Uniting Performance and Sustainability in the Power Network of the Future

Blueprint for a Smart Energy Enterprise Development Zone in Silicon Valley
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BACKGROUND

In 2008, the Rockefeller Brothers Fund and Global Urban Development selected Joint Venture Silicon Valley to head a new national initiative, the Climate Prosperity Project, and designated Silicon Valley as one of seven pilot regions.

Climate Prosperity promotes the view that the climate crisis is an opportunity to build new industry clusters, create whole new classes of jobs and grow the economy, while at the same time enhancing our quality of life and solving one of the world’s most pressing problems, climate change.

Joint Venture formed the Silicon Valley Climate Prosperity Council, chaired by San José Mayor Chuck Reed and Chris DiGiorgio, California Managing Director of Accenture. The strategy for this initiative—The Greenprint for Silicon Valley—was published in 2009 and provided a framework and plan of action focused on four areas: renewable energy, building efficiency, clean, convenient transportation and green infrastructure.

Under the direction of the Council, the Climate Prosperity team has since led the development and implementation of such influential programs as the Silicon Valley Energy Storage Symposium series and the largest multiagency procurement of renewable energy in the country to date.

The Climate Prosperity Council also identified growing the “smart energy” industry and creating a large-scale demonstration program in Silicon Valley as a priority. Smart energy refers to a range of new technologies, solutions, standards and practices that are enabling cleaner and more efficient production, distribution and consumption of energy.

Over the past several months, Joint Venture has worked closely with key member organizations and AltaTerra Research to define a Silicon Valley-based “Smart Energy Enterprise Development Zone.” Essential in this effort has been collaboration among a broad group of stakeholders, including leading corporate customers, developers, municipalities, and utility and solution providers.

The goal of this initiative is to build the country’s highest-performance two-way power network, one that supports and rewards active energy management and clean distributed generation on a sustainable economic scale.

This report provides a vision and a road map for the development of a Smart Energy Enterprise Development Zone in an area spanning north Sunnyvale, north Mountain View and Moffett Field. This zone will serve as a replicable example for development and implementation of “smart energy” solutions in other regions, and incorporates Silicon Valley’s latest developments in efficiency, clean energy, grid performance and business model integration.
We would like to thank the following organizations for providing input and insight as we developed this blueprint:

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- Google
- Intuit
- Juniper Networks
- Lawrence Berkeley National Laboratory
- Moffett Park Business Group
- NASA Ames Research Park
- NetApp
- McCalmont Engineering
- Optony
- Pacific Gas & Electric Company
- SunPower
- Sustainable Silicon Valley
- University Associates
- Yahoo! Inc.
1. EXECUTIVE SUMMARY

AN EMERGING SMART ENERGY REVOLUTION

Around the world, concerns for sustainability have placed a premium on energy efficiency and the use of clean, renewable sources of energy. Related goals and standards are advancing rapidly and national-scale investments are now being made in efficiency and clean energy programs.

At the same time, innovation in electronics and information technology are reshaping customer interaction with the traditional electric grid—in such forms as electric vehicles (EVs), networked energy management and solar photovoltaic systems.

The convergence of these developments signals a transformation in how energy will be sourced and utilized in the future. “Smart energy” describes a portfolio of new practices, standards and technologies for maximizing performance and sustainability in the production, distribution and use of electric power.

In contrast to traditional energy systems, smart energy is characterized by:

- A bidirectional flow of energy and real-time information
- Dynamic incentives for responsive, affordable matching of supply and demand
- Clean energy sources that may be distributed and/or variable
- More efficient energy uses, and electrification of transportation
- Integration and interoperability across sources, distribution and use
- A high degree of availability, reliability and quality
- Evolving energy- and sustainability-related metrics

Figure 1: Key smart energy portfolio elements.
Spanning utilities and customers, a smart energy portfolio encompasses eight key elements (see Figure 1). For example, integrated building systems help manage and optimize building energy use at a detailed level. Distributed generation provides a source of clean energy at customer locations, and new demand management and pricing programs encourage optimal matching of power supply and demand between customers and the power providers.

Characteristically, smart energy elements are often interdependent. Distributed generation systems, for example, are usually tied to specific utility-provided rate structures and incentives. And broad-scale deployment of electric vehicles is gated by establishment of suitable charging infrastructure, related policies and standards.

In the end, effective collaboration and integration are essential in building a smart energy future.

A NEXUS FOR SMART ENERGY IN SILICON VALLEY

The effects and opportunities associated with smart energy converge uniquely on Silicon Valley. An advanced policy and regulatory environment, sophisticated energy customers, an uncoupled utility, and economic leadership in electronics and information technology represent the essential ingredients for a future of smart energy leadership—as solution providers, as customers and as a region.

This matters to Silicon Valley for several reasons:

- California, its regional agencies and its municipalities have taken a leading role in energy efficiency, renewable energy and greenhouse gas (GHG) reduction policies and programs.
- New grid dynamics and management challenges are emerging from the addition of renewable energy, distributed generation and electric vehicles to the grid.
- Market and industry pressures are forcing the information and communication technology (ICT) industry to improve efficiency, reliability and sustainability in the face of growing power needs.
- New electronics and IT applications converging with traditional energy and transportation solutions are an engine of future growth for Silicon Valley.
- Smart energy markets are highly competitive around the world, and Silicon Valley must continue to advance its credentials in this lucrative market.

COLLABORATION NEEDED TO ADDRESS KEY CHALLENGES

Smart energy promises essential long-term economic and environmental benefits. Yet, as is often the case, the challenge lies in the details. The energy ecosystem is especially complicated with many moving parts and a diverse set of stakeholders. Customer requirements vary widely and new solutions carry cost and risk.
In addressing these challenges, collaboration serves as a “force multiplier.” Bringing stakeholders together is critical for defining common opportunities, developing integrated standards and solutions, leveraging time and investment, and realizing more rapid propagation of best practices.

In this spirit, a host of prominent smart energy collaborations have emerged around the United States, supported by large-scale public and private investment. Surprisingly, there is no such broad-scale collaboration in Silicon Valley.

A SILICON VALLEY “CALL TO ACTION”

As the world’s leading region for high-technology research and development, Silicon Valley has a long history of enabling business innovation. And now, thanks to new developments in electronics and information technology, our region is in a position to transform how energy is sourced, distributed and utilized around the world.

Silicon Valley is already home to many isolated examples of what the smart energy future holds. Utility Pacific Gas & Electric (PG&E) is underwriting millions of dollars in customer-side energy efficiency upgrades at local companies. Google has piloted a two-way vehicle-to-grid EV charging system. And local solution providers, such as Bloom Energy and SunPower, are industry leaders in distributed generation and have a number of local installations. Yet despite a wealth of point examples, there is no integrated, programmatic view of smart energy applied broadly in Silicon Valley.

Figure 2: Collaboration objectives.

<table>
<thead>
<tr>
<th>Improve reliability, affordability</th>
<th>Pilot and implement new capabilities, models and processes for efficient utilization of grid energy assets, improved reliability and affordability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance sustainability</td>
<td>Reduce local GHG emissions through the expanded use of grid-effective clean and distributed sources of energy, and increased electrification of transportation</td>
</tr>
<tr>
<td>Expand market opportunity</td>
<td>Provide global market expansion and brand enhancement for Silicon Valley companies deploying advanced energy, information and transportation solutions</td>
</tr>
<tr>
<td>Attract investment</td>
<td>Attract additional energy-related technology companies, investment and research funding as a hub for development and deployment of advanced solutions</td>
</tr>
<tr>
<td>Accelerate climate prosperity</td>
<td>Accelerate sustainable deployment of smart energy, return tangible benefits to participants, and provide both leadership and a replicable model for other regions</td>
</tr>
</tbody>
</table>
Under the direction of Joint Venture's Climate Prosperity Council, a working group of stakeholders was engaged in a visioning and strategy effort to outline a smart energy collaboration based in Silicon Valley (see Figure 2). In doing so, the group identified a handful of critical objectives—improving reliability and affordability of local power, advancing sustainability, expanding market opportunity, attracting investment and accelerating climate prosperity.

Silicon Valley brings a special combination of assets and capabilities from which to establish a new and unique brand of smart energy collaboration, a real-world platform for leadership in integrated smart energy development and deployment.

In establishing this collaboration, the working group stressed a number of guiding principles consistent with how Silicon Valley operates, and making this effort customer-focused, commercially sustainable, rapid and results-oriented.

Also, they envisioned this collaboration in the context of a physical and organizational platform serving smart energy and sustainability needs over time. As new approaches and solutions are tested, deployed and/or scaled, this platform will facilitate the measurement of results and information sharing through traditional and online channels.

**BUILDING A SILICON VALLEY-BASED SMART ENERGY ENTERPRISE DEVELOPMENT ZONE**

Central to this vision is the establishment of an enterprise development zone (see Figure 3). This area will serve as a focal point for building:

- The country’s highest-performance two-way power network, supporting and rewarding active energy management and clean distributed generation on a sustainable economic scale
- A replicable example that demonstrates Silicon Valley’s latest developments in efficiency, clean energy, grid performance and business model integration

*Figure 3: Smart Energy Enterprise Development Zone (SEEDZ).*
Through collaborative efforts of local and industry stakeholders, the Smart Energy Enterprise Development Zone (SEEDZ) will be home to a range of tactical practice advancement initiatives and strategic development programs.

The 8.25-square-mile zone encompasses the Moffett Federal Airfield, the City of Mountain View north of Highway 101 and the City of Sunnyvale north of Highway 237. The zone comprises 300 energy customers in 31 million square feet of building space, mostly for high-tech office, lab and data center uses. In addition, billions of dollars of investment are planned for development of more than 8.5 million square feet of new office and lab space.

The zone has a unique and progressive energy profile, featuring high concentrations of distributed generation and electric vehicle charging infrastructure. Current peak power demand is estimated at 175-200 MW, with approximately 13 MW of distributed generation across 18 installations. Hundreds of EV charging stations are currently in place or planned.

Why a “Zone”?
For many reasons, a geographic focus is helpful for enabling smart energy solutions:

- Customers are in close proximity, enabling shared approaches and leverage
- Common utility and programs, grid infrastructure and jurisdictions
- High degree of commonality in needs and objectives among stakeholder groups
- Sets an appropriate project scale that is measurable, quantifiable and replicable
- Helps isolate test bed inputs, outputs and results
- Builds personal and neighborhood relationships that foster collaboration

In the zone, high-tech industry customers have growing demands for high-quality power. Quality and reliability are extremely important here as momentary interruptions bring down expensive development equipment and processes.

Leading customers in the zone—such as Google, Juniper Networks, NetApp, Yahoo and Intuit—are currently ranked as leaders in corporate sustainability by organizations such as the Carbon Disclosure Project and Newsweek magazine. PG&E is a recognized leader in solar installations and has plans to spend $1 billion on smart grid improvements by the year 2020.
Collaborations within SEEDZ will be built around key smart energy elements. The working group has identified a broad range of candidate initiatives associated with one or more of these elements (see Figure 4). In the process, some specific initiatives have been identified as high-priority “quick wins,” and other areas as likely candidates for strategic development programs and additional third-party funding.

**MEASURES OF SUCCESS—A BALANCED SCORECARD**

Over time, monitoring and performance metrics will be embedded into SEEDZ. Evaluating and judging success will be measured on the basis of complementary operational performance, sustainability and economic growth factors (see Figure 5).
GETTING STARTED

Like any venture, launching a smart energy development zone in Silicon Valley will take organization, resources and time. Key stakeholders will include major energy customers, technology solution providers, the public utility, and municipal and institutional players (see Figure 6).
Stakeholders will be actively engaged and contribute in a variety of ways, including staffing and financial resources, expertise, leading or participating in specific programs, or serving as a test bed for new innovations. In return, stakeholders will see tangible benefits in the form of solving shared problems, improving performance and, ultimately, enhancing climate prosperity.

The road map for SEEDZ formation outlines three general phases (see Figure 7):

1. Building a framework for collaboration
2. Launching the operation
3. Sustaining programs

To build momentum and involvement, work on tactical initiatives begins early, in the collaboration development phase—as do market outreach, engagement and strategic program activities. Concurrently, the collaboration will begin to establish a mechanism to address strategic needs facing the scaled deployment of smart energy.

Market engagement. SEEDZ will provide brand and market development benefits for stakeholders. This will be done through market outreach and by sharing solutions. Early on, SEEDZ will develop market engagement mechanisms such as a webinar series, a national contact list, and tours and demonstration to help establish the zone’s profile and share current best practices.
**Practice advancement initiatives.** In the near term, stakeholders have identified three quick-win practice advancement initiatives as foundational projects, ones that will build knowledge and momentum. These initiatives include:

- *Power quality information sharing:* Sharing of power quality measurements from customers to identify distribution problems and guide investment.
- *Inventory of smart energy practices:* Developing and sharing smart energy practices to accelerate the adoption of smart energy solutions.

**Capstone strategic development programs.** Uniting leading Silicon Valley customers, industry, government and utility players in strategic development programs is the capstone opportunity for SEEDZ. Building out the SEEDZ vision over the next 5-10 years will take a shared understanding of smart energy design, associated programmatic and technology elements, and funding. Defining common strategic development needs will help to attract resources and outside investment to scale programs, infrastructure and demonstration projects.

As the SEEDZ coalition comes together, a smart energy schematic-level design and evaluation effort will further outline potential strategic development programs. This process will establish shared definitions of key customer and utility-side capabilities needed to support the SEEDZ vision, key gaps, and shared research and development opportunities.

Such shared opportunities will likely involve advanced power distribution and management infrastructure, district generation, new dynamic pricing processes, zone policies and adoption measures, and advanced technologies for two-way integration of buildings, electric vehicles, distributed generation and storage.

With SEEDZ, it is expected that smart energy investments will be made by both customers and the utility, and will be business-case driven. In addition, by establishing itself as a high-profile smart energy collaboration, SEEDZ will have the opportunity to attract significant incremental infrastructure and research funding from utility, state, federal and other third-party sources.
THE JOURNEY FORWARD

Building out the SEEDZ vision will not be easy. New technologies and solutions must be tested, deployed and scaled. Policies will have to be reworked. New standards and measures must be adopted. Utilities must adapt business models, operations and incentives to changing source and use profiles. And customers need to prepare for a future of energy optimization and real-time integration.

Yet Silicon Valley is home to many of the world’s most innovative companies and energy customers, progressive municipalities, leading research institutions and forward-looking utilities. If Silicon Valley can’t succeed, then who can?

Acting now in a coordinated way will enhance and project Silicon Valley’s role at the forefront of smart energy innovation. It will further protect our local environment, and enhance regional competitive positioning in this new, rapidly growing market segment. The SEEDZ collaboration will operate with a laser-focus on developing both near-term and long-term results—accelerating climate prosperity benefits for stakeholders, the Silicon Valley region and the global smart energy marketplace.
2. A SMART ENERGY NEXUS IN SILICON VALLEY

Around the world, societal concerns for sustainability are placing a premium on the use of clean, renewable sources of energy and improved energy efficiency.

Aggressive renewable portfolio standards, advancing automobile and building efficiency standards and regulatory and voluntary GHG reduction programs are evidence of this trend. Further, governments around the world are expanding investment in smart energy research, industry support and customer incentives.

The scale and trajectory of these developments signal a major transformation in how energy will be sourced, distributed and utilized in the future. New smart energy practices, standards and technologies will be at the forefront of this transformation.

The effects and opportunities associated with this transformation converge uniquely on Silicon Valley. An advanced policy and regulatory environment, sophisticated energy customers, uncoupled utilities and economic leadership in electronics and information technology represent the essential seeds for a future of smart energy leadership in Silicon Valley—as providers and as customers.

WHAT IS SMART ENERGY?

As studied by the Joint Venture working group, smart energy describes an emerging portfolio of new practices, standards and technologies for maximizing performance and sustainability in production, distribution and use of electric power. Versus traditional energy systems, smart energy is characterized by:

- A bidirectional flow of energy and real-time information
- Dynamic incentives for responsive, affordable matching of supply and demand
- Clean energy sources that may be distributed and/or variable
- More efficient energy uses and electrification of transportation
- Integration and interoperability across sources, distribution and use
- A high degree of availability, reliability and quality
- Evolving energy and sustainability-related metrics

Terms such as “smart grid” or “smart microgrid” have similar definitions, yet to some they connote a focus on power transmission and distribution management technologies. The term “smart energy” is meant to imply an expanded view, including such components as customer-side efficiency, electrification, supply-and-demand incentive structures and sustainability-related measures.

The working group identified eight elements essential to realizing a smart energy vision (see Figure 8). Importantly, individual elements are often interrelated and must be considered in combination to achieve the greatest benefit.
As an example, EVs generally offer improved efficiency and reduced emissions versus fossil-fueled vehicles. Yet EVs represent a new demand on the grid. Maximizing the potential cost and environmental savings associated with expanded penetration of EVs will take an integrated approach to new grid infrastructure, grid/vehicle interoperability standards, demand management structures and local policies and incentives.

**WHY SMART ENERGY MATTERS IN SILICON VALLEY**

**California Leadership in Environment, Energy and Sustainability.** California has long been a leader in addressing energy efficiency and environmental sustainability, and has established some of the most far-reaching goals and policies in the country. California’s regulatory leadership, combined with local technology expertise, has resulted in a burgeoning clean technology industry in Silicon Valley.

In 1978 concerns over air quality and oil prices led to the passage of Title 24, which established the nation’s strictest energy-efficiency standards for buildings and appliances. And in 1982 the California Public Utilities Commission (CPUC) adopted decoupling policies to remove disincentives for utilities to promote energy conservation and efficiency among customers. The California Energy Commission estimates these standards and policies have saved customers $56 billion through 2003, and will save another $23 billion by 2013.⁴
More recently, Assembly Bill 32, the Global Warming Solutions Act of 2006, committed California to reducing GHGs to 1990 levels by the year 2020. AB 32 is the most aggressive state-level GHG emissions act in the country, and mandates a range of policy and standards-based mechanisms to meet reduction goals.

In the San Francisco Bay Area, many regional agencies and municipalities are developing detailed climate action plans. These plans include identification of municipal and community-wide GHG reduction initiatives focused on energy, the built environment and transportation.

California has also been a leader in the deployment of renewable energy resources. Under the “Million Solar Roofs” vision, the California Solar Initiative (CSI) is more than a third of the way toward reaching its goal of building 3,000 MW of new solar capacity by 2016. And in 2011, California increased its Renewable Portfolio Standard (RPS), now requiring investor-owned utilities, electric service providers and community choice aggregators to obtain 33 percent of their power from renewable sources by 2020.

**Convergence of Energy, Electronics and Information Technology.** Recently, solar photovoltaic systems, fuel cells, electric vehicles and storage technologies have reached commercial scale and are being connected to the grid in increasing numbers. At the same time, new power electronics and software-based control applications are changing how energy distribution and utilization are monitored and managed.

Successful integration of new electronics and information technology applications with the traditional power grid will take strong technology and integration skills. And it’s important to have willing “early adopter” customers to serve as pilot sites for research and deployment of new integrated solutions. Silicon Valley is well suited to this task, with highly technology-savvy energy customers and strong integration and technology expertise.

**New Grid Dynamics and Management Challenges.** According to the Massachusetts Institute of Technology report *The Future of the Electric Grid,* renewable generation, distributed generation, electric vehicles and greater demand variability all pose challenges to the grid if not addressed. This is an excellent example of a real-world integration problem that will occur sooner rather than later in Silicon Valley and can be solved by applying strong local expertise.

California is increasing its renewable energy mix from around 20 percent today to 33 percent in 2020. Much of this new capacity will come from utility-scale renewable generation, such as wind and solar farms. Output from these variable resources is challenging to predict accurately. As the MIT study notes, “efficiently increasing the penetration of grid-scale renewable generation while maintaining reliability will require modifications to the power system design and operation.”
Further complicating this picture is a steady increase in distributed renewable generation at customer sites. High penetration rates in a given location can cause unusual distribution flow patterns of power and stress electrical equipment. As such, integrating high levels of distributed generation will require new monitoring equipment and interconnection standards that protect the grid.\textsuperscript{vi}

And from a demand standpoint, growing adoption of EVs will significantly increase peak electricity usage, if the proper infrastructure and incentives are not provided to encourage off-peak charging. Taken further, smart EV charging could help to improve capacity use during low-use periods, and at some point in the future, offer capacity back to the grid during peaks.

**Market and Industry Pressures.** In business operations, ICT firms require extremely high-quality power. Excessive voltage fluctuation or momentary power interruptions shuts down expensive development and production equipment and interrupts the processes running on the equipment. Area customers described an 8-10 hour recovery cycle from a power interruption, which is extremely expensive in terms of direct and indirect costs.

Nationally, power interruptions, primarily from short interruptions less than five minutes, cost commercial and industrial businesses nearly $80 billion annually.\textsuperscript{vii}

And at a higher level, the ICT industry, in Silicon Valley and elsewhere, has growing data center power needs to serve a market shift toward cloud computing, web services and mobile computing. Many major companies in the industry are under direct pressure from non-governmental organizations (NGOs) and other stakeholders to improve energy efficiency, reliability and sustainability, while keeping energy costs low.

**Engine for Regional Growth.** Silicon Valley is at the epicenter of an emerging smart energy economy. Global investment in clean energy alone reached $269 billion in 2011 and has grown more than 600 percent since 2004.\textsuperscript{viii}

And the smart energy market is becoming increasingly competitive, with nations like China, Germany and India investing heavily. China has also become the most attractive market for investing in clean energy, according to a quarterly survey by Ernst & Young.\textsuperscript{ix}

Established Silicon Valley leaders and start-ups are aggressively engaged in new, highly competitive smart energy markets around the world and/or are deploying these same solutions in their own operations.
California and Silicon Valley lead the nation in clean technology investment and innovation (see Figure 9). Totaling $1.76 billion in 2011, clean tech investment in Silicon Valley represented 12.5 percent of total venture capital funding in the country. The solar industry is particularly strong in the state, attracting $1.2 billion of venture capital funding and accounting for 41 percent (182 patents) of all clean tech patents filed nationwide.

Silicon Valley is home to numerous young and rapidly growing companies developing smart energy technologies, such as Bloom Energy, Coulomb Technologies, Bridgelux, eMeter, Silver Spring Networks and Tesla. SunPower, a major solar manufacturer based in Richmond, now has annual revenues of $2.3 billion.

At the same time, leading information technology firms in the area, such as Google, Juniper Networks, Yahoo! and NetApp continue to make visible investments in energy efficiency, clean energy and other smart energy elements in their business operations.

In total, the market opportunity for energy efficiency via new applications of information technology, communications and electronics is vast. As highlighted in a 2008 Global eSustainability Initiative (GeSI) study, new ICT-based solutions in buildings and electric grids, logistics and transportation, and industrial motor systems represent an estimated aggregate energy savings worth $946.5 billion globally, and emissions savings of 7.8 GtCO2e by the year 2020. Clearly, there is a large market opportunity for Silicon Valley companies focused on smart energy technologies.
3. SMART ENERGY CHALLENGES AND THE VALUE OF COLLABORATION

Smart energy promises essential long-term economic and environmental benefits. Yet, as is often the case, the challenge lies in the details. The energy ecosystem is uniquely complicated. Customer requirements vary widely, and introducing new technology carries cost and risk.

In addressing these challenges, collaboration is serving as a “force multiplier.” Bringing various stakeholders together helps to identify areas of common opportunity, define integrated standards and solutions, leverage time and investment, and more rapidly propagate best practices. In this spirit, a host of prominent smart energy collaborations have emerged around the U.S. Yet at present, there is no such large-scale collaboration in Silicon Valley.

A COMPLEX ENERGY ECOSYSTEM

The energy ecosystem has many moving parts (see Figure 10). On the utility side are operations centers and an extensive network of power generation, transmission and distribution infrastructure. On the customer side are building systems and production equipment, distributed generation and vehicle-charging infrastructure.

Source: NIST

Figure 10: Conceptual reference diagram for smart grid information networks.
From a process standpoint, a complicated web of utility rates, incentive structures and third-party services influence how power is used. And there are many stakeholders in the mix—including utilities, power providers, different customer types, service providers and regulatory agencies at the federal, state and local level.

In the world of smart energy, effective solutions often take coordinated action. As an example, automated demand-response programs require specific technologies at utility and customer sites, information technology standards to support a real-time electronic “handshake,” and a compelling energy pricing program that reflects benefits to both the utility and the customer.

**VARYING CUSTOMER NEEDS AND CONSTRAINTS**

On the customer side of the equation, the U.S. Department of Energy estimates commercial facilities waste nearly 30 percent of the electricity they use, due to avoidable inefficiencies. Real opportunities for efficiency savings clearly exist. A commonly cited, high-profile example is the Empire State Building retrofit project. The building’s owner implemented eight major efficiency improvements, reducing energy use 38 percent with less than a three-year payback and a 66 percent annual return on investment (ROI). And in Silicon Valley, Adobe Systems has implemented more than 140 efficiency and energy-related projects at its two million-square-foot headquarters complex, resulting in $4.4 million annual energy savings with a 2.4-year payback and a 42 percent ROI.

While fixing commercial building energy inefficiencies represents approximately $50 billion in potential annual energy savings to U.S. businesses, a number of real-world issues must be overcome in the process.

It’s often said that no two buildings are the same. Age, structural characteristics and systems such as HVAC, lighting and building management vary greatly from one to the next. Improving efficiency or adding distributed generation means assessing a unique set of circumstances at virtually every building.

For instance, surveys of existing commercial buildings indicate that fewer than 30 percent are currently suitable for solar. And even though efficiency improvements can yield 30-40 percent energy savings and strong ROIs, customers are reluctant to make investments of any kind in buildings approaching the end of their useful lives.

Another key factor is the owner/tenant relationship. Agency issues are common in leased facilities, where tenants pay for operational costs. Historically, there’s been little direct incentive for owners to invest in new energy-saving technologies. In addition, many multi-tenant commercial facilities lack sub-metering, so utility costs are often prorated by square foot. In such a case, tenants have little direct control or incentive for using energy wisely.
Return on investment calculations and availability of financing are perpetual challenges for smart energy projects. Customers are often hesitant to invest in projects that have longer than a two-year ROI. While efficiency projects often pencil out within that timeframe, payback periods for distributed generation systems such as solar are typically longer. And whether or not the ROI is compelling, customers may have limited access to necessary upfront financing or viable financing terms.

Finally, as it relates to smart energy projects, organizational bandwidth is invariably in short supply. Within most organizations, facilities and energy management budgets are lean, and available time and expertise is limited. This makes effective market education, engagement and leverage essential for scaling smart energy solutions.

NEW TECHNOLOGY AND RISK MANAGEMENT
Deploying new smart energy solutions involves technology integration risks, both for utilities and customers. Similarly, new energy pricing and demand management practices represent a business risk—for customers and utilities. Will new solutions work as specified? To what extent will they be adopted? Will there be positive or adverse impacts to power quality or service levels? Will costs be recovered and ROIs met?

These questions are growing in importance and scale. Recent years have seen a dramatic increase in new technologies being introduced to the grid. New questions are emerging around how best to manage and optimize this rapidly changing system of energy inputs and outputs.

Standards are critical for ensuring the integration and interoperability of new technologies. Yet the many touch points that exist between different industry players and the complexity of the energy ecosystem make this challenging.

WHAT CAN BE DONE?
So this is complicated. Fortunately, new practices, standards and business models are tackling the smart energy challenge head-on. And major investments are being made in smart energy demonstration projects around the country to implement and assess new energy technologies and market-based approaches.

At a tactical level, for example, “green leasing” practices are expanding between building owners and tenants. These practices address agency issues and encourage owner/tenant collaboration, aligning incentives for effective investment in efficiency and sustainability-related improvements. Real estate services provider Jones Lang LaSalle, for instance, has developed a Green Office Toolkit providing tenants with a range of tools on green leases and implementing sustainability improvements.
Also, building certifications such as Leadership in Energy and Environmental Design (LEED) and ENERGY STAR are now having a major impact in terms of improving energy efficiency in buildings. Critically, they provide standards by which owners, tenants and municipalities can measure and value building energy and environmental performance. Participation in ENERGY STAR has increased from approximately 30,000 buildings in 2006 to nearly 210,000 buildings in 2011. New business models have emerged to address the issue of upfront financial cost and availability of expertise. Power Purchase Agreements (PPA) and Energy Service Agreements (ESA) are eliminating upfront costs by providing customers with distributed renewable generation and energy efficiency as a service. Innovative new policy tools, such as Property Assessed Clean Energy (PACE) programs, on-bill financing and community solar are also helping to reduce upfront costs.

From a technology standpoint, open standards bodies such as The National Institute of Standards and Technology (NIST), the Institute of Electrical and Electronics Engineers (IEEE) and the International Electrotechnical Commission (IEC) are working on the collaborative development of detailed standards for interoperability in smart energy systems, spanning generation, transmission, distribution and use.

Along a related vein, the Perfect Power Institute is working on an extensive set of power system design and performance metrics spanning reliability, quality, cost and operational efficiency, environment and energy efficiency, safety, and customer engagement.

**BRINGING IT ALL TOGETHER . . .**

At both a customer and utility level, proving out new technologies and programs is critical to adoption and scaling. Pilot projects and best-practice sharing are time-honored ways of addressing new technology risk. Pilots need to be carefully constructed to isolate key inputs and outputs, and then measured and verified to demonstrate achieved benefits.

Just as important is sharing results. This helps utilities and customers assess likely risks, understand the benefits and tailor their approaches. And it accelerates adoption of promising solutions by reducing the “fear of the unknown.”

Major smart energy collaborations are currently underway in various cities and regions across the country. These collaborations serve as test beds for piloting advanced energy technologies, business models and energy management systems, and understanding associated customer behaviors.

Millions of dollars of investment are being deployed in these collaborations, from federal, state, utility, institutional and private-sector sources. Selected projects are listed in Figure 11. Surprisingly, there is no such large-scale collaboration in Silicon Valley.
Current collaborations vary in their objectives, scope and funding, but each is pursuing elements vital to smart energy. As an example, Envision Charlotte is helping building owners monitor and manage their energy use in real time. With nearly $5.5 million in funding from Duke Energy and Cisco, building owners are not charged for participating.

Other collaborations are significantly larger in scope, involving hundreds of millions in investment. The Sacramento Municipal Utility District (SMUD) has developed the SmartSacramento demonstration project to encourage customers to be part of energy solutions. With more than 20 individual projects, SmartSacramento has received a $127.5 million grant from the DOE, which SMUD is applying to its $308 million smart grid investment in the program.

<table>
<thead>
<tr>
<th>Project name</th>
<th>Partners</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albuquerque Business District Smart Grid Project</td>
<td>Shimizu Corp., Mitsubishi, Fuji Electric, Sandia Labs, UNM</td>
<td>Two-year study at commercial facility integrating 50 kW PV, 240 kW gas generator, 80 kW fuel cell and 90 kW battery to develop a microgrid.</td>
</tr>
<tr>
<td>Illinois Smart Building Initiative</td>
<td>Draper &amp; Kramer, M&amp;J Wilkow, Argonne Lab, seven Korean firms</td>
<td>Multi-property project to combine DR, ancillary services and EE projects to find new revenue streams and develop new business models. Funded with $2.7 million from the Korean government and $1 million from the state of Illinois.</td>
</tr>
<tr>
<td>Irvine Smart Grid Project</td>
<td>EPRI, Southern California Edison</td>
<td>$80 million project deploying smart grid technologies to improve operating performance of the local distribution system and encourage customers to participate in the control of electric demand.</td>
</tr>
<tr>
<td>Pecan St. Project</td>
<td>Austin, Austin Energy, UT, Dell, Oracle, Cisco, Microsoft</td>
<td>• Organization developing advanced technologies, business models and customer behavior surrounding advanced energy management systems. • Piloting 100 homes to participate in energy audit and installation of monitoring systems.</td>
</tr>
<tr>
<td>Philadelphia Navy Yard</td>
<td>PIDC, 11 academic institutions, UTC, IBM, two national labs</td>
<td>Developing Energy Innovation Hub with $120 million Department of Energy grant serving as a test bed for RE integration, microgrids and the development of smart grid technologies. Site has an independent electric grid.</td>
</tr>
<tr>
<td>SmartSacramento Smart Grid Demonstration</td>
<td>EPRI, Sacramento Municipal Utility District</td>
<td>More than 20 individual projects combining existing, proven technologies with the pilot testing of several new technologies. Project includes consumer behavior study, energy storage and solar feasibility study.</td>
</tr>
<tr>
<td>UC San Diego Microgrid</td>
<td>Chevron Energy Solutions, UCSD</td>
<td>Microgrid with the ability to manage 42 MW of generating capacity, including cogen plant, solar array and fuel cells. The campus can isolate itself from the larger electric grid to maintain power in an emergency.</td>
</tr>
</tbody>
</table>
4. A SILICON VALLEY CALL TO ACTION ON SMART ENERGY

As the world’s leading region for high-technology research and development, Silicon Valley has a long history of enabling new business innovation. And now, recent developments in electronics and information technology stand to transform how energy is sourced, distributed and utilized around the world.

Under the direction of Joint Venture’s Climate Prosperity Council, a working group of stakeholders was engaged in a visioning and strategy effort to define the outlines of a smart energy collaboration based in Silicon Valley.

A PLATFORM FOR LEADERSHIP

Indeed, Silicon Valley is already home to many individual examples of what the smart energy future holds.

For example, as an energy customer, Google has piloted the first vehicle-to-grid system, along with PG&E. Also, PG&E has helped underwrite millions of dollars in customer-side energy efficiency upgrades at local companies such as NetApp, Juniper Networks and Yahoo. And as a provider of solutions, Silicon Valley-based companies such as SunPower and Bloom Energy are industry leaders in distributed energy generation, and a wide range of local companies are at work in energy efficiency, management and control systems.

Despite a wealth of point examples, there is no integrated, programmatic view of smart energy applied broadly in Silicon Valley. Further, many critical “how-to” questions are emerging around ways to integrate and utilize smart energy solutions as they propagate in the market—for example:

- How can power quality and reliability be maintained and improved as new variable generation and vehicle-charging infrastructure are added to the grid?
- How is distributed generation best deployed and integrated by large customers?
- How can new, more dynamic sources of supply and demand be best matched within a grid distribution network?
- Will customers respond to more dynamic pricing as efficiency improves?
- How can building systems dynamically optimize efficiency and cost?
- How can emissions savings and environmental benefits be aggregated?

Answering such questions will take time, resources and interaction between early-adopter customers, utilities, solution providers, research institutions and governmental entities. Interactions will include identification and sharing of best practices, technology pilots, new supply and demand management processes and integration approaches, and testing and deployment of new distribution infrastructure and capabilities.
Silicon Valley brings a special combination of assets and capabilities from which to establish a new and unique brand of smart energy collaboration, a real-world platform for leadership in integrated smart energy development and deployment.

Collaboration objectives, as defined by this group, are built around high-priority opportunities for improving power quality and affordability, environmental sustainability and economic growth (see Figure 12):

| **Improve grid reliability, affordability** | Pilot and implement new capabilities, models and processes for efficient utilization of grid energy assets, improved reliability and affordability |
| **Advance sustainability** | Reduce local GHG emissions through the expanded use of grid-effective clean and distributed sources of energy, and increased electrification of transportation |
| **Expand market opportunity** | Provide global market expansion and brand enhancement for Silicon Valley companies deploying advanced energy, information and transportation solutions |
| **Attract investment** | Attract additional energy-related technology companies, investment and research funding as a hub for development and deployment of advanced solutions |
| **Accelerate climate prosperity** | Accelerate sustainable deployment of smart energy, return tangible benefits to participants, and provide both leadership and a replicable model for other regions |

**Figure 12: Smart energy stakeholder collaboration objectives.**

**REFLECTING THE CULTURE OF SILICON VALLEY**

The stakeholder group stressed a number of guiding principles consistent with how Silicon Valley operates. Taken together, they define a smart energy collaboration distinct from the rest of the country:

- **Customer-driven:** Customer needs and preferences will drive collaborations
- **Commercially sustainable:** Successful solutions will be leveraged and scaled
- **Portfolio vs. monolithic approach:** Multiple initiatives will run concurrently and will utilize both bottoms-up and top-down approaches
- **Rapid and results oriented:** Centered on delivering rapid, tangible results
- **Lead/opt-in:** Participants in a given initiative must lead or “opt-in”
- **Information sharing:** Participants will share best practices and lessons learned
- **Measurement platform:** Early priority will be given to baselining initiatives and processes for tracking energy and sustainability metrics in the zone
5. A SMART ENERGY ENTERPRISE DEVELOPMENT ZONE IN SILICON VALLEY

The Joint Venture stakeholder working group has outlined a comprehensive smart energy vision and collaboration, to be based in Silicon Valley.

This vision includes high-level goals, establishment of a geographic zone, definition of a smart energy scope and key elements, measures and mechanisms to make Silicon Valley a foremost example of smart energy excellence.

A VISION FOR 2020

Central to the vision is establishing an “enterprise development zone,” a focal area for commercial integration and demonstration of smart energy practices, standards and technologies. Over the next decade, the goal is to build:

- The country’s highest-performance two-way power network, supporting and rewarding active energy management and clean distributed generation on a sustainable economic scale

- A replicable example that demonstrates Silicon Valley’s latest developments in efficiency, clean energy, grid performance and business-model integration

Through the collaborative efforts of local and industry stakeholders, supply-side and demand-side smart energy elements will be broadly deployed and integrated into the country’s highest-performance two-way power network (see Figure 13).

In the process, the Smart Energy Enterprise Development Zone (SEEDZ) will become home to a range of tactical practice advancement initiatives, strategic development programs and a high-profile market engagement and education function.
ZONE CHARACTERISTICS AND PLANS

The Smart Energy Enterprise Development Zone encompasses the Moffett Federal Airfield, the City of Mountain View north of Highway 101 and the City of Sunnyvale north of Highway 237 (see Figure 14). An exceptional group of local stakeholders, a unique energy use profile and geographic characteristics, and extensive growth plans make this an ideal area for development of the world’s most advanced power network.

Why a “Zone”?

For many reasons, a geographic focus is helpful for enabling smart energy solutions:

• Customers are in close proximity, enabling shared approaches and leverage
• Common utility and programs, grid infrastructure and jurisdictions
• High degree of commonality in needs and objectives among stakeholder groups
• Sets an appropriate project scale that is measurable, quantifiable and replicable
• Helps isolate test bed inputs, outputs and results
• Builds personal and neighborhood relationships that foster collaboration

Figure 14: Proposed Smart Energy Enterprise Development Zone.

The zone is primarily commercial and industrial, consisting of more than 5,300 contiguous acres (approximately 8.25 square miles). Currently there are 470 buildings comprising more than 30.9 million square feet. Some multi-tenant residential building is planned for the future. Most of the present space is utilized for general office, laboratory, light industrial and data center functions. The zone is home to more than 300 businesses, including many leading technology companies.
Stakeholder Leadership in Efficiency and Sustainability. The zone supports corporate headquarters for several of the world’s leading information technology companies, including Google, NetApp, Juniper Networks, Yahoo!, Intuit and LinkedIn. In addition, a number of prominent technology companies such as Microsoft, HP and Amazon have major research facilities in the zone.

Many of these firms are leaders in corporate sustainability and have aggressively deployed smart energy practices and solutions (see Figure 15). All of the firms listed in Figure 15 participate in the Carbon Disclosure Project (CDP), which assesses and rates companies annually relative to GHG reporting and other sustainability elements. And, impressively, all of the listed firms were ranked in the top 100 of the Newsweek Green Ranking of U.S. companies.26

<table>
<thead>
<tr>
<th>Company</th>
<th>Sustainability Goals/Achievements</th>
<th>CDP Rating</th>
<th>Newsweek Green Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google</td>
<td>• Used 33% renewable energy in 2011, 13% RE purchased by Google, 20% from the grid</td>
<td>89</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>• Goal of electrifying 5% of parking space at headquarters</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Six million square feet of LEED-certified building space</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 1.7 MW solar array at Mountain view campus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hewlett-Packard</td>
<td>• Reduced energy consumption or products to 40% of 2005 levels</td>
<td>92</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>• Doubled voluntary RE purchases to 8% of electricity use</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Reduce GHG emissions by 20% relative to 2005 levels by 2013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intuit</td>
<td>• Reducing GHG levels 15% of 2007 levels by 2012</td>
<td>58</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>• HVAC initiative saved 150 MW in Mountain View headquarters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juniper Networks</td>
<td>Reduced GHG emissions 5% per employee from 2010 to 2011</td>
<td>59</td>
<td>79</td>
</tr>
<tr>
<td>Lockheed Martin</td>
<td>• Reduced GHG emissions 30% of 2007 levels by 2012</td>
<td>93</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>• Thirty-nine sites seeking or have achieved LEED certification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsoft</td>
<td>30% reduction of 2007 emission per unit of revenue by 2012</td>
<td>81</td>
<td>31</td>
</tr>
<tr>
<td>NetApp</td>
<td>• 2010 Uptime Institute Green Enterprise IT Award finalist</td>
<td>59</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>• Participating in the PG&amp;E Automated Demand Response program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yahoo!</td>
<td>• First commercial campus to be awarded LEED Gold (EBOM—1 million square feet)</td>
<td>59</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>• Utilizes innovative dynamic outside air cooling for data center (17% reduction from conventional footprint)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PG&E, the utility provider for the zone, is a leader in renewable energy with more installed solar than any other utility. PG&E is promoting the adoption of smart metering, plug-in electric vehicles and the smart grid. The company plans to spend between $800 million and $1.2 billion on smart grid projects over the next 20 years. The company was also ranked 38th on Corporate Responsibility Magazine’s 2012 list of 100 Best Corporate Citizens.

The cities of Sunnyvale and Mountain View are also promoting and supporting businesses’ energy efficiency and smart energy-related efforts. As an example, Sunnyvale was an early pioneer in establishing green building incentives for new construction, additions and remolds of commercial buildings. Buildings that achieve LEED Gold certification are eligible for a 10 percent increase in the floor-area ratio or an additional 10 feet in height. These incentives have been highly effective in improving energy efficiency and sustainability in commercial buildings.

Silicon Valley is also home to some of the world’s leading energy technology firms and start-ups. These include Bloom Energy, which is developing fuel cells to power businesses and homes; SunPower, which manufactures and installs high-efficiency solar panels; and Cypress EnviroSystems, a subsidiary of Cypress Semiconductor, which is creating digital control technologies to help older plants and buildings save energy and improve productivity.

Futuristic Attributes of Power Generation and Use. Many of the zone’s energy customers are engaged in advanced product research and development activities, and rely on high-quality power. These functions are central to Silicon Valley’s economic performance and growth. Momentary power outages or irregularities in power quality are very expensive, shutting off equipment and interrupting development processes.

At the same time, the energy profile in this zone is becoming increasingly distributed and dynamic—highly representative of the new smart energy future. The zone now hosts approximately 13 MW in distributed generation from 18 solar PV, fuel cell, landfill biogas and cogeneration units, and several additional installations are planned. Several hundred electric vehicle charging stations have been already been deployed, mostly on corporate R&D campuses, with hundreds more planned.
Current power demand in the zone is substantial, estimated at between 175 and 200 MW. This number is expected to rise with upcoming development. To support growth and improve power quality, substation and distribution infrastructure improvements are now on the drawing board (see Figure 16).

The top 20 customers in the zone currently account for more than 85 percent of the electric load. This concentration will help support effective analysis of new demand management tools and customer engagement processes.

Billions in Redevelopment Underway. In 2011, the City of Sunnyvale had more commercial building activity than in any year in its history. Corporations and property developers currently have plans in place to invest billions of dollars in the zone to develop more than 8.5 million square feet of new facilities. A number of companies are also exploring future expansion of their corporate campuses and demolishing older, smaller structures to make way for new multistory office buildings.

In the Moffett Park area, the City of Sunnyvale has established advanced green building requirements and incentives. Much of the new construction in the area is to LEED Gold or higher, based on floor area development incentives offered by the City.

The zone also features a significant amount of available roof space, parking lots and closed landfills, which potentially could be used for distributed renewable generation projects. The City of Sunnyvale operates a wastewater treatment plant in the zone and is planning to expand power generation. And in both Sunnyvale and Mountain View, landfills are currently producing biogas for use in local power generation.
SMART ENERGY PORTFOLIO ELEMENTS
The SEEDZ vision for smart energy takes an integrated view, encompassing supply-side, demand-side and distribution capabilities.

The vision considers eight key elements—practices, standards and technology solutions essential to a smart energy future. Smart energy elements demand management and pricing, development incentives and financing practices. Technology-related elements include integrated building systems, distributed generation systems, and electric vehicles and charging infrastructure.

Within SEEDZ, the scope of selected practice advancement initiatives and strategic development programs will be built around one or more of these elements and essential points of integration.

The working group, in individual interviews and group meetings, identified a broad range of possible collaborations. A number of these are summarized in Figure 17, in a brief review of the smart energy elements within the SEEDZ scope.

Figure 17: Smart energy elements—an integrated view.

Integrated building systems
Advanced HVAC/lighting, energy management systems, automated load shifting, continuous commissioning

Demand programs
Scaled adoption of DR and ADR, advancement of new dynamic pricing models

Grid infrastructure
Power quality monitoring, advanced distribution automation, self-healing

Interoperability standards
Building energy management and utility integration standards, DG and storage integration, NIST smart grid standards

Distributed generation
Onsite (potentially shared) solar PV, fuel cells, biogas, SWH, DG/grid integration, district heat/cooling

Electric transport
EV charging infrastructure, smart charging programs, EV grid impacts/integration

Storage and backup
Thermal and electric storage, backup, DG/islanding integration, rate arbitrage

Incentives and financing
Development incentives and standards, availability and piloting of PACE, on-bill financing, other commercial structures
Integrated Building Systems. These play a crucial role in monitoring, managing and controlling building systems and energy use, as well as enabling customers to respond effectively and dynamically to demand response events. Advanced energy management functionality can track energy use at a very detailed level, and enable “continuous commissioning” of building performance relative to historical trends.

In practice, building systems and energy management capabilities vary widely depending on a building's age, size, use and other factors. Many zone customers, especially larger customers with newer facilities, have sophisticated capabilities in place and best practices to share.

Potential SEEDZ collaborations include identification of best practices associated with systems for automated demand response, detailed energy monitoring and continuous commissioning, and a wide range of approaches and solutions for optimizing building systems and plug-load efficiency.

Also, there's an opportunity to identify and promote a “zone standard” for integrated building system capabilities. And at a strategic level, SEEDZ will explore with zone members the establishment of municipal requirements for integrating smart energy-enabled building systems standards in new construction or major retrofits.

Distributed Generation. SEEDZ customers have implemented a number of distributed renewable energy-generation solutions. Currently, six sites in the zone have installed or plan to install solar, including Google, Microsoft and Lockheed Martin, and four sites have installed or have plans to install fuel cells. In addition, the Sunnyvale Waste Treatment facility provides and consumes biogas, while NetApp operates a cogeneration facility.

By leveraging purchasing power, SEEDZ stakeholders could establish joint RFIs or group purchasing programs to lower the cost of new distributed generation, such as solar PV systems for parking lots. In addition, SEEDZ customers and municipalities can explore collaboration opportunities around distributed renewable energy at a district level.

The integration of significant distributed renewable capacity, which can be intermittent and variable, presents new challenges and opportunities for a local distribution grid. SEEDZ represents an important platform for development of advanced standards for the integration of distributed generation with the grid, to maintain and improve overall power reliability and quality.

Demand Programs. Demand response programs and dynamic pricing structures are cost-effective ways to smooth demand for electricity and reduce expensive standby capacity. Time-of-use (TOU) electricity rate structures, a basic form of variable pricing, are used by customers representing more than 95 percent of the energy load in SEEDZ. More dynamic pricing structures are offered through various demand response programs, but customer participation in these programs to date has been limited.
An important area of collaboration for SEEDZ will be identifying best practices and programs for demand response, automated demand response and scaling adoption of these approaches. Also, the collaboration can explore and potentially serve as a customer test bed for new pricing structures and the development of “fast” automated demand response programs.

**Electric Transport.** To date, hundreds of level 1 and 2 electric vehicle chargers have been deployed on corporate campuses in the zone, and there are plans to install many more as the number of employees driving EVs continues to grow.

Google is a recognized corporate leader in deploying EV infrastructure, with more than 240 level 2 and 160 level 1 charging stations at its Bay Area offices. Google also has a fleet of more than 50 electric vehicles for its employee car-sharing service. Zone customers Juniper Networks, NetApp and others have also built charging infrastructure for their employees.

The SEEDZ collaboration will encourage adoption of EVs by facilitating the sharing of local best practices for EV program technologies, implementation and administration. Practices and pilot programs for the development and deployment of level 3 and DC fast-charging infrastructure will be piloted in the zone. Finally, SEEDZ represents an excellent potential platform for conducting controlled, commercial-scale EV grid integration pilot studies, and the advancement of utility and municipal development requirements.

**Grid Infrastructure.** SEEDZ customers, particularly ICT companies and data centers, require reliable, high-quality power. Over the past several years, a number of major customers in the zone have faced serious power reliability and quality issues. The reliability situation is reported as improving, yet even momentary lapses in power quality can be very expensive for customers. Power quality issues, such as short-term voltage dips, swells and imbalances, can shut down computing and lab equipment and require time-consuming restoration processes.

SEEDZ will place a priority on improving the power quality and reliability in the zone to meet the demands of customers. Several major customers currently have equipment to measure power quality at a very detailed, localized level. Aggregating detailed power quality from different customers and facilities in the zone represents a good “quick-win” opportunity. It will help to better identify and pinpoint power quality issues, and provide the basis for a power quality “analysis platform” in the zone.

From a strategic standpoint, SEEDZ customers will work with the utility on advanced grid infrastructure development and expansion in the zone. This could involve pilot implementations and deployment of emerging automated distribution infrastructure such as volt/VAR optimization, FLISR (fault location, isolation and service restoration) technologies and distribution management systems (DMS).
**Advanced Storage and Backup.** SEEDZ energy customers have become increasingly interested in deploying advanced energy storage solutions to help with the integration of onsite renewables, and to provide backup power. Storage and backup solutions can enable customer sites to “island” from the electric grid and continue operating during power outages. Despite the interest in advanced storage, new standards and best practices are required for integrating advanced storage solutions with the electric grid and customer-distributed generation resources.

SEEDZ will establish a zone inventory of distributed storage solutions and develop a workshop to share best practices and storage solutions. The zone can also serve as a pilot for islanding use of onsite distributed generation such as fuel cells and solar arrays as a source of backup power.

**Standards and Interoperability.** Refinement of standards and interoperability will speed adoption of smart energy solutions. And there are many different types of standards, all of which are important—procedural, physical and electronic, for instance. Examples include rules and procedures for interconnecting a solar array with the grid, the physical shape and characteristics of an EV charging plug, or the exact electronic data formats supporting automated demand response.

Standards are essential for enabling an “end-to-end” smart energy vision, integrating key supply, distribution and demand processes. They serve to enable value, reduce cost, improve usability and uptake, and reduce the need for custom integration.

SEEDZ stakeholders will share smart energy-related standards information as appropriate. And as a group, in communication with industry-standards bodies such as NIST, IEEE and IEC, SEEDZ will actively promote development of new or more detailed standards where most needed.

**Incentives and Financing.** Customer-side smart energy projects may face challenges meeting desired return on investment rates, or accessing sufficient upfront financing. As such, the use of incentives and financing structures are important practices for scaling adoption of smart energy solutions.

SEEDZ will collaborate on developing an inventory of zone-applicable energy efficiency and distributed generation financing structures from the utility, municipal and commercial sources. SEEDZ may also explore developing zone financing relationships/programs to increase investment in energy efficiency and distributed generation solutions.
CONCEPTUAL DESIGN AND MEASURES

By the year 2020, SEEDZ aims to build a high-performance, integrated smart energy network, encompassing sources, distribution and use. This smart energy network will be characterized by the elements shown in Figure 18:

<table>
<thead>
<tr>
<th>Integrated Building Systems</th>
<th>Advanced, integrated building energy solutions have helped reduce energy consumption and enabled customers to automatically respond to dynamic pricing signals, participate in DR events and manage energy in real time vs. modeled performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed Generation</td>
<td>Expanded deployment of distributed renewable generation in the zone, including shared community/district renewable resources, and advanced integration of distributed generation with the grid</td>
</tr>
<tr>
<td>Demand Programs</td>
<td>High level of zone participation in DR/ADR programs, dynamic pricing structures, bill/rate aggregation and simplification programs are saving customers money—resulting in reduced peaks and a more stable and reliable grid</td>
</tr>
<tr>
<td>Electric Transport</td>
<td>Vehicle-to-grid integration advanced standards for fast charging, grid integration and automatic EV response to pricing signals have enabled a shift away from less-efficient fossil fuel–powered cars</td>
</tr>
<tr>
<td>Grid Infrastructure</td>
<td>Advanced automated distribution management in place—for example, detailed monitoring, self-healing, advanced interconnection and islanding capabilities—enabling enhanced grid performance, power quality and reliability</td>
</tr>
<tr>
<td>Storage and Backup</td>
<td>Advanced energy storage solutions in place, allowing fast response and grid stabilization during rapid variations in energy load/supply, local backup, improved demand response capacity and enhanced grid integration of distributed generation sources</td>
</tr>
<tr>
<td>Interoperability Standards</td>
<td>Improved interoperability standards and specifications have simplified supply and demand–side integration of smart energy solutions, accelerating adoption and improving ROI</td>
</tr>
<tr>
<td>Incentive and Financing</td>
<td>Effective financing structures and incentives are facilitating wide-scale adoption of new smart energy solutions by shortening payback periods and removing upfront financing barriers</td>
</tr>
</tbody>
</table>

An important principle for SEEDZ is to maintain objective, stakeholder-relevant measures that describe desired “smart energy” results. Measures help guide priorities and provide a basis for monitoring progress. Also, they help to define SEEDZ to the outside world, and serve as a replicable example.

A set of proposed metrics are outlined below, and will be developed further as SEEDZ progresses. These measures are intended to be consistent with the operational, sustainability and economic growth objectives of SEEDZ.

**Power Reliability.** Reliability will be defined by the number of sustained and momentary power interruptions. Momentary interruptions, which consist of any event when voltage goes to zero for less than five minutes, will be a primary focus. SAEFI, MAIFI and CEMMI-5 are potential metrics for measuring power interruptions in the zone.
**Power Quality.** Power quality will measure voltage variations, swells, dips, imbalances and phase interruptions within the zone. The zone will seek to utilize a detailed power-quality metric, potentially based on a European power-quality metric EN 50160, which sets specific standards and limits for voltage variations, dips, swells and events.

**Demand Profile.** The ratio of peak demand to average demand over a year, or “peakedness”; this is a measure relevant to efficient utilization of grid assets.

**Demand Flexibility.** The availability of demand response capacity as a percentage of the total peak load in the zone.

**Financial Savings.** Estimated savings associated with major SEEDZ programs; savings should consider reduced energy costs, additional value from increased power quality and reliability, etc.

**Emissions and Energy Intensity.** SEEDZ will seek to track the reduction in total and peak energy use relative to building square footage in the zone. Emissions intensity will be measured based on a weighted blend of power provided by the utility and local distributed generation sources.

**Distributed Generation Penetration.** The ratio of distributed generation within the zone relative to the average daily peak demand.

**EV and Charging Infrastructure Penetration.** SEEDZ will develop a baseline inventory of electric vehicles and charging infrastructure, and establish a metric for EVs and charge-enabled parking as a percentage of all vehicles and parking.

**Market Engagement.** Market engagement will be measured by the amount of outreach impressions and participation in events and SEEDZ programs.

**Directed Funding.** SEEDZ will track the increase in federal, state and innovation funding directed toward SEEDZ initiatives.

**Future Goals.** Individual initiatives and collaborations will work on developing additional metrics and measures to evaluate the success of different projects.

**STAKEHOLDER ROLES AND BENEFITS**

Stakeholders will contribute in a variety of ways, including taking leadership roles in selected initiatives, and providing expertise, staff resources and financial resources. In return, SEEDZ will work to provide results that benefit individual stakeholders, and contribute to the success and momentum of the effort as a whole.
Via interviews, meetings and group reviews, a broad range of local stakeholders have participated in the development and vetting of the SEEDZ vision. Over the coming months, stakeholder engagement and outreach will continue, and new organizations will join the SEEDZ collaboration (see Figure 19). Participants will include customers and other organizations directly involved with work in the development zone, as well as an extended network of regional and market participants that will be engaged over time.

The stakeholder and benefits table (Figure 20) describes representative “gives” and “gets” for SEEDZ stakeholders. For example, energy customers will share smart energy best practices. And selectively, they will agree to lead or participate in SEEDZ practice advancement initiatives and strategic development programs.

In return, energy customers will benefit from new and leveraged infrastructure investment, offering improved power reliability, quality and affordability. Plus, they will have access to best practices and expertise from neighboring organizations. And if desired, they will have the opportunity to share their smart energy experience publicly via SEEDZ-branded webinars and conferences.
**Figure 20: Stakeholder roles and benefits.**

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Example “gives”</th>
<th>Example “gets”</th>
</tr>
</thead>
</table>
| **Energy customers/ Property owners and developers** | - Share best practices and information re: energy and efficiency  
- Lead and/or participate in selected project and collaborations  
- Install/deploy smart energy improvements  
- Be willing to serve as potential test bed for selected new programs, products and solutions  
- Offer financial and/or staff assistance | - Improved affordability, reliability and quality of power through district programs, new leveraged/shared infrastructure  
- Best practices, cost savings and faster ROI on selected energy efficiency and renewable energy projects  
- Contribution to sustainability goals, awards and recognition  
- Potential access to innovation grants and programs |
| **Utilities/Energy providers**        | - Lead and/or participate in selected project and collaborations  
- Designate a district as a key test bed for new structures, offerings and services  
- Potentially locate new, advanced substation with high reliability and self-healing properties  
- Potentially expand current customized offerings on an aggregated basis  
- Offer financial and/or staff assistance | - Greater participation in utility energy programs, cost savings through leveraged outreach and engagement  
- Willing, technically capable customer as test beds for new rate structures, automation and integration  
- Ability to measure and demonstrate the value of DR and new pricing signals  
- Ability to publicly showcase best practices and solutions at live customers |
| **Technology and solution providers** | - Educate district on new products and services  
- Assist with adoption, financing and deployment of new pilot solutions  
- Participate in market engagement and education activities  
- Offer financial and/or staff assistance | - Opportunity to showcase involvement in leading-edge implementations of new products and services  
- Access to high-quality potential customers  
- Smart energy integration experience and success stories  
- Branded association with SEEDZ, potential representation in case studies, demonstrations, market outreach |
| **Local governmental entities**       | - Lead and/or participate in selected project and collaborations  
- Work on removing permit, building code and other barriers to smart energy solutions  
- Offer financial and/or staff assistance | - Awards, recognition and sharable practices for sustainability  
- Attract and retain businesses  
- Improved quality, affordability and reliability of power  
- Progress toward municipal and state sustainability goals |
| **Research and educational institutions** | - Offer technical assistance for feasibility studies and deployment of new solutions  
- Gain access to grant opportunities  
- Offer financial and/or staff assistance | - Forming consortium for applied research and innovation grants  
- Access to high-quality potential partners  
- Opportunity to participate in leading-edge deployments and develop new knowledge capital |
6. GETTING STARTED

Like any venture, launching a smart energy development zone in Silicon Valley will take organization, resources and time.

In this spirit, the road map for SEEDZ formation outlines three general phases—collaboration development, operational startup and sustaining programs. To build momentum and involvement, work on tactical initiatives begins early, in the collaboration development phase—as do market outreach, engagement and strategic program activities.

Active stakeholder involvement and support are essential for success. To motivate this support, stakeholders must see benefits from collaboration. These will come in the form of solving shared problems, improving performance, and ultimately, enhancing climate prosperity.

OVERALL APPROACH AND ROAD MAP

As shown in Figure 21, the approach for building SEEDZ identifies three critical sets of activity, organized in three sequential phases.

Collaboration development in Phase 0 includes the vision and strategy effort described in this document. Building off the strategy are “quick-win” practice advancement initiatives, stakeholder engagement and organization activities, and initialization of strategic program development efforts.

<table>
<thead>
<tr>
<th>Phase 0</th>
<th>Phase 1</th>
<th>Phase 2</th>
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<tbody>
<tr>
<td>Collaboration development</td>
<td>Operational startup</td>
<td>Sustaining programs</td>
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<td>Organization</td>
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<td>Vision and strategy</td>
<td>Public launch</td>
<td>Market engagement and education</td>
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<td>Start-up “Quick Win” initiatives</td>
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<tr>
<td>• Leading Smart Energy Practices survey</td>
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<td>• Customer bill/rate aggregation</td>
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<tr>
<td>• Power quality data sharing</td>
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<td>• Shared parking log solar RFI</td>
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<td>• Building energy systems spec</td>
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<tr>
<td>Strategic development</td>
<td></td>
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<tr>
<td>Strategic needs assessment</td>
<td></td>
<td>Strategic funding and detailed design/build of development projects</td>
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<tr>
<td>• Schematic visioning and design</td>
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<td>• For infrastructure projects, program deployments, research and demonstrations</td>
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<tr>
<td>• Asset evaluation and capability gap</td>
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<tr>
<td>• Strategic project definitions</td>
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</table>

*Figure 21: SEEDZ phasing and road map.*
Phase 1 features the official public launch of SEEDZ. In addition to ongoing practice advancement initiatives and strategic development work, important market engagement mechanisms such as a webinar series, a national contact list and a touring demonstration will be established.

Finally, Phase 2 will mark funding and detailed design of strategic development programs, ongoing practice advancement initiatives and the zone's first annual “Smart Energy Enterprise” conference.

**ORGANIZATION AND ENGAGEMENT**

The Smart Energy Enterprise Development Zone comprises a diverse group of stakeholders. A dedicated SEEDZ team, initially a core group of two or three staff members, will guide start-up activities and facilitate stakeholder involvement.

Initially, this team will work as an initiative under the direction of the Joint Venture Climate Prosperity Council. As SEEDZ progresses, a more distinct organizational structure and board function will likely be considered.

An early objective is to develop an effective outreach and market engagement mechanism to enable SEEDZ participants to share local experience and best practices with a wide external audience. This is envisioned via a SEEDZ online conference (webinar) series, with one or two events per quarter. Subsequently, a touring demonstration is also envisioned, which could be a virtual and/or physical overview of key best practice solutions within SEEDZ.

**PRACTICE ADVANCEMENT INITIATIVES**

SEEDZ stakeholders will identify selected smart energy “practice advancement” initiatives. These are defined as shorter, high-impact projects that do not require significant capital investment, time or resources. Types of practice advancement initiatives would include best-practice development and/or sharing, zone surveys, high-level solution opportunity assessments or joint RFIs.

Participants will opt into selected practice advancement initiatives. One or more of the participants will be designated as a lead or sponsor.

Through individual and group meetings with SEEDZ members, three initial quick-win initiatives have been identified, to be initiated in the fall of 2012.

**Power Quality Information Sharing.** Real-time, detailed power quality measurements will be aggregated and presented from multiple customer locations to establish a shared view of power quality across the zone (see Figure 22). The common platform will serve as a baseline for the identification and resolution of power quality issues, and will help guide longer-term utility infrastructure investment.
Figure 22: Customers increasingly have detailed power quality measurement capabilities, as shown in this metering reading from a zone customer.

Leading Smart Energy Practice Inventory. SEEDZ stakeholders will be surveyed regarding their smart energy practices to assess the current state of smart energy in the zone and help to establish best practices. The resulting best practices will be shared with members via online resources and in-person meetings to accelerate the adoption of smart energy solutions and practices. The survey will also help to identify high-value areas for ongoing practice advancement and collaboration.

Model Zone Specification for Integrated Building Systems. SEEDZ stakeholders will develop a model spec for an integrated building system. These systems serve to monitor, manage and control building systems and energy use. In addition, they can enable customers to effectively and dynamically respond to demand response events. Advanced energy management functionality can track energy use at a very detailed level, and enable continuous commissioning of building performance relative to historical trends. Zone participants will be encouraged to adopt such a specification for all new construction and major renovations.

THE CAPSTONE: STRATEGIC DEVELOPMENT PROGRAMS

As we’ve noted, large-scale smart energy demonstrations and infrastructure projects are underway around the country. Uniting leading Silicon Valley customers, industry, government and utility players in strategic program collaboration represents the capstone opportunity for SEEDZ.

SEEDZ envisions the nation’s highest-performance two-way power network that supports and rewards active energy management and clean distributed generation on a sustainable economic scale. Building out this vision over the next 5-10 years will take a shared understanding of smart energy design, as well as associated programmatic and technology elements and funding.
With SEEDZ, it is expected that smart energy investments will be made by both customers and the utility, and will be business-case driven. In addition, by establishing itself as a high-profile smart energy collaboration, SEEDZ will have the opportunity to attract significant incremental infrastructure and research funding from utility, state, federal and other third-party sources.

To launch this activity in the fall of 2012, a smart energy schematic design and evaluation effort will be important for defining potential strategic development programs. This process will establish shared definitions of key customer and utility-side capabilities needed to support the SEEDZ vision, key gaps, and shared research and development opportunities. Examples could include advanced distribution and distribution management infrastructure, district generation, new dynamic pricing processes and advanced technologies for two-way integration of buildings, electric vehicles, distributed generation and storage.

This process will take into account current utility infrastructure and capabilities as well as planned utility development and investment. It will involve a focused group of key customers, the utility, municipal representation and, importantly, participating research institutions such the Electric Power Research Institute (EPRI) and Lawrence Berkeley National Laboratory (LBNL).

Candidate strategic development programs may then be matched with potential sources of funding. In turn, high-priority smart energy development programs at the utility, state or federal level can be pursued for placement with the SEEDZ collaboration in the context of an exceptional group of stakeholders and a well-articulated smart energy vision.

**THE CLIMATE PROSPERITY JOURNEY**

Building out the SEEDZ vision will take time, focus and resources. SEEDZ participants are essential to realizing this vision. They will guide and implement the changes necessary to achieve new levels of performance and sustainability in the integrated power system of the future.

SEEDZ participants in Silicon Valley are from organizations ranking among the world’s most innovative companies and energy customers, progressive municipalities, leading research institutions and forward-looking utilities.

Acting now in a coordinated way will enhance and project Silicon Valley’s role at the forefront of smart energy innovation. It will further protect our local environment, and enhance regional competitive positioning in this new, rapidly growing market segment. The SEEDZ collaboration will accelerate climate prosperity benefits for direct stakeholders, the Silicon Valley region and ultimately, those pursuing smart energy solutions around the world.
### APPENDIX 1: INITIAL CANDIDATES FOR SEEDZ INITIATIVES

<table>
<thead>
<tr>
<th>Theme</th>
<th>Practice advancement</th>
<th>Strategic development</th>
</tr>
</thead>
</table>
| Grid infrastructure/reliability      | • Aggregate local power quality measurements from SEEDZ customer and share on common platform to help pinpoint failures  
• Develop shared “as-is” view of utility distribution infrastructure and automation capabilities, utility investment/upgrade plans | • Pursue pilot implementation and validation of automated distribution infrastructure (for example, volt/VAR, FLISR, DMS) |
| Building efficiency/integrated systems | • Best practices/pilot collaboration on workspace and plug load energy efficiency  
• Best practice-sharing on continuous commissioning technologies and services  
• Best practices for energy efficiency in new construction/retrofit of building/lab space | • Pursue municipal requirements (incentives?) for energy management systems in new construction/major retrofits  
• Investigate shared district infrastructure for heating/cooling systems |
| Onsite/district renewables           | • Joint RFI for parking lot solar  
• Community solar/biogas opportunity assessment | • Community solar/biogas implementation  
• Advanced DG/grid integration for power quality/voltage |
| Electric transportation              | • SEEDZ inventory for charging infrastructure  
• Fast charging pilot/practices  
• Best practice-sharing for EV program technology, implementation and administration | • EV-controlled grid integration pilot study  
• Advanced municipal development requirements |
| Interoperability standards/specs     | • Develop guide for energy management  
• Systems spec for new building/major retrofits | • Architecture for integration of utility meter/pricing data, open ADR, customer interfaces and customer-side systems/devices |
| Demand programs and adoption         | • Status and best practices and technology for open ADR  
• PG&E status re: current/new DR rates, upcoming rate cases and feasibility of zone pilot  
• DR program RFI for aggregators | • Bill/rate aggregation and simplification; development of zone program  
• Dynamic pricing opportunity assessment  
• Dynamic/fast ADR pricing; automated load management pilot |
| Advanced storage/backup              | • Zone inventory of distributed storage and solution workshop | • Customer site islanding pilot/utilization of onsite DG for backup power source  
• Development/deployment of customer resource optimization strategies (for example, DERCAM model) |
| Financial structures/incentives      | • Inventory of zone-applicable EE/DG financing structures from utility municipal commercial sources (for example, PACE, on-bill financing) | • Financing pilot projects |
| Market engagement                    | • SEEDZ kickoff and press announcements  
• Zone mailing list development and communications  
• Develop SEEDZ touring demonstration featuring current smart energy successes | • Online conference format and series  
• Annual onsite conference |
| Organizational development           | • List development and additional recruitment  
• Additional funding commitments  
• Launch selected start-up initiatives  
• Formalize structure and governance | • Involvement in collaboration for grant applications  
• Annual report to stakeholders |
### APPENDIX 2: ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADR</td>
<td>Automated demand response</td>
</tr>
<tr>
<td>CDP</td>
<td>Carbon Disclosure Project</td>
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<tr>
<td>CEC</td>
<td>California Energy Commission</td>
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<tr>
<td>CPUC</td>
<td>California Public Utilities Commission</td>
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<tr>
<td>CSI</td>
<td>California Solar Initiative</td>
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<tr>
<td>DG</td>
<td>Distributed generation</td>
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<tr>
<td>DMS</td>
<td>Distribution management systems</td>
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<tr>
<td>DR</td>
<td>Demand response</td>
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<tr>
<td>EE</td>
<td>Energy efficiency</td>
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<tr>
<td>EPRI</td>
<td>Electric Power Research Institute</td>
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<tr>
<td>ESA</td>
<td>Energy service agreement</td>
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<tr>
<td>EV/PHEV</td>
<td>Electric vehicles and plug-in electric vehicles</td>
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<td>GeSi</td>
<td>Global eSustainability Initiative</td>
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<tr>
<td>GHG</td>
<td>Greenhouse gas emissions</td>
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<tr>
<td>ICT</td>
<td>Information and communication technologies</td>
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<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
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<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
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<tr>
<td>LBNL</td>
<td>Lawrence Berkeley National Laboratory</td>
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<tr>
<td>LEED</td>
<td>Leadership in Energy and Environmental Design</td>
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<tr>
<td>NIST</td>
<td>National Institute of Standards and Technology</td>
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<td>PACE</td>
<td>Property Assessed Clean Energy Bonds</td>
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<td>PG&amp;E</td>
<td>Pacific Gas and Electric Company</td>
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<td>PPA</td>
<td>Power Purchase Agreement</td>
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<td>RPS</td>
<td>Renewable portfolio standard</td>
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<tr>
<td>SEEDZ</td>
<td>Smart Energy Enterprise Development Zone</td>
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<tr>
<td>TOU</td>
<td>Time-of-use electric rate</td>
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</tbody>
</table>
APPENDIX 3: ENDNOTES

1 Information and Communication Technologies (ICT) refers to any communication technology or application from cell phones, to computer chips, to software programs, and the internet.


4 California Renewable Portfolio Standard (RPS), California Public Utilities Commission.


6 Ibid, pg. 17.


12 Smart 2020: Enabling the low carbon economy in the information age, GESI and the Climate Group, 2008.


15 https://altaterra.site-ym.com/store/view_product.asp?id=1076028

16 The DOE Building Energy Data Book estimates total commercial energy expenditures of $174.5B in 2012. http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=3.3.3

17 Ibid.


26 Momentary average interruption frequency (MAIF) tracks the systemwide average of momentary power interruptions per year divided by total customers served. The customer experience multiple momentary interruptions index (CEMMI-5) is the percentage of all customers that experience more than a certain number of interruptions over a certain time period.
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Uniting Performance and Sustainability in the Power Network of the Future
### Public Sector

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- NASA Ames Research Park
- NetApp
- McCalmont Engineering
- Optony
- Pacific Gas & Electric Company
- SunPower
- Sustainable Silicon Valley
- University Associates
- Yahoo! Inc.

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