as the rest of the Energy Coupon Project team.

NOMENCLATURE

ERCOT	Electric Reliability Council of Texas
REP	Retail Electric Provider
TDU	Transmission and Distribution Utility
kWh	kilowatt-hour
PUC	Public Utility Commission of Texas

CHAPTER I

INTRODUCTION

This project is particularly relevant to Texas, but could also be applied to other regions given additional research. The two major parts of this research, retail power markets and ancillary power, necessitate deregulated power distribution and an abundance of residential pools.

Deregulated Retail Power Market

The premise of deregulated power markets is that retailers can compete for customers by offering plans that fit customers' needs. This may mean programs that subsidize certain times of day or periods of the week, or plans that link the price per kWh to another index. While no state offers energy choice to all citizens, Texas is the closest at 85%. The states with some degree of deregulation can be seen in Figure 1 [1].

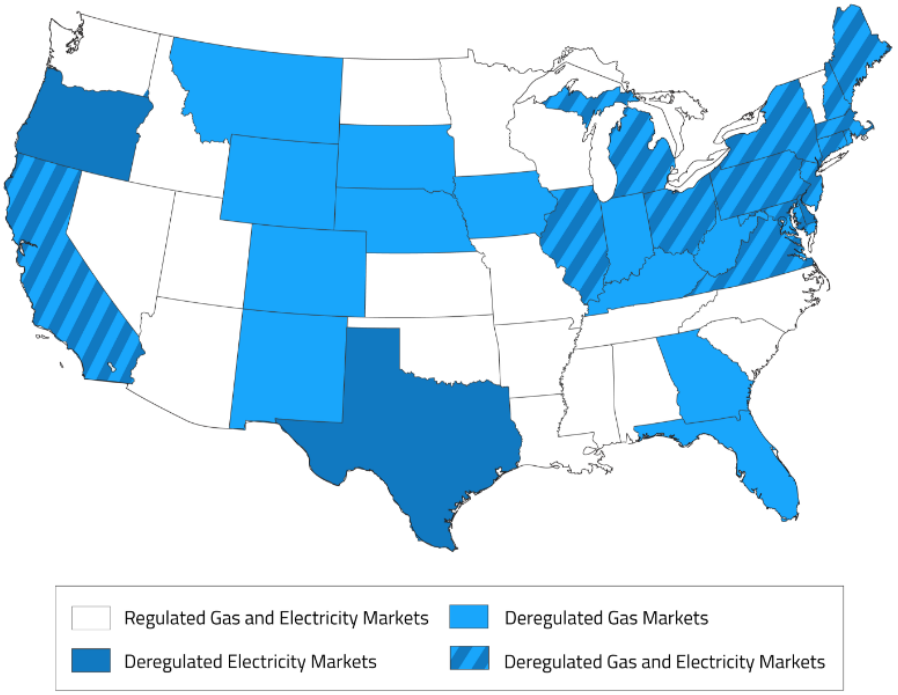


Figure 1: Map of deregulated energy markets in US

The issue is that for any given zip code there could be over 300 unique plans from over 100 providers. Few consumers are sophisticated enough to determine which plan best fits their usage patterns, so the marketplace may fail to be as competitive as expected.

Texas Retail Power Market

The critical advantage of doing this research with Texas as the region of interest, as opposed to another deregulated state, is that there exists a single source to search for retail power plans by provider and zip code. While this is a manual and tedious process, there is a wealth of data available.

Types of REPs in Texas

There are three primary types of REPs in Texas, as defined by the Public Utility Commission of Texas (PUC) [2]:

1. A provider which defines its service based on a geographic region, being all or part of Texas, and whose selection of a region does not discriminate against customers.
2. A provider whose electricity will be offered to an exclusive group of consumers, each consuming over one megawatt. The REP is only allowed to serve these customers.
3. A provider that sells electricity directly from a generation site owned by that provider to customers that are not defined as small commercial businesses or residences.

This project will focus on the first type, REPs that sell to geographic regions, specifically targeting residences and small businesses.

Types of Electric Plans

There are three primary types of plans: fixed, variable, and indexed [3]. These categories are intended to indicate the type of pricing structure one would accepted to see in the plan, but often contain additional elements the complicate strict definite assignments.

Fixed Rate

A fixed rate plan is intended to be the simplest type of plan. The price per kWh will not change during the contract period, regardless of market fluctuations. However, other elements of the price, such as those determined by state, local, or federal law, may change.

Variable Rate

The rate per kWh can change at the discretion of the electric company. To incentive providers to keep rates low, these plans do not have monthly contracts or cancellation fees. While customers are exposed to upside risk in the energy market, REPs cannot remain competitive and abuse consumers.

Indexed Rate

An indexed rate is pegged to a pricing formula that is a function of a publicly available index. These rates can fluctuate much like variable rates. These types of plans are intended for the least risk adverse consumers, as the electric company does not shield them as heavily.

Primary Pricing Factors and Other Criteria

There are many ways to construct an electric plan. However, there are several common elements of a pricing structure.

TDU Fees

TDU fees are determined by geographic region and are set by law. There are five regions in Texas:

1. Oncor – Dallas-Fort Worth metropolitan area, Midland-Odessa, Waco, etc.
2. CenterPoint Energy – Houston metropolitan area, Beaumont, etc.
3. AEP Central – Corpus Christi, McAllen, Victoria, Laredo, etc.
4. AEP North – Abilene, San Angelo, etc.
5. Texas New Mexico Power Company (TNMP) – Glen Rose, League City, etc.

Table 1: TDU fees by region [4]

	Oncor	CenterPoint	AEP Central	AEP North	TNMP
Delivery Rate ($/kWh)	0.034175	0.041112	0.040810	0.038331	0.032779
Monthly Base ($)	3.49	5.47	9.00	10.53	8.65

Table 1 shows the fees for each utility company. Electric companies often include these fees within others, but may also list them as a separate line item. This information can be hidden within the fine print of the terms.

Base Charges

A bases charge may be recurring or one-time, or daily or monthly. For many plans, there may be a sign-up fee or early cancellation fee. The latter is particularly important for a consumer that wants to switch plans often to maintain a low rate. The most common base charges, however, are those that are applied to the bill monthly or daily. Daily charges are typically less than a dollar while monthly charges range from a few dollars to over $100. Consumers who do not enroll in automatic payment services may also face an additional monthly fee. As with anything, a REP may choose to omit charges of this nature.

Free Time Periods

Providers may offer, particularly in variable rate plans, free periods. These are either free nights (typically 6:00 PM – 8:00 AM) or free weekends (usually Friday at 6:00 PM – Sunday at

midnight). The underlying assumption is that the majority of a consumer's energy consumption is from Monday through Friday during the daytime. For consumers that have something like a lake house that is only used on the weekends, these plans could provide huge savings.

Usage Rebates and Penalties

REPs may choose to reward or penalize consumers based on their monthly consumption habits. The most common type of penalty is a minimum usage fee. In this instance, an additional fee will be added to the bill if an amount below a specified threshold is consumed.

Rebates are typically found attached to fixed rate plans. When the customer's monthly consumption falls within a certain range, the REP will rebate a specific amount to the bill. On the whole, the practice of rebates and penalties encourages costumers to consume within a certain range consistently.

NYMEX Gas Index

A common index used in the indexed plans is the NYMEX Gas Index. In cases where this is used, the primary determinant of a user's bill will be the kWh consumed that month multiplied by the NYMEX index (and then multiplied by a defined coefficient). An example formula may resemble this:

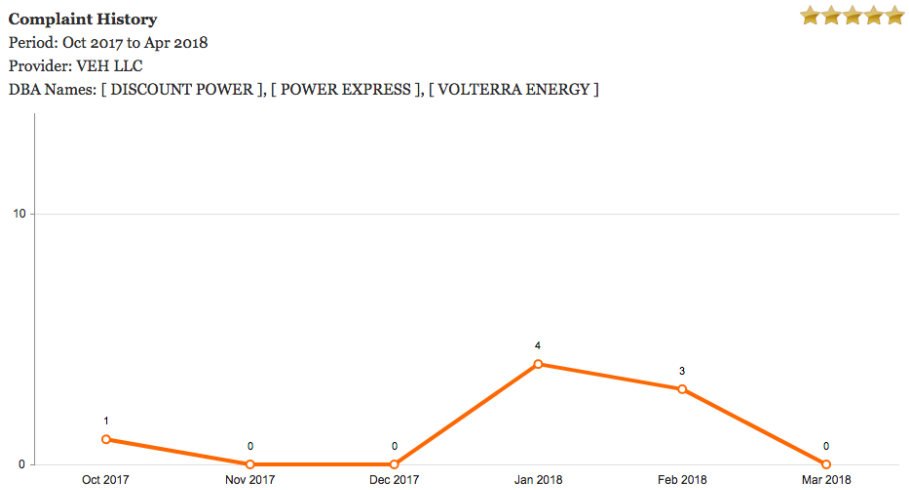
Eqn. [1] $$Indexed\ Energy\ Charge = 0.02185 * NYMEX\ Gas\ Price$$

The gas price will be the closing value of the monthly NYMEX natural gas futures contract in $/MMBtu.

Scorecard Rating

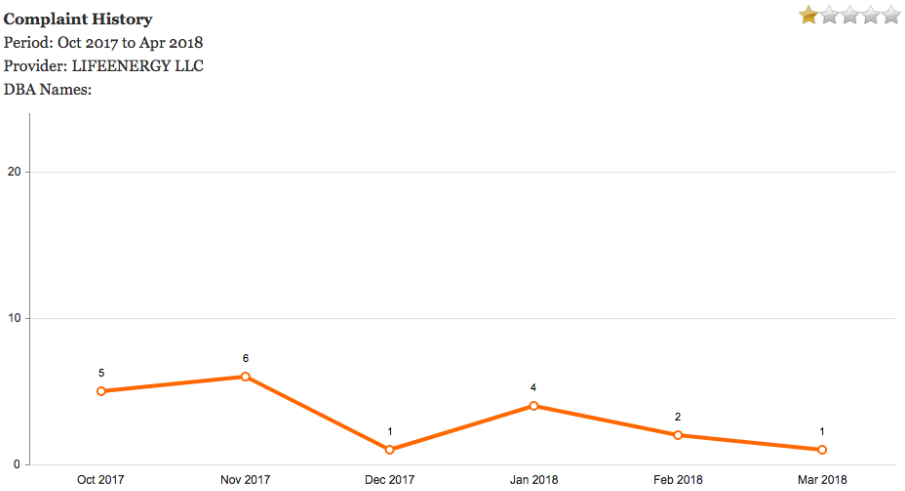
While this does not affect the price charged to a user, it is a noteworthy selection criterion. The PUC assigns a rating of one to five stars to every REP. These ratings are split into even quintiles and are determined by a rolling six-month average of the number of complaints

received by the PUC. Figures 2 and 3 are examples of retailers' complaint histories as provided by the PUC [5].



Stat	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	6 Month Total
Billing	1	0	0	2	1	0	4
Discontinuance	0	0	0	0	2	0	2
Provision Of Service	0	0	0	2	0	0	2
Cramming	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0
Quality Of Service	0	0	0	0	0	0	0
Slamming	0	0	0	0	0	0	0

Figure 2: Complaint history for 5-star REP



Stat	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	6 Month Total
Billing	5	2	1	3	2	1	14
Provision Of Service	0	4	0	1	0	0	5
Cramming	0	0	0	0	0	0	0
Discontinuance	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0
Quality Of Service	0	0	0	0	0	0	0
Slamming	0	0	0	0	0	0	0

Figure 3: Complaint history for 1-star REP

CHAPTER II

METHODS

Overview

The most critical aspect of this research is the pricing information by plan from Retail Electric Providers (REPs). It is convenient that these data are free and accessible online from the Public Utility Commission of Texas (*Power*). Accessing the critical information, though, is very labor intensive. Each plan must be viewed and manually searched for key information, which may come in the form of a table (Figure 4) or a dense paragraph in the fine print (Figure 5).

The price you pay each billing cycle includes the following: Energy Charge (cents per kWh) as shown above; Base Charge of $1.50 (flat fee per billing cycle); $4.95 Minimum Usage Fee (flat fee per billing cycle only if your usage is below 500 kWh); $85 Usage Credit per billing cycle if your usage is greater than 999 and less than 1,501 kWh; $40 Usage Credit per billing cycle if your usage is greater than 1,500 and less than 2,001 kWh; and regulated Transmission & Distribution Utility (TDU) delivery charges in effect for the associated billing cycle, passed through at cost (with no mark-up).

Figure 4: Plan with details in paragraph

Hello Energy Charges

	Weekdays (per kWh)	Weekends All Charges
Centerpoint	14.7¢	0.0¢
Oncor	13.1¢	0.0¢
AEP-TCC	15.6¢	0.0¢
AEP-TNC	15.6¢	0.0¢
TNMP	14.4¢	0.0¢
Sharyland	15.6¢	0.0¢

TDU Delivery Charges

	(per kWh)
Centerpoint	0.0¢
Oncor	0.0¢
AEP-TCC	0.0¢
AEP-TNC	0.0¢
TNMP	0.0¢
Sharyland	0.0¢

Figure 5: Plan with details in table

These data, once collected manually, can be analyzed with respect to geography, plan type, REP, plan length, etc. Sample usage data were collected from previous experiments from the Energy Coupon Project.

A major step in creating a tool to help consumers is developing a baseline understanding of the market. I attempted to reach out to retailers directly to see if there was easily accessible information on dominant market players, typical pricing guidelines, etc., but was denied this

information outright. Therefore, the public data from Power to Choose are the only means to draw these necessary insights.

Locations of Interest

A few areas of interest were selected for the primary data collection and analysis: Victoria, Texas (77901); Cypress, Texas (77429); and Arlington, Texas (76006). The areas are noted on the map (Figure 6).

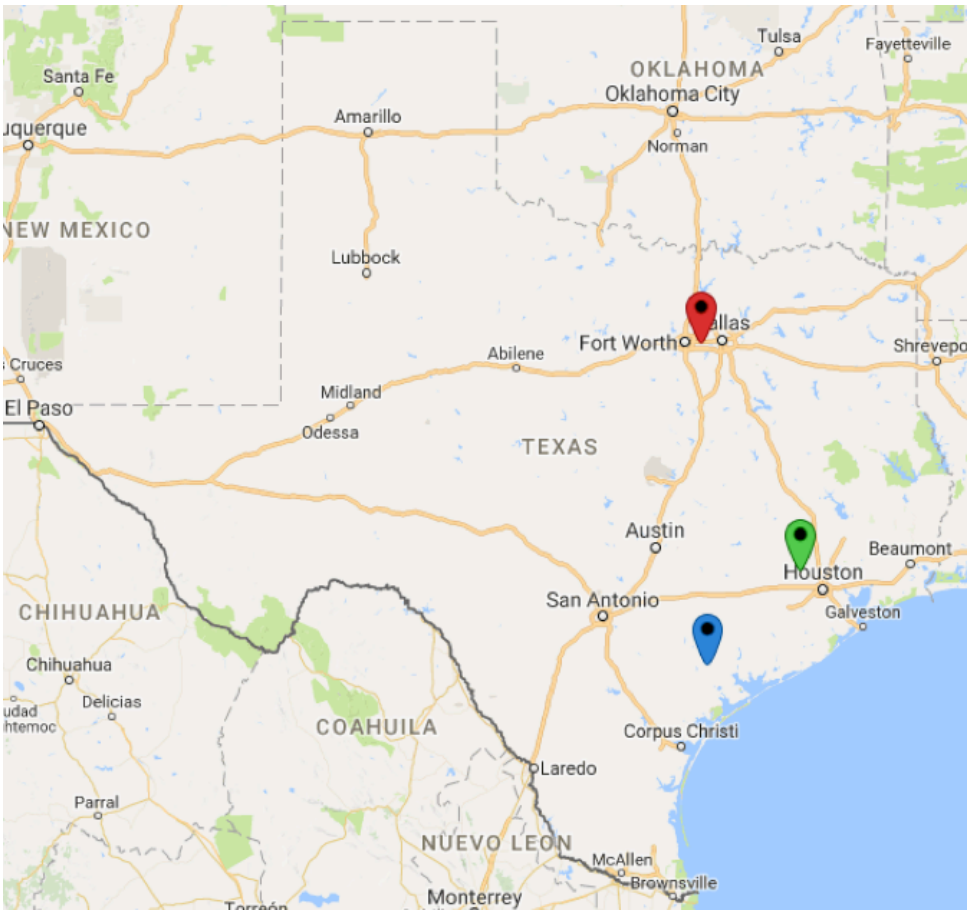


Figure 6: Map of REP sample locations (Arlington in red, Cypress in green, Victoria in blue)

Reasons for Selection

These three locations were selected because they are sizeable cities in three different ERCOT regions. Arlington falls under Oncor jurisdiction, while Victoria is under AEP Texas Central and Cypress is under Centerpoint. At the very least, the different TDU fees will drive pricing difference between these areas.

The major cities in these areas, such as Dallas and Houston, have been omitted because they would not be expected to contain the same concentration of homeowners as the suburban areas. Individual residential consumers and small businesses are the focus of this study, not high energy consumers like office buildings.

Omitted Areas

While the Dallas-Fort Worth and Houston metroplexes are represented by Arlington and Cypress, respectively, and the greater Rio Grande Valley region by Victoria, the Austin and San Antonio have been excluded. This is because both of these areas, like College Station, have municipally owned power.

Austin's Austin Energy and San Antonio's CPS Energy both individually are two of the largest municipally owned power companies in the country. These companies are crucial city revenue stream, which is why the cities choose not to participate in the retail electric market, and instead purchase electricity wholesale from ERCOT.

Evaluation of Plans

Data for eighty-one plans have been collected for analysis. These plans include those with a large variety of pricing structures and are equally split among the three major geographic areas mentioned above. Most importantly, similar plans were selected in each area to ensure that

direct comparisons could be made. For example, if TXU had a plan available in all three areas, it would be selected and assigned the same identification number for easy comparison.

Consumer Data

A wealth of consumer data is available from the Energy Coupon Project at Texas A&M. This research collected consumer energy data from smart meters in Cypress, Texas. A few sets of this data have been used to accurately model the energy consumed by standard customers. In particular, five user data sets were randomly selected. The data sets contain energy usage data from June 1, 2015 to May 31, 2016 in thirty-minute increments. This allows for accurate modeling for all varieties of plans, in particular those with free nights or weekends. A summary of the user data can be seen below in Table 2.

Table 2: Electricity consumption by user

	Usage (kWh)				
	User A	**User B**	**User C**	**User D**	**User E**
Jun-15	3729	2697	2283	685	3830
Jul-15	4548	3641	2703	678	4000
Aug-15	4351	3608	2845	682	4245
Sep-15	3515	2782	2333	136	3571
Oct-15	2620	1875	1270	558	3245
Nov-15	1510	1753	1073	416	2562
Dec-15	1269	1668	1661	400	2569
Jan-16	948	2065	1941	442	2246
Feb-16	961	1849	1221	377	2140
Mar-16	1480	1921	740	400	2383
Apr-16	2202	1930	990	434	2221
May-16	2782	2417	1510	424	3310

The users represent a wide variety of consumption habits. One can assume that while *D* is likely for an apartment, *E* is by comparison almost certainly a large house. The others represent users between these two extremes.

Platform for Consumer Electricity Spending Savings

The exact design of the platform is contingent upon the findings from the retail plan analysis, and the term "platform" is used broadly intentionally. It could take the form of a mobile or web application that allows users to select cheaper plans. Alternatively the platform could be a functionality of a popular voice assistant, such that a user could ask it to switch to the cheapest plan currently available.

Requirements for an Effective Platform

For an automated system to provide substantial benefits to consumers and also create revenue on its own, a desired goal, there must be substantial variation in pricing. Pricing would be expected relatively similar, as this *should* be a commodity market. There is no super electricity, and consumers generally expect their electricity to be delivered constantly. The only exception may be during major weather issues, like natural disasters, but the retailer does not handle the complications that arise from these. The only area for differentiation is quality of customer service, which can be measured by the star-rating system mentioned in the Introduction.

However, because it is so difficult for an individual to determine their personal cost, competition may not be driving prices to equilibrium. The vast combinations of charges that retailers can impose on consumers also make it difficult to determine what a "good price" is, as consumer habits affect this drastically.

Therefore, for this platform to be determined feasible, we would want to see a high standard deviation in price across plans for each customer in each area. It would be additionally helpful if this was not correlated to quality of service, that way the platform could provide quality retailers at excellent price points to consumers.

CHAPTER III

RESULTS

Variety in Retail Plans

The plans were selected randomly by category, meaning that a set of fixed plans were randomly selected, a set of variable plans were randomly selected, and so on. Most of the plans are also directly comparable between zip codes. In some cases, a substitute had to be established because a certain retailer or plan did not exist in a specific area. Table 3 shows the breakdown of plans by zip code, type, and cross-comparability (plans with the same ID can be compared unless there is an "**X**").

Table 3: Selected retail electricity plans

Type	ID	77429 – Cypress	76006 – Arlington	77901 – Victoria
Fixed	1	✓	✓	✓
	2	✓	✓	✓
	3	✓	✓	✓
	4	✓	✓	✓
	5	✓	✓	✓
	6	**X**	✓	✓
	7	✓	✓	**X**
	8	✓	✓	✓
	9	✓	✓	**X**
	10	✓	✓	✓

Table 3 continued: Selected retail electricity plans

Type	ID	77429 – Cypress	76006 – Arlington	77901 – Victoria
Variable	11	✓	✓	✓
	12	✓	✓	✓
	13	✓	✓	✓
	14	✓	✓	✓
	15	✓	✓	✓
	16	✓	✓	✓
	17	✓	✓	✓
	18	✓	✓	✓
	19	✓	✓	✓
	20	✓	✓	✓
Indexed	21	✓	✓	✓
	22	✓	✓	✓
	23	✓	✓	✓
	24	✓	✓	✓
	25	✓	✓	✓
	26	✓	✓	✓
	27	**X**	✓	✓

This selection of plans allowed for me to develop a strong sense of how the pricing varied by plan type. This is not, however, reflective of the actual distribution of plans by type.

Table 4: Distribution of plan types

	77429 – Cypress	76006 – Arlington	77901 – Victoria
Fixed	285 (89%)	299 (88%)	250 (86%)
Variable	30 (9%)	35 (10%)	31 (11%)
Indexed	7 (2%)	7 (2%)	9 (3%)
Total	**322 (100%)**	**341 (100%)**	**290 (100%)**

If the distributions in Table 4 were used, it would provide little insight into the natures of variable and indexed plans.

Understanding Electricity Pricing

The most essential aspect of this project is developing an understanding of retailer pricing. The most tempting approach would be to compare plans based on a common pricing element, such as the base rate. Figure 7 shows the twenty-two plans from the Cypress area that utilized a base rate per kWh as part of their pricing model.

Figure 7: Per kWh base rates of selected plans

There is little correlation between the rates in the figure above. This indicates one of two possibilities:

1. The retailers are unsophisticated and price their products haphazardly
2. Even the most common pricing element is not a determining factor of overall plan pricing

Option 2 is more reasonable; it leaves open the possibility the pricing formulas on the whole are competitive with another.

Price Parity within Plan Types

The three varieties of plans are intended to target customers who have certain risk-averseness: variable plans are for risk-averse customers and index plans are for risk takers. Because of the market influences on two of the three types, there should not be price parity across the board. If the retailers are trying to target a wide variety of users, though, there should be some degree of parity within each category at specific consumption levels. Figure 8 shows effective rates for each plan in the Cypress area assuming the customers consume energy at a constant rate each month, totaling 500 kWh, 1000 kWh, or 2000 kWh. This exposes how a plan may function outside of the assumptions of the REP. The listed prices for plans that have free nights, weekends, or other time based benefits often assume specific ratios of usage, for example, *62% of all power is consumed during the daytime, defined as the period between 7:30 AM and 6:30 PM*. Another provider may establish daytime as 8:00 AM to 5:30 PM, distorting the rates found on Power to Choose.

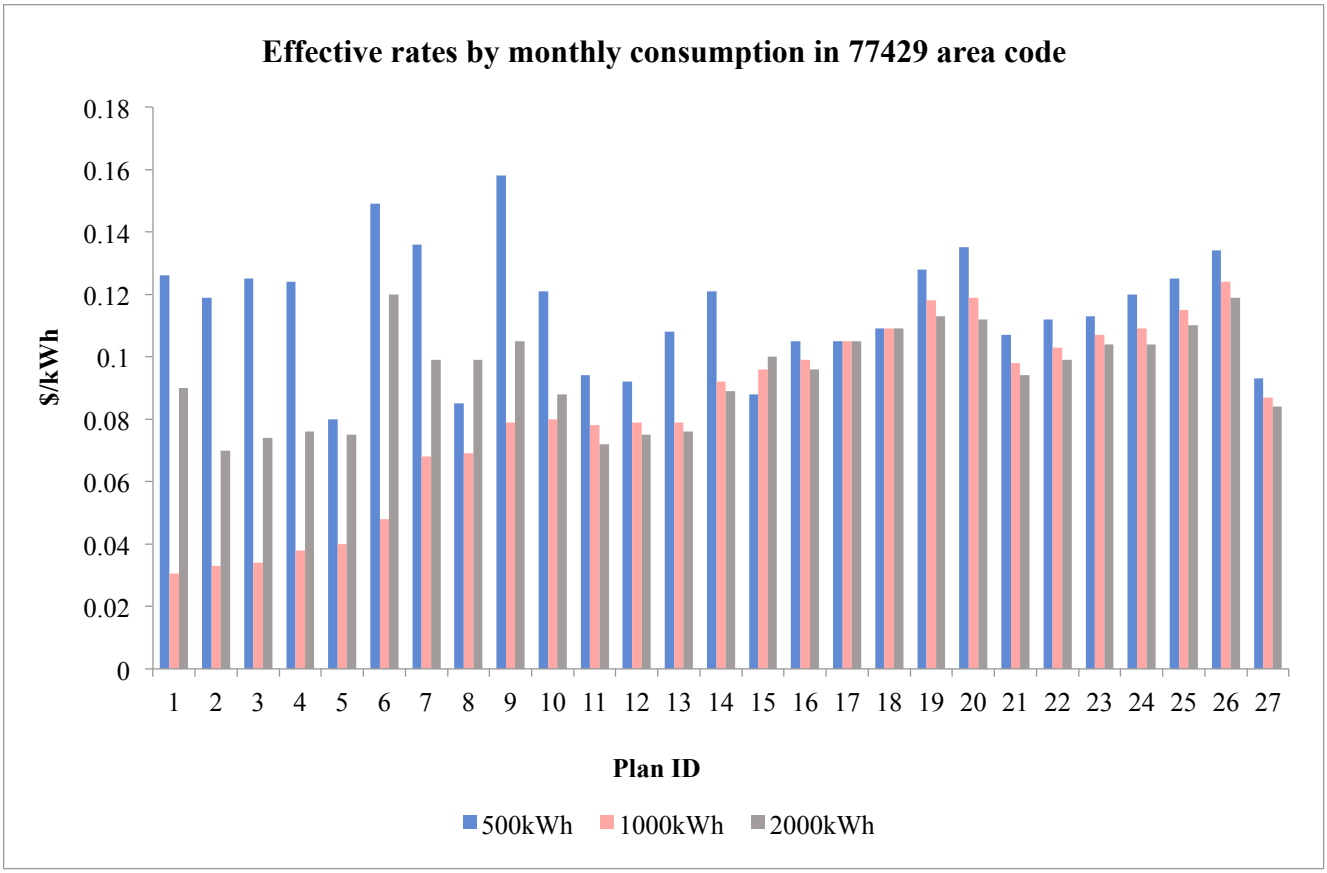


Figure 8: Effective rates in $/kWh of selected plans

Even within types, there is a substantial amount of variation between plans at these usage levels. It is also made abundantly clear that the "fixed" plans vary heavily based on consumption. Certain plans exhibit this more drastically than others.

For example, Plan 1 penalizes consumers for consuming less than 500 kWh, rebates a large amount for using between 1000 and 1500 kWh, rebates a small amount for using between 1501 kWh and 2000 kWh, and charges the normal rate scheme otherwise. This results in a few strange features: most notably, it costs nearly $100 more per month to consume 999kWh than it does to consume $1000 kWh (Figures 9 – 10).

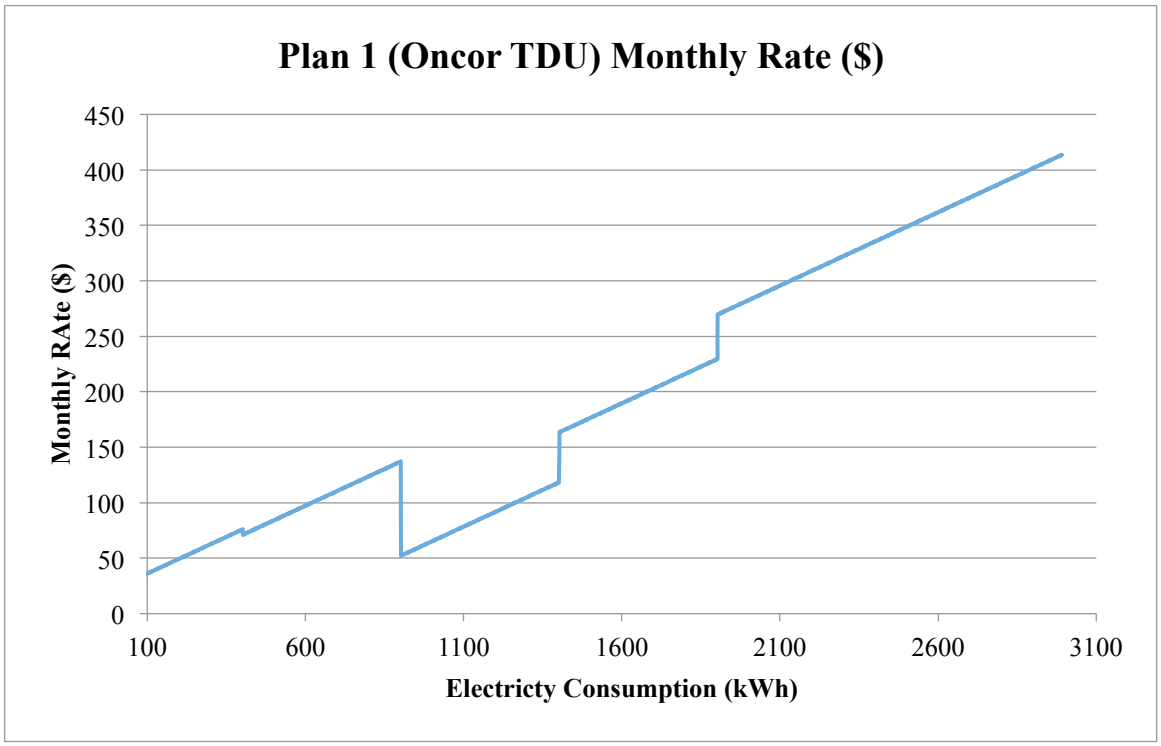


Figure 9: Plan 1 monthly rate ($) vs. consumption

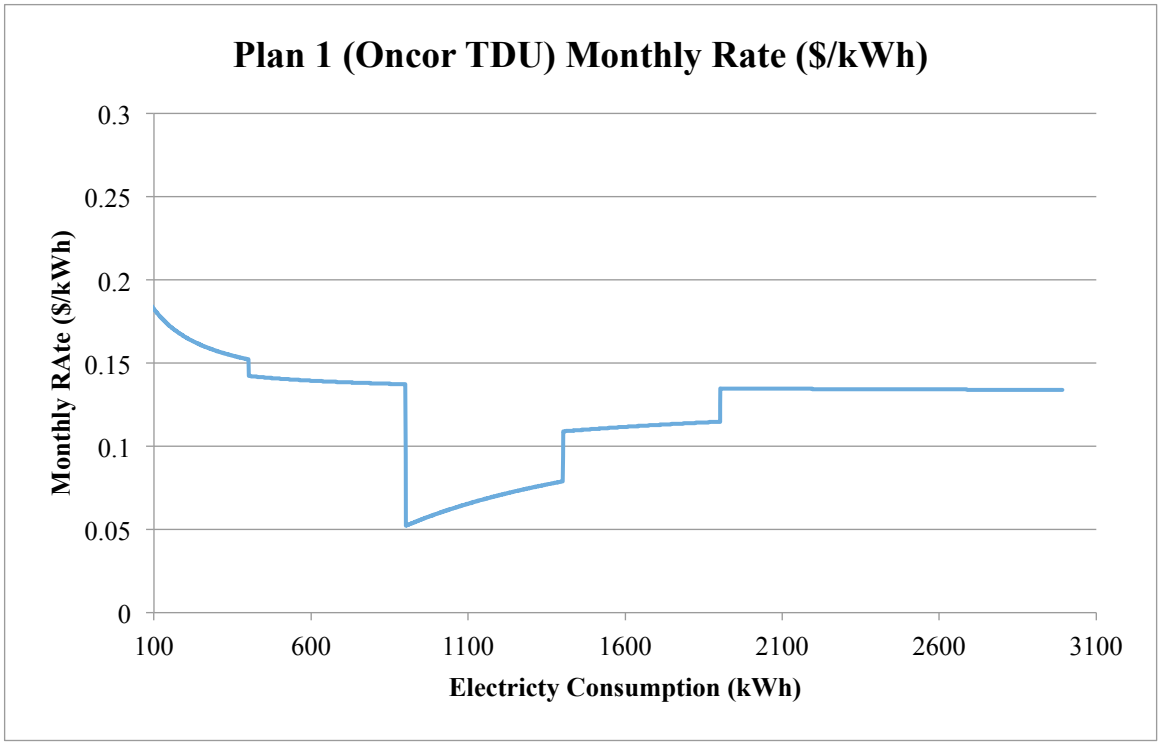


Figure 10: Plan 1 monthly rate ($/kWh) vs. consumption

Plan 5 has odd nuances as well. The customer is charged a small flat rate up to 1000 kWh, than the flat rate increases by a factor of 7.5 beyond that. An additional price per kWh is added after 2000 kWh as well. This produces the curves shown in Figures 11 and 12.

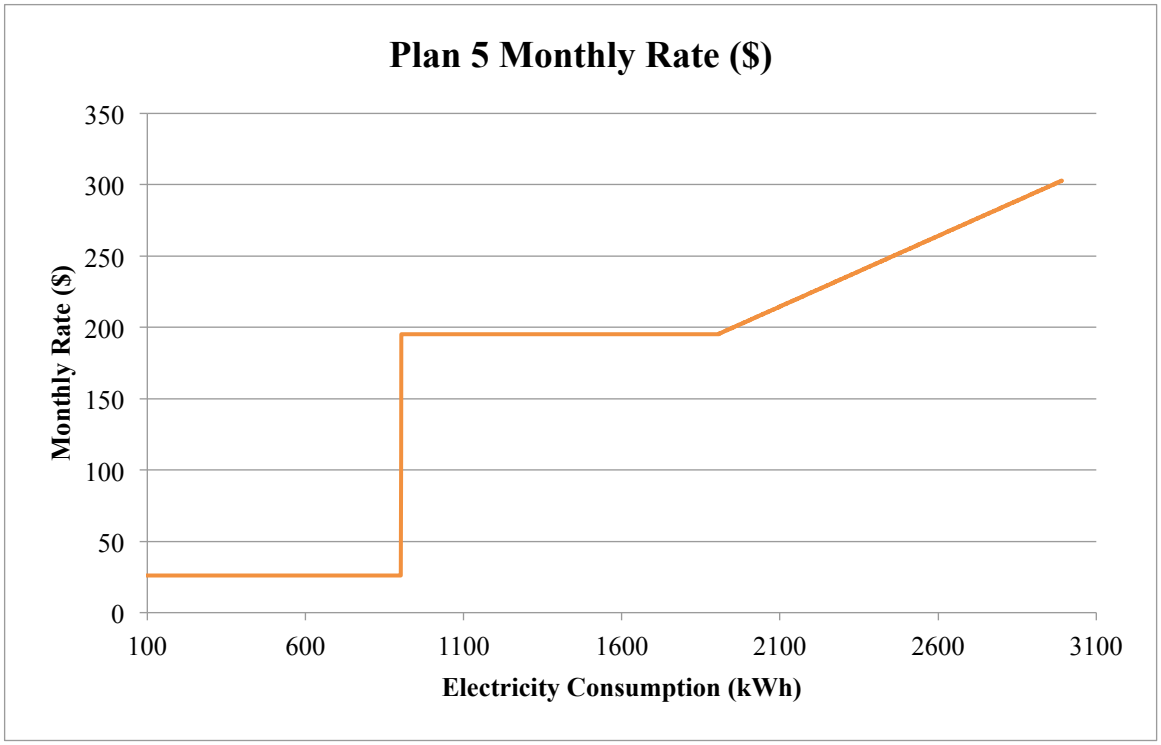


Figure 11: Plan 5 monthly rate ($) vs. consumption

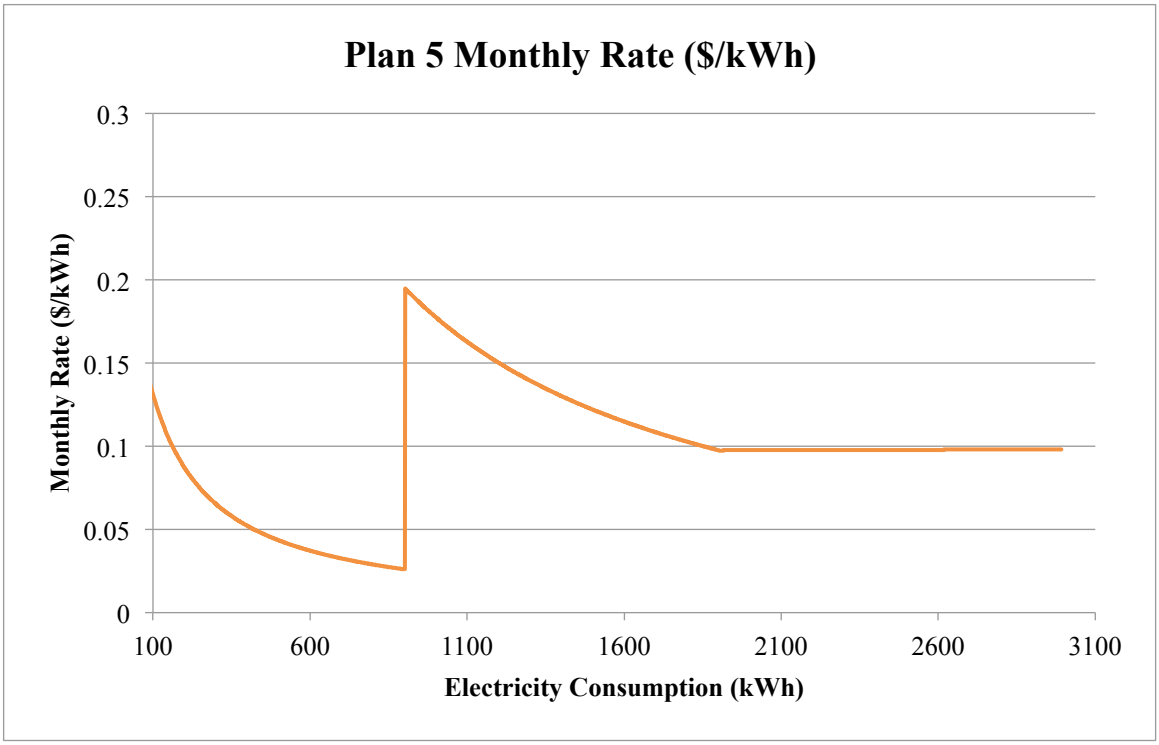


Figure 12: Plan 5 monthly rate ($/kWh) vs. consumption

This lack of price parity indicates that retailers are not using a generalist approach to capture every customer with a given plan: each plan is optimized for a certain type of customer. This means that when all of the plans are simulated with each user data set, there should be a large range of between the most expensive plan and the cheapest plan. Additionally, in most cases, the cheapest plan for someone who consumes very little electricity should be very different from one who consumes a substantial amount of electricity.

Modeled Results

The user data was used to model each of the eighty-one plans a resolution of one month. However, the data is most clear at the annual spend level, so that will be used primarily.

Annual Spend by Plan and Area

The plans that could be directly compared across the three zip codes (all except 6, 7, 9, and 27) are modeled in Figures 13 through 17 for each user.

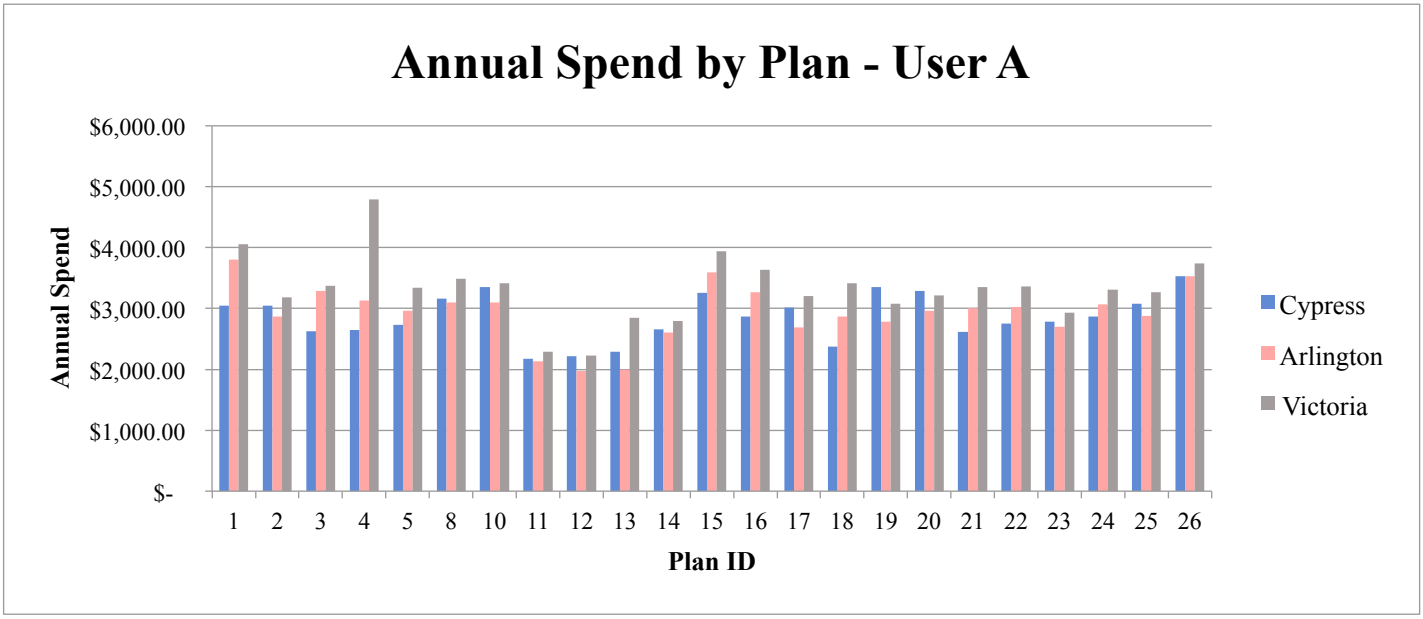


Figure 13: Annual spend by plan - User A

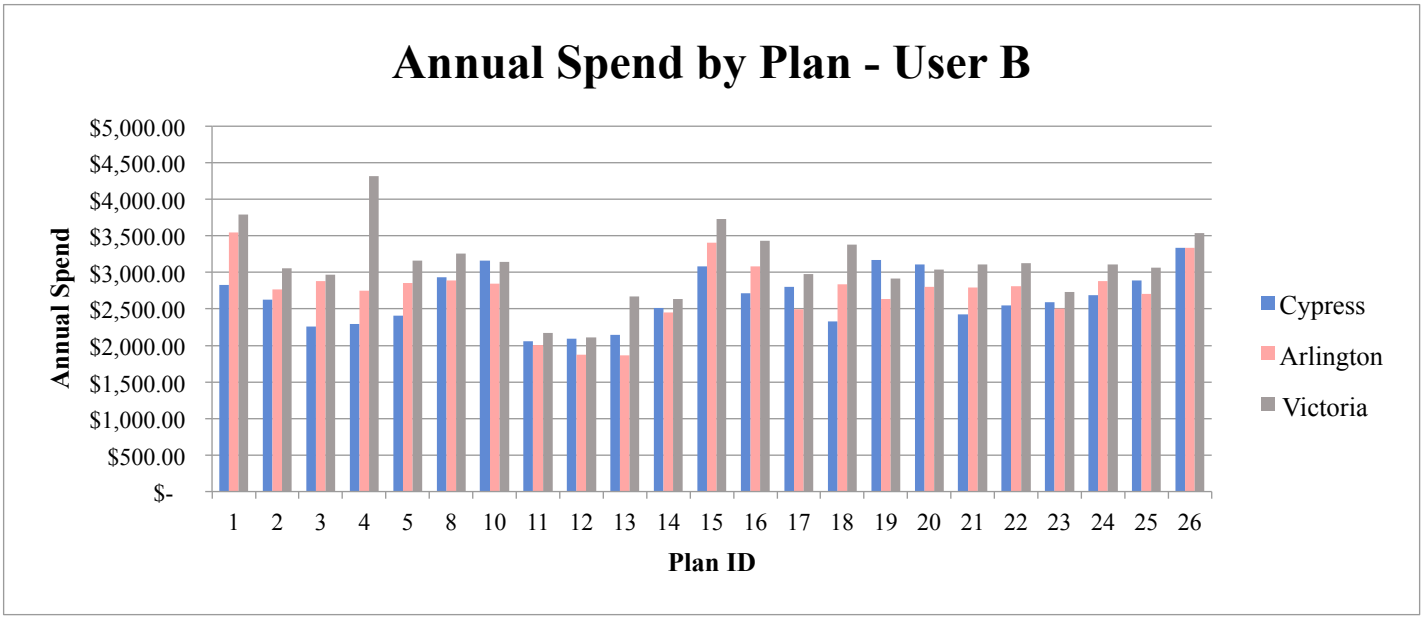


Figure 14: Annual spend by plan - User B

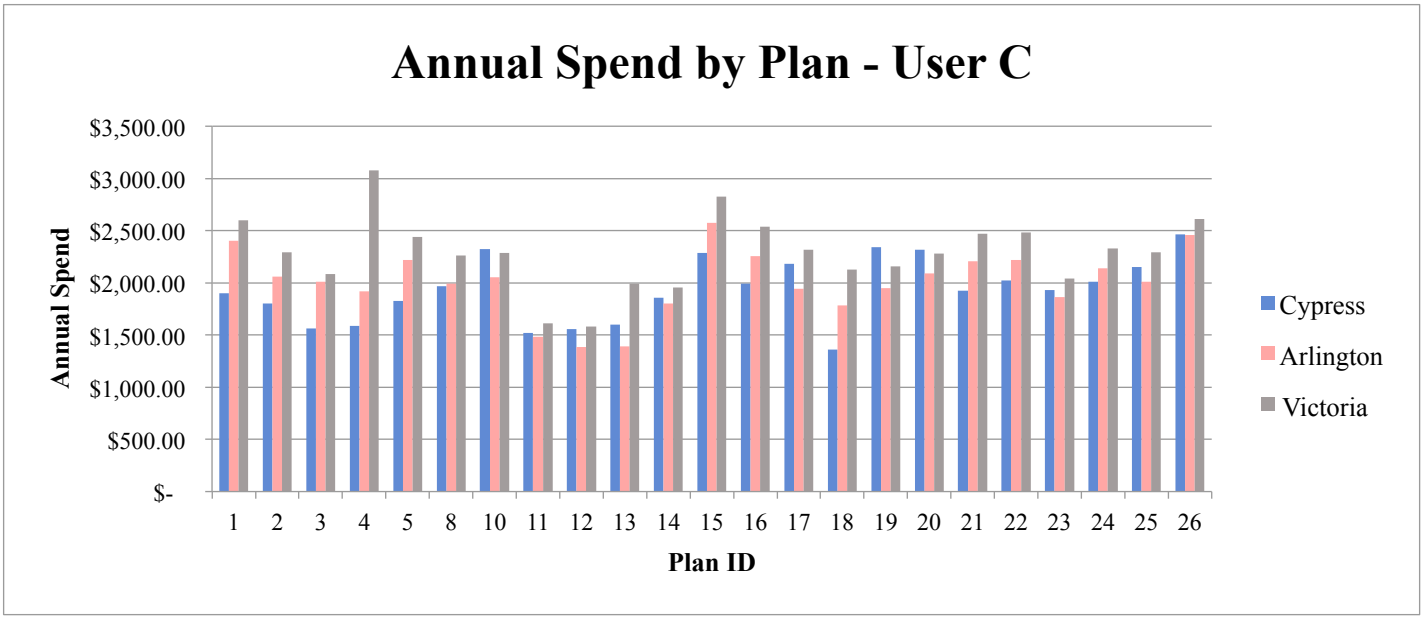


Figure 15: Annual spend by plan - User C

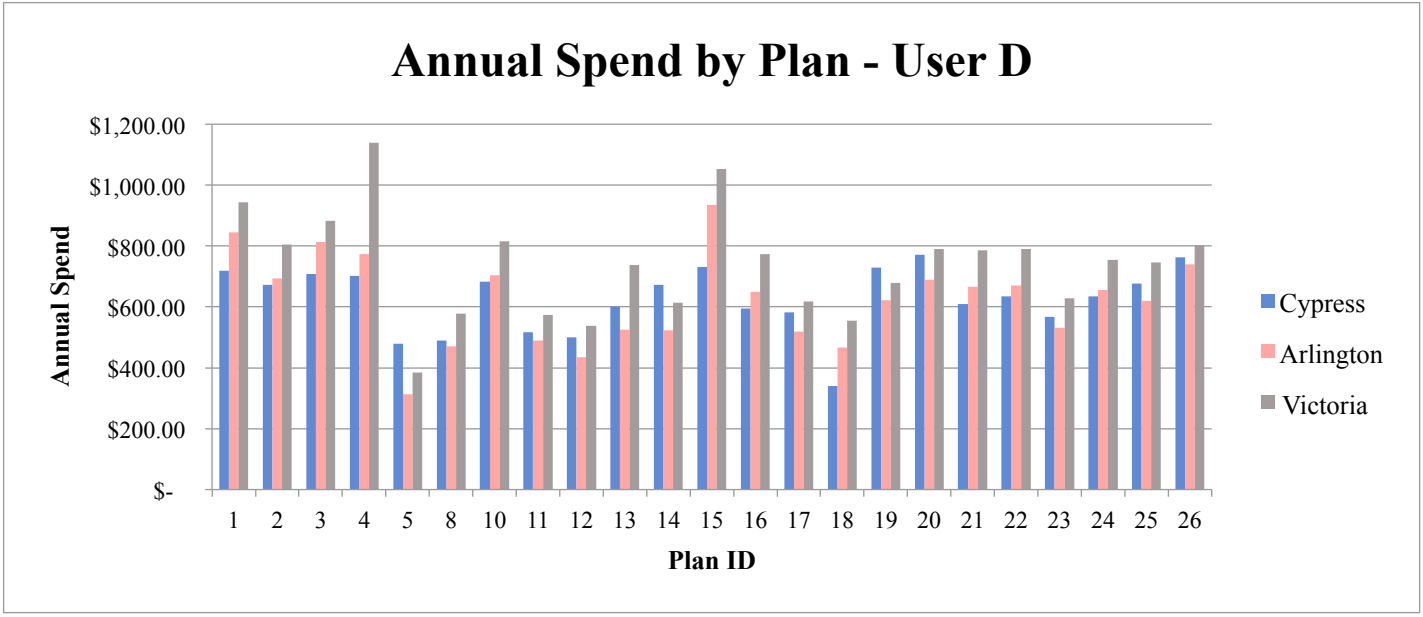


Figure 16: Annual spend by plan - User D

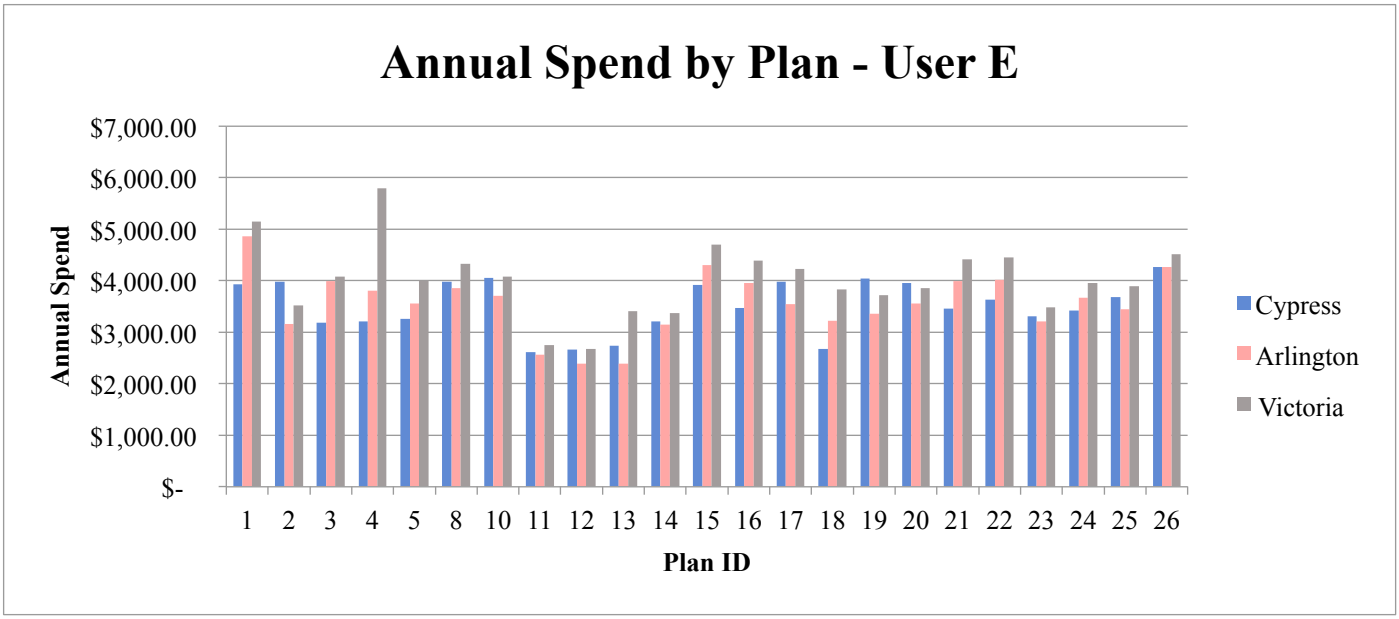


Figure 17: Annual spend by plan - User E

For each of the users above, the relationships between plans across areas are similar. For example, Plan 4 is always highest in Victoria and lowest in Cypress, no matter the usage habits. Plans 11 through 13 are always cheapest in Arlington. Even Plan 17 (free weekends) and Plan 18 (free nights) follow the same relative pattern across users.

This shows that pricing is relatively consistent across regions. Pricing across plans for a user, however, is not this straightforward. There appears to be a huge range of potential prices a user could pay based on plan selection (Figures 18 – 20).

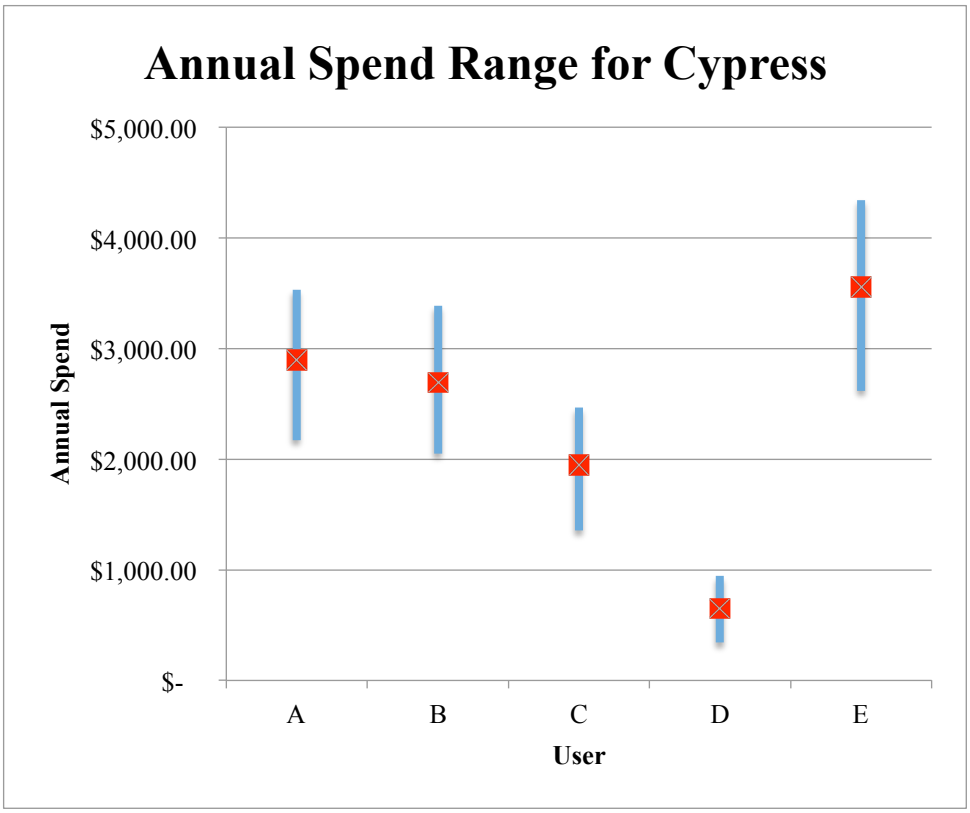


Figure 18: Annual spend range for Cypress, TX

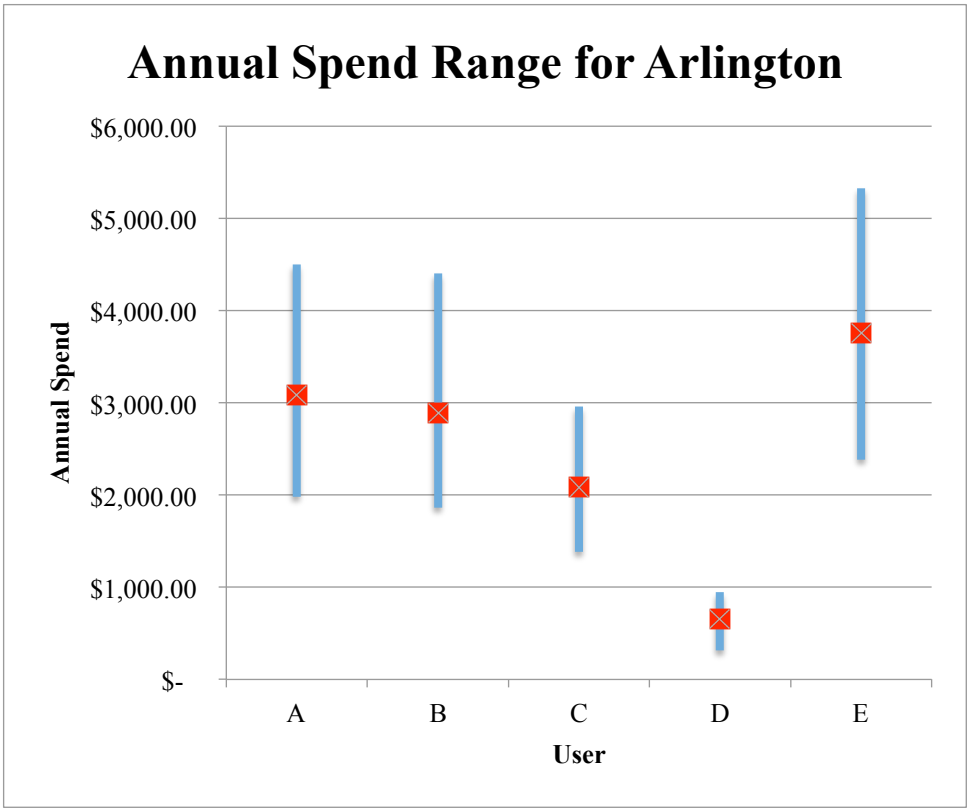


Figure 19: Annual spend range for Arlington, TX

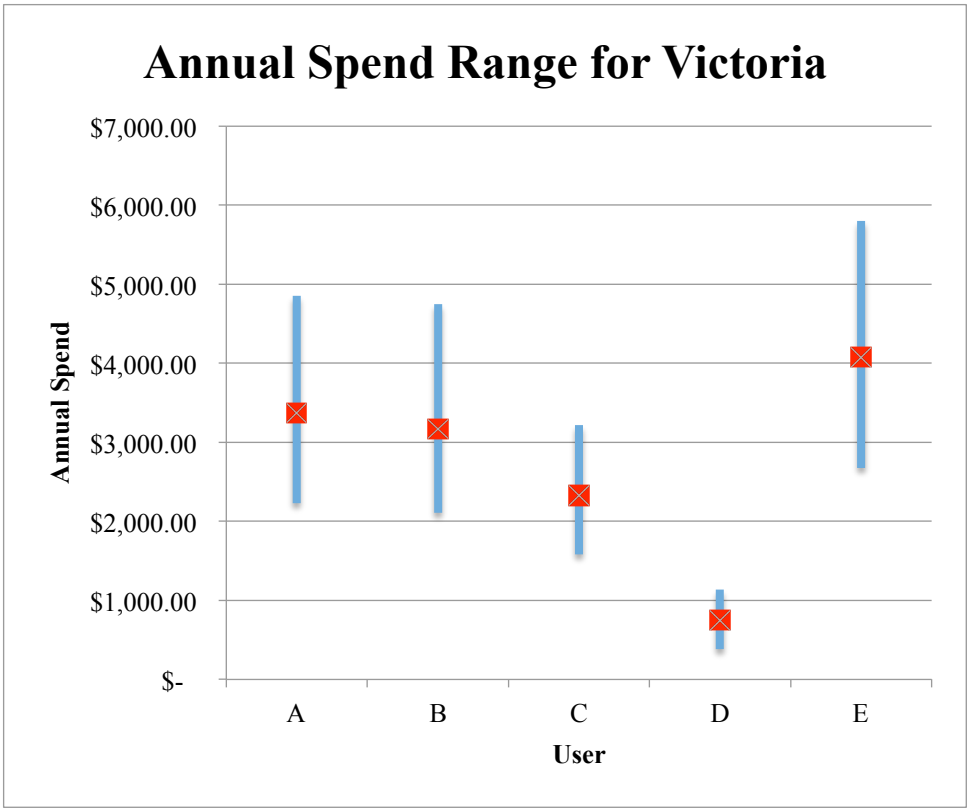


Figure 20: Annual spend range for Victoria, TX

In every location for every user, there is a sizeable range of energy costs. The averages, denoted by the red markers, are well centered within these ranges. An improper plan selection could cost a consumer more thousands of dollars. For example, the highest annual spend for User E in Victoria is about $5,800, while the lowest is $2,700. If User E (the largest consumer of electricity) was unlucky enough to select the most expensive plan (Plan 4), then he or she could reduce their costs by over 50% by switching to Plan 12: an annual savings over $3100. Even for User D (the smallest consumer) in Cypress, the tightest range of all of the user-location combinations, there is a potential savings of $600 per year.

The benefits are not just on the fringe. In each case, a consumer paying the average price still has the opportunity to save several hundred dollars per year by switching to a cheaper plan.

Relating Price and REP Rating

One concern for the feasibility of the platform is the possibility that the cheapest plan may always be associated with a REP that provides a low level of customer service. Figures 21 through 25 relate the PUC assigned rating to annual spend for each user. These data include all three locations.

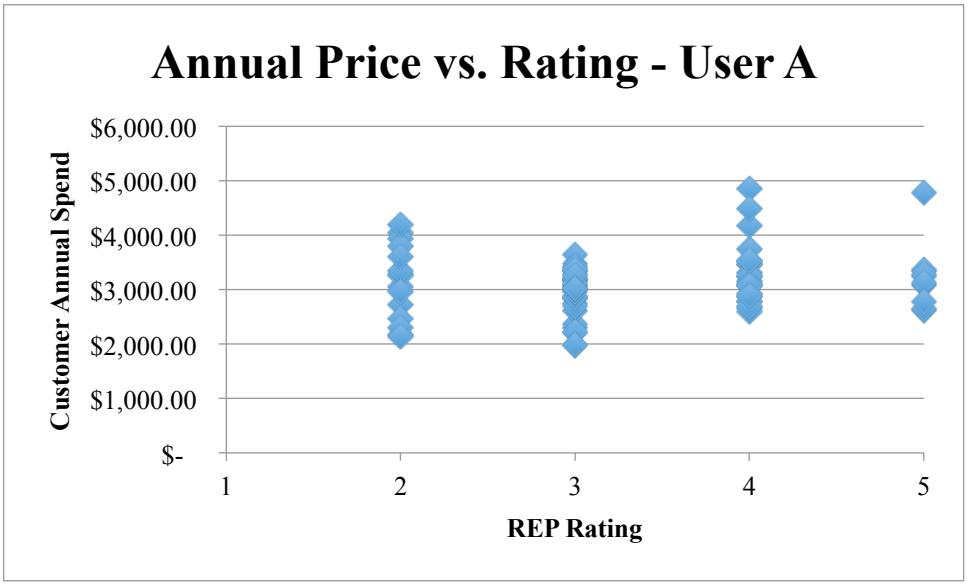


Figure 21: Annual price vs. rating - User A

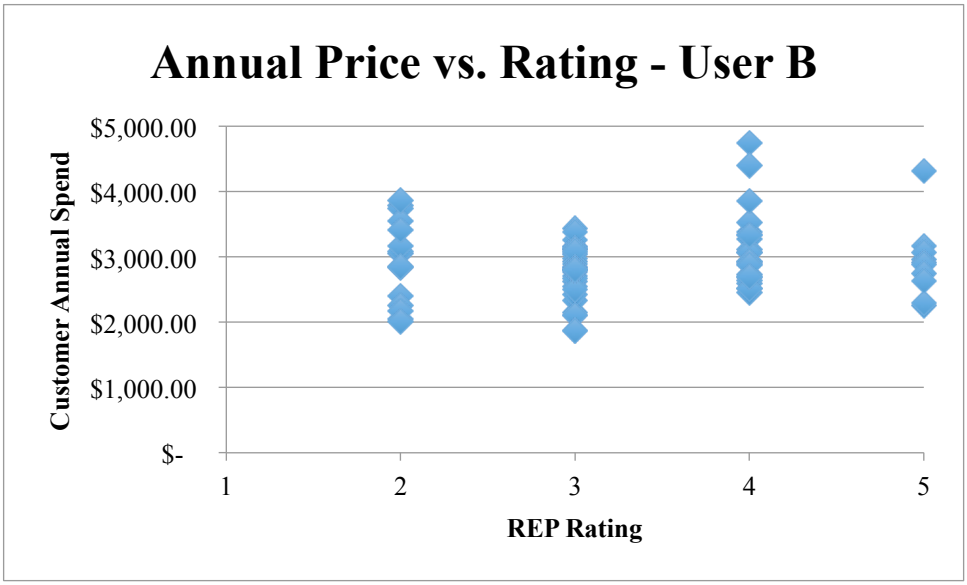


Figure 22: Annual pricing vs. rating - User B

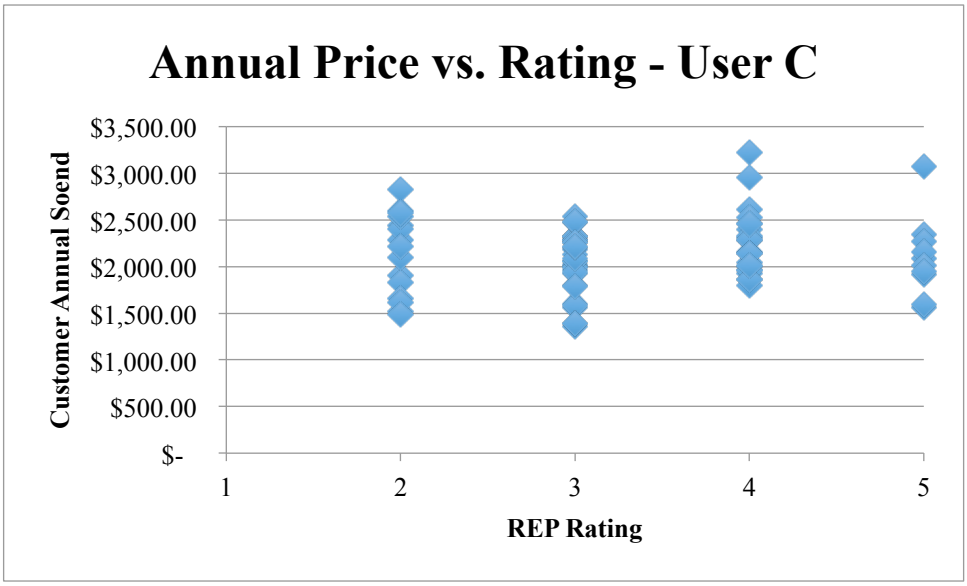


Figure 23: Annual price vs. rating - User C

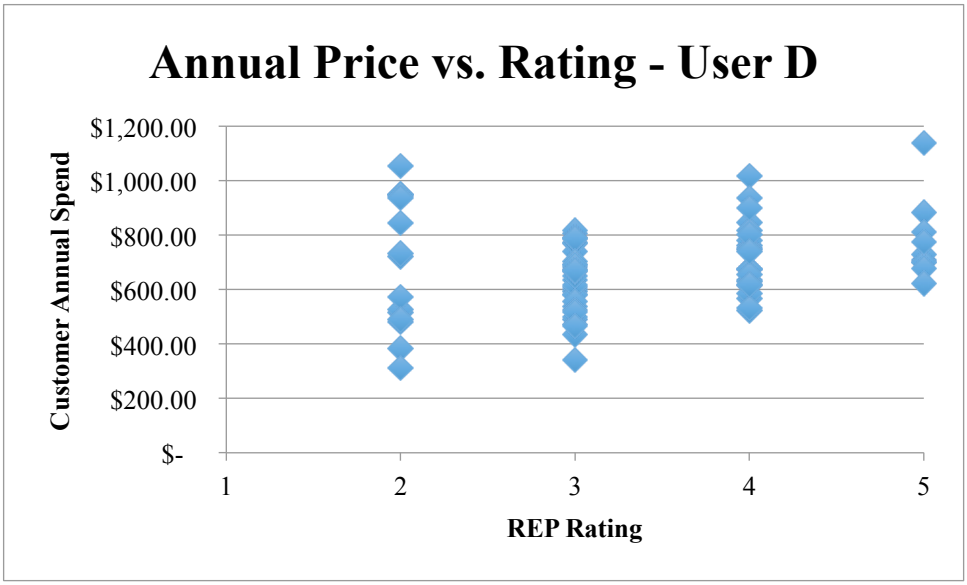


Figure 24: Annual price vs. rating - User D

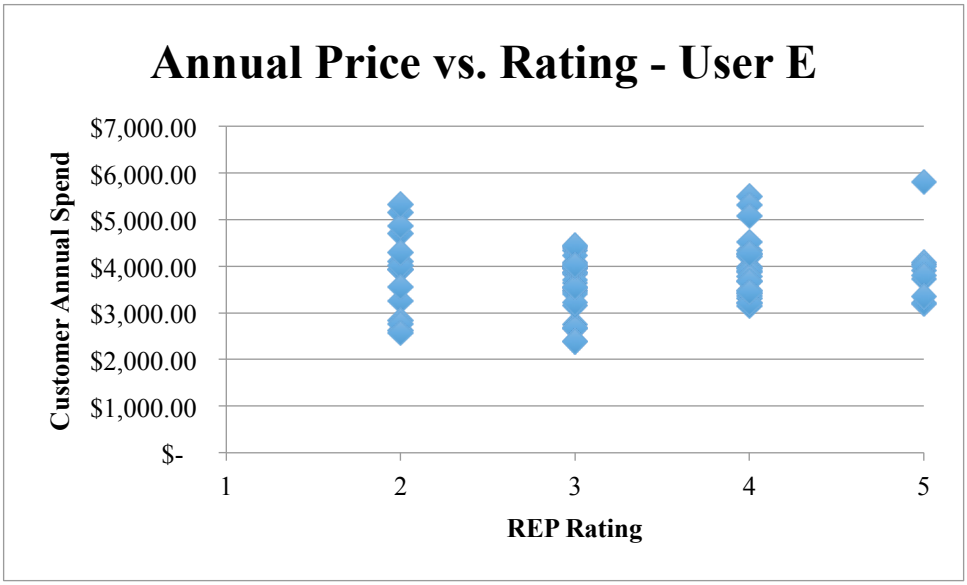


Figure 25: Annual price vs. rating - User E

Based on these plots, there is little correlation between price and quality of service (for which we assume rating is a proxy). There are cases in which the highest rated provider is the cheapest or near the cheapest and others where the lowest rated provided is nearly the highest price. This is a good sign – in the case of a platform, consumers should not have to sacrifice level of service to save money every time.

CHAPTER IV

CONCLUSION

Overall, these results indicate that a platform to assist consumers in plan selection would provide substantial savings for many consumers. Considering these savings could are often on the scale of hundreds or thousands of dollars per year, a subscription based fee in the range of $50 to $100 per year to continuously search for better plans, or even a lower single-use switching fee should be very reasonable.

Further Research

While the current data indicates a preliminary possibility of the platform being useful and being able to generate revenue, there is still a need for additional customer research and product development.

Customer Research

The appropriate next step for this research would involve surveying electricity consumers to develop a clear understanding of their current knowledge of the electricity market and interest in this type of product.

Product Development

As mentioned, the platform could take any number of forms, from a mobile application to an automated web based service. However, if it is indeed the case that consumers are knowledgeable about this market and the potential savings, other related products may be bundled to increase its mainstream appeal. Energy saving functionality like household appliance management, like turning off smart lights or adjusting the thermostat, are some possible bundling options.

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