Evaluation of Data Access Authorization Methods using A/B Testing

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Figures

Contents

Executive Summary

A focus group of non-utility people were gathered to gauge their sentiment for data security on two types of online customer data access authorization flows. Designated Case A and Case B, the former represents the existing PG&E Share My Data authorization flow based on MyAccount authentication, while Case B represents an Alternate authorization flow modeled after a 2-factor/multi-factor (2FA/MFA) authentication scheme. The results indicate that customers are reassured by well-known brands when interacting with authorization flows. Furthermore, some focus group participants indicated that Alternate authorization flow did confer a degree of reassurance for data security, though a majority showed preference for branded interaction.

Introduction

This Demand Response Emerging Technology project examines the potential customer impact for methods of online customer acquisition involving energy services, and in particular compares and contrasts authentication and authorization flows embedded in an established method using PG&E's Share My Data (SMD) service platform, against a hypothetical "Alternate Authorization" method, modeled after multi-factor authentication flow, but one that uses one-time passcode (OTP) only. The objective is to measure the potential impact on sentiment when the customer is acquired through the Alternative Authorization method instead of the existing SMD method. The results provide information about factors that can inform stakeholders of key issues when recommending actual data release platform feature sets.

Background

Scaling online services to large market penetration is of general interest to many Energy Services Providers (ESP), and especially here in California, online services are becoming part a larger part of the diverse energy services landscape. Expansion of such services along with more distributed energy resources is seen as critical to California's energy future. One of the most important aspects of scaling such services is to cost effectively acquire customers and onboard them onto the ESP's services, be they for demand response providers (DRP), energy efficiency (EE), distributed energy resources (DER), or solar power purchase agreement (PPA) services. Understanding the factors contributing to success or failure of online customer acquisition is seen as critical to the growth of the entire ESP industry.

DRP, EE, DER, or PPA vendors increasingly manage energy independently from the energy utilities of any given service area. For these service providers to operate a viable business and bring value to customers, utilities and service vendors need to work together on a variety of fronts, and transfer of privacy identifying information (PII) and energy data from the utility to the service provider is becoming an essential part of making or breaking the ESP business model.

Energy utilities in California are bound by Tariff Rule 27 on Data Privacy, along with other Tariff rules associated with specific energy services under regulatory oversight by the California Public Utilities Commission (CPUC). Furthermore, the recent California Consumer Privacy Act (CCPA) adds another layer of requirements for utilities and services to mind when cooperating and coordinating for data access pertaining to customer data. Key provisions include customer authorization of access to PII and energy data and clear statement of terms and conditions for a service. Intertwined in this provision is the customer being authenticated before release of the PII & energy data resource.

ESP's find it essential to drive costs down to successfully acquire customers and operate their energy service, and this fact has in part been a driving force behind Rule 24 Click Through Proceedings at the CPUC since 2016. Hence a workable business process coordination between service providers and the utility was sought to deliver PII & energy data out of the utilities and into the hands of the ESPs. This need translated to establishing an effective data service interface between the utility and ESPs. The outcome of the Rule 24 Click Through Proceed for PG&E has been the upgraded SMD experience deployed in 2018 under three distinct phases.

The current, upgraded SMD flow provides data access to third parties and is supported by PG&E's Data Privacy and Cyber Security programs which follow industry privacy standards and key regulations.[1] This includes the National Institute of Standards and Technology (NIST) Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0 and Guidelines for Smart Grid Cybersecurity,[2] among many others. Through the SMD service, PG&E delivers customer authorized gas[3] and electric interval usage data, detailed and summary bill data, and other energy related information.[4] PG&E has the responsibility to act as the authentication authority[5] and as the data custodian[6] and has therefore implemented the necessary requirements to render these responsibilities.

An Alternate authorization flow is presented in this evaluation, in order to assess its efficacy for customer acquisition when compared with the existing SMD flow. This Alternate authorization flow is modeled in part from proposals suggested by third party DRPs during the Rule 24 Click Through Customer Data Access Committee meetings. The main feature of the Alternate authorization flow is that there is no redirection of the customer website away from the ESP website, i.e. the customer interacts only with the ESP website without ever being referred to a PG&E website or window.

A natural consequence of the Alternate authorization interaction is the change in how PG&E validates that the customer is who he/she says they are, i.e. authentication. Whereas in SMD, the customer's input credential is directly compared at PG&E with internal database information, in the Alternate authorization flow, a one-time passcode, or personal identification number (PIN) is issued by PG&E "out-of-band", i.e. outside of the direct route of communication between the customer and ESP. This out-of-band method may involve an SMS message directly to a customer's phone via text information. The customer then enters that OTP into the ESP website and ESP forwards that information to PG&E, thereby proving that the customer is interacting with the ESP, and is who PG&E knows as the possessor of the phone (a factor to account for what the customer has). This enables PG&E to authenticate the customer as valid based on the possession of the OTP via an existing trusted path. While it involves many steps, this closely parallels, but does not duplicate the method used in 2-factor / multi-factor

[1] IETF RFC 6960, 3748, 5247, 5295

[2] NIST Special Publication 1108R2 and NISTIR 7628 Revision 1

[3] Gas data is not available to Demand Response Providers under Rule 24

[4] Using NAESB's (North American Energy Standardization Board) energy service portal interface (ESPI) data model. The data delivery method conforms to the Green Button Alliance sanctioned Green Button Connect framework, where OAuth2 mechanism is the standard (IETF RFC 6749).

[5] Party responsible to verify authenticity of requestor identity

[6] Party responsible for access release and protection of data

authentication (2FA/MFA) in the industry, to validate a personal identity against a known, good set of information.

In general, this evaluation aims to determine whether the Alternate authorization flow, as represented by the OTP exchange, is too onerous or not for a customer to use, in an online ESP customer acquisition process.

Description and Methodologies

As a means of measuring the relative merits of the SMD and Alternate Authorization based online acquisition methods with potential consumers of ESP services, a series of test sessions with a focus group was devised, where the potential consumers were presented with the two authorization methods and asked about their relative comfort with the approaches. The methodology chosen was “A/B Testing” (refer to Appendix A for a description), a standard website industry user experience measuring method to help gauge the reactions of people to the two approaches.

Description

To perform this A/B test, 2 prototypes (Figure 1 & Figure 2) were created using an online InVision tool. Control (Case A) *(For more information on what a Control is, please see Appendix A)* version was created to simulate the existing flow today used by PG&E SMD service to 3rd parties; Variation (Case B) *(For more information on what a Variation is, please see Appendix A)* was a facsimile of the Alternate authorization approach representing a newly proposed flow. The focus group evaluation focused on Usability, to help us understand how easy the approaches were to use with real people. Upon completion of the test task session, typically while under observation by the testers, the participants were asked about problems they encountered and any confusion they experienced. *For more information on what Usability Testing is, please see Appendix B.*

Finding the right demographics

The people assumed to interact with online ESP were imagined to be young-to-middle aged working people, with college degrees and generally with normal aptitude for work and social skills. We performed the A/B testing to a total of 14 participants, selected to represent the suitable consumer base. These users were divided into the following groups:

- A total of 5 PG&E customers, and non-technical users
- 3 males and 2 females between the ages of 40 - 55 years old.
- Occupation: Sales, Business System Analysts, Risk Managers

The first set of A/B test provided us with insights and feedback on the tests themselves, and with the results, we followed up with a broader audience of users.

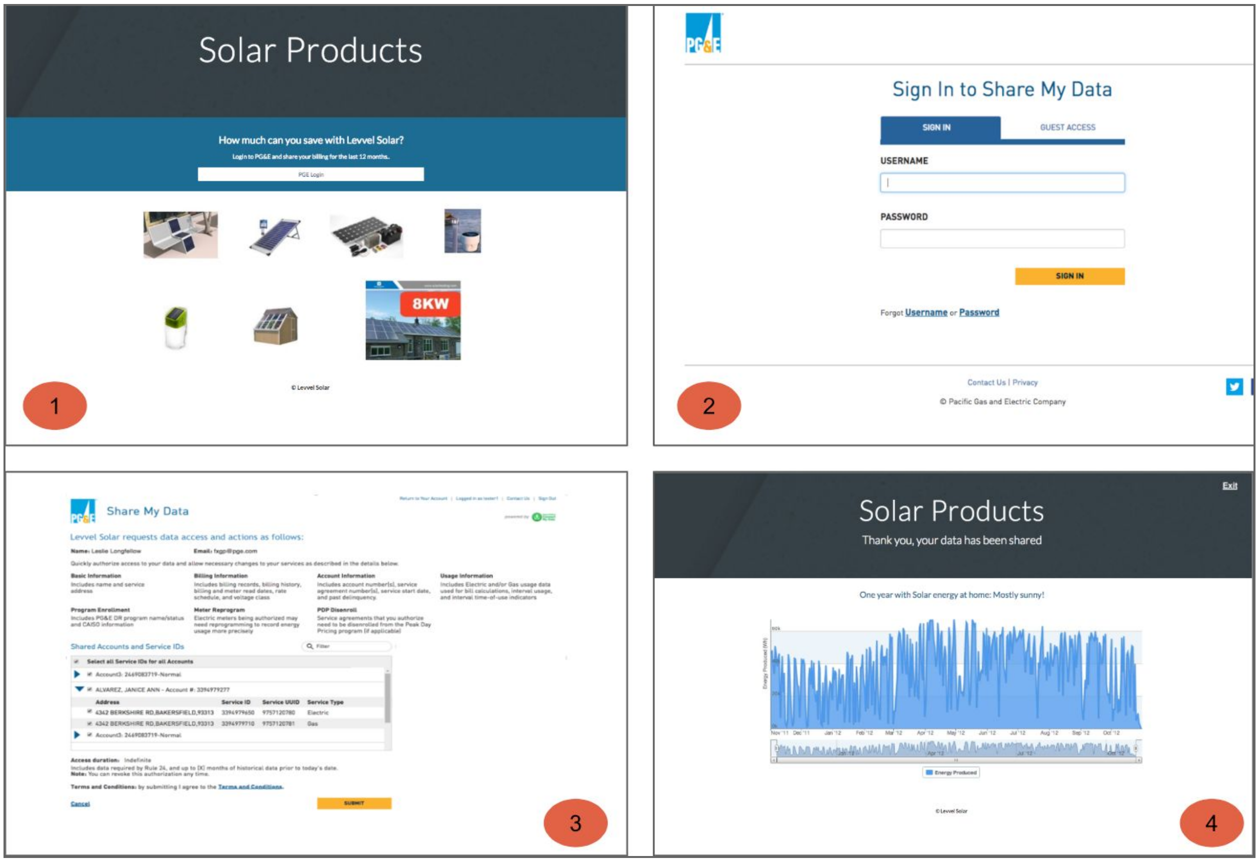
The second group of users also were PG&E customers, but with no particular technology background. The group was composed of:

- 9 PG&E customers, and were non-technical users.
- 2 males and 7 females between the ages of 24 - 45 years old.
- Occupation: Teachers

Both of these groups were presented the SMD authorization approach and the Alternate authorization approach in turn, then asked to fill out a survey, and additional interview session was held to obtain their impressions while interacting with the system mock-ups. The two groups were tested on separate days.

Study Implementation

To implement the testing, a mock UI representation of the typical customer online workflow was created. A simulated Solar Products company web page was presented to the customer, and with some typical interaction, the customer was guided onto the online authentication and authorization pages. The Case A test was simulated with the participants following PG&E's SMD flow to authorize data access with third parties. In contrast, the Case B test was simulated with participants following an Alternate authorization flow. The following is a description of the SMD and the Alternate authorization flows.



Solar Products

How much can you save with Levvel Solar?

Login to PG&E and share your billing for the last 12 months.

PGE Login

© Levvel Solar

Sign In to Share My Data

SIGN IN | GUEST ACCESS

USERNAME

PASSWORD

SIGN IN

Forgot Username or Password

Contact Us | Privacy

© Pacific Gas and Electric Company

Share My Data

Return to Your Account | Logged in as tester1 | Contact Us | Sign Out

Levvel Solar requests data access and actions as follows:

Name: Leslie Longfellow Email: fxgp@pge.com

Quickly authorize access to your data and allow necessary changes to your services as described in the details below.

Basic Information Includes name and service address

Billing Information Includes billing records, billing history, billing and meter read dates, rate schedule, and voltage class

Account Information Includes account number(s), service agreement number(s), service start date, and past delinquency.

Usage Information Includes Electric and/or Gas usage data used for bill calculations, interval usage, and interval time-of-use indicators

Program Enrollment Includes PG&E DR program name/status and CAISO information

Meter Reprogram Electric meters being authorized may need reprogramming to record energy usage more precisely

PDP Disenroll Service agreements that you authorize need to be disenrolled from the Peak Day Pricing program (if applicable)

Shared Accounts and Service IDs

Filter

☑ Select all Service IDs for all Accounts

☑ Account3: 2469083719-Normal

☑ ALVAREZ, JANICE ANN - Account #: 3394979277

Address	Service ID	Service UUID	Service Type
☑ 4342 BERKSHIRE RD,BAKERSFIELD,93313	3394979650	9757120780	Electric
☑ 4342 BERKSHIRE RD,BAKERSFIELD,93313	3394979710	9757120781	Gas

☑ Account3: 2469083719-Normal

Access duration: Indefinite

Includes data required by Rule 24, and up to [X] months of historical data prior to today's date.

Note: You can revoke this authorization any time.

Terms and Conditions: by submitting I agree to the Terms and Conditions.

Cancel

SUBMIT

Exit

Solar Products

Thank you, your data has been shared

One year with Solar energy at home: Mostly sunny!

© Levvel Solar

Figure 1. Control Case A

SME Data Access Authorization Flow

The current SMD service, Case A, is described with the following steps:

Step 1.0: Customer interacts with a third-party or ESP web service. The web service redirects the customer to PG&E's SMD sign-in page for authentication by PG&E.

Step 2.0: Customer enters PG&E account credentials to a PG&E pop-up upon the redirect. PG&E validates the authenticity of the customer and allows access to the PG&E authorization page.

Step 3.0: Customer is presented with authorization details of data release to the ESP, along with terms and conditions of the service, with default settings and default expiration dates.

Step 4.0: Upon customer either accepting or rejecting the authorization, the customer is returned to the ESP web service.

This concludes the data access authorization, and henceforth until the expiration of the authorization, the ESP may access the PII and energy usage information of the customer directly from PG&E.

Given that PG&E provides the SMD service as the default method for customer authorized sharing of PII and energy data with ESPs, nevertheless the ESP industry has requested alternative ways for customers to authorize access to data from the energy utility. A CPUC proceeding for Rule 24 Click Through has discussed alternative methods at length, under the Customer Data Access Committee (CDAC) from 2016-2018. Accordingly, PG&E has devised one possible "Alternative Solution" to serve similar use cases to that served by our SMD service.

The Case B evaluation aims to simulate specifically the Alternate authorization flow that the participants might follow if they were to experience the Alternate Solution.

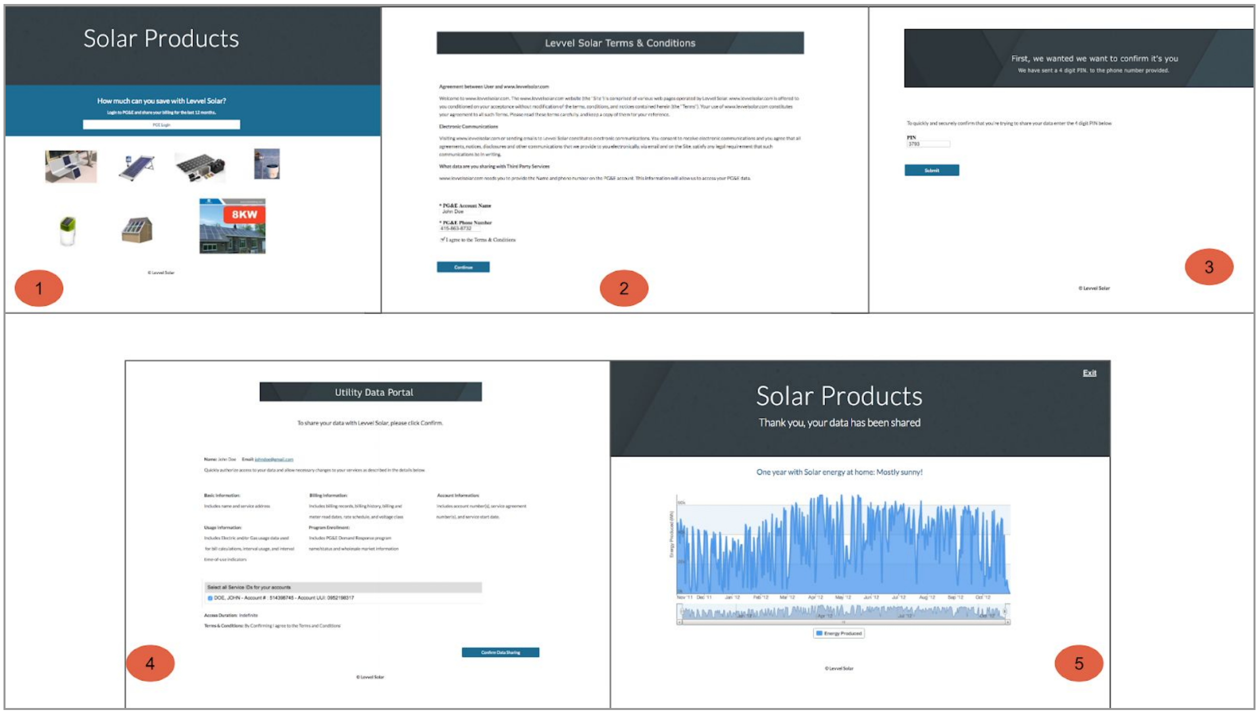

Solar Products
How much can you save with Levvel Solar?
Login to PG&E and share your billing for the last 12 months.
PGE Login
8KW
© Levvel Solar
1
Levvel Solar Terms & Conditions
Agreement between User and www.levvelsolar.com
Electronic Communications
What data are you sharing with Third Party Services
* PG&E Account Name
John Doe
* PG&E Phone Number
415-863-8732
☑ I agree to the Terms & Conditions
Continue
2
First, we wanted we want to confirm it's you
We have sent a 4 digit PIN. to the phone number provided.
To quickly and securely confirm that you're trying to share your data enter the 4 digit PIN below
PIN
3793
Submit
© Levvel Solar
3
Utility Data Portal
To share your data with Levvel Solar, please click Confirm.
Name: John Doe Email: johndoe@gmail.com
Quickly authorize access to your data and allow necessary changes to your services as described in the details below.
Basic Information:
Includes name and service address
Billing Information:
Includes billing records, billing history, billing and meter read dates, rate schedule, and voltage class
Account Information:
Includes account number(s), service agreement number(s), and service start date.
Usage Information:
Includes Electric and/or Gas usage data used for bill calculations, interval usage, and interval time-of-use indicators
Program Enrollment:
Includes PG&E Demand Response program name/status and wholesale market information
Select all Service IDs for your accounts
☑ DOE, JOHN - Account # : 514398745 - Account UUI: 0952198317
Access Duration: Indefinite
Terms & Conditions: By Confirming I agree to the Terms and Conditions
Confirm Data Sharing
© Levvel Solar
4
Exit
Solar Products
Thank you, your data has been shared
One year with Solar energy at home: Mostly sunny!
Energy Produced (Wh)
Nov '11
Dec '11
Jan '12
Feb '12
Mar '12
Apr '12
May '12
Jun '12
Jul '12
Aug '12
Sep '12
Oct '12
Energy Produced
© Levvel Solar
5

Figure 2. Variation Case B

Alternate Authorization flow for Data Access

The following describes Case B Alternate authorization flow method in five steps:

Step 1.0: This is the entry point to the Alternate authorization flow. It begins when the customer engages an ESP entity on their web service portal. A comprehensive Terms & Conditions (T&C) are presented by the ESP to the customer at this stage. For residential and small or medium Business customers with multiple service agreements, the T&C shall inform the customer that agreeing to use this Alternate authorization flow enables ESP to access meter or service agreement information prior to full authorization of the larger set of PII and energy data elements.

Step 2.0: After the customer accepts the T&C presented by the ESP, the customer enters identifying information into the ESP website. Alternate authorization flow operates on the ESP website and it will prompt the customer to input customer identifying information, such as name, phone number and/or address. The identifying information will be transmitted by the ESP to PG&E using an application programming interface (API) that binds the customer identifying information together with the ESP identifying credentials. This will enable the Utility to identify the customer and validate that the ESP is pre-registered with the utility to handle customer data.

PG&E receives the customer identifying information from the ESP. PG&E's systems will then search and verify the customer identifying information against our internal records. Once a match is found, available communication channel is used for that customer to receive authenticating "secret" (e.g. multiple digit pin/code via text message or email) directly from PG&E, and customer shall enter that information on the ESP service. For each available communication channel (phone number, email address etc.), PG&E will mask personally identifiable information (PII) to the extent possible so that only the customer can identify the meaning of the content. If an error occurs in the processes described here (e.g. no such customer or MFA options found etc.), a failure notification is transmitted back to the ESP so that the customer may be informed on how to proceed.

PG&E generates a unique, time limited "secret" (e.g. one-time passcode, or OTP) along this process. The OTP is sent through the selected communication channel so that it reaches the customer directly.

The customer receives the OTP through a default chosen communication channel then inputs the OTP in the designated field on the ESP site. This OTP is then transmitted back to PG&E from the ESP.

Step 3.0: PG&E receives the OTP and verifies it is the OTP recently issued to the customer of record. Upon verification, the customer is authenticated as a PG&E customer interacting with the ESP.

Step 4.0: PG&E considers the customer authenticated, and the customer can proceed to the authorization of data through an OAuth2-like process that eventually results in issuance of an access token by PG&E. Note, for PG&E's Alternate authorization flow, the ESP is responsible to present the authorization scope information to the customer when asking for authorization.

Step 5.0: Upon customer either accepting or rejecting the authorization, the ESP retrieves data from PG&E and presents it on its web service to the customer.

Results & Analysis

The following results were obtained from the A/B testing participants:

The participants were asked about their general impression on authorization of access to their bill data, and most respondents answered that they are interested in secure ways of implementing access. However, when asked whether they felt their energy usage data needed to be confidential, all participants expressed ambivalence. Therefore, it is important to interpret this result as participants being comforted by security, but may not be concerned about sharing data, depending on the nature of the content.

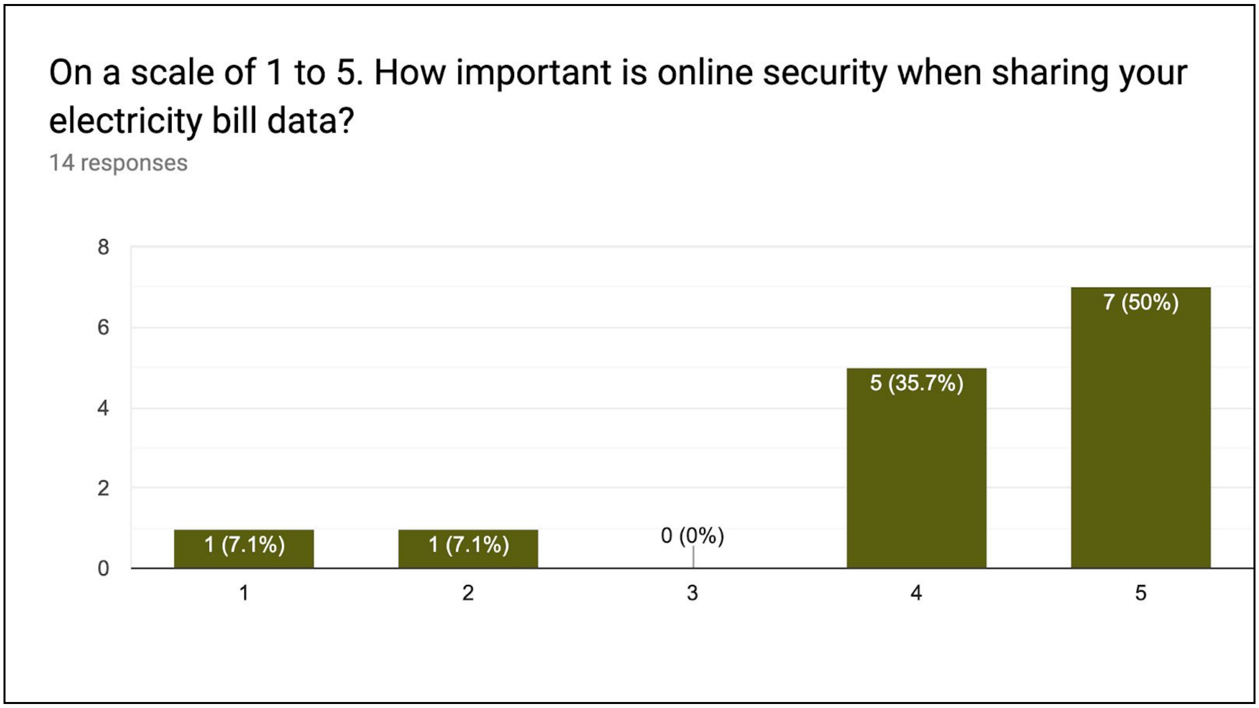


Figure 3: How important is online security?

When participants were asked generally about SMD Authorization Flow as Case A, the following responses were received:

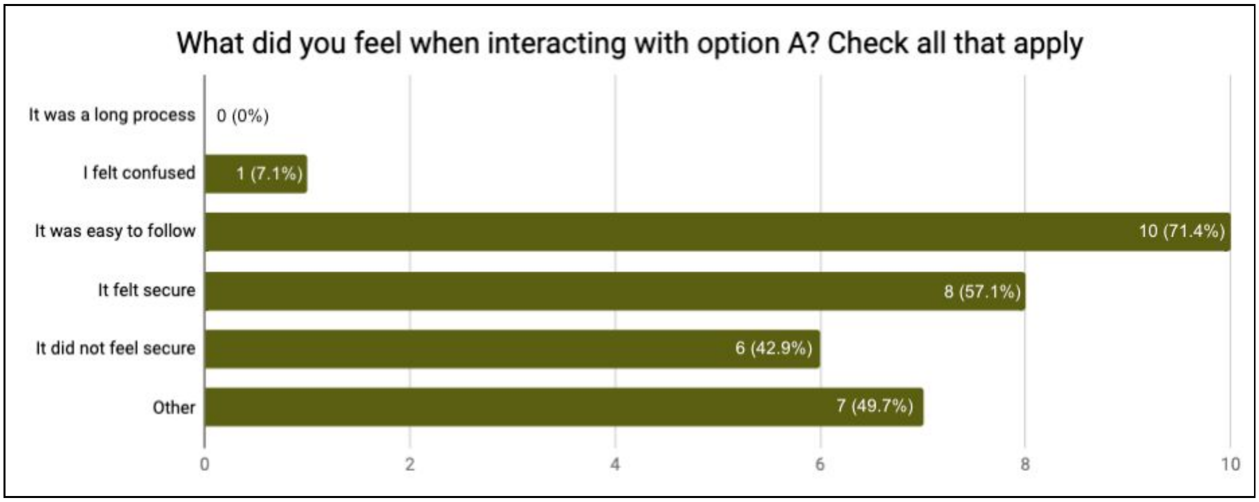


Figure 4: Case A sentiment

Users commented that:

- *"I liked that what exactly was going to be shared was posted before I agreed. The organization of the page was easy to read and if I didn't like what was going to be shared*

I could have quickly gotten out and not submitted my information."

- *"I felt that it was simple, but the easiness was concerning. It seemed too easy for me to login and share all of my information"*
- *"Felt like a PG&E site"*

The participants also answered questions about Alternate Authorization Flow, after experiencing the mock-UI system:

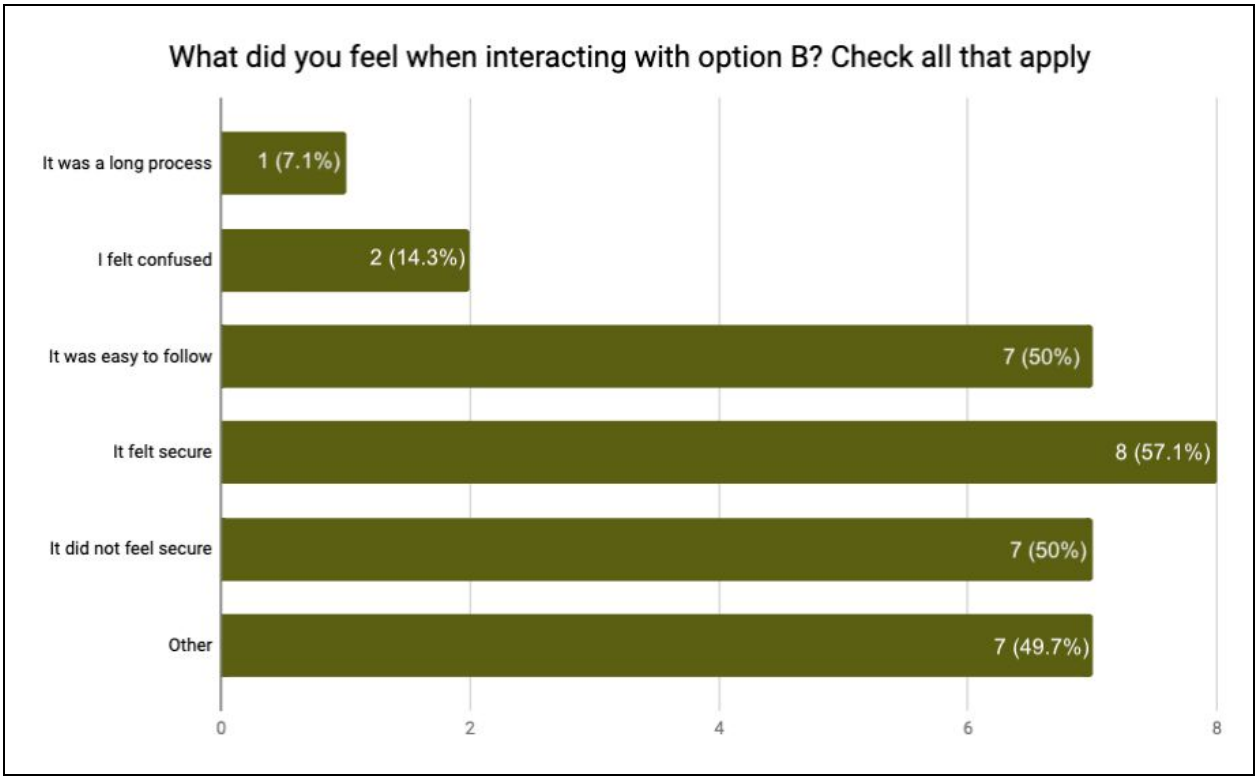


Figure 5: Case B sentiment

The evaluation did not find appreciable difference between the impressions participants got between SMD and Alternate Authorization. However, the specific comments are elucidating.

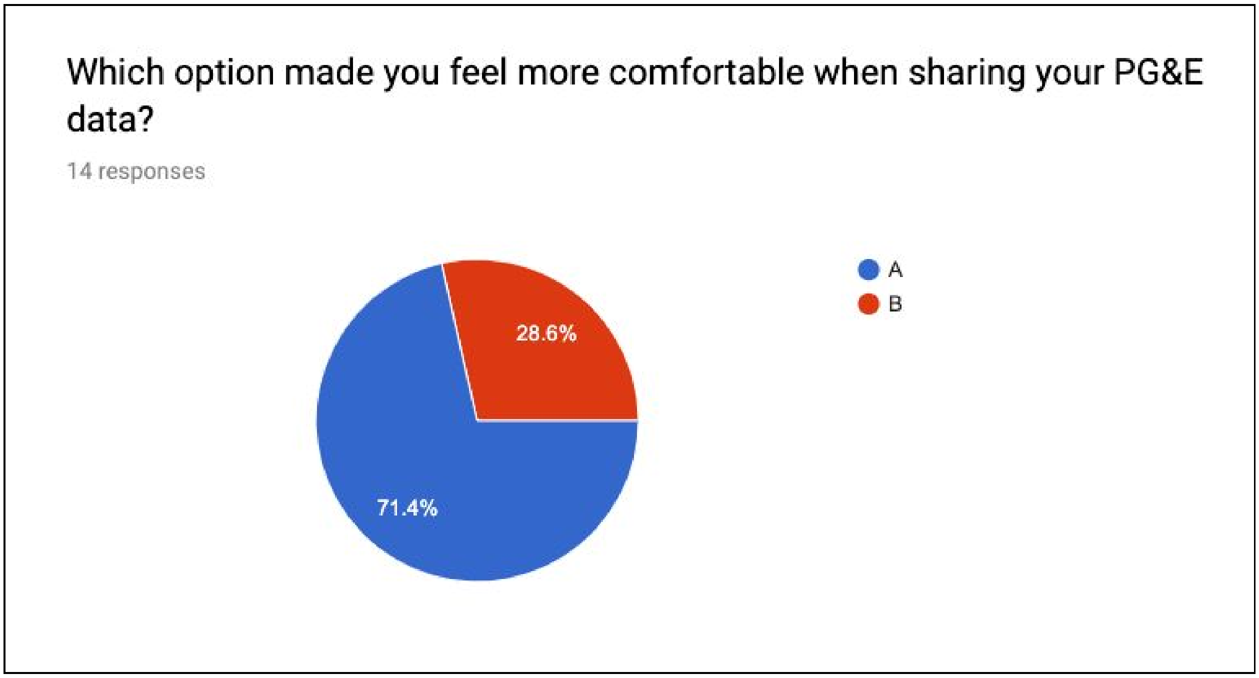
User comments:

- *"What I did not like is that it felt like I was agreeing to share my information before I was ready because of the sequence of questions and steps. I liked the option of having the PIN but I did not like that it did not tell me exactly what I was sharing until after I agreed with the terms and conditions."*
- *"Option B appeared less associated with PG&E and more from a third party that is unknown and unfamiliar. People do not trust the unfamiliar. Also, I could easily click on my address, but knowing what my account is to enter it would be annoying."*
- *"Option B felt much more secure as opposed to option A. I liked being able to enter my login information and then having to enter a PIN. I felt more secure with that. Yet, I would think that the use of even more questioning would be useful as well."*

- *"Terms and Conditions page upfront makes you think you are agreeing to something before knowing what it actually is."*

The comments indicate that in general, Alternate authorization flow process is not a detractor to the workflow that the customer is presented with. In fact, the presence of OTP input boosts perception of security. Another salient comment was that if Terms & Conditions need to be presented before use, that creates anxiety on the part of the participant.

The participants also understood that SMD Authorization flow and Alternate Authorization Flow were offered from different platforms, former being PG&E, and the latter being that from a third party. This directly led to the following observation about comfort interacting with the service:



Which option made you feel more comfortable when sharing your PG&E data?

Figure 6: Overall Result

There was a clear preference for the familiar, PG&E service and website. However, a significant portion, over a quarter of the participants, found that interacting solely with the ESP site was acceptable. This directly correlates to the sense of security felt by interacting with a OTP-based Alternate Authorization flow system.

There were 2 questions in the survey that in great part defined the result of the test. Those were whether or not the flows felt secure. The results are as follows:

- Case A (SMD Authorization Flow) - 8 out of 14 users said it was secure and 6 out 14 users said it was not secure.
- Case B (Alternate Authorization Flow) - 8 out 14 users said it was secure and 7 out of 14 said it was not secure.

Nine users from Case A and eight from Case B say both prototypes felt secure implies from the size of the sampling, most user responded “It felt secure” in the survey. Interestingly, we found users
thought OTP added an extra layer of security and some commented that having OTP in Case A would make it better.

Users were also interviewed in general, and most said that Case A gave them a feeling of familiarity. In other words, PG&E branding endows a sense of security through the process flow.

Overall, the analysis determined that 11 out of 14 users (71.4%) supported the use of current SMD Authorization Flow (Case A) purely based on its familiarity. There was no appreciable difference in preference of Case A over Case B in participants perceiving the flows to be more secure than the other. Isolated comments were gathered indicating that OTP is an accepted and familiar security apparatus independent from the sense of security endowed by a known brand such as PG&E.

Conclusions

This evaluation focused on performing an A/B test on a focus group who interacted with two variants of data access authorization and found that users prefer secure ways of sharing their PG&E data to ESPs.

The A/B test found through survey and subsequent interviews that non-tech savvy customers were generally anxious of the Internet and emphasized the importance of having a secure way to share their PG&E data. Familiarity with the website contributed to how comfortable customers felt when interacting with a web service. As such, the majority of participants associate familiarity with security when they saw PG&E branding. They mentioned that it felt more secure to interact with PG&E.

Interestingly, customers indicated that they would like to see one-time password (OTP) implemented also in Case A because it them feel that it added an extra layer of security.

The results indicate that current SMD Authorization Flow was accepted and there was some indication of slight preference for the current method, but we also note here that participants indicated potential improvement are possible by the addition of one-time passcodes.

Appendix

Appendix A

What is A/B Testing?

A/B testing (sometimes called split testing) is a type of test used to compare two versions of a test subject, usually a web service or a page, to understand which one performs better in a focus group setting. Methodology used here was to compare two web page variants (Case A and Case B) to a focus group. The test aims to determine which one that gives a better conversion rate, achieve a user base.

What are Control and Variations?

Control refers to the original version of the web service where no change is made. The control is the base against which all web service test results are compared. Variation is the modified version of the web service to test against Control. Multiple variations of the web service are often used to determine what works best.

All websites on the web have a goal - a reason for them to exist

- eCommerce websites want visitors buying products
- SaaS web apps want visitors signing up for a trial and converting to paid visitors
- News and media websites want readers to click on ads or sign up for paid subscriptions

Every web service targets conversion from a visitor to a user of the system. The rate at which a web service is able to do this is its "conversion rate". Measuring the performance of a variation (A or B) means measuring the rate at which a variation can convert visitors to achieve a business goal. Even though every A/B test is unique, certain elements are typically tested:

- The call to actions (i.e. a button) wording, size, color and placement
- Headline or product description
- Form length and type of fields
- Layout and style of web service
- Product pricing and promotional offers
- Different flows of an application to generate more conversation
- Images on landing and product pages
- Amount of text on the page (short vs. long).

A/B Testing Process

The correct way to run an A/B testing experiment is to follow a rigorous process as is relevant. It includes the
following steps:

1. **Study Website Data:** For production systems, use a website analytics tool such as Google Analytics, and find the problem areas in a conversion funnel. For example, identify the pages with the highest bounce rate. For example, a homepage may have an unusually high bounce rate. In the case of this evaluation, Case A and Case B mock-UI serves as the system under study.

2. **Observe User Behavior:** Utilize visitor behavior analysis tools such as Heatmaps, Visitor Recordings, Form Analysis, and On-page Surveys, and find what is stopping the visitors from converting. For example, “The CTA button is not prominent on the home page." In the present evaluation, on-page surveys were utilized.

3. **Construct a Hypothesis:** Per the insights from visitor behavior analysis, build a hypothesis aimed at increasing conversions. For example, “Increasing the size of the CTA button will make it more prominent and will increase conversions.” In the present case, instead of a hypothesis, and subsequent test, Case B is built a priori, and compared against Case A.

3. **Test your Hypothesis** : Create a variation per hypothesis, and A/B test it against the original page. For example, “A/B tests the original homepage against a version that has a larger CTA button.” Calculate the test duration with respect to the number of monthly visitors, current conversion rate, and the expected change in the conversion rate.   In the present case, a focus group and survey is used to analyze the data and effectiveness of Case A and Case B.

4. **Analyze Test Data and Draw Conclusions:** Analyze the A/B test results, and see which variation delivered the highest conversions. If there is a clear winner among the variations, implement. If the test remains inconclusive, go back to step number three and rework hypothesis. In the present case, some conclusions can be drawn, per the Summary and Conclusion sections.

5. **Report results to all concerned:** Let others in Marketing, IT, and UI/UX know of the test results and the insights generated. Here, the results should inform implementers on feature set considerations for data access authorization flow.

How to find the right demographics for your test.
The following factors are relevant for test subjects:

- Age
- Location
- Gender
- Income level
- Education level
- Marital or family status
- Occupation

- Ethnic background

Consider the psychographics of your target.

Psychographics are the more personal characteristics of a person, including:

- Personality
- Attitudes
- Values
- Interests/hobbies
- Lifestyles
- Behavior

Appendix B

What is Usability testing?

Usability testing is a way to see how easy it is to use something by testing it with real users. It is a qualitative testing that focuses on the 'why'.

Users are asked to complete tasks, typically while they are being observed by a researcher, to see where they encounter problems and experience confusion. If more people encounter similar problems, recommendations will be made to overcome these usability issues.

Usability Testing answers questions like "Can users successfully complete the given task?" or "Is the navigation smooth as butter?" or "Do certain elements distract the user from their end goal?" Such testing also ensures that there is no guesswork involved in designing each of the design alternatives, and hence the designs tend to be better.

Usability testing gives implementers the chance to see a product through the eyes of users, essentially "walking in their shoes" to uncover problems standing in the way to converting a user or using a product to achieve their goals. Watching customers interact with the product is also one of the best ways to generate hypotheses.

The A/B testing used the Usability Test methodology as the main method to evaluate Case A and Case B.

Appendix References

The authors cited information from the below references.

1. https://static1.squarespace.com/static/5b6612f396e76f2d143454ba/t/5bc645849140b7f99e6e8fe8/1539720581209/AB%2BTesting%2BGuide%2Bfor%2BOptimizely.pdf
2. https://www.optimizely.com/optimization-glossary/ab-testing/
3. https://blog.hubspot.com/marketing/how-to-do-a-b-testing
4. https://www.smashingmagazine.com/2010/06/the-ultimate-guide-to-a-b-testing/