

# PG&E Pitch Fest 2023 & the Rest of the Story

*By John Benson*

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## 1. Introduction

This is a long and torturous story. The “hottest” part of this story was in the period between 2016 and 2020. I was there then, following this story and posting many papers. This paper will examine the latest stage of this saga, but if you would like to go back to the beginning, start with the two-part series from 2019 described and linked below, and go to older papers referenced therein.

***California Wildfires, Utilities and Grid Resilience:*** *This is a two-part series on the subjects in the title. Although we have had many hundreds of wildfires this year, the most severe repercussions seem to have been avoided.*

*Part 1 is a review of the Public Safety Power Shutoffs (PSPS) as used by PG&E and other California IOUs. Also CAL FIRE and other fire-fighting departments and agencies are getting much better at recognizing and quickly fighting the wildfires that have the potential to become monsters and evacuating residents early in their likely path. California is rapidly pouring resources into this battle, and plans to do much more.*

*Part 2: Governor Newsom, realized that the state of California was dealing with a related series of hugely complex problems early this year as PG&E started talking about filing for Chapter 11 bankruptcy. The state assembled a strike force to create a report regarding the situation. This report was issued on April 12, and is summarized in this paper.*

<https://www.energycentral.com/c/pip/california-wildfires-utilities-and-grid-resilience>

<https://www.energycentral.com/c/pip/california-wildfires-utilities-and-grid-resiliency-part-2>

You might think that this post is about wildfires. It's not, rather it starts with the main methods used to avoid having the grid start wildfires and expands from there. It also explores a particular wrinkle that Northern California brings to create the needed technology: innovations.

## 2. The Process

*At PG&E, we are building a climate-resilient energy system for California's future.<sup>1</sup>*

*A system that starts with safety, even in the face of climate change. A system that harnesses the clean energy resources of today and tomorrow. A system that customers can rely on.*

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<sup>1</sup> PG&E R&D Strategy Report, June 2023, [https://www.pge.com/pge\\_global/common/pdfs/about-pge/environment/what-we-are-doing/innovative-community-programs/PGE-RD-Strategy-Report.pdf](https://www.pge.com/pge_global/common/pdfs/about-pge/environment/what-we-are-doing/innovative-community-programs/PGE-RD-Strategy-Report.pdf)

*But we cannot build this system alone. We need solutions and ideas from a broad spectrum of sources.*

*That's why we are sharing our new, 2023 Research and Development Strategy, outlining our nearly 70 highest priority challenges in building the next generation of California's energy infrastructure.*

*We need breakthrough thinking, radical collaboration, and swift execution to act on these challenges. We openly share them because we want to partner with the best and the brightest as we work to serve people, the planet and the prosperity of our hometowns.*

*We encourage all thinkers, creators, dreamers and doers anywhere in the world to help us overcome these challenges. We want to hear from everyone—private industry, academia, government agencies or startups working on the next big thing in a garage. Join us on our innovation journey. The future is ours to imagine and build, together.*

*Sincerely,  
Patricia K. Poppe  
Chief Executive Officer  
PG&E Corporation*

## **2.1. What does the future look like?**

*The future at PG&E is a cleaner, safer, and more reliable energy system that is more resilient to the effects of climate change, adaptable to system dynamics and local conditions, and more accessible to affordably support the needs of all customers in a timely manner.*

### **CLEANER**



We strive for a future that includes a **carbon-neutral energy system** capable of meeting the full range of our customers' needs with a portfolio of renewable and zero-carbon resources. The transition to this decarbonized system will dramatically reduce PG&E emissions and enable our customers to do the same, helping to heal the planet and to create a brighter world that supports healthier communities and ecosystems.

### **SAFER**



We strive for a future that includes the **elimination of catastrophic wildfires** and the assurance that everything and everyone, from our customers to our co-workers, is always safe. Building this future will enable PG&E to restore and strengthen trust with our customers and our communities.

**RESILIENT** We strive for a future that includes an **energy system purpose-built to withstand the evolving extremes of the physical world brought about by climate change**. The evolution of today's system to support this more resilient future will also bolster PG&E's ability to maintain service continuity and ensure safety amidst increasingly challenging environmental conditions.



**MORE  
RELIABLE**



We strive for a future that provides customers **freedom from the impacts of outages**, empowering customers with the **consistent energy service** needed to seamlessly operate their businesses and manage their everyday lives. Achieving this goal will enhance PG&E's ability to deliver excellent customer experiences every day.

**ADAPTABLE**



The future is a more dynamic energy system capable of **seamlessly optimizing operations based on system and local needs**. Architecting this future will rely on strong foundational capabilities of innovation and breakthrough thinking that will enable PG&E to see around corners and more nimbly adapt to evolving dynamics.

**AFFORDABLE**



The future is empowering our customers to **prosper by powering their lives and work without constraining their budgets**. Unlocking a more affordable energy system amidst system-wide transformational change will require prudent and high-impact investments, lean and efficient operations, and a continual focus on seizing **opportunities to deploy innovative solutions to maximize system value**.

**ACCESSIBLE**



The future is **providing timely access to clean, reliable energy** to support the evolving needs of our customers in their transition away from fossil-based fuels, whether plugging in a new EV or decarbonizing the hardest to tackle industrial processes. Building the capability to seamlessly connect customers will be a critical enabler to unlocking a cleaner, brighter future and **delivering on PG&E's triple bottom line of serving people, the planet, and the prosperity of California**.

## 2.2. Where are we today?

*The State of California has adopted some of the nation's most progressive clean energy policies, making it a national leader in the transition to a cleaner energy system. Our vision for the future is similarly ambitious; however, the challenges that we face to deliver on these goals are not insignificant. PG&E is resolute in our commitment to progress, and we are energized by our mission to deliver better outcomes for our customers and the planet every day.*

*PG&E provides vital energy services to millions of customers across a large and heterogeneous service area, while navigating the leading edge of emerging trends, including accelerating EV adoption, increasing renewables penetration, and worsening climate impacts.*

## 2.2.1. Characteristics of PG&E's System


### SCALE:

The size of PG&E's operations provides both a unique opportunity for delivering positive impact at scale and a distinct challenge to executing on the change necessary to get there



PG&E operates and maintains:

**>175,000** = **7x**  
combined miles  
electric & gas  
T&D ASSETS



Service area population:

**16 million**  
CALIFORNIANS  
(That's 1 in 20 Americans!)



**Our unique challenge:** Identifying technologies that are scalable in terms of cost, operability, and maintenance across PG&E's vast network of assets and dispersed communities of customers

### HETEROGENEITY:

The heterogeneity of the geographies that comprise PG&E's service area is rivaled only by the diversity of our customers' needs



PG&E's service area encompasses wide ranging climate variability and spans urban centers and sparsely populated counties:



PG&E serves a **wide spectrum** of customers

from aggressive early adopters of building and transportation electrification to some of the most difficult-to-electrify industrial end users.

**Our unique challenge:** Identifying universal solutions that can solve system-wide challenges while providing flexibility to address specialized needs

### ON THE FRONT LINE:

Other utilities' challenges of tomorrow are PG&E's realities of today



PG&E territory is nation-leading in adoption of distributed energy resources (DERs):



**1 out of 5**



**1 out of 7**

Devastating effects of climate change:

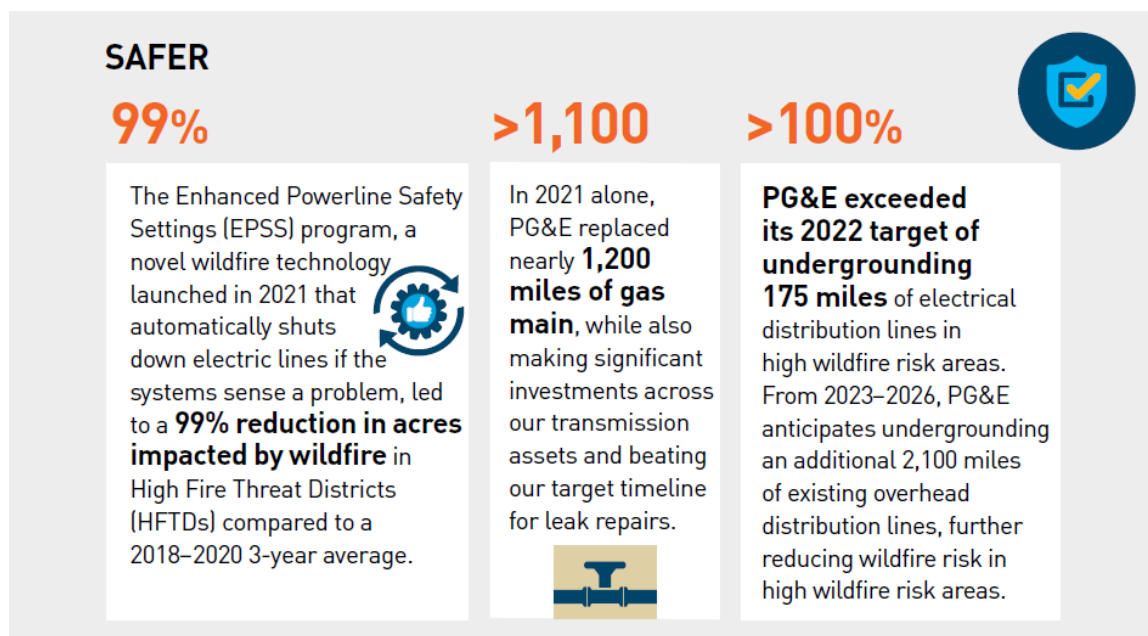


**Our unique challenge:** Navigating the leading edge of today's technologies to identify the novel solutions capable of outpacing the impacts of evolving climate, customer, and regulatory dynamics

*Navigating these unique challenges may not be straightforward, and there is still much to be done, but we have made meaningful strides over the last several years and continue to work diligently every day to make progress towards our goals.*



RNG = Renewable Natural Gas, a.k.a. Biomethane, generated using only biological sources.





### **3. Bridging the gap: How R&D helps us get there**

*The nation's electric grid and natural gas systems were designed for a world powered centrally by fossil fuels in which supply and demand dynamics evolved more predictably over time. Today, the operating environment for utilities globally is changing rapidly, placing increasing strain on systems that were designed for a fundamentally different world...*

#### **3.1. Key trends driving the need for R&D**

##### **3.1.1. Electrification**

*The rapid pace of electrification, particularly the growing adoption of electric vehicles (EVs), is expected to result in an unprecedented 70% growth in load over the next 20 years.*

*Today's system must be transformed to accommodate such a significant increase in demand. Further, the rapid, widely distributed, and unpredictable nature of load growth will challenge the limits of conventional technologies to keep pace with the rate of change and to dynamically adapt to evolving needs.*

*Accelerating electrification similarly introduces challenges to PG&E's gas system, but in the opposite direction. Customers' expected transition away from fossil-based natural gas may result in meaningfully lower aggregate demand over the coming years.*

*Declining throughput and resulting downward pressure on revenues may create rate pressure, as PG&E necessarily would continue to incur substantial costs to maintain safe and reliable operations using current technologies*

##### **3.1.2. Decarbonization**

*For its many benefits, the shift to renewable energy sources will also introduce material challenges. These challenges include a steepening duck curve, seasonal variability in energy production (e.g., lower winter output), reduction in available dispatchable resources, and an increasing need for both more diversity in types of generation and expanded transmission capacity to integrate renewable generation into the broader system.*

**Author's comment:** The duck curve is a graph of power production over the course of a day that shows the timing imbalance between peak demand and solar power generation.

*The interconnection of growing numbers of DERs will not only require PG&E to accurately anticipate evolving net load dynamics across the system, but also to anticipate, mitigate, and optimize the impacts and opportunities of DERs on the hyper-local system as well.*

##### **3.1.3. Climate Change**

*California is at the forefront of experiencing the impacts of climate change. Highly variable weather conditions from extreme drought to torrential rates of precipitation have created a myriad of challenges and heightened risk to both our electrical system and our communities more broadly.*

*Some of the most notable impacts include the increased severity and duration of wildfire season, the heightened risk of damage to key infrastructure with severe storms and rising sea levels, and the added unpredictability of renewable output under highly variable weather patterns.*

*Climate change is increasing the incidence of severe weather that poses a risk to the integrity of our assets. Though most of our natural gas network is buried underground, it is susceptible to risks from landslides and erosion that may materialize more frequently with worsening climate impacts...*

## **3.2. Our Strategy**

*The historical modes of operating were not designed to meet these challenges, which is why we are aggressively pursuing novel technologies, solutions, and business models to deliver on our vision for the future. R&D is critical to bringing these technologies and solutions from conception to reality at the scale necessary to effect system-wide change. We are investing significantly in building the strong foundational capabilities needed to deliver on our True North Strategy and invite innovators to help achieve these ambitious goals. Innovation from a broad range of stakeholders will be needed to bridge the gap between the system of today and that of the future.*

### **3.2.1. The Role of the Entrepreneurial Community**

*We seek bold, breakthrough thinking from the entrepreneurial community to push the boundaries of what is currently possible with the technologies of today. The rapid pace of change affecting our energy system necessitates that we adapt more quickly than ever before, embracing broad-based and stepwise transformation across our operations.*

*We are confident that the world's innovators not only can help us to solve our most vexing challenges with new and novel technologies, but also can help us see around corners and move quickly as circumstances continue to evolve...*

*For our part, PG&E seeks to accelerate the pace of development and commercialization of these novel solutions by piloting and deploying them across our system and providing commercial support as an early adopter. We believe that PG&E and the entrepreneurial community can work in close collaboration to leverage our respective strengths and expertise to bring game-changing technologies to market sooner. As partners dedicated to building a cleaner and brighter world, we will deliver the change necessary to achieve our climate commitments...*

## **3.3. Goal of the R&D Strategy Report**

*The balance of this report outlines high priority problem statements we are seeking to address through innovative technologies and breakthrough foundational research. These problem statements span the gas and electric sides of our business and align to several key themes described in subsequent sections...*

## **3.4. How we'll do it**

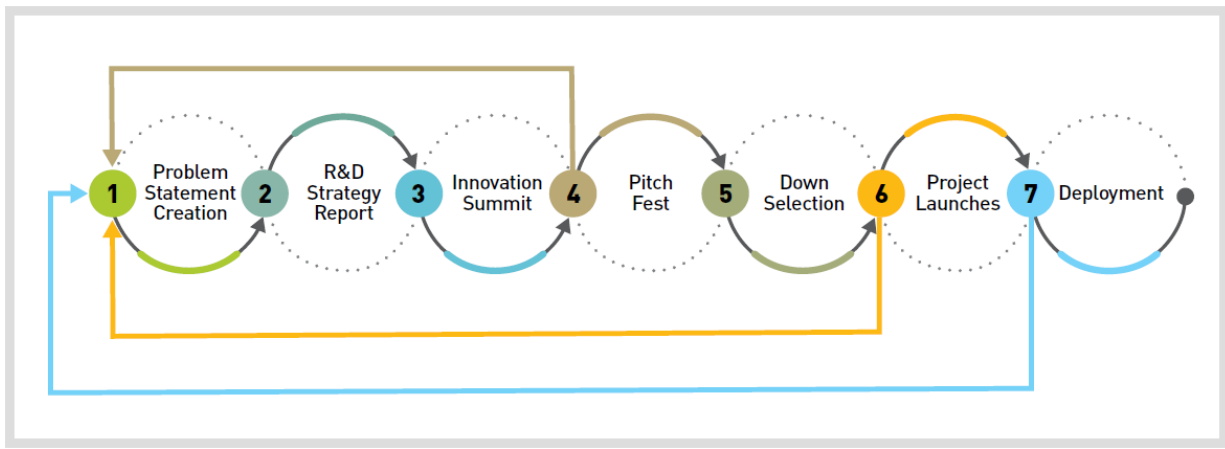
### **3.4.1. 2023 Innovation Summit**

*The PG&E Innovation Summit 2023 was a hybrid in-person and online event on July 25 in San Ramon, California.*

*PG&E's Innovation Summit 2023... convened thousands of innovators, researchers, academics, investors, public servants, and others to collaborate on solutions to address the nearly 70 highest priority challenges identified in the PG&E R&D Strategy Report.<sup>2</sup>*

### 3.4.2. Pitch Fests

*Following PG&E Innovation Summit 2023, all interested researchers, innovators, and entrepreneurs of any description will have the opportunity, through an online portal to apply to pitch the ideas, research, technologies, or solutions they are developing that they believe can materially address one or more of the problem statements in the report. The following chart outlines this process:*



*Innovators with an idea, technology or solution addressing one or more of the problem statements are now invited to apply to pitch PG&E decision makers and subject matter experts at the Innovation Pitch Fest 2023, September 12 - 14 in San Ramon, CA.*

#### 3.4.2.1. Participants

*PG&E evaluated more than 600 applications to participate in Pitch Fest and selected just 54 organizations to participate. During Pitch Fest, each organization had 15 minutes to present their respective solution to PG&E decision-makers. Successful pitches have the potential to lead to a range of follow-on engagements with PG&E, including but not limited to direct partnership and grant opportunities.<sup>3</sup>*

The organizations participating in Pitch Fest include the following companies. Your author has added a brief description of each company from their website where this can be identified. The firm-names of what seems to be the best targeted solutions are in a bold typeface.

<sup>2</sup> [https://www.pge.com/en\\_US/about-pge/environment/what-we-are-doing/innovative-community-programs/innovation-technology-strategy.page](https://www.pge.com/en_US/about-pge/environment/what-we-are-doing/innovative-community-programs/innovation-technology-strategy.page)

<sup>3</sup> Dave Kovalesski, Daily Energy Insider, "PG&E picks participants for its Innovation Pitch Fest," Sep 12, 2023, <https://dailyenergyinsider.com/news/41075-pge-picks-participants-for-its-innovation-pitch-fest/>



### **Gas Innovations:**

<b>Onboard Dynamics:</b> introduced its unique, patented natural gas compression technology.	<b>C-FER Technologies:</b> has helped clients tackle their most challenging technical problems to improve safety, efficiency and environmental performance
<b>Sapphire Technologies:</b> develops and manufactures energy recovery systems such as turbo-expanders that harness the power of gas expansion to produce reliable and clean electricity	<b>Project Canary:</b> is a team of scientists, engineers, financial analysts, and seasoned industry operators working together to reduce greenhouse gases and decarbonize energy operations.
MMT: Unable to find site.	<b>Barr Geospatial Solutions:</b> provides geospatial services with aerial LiDAR, imaging, surveillance, methane leak detection and AI technology.
<b>RodRadar:</b> offers a technology platform that automatically detects underground utility infrastructure in real time, on location, without the need for expert analysis.	<b>TrelliSense:</b> Methane leak detection, quantification and localization over thousands of acres with the industry's lowest-cost sensors.
ZeroCO2Energy: unable to find site.	

### **Undergrounding:**

<b>CivilGrid:</b> centralizes utility, environmental, and geotechnical site data in a GIS platform with hundreds of data layers in a single map.	GE Vernova: This is a major part of what was previously General Electric and includes electric generation, grid and related businesses
<b>CivRobotics:</b> surveying system and CivDot robot provides autonomous ground layout with inputs from drawings in CSV or DXF format. Choose starting point and CivDot will optimize and mark the route.	Melni Innovations: This is a bit of a guess. There are two companies, and both in Idaho Falls. Melni Technologies makes several direct-burial splices, and that seems to work for this category.
<b>Parsons:</b> Parsons is a diverse architect and engineering firm. Projects include underground transmission lines	SAM: Unable to find firm's site.

<i>ABB: ABB is a major electric utility vendor comparable to GE and Siemens.</i>	<i>The Okonite Company: makes a wide range of electrical cabling, including those used for underground applications.</i>
<i><b>Biosirius, Inc.</b> in Markham, Ontario, Canada makes several products for undergrounding electric cables.</i>	

### **Electric Vehicles**

<i><b>Eaton:</b> A large multinational corporation. Relative to EVs, I found a class of products named “Electric vehicles and EV charging”</i>	<i>Connect California: Unable to find firm’s site.</i>
<i><b>Itselectric:</b> Our mission is to bring curbside EV charging to cities across the U.S. and advance the adoption of electric vehicles.</i>	<i><b>Nuvve:</b> offers charging stations with a vehicle-to-grid (V2G) solution.</i>
<i><b>Gridtractor:</b> from the site: ...an electrified Ag operator generates power to supply its needs and sell to the grid, schedules irrigation to minimize energy costs and uses zero emissions electric tractors to slash fuel bills, power pumps that have to run on peak, and store energy to sell to the grid...</i>	<i><b>The EV Button:</b> our goal is ensuring your fleet electrification strategy does not have to start from scratch. That’s where leveraging existing infrastructure is both a sound business decision and one that maximizes societal impact.</i>
<i><b>Lumin:</b> from Wikipedia article on “Changan Lumin”: In 2022, Changan unveiled a new city car, creating a new Lumin model line: affordable electric cars, small 3-door model space for 4 passengers.</i>	<i><b>ev.energy:</b> Automatically charge your vehicle with the cheapest and cleanest electricity available in your area.</i>
<i>Valmont Industries: I found their site, but it was perhaps the world’s worse. A diversified company that may make solution that are applicable to this category (or not).</i>	<i><b>WeaveGrid:</b> A marked improvement to the site on the left. I quickly found: “We ensure the grid can support electric vehicles safely, affordably, and reliably by supporting your system planning efforts...”</i>
<i><b>New Sun Road:</b> Even better, a PG&amp;E use-case - BoxPower, PG&amp;E: Commissioned June 2021 Remote monitoring and control managed by Stellar. 36.5 kW of PV with 69.12 kWh battery storage and 2 integrated propane generators.</i>	

### Integrated Grid Planning

<b>Ubicquia:</b> Utilities need real-time visibility of field assets with data to effectively manage resources, optimize performance and work to deliver customer value.	ACTUAL: unable to find site (silly name)
Palantir Technologies: This firm make AI Software, but their site doesn't say what they want to do with it.	<b>Camlin Energy:</b> under "energy" this firm offers three solution sets: Asset Monitoring, Bio-gas and Gas solutions and Fault & Load Management.
<b>Infravision:</b> The solutions that this firm offers seems to be centered on service management.	Siemens Energy: A large multinational corporation with many solutions for utilities
GE Vernova: Ditto "Siemens Energy" comments	<b>Royal Power Energy:</b> a power solutions, technology, & distribution company that integrates and brings to market technologies in the energy efficiency arena.

### Wildfire Innovations:

<b>Treeswift:</b> captures higher quality, more verifiable forest data than what current methods provide, and equip foresters with new tools to efficiently collect forest data at large scales.	<b>Sentient Energy:</b> Utilities serving wildfire prone geographies need to leverage technology solutions that address multiple elements of wildfire risk.  One way to mitigate risk is to ensure good system visibility and fault location during wildfire events, even if reclosing is disabled...
eSmart Systems: I found the site, but couldn't find any solutions applicable to this category.	Ubicquia: See entry for this firm above, under Integrated Grid Planning
Future Grid: could not find site.	<b>N5 Sensors:</b> from site: N5Shield™ is an architecture that leverages cloud-connected smarter sensors, artificial intelligence, and real time alerts to make communities safer.
<b>Delphire:</b> Makes a product / system called the SENTINEL FD3™. This is appears to be a combination video camera, sensor package and AI application to detect and verify wildfire ignition.	<b>The Davey Tree Expert Company:</b> Offers utility vegetation management and line clearance management solutions.

<b>GRID20/20:</b> on site: “The assets between substations and endpoint meters is the most volatile and vulnerable segment of the grid. GRID20/20’s solutions help to mitigate these vulnerabilities.”	
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### **Supply and Load Management:**

<b>EnerVenue:</b> Pairing low-cost, decentralized renewable energy with grid-scale storage will speed decarbonization. These are storage technologies that deliver on their promise to be flexible, safe, and long-lasting. Today, EnerVenue’s metal-hydrogen solutions are redefining what can be expected from battery storage.	<b>Ubicquia:</b> see above entry for this firm, under Integrated Grid Planning
<b>Piclo:</b> develops software solutions that make energy networks smarter, flexible and more sustainable. Piclo Flex is a marketplace for energy flexibility services, enabling system operators to source energy from flexible service providers (e.g. electric vehicles) during times of high demand or low supply.	<b>Flex Power Control:</b> The Smart Power Integrated Node (SPIN) is a 10kW residential microgrid system. SPIN’s next generation hybrid inverter technology allows homeowners to manage all energy in one device. This includes PV, storage, and EV charging (including V2G)
<b>VelleX Computing:</b> is developing grid-on-a-chip, a groundbreaking mixed-signal computing chip that enables faster and more accurate computing for grid applications.	<b>Moxion:</b> Meet the MP-75, the intelligent mobile battery built to replace diesel generators.
<b>Upstart Power:</b> designs and manufactures the Upgen™ line of solid oxide fuel cell (SOFC) generators. These are designed to cycle (many on/off) and to operate only when needed allowing them to pair with today’s solar and battery storage systems.	<b>Grid-Science</b> (parent company): WMAC (solution) is one of the first companies to provide cost-effective, LV monitoring solutions. WMAC uses the latest IoT technologies, radio networks, edge processing and cloud computing to monitor LV assets.
<b>Kraken Technologies:</b> This is a UK firm that is offering a solution in the US: Smart Flex allows energy companies in the US to bring bills down for their customers whilst helping balance the grid during times of high demand, all alongside offering some of the world’s best customer service.	<b>Gridspertise:</b> This firm seems to offer a number of solutions focused on the meter – consumer interface.

<p><b>Mainspring Energy:</b> I've written a paper about this company previously (see below). They make an innovative linear generator that can use a wide range of fuels</p>	
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Section 3 of the paper linked below covered Mainspring Energy's Linear Generator.

<https://energycentral.com/c/gn/linear-thinking>

## 4. Problem Statements

**Author's comments:** Although your author will use PG&E's problem statements as a basis for this section, these will be edited to some extent, and some statements are not used. The problem statements will be grouped by "Key R&D Themes" in the subsections below. Note that each statement is greatly abbreviated vs. reference 1.

### 4.1. Expand load management across all system levels

*Developing load management capabilities at the transmission, distribution, and customer levels is necessary to accommodate and balance the massive influx of distributed energy resources (DERs) on the system and manage the increasingly intermittent, non-dispatchable supply mix.*

**Problem Statement (PS) 1, Visibility into Load Data:** *PG&E lacks consistent visibility into the device type, location, and energy usage data of existing and new DERs connecting to the grid. This poses a major challenge for distribution and transmission planning and operations and is a barrier to designing and implementing targeted demand management programs.*

**PS 2, Grid edge computing:** *PG&E's current centralized monitoring and control system is not equipped to efficiently manage an increasingly complex distribution grid characterized by higher volumes of customer-sited DERs and increasingly bidirectional power flows in the least-cost way. Decentralized computing solutions capable of coordinating customer sited DERs with real-time grid conditions are needed to limit service disruptions and automate power flow optimization on the distribution system.*

**PS 3, Customer connection interface:** *PG&E lacks a consistent interface at customer sites capable of coordinating flexible loads with local conditions on the distribution system, thus limiting the potential for comprehensive load management on the distribution system.*

### 4.2. Deploy clean supply and energy storage technologies

**PS 1, Optimizing the deployment and market integration of long-duration storage assets:** *Long-duration assets will likely be an integral part of the net zero transition; however, much remains unknown across the industry regarding the implications of deploying and integrating these assets into the existing portfolio of supply resources at scale.*

**PS 2, Deploying new clean supply and energy storage technologies:** *Relying solely on existing clean generation and storage technologies to support the transition to a net zero grid by 2040 will likely yield suboptimal results in terms of reliability and affordability.*

### **4.3. Reduce the need for conventional capacity upgrades**

**PS 1, Underutilized T&D infrastructure:** PG&E is not equipped with the tools necessary to maximize utilization of its current T&D system, thereby limiting its ability to accommodate rapid increases in load growth in a time and cost-efficient manner.

### **4.4. Optimize prioritization and reduce costs of unavoidable capacity upgrades**

**PS 1, Service upgrade planning and connecting new loads:** PG&E's current tools and processes for planning service upgrades and connecting new loads to the system are not designed to accommodate the expected pace and scale of load growth over the coming years, requiring new tools to more efficiently integrate high volumes of new load requests and more effectively plan for service upgrades.

**PS 2, T&D asset replacements and upgrades:** Upgrades to the T&D system typically require up-rating existing infrastructure which may trigger costly foundational investments in assets that otherwise may still have useful life or could be partially upgraded at lower cost than a full redesign.

### **4.5. Ensure affordable and timely connection for every EV**

**PS 1, Multi-family connections:** Connecting an EV charger at a multi-family home can be a lengthy and costly process that is further complicated by the need for a third party (i.e., property owner/manager) to undertake these investments and provide ongoing operational support for billing and maintenance.

**PS 2, Capacity constraints for Direct Current Fast Chargers (DCFC) and fleets:** PG&E is deploying systems that are able to dynamically limit power flow to DCFCs based on system constraints; however, not all existing charging equipment has the ability respond to PG&E's signals by modulating load within these dynamic constraints or by utilizing alternate sources (e.g., storage) to meet load.

**PS 3, Single-family connections:** Customers connecting an EV charger at a single-family home may encounter unanticipated and significant costs and wait times to complete the on-site electrical work and may unknowingly create challenges for the broader system as service transformers become increasingly constrained, resulting in added costs to PG&E to upgrade existing infrastructure.

### **4.6. Unlock potential of EVs as grid assets**

**PS 1, V2X connections:** Technologies required to enable V2X are costly and time-consuming to install for both the utility and customer.

**Author's comment:** V2X is an abbreviation for providing a bidirectional connection between and infrastructure that might provide charging service for the EV, and/or allow the infrastructure to also obtain power from the EV (a.k.a. Vehicle to Everything or bidirectional charging).

**PS 2, Novel grid applications:** Today's grid was not built for a world in which electric vehicles are a dominant form of transportation, not only challenging our capacity to rapidly absorb the rate of EV adoption, but also limiting our ability to capitalize on the full potential of EVs as grid assets.



#### 4.7. Improve monitoring, inspection, and analysis of asset health and integrity

**PS 1, Asset lifetime prediction:** *Current technologies lack the ability to determine the expected safe lifetime of transmission assets once degradation has been documented, leading to unpredicted, continued asset degradation and potential risk of failure, as well as additional costs when assets are unnecessarily replaced prematurely.*

**PS 2, Limitations of overhead inspections:** *Best-in-class technologies for performing inspections of overhead assets are resource intensive and provide limited visibility into internal degradation, resulting in an incomplete understanding of asset health.*

**PS 3, Continuous monitoring:** *There is currently no cost-effective method for ubiquitous and continuous monitoring of the entire overhead system, limiting visibility into asset conditions and PG&E's ability to proactively remediate evolving threats between inspection cycles.*

**PS 4, Crowdsourcing third-party data:** *Third parties, such as the public and companies unaffiliated with PG&E, collect a tremendous amount of data that could be relevant to the efficient monitoring of PG&E assets and vegetation nearby, but there is no comprehensive method of collecting and utilizing all of this data.*

#### 4.8. Eliminate wildfire ignitions with improved protection schemes

**PS 1, Eliminating ignitions:** *While EPSS is enabled on all circuits in HFTDs, there are still reportable ignitions occurring on EPSS-enabled circuits and gaps in the abilities of this technology.*

**Author's comment:** To help mitigate the risk of ignitions associated with catastrophic wildfires, Pacific Gas and Electric Company (PG&E) has adjusted the sensitivity of its electric equipment to turn off power quickly and automatically if the system detects a problem. PG&E calls this Enhanced Powerline Safety Settings (EPSS). If an object strikes a line, safety equipment detects the change in current and shuts off power within one-tenth of a second...<sup>4</sup>

**PS 2, Fault energy:** *Current technologies to reduce fault current, a leading cause of ignition risk, are only capable of addressing a subset of fault types, cannot de-energize rapidly enough in all cases, and are costly to deploy.*

**PS 3, Fail-safe electrical equipment design:** *Mainstream electrical equipment is not primarily designed to fail safely, thus increasing the risk of catastrophic wildfires, as well as adding costs for monitoring and fault mitigation to compensate for the lack of fail-safe design as a primary design principle.*

**PS 4, Gaps in ignition notification:** *Today's ignition monitoring and notification technologies are limited in their ability to provide highly accurate and location-precise information across PG&E's system on a real-time basis, leaving room for improvement in ignition response times.*

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<sup>4</sup> CPUC Information Sheet on Enhanced Powerline Safety Settings, Sep 2022, <https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/news-and-outreach/documents/fact-sheets/epss-fact-sheet.pdf#:~:text=To%20help%20mitigate%20the%20risk%20of%20ignitions%20associated,PG%26E%20calls%20this%20Enhanced%20Powerline%20Safety%20Settings%20%28EPSS%29>

**PS 5, Fault location and response:** State of the art technologies are limited in their ability to precisely locate faults and incipient faults, limiting PG&E's ability to respond immediately to restore power or address a developing risk as valuable time must be spent identifying the precise location in the field.

#### **4.9. Eliminate customer impacts from PSPS/EPSS**

**PS 1, Lengthy PSPS/EPSS patrols:** Outage patrols that are needed to conclude EPSS and PSPS events can be personnel-intensive, often limited to daylight hours, and therefore take an extended amount of time to complete, exacerbating inconvenience for customers as timelines for power restoration can be lengthy and difficult to predict.

**PS 2, Broad EPSS impacts:** Relay response rates for EPSS are not currently fast enough for PG&E to perform micro-targeted EPSS activations when there are multiple protective devices on the feeder, leading to more customers being affected by outages than necessary.

**PS 3, PSPS/EPSS customer outages:** While highly effective at reducing wildfire risk, PSPS and EPSS programs are also highly impactful to customers, resulting in potentially lengthy electrical outages that can be disruptive and costly and may impact the same customer multiple times throughout the course of the year.

#### **4.10. Optimize vegetation management**

**PS 1, Accuracy of vegetation management patrols:** Current modeling and analytics solutions are insufficient for precisely targeting and prioritizing vegetation management patrols based on evolving conditions across the system.

**PS-2, Gaps in moisture monitoring:** The industry's current understanding of how various moisture readings impact tree health and associated ignition and propagation risks is limited and industry standard techniques to assess live fuel moisture content are subject to high degrees of variability based on factors unrelated to risk (e.g., time of day for sampling).

**PS 3, Healthy tree failure:** Green healthy trees can fail despite having no visible defects, thus creating an ignition risk in HFTDs that PG&E cannot currently abate through vegetation management.

**PS 4, More targeted removal of fire-damaged trees:** Current technologies are not able to systematically determine whether a fire-damaged tree will subsequently recover, leading PG&E to take a conservative approach to abatement in order to limit wildfire ignition and propagation risk as much as possible.

#### **4.11. Enhance and standardize forest management practices**

**PS 1, Wood management and conversion:** PG&E generates and manages large amounts of wood debris resulting from vegetation management programs, which is labor intensive, potentially dangerous to co-workers, and requires wide-scale use of GHG emitting equipment.

**PS 2, Targeted forest management:** PG&E is unable to analytically prioritize potential land use treatment investments due to the lack of relevant advanced analytics and valuation capabilities.

#### **4.12. Improve the efficiency of underground civil construction from survey to installation**

**PS 1, Construction methods:** *Converting overhead lines to underground has a high unit cost per line mile due to challenging environmental conditions (e.g., soils, rock, accessibility), lack of space and presence of existing underground facilities, and the need to cross canyons, creeks, and other challenging terrain.*

**PS 2, Site survey of terrain conditions and other obstructions:** *Existing site survey and mapping tools lack speed and accuracy and are inadequate in identifying soil types and third-party utilities, resulting in suboptimal route planning and construction and less efficient spoils mitigation and management.*

**PS 3, Conductor and splice technologies:** *Current conductors are limited in their pull lengths, requiring frequent installation of primary boxes, generating spoils, and necessitating splices, which are a common failure point for underground networks due to their complexity and reliance on manual workmanship.*

#### **4.13. Identify scalable solutions for system components difficult to underground**

**PS 1, Service drops:** *Conventional methods for undergrounding the service drops for an individual customer are both costly and burdensome to customers, often requiring enhanced coordination to schedule work and disruption of customer property.*

**Final author's comment:** There were many problem statements for PG&E's Gas System. Although PG&E has many issues with their natural gas distribution system, and in some cases these are parallel to those with their electrical system, the gas system is already almost 100% underground, and very rarely acts as an ignition source for wildfires. Thus these will not be covered in this paper.