SparkCleanEnergy:
[Em]Powering Grid Resilience Student Innovation Prize 2014

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Introduction

ReGrid is a fully-interactive, consumer-oriented interface with the goal of strengthening the relationship between utility companies and the individuals and businesses they service. When implemented, this software will facilitate the exchange of information between all stakeholders involved. This app is not only a platform where customers can manage payments and view their energy use, but also a direct line for reporting valuable outage information. The timely reporting of grid line issues will improve grid resiliency and save stakeholders money by reducing the length of blackouts. The financial incentives of our Energy Savings Day program will engage otherwise disinterested consumers, while critically reducing load factors during peak energy demand cycles. ReGrid is a clear choice for modern, forward-thinking utility companies that are committed to strengthening their customer relationships and establishing a more robust, reliable, and efficient grid.

Resiliency:

The primary causes of electrical blackouts are excessive electrical demand, energy shortages, and damage from storms. With energy being used, on average, a second after its creation, the system can be improved for efficiency. For example, when one plant disconnects from the grid, other plants are forced into overdrive to meet demands. Then, to prevent themselves from overexertion, these plants often have no choice but to disconnect from the grid as well, leaving more people without power. Also, when blackouts affect a lot of people, call centers get very busy which makes it harder to report cases. The occurrence of abnormal seasonal temperatures also threatens to throw off projected energy uses. This offers an increasing incentive on companies to increase distributed generation of electricity. Grid resiliency can help solve many of these issues. It creates a stronger, more reliable system that has the potential to be cost effective for both consumers and suppliers alike. The importance of resiliency cannot be understated because it creates a stable distributive system for the basic need of electricity that millions of people depend on.

The Microgrid Connection:

Because a microgrid can fully disconnect from the grid, it is sheltered from distant grid failures that would historically have cut local power, in some cases for weeks on end. (In our technology-driven world, there is no need to further underline how damaging these power outages are for societal productivity). Microgrids will increase the adoption rate for renewables because they rely on decentralized, local energy production. In a microgrid system, line losses are minimized by the alignment of institutional production and consumption, thus precluding the need to purchase power at peak hours from the larger grid. For these reasons, many experts have hailed microgrids as a viable solution for our currently vulnerable and inefficient energy distribution system and our fossil fuel path dependency.

App Description

Tutorial: (We will have a 3 page tutorial that opens the first time the app is opened. As with any new app, this part will explain the purpose of the app and provide operational instructions).

Login Page: After users download the application, they are directed to a simple initial login page. ReGrid uses existing online bill paying accounts as the login information. Users are prompted to login the first time they download the application and whenever they navigate to "bill payment" information.

Profile Page: The app opens up with a clean, attractive interface. Users will see their account information at the top of the page. They will have the option to add additional basic personal info linked to their account and upload a .jpg picture of themselves. This valuable information, such as house size and number of occupants, will be used in calculating usage comparisons with other households. When you have a new message in your inbox, a bar appears immediately below the profile banner with the initial text of the message and an indicator of how many unread messages you have. Below this is a small "View Bill" banner that links to a larger, more detailed bill page. Next is an "Energy Savings" banner indicating your total savings made since initiating use of the app. It links to a larger savings page with detailed historical savings information.

Below the Savings Banner is an "Analytics" banner that links to statistics provided by smart meters or historical energy bills and usage figures (if the user does not have a smart meter). On the bottom of this page there is a graph that provides a graphical representation of the Analytics. This graphic shows your monthly usage compared to the national average. In the top right corner of the page, a gear icon will indicate the settings page that can be accessed by a simple touch of the gear. At the top left hand corner of the app will be a directory button, that slides to the right, showing the directory.

The profile page also includes a user ranking system, shown as part of Account Information. It includes a written description and an image. The ranking starts out as bear cub, juvenile, big bear, and then goes to brown bear, black bear, polar bear, and finally grizzly bear. People move to higher rankings based on completion of energy efficiency upgrades and utility engagement opportunities. These would be app-based tasks, but could also include external actions like getting an energy audit. Here are some additional examples of ways to improve ranking:

1. Enter more information about yourself
   a. Fill out the household information
2. App Usage
   a. Access "Tips" two days in a row
   b. "Einstein award"- click to find out more about a tip five times in a row
   c. Check weather for the first time through the app
3. Share your energy usage in the Analytics page
   a. Beat your neighbors in a month-long energy competition

4. Save Energy
    a. Participate in your first energy savings day
    b. Lower your usage in a given month compared to the previous year
    c. Keep your usage below the national average for six months

App Directory: The directory can be accessed from any main page by clicking the icon in the top left corner, which pulls out a side bar from the left side of the screen. In the directory, users can navigate to additional pages that are not found in the home screen.

Inbox: The Inbox page resembles an email interface and is the hub of communication for consumers and utilities. From this page, consumers receive notifications about Energy Savings days and other important information. Utilities can personalize notifications to best serve diverse consumer bases. Like email, if there are unread notifications they will marked as such on this page. Additionally, users can choose to forward the inbox notifications to their real email address.

The example on the left illustrates the notifications that are delivered in the Inbox:

1. Energy Savings Day announcement: This includes a yes or no tab on the right. Users with a smart meter will be signed up already, but also have to click yes or no to opt into the challenge. This incentivizes active usage of the application and that automatic savings are not the default.
2. Utility planning an outage: "Power will be out from 4:00am to 6:00am on November 6th, 2014 for scheduled maintenance." Utilities can customize this message to their specific consumer bases.
3. Outage announcements: The user will receive information about the expected power return time (if known) and updates on local repair work.

View Bill: The user manages payment information from the View Bill page. Customers have the option to pay their bill (including autopay settings) from within the application, in order to reduce and eventually eliminate paper bills. The application contains a PDF statement of the user's bill, so that users can access it quickly and remotely.
    They can also view past bills and compare them with their current bill. This, in addition to Analytics, allows the user to see differences and changes in their usage of electricity, and gives them the information necessary to become more efficient. The bill summary gives even more information of the energy usage over the past month.

Energy Savings: Users can access their energy savings history from the Energy Savings History page. The page tracks a rewards program that will incentivize users to reduce their energy usage on high demand days that are designated by the utility. It tracks how much money was saved during high demand days in every season. The focus of this page is on Energy Savings Days, but if the utility sees additional opportunities to reward the user, this is where the rewards and savings would go. The Savings History provides a visual of how much money users have saved since signing up for the incentive program.

Analytics: In the Analytics page, users find graphs describing their energy use over time. The user can frame the graph in four different time durations: one day, one month, one year, or two years. The customer can also compare their usage with that of their neighbors and the national average. The comparisons would be done using BTU/sq. ft. in order to avoid problems in comparing houses of different dimensions. The main purpose of the page is to incentivize app usage (as well as energy reduction) by giving the user interesting rameworks for comparison.

Outage Dashboard: This page is where users can report outages and access recovery progress. The user indicates the power status of their home through the large Home Power status button. "Off" indicates an outage, and "On" shows that the power is unaffected. If the user has a smart meter, the utility will be able to automatically detect power status, but if they do not, the utility company cannot know for sure that the power is off at that location. For that reason, below the indicator is the option to report an inconsistency with what the utility company is reporting and what is actually occurring at the home. Next to the indicator is a time estimate for power recovery. We assume that this application will be integrated with the utility's backend database of customers, meaning that the application will draw from the best available data (regional, zip code or neighborhood) to indicate power status. The application will also have the capability to prompt the user to input power status through a push notification that says:
Does your home have electric power right now? Yes / No.
This data will provide the utility with more finely disaggregated data on homes' power status, which will supplement current outage reporting systems.
    The map uses a stoplight lighting scheme to indicate which areas in the consumer's region have full power (green), partial power (yellow), and no power (red). Also on this page, the consumer can report an outage and send a picture to the utility, if conditions are safe. The two banners at the bottom link to more information: The "Weather Update" links to a quick summary of any weather concerns; and "The Stream" allows people to join a regional conversation about a power outage through a Twitter stream.

Weather Update and Emergency Warnings: The weather page pulls a simple feed from NOAA's National Weather Service. If NOAA issues any weather alerts for the users region, they will appear here. The display will use the user's known or inputted zip code to display current temperature and storms forecast for the next two days. It would be possible to incorporate additional information here from NOAA's stream (ex: wind speed, visibility, full 7-Day detailed forecast).

Warning Page: This page is to ensure that no one gets hurt due to the use of this application. We do not want people to seek out downed lines or trees. The warning emphasizes that users should call 911 if anyone is injured, and should stay far away from any potential hazards (and inside during any storm activity). This page appears when a user clicks on "Report Line Damage."

Take a Picture: Users can take a photo or a short (10-second limit) video of potential visible causes of the power outage. Once the user takes an image, it takes you to the Share Report page. For example, if the user hears repeated explosive noises, they could record them on their phone in a video and tag it with a description. The first time the user reports damage, the operating system will prompt for permission to access the camera and to use location services. By enabling these permissions, the photo will be geotagged and shared with utility, allowing them to organize photos of damage by location.

Share Report: This page has a top banner that reiterates the safety warning. A small version of your photo pops up, with an optional written description. For convenience and easier data sorting, the page also includes a checklist of possible observed hazards. Users press send, and the photo goes directly to the utility with a geotag embedded (if the user has consented to share location). This will help the utility prioritize team dispatch and determine precisely where and what has caused the power outage. Once you hit send, it takes you to the Thank You page.

Thank You: This page confirms the submission of the photo and provides a link back to the profile page.

Stream: The stream is an embedded Twitter feed. It will draw from specific tags (@myutility) and hashtags (#myutility, #blackout). There is also the capability to post to Twitter directly from the app. Through the stream, the user of the app can access pictures of damage or important tweets during grid-compromising weather events. People can find information about emergency shelters and disaster response, and they can find solidarity with neighbors in the stressful time of a blackout.

Tips: The Tips page gives users sustainability tips from the "Gridly Bear." These tips encourage a lifestyle of energy efficiency. On each tip there is an option for Read More, which will bring the user to the utility webpage for more detailed information.
Examples of Gridly Bear's Tips…

- Change an incandescent light bulb to a fluorescent bulb today. Saving energy is so fun!
- Why don't we bike to work today instead of drive. That would be a blast!
- It's cold out today. I should make sure all the windows are shut!
- Maybe I won't fly to the other side of the country for vacation this year. Stay-cations are a blast!
- I'm going to drive slowly today. There's no need to rush. I can save money on gas and be safer!
- Brrr it's cold! I'm going to put on another layer instead of turning up the heat.
- My energy bill is way too high! Sounds like it's time to do an energy retrofit. New windows? Great! Maybe I can pay for it with a state incentive
- Boo! Watch out for phantom loads in your house! A phantom load is an appliance that draws energy while switched off. (Microwaves, TV's, gaming systems, etc.)

*Settings***:**
The settings page is where users can alter their account information and settings and find application support. Users can change their email, password, and phone number, and here they can also connect their Twitter account. Application support includes general information about the application, like the Terms of Service, Privacy Policy, and view the app tutorial again by clicking on the "Help Center." Users can also report bugs with the app here, by clicking "Report a Problem." Users can log out from the app through this page, in the bottom left corner.
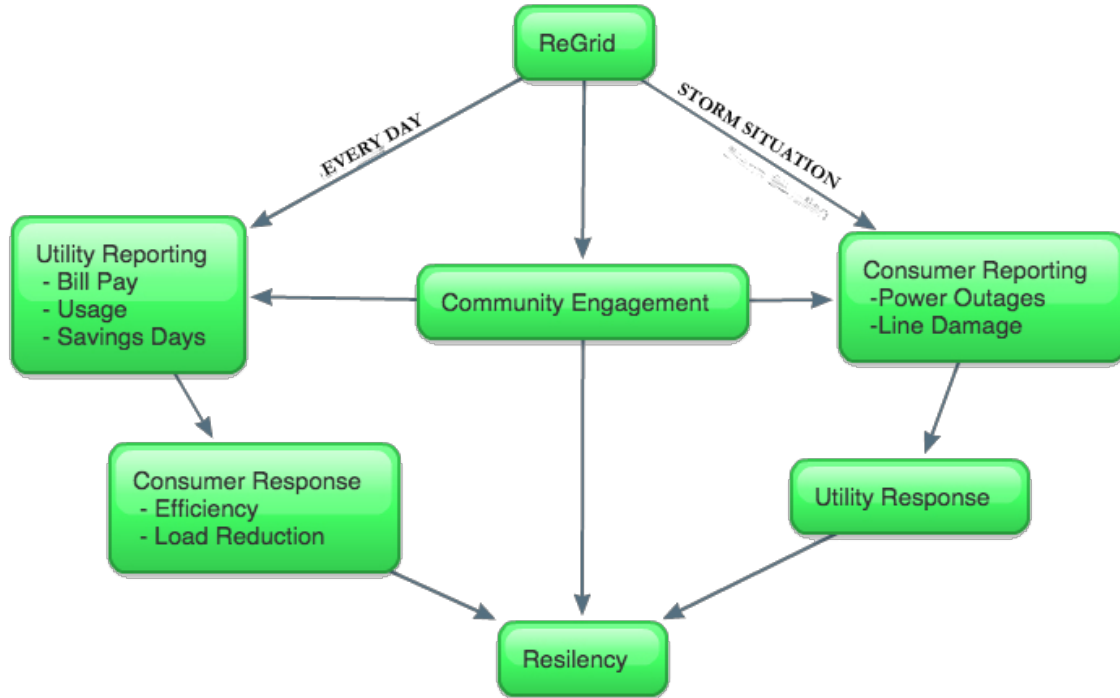
*Contact Us***:**
This a simple page with the utility's contact information. This includes the outage hotline number, office email, office address, and website.

How the Back End Works

Utilities already collect user reported information through social media and outage hotlines. The Contact Us page and the Stream feature function as the established utility reporting methods of outage hotlines and Twitter respectively. In the application, users are prompted to report information in the form of geotagged photos, hazard checklists and open-ended descriptions. This data can be processed by the utility in two ways: on a map or in list form. The geotagged photos give a visual overview of the affected area and a detailed picture of the potential problem. The technology for the map-based outage reporting already exists in driving accident-reporting applications such as Waze. Thus, adapting the data aggregation algorithms for our use will be straightforward. In addition, the list view allows for a task-by-task breakdown of the issues that the utility needs to resolve. This information enables utilities to most efficiently dispatch crews and thus restore power.

Current utility collection of power outage data does not utilize smart meters to their full potential. In the application, the Outage Center page will serve as a conduit for utility-consumer relations. When used in conjunction with a smart meter, the utility receives updates on the home's power status that is automatically reflected in the application. In the absence of a smart meter, the consumer can report an inconsistency in the power status to their utility in the Outage Center.

Flow Chart Description

ReGrid promotes grid resiliency by building stronger relationships between consumers and utilities. Monetary incentives and game-style achievement levels encourage consumers to actively engage with their utility. Through our app, the consumer has the power to participate in load reduction savings days, learn about energy efficient choices, compare their usage to other customers, view and pay their bill, and report power outages or line damage all on one easy platform. This integration streamlines the recovery process for both the consumer and the supplier, bringing the power back on faster and reducing economic losses. Increasing the disaster response efficiency of the utility is only one part of grid resiliency. Encouraging user energy efficiency promotes a more resilient grid by reducing total load and smoothing spikes in usage. This results in a more stable grid that is less susceptible to outages and more able to bounce back quickly when it does go down.

Next Steps

In order to completely ReGrid the system, implementation of smart metering technology and microgrids is essential. Climate change is bringing impending danger to our electrical networks and without a fundamental upgrade these social media steps will be for nothing. Microgrids will decrease outage frequency and severity through autonomous systems and local management accountability. Smart meters will tie in with the social media infrastructure we propose, to provide quick response times to the outages that will inevitably occur. These pieces go hand in hand and only through their integration can we bring about meaningful change to our grid system.