Long-term Electricity Planning in the SDG&E Service Area

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Introduction

When citizens want electricity, they "flip the switch" and the electric appliance does its job. Most citizens don't know how electricity is generated or how it gets to their houses or places of work. One reason they don't take the time to find out is that electric service has been very reliable and affordable for decades. While the United States has had commercial electricity service for only ~130 years, our society can no longer function without it. Each year we find new ways to use this convenient energy form. Fortunately most citizens don't have to deal with the arcane world of planning for additional electric facilities. Utilities develop plans and present the plans in public at the California Public Utilities Commission (CPUC). Interest groups (interveners) and private citizens comment on the plans at hearings held by the CPUC. The CPUC Commissioners make the final decisions on the plans, based on all of this input.

However, recent discussions of renewable energy and global climate change have focused more citizen attention on how electricity is generated and transported. California has mandated that utilities, such as SDG&E, supply 20% of their electricity (measured in kWh) from renewable resources by 2010. In addition, the mandate directs the utilities to limit the price they pay for renewable resources to prevent the price of electricity from increasing dramatically. The three California investor-owned-utilities have pledged to follow this mandate and have plans in place to meet this goal.

To many people this is a major advancement toward the goal of energy independence. Others look at this achievement as a major reduction in the use of "fossil fuels" and "carbon footprint". But a third group[1] (the Powers' proposal) sees no reason to celebrate. They will not celebrate unless essentially all of our electricity comes from rooftop photovoltaic cells in the next few years. (Photovoltaics are the rooftop solar panels that produce electricity when the sun is shining.) This small group of people proposes that we have no new transmission facilities for transporting electricity into the region, and no new large generation facilities in the region. They criticize SDG&E for not following their mantra, without describing the high risk their proposal poses to the reliability and cost of electricity in our region.

The purpose of this paper is to rebut those arguments, showing that a balanced approach to utility planning is the best for the environment, best for the consumer and best for local businesses.

Before delving into the details one should look at what questions are critical to ask about a utility plan. It is also critical to examine our personal capacity to change the way we use electricity and the risks we, the citizens, are willing to take:

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[1] San Diego Smart Energy 2020 – 21st Century Alternative, Bill Powers, P.E., E-Tech International, 6 October, 2007

- How much are citizens (that is, you and me) and businesses willing to pay for their electricity? What increase will you accept to achieve specified goals?
- What utility assets are necessary to ensure continued reliable electricity? The assumption in this question is that electricity will always be available when you want it.
- When will we be able to transition to new technologies, and how quickly, and at what cost?
- What is the risk of rapidly changing the existing system to a new, yet untried, system? Could there be unintended consequences of a rapid change in our utility assets?
- What technologies are practical and achievable now and when will others be ready for deployment?
- How do we achieve reasoned assessment and establishment of a prudent plan for the future?
- What are electricity users willing to do to manage their electricity use more wisely?

Situation in San Diego

California and San Diego continue to attract new citizens and business. SANDAG forecasts that the population of the San Diego Region will increase by over 1.42% per year between 2006 and 2010, and by 1.2% per year from 2010 to 2020[2]. Because of this growth, the construction industry will erect hundreds to thousands of new houses each year. While we may have a temporary slowdown of new house construction, it will not last long. All of our colleges and universities are continuing to grow in student populations and facilities to serve them. UCSD alone is adding a 600,000 to 700,000 square feet per year. In all new buildings energy use per square foot is going down because of new construction techniques and new technologies. However the larger number of buildings and houses is growing faster than the decrease in energy use per square foot. Therefore SDG&E must identify and secure an additional 100 MW of electricity capacity every year. This is equivalent to a new, large, conventional power plant every five years.

California's government develops energy codes for new buildings (Title 24). Every three years these codes are updated with more measures to reduce energy use. These codes have been used for decades and have been very effective. Californians are among the most efficient users of energy in the United States. In 2004, California was ranked number 49th in total energy consumption[3] per capita among the 50 states and the District of Columbia. This is very impressive when one considers that our high tech and entertainment industries require significant quantities of energy.

The clean tech industries that are developing in this region demand an increasing amount of electricity. These industries do not locate or expand in areas that have limited or unreliable electricity supply. The price of electricity in our state is already high enough to

[2] http://profilewarehouse.sandag.org/profiles/est/reg999est.pdf.
[3] www.eia.doe.gov/emeu/states/sep_sum/plain_htlml/rank_use_per_cap.html

encourage large new computer-based companies to locate in other states. Increasing the cost of our power further, could discourage other companies from expanding in our region and the state. Before discussing new generation strategies, it is instructive to review how utility strategies are approved in California.

Role of the California Public Utilities Commission

The California Public Utilities Commission (CPUC) has its roots in the California constitution. It is directed to protect the public interest of all citizens. The commissioners are appointed by the Governor and confirmed by the state Senate. The commissioners serve overlapping six year terms. A large staff of technical, legal, and economic experts serves the commissioners. For example, the Division of Ratepayer Advocates alone (this is the group that specifically advocates on behalf of small customers) had a budget for Fiscal Year (FY) 2006/2007 of $24.9 million. These funds were directed toward 133 authorized positions, legal services, and administrative overhead.

When the CPUC reviews utility plans it must ascertain whether the plans meet applicable statutes, provide reliable energy at just and reasonable rates, sustain economic viability of the region, and protect the environment. Through this process, the CPUC compares utility proposals presented by others and, on the basis of extensive analysis adopts the best proposal to meet the electricity needs of consumers.

The recent proposal to dramatically increase the use of photovoltaic (PV) cells to provide electricity is an alternative to the utility plan. A full examination by the CPUC of this proposal, would consider how much energy is needed at various times of the day in San Diego today and in the future. Next it would consider how a utility could make the PV-derived energy available when needed, and whether this level of reliance on PV would provide for reliable electricity service at all times. They would also examine the costs of the heavy reliance on PV for these purposes.

The CPUC already adopts procurement plans based on a “loading order” under which electricity supplies are procured by first investing in energy efficiency, second in demand response and conservation measures, third through renewable energy sources to meet the state’s renewable portfolio standard and lastly through other energy sources.

As citizens, we have to look at all of the costs of the Powers’ proposal, as well as the plan’s viability, and it’s impact on system reliability All of these elements associated with PV must become part of the public record and be transparent so that a reasoned assessment is possible. Currently the true costs of solar energy are not transparent. Some of the non-transparent costs include the cost of net metering. People who install PVs and produce more electricity than they need at a given time are provided credit for the over-production. The credit is equal to the full retail value for that energy. The utility does not receive any revenue for maintaining the system to receive that energy. To compensate for that under billing, the utility must raise its rates to other users who do not have PVs. As more people install PVs, those that don’t will be penalized by higher rates. Many people live in housing units unsuitable for solar cells. Their homes are shielded from the sun by mountains, other buildings, or trees. Other homes are in high rise buildings that do not have the roof area to install solar cells for every unit. Yet others may not have the financial resources available to make a large, discretionary investment in a PV system. These customers will become victims of the cost shifts created by net metering. Thus the current method of compensating people who install PVs shifts cost to those that don't. It also blurs the price signals necessary for citizens to install energy efficient appliance and lighting.

Why did the CPUC approve such a rate structure to promote PVs if it has these negative features? The CPUC had to follow a legislative mandate to encourage people to install solar cells. Policy makers felt that they could jump-start the market by providing incentives to market innovators. Thus, the current rate structure was meant to aid the transition to solar energy. When a large number of homes and businesses install solar cells, the CPUC and utilities must examine the full and true costs of wide spread deployment of PVs to ensure those costs are allocated fairly. A thorough cost analysis, considering all true costs of solar energy, could lead to rate changes much less favorable to those who install solar cells, especially if the lucrative subsidies were reduced or eliminated. In addition, the analysis of the hidden costs of solar energy could lead to dramatically higher rates for all customers if the Powers' proposal were implemented.

In any case, the CPUC must examine the effect of special pricing for net metering of solar energy on the price signal it sends to customers and alternate suppliers. SDG&E has approval to install time of use meters throughout their service area. These meters will allow the utility to charge more for electricity during times of high demand and less during periods of low demand. Theses price changes are called "signals" alerting customers to shift their use of electricity away from period of high demand. When customers voluntarily reduce use of electricity during peak periods, they level the load on the utility grid reducing the need to start inefficient and sometimes high-emission back-up generation. Leveling the load also reduces the need to plan for and install new generation and transmission facilities. Wide spread use of net metering can affect the price signals so that energy efficiency measures are not deployed.

Now that we no longer need to bring market innovators into the solar energy arena, subsidies must be reduced or eliminated. The effect of subsidies and net metering on energy efficiency and non-solar ratepayers are not evident in the Powers report. The authors of that report bury the true cost of PVs in rates for other users. Legislation, such as AB1x, further obfuscates the true cost of PVs by using tiered rates.

California Legislation and Regulation

The California legislature has reacted to the electricity price events of 2001 and 2002. In an earnest effort to stabilize utility prices, and to protect the environment, they have introduced dozens of bills. Many have passed. This blizzard of legislation (about 60 energy bills in the past year) has greatly complicated the task of planning for future needs. Many bills require the development of new regulations by state agencies. The crafting of regulation can lead to serious consequences for those planning facilities that must be started now but may not ready for use for 5 to 10 years. This problem is often termed "regulatory uncertainty". Investors may decide not to risk funds in California if there is a possibility that the financed facility may not be allowed to operate long enough to return their capital. As citizens we must ask how anyone can plan for future utility service in the current environment. Utilities have legislative and regulatory experts who analyze trends. They work with the technical experts in an attempt to comply with current and future legislation, while building a system that will protect the common good

State agencies have developed a preferred method of addressing the need for electricity system improvements. The method is called the "Loading Order." What this means is that any utility must solve its need for increased electricity resources by following a priority list. The ordered list is:

- Energy efficiency
- Demand Response
- Renewable energy
- Distributed resources
- Traditional resources

Each utility must develop programs to install the maximum amount of cost effective energy efficiency in its service area[4]. The policy makers reason reducing the demand for electricity is the most cost effective method of meeting the total needs of the system. Also, utilities must develop demand response programs that allow the utilities to shut down large users of electricity during periods of very high demand. The large users who volunteer for inclusion in these programs receive rate reductions. Reducing the peak demands reduces the need for new power plants and new transmission lines. Utilities are only expected to pursue demand reduction initiatives that are cost effective, reliable, and feasible. In addition, the utilities must seek renewable energy resources to meet their demand. All investor owned utilities must supply 20 percent of their energy from renewable resources by 2010. These resources must be on their side of the meter. As a general principle, roof top photo-voltaics do not count toward this goal. Finally, distributed generation should be considered where it is economically viable. Hotels and hospitals are prime candidate for distributed generation. Many hotels and hospitals in this area have generators fired by natural gas. The hot exhaust gases are used to heat water for laundry or swimming pools. This is often called combined heat and power. Any resource plan needs to incorporate these elements of the loading order. This does not mean that the utility cannot include fossil resources in its plan if they are necessary to meet necessary and prudent system requirements. The individual elements of the loading order mentioned above may not be available in a cost effective manner in the same time frame as the demand. Transmission lines are not included in the loading order. Transmission lines are necessary components of most renewable energy plans. These lines can connect distant renewable energy generation to our region, and are used to provide backup and reliability functions.

[4] SB 1037, 2006

The "loading order" uses terms such as "cost effective" energy efficiency. While there are complex rules defining "cost effective", the intent of the policy is to minimize societal cost of providing electricity. In the case of renewable energy, legislation does not mandate utilities to acquire renewable energy priced above a certain level. Thus utilities do not have to buy at any price to meet the renewable energy mandate. Many renewable energy resources are not currently cost effective at this time. Even with today's high price for natural gas, generators using natural gas provide electricity at lower costs than any commercialized type of solar energy generator, and they do this with greater reliability and dependability during all hours when energy is needed.

In a 2005 report, "Potential for Renewable Energy in the San Diego Region[5]", the authors came to the conclusion that there is an abundant resource of renewable energy in the San Diego region. Much of that resource is located in the desert areas (Imperial County) to the east of San Diego or high in the San Diego area mountains. Each area requires enhanced transmission facilities to bring the renewable resource into the cities. That report also details the state of development of each renewable technology. The report does not analyze the cost effectiveness of any technology or renewable resource. Extensive research and development efforts are underway to improve the economics of most renewable energy technologies.

Other California legislation, AB 32, attempts to address the issue of global climate change. The objective of this legislation is to reduce carbon (and other select gasses) emissions into the atmosphere. Combustion of petroleum and natural gas fuels produce carbon dioxide (CO_2) when burned. Carbon dioxide is released in the exhaust stream. Once released into the atmosphere, CO_2 has a long residence time. California is trying to do its share in reducing the emission of these global greenhouse gases released. While a great many citizens support the goals of this legislation, the true cost is not well known and publicized. Before the state takes draconian actions to change the way utilities produce electricity to reduce CO_2, it must accurately assess the true cost of policy implementation, inform the public of the effects of any regulations on their electric bills, and enforce the new regulations uniformly and fairly on all users of specified fuels. Currently the State of California regulates the investor owned utilities, but only suggests actions to municipally owned utilities such as Los Angeles Department of Water and Power. Regulations should not create economic advantages and disadvantages in different parts of the state.

The legislature and state regulators have great power to solve our energy problems, or to create disasters. One only needs to revisit the results of AB 1890 (1996). That bill was the so-called electricity deregulation bill. Every legislator signed the bill (most without reading it), as did Governor Pete Wilson. While the intentions of the legislators were good, the bill led to grave unintended consequences. Rates sky-rocketed and electricity was in short supply. Businesses closed or relocated to areas of the state supplied by municipal utilities or left the state entirely. The electricity system of this state is very complex in every measure. In most cases it is impossible to predict the consequences of massive changes to the system. Because of the critical importance of electricity to our

[5] Potential for Renewable Energy in the San Diego Region, August 2005. www.renewablesg.org

safety, environment, businesses, and way of life we cannot afford to make massive changes in a short period of time. Legislators and regulators must introduce changes in a measured manner, similar to the way the captain of a giant cargo ship changes the direction of his ship.

Utility Design for the Next 10 Years

There is no question that we are entering a period of change in electricity service. We have had a dominant design for decades and it has served us very well. However, new societal requirements and the emergence of new technologies are driving changes in how utilities provide this essential product. This era of change will be characterized by many legislative mandates, more public participation, new technologies, and new rate structures. While in this period of change, we must hold steadfast to the good features of the existing system. These features include high reliability, public safety, fair and affordable rates, attention to environmental issues, and objective evaluation of alternatives. To preserve the good features, we have to determine if new technologies work as promised, before large scale deployment. We also have to determine if the new technologies will integrate into the current grid system without causing system stability problems. In addition, state regulators have to provide certainty to the investors who finance our complex and expensive infrastructure. The investors need to know that they can recover their investments. And, we have to establish clear lines of responsibility for maintaining and improving the new systems.

While we redesign and implement a new electric system we must be assured that electricity will continue to be available, and available at a reasonable price. Redesigning an automotive engine can take several years. More years are consumed in extensive testing to ascertain performance and possible problems. The utility grid is many times more complicated. We don't know how to store significant quantities of electricity. Electricity flows are dictated by the physics of the system, not by regulations or wishes. Electricity creation must balance demand for electricity on a second by second basis or major problems can result. For example, technologists have developed very good distributed generators. These are installed in many places in the region. But most of these distributed generators, while connected to the grid for backup, are not designed to work hand-in-glove with the grid in a supply mode. The grid of the future must have the technology to allow thousands of small generators such as PVs to export to the grid when the grid needs the power, not when the generators have the power to sell. In addition, the grid must have low cost and effective electricity storage technologies. This will require the development of complex software, communications, and controls. Work is underway in each of these areas but systems employing these technologies have not yet been demonstrated. As we look forward to the utility of the future we also don't know how consumers will react to the advanced meters which will send price signals to them. The anticipated result is a flatter demand curve. But, how flat will it be? When planning for the future, the utility has to predict consumer behavior, and then install equipment that will respond to now unknown changes in demand. Utilities must predict how much renewable energy will be available on any given day of the year. If the sun doesn't shine or the wind doesn't blow, what facilities must be in place to provide continuous electricity service? Each backup facility must be maintained so that it can respond immediately. It must have a supply of fresh fuel available. Each of these takes planning and implementation, and each has a cost connected to it. In addition, utilities must predict how consumers may change their patterns of use because of new electric appliances. For example, the plug-in electric car is one the major unknowns that may appear in the ten year planning window. The introduction of a plug-in car could dramatically change the pattern of electricity use and create a larger demand during nighttime hours.

To achieve the important societal goals of an electric system and to reduce the risks of new technologies, utilities must provide a balanced approach. No one technology can provide assured service when there are so many unknown factors. Our current system provides electricity from large hydro facilities, renewable resources, nuclear power plants, and high-efficiency natural gas plants. SDG&E relies on both local generation and distant generation supplied via transmission lines. This balance of resources provides a robustness that cannot be matched in a system based on one technology. Any new technology must be introduced in a measured way to prevent system wide problems. Ethanol is a good example of how a mandate for vehicular fuel has affected negatively food prices and water supplies.

Any ten year plan should include combined heat and power (CHP) at the local level. Thermal energy storage is another proven technology that deserves a place in such a plan. For various reasons these have not been widely deployed. Many CHP units cannot meet the ultra strict air emissions requirements of the California Air Resources Board. In other cases it is difficult to match both the electricity needs at a site simultaneously with the thermal needs. Many sites do not have thermal loads that can be cost effectively served by combined heat and power generation. As the technologists develop new control methods, CHP units can be grid connected in such a manner that they serve the local thermal load while relying on the grid to either absorb excess electricity or to provide electricity when more is needed. Other barriers include those that also plague energy efficiency measures. Many companies and businesses rent their buildings from investors. The building owners have no incentive to install energy efficiency, CHP or thermal storage. The company renting the facility has no incentive to improve its landlord’s property. Additionally, the CPUC with public and utility input, must develop cost-based rates that do not penalize the owner/user of the CHP, the remaining, non-participating customers, or the utility to which CHP unit is connected. One solution to increased use of CHP and thermal storage may be utility ownership and operation of such facilities.

Does SDG&E have it right? It is good attempt to balance societal needs with the loading order, existing laws and regulation, and available technologies. They have put energy efficiency first with many local programs. They have a robust demand response program that is well subscribed. SDG&E has solicited for renewable resources, and is procuring all that meet the requirements outlined by the CPUC. Can it be improved? Certainly, public process allows individual inputs. Are there reasonable alternatives or additions to the SDG&E plan? As in many areas of life, different people will solve a problem in different manners. In utility planning, there are many technical constraints that prevent widely differing plans. The plan that SDG&E has presented is one that has been vetted at the CPUC, with the opportunity for people to offer good ideas and realistic alternate plans.

The Changing Consumer

In any discussion of utility planning one should not consider consumer behavior static. Both residential and business use of electricity have changed dramatically in the past decade. Every home has new appliances, new entertainment devices, and many more convenience and security items that consume electricity, some night and day. At the same time, almost unknown to the consumer, many appliances, refrigerators for instance, are becoming increasingly more efficient. Businesses are installing energy saving lighting while increasing their computing capacities.

Many residential consumers are now selecting energy efficient compact fluorescent lighting. The cost of these devices is rapidly decreasing and the early problems have been mostly solved. Other consumers buy washing machines, refrigerators and other appliances based on their energy use. Unfortunately, this is not yet widespread. Because electricity is relatively inexpensive, the consumer selects most electrically driven devices on the basis of features other than electricity use.

While most consumers want to save energy, they have not made major modifications to their own behavior. Most don't reduce or eliminate lighting in unused rooms. Others leave un-watched televisions operating for hours. Many wasteful habits are continued because the overall price of electricity has not been high enough to change their behavior. Soon, SDG&E customers will have time-of-use electric meters that allow the utility to bill a variable rate depending on the time of day and the total system demand. These meters will provide a strong economic signal to reduce the use of electricity during the peak period of the day. The meters may also cause changes of customer behavior at all times of the day. However, as stated above, it is difficult to predict consumer behavior.

One of the largest users of residential electricity is air conditioning. With more houses being built further from the ocean, more houses have central air conditioning. While these units can consume large amounts of electricity they are not used as often in this area as many imagine. Typical usage per home is in the range of 300 to 500 hours per year. The use of air conditioning during the peak hours of the day will likely go down with time-of-use meters. And, as we improve existing houses and build tighter new houses, the need for air conditioning will be further reduced.

One area of growth in electricity use may be the so-called plug-in-hybrid automobiles. High gasoline prices are likely to remain, causing consumers to purchase electrically powered cars. In addition, many will chose these vehicles because they can charge them at home, thus avoiding a trip to the gasoline station. This increased load could have a major effect on the grid and the 24 hour pattern of electricity usage. The utility may have to supply more electricity during the nighttime.

Energy efficiency is the first strategy in the California loading order. It can only be achieved when individuals take responsibility for their own energy use. It cannot be done by the utility, or by the legislature, or by energy plans. Utilities developing energy plans include consumer education as a critical part of their energy plans. The consumer must use the education to reduce his/her wasteful energy consumption.

Rebutting the Powers' Proposal

Contrary to predictions and many reports, the price of photo-voltaics has been rising for the past three years.[6] At the same time incentives for the residential client have declined. The net result is a longer time to pay off the initial investment. And, most payback calculations don't factor in other costs. This includes the cost of replacing or repairing the required inverter at regular intervals. These intervals can be as short as five years, and the inverter is a significant part of the overall price. In addition, individuals don't always maintain household equipment. Photovoltaic panels require frequent cleaning to assure the maximum output of electricity. Without that cleaning, the electricity produced by the PV will be reduced and the payback period greatly extended.

People addressing the issue of increased first cost often cite the mantra that increased demand will lead to lower prices. Just the opposite has happened with photovoltaic panels. Germany and Japan have very aggressive incentives to install these devices. People in those countries are rapidly installing them, and, in the process, increasing the demand above levels of supply. The silicon used in photovoltaic panels is in very short supply with prices increasing annually. There is some relief in sight as major companies are building new silicon foundries to meet some of this high demand for silicon. However, the costs to build the balance-of-system, and to install the PV units have also been growing extremely fast. Material such as glass, steel, copper, and aluminum have been increasing in price. The cost of labor has also increased. Even if the silicon were free, the other components of a solar energy system are so high today that the cost of solar electricity would still be quite high. Solar energy is not free energy. New approaches to harnessing the power of the sun must be developed to lower the first cost. Increased R&D funding should be supported to enable cost effective solar power.

If San Diego or any other region were to dramatically increase its demand for photovoltaic panels, the worldwide result would be higher, not lower, prices.

Most solar systems installed on homes today have no energy storage. When the sun is shining and excess power is being produced, the excess is "sold" to the grid via net metering. If the grid goes down for any reason, the home-based photovoltaic system shuts down and the house receives no electricity, even if the sun is shining. To solve that problem and to extend the use of solar energy over more hours of the day, energy storage in some form is required. The Powers' proposal selected batteries for electricity storage. While this is technically possible, there are many issues involved with battery based energy storage. Battery technology has not advanced as fast as many would like. The lead-acid battery found in your automobile has numerous drawbacks for daily use in a

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[6] "The California Solar Initiative – Triumph, or Train Wreck?" Glenn Harris and Shannon Moynahan, SunCentric Incorporated, September 2007

solar energy system. That battery is not designed for daily, deep discharges. While vendors claim a useful life of 7 to 10 years, the warranty is often closer to 2 years in cyclic use. Daily discharges to extend the use of solar energy in the evening would lead to a greatly reduced battery lifetime. Nickel cadmium batteries are very expensive, and if not properly charged can overheat. Both lead-acid and nickel-cadmium batteries employ dangerous metals in their construction. Nickel metal hydride batteries are safer and more environmentally benign. Nickel metal hydride batteries must have very complex charging systems to avoid overcharging and hydrogen release outside of the cell. Most people look to the lithium based batteries for large scale energy storage. These batteries are now available for computers and other small appliances. One inventor is installing them in a custom electric car. These batteries still have development problems. One major problem is the possibility of self-ignition when energy is rapidly withdrawn. The cost of lithium batteries is still high and the materials inside are hazardous. Before we engage in widespread deployment of large solar energy storage batteries we have to perform an environmental impact assessment on the manufacturing, use and recycling. Battery storage will also increase the already high cost of solar energy. Cost analyses must be performed by independent analysts to ascertain the true costs of a photovoltaic system with battery backup.

Assuming the solar energy system could be close to economic, there are other costs to consider. On many days San Diego has significant fog or cloud cover. In the winter, storms bring in clouds that obscure the sun. People want to continue their life as usual. Once the backup batteries are discharged, the solar system will provide no electricity. A prudent community will have backup generators that are capable of taking on a large percentage of the load. These units must have a fuel contract and pipes to bring in the fuel. Standby fuel contracts are very expensive. Someone has to pay for the generators, pipes, and fuel contracts even when these units are not being used. Operators must be trained and on standby for these units. All of these costs must be added to the cost of the solar energy system.

For massive use of any type of distributed generation, new control systems must be developed if they are to be grid connected. Utilities bring power in an area and step down the voltage using electric transformers. Residential neighborhoods are served at the lowest voltage level to match the appliances found in houses. Electricity produced by rooftop solar systems produce power at this neighborhood level. If the neighborhood does not need the amount of power generated locally, the utility has to transport the electricity greater distances. Transporting power at low voltages leads to larger losses than at higher voltages. The current system is not designed to step up the voltage of solar electricity for transport to another area. Large investments in the grid system are required to allow for widespread use of grid-connected distributed generation. Once these facilities are installed, the utilities must design and deploy control software to accept and deploy the electricity from these generators. Questions will arise if the grid cannot use the power produced. Recall that the grid must instantaneously balance the generation and demand for electricity. Will the utility have to shut down the local generator? How will costs be allocated if one generator is allowed to run and another is shut down?

Numerous other cost and rate issues cloud the widespread use of grid-connected distributed generation.

If this community were to adopt the Powers' plan, there could be a requirement for most houses to have a solar energy system. To maximize solar energy output the roofs on existing house may have to be rebuilt. New houses would have to be located on the lots to maximize the use of solar energy using land less efficiently. The effect of each would be to dramatically increase the price of houses. San Diego housing already ranks as some of the most expensive in the United States. Affordability would be drastically reduced. Companies looking to locate in this area could translate the higher cost of housing into the need for higher salaries and decide to locate elsewhere. And because solar electricity will not be less expensive than what we have today, there will be no offsetting benefits to the community.

Returning to the questions in the introduction of this paper, are we willing to take the risk that we will be installing systems that could reduce reliability and increase cost? Until the technology advances to provide much lower costs, and all of the back up system issues have been resolved, the risks are not acceptable. Putting all of our eggs in one, unproven basket could lead to massive unintended consequences for this community. This is not a risk that I am willing to take.

The Investor Owned Utility and an Alternate Model

When electricity was first offered for sale in the United States, hundreds of small companies emerged to satisfy the rapidly growing need. Legislators soon realized that the public would not be served well with so many small, independent companies, each with different standards, policies, financial strength, and pricing strategies. State governments created public utility commissions to ensure that consumers were treated fairly, and had access to reliable power at an affordable cost. The creation of these commissions led to a consolidation of the electricity companies into larger companies that had the financial strength to provide universal and reliable service, given the high cost of infrastructure needed to generate electricity and provide transportation of that electricity where it is needed and when it is needed. These commissions also defined the purpose of regulated utilities. The utilities are charged with providing

A. Reliable electric service

B. Universal service throughout the utilities service area to increase the common good

C. Public safety and convenience. Electric facilities have the capacity to do great harm if not properly operated and maintained.

D. Affordable rates achieved through an open process of rate regulation.

E. Long term facility planning to ensure adequate power at all times.

F. Regional and statewide integration of energy resources and infrastructure. This is useful when one area is experiencing a heat wave while a distant area has abundant electricity resources or when generation in one area is not producing at adequate levels.

Utilities must ensure that lights stay on in the short term and must have a plan to assure reliability in the long term. They also must manage the cost of providing the required infrastructure. These requirements have led utilities to be capital investment companies. They know how to raise capital for energy projects, how to manage the risks associated with large capital projects, and how to get the financial return to ensure more capital for future projects. Utilities have a long term perspective in terms of planning, financing and constructing the appropriate infrastructure.

Is there a viable option to the investor owned utility? A few cities in California have municipally owned utilities. These so-called “munis” operate as a complete utility. While there are pluses and minuses of this form, it is very difficult to form a municipal utility at this time. There is a third form of electricity provider that some claim is more economical. The California legislature created the Community Choice Aggregation (CCA) model. A community can create a CCA to provide electricity to its citizens. The CCA is a hybrid utility that does not perform all of the functions of a traditional utility. The focus of a CCA is on procuring electricity for its customers. The electricity is transported to the customer over utility facilities. Because the CCA is part of local government it has access to lower cost financing through municipal bonds. Municipal bonds typically have interest rates 2 to 4 points lower than private capital. Because of the large amount of capital required for electrical facilities, some argue that the lower cost of capital will reduce the cost of electricity to the citizens in the CCA service area. On the first look this would appear to be true, as with most arguments the devil is in the details. A CCA procures electricity for its customers, but unlike typical utility procurement activities, the procurement plans of a CCA are not reviewed by the CPUC through a public process. CCAs typically resist engaging in long-term planning for new resources and facilities. Under a CCA structure, it is not clear who would provide these long-term plans. At present, there are no operating CCAs in California. However, in concept, a CCA provides electricity by building or buying electric generation facilities, or entering into the wholesale power markets to buy electricity from others. To the extent that the CCA owns new or existing generation, it will also need to continually operate and maintain those facilities in order to ensure reliable operation, and it will need a strategy for dealing with shortages of electricity in the event of failure of their generating plant or unforeseen load levels from their customers. In order to carry this out, the CCA will need to carry out the same long-term planning that utilities have traditionally performed, maintain the same workforce that utilities have developed for planning, operation and maintenance, billing, and customer service, and maintain a financial structure that is competent to ensure adequate electricity supply, manage financial risks, obtain new capital to support added generation, manage contracts with third parties, and so on. These are difficult jobs for today’s sophisticated utilities, both investor-owned, and publicly owned. They will be even more challenging for start-up CCA operations that have not yet developed the experience and expertise. To date, representatives of cities considering CCA have resisted being bound to such long-term planning obligations. Those entities have, in essence, argued that the investor owned utility should continue to provide backup for local systems, and do long term planning at no cost. Without revenue there will be no investor owned utility to perform these functions. California’s experiment with utility de-regulation in the late 1990s left a similar void with regard to long-term resource planning. We all know the results of that failed experiment.

Also, it could be difficult for a CCA to obtain municipal bond financing. In contrast to investor owned utilities, communities have many needs for capital. They have to finance water systems, wastewater treatment plants, schools, and other infrastructure. Energy is not always the top priority for cities. Up until now, cities have not budgeted either operating or capital funds for energy projects for their citizens. Because cities have limits on their ability to borrow money, some energy projects may not get funded when needed. The City of San Diego has had financial problems over the past several years that have kept it out of the low-cost capital market. Many infrastructure projects (not energy projects since San Diego does not have a CCA) have been delayed. If similar delays occurred in electricity generation projects, and power is not available from other sources, a CCA city might be faced with degraded electrical service or rolling blackouts. Even when they have the capital, cities do not have the experienced staff to maintain electric generation facilities and create plans for future needs. The electricity market is highly complex. It requires people with exceptional skill to produce and/or generate electricity in a way that maintains high reliability and safety at reasonable prices. The salaries for the key people may not fit into municipal salary schedules. To circumvent this problem some CCAs may seek third party operators to perform this work. These third party operators would be profit seeking companies. In the CCA model the outside operators are managed by civil servants who may not be trained in sound utility practice. This could lead to higher prices and lower levels of reliability. This solution is not for the risk adverse or faint of heart.

Summary

Let’s not let the rhetoric of “free, clean energy” cloud the debate. While solar energy should and will play a significant role in our energy future, it cannot play a dominant role in the near future. Costs are still far too high. Storage technologies are not fully developed and/or may be environmentally damaging. Citizens demand reliable and cost effective electricity, and for the most part, they have been receiving that. During the transition to new energy technologies such as solar energy, we need to ensure that citizens continue to get cost effective and reliable electric service. Major changes to the complex electric system must be accomplished gradually with safeguards to public safety and convenience. Safeguards include new energy management software at the distribution level and a continued presence of traditional generators to assure supply during long winter nights and storms. To reduce the need for new energy facilities, individuals must take responsibility and actions to change the way they use energy.

There is no one right answer, but some answers are more dangerous to the public good than others. In the long run we need abundant renewable energy sources, clean air, and reliable, affordable electricity. But we need to achieve this through a well thought out approach. How we transition from where we are today to a future system is critical.