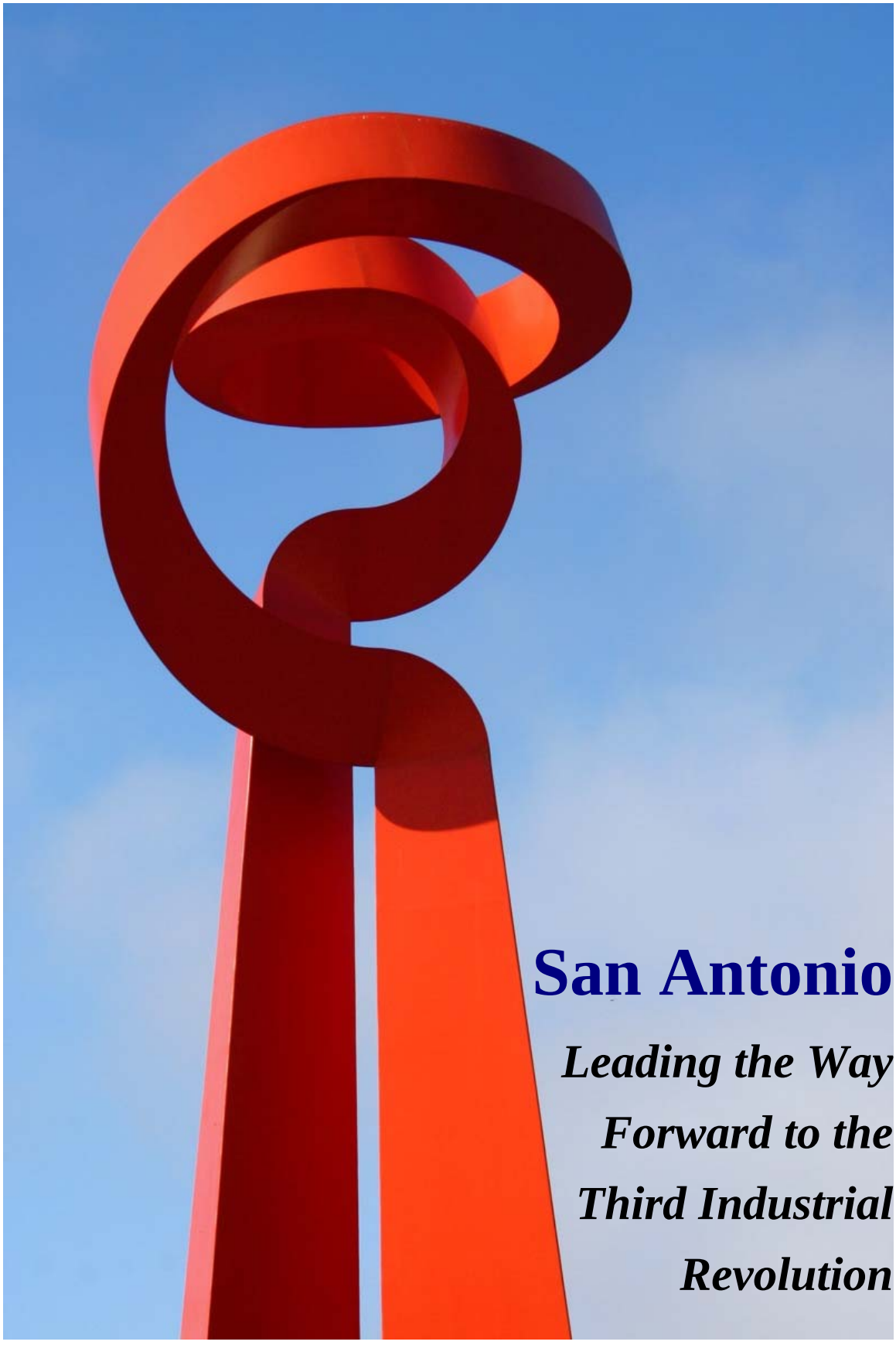

San Antonio

Leading the Way Forward to the Third Industrial Revolution

9/28/09

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Preface

CPS Energy and the City of San Antonio have made a commitment to transition the Alamo region into a Third Industrial Revolution economy over the course of the first half of the 21st century. This would make San Antonio the first metropolitan region in the United States to usher in a post-carbon economic era by 2050.

The consensus in the scientific community is that to hold the earth's temperature to two degrees Celsius or below will require at least an 80 percent reduction in global warming gasses in the developed nations by 2050. This is a daunting challenge, but an absolutely critical task if we are to avoid the potentially catastrophic consequences of climate change on earth's ecosystems.

CPS Energy and the City of San Antonio have already made impressive contributions to a Third Industrial Revolution, putting the Alamo area in a leadership position among metropolitan regions in the United States. However, we believe that CPS' current projected scenario regarding future energy efficiency programs and power generation through 2034 still falls short of the ambitious goal that CPS has set to make San Antonio a Third Industrial Revolution flagship for the country.

To meet its objectives of "becoming a lighthouse" for a new, sustainable economic era, CPS and the city will need to establish an unprecedented partnership with the business community and civil society - in effect, to create a single voice - if it is to succeed in reaching its objectives of leading Texas and the United States into a new period of sustainable growth.

We are suggesting something that, to our knowledge, has never been attempted before: all two million people in the metropolitan region actively participating in their own energy future. That is, after all, what the Third Industrial Revolution is all about. While a demanding mission, nothing less will suffice to address the enormity of the threat posed by the global economic meltdown, the energy crisis, and the real-time impacts of climate

change. This white paper presents a broad, long-range vision and is not intended to be a comprehensive master plan. There is not one defined road to achieving the four pillars of the Third Industrial Revolution. Each city and region must chart its own path to develop energy policies and plans in order to meet their specific future needs.

The Eyes of Texas and the nation will be upon San Antonio. The crisis is clear. The challenges are extraordinary. While the solutions are difficult, they are attainable. What is needed now is the good will and determination of every resident in the greater San Antonio region to lead the country by example and inspire the world.

Jeremy Rifkin

Chairman

Third Industrial Revolution
Global CEO Business
Roundtable

San Antonio: Leading the way forward

Introduction

There is a wide consensus that we are approaching the sunset of the oil era in the first half of the 21st century. The price of oil on global markets continues to remain high and peak global oil is within sight in the coming decades. At the same time, the dramatic rise in carbon dioxide emissions from the burning of fossil fuels is raising the earth's temperature and threatening an unprecedented change in the chemistry of the planet, with ominous consequences for the future of human civilization and the ecosystems of the earth.

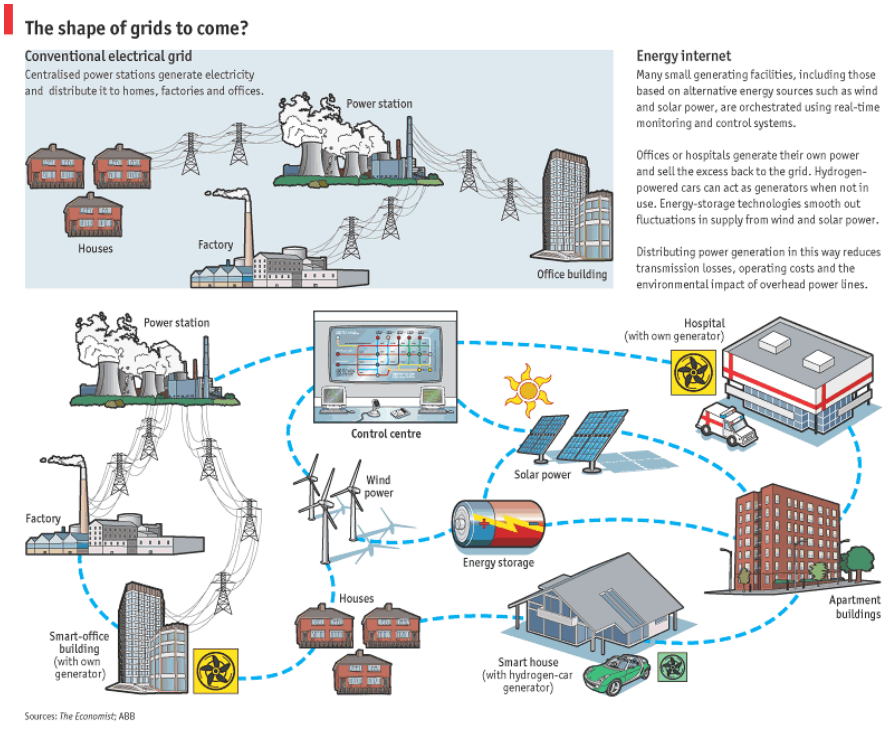
The triple threat of the global economic crisis, the global energy crisis, and the global climate change crisis are interwoven and feed off of each other. Addressing the triple threat to our way of life will require a new economic story that can remake civilization along sustainable lines.

The great pivotal economic changes in world history have occurred when new energy regimes converge with new communication regimes. When that convergence happens, society is restructured in wholly new ways. For example, the first hydraulic agricultural societies - Mesopotamia, Egypt, China, and India - invented writing to manage the cultivation, storage, and distribution of grain. Surpluses of stored grain allowed for an expansion of population and the feeding of an indentured labor force which, in turn, provided the "man power" to run the economy. The convergence of written communication and stored energy in the form of surplus grain, ushered in the agricultural revolution, and gave rise to civilization itself.

In the early modern era, the coming together of coal powered steam technology and the printing press gave birth to the first industrial revolution. It would have been impossible to organize the dramatic increase in the pace, speed, flow, density, and connectivity of economic activity made possible by the coal fired steam engine, using the older codex and oral forms of communication. In the late 19th century and throughout the first two

thirds of the 20th century, first generation electrical forms of communication -the telegraph, telephone, radio, television, electric typewriters, calculators, etc. -converged with the introduction of oil and the internal combustion engine, becoming the communications command and control mechanism for organizing and marketing the second industrial revolution.

We are now on the cusp of a Third Industrial Revolution. Today, the same design principles and smart technologies that made possible the internet and vast "distributed" global communication networks, are just beginning to be used to reconfigure the world's power grids so that people can produce renewable energy and share it peer-to-peer, just like they now produce and share information, creating a new, decentralized form of energy use. We need to envision a future in which millions of individuals can collect and produce locally generated renewable energy in their homes, offices, factories, and vehicles, store that energy in the form of hydrogen, and share their energy with each other across a continent-wide intelligent intergrid.



The Economist, "Building the Energy Internet" May 11,2004. Electronic Edition.

In 2007, the European Union passed a written declaration committing itself to a Third Industrial Revolution economic game plan. That same year, the European Union committed its 27 member states to a 20/20/20 by 2020 initiative: a 20 percent increase in energy efficiency, a 20 percent reduction in global warming gas emissions, and the generation of 20 percent of its energy needs with renewable forms of energy, all by the year 2020.

The City of San Antonio, the nation's seventh largest city, and CPS Energy, are committed to becoming a beacon for the nation by echoing the EU's Third Industrial Revolution and 20/20/20 goals. To realize this goal, the City of San Antonio and CPS Energy will need to create an integrated master plan to establish the four pillars of the Third Industrial Revolution infrastructure between now and 2020. The four pillars of the Third Industrial Revolution are: renewable energies; buildings as power plants; hydrogen storage; and the promotion of smart-grids and plug-in vehicles. San Antonio is well-positioned with its forward looking municipally owned utility, CPS Energy, and a city government committed to a sustainable future, to lead the nation as it takes on the challenges of peak oil and climate change.

The question is often asked whether renewable energy will, in the long run, be sufficient to meet the needs of the San Antonio region. Today, second generation information systems grid technologies allow businesses to connect tens of thousands of desktop computers, creating far more distributed computing power than even the most powerful centralized computers that exist. Similarly, tens of thousands of local producers of renewable energy in the San Antonio region, with access to an intelligent utility network, can potentially produce and share far more distributed power than the older centralized forms of energy - oil, coal, natural gas and nuclear - that we currently rely on.

The creation of a renewable energy regime, loaded by buildings, partially stored in the form of hydrogen, and distributed via smart intergrids, opens the door to a Third Industrial Revolution. It should have as powerful an economic impact in the 21st century as the convergence of print technology with coal and steam power technology in the 19th

century, and the coming together of electrical forms of communication with oil and the internal combustion engine in the 20th century.

This report lays out a Third Industrial Revolution Vision and game plan for San Antonio with key recommendations for meeting the challenges ahead. By following the path laid out herein, San Antonio could pave the way for a more innovative and productive economy that is energy efficient, equitable, environmentally sustainable and rooted in a strong local workforce.

The road ahead requires a "systems approach" that adequately and simultaneously addresses the economic, energy, and environmental challenges that we face, as well as the human and social dimensions. The transition will require a strong commitment to energy efficiency, upon which the four key pillars of the Third Industrial Revolution will be built. These four pillars - or what we might call the four critical elements of future sustainable development - include: (i) the expanded generation and use of renewable energy resources, (ii) the use of buildings as power plants, (iii) the development of hydrogen and other storage technologies, and (iv) the development of a new energy infrastructure and transport system that is both smart and agile.

It should be emphasized, however, that the successful realization of the Third Industrial Revolution vision is not simply a function of innovative engineering, new technologies and physical infrastructure. New social, cultural and behavioral mechanisms will be needed if we are to empower individuals and communities and ensure equitable participation in the transformation to a post-carbon world.

San Antonio has already taken significant first steps toward this new era of sustainability. The City of San Antonio's "Mission Verde" and the CPS Energy's "Vision 2020" both emphasize specific actions that the community has taken to transition into the Third Industrial Revolution. Green jobs and adequate financing mechanisms are among the challenges being addressed by the City's Mission Verde plan. And CPS Energy has already embraced the need for a more energy-efficient economy that is increasingly

powered by renewable energy and other clean energy technologies. These actions, coupled with the insights and ideas that emerged from the April 2009 workshop on sustainability (convened by the City of San Antonio and CPS Energy) provide the groundwork for specifying how the vision of a Third Industrial Revolution might be applied to the specific conditions and constraints faced by the city of San Antonio.

The Current Economic Circumstance in San Antonio

Analysis of key Bexar County statistics shows a rapidly evolving economy which has been growing faster, on average, than the nation, and shares certain similarities to the larger United States, while retaining multiple unique strengths. Bexar County is roughly similar to the US in terms of the relative size of working and non-working populations - in both there are around twice as many persons of working age (16 to 64 years) as opposed to non-working age. They are also similar in that in each the ratio of non-working to working persons has fallen over the last two decades. Thus, despite the graying of the population from aging baby boomers, Bexar County has managed to maintain a sizable pool of employable persons. Bexar also mimics US trends in the ratio between total population and total employment. In each case the relative size of the employed pool has increased.

Shift-share analysis - which is used to help explain the job creation process within a community[1] - shows that over the 1990 to 2008 period, Bexar County has significantly outpaced the national economy, growing 58 percent faster than the US as a whole. Indeed, nearly every sector in Bexar County grew much quicker than its national counterpart. The major exception is in manufacturing. While US manufacturing employment grew by 25 percent over the period, the employment in Bexar County actually shrunk, to just under 40,000 jobs. Furthermore, manufacturing represents a smaller share of Bexar County employment than in the nation as a whole. Despite the thin representation of manufacturing jobs within the region, the data show that Bexar

[1] Laitner, Skip, and Marshall Goldberg. 1996. "Planning for Success: An Economic Development Guide for Small Communities." Washington, DC: American Public Power Associaton.

County has strengths to build on. With competitive advantages in finance and insurance, information, wholesale trade, and professional and technical service sectors - which together make up 20 percent of the employment in Bexar County[2] - the county and San Antonio are well-positioned to lead the way into a Third Industrial Revolution.

Bexar County also has a strong and competitive local government sector. While the county has lost a significant number of federal non-military jobs over the last two decades, it has gained a great number of jobs - over 30,000 - in city and county governments, who will be key partners in the transition to create a greener economy.[3]

Compared to the national average, economic growth in both San Antonio and Texas has been relatively robust. Surprisingly, however, energy use in San Antonio has not increased at the same rate as Texas or the United States. San Antonio's lower energy intensity is due to its somewhat unique economic structure, which is less heavily based in manufacturing and the fact that fewer vehicle miles are traveled. Not surprisingly, the immediate implications for San Antonio's emissions of greenhouse gases are favorable. Economically, both Texas and the metropolitan region of San Antonio have experienced greater levels of growth when compared to the nation as a whole. Much of this growth has resulted from the notable population growth in the state and the region, as well as the expanded levels of productivity per capita. Since 1969, for example, the population of the state and the region grew 85-90 percent faster than the national average. During the same period, economic productivity per capita was 12 percent higher than in the U.S. as a whole. Between now and 2030, growth in the San Antonio economy will continue to outstrip that of the U.S., expanding area income by nearly 90 percent - compared to 61 percent at the national level.[4]

Interestingly, while per capita energy consumption in Texas is higher than the national

[2] ICF Consulting, "Alamo Regional Industry Cluster Analysis" July 2005
[3] This number reflects state, county and city. A gain of 30,000 jobs over the years 1990 through 2008. The county lost 19,000 Federal civilian and military jobs. Net gain is 11,000 jobs. Woods and Poole Economics, Inc. 2008.
[4] Woods & Poole Economics, Inc. "2008 Historical Data and Economic Projections for Bexar County, Texas 1969 2040." Washington, DC: Woods & Poole. http://woodsandpoole.com/.

average, per capita energy consumption in San Antonio is considerably lower than the national average. For example: for every unit of energy consumed per person in San Antonio, there are 1.6 units consumed per capita at the national level and 2.35 units at the state level. In other words, if all energy sources (whether electricity, natural gas or gasoline), were converted to gallons of gasoline equivalent, state level energy use per capita for Texas would be on the order of 4,000 gallons, while estimates of per capita energy consumption at the national level would be closer to 2,700 gallons. On the other hand, estimates of per capita energy consumption for San Antonio are surprisingly low – at only 1,700 gallons equivalent in 2006.

Because energy consumption generally depends on the use of fossil fuels, this lower level of energy use in San Antonio translates into a similarly low level of greenhouse gas emissions. In 2006, levels of energy-related greenhouse gas emissions were estimated at 27, 20, and 17 metric tons (per capita) of carbon dioxide (CO_2) equivalent for Texas, the United States and San Antonio, respectively.[5] In general, the reason for these reduced levels of both energy use and CO_2 emissions is that San Antonio area residents travel somewhat less and use less electricity than the average person. Moreover, the number of manufacturing jobs per capita is about half of the number of manufacturing jobs elsewhere in the U.S. economy. In summary, San Antonio is using less energy and producing fewer greenhouse gas emissions when compared with both state and national averages. The question remains, then, how might these past trends combine with future economic growth to shape energy use and greenhouse gas emissions between now and 2030?

Looking Forward

As we anticipate how San Antonio's economy might grow over the next 20 years or so, four factors are worth noting. First, the current levels of energy use and greenhouse gas emissions are related more to the structural features of San Antonio's economy as

[5] See ACEEE memo for further discussion: adapted from Alamo Area County Council of Governments. 2008. "Bexar County Greenhouse Gas (GHG) Emissions Inventory 2005".

opposed to the net efficiency of the economy. For example, manufacturing is generally a more energy-intensive economic activity, and because the local economy relies less on manufacturing jobs to support its population base, less energy is being used. A more urban economy also generally requires less travel. For that reason, less energy is used in the transport of people and goods. In both cases, comparable efficiencies generate less demand for energy because of the less energy-intensive aspects of the economy. Yet, as we shall see below, there are still significant cost-effective opportunities to improve the energy efficiency of the regional economy in ways that further decrease energy use and save businesses and consumers money.

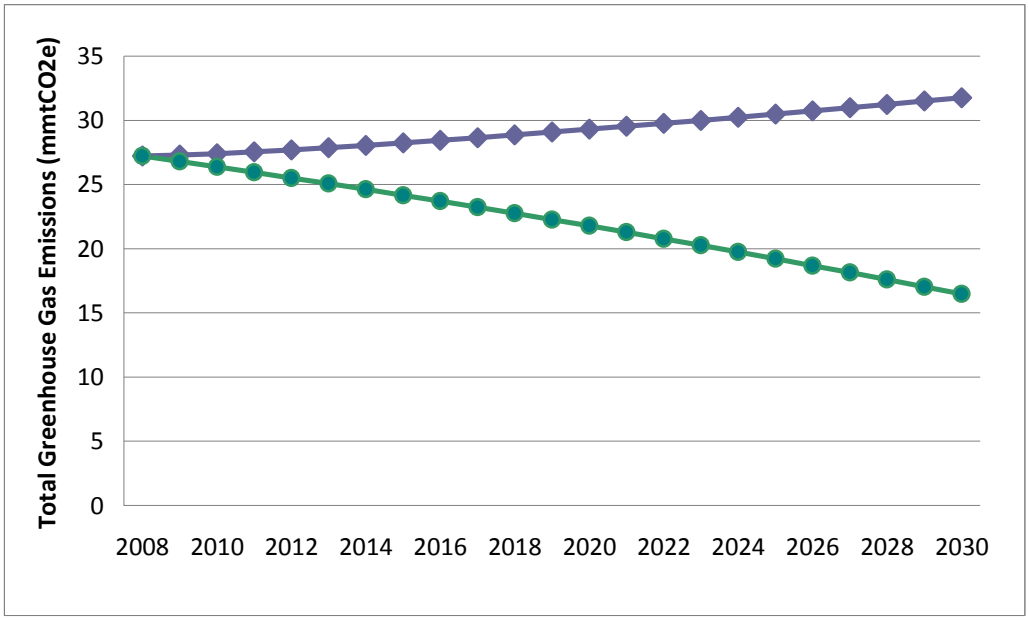
The second factor is that San Antonio's growth in greenhouse gas emissions (per unit of economic activity) will be slower than its economic growth as a result of existing trends in efficiency improvements. The third important consideration is that even greater emissions reductions are possible through both the adoption of more energy-efficient technologies and the integration of those technologies with the four pillar infrastructure that makes up the Third Industrial Revolution. This combination can help San Antonio to achieve net emissions reductions while sustaining current levels of economic growth and creating new jobs.

Finally, San Antonio's choice to pursue the Third Industrial Revolution business model presents unique opportunities for the city to narrow the socio-economic gap that exists between what some have called the "Two San Antonios." Unfortunately the normal market policies and business-as-usual practices underpinning current economic growth are unlikely to close the existing socio-economic gap on their own.

These key concepts and trends are illustrated by the two different greenhouse gas emissions pathways in Figure 1. Beginning with a complete 2005 emissions inventory for Bexar County, the chart highlights a business-as-usual reference case in which personal income of Bexar County grows 90 percent over the period 2008 through 2030. At the same time, normal market efficiencies and new investments drive down the intensity of total emissions per dollar of income by about 38 percent in 2030 compared to

2008. If that occurs and if income rises by about 90 percent over that same time horizon, then total greenhouse gas emissions will rise 17 percent, increasing from an estimated 27.2 million metric tons of CO_2 equivalent in 2008, to about 31.8 million metric tons in 2030.

Figure 1. Bexar County Greenhouse Gas Emissions Trajectories 2008-2030.



Source: ACEEE (2009)

Unfortunately, even though normal market efficiencies, in fact, do moderate both energy demand and greenhouse gas emissions, an increasing number of scientists suggest that emissions should be reduced by 80 percent of current levels by 2050. Hence, the normal market gains are only a down payment on what must be achieved over the next four decades or so.

Informed behaviors and productive investments in energy-efficiency and the family of smart technologies underpinning each of the four pillars can get the job done. Before the report explains these opportunities in more detail, this section highlights the magnitude of investments necessary to move San Antonio onto a trajectory leading to the Third Industrial Revolution. It also summarizes the energy savings benefits together with the net employment that would likely follow any investment strategy that catalyzed movement within the Third Industrial Revolution.

Required Investment

As with any new market or economic strategy, it takes money to make money. For San Antonio that means thinking through ways to make better use of normal investment dollars, and perhaps finding a new level of greater investment in both people and technologies. Moving San Antonio from a business-as-usual case of a 17 percent increase in overall greenhouse gas emissions, to a transition that greatly reduces emissions, will require somewhere near the order of 15 to 20 billion dollars of smart investment. This is an economy-wide estimate that covers productivity benefits and emission reduction technologies across all sectors and all fuels within the area economy. It includes all energy uses within residential and commercial buildings, all processes and operations within industry and all forms of transportation in and around San Antonio.

While this seems like a large amount of money, an even larger amount of routine investments are needed to keep the local economy going in any event. This is true whether we are talking about new streets, schools, vehicles, industrial equipment, or new transmission lines and power plants. In fact, it appears that San Antonio will make an average annual investment in its economy on the order of $16 billion a year between now and 2030. In other words, if San Antonio can free up the equivalent of one year's normal investment over the next two decades, or just 5% per year ($800 million) and divert these dollars into the kinds of productive technologies described later in this white paper, then the economy can be well on its way toward transitioning to a Third Industrial Era.[6]

These investments will garner substantial returns. As it turns out, energy bill savings will be quite significant over the period 2010 through 2030. This level of productive investment and the resulting energy bill savings can be re-spent within the area economy, which translates into a net positive impact on employment. Under the scenario examined here and highlighted in Figure 1, the initial investment drives a net employment benefit on the order of 1,000 new jobs in 2010. As the level of investment grows, and as energy

[6] Please refer to ACEEE memo in Appendix for further discussion and explanation of methodology.

bill savings accumulate[7], the net gain in jobs would grow to about 16,000 more jobs than might otherwise be available in the business-as-usual forecast.

Energy Efficiency: A Critical Foundation Principle

Henry Ford once commented that picking up and reclaiming the scrap left over after production is a critical public service. But, he noted, planning so that there will be no scrap in the first place is actually the higher public purpose. In a similar fashion, planning so that there will be no wasted energy in the production of our nation's goods and services is also a critical public service. Drawing on that parallel, energy efficiency is the cost-effective investment in the energy we don't use to produce goods and services. But choosing the more energy-efficient path or the more productive technologies is not an immediately obvious prospect for most people. Hence, there is a critical need for consumer information, policy solutions, and new business models to accelerate the continued development and widespread adoption of energy-efficient technologies and behaviors. The more quickly we act, the more quickly the benefits will accrue to businesses and consumers, and to the environment and global climate change.

A Strong Foundation Now In Place

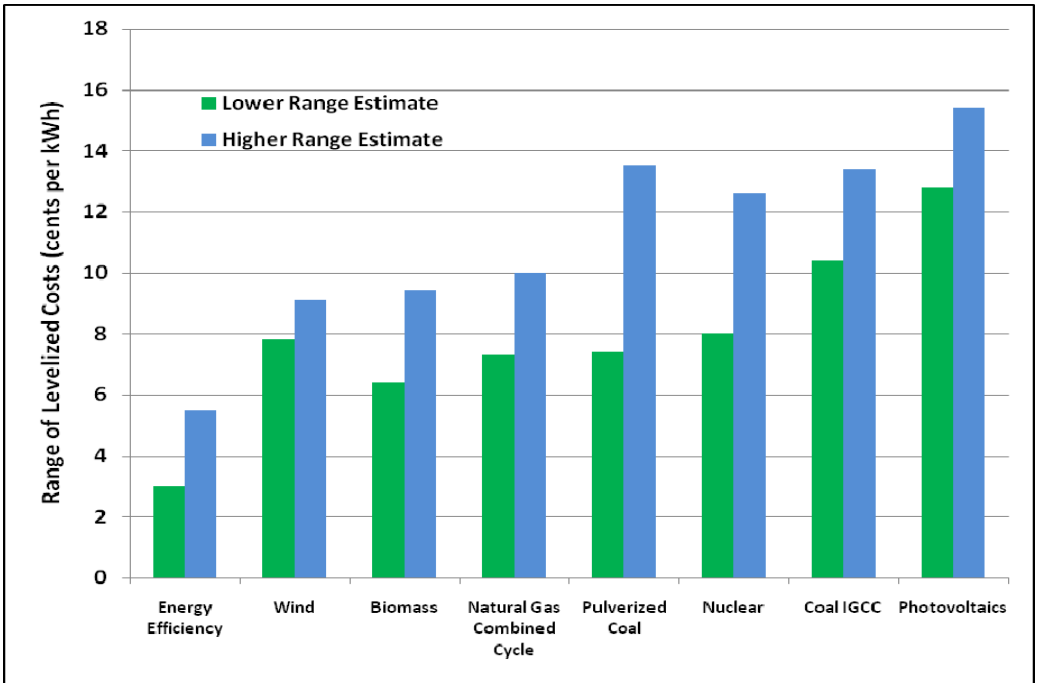
The recent efforts by CPS Energy and the City of San Antonio provide momentum to move the community toward the Third Industrial Revolution through greater energy efficiency improvements. At the same time, to reach a community-wide goal of a 20 percent efficiency improvement by 2020 requires a doubling of its current efforts. From an economic perspective, the investment opportunity is there, but from a planning perspective, there is still work to be done.

In May 2009, the San Antonio City Council approved CPS Energy's plan to fund $849 million for its energy efficiency program called STEP (Save for Tomorrow Energy Plan). This aggressive initiative is one of the largest energy efficiency efforts ever

7 The annual energy bills savings across all fuels and all sectors would rise from about $100 million today to more than three billion dollars by 2030

undertaken by a major city. As Figure 2 indicates, the expanded efficiency program will prove to be a hugely cost-effective investment for the city, and it will provide a critical down payment toward building a more sustainable economy.

Figure 2. Range of Costs for New Electricity Resources



Source: Lazard (2008) and ACEEE (2009)[8]

As the STEP program ramps up, the new energy-efficient installations and retrofits are projected to reduce electricity demand by 771 MW by 2020. Reducing demand at this level is the equivalent of eliminating the need for a new power plant. In energy terms, this savings appears to be over 10 percent of the projected demand in 2020. To reach 20 percent savings of anticipated electricity use by 2020 and fall in line with the 20/20/20 by 2020 goals, therefore, will require a business model that roughly doubles this effort. In other words, nudging San Antonio's economy toward the Third Industrial Revolution will require the elimination of *two* power plants through greater energy efficiency investments by 2020.[9]

[8] These are national averages and, obviously, must be adjusted based on regional and local factors.
[9] A similar commitment would be required for San Antonio's transportation and other non-electricity uses of energy.

Comparing Generation Units with the Energy Efficiency Resource

If CPS Energy is to double its efficiency savings consistent with the transition to the Third Industrial Revolution, it is helpful to provide a more direct comparison of the energy efficiency resource with one of the standard electricity generation options. In this case, the table below compares the proposed purchase and construction of two additional nuclear units at the South Texas Project facility to the cost associated with the Save for Tomorrow Energy Plan (STEP). It further compares additional efficiency gains that might supplement the STEP investments in what we might call "STEP Plus." These comparisons are made in megawatts of generating capacity (MW), in the energy generated or displaced by that equivalent capacity (in billions of kilowatt-hours), in the initial upfront capital cost that CPS Energy might have to pay (in millions of dollars), and in terms of what is referred to as the levelized cost, or annual cost of generating or displacing energy when both capital and operating costs are included over time.

The STEP program is a critical part of the CPS Energy "Sustainability Portfolio." But as we note in the main body of the report, it appears to provide just over 10 percent of the anticipated baseline sales of electricity by 2020. This is half of the level required to position the City of San Antonio so that it can reach the 20 percent target by that same year. At the same time, CPS Energy is considering the purchase of a 40 percent share of the South Texas Project (STP) expansion, which would provide the utility with an additional 1,080 MW of capacity. Because of the very high (85 percent) capacity factor, this added generation capacity would deliver about 8 billion kWh of electricity for the community. The direct outlays would be on the order of $4 billion which would cost about 8.5 cents per kWh over the life of these new units. It is difficult to imagine that the efficiency resource alone can be deployed at a sufficient scale to displace all of the STP expansion by 2020. But with a full commitment of planning and resources, additional energy efficiency investments could augment STEP with a minimum 220 additional MW of energy efficiency by 2020 – for a total STEP Plus contribution of 990 MW equivalent. Both the incremental cost and the increment efficiency gain and the augmented STEP Plus cost and efficiency gain are highlighted in the table below. Moving toward an additional cost-effective investment in the energy efficiency resource would provide an important step toward an investment in the Third Industrial Revolution.

This transition would also be made easier by the CPS Energy commitment to smart grid investments, which may provide a minimum 80-100 MW (about 0.3 billion kWh) of energy system benefit. As smart meters are eventually installed in homes and businesses, consumers would then have the capacity to interact and respond to peak pricing signals and other information. In effect, they would be able to further save on their energy bills.

	STP Units 3&4	STEP	STEP Increment	STEP Plus
Capacity (MW)	1,080	771	220	990
Energy (Billion kWh) [1]	8.0	2.6	0.6	3.2
Capital Cost ($ million)	$4,000[2]	$849[3]	$577[3]	$1,425[3]
Annual Cost ($/kWh)	$0.085	$0.031	$0.082	$0.043

Notes:

1. The generation or displacement of electricity assumes a capacity factor of 85% for STP Units 3 & 4 and 39% for energy efficiency. In effect, it requires more than twice the capacity for energy efficiency resources to offset a megawatt of capacity from a typical nuclear power plant.

2. There are an estimated $1.2 billion in financial costs associated with construction STP Units 3 & 4. However, to provide a more direct comparison with efficiency investments supported by CPS Energy, those costs are omitted in this comparison of capital costs borne by CPS Energy.

3. The capital costs for the energy efficiency programs are those costs borne by CPS Energy. It is anticipated that customers benefiting from the efficiency improvements will match 25 percent of the incentives that might be provided by CPS Energy.

Source: These estimates are based on a variety of data from CPS Energy, the Energy Information Administration (2009), and Lazard (2008). The calculations were provided by John A. "Skip" Laitner, ACEEE (2009).

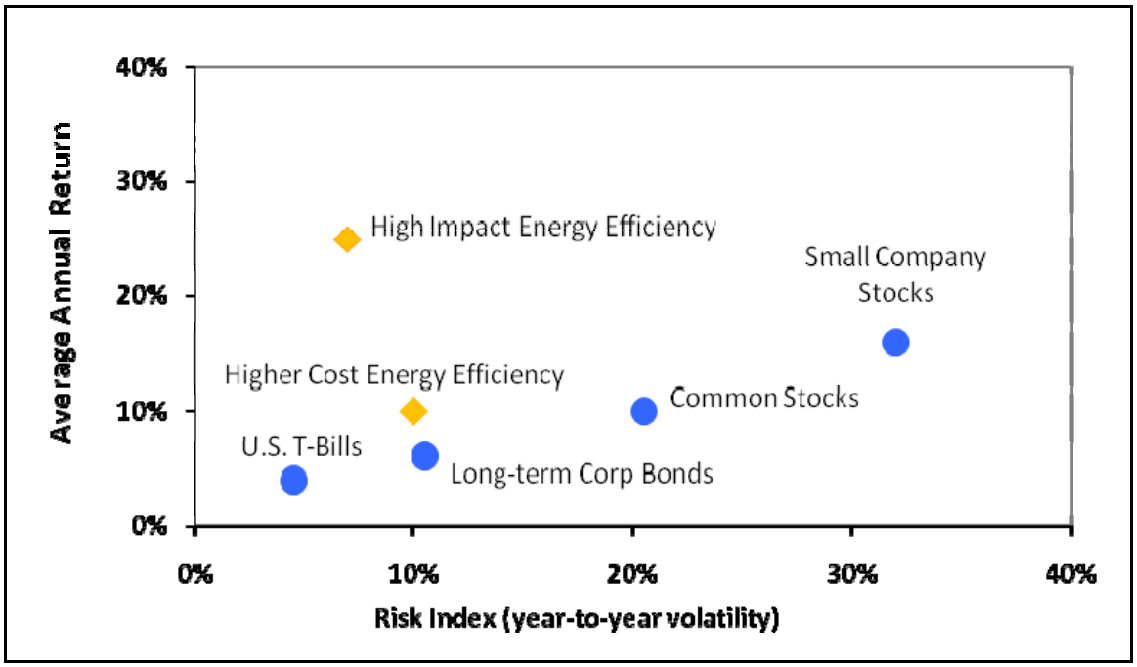
Build the Financial Capacity

Although utility companies have historically funded technology driven incentives, efficiency installations rely on a deeper level of customer participation. The ultimate success or failure of the program will depend on careful monitoring, evaluation and open dialogue with all relevant stakeholders. These types of efficiency programs and goals will not be possible without the backing of the entire city's businesses and consumers. Gaining buy-in from groups such as COPS/Metro, the San Antonio Manufacturers' Association, the Sierra Club, and The Hispanic Chamber of Commerce will be critical. Luckily, San Antonio already has a strong foundation on which to build.

In 2008, San Antonio was among the top 25 U.S. metropolitan areas with the largest numbers of buildings qualifying for EPA's ENERGY STAR. These buildings typically use 35 percent less energy and emit 35 percent less carbon dioxide into the atmosphere than average buildings. Local businesses like USAA Insurance Company, San Antonio Marriott, and H-E-B are among those with ENERGY STAR buildings within the city.

As it is easy to see from Figure 3, the low risk and high levels of return speak for themselves. The question remains, then, how best to optimize and utilize limited resources to catalyze a Third Industrial Revolution within the greater San Antonio region. The following is an overview of the available funding mechanisms and policy considerations when evaluating the development of a comprehensive energy efficiency plan. There are many examples from which to draw lessons, but whether emulating a model from another region or creating something entirely innovative, most important will be the careful monitoring and the level of response to customer demands. CPS and the city must seek to understand which segments of the market are participating and where there might be a need to further incent whatever programs and initiatives are designed.

Figure 3. Comparing Risk and Return on Investment Opportunities



Source: ACEEE (2009)

Advancing the Energy Efficiency Investment Opportunity

Federal funds may be available to complement Texas' own LoanSTAR program (Loans to Save Taxes And Resources). LoanSTAR, a revolving loan fund featuring 3 percent interest loans for efficiency improvements, has provided the foundation for hundreds of millions of dollars in efficiency investments in public sector buildings over the last two decades. These investments have now saved over $219 million in energy costs.

Bonds are another option to be considered by San Antonio, but they are suitable only for loans, not for subsidy or rebate programs. General obligation bonds pay lower rates of interest than revenue bonds, but the former generally require political approval. Revenue bonds supporting private sector activity are sometimes taxable, while bonds for upgrades

of public buildings are generally not.[10] Public entities can also experiment with different types of funding simultaneously.[11]

Performance contracting provides still another financial mechanism to generate further energy savings. Performance contracting is a $3 billion industry and is often used by state agencies, municipal agencies, and universities. Energy Services Companies, or ESCOs, including services provided by established companies such as TAC Americas (a division of Schneider Electric) or Siemens, guarantee a minimum level of energy efficiency gains. In the eyes of the financial community, these agreements significantly reduce the risk associated with efficiency investments. It also eliminates the need for high up-front capitalization and increases return on investment (ROI).[12] In some cases, upfront costs can be financed through low interest bonds, possibly using a Tax-Exempt Lease Purchase (TELP) agreement to take advantage of the good credit and tax status that most municipalities enjoy. In addition, performance contracts can include provisions that all contractors and employees be local.

Public Private Partnerships (PPPs) are another financial arrangement that can ensure a quicker ROI. Traditionally focused on major transport development and large-scale infrastructure projects, PPPs have expanded to cover a broad range of projects and services. These partnerships between governmental agencies and private entities increase financing opportunities and ensure due diligence when assessing rate of return and risk assessment. Additionally, these partnerships lower costs, provide resource savings, and provide managers with breadth and depth of technical expertise.

In Rouen France for example, a contract for the centralized management of the "safety of public spaces" - in effect, a series of public lighting, traffic management and close-circuit surveillance TV systems - was awarded to an investment management consortium with a value of over 100 million Euros over a period of twenty years. As the city did not have

10 Private revenue bonds that are mostly geared toward programs providing public benefit are exempt from taxes, but a capped amount of these bonds are available to states and municipalities.
11 Minnesota uses a combination of taxable and non-taxable revenue bonds to fund its "Fix-up Fund".
12 See TAC "recommendations" on page (x) we standardize these recommendations after we have the final markup

the capital to make these investments, Philips recruited a financial company to help assess and capitalize the installations.[13] In similar way, Cushman & Wakefield and Cross & Company have often made use of the Enhanced Use Leasing program (EUL), where the public entity contributes the building and the private sector brings capital to renovate or redevelop property for public sector use.[14]

There are a number of examples for mid-sized residential energy efficiency financing programs that may provide a model development for San Antonio[15]. Five such examples are briefly described next:

- Idaho runs a residential efficiency financing program out of its state office of energy, which has lent about $2 million over its existence. Loans have an average value of $4000, are paid back over 5 years, collect an interest rate of 4 percent, and are secured by a lien on property. The fund is revolving, so that 1/5 of the portfolio's value is repaid each year.

- Funded with $2 million provided by severance tax on oil and gas producers, the Kansas Energy Efficiency Program (KEEP) makes loans for efficient home improvements. The Kansas Housing Resources Corporation buys half the loan at 0 percent interest rate while a participating private bank buys the other half at the market interest rate, meaning the loan is offered at half market interest rates. The average loan amount is $9,800, secured by a lien against the borrower's property. To date, there have been no defaults.

- Oregon has run an energy efficiency loan program out of its state energy office since 1980, and made $380 million in loans since then to all sectors. The average interest rate is between 6.0 and 6.5 percent, and the average loan size is $486,000. Oregon is unique is that it charges administrative fees on its loan. Application and underwriting fees adding up to 0.6 percent, and a closing fee of 1 percent, has encouraged large loan sizes.[16]

- The New York State Energy Research and Development Agency (NYSERDA) operates a loan program - managed by one full time employee equivalent - that since inception has saved 6,629 households an average of $756 each in energy

13 The financial company got 50 percent of the 30 percent savings, the city of Rouen got the other half.
14 We have not touched on Energy Efficient Mortgages offered by the federal government by choice, as they have inevitably proven to be less popular as result of burdensome energy auditing and burdensome requirements for participating lending institutions.
15 See, Brown 2008.
16 Because some of the underwriting fee may count towards the closing fee, the actual total fee may be less than 1.6 percent.

bills. The average loan size is $7,500 and loans are made for 5 and 10 years. Loans are made by private lending institutions at lower than market rates, and NYSERDA pays lending institution for the net present value of difference between the subsidized and market rates. There are two prevailing interest rates in the program, typically 1 percent within the service territory of Consolidated Edison, to a range of 2 to 5 percent outside the utility service territory.

- Pennsylvania has a unique model for a loan program. It is operated by a third party financing organization and funded through loans from the Pennsylvania State Treasury. Capitalized with $20 million in low interest loans from the State Treasury, the third party financing organization makes loans that average $6,316 per households. The loans pay an interest rate of 8.99 percent, the state treasury earns 4.99 percent on its seed funding, and the spread between these figures is retained by the third party financer.

In summary, with the City Council's approval for the $850 million STEP Plan, CPS Energy can provide the early momentum in leading the way toward the Third Industrial Revolution. The City's Mission Verde statement also provides a thoughtful underpinning for the larger community-wide effort that is needed. At the same time, as good as the STEP Plan is, it appears to take CPS Energy only halfway to the larger goal of a 20 percent energy savings by 2020. Hence, there is a need to double the level of energy savings across San Antonio by 2020. Although this next increment should still provide a cost-effective investment for households and businesses,[17] it is a sufficiently large increase that warrants further program assessment to determine how best to invest those next dollars. At the same time, the CPS program does not deal with other energy-related consumption - notably, natural gas and transportation energy use. Again, to identify the cost-effective investments that make the most sense for San Antonio, a further program assessment and updated strategy is warranted.

With the need to expand the efficiency goal to include the larger San Antonio region, a critical step forward would be to convene a transition taskforce to identify the larger

17 Generally, the professional staff at the American Council for an Energy-Efficient Economy believes there is room for cost-effective energy savings of 30 percent by 2030. As further examples of this opportunity, the recent Demand Side Management Potential Study (Nexant 2008) indicated an economic potential for energy efficiency improvements on the order of 20 percent (at customers' full participation) by 2020. A separate analysis by the Lawrence Berkeley National Laboratory suggested building electricity consumption could be reduced by one-third at a levelized cost of 2.7 cents per kilowatt-hour. As suggested by the data in Figure 2, this is one-third to one-half the cost of most new generation units, and less than the cost of many existing units.

community-wide energy efficiency goals for 2020. And because this is a long-term commitment, the taskforce - with appropriate support from an established team of energy, economic development, and financial management consultants – may want to extend the sustainability objectives out as far as 2030. Since this is logically an exercise in community economic development as well as long-term sustainability, the taskforce should also be charged with establishing reasonable metrics to assist the city and the Alamo region in the ongoing evaluation of this transition effort. Among the metrics to be included are those linked to: job creation, new business startups, energy savings, greenhouse gas and other emission reductions, and financial returns.

First Pillar: Distributed Renewable Energy

Renewable forms of energy - technologies that draw on solar heat and light, wind resources, hydropower, geothermal energy, ocean waves, and biomass fuels - anchor the first of the four pillars of the Third Industrial Revolution. In Texas these resources are abundant. For example, if we look only to what might be termed "accessible" solar heating and electricity,Texas could provide more than 20 times its total energy needs based on today's energy consumption patterns.[18]

While these sunrise energies currently account for a small percentage of the global energy mix, they are growing rapidly as governments mandate targets and benchmarks for their widespread introduction into the market and their falling costs make them increasingly competitive. As businesses and homeowners seek to reduce their carbon footprint and become more energy efficient and independent, billions of dollars of public and private capital are pouring into research, development and market penetration. As these incentives take hold and the market expands, costs of these renewable energy technologies will become increasingly competitive. The question for the Alamo area

18 See, "Texas Renewable Energy Resource Assessment," prepared by Frontier Associates, LLC, for the Texas State Energy Conservation Office, December 2008.

economy becomes one of competitiveness. In short, will San Antonio choose to be competitive in this emerging and robust growth market?[19]

Renewable energy is a highly-dispersed and locally-managed resource. The distributed nature of renewable energy technologies can be contrasted with centralized power sources. These larger systems are managed by large firms and typically are encumbered by complicated, obscure regulations. Distributed renewable energy systems are increasingly characterized as "agile energy systems," especially when coupled with or enabled by smart grid technologies.[20] They inherently provide an emerging set of new civic-based market or investment opportunities.

The fact that these systems are dynamic, progressive and cost-effective, as well as readily adapted to a wide variety of economic circumstances, are reasons why more and more business and community leaders are moving towards a renewable-based economy.[21] As one very recent example of rising support, Maine's Community-Based Renewable Energy Act was passed unanimously in both chambers of the state legislature and was signed into law by Maine Governor John Baldacci on June 9, 2009. Another case in point is the recent detailed study for Marin County in California that found that the county could meet 50 percent of its energy needs with cost-effective renewable energy by 2017.

Lending further "proof of concept" to the staying power of renewable energy technologies is the growing number of businesses that are turning to these flexible resource technologies. Texas-based Dell computers uses a combination of biogas, solar, and wind energy to meet more than 100 percent of its total electricity needs. Another

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19 Indeed, this question follows the insights of Henry Ford whose primary innovation was not the invention of the assembly line. His real genius was marketing – he cut prices to sell more cars, and he then invented mass production to enable those lower prices to actually take hold. In effect, mass production was the result, not the cause of his low prices. See, Theodore Levitt, "Marketing Myopia," *Harvard Business Review*, July 2004. See also, Henry Ford, *My Life and Work* (Doubleday), 1923.

20 See Clark's "The 21st Century "Green Energy Economic Paradigm: Agile Energy Systems."

21 As a recent number of studies have suggested, wind and biomass resources are among the more cost-effective renewable energy resources with levelized costs that range from 6 to 9 cents per kilowatt-hour (kWh). This compares to costs of 10 cents per kWh or more for newly constructed conventional coal and nuclear power plants.

Texas-based firm, Whole Foods Market, uses solar and wind energy to provide all of its electricity requirements. Dallas-based Williamson Printing uses 100 percent wind energy for its power needs. Two non-profit organizations, Foundation Communities and the Rebekah Baines Johnson Center, add to the list of 100 percent green power users. The Aveda Institute of San Antonio is still another non-profit which relies on 100 percent renewable energy. The Lovett Commercial & Lovett Homes is a real estate firm in Houston that is going 100 percent renewable power. Among the Fortune 500 high tech firms that also have facilities in Texas, Cisco Systems, Apple Computers, and Advanced Micro Devices provide 46, 88, and 102 percent of their electricity needs with renewable energy technologies, respectively. In these cases, the renewable-generated electricity is purchased through agreements with other suppliers who actually provide these services to each of these Fortune 500 companies.

An Economic Development Perspective

While San Antonio has access to excellent solar, wind, geothermal, and biomass resources, more critically, the region also has a long-standing history of being a center for creativity and industrialism. And the region is blessed, as well, with a skilled labor force and a supportive infrastructure - including rail spurs, highways, and telecommunication resources - that might foster the development of new industrial activity built around investments in renewable energy technologies.[22] Rather than be limited only to productive investments in renewable energy systems that have been manufactured elsewhere, the area economy should ensure a sustainable transition to a Third Industrial Revolution economy by developing the capacity to locally manufacture, assemble, finance, install and service a wide variety of renewable systems. In other words, San Antonio might become a leading developer of the many different elements within the supply chain for renewable energy technologies. Groups such as Solar San Antonio, an active and effective local organization, enabled with the correct policy and investment

22 A recent industry cluster analysis shows that San Antonio employs a relatively large share of high quality jobs that may also provide a uniquely base for development of the renewable energy industry in the Alamo region. Among these are jobs in aerospace, automotive and advanced manufacturing, construction equipment and supplies, financial services, and information technology. See, ICF Consulting, "Alamo Regional Industry Cluster Analysis (July 2005).

strategies, could help provide a solid base for developing models to incorporate the multiple components within the renewable energy supply chain. This organic growth strategy should have significant potential for economic stimulus and job creation; especially as marketing and production innovations bring down costs of renewable energy systems at all levels within the supply chain.

Although most cities look to solar cell and module manufacturing as the preferred economic development strategy for solar energy, there are other industries that contribute to the supply chain that also require manufacturing and engineering expertise such as: raw silicon processing, glass manufacturing, inverter production, racking manufacturing, and other various electrical components. Similar business opportunities exist with the other renewable energies.

With this in mind, San Antonio's universities, community colleges, and vocational schools may wish to develop educational curricula to provide the skills needed to attract industrial employers that contribute to the entire supply chain for various renewable energy technologies and components. In this regard, it will be important for the city to match its economic development goals with a comprehensive assessment of its strengths and to set out a development strategy that builds on the numerous existing opportunities provided by this first pillar.[23]

Transparency and efficiency at the permitting, zoning and interconnection levels are as important considerations as the financial incentives and policies that they support. Best practices show that removing non-economic barriers and establishing transitional incentive programs are two of the most significant indicators of success. Programs such as California's Production Based Incentive (PBI) and New Jersey's Renewable Energy Credit are among the more interesting domestic projects from which lessons can be drawn.[24]

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23 CH2M Hill "Mission Verde-Concluding remarks from Sustainability Conference" (See Table 1 "System Output vs. Mounting Type)
24 Further expanded in Q-Cells Recommendations

Internationally, Spain and Germany have both seen the powerful economic effects of transitioning to a renewable energy economy. As Figure 4 shows, the German renewable energy sector has experienced significant job growth. In fact, in 2003, conventional energy employment (coal, oil, gas and uranium) accounted for 260,000 jobs. By 2007, renewable energy employment accounted for more than 249,300 jobs. More impressive, however, is that renewable energy used for primary energy consumption remains below 10 percent (as displayed in Figure 5). In other words, less than 10% of the energy produced by renewable sources creates nearly as many jobs as all other energy sources combined. Spain is another example of an explosive shift toward a renewable energy economy. The Spanish economy, which supports over 188,000 renewable energy jobs and 1,027 renewable energy companies, has reportedly produced five times more jobs than the conventional energy industry.[25]

Much like energy efficiency investments, renewable energy technologies can eliminate or postpone conventional energy costs indefinitely. That is why renewable energy investment translates to a long-term reduction, or stabilization, of energy bills paid by both consumers and businesses. Again, this money can then be saved, or more likely, spent on other goods and services within the regional economy.

25 Sáinz, Joaquín. "Estimación del Empleo en Energías Renovables 2007." ISTAS 2008. 25 Acciona Recommendations.

Figure 4

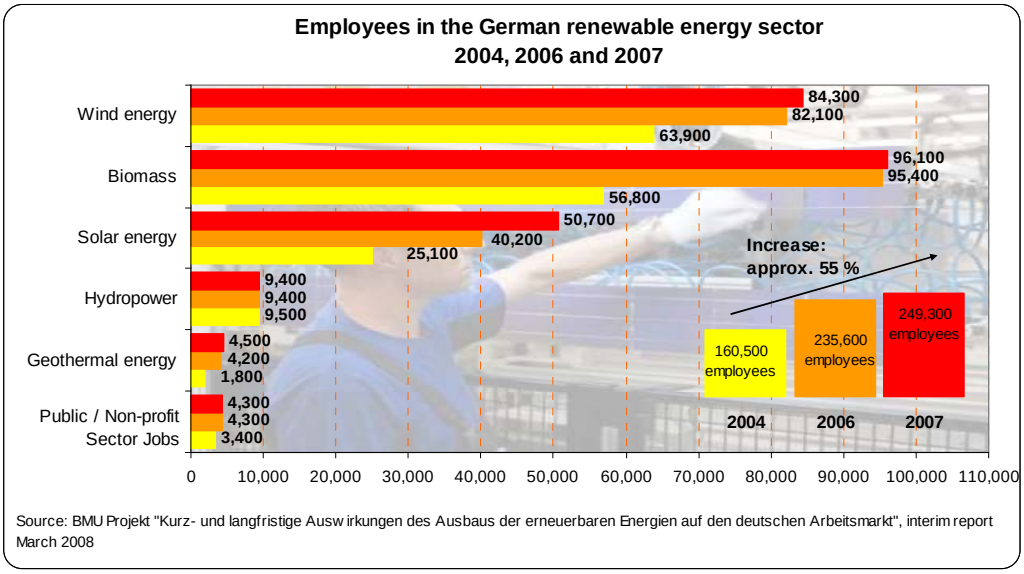
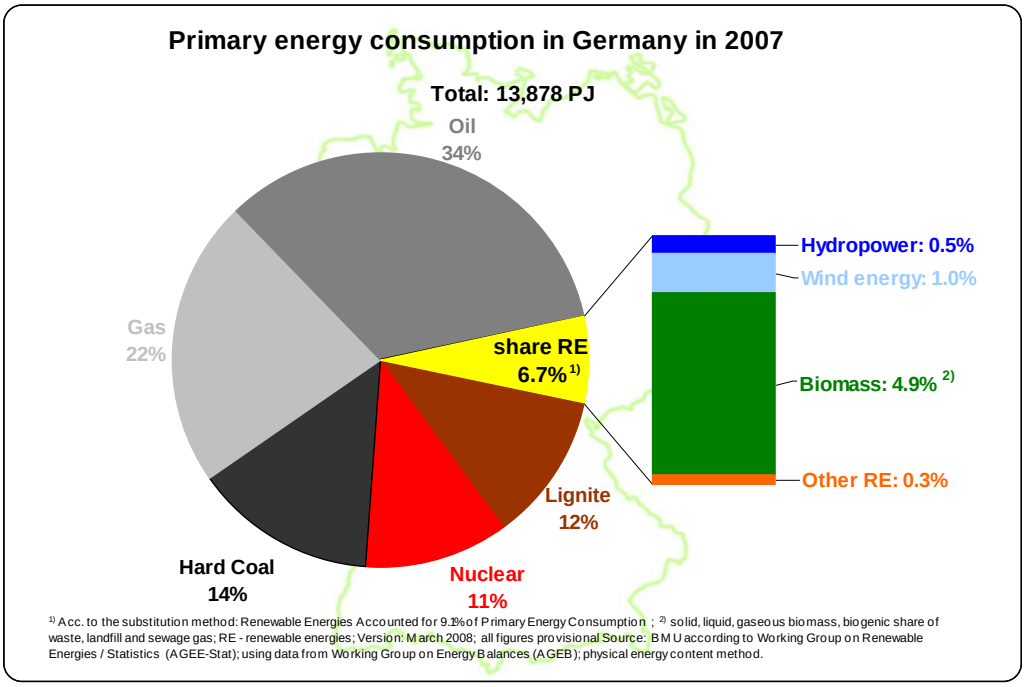


Figure 5



Advancing the Pillar One Investment Opportunity

CPS energy has committed to the strategic energy goal of producing 1200 MW of renewable energy by 2020, and is already producing 850 MW. These initial renewable

energy targets provide a great deal of momentum to move the community toward the Third Industrial Revolution. There are three aspects that might advance the Pillar One initiative to the greater economic benefit of the Alamo area, however. First, rather than provide a 20 percent target for the electric utility system in 2020, CPS Energy might adopt the European Union target of 33 percent goal for the system as an anchor to give the community a stronger capacity to reach a 20 percent goal across all energy resources.[26] Second, rather than specify the goal in capacity terms (or megawatts of capacity) which reflects only the ability to generate energy (or megawatt-hours of electricity), CPS might want to choose to set up the renewable energy target in terms of energy. From a standard business model perspective, a move from program goals that are expressed in megawatts to goals that are expressed in megawatt-hours is a significant departure from the normal viewpoint of a utility planner. But from a community economic development perspective, and with a transition to the Third Industrial Revolution in mind, the emphasis on energy production provides a more useful planning metric.[27]

Finally, rather than focusing only on the investment or purchase of electricity generated by renewable energy technologies, the community should use the market power of this expanded energy goal to build the production capacity across the entire supply chain - from the manufacture and assembly of renewable energy systems, to the sales, financing and servicing of such systems - in ways that build local expertise, businesses, and jobs. At the same time, the community should celebrate the initial CPS vision and charge the transition taskforce (described in the previous section on energy efficiency and further at the end of this report) to identify the long-term commitment to Pillar One as an exercise in community economic development. As with energy efficiency goals, this includes

[26] Without being overly complicated, if electricity from CPS Energy represents about 40 percent of the region's total demand for energy and related resources (other energy uses include natural gas and transportation fuels, for example), this means about 12 percent of the remaining city's energy needs would have to come from renewables in order for the entire region to average 20 percent renewables by 2020.
[27] Generally speaking, both energy efficiency and renewable energy resources have a capacity or utilization factor that is about half the standard baseload generation unit. From an energy perspective, therefore, twice the megawatts of renewable must be installed to provide the same level of megawatt-hours of electricity as a coal or nuclear power plant. As the same time, if we are concerned about carbon dioxide and other pollutants, referencing the production and consumption of energy appears to be the more logical planning metric.

developing reasonable metrics to assist CPS Energy, the City of San Antonio and the Alamo region, in the ongoing implementation and evaluation of the transition effort. Again, such metrics would include job creation, new business startups, energy savings, greenhouse gas and other emissions reductions, and financial returns.

Second Pillar: Buildings as Power Plants

While renewable energy is found everywhere and new technologies are allowing us to harness it more cheaply and efficiently, we still need infrastructure to load it. This is where the building industry steps to the fore, to lay down the second pillar of the Third Industrial Revolution. Worldwide, buildings consume 30 to 40 percent of all the energy produced and are responsible for equal percentages of CO2 emissions. Nationally, buildings account for 75 percent of electricity consumption. But in San Antonio, this figure is over 90 percent.

For the first time, new technological breakthroughs make it possible to renovate existing buildings and design and construct new buildings that create some, or even all, of their own energy from locally available renewable energy sources, allowing us to reconceptualize buildings as "power plants." The economic implications are vast and far reaching for the real estate industry and, for that matter, the world.

Over the next 25 years, thousands of San Antonio buildings, homes, offices, shopping malls, and industrial and technology parks could be converted or constructed to serve as both "power plants" and habitats. These buildings will collect and generate energy locally from the sun, wind, waste, and geothermal heat to provide for their own power needs, as well as surplus energy that can be shared on the grid.

A new generation of commercial and residential "buildings as power plants" is going up now. In the United States, Frito-Lay is retooling its Casa Grande plant, running it primarily on renewable energy and recycled water. The concept is called "net-zero." The

factory will generate virtually all of its energy on-site by installing solar roofs and by recycling the waste from its production processes and converting it into energy.

The General Motors factory in Aragon, Spain, the largest GM production facility in Europe, has installed a 10 Megawatt (MW) solar plant on its factory roof at a cost of $78 million. The power station produces enough electricity to power the equivalent of 4,600 homes. In France, Bouygues, the French construction company, is taking the process a step further, putting up a state of the art commercial office complex this year in the Paris suburbs that collects enough solar energy to provide for all of its own needs, while also generating surplus energy.

The Walqa Technology Park in Huesca, Spain is nestled in a valley in the Pyrenees and is among a new genre of technology parks that produce their own renewable energy on-site to power their operations. There are currently a dozen office buildings in operation at the Walqa Park, and 40 more slated for construction. The facility is run almost entirely on renewable forms of energy, including wind power, hydro, and solar. The park houses leading high tech companies including Microsoft and Vodafone.

The creation of a network of distributed power plants made up of thousands of buildings can maintain a stable and reliable electricity grid. If these buildings are energy efficient and can create more energy than is consumed at certain times of the day or week, the excess energy can be stored or transmitted to nearby neighbors.

Just as the distributed renewable energy sector is labor intensive, so too are the jobs and services required to convert buildings into power plants. Converting existing buildings to use energy efficiently, while simultaneously constructing new buildings to maintain positive power generation, will generate thousands of jobs for the people of San Antonio. Additionally, as companies, individuals, and the City gain experience in these areas, this newly-acquired knowledge and skill-set can become a service for hire.

Critical Steps in the New Design

There are two steps to a building becoming a power plant: energy efficiency and power generation. In terms of energy efficiency measures, there are two different categories of buildings, and thus, two different strategies that must be considered: 1) new building construction and 2) retrofitting existing buildings. For new construction, the City has passed a city ordinance (effective in 2010) that requires new building construction to be 15 percent more energy efficient than the existing 2008 code, 30 percent more efficient by 2012, and with a net zero goal by 2030.

It is important to secure the "low-hanging fruit" available in buildings. Lighting is one important "fruit" not only for increasing productivity, but also for increasing the comfort and well-being of its inhabitants. Currently 20 percent of global energy production is used for lighting, while in the US it is about 8 percent. In fact, it is estimated that globally, new opportunities in lighting could save 40 percent of the energy used, over €100 billion in costs, and 530 power plants.[28] Preliminary audits in San Antonio show an average of a 1.5 year payback for lighting improvements. In 2007, President Bush passed the energy bill banning incandescent light bulbs by 2014. The phase out begins with the 100 watt light bulb in 2012 and ends with the 40 watt light bulb in 2014. San Antonio might want to consider taking more aggressive measures that phase out these bulbs even sooner.

Some form of certification should accompany these plans for green retrofits and new construction if San Antonio hopes to add more market value to their building stock. One certification and measurement tool commonly used is the US Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) program. Many local governments have adopted LEED incentive programs and there are numerous examples of incentive structures for municipal government agencies available for review. Some organizations have learned, however, that LEED certification can significantly increase design and construction costs. Thus, for small residential projects, other options

28 Verhaar, Harry Dec. 2008 issue of European Energy Review

may be more attractive.

For this reason, The Metropolitan Partnership for Energy in San Antonio has developed Build San Antonio Green (BSAG). This local standard, developed by many stakeholders and co-administered with the Greater San Antonio Building Association, works with the building and development community to certify buildings through a quality review process. Not only does such a program offer an alternative certification process, but it also requires builders to receive ongoing training through Continuing Education Classes (CEC).

The "Report on the Formation of a Green Retrofit Program" funded by the Environmental Defense Fund and delivered to the San Antonio Mayor's office earlier this year gives a clear-eyed perspective on how best to finance these power plants. In particular, the report discusses the promising PAYS (Pay As You Save) system. PAYS would finance energy efficiency in San Antonio through a surcharge added to the utility bill of a building. The tariff would be attached to the meter, not the owner or occupier.

The proprietary PAYS system is similar to other financing schemes. The Berkeley First model is another pay-as-you-save model. However, the Berkeley model is funded by an additional line item on property taxes rather than a utility bill surcharge. In general, programs that attach payment to a building through property taxes, or to an energy meter through a utility surcharge, will provide more appropriate incentives than those that attach payment to a person. Moreover, these types of programs are more accessible to persons who have poor credit scores, but have a history of consistent payment of property taxes and utility bills.

For low income households, the free retrofit program run by the city of Houston may be more appealing. Houston's program, called the Residential Energy Efficiency Program (REEP), is a block-by-block efficiency retrofit program targeted to reach low income neighborhoods. The program utilizes a standardized production line approach to achieve participation rates reaching more than 50 percent of its eligible residences. For an

investment of roughly $1,000 per household, energy use is reduced 12 to 18 percent.[29] The consultants who produced the aforementioned report recommended that the city of San Antonio use both the PAYS and REEP models to achieve its building efficiency goals. They also recommended that the city initially establish a pilot program along these lines that could be financed with new tax-privileged federal bonds called "Qualified Energy Conservation Bonds" and "Clean Renewable Energy Bonds."

A combination of bonding and third party financing allowed The Los Angeles Community College District (LACCD) to transition from owning buildings to operating power plants. Passing "Measure J" by 70 percent allowed for bonds to be issued for renewables and building infrastructure. With the banks investing the capital, LACCD pays back the loan by buying electricity out of the campus system. The electricity rate is less than if they were paying utilities.[30] Banks can also take advantage of federal, state, and local utility incentives, and monetize the depreciation of the equipment through tax write-offs. For its energy efficiency measures, the district called on Energy Services Companies (ESCOs) to complete investment grade audits and recommend retrofits. The ESCOs financed the efficiency upgrades and were repaid out of the energy savings.

LACCD, with a baseload demand of 4 to 6 MW and annual energy costs of around $10 million, will be completely energy self-sufficient by the end of 2010. By installing wind turbines on the perimeter of the campus, geothermal heat pumps in the buildings, and photovoltaic arrays that double as shade for parked cars, new building construction does not even add to the base load. After installing electric re-charging stations and selling surplus electricity to Southern California Edison (SCE), LACCD transformed an initiative that began with the goal of merely "greening the campus" into a larger strategy that generates revenue, and positions this community college district as a nationally recognized pioneer in innovation.

[29] Eugster, Cris. 2009. Personal Communication with Chris Knight, American Council for an Energy-Efficient Economy, Washington, DC.
[30] This includes maintenance and capital costs

Advancing the Pillar Two Investment Opportunity

Combining San Antonio's experience in renewable energy with the available funding for energy efficiency retrofits, the City of San Antonio could launch a city-wide, "buildings as power plants" initiative. The first step, of course, would be to conduct a broad-scale energy audit based on: size and physical characteristics, owner/tenants, and energy use. The city has already taken the first steps by planning audits in lighting, HVAC, energy and water through the newly created Office of Environmental Policy (OEP). After these audits have been completed for energy efficiency measures, buildings slated for conversion can be further divided based on the capacity for renewable energy integration.[31] A more complete integration of the Pillar Two investment strategy, together with the identification of appropriate metrics to assist in the evaluation of this strategy, would be another responsibility of the transition taskforce described in the previous section and elsewhere in this report.

Third Pillar: Energy Storage

The introduction of the first two pillars of the Third Industrial Revolution - renewable energy and "buildings as power plants" - requires the simultaneous introduction of the third pillar. To maximize renewable energy and minimize cost, it will be necessary to develop storage methods that facilitate the conversion of discontinuous supplies of energy sources into reliable assets.

This is because renewable energy is intermittent. The sun is not always shining, the wind is not always blowing, water is not always flowing, and agricultural yields may vary. When renewable energy is not available in San Antonio, electricity cannot be generated and economic activity grinds to a halt. But, if some of the surplus electricity can be used to extract hydrogen from water, which can then be stored for later use, citizens can have a continuous supply of power.

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31 For a larger discussion on baseline information and strategies for large-scale implementation see Cushman & Wakefield/ Cross & Company "Situational Analysis and Recommendations for Master Plan"

What many fail to consider is that when significant amounts of renewable energy are present on the grid, an increased number of power generators are needed on standby to handle large power fluctuations. At penetration levels greater than 20-25 percent (and recall that the Pillar Two recommendation suggests an overall goal of 33 percent renewable as a share of electricity generation by 2020), most grids start to hit the limits of their ability to handle these fluctuations.[32] To move beyond those limits, energy storage is a necessity. If there were a way to store large quantities of energy and provide a means to balance load and power, the need for grid stabilization services would be better met and there would be greater capacity in grids to take on more renewable energy.

Today the most popular form of energy storage for utility companies is pumped hydro. This simple storage method involves pumping water to a high elevation. When it is released, it flows downhill and drives a hydroelectric turbine. This storage form is limited by its stringent requirements for excess energy, a plentiful water supply, and a variable geography.

Another storage technology for utility-scale energy storage is Compressed Air Energy Storage (CAES). Such a system pumps air where it is stored until needed. Upon release, the system mixes the high velocity air with natural gas and it co-fires this as a clean fuel in a regular natural gas combustion turbine - using 30 to 40 percent of the natural gas compared to a regular turbine. At present, there are only two CAES plants worldwide, one in Germany and one operated by the PowerSouth Energy Cooperative in McIntosh, Alabama. PowerSouth pumps the compressed air into a 19 million-cubic-foot underground cavern.[33]

While CAES energy storage is not reliant on water and nearby high elevations like pumped hydro, it does require the presence of a hydrocarbon-based fuel in order to be co-fired, and therefore, has a somewhat higher level of greenhouse gas emissions. Both

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33 The Iowa Association of Municipal Utilities is also planning a CAES system for wind power, dubbed the Iowa Stored Energy Park.

CAES and pumped hydro energy storage technologies are large and expensive systems, and thus, mostly restricted to centralized utility-scale applications.

Other best practices and benefits of energy storage systems can be gleaned from projects emphasizing battery-based projects, of which there are several notable examples in the United States. In 2006, the utility American Electric Power (AEP) tested out an energy storage system at its substation in North Charleston, West Virginia. With supporting funds from the US Department of Energy's Energy Storage Program, AEP installed 1.2 MW, in total weighing 77 tons, of Sodium-Sulfur (NaS) batteries at a cost of $2.2 million. When fully charged, this battery can supply 500 to 600 households with enough power for 6 or 7 hours.[34]

The North Charleston battery installation has multiple benefits. One large and immediate benefit was the delayed investment in a new substation.[35] Longer-term benefits include easing the effects of heavy penetration of customer-sited distributed generation, improved equipment life through a reduction in peak loads, and the ability to conduct energy arbitrage. Even though operating at less than full capacity, the 1.2 megawatts (MW) North Charleston battery probably saved AEP around $50,000 in its first 11 months alone. This was done by allowing the utility to exploit differences in locational marginal prices.[36]

Two-and-a-half years later, AEP decided to install a 2 MW system on the Milton circuit in West Virginia. While the 1.2 MW unit at the Chemical Substation was turned on during times of the day that typically have heavy loads, the Milton battery is automatically turned on when load reaches a certain level. It will also have an "islanding" capability of supporting the grid when regular generation has failed. AEP has plans for similar batteries on its grid in Ohio and Indiana.[37]

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34 http://www.electricitystorage.org/images/uploads/docs/Sandia_First_Storage_AEP.pdf
35 Hohmann, George. December 18 2008. Charleston Daily Mail. "Utility installs giant batteries in Milton." http://www.dailymail.com/Business/200812180200.
36 Nouri, Ali. 2007. "Installation of the First Distributed Energy Storage System (DESS) at American Electric Power (AEP)". Sandia National Laboratories.
37 http://www.electricitystorage.org/images/uploads/docs/Sandia_First_Storage_AEP.pdf

The Milton installation is the largest utility-scale battery in the US, but is dwarfed by international competition. Japan Wind Development Co. has connected a 51 MW wind farm to a 34 MW NaS battery complex. The battery will be able to store wind energy generated at night when winds are strongest, and provide power to 26 thousand homes during the day (Hohmann 2008).

Highly modular technologies that can provide carbon-free power in centralized and distributed applications are the future of energy systems. These systems can be combined to deal with large loads and storage requirements, but they are also well-suited to distributed deployment in industrial facilities, clean energy vehicles, and households.

Hydrogen: the Universal Medium

There is one storage medium that is both widely available and relatively efficient. Hydrogen is a universal medium that "stores" all forms of renewable energy to assure that a stable and reliable supply is available for power generation and for transport. Hydrogen is the lightest and most abundant element in the universe and when used as an energy source, the only by-products are pure water and heat. Our spaceships have been powered by high-tech hydrogen fuel cells for more than 40 years.

Here is how hydrogen works. Renewable sources of energy - solar cells, wind, hydro, geothermal, ocean waves - are used to produce electricity. That electricity, in turn, can be used, in a process called electrolysis, to split water into hydrogen and oxygen. Hydrogen can also be extracted directly from energy crops, animal and forestry waste, and organic garbage (biomass) without going through the electrolysis process.

Hydrogen can also be used to provide ancillary services or demand response through load control (as opposed to ramping up power generation from standby mode). The hydrogen can also be used in a number of different applications from transportation to industrial

applications. There are a large number of options to store this hydrogen gas at a variety of pressures for very low incremental cost compared to more traditional electrical energy storage devices such as batteries. Electrolyzers can be turned on and off very rapidly or follow a power signal, allowing it to be used for grid stabilization. The by-product of providing grid stabilization services is the generation of hydrogen.

Using hydrogen as an energy storage and transmission media in this way has an additional economic benefit. Combining wind or solar generation assets with hydrogen provides a potentially more efficient way of developing electricity than more conventional forms of power generation. Many generation methods operate in a steady state fashion, often referred to as baseload power. The drawback to these assets is that they don't respond to load demand very well. In other words, they continue to produce the same amount of power, whether the grid demands it or not. But by coupling renewable energy with hydrogen storage, you not only handle the intermittency of the renewable power source, but also provide a means to match the load demand moving up and down over the course of the day. This can prove to be a more effective use of "power generation" since there is no "wasted" power. A renewable energy/hydrogen plant sized to meet a typical load profile may actually be less expensive, on a capital cost basis, than some large scale conventional baseload power plants.

Hydrogen is easily obtained from industrial processes, wherein it can then be compressed and stored in tanks or in subterranean natural gas reservoirs like those used by CAES systems. Most importantly, upon chemical conversion to heat and power through a fuel cell, hydrogen releases virtually no greenhouse gas emissions. Distributed fuel cells fed by pipelines of hydrogen synthesized using clean energy-fueled electrolysis could conceivably provide all of the heating, cooling, and electricity needs of modern societies without contributing to climate change.

Current technologies can cleanly produce hydrogen at prices comparable to that of gasoline. The National Renewable Energy Laboratory (2006) found that wind turbines could generate hydrogen through on-site electrolysis for a near term price of $5.55 per

kilogram and a long term price of $2.27 per kilogram.[38] Given that one kilogram of hydrogen contains roughly the same amount of energy as one gallon of gasoline, producing hydrogen can be competitive with gas given present-day prices at the pump. Transmitting wind electricity to distributed fueling stations where it would be converted to hydrogen - at next generation "gas stations", for instance - was found to be even cheaper, at $4.03 per kilogram in the near term and $2.33 per kilogram in the long term.

Researchers are currently experimenting with new methods of hydrogen synthesis that can produce gas even more cheaply and cleanly. Electrolysis can produce hydrogen, and if the electricity is from a clean energy source, this process emits few greenhouse gases. In the future, "bio-hydrogen" may even be produced using food, sewage, or crops as a substrate.[39] But today, it is possible and profitable to create an integrated system for the production, distribution, and consumption of hydrogen at a local level, as the Munich Airport has demonstrated.

Beginning in 1997, the German state of Bavaria partnered with 14 companies to develop hydrogen busses, generation systems, and refueling infrastructure at the Munich Airport. Hydrogen gas - as used in buses - is obtained from the waste of a local petroleum refinery as well as the use of a pressurized electrolyzer. Meanwhile, the airport uses liquefied hydrogen in an automated refueling station (with robot dispensers) for the smaller tanks in passenger cars.[40] The first five years of the project cost about $20 million, but has resulted in over 13 thousand visitors, and are set to be expanded upon in subsequent stages.[41]

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38 Levene, J., B. Kroposki, and G. Sverdrup. 2006. "Wind Energy and Production of Hydrogen and Electricity--Opportunities for Renewable Hydrogen." National Renewable Energy Laboratory. http://www.nrel.gov/docs/fy06osti/39534.pdf

39 University of Glamorgan, Sustainable Environment Research Center. "Wake up to a low carbon future: Hydrogen and fuel cells". www.welshenergysectortraining.org/hydro percent20fuel percent20cell percent20Glamorgan.ppt

40 http://www.ieahia.org/pdfs/munich_airport.pdf

41 Burmeister, Wolfgang. "Hydrogen Project at Munich Airport".

Perhaps what is most interesting for San Antonio is that the airport makes use of a special electrolyzer made for decentralized hydrogen production. A 450 kW electrolyzer is hooked up to the local grid, and then produces hydrogen using electricity and water. If the local grid is powered with clean energy, or the electrolyzer is hooked up its own solar energy system, this hydrogen can be produced with near zero emissions of greenhouse gases. Conceivably, such a system could be used both for the production of hydrogen for vehicles and for fuel cells located in households and businesses.

Implementing hydrogen technology for utility, storage and transit applications will require a coordinated effort from the utility, municipality, and transit authority. Only such a coordinated approach will lead to the realization of the full potential of hydrogen technology. Hydrogen can also be used for generator cooling. This is a well-known and widely used application. Optimizing an overall hydrogen energy system on a broader basis will take some insightful planning across several agencies in the community. The utility will need to integrate demand response and grid stabilization programs alongside the transit authority, who must work toward targets for zero emission transit. Not only does hydrogen transfer large amounts of energy to vehicles quite easily, but the only way to achieve zero emission public transit is through the use of hydrogen, since the energy demands are simply too great for pure battery operation. As a point of departure for San Antonio, transit busses fueled by hydrogen technology may be an ideal way to get started; they make great "rolling billboards" and can engage the community on a very personal level.

Advancing the Pillar Three Investment Opportunity

While energy efficiency is about cost-effective reductions in wasted energy, and renewable energy technologies are a smart supply-side option, storage systems provide an entirely different element of energy services. The ability to store energy in a flexible energy form and in a variety of decentralized systems and media enables any given energy system to provide useful energy when and where it is most needed and in a cost-effective manner. Over the longer post-2020 time horizon, hydrogen fuels may also provide a direct source of power in addition to its many benefits as a storage medium.

Right now, however, demonstrated technologies that are both cost-effective and reliable have not significantly penetrated the market. And unlike energy efficiency and renewable energy resources which can be immediately deployed in community-size quantities, storage technologies - whether pumped storage, batteries, or hydrogen - lack sufficient scale to make the same level of impact. In short, they are technologies which must be further developed at the commercial scale and then integrated with other critical resource technologies. Hence, a different investment strategy is required to optimize for full system benefits.

It is in this last regard that the recommended transition taskforce may find a more difficult challenge - in effect, to: (i) identify an optimal mix of storage technologies, given both the energy efficiency and renewable energy goals previously discussed; and (ii) provide a roadmap that greatly increases the probability that an optimal set of hydrogen and other storage technologies will be available at the scale and at the level of distribution needed to ensure reliability and cost-effectiveness. As a second critical task, the Taskforce will need to develop, in parallel with the other Pillar technologies, an appropriate set of metrics both to guide the development as well as the implementation and evaluation of this Pillar Three effort. Such metrics would begin to include an initial focus on scale, cost, and reliability, as well as job creation, new business startups, energy savings, greenhouse gas and other emissions reductions.

Fourth Pillar: Smart Grids and Smart Infrastructure

By benchmarking a shift to renewable energy, advancing the notion of buildings as power plants, and funding, supporting, and integrating an aggressive hydrogen fuel cell technology R&D program, San Antonio will have erected the first three pillars of the Third Industrial Revolution. The fourth pillar is the smart reconfiguration of San Antonio's larger infrastructure. This includes reconfiguring the transportation system, the communications network, and the power grid along the lines of the Internet - and what some are beginning to call the Smart Web. The "intelligent utility network" will

enable the community to produce and share more forms of their own energy in many more cost-effective ways. The smart grid will also provide energy companies and utility systems with the means to increase system reliability, enhance market robustness, and reduce overall energy system costs. Finally, an intelligent utility network will allow businesses and homeowners to provide, move, and ship goods and services in new and different ways.

A smart intergrid that allows producers and consumers to tap into multiple resource options by way of several different energy providers will not only give end users more power over their energy choices, but will create significant new efficiencies and business opportunities in the distribution of electricity. The intergrid is a stark contrast from today's centralized distribution of energy resources like fossil fuels. [42] In 2008, for example, central generation and transportation of electricity wasted two-thirds of all US energy, just short of 28 Quads. This rate of inefficiency is essentially unchanged since 1960 and is more than Japan uses to power its entire economy.[43]

With a smart intergrid, however, if the grid is experiencing peak energy use with the prospect of system overload, smart grid sensors and software can automatically direct a homeowner's washing machine to rev down one cycle per load or drop the air conditioning requirements by one degree or more. Consumers who agree to these slight adjustments in their electricity use could receive credits on their bills. Since the true cost of electricity on the grid varies (sometimes significantly) during any 24-hour period, moment-to-moment information can open the door to "dynamic pricing" opportunities. This, in turn, will allow consumers to increase or drop their energy use automatically - in part as a function of price (and perhaps other preferences such as drawing a greater mix of renewable energy as part of household demand). Real time pricing also allows local

[42] In the ultimate sense, a customer – whether a user or a producer of power, or both – would have access to multiple energy forms through multiple vendors. In effect, a smart intergrid connection would allow any single customer to buy, sell, or use hydrogen, electricity, compressed air, steam, and mechanical or shaft power and optimize the production of other goods and services.

43 John A. "Skip" Laitner, presentation to the ACEEE Energy Efficiency Finance Forum, San Francisco, CA, April 2009. The calculations are based on data from the Energy Information Administration.

energy producers the choice of automatically selling energy back to the grid or dropping off the grid altogether.

Components of the Smart Grid

The fourth pillar of the Third Industrial Revolution is made of four basic components: minigrids, which are community or neighborhood-scaled grids or industrial parks or plazas that operate within a larger power system; smart meters, which direct and optimize the ebb and flow of energy from consumers to producers; embedded sensors and relays, which enable real-time operation and system optimization; and intergrids, which connect multiple resource options with multiple agents (whether producers or buyers). Minigrids enable energy to be produced and consumed locally and smart meters communicate energy flows into and out of homes and buildings. The bi-directional communication that these meters provide allows buildings to both produce and consume energy while providing the user and utility with net energy usage data. Embedded sensors and relays allow electricity in the grid to be routed wherever and whenever it is needed most. Embedded sensors also ensures reliable power and reduces the likelihood of browns-outs and service disruptions.

Demonstrations of intergrid projects are occurring on many levels; across entire countries, such as Malta; regionally, in several European locales; and domestically, through utilities such as Southern California Edison and Duke Energy. Installing smart meters is the first upgrade that could be quickly deployed for only two to three dollars per month, per residential customer.[44] Smart meters can also provide an immediate payback as they can affect behavioral changes. Washington DC has a pilot time-of-use pricing program that has saved up to 70 percent of use during certain periods.

Regulatory changes are needed to usher in the advanced intergrid. Energy efficiency and distributed generation will not be a high priority for utilities that are supported by sales of kilowatt-hours. Thus, regulators must work with utilities to decouple energy sales from

44 Barry Smitherman, chairman of the Texas Public Utility Commission, 4/6/09.

energy services and accelerate changes in business models to create organizations compatible with the new business models in the Third Industrial Revolution.

Beyond State of the Art

A number of cutting-edge firms are working to integrate wireless networks with advanced metering reading (AMR) capabilities. As a testament to the economic development prospects of flagship demonstration projects, Tendril started up in the same city as the premier US Smart Grid demonstration project in Boulder, CO (Technology Review 2009). The use of wireless data transfer avoids the costly labor and materials necessary for hard wiring and it also promotes functional flexibility. Information on the customer regarding home energy use can be beamed rapidly and cheaply over the internet to utilities. Utilities can then communicate new price and market conditions directly to customers. Electricity information is just one type of data that can be integrated on wireless networks. Wireless Home Area Networks (HAN) can integrate multiple sources of home information, from electricity use, to temperature and communications capabilities.

CPS Energy has demonstrated that it understands this critical resource opportunity. Indeed, it has already planned for smart grid investments on the order of $113 million through 2020 as part of its on-going commitment to promote sustainability within the CPS system. With smart meters being installed in homes and businesses, consumers will soon have the capacity to interact and respond to peak pricing signals and other information. In effect, consumers can become active, participating agents in helping reach the 20/20/20 by 2020 goals, as they will be able to reduce peak demand for energy as needed. Hence, energy efficiency combined with smart grid investments can provide important flexibilities for the larger energy system within San Antonio. Assuming this smart meter investment translates into as many as one-half of CPS customers integrating smart meters into their normal patterns of buying and using electricity, this may provide perhaps 80-100 MW or more energy system benefit.

The economic development potential of electricity is enhanced by the integration of cutting edge information and communication technologies across the entire power grid. Established firms like IBM, GE, Siemens and KEMA excel at integrating smart products into large infrastructure systems. Smaller firms, in turn, are specializing in the sensors and devices that make the smart grid possible.

The bi-directional flow of energy also creates the possibility of interfacing with the transportation system. When energy is in high demand, smart meters and plug-in hybrid vehicles add more energy storage capacity to the grid. Electric and hydrogen powered fuel cell plug-in vehicles can become "power stations on wheels," with a generating capacity of twenty or more kilowatts. Since the average car, bus and truck are parked much of the time, they can be plugged in during non-use hours, to the home, office, or the network to provide electricity back to the grid. Thus, electric and fuel cell plug in vehicles also become a way to store massive amounts of renewable energy.

Projects and industry partnerships are being formed at all levels to explore these new applications of smart grid. In 2008, Daimler and RWE, Germany's second largest power company, launched a project in Berlin that established recharging points for electric Smart and Mercedes cars. Toyota has now joined with EDF, France's largest utility, to build charging points in France and other countries, for its plug-in electric cars. Similarly, Renault-Nissan is readying a plan to provide a network of hundreds of thousands of battery charging points in Israel, Denmark and Portugal to service Renault's all electric Mégane car. By 2030, charging points for plug-in electric vehicles and hydrogen fuel cell vehicles will be installed virtually everywhere - along roads, in homes, commercial buildings, factories, parking lots and garages - providing a seamless distributed infrastructure for sending electricity to and from the main electricity grid.

Smart Grid Operations and Utilities of the Future

Smart Grid projects are increasingly popular, especially in states with progressive utility regulation such as California. On June 18th of this year, the board of the Sacramento

Municipal Utility District approved a 30 month rollout of 620,000 smart meters. And the huge California utility PG&E has committed $2.2 billion toward a smart grid program, utilizing networking technology from Silver Spring Networks.

Austin Energy (AE) has been working on a smart grid since 2003. It began its smart grid efforts with Smart Grid 1.0, focused on the utility side of the grid. This involved installing 410,000 smart meters that communicate via a wireless mesh network. AE has also installed 86,000 thermostats that it can control remotely and 2,500 distribution grid sensors.[45] Austin predicts that its entire service territory will be "smart" by August of this year. Most recently as part of its 1.0 strategy, AE has been working with General Electric to integrate GE's distribution management system, which will essentially function as a GPS for the grid.

These efforts are now being folded into the Pecan Street Project, which is a part of Smart Grid 2.0. This segment of Austin's smart grid project extends beyond the meter, including appliances, distributed generation, and vehicles. Indeed, Austin's Pecan Street project explicitly includes a vision of an electricity grid reconnected with the transportation sector. Austin also emphasizes that it doesn't see smart grids as bad business. Part of its vision for the smart grid are "smart business plans" that allow Austin Energy to be a leader without compromising its financial footing.[46]

Xcel Energy completed the first phase of its effort to turn Boulder into a "Smart Grid City" in August 2008. The Smart Grid City project focuses on customer empowerment, wherein the utility company encourages customers to manage their own power consumption online. When the demonstration project is complete, it will include 10,000 Boulder homeowners. So far, relatively few meters have been installed in Boulder (around 15,000) and project leaders have demonstrated a more cautious approach to creating a smart grid.

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45 St. John, Jeff. 2009. "Top Ten Smart Grid". April 30 2009 article in Greentech media. http://www.greentechmedia.com/articles/read/top-ten-smart-grid-3605/N10/

46 Carvallo, Andres. "Austin Energy Plans Its Smart Grid 2.0". Article by Austin Energy Chief Information Officer Andres Carvallo. http://www.ciomaster.com/2009/04/austin-energy-plans-its-smart-grid-20.html

The best example of the realization of the potential of the smart grid comes from overseas, from the Italian utility Enel. In the 1990s, Enel conducted a large pilot study of the feasibility of remote meter management for residential customers by installing 70,000 meters. In 1998, the utility decided to go ahead with a plan to replace all residential and small business meters with digital meters that could be read remotely, a project estimated to have a 4 year payback.

Enel uses concentrators to combine the information from many separate meters and then transmits this information to the information processing center via modems. Enel installed 20 thousand meters per day and by 2006 was remotely managing 28.8 million meters. Enel spent 2.1 billion Euros creating its smart grid. This includes every cost from R&D to IT systems development. More importantly, Enel estimates that the project achieves an annual savings of 500 million Euros.

As a result of its project, Enel has eliminated estimated billing, enabled remote reading of power consumption, facilitated remote change of contractual parameters, and improved fraud detection and prevention. Its meters have a lifetime of 15 years and a failure rate of less than three-tenths-of-a-percent per year. Since 2006, Enel has provided bidirectional policy phase meters that can be used with distributed generation systems. Another new development is integrated digital metering of gas, water, heating, and electricity.[47]

Recently, Enel partnered with Daimler in the "e-mobility Italy initiative" to build a network of 400 electric vehicle charging stations to use with 100 electric vehicles in Rome, Pisa, and Milan. The recharging system will use the same type of technology as Enel's 32 million digital smart meters.

Hydro One, a utility in Ontario Canada, is also implementing a smart grid system. By 2025, the utility is going to have to replace 80 percent of its generating facilities while

47 Rogai, Sergio. 2006. "Enel's Metering System and Telegstore Project". Presentation to NARUC Conference, Washington, DC, 19th February 2006. See, http://www.narucmeetings.org/Presentations/ENEL.pdf.

also expanding its generating capacity. Hydro One is similar to CPS in that it takes a long-run view of competitive business models and strategic investments. Given this backdrop of large investments, Hydro One decided to implement solutions that will maximize their resources, which includes an Advanced Metering Infrastructure (AMI) to serve all of its 1.3 million customers by the end of 2010.

As of December 2008 Hydro One had installed over 700,000 meters. The utility partnered with General Electric, Trilliant, Motorola, and Capgemini to create an open network that will allow the layering of additional applications on top of the basic technology, permitting advanced usage of smart thermostats and home displays. The communication networks that Hydro One are putting in place will also enable a wide variety of new productivity-enhancing business capabilities. These include automated vehicle location, safety monitoring, emergency communications with vehicles, and a much more mobile workforce.[48]

CPS Energy is currently formalizing a three part smart grid strategy comprised of a long-term vision for a CPS Energy smart grid, a roadmap charting the course for achieving that vision and a comprehensive implementation plan. The existing initiatives include: installation of Intelligent Electronic Devices (IEDs) such as digital relays and reclosers; Distribution Management System installation; Outage Management System (OMS) installation and applications; and the deployment of a Geospatial Information System (GIS). To that end, CPS Energy has been actively engaged in the processes that will result in the deployment of an Automated Metering Infrastructure (AMI) consisting of meters and a secure two-way communications system that will enhance customer choice related to rate options; demand response; communicating customer usage patterns; improved service restoration; and overall efficiency improvements in the daily operations of the electric system.

48 Hydro One. 2009. "The Hydro One Smart Network: The Future Has Arrived". http://www.smartgridnews.com/artman/uploads/1/Hydro_One_Case_Study_012209.pdf.

The evolution of smart grid will be crucial in advancing energy efficiency, renewable energy, and a cleaner transportation system. CPS can capitalize upon the experiences of others by determining what aspects of smart grid the city, CPS, and other stakeholders value the most. Different service areas have differing priorities and experience has shown that this shapes the development of the smart grid. The experience of Enel in Italy shows the effect of a commitment to market transformation combined with maximum value creation. Hydro One in Canada has the best example of a smart grid that emphasizes open communication protocols which allow broader application than most would imagine. Xcel energy in Colorado demonstrates an approach focused on consumer interaction, including some of its pitfalls.

Advancing the Pillar Four Investment Opportunity

A large scale deployment of smart grid in San Antonio will require an integrated approach involving simultaneous engagement in organizational transformation, business process transformation, solutions implementation, standards coordination, and regulatory involvement.[49] CPS has the opportunity to reduce learning curve delays by leveraging best practices and lessons learned from the many demonstration projects currently under implementation. Utilities, trade associations, and the Department of Energy are all developing databases and information clearinghouses that can enable the City and CPS Energy to avoid pitfalls that others have experienced.

Focusing on specific market demographics and prioritizing specific technical elements is essential. For instance, CPS Energy has historically maintained low retail electricity and gas prices; therefore providing new energy services and time based rates may require greater customer outreach programs for ensuring broad acceptance and realization of benefits.

Smart grid technology application, much like distributed renewable generation discussed above, can create completely new business models and applications for both CPS and the

49 For an elaborate discussion on strategic involvement, see "General Electric's Recommendations"

City. Leveraging data from near-real-time systems - inherent in the potential for San Antonio's smart grid infrastructure - creates the opportunity to expand a traditional utility's service line to include energy advisory, energy management, and control services. There are many lessons to take from other industries (i.e., telecommunications and supermarkets) that have leveraged the value of consumer data to expand service lines and apply new business models.

Creating alliances and partnerships with key organizations charged with development of standards for device and systems interoperability, as well as cyber security measures, will also allow the City of San Antonio and CPS energy to mitigate the potential of systems obsolescence. Other alliances with appliance manufacturers whose products overlap with the City and CPS' smart grid architecture should also be considered, as many manufacturers are becoming proactive in working with the utility industry for product demonstration and future product enhancements.[50]

As a first step toward coalescing and coordinating the many alliances and partnerships that will be needed if the Alamo region is to optimize the development of Pillar Four, the transition taskforce may find yet another difficult challenge, but one similar to outcomes needed for Pillar Three. In this case, the Taskforce should be directed to: (i) identify a range of smart infrastructure technologies that might enhance the seamless operation of the many different technologies embraced within the first three pillars; and (ii) provide a road map that ensures the optimal set of smart infrastructure technologies are available at the scale and distribution needed to ensure reliability and cost-effectiveness. Again, in parallel with the other technologies, the Taskforce would identify an appropriate set of metrics to guide the development as well as the ongoing implementation and evaluation of the Pillar Four challenge. As with Pillar Three, the development and implementation metrics would include an initial focus on the scale, cost, and reliability of the system grid and community infrastructure, as well as on job creation, new business startups, energy savings, greenhouse gasses and other emissions reductions.

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50 See KEMA (R. Wilhite) "Key recommendations for the City of San Antonio/CPS Energy

The Distributed Social Vision

Knowledge will be the key to fostering the Third Industrial Revolution and ensuring a smooth transition. The remaking of the infrastructure and the retooling of industries is going to require a massive retraining of workers. The new high-tech workforce of the Third Industrial Revolution will need to be skilled in renewable energy technologies, green construction, IT and embedded computing, nanotechnology, sustainable chemistry, fuel cell development, digital power grid management, electric and hydrogen powered transport, and hundreds of other technical fields. Entrepreneurs and managers will need to be educated in how to take advantage of new businesses models, including open-source and networked commerce, distributed and collaborative research and development strategies, and sustainable low carbon logistics and supply chain management. The skill levels and managerial styles of the Third Industrial Revolution workforce will be qualitatively different from that of the workforce of the second industrial revolution.

To this end, just as the first and second industrial revolutions were accompanied by vast changes in the educational system, the Third Industrial Revolution will require equally innovative educational reforms in order to prepare future generations to work and live in a post-carbon world. The new curriculum will focus increasingly on advanced information, bio- and nanotechnologies, the earth sciences, ecology, systems theory, collaborative and distributive education, open-source learning models, and social capital. We will need to educate our children to think as global citizens and prepare them for the historic transition from 20th century conventional geopolitics to 21st century global biosphere politics. Education will increasingly focus on both global responsibility to preserve the health of the planet's biosphere and local responsibility to steward regional ecosystems. Living sustainably will become the anchor of 21st century learning environments.

Efforts to create and retain green high-tech jobs in San Antonio can be enhanced through education and community partnerships. Such partnerships will cultivate talent by bringing together higher learning institutions, such as Texas A&M's newest San Antonio location with local businesses and neighborhoods. A similar model, the Triangle Universities Center for Advanced Studies Inc. (TUCASI) was employed with much success in the development of Research Triangle Park in North Carolina.[51]

A program like TUCASI would connect students with the high-tech industries that San Antonio is cultivating. The new students drawn to San Antonio's higher-learning institutions would supply the talent needed to develop and grow existing high-tech and green industry. Also, some of these students would presumably start their own firms, ensuring that San Antonio's industrial development is always on the cutting edge.

To prevent the creation of two San Antonios, the city should consider the use of energy skilling programs for both energy and equity goals. The city of Oakland, CA has adopted targeted skilling programs as a means to ratchet up the income of low-wage manual laborers, funded initially by a grant from the federal level through green jobs legislation passed in 2007.[52] However, given San Antonio's ambitious goal of being a Third Industrial Revolution lighthouse city in the United States, a broader and more comprehensive program is in order. When planned well, an education/skilling campaign can be an integral part of a more comprehensive plan aimed at increasing the enduring human capital and knowledge base of a region.

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[51] TUCASI was founded in 1975. http://www.rtp.org/main/index.php?pid=53&sec=1. Flexible office and state-of the-art lab space for new businesses (Park Research Center) has also been key to RTP's role as an economic incubator in the community
http://www.rtp.org/files/Fact%20Sheets/park_research_center_022307.pdf.

52 The Green Jobs Act of 2007 authorized $125 million for employee education/skilling programs that address skill shortages in "green" industries.

Such a project would increase the quality of public school education generally, focusing on math and the sciences. Concurrently it would also address higher and community education. Increased funding through state and federal grants and heightened faculty recruitment efforts for undergraduate programs in Science Technology Engineering and Mathematics (STEM) would provide the academic foundation for building a high-level scientific base at the University of Texas San Antonio, Trinity University, and St. Mary's University. Extension and normal course programs in HVAC improvements and solar panel installations could be run out of the campuses of the Alamo Community College District to create a living laboratory model similar to the LACCD model as discussed in Pillar Two. In sum, all educational assets of the region could be fully engaged, creating many educational synergies with significant potential multiplier effects over the course of the next two decades.

Some cities that have taken on this challenge have started largely from the grassroots level and still achieved considerable success. Among these efforts are the so-called "transition towns," around 120 towns and cities around the world that are choosing to be beacons of sustainability in an era of peak oil (Smitherman 2009). While some may criticize their efforts as "mere virtue," many are positioned to prosper in an era of resource scarcity. Because the transition town movement is so "bottom up" it may not apply fully to the situation of San Antonio. Yet the efforts of transition towns may be a good model, especially for how to increase awareness of public issues and facilitate organic behavioral change. Because these towns have had to start from the bottom, they've worked to generate smaller behavioral and micro-cultural shifts before they could effect larger change. Even though San Antonio's Mission Verde plan has buy-in from many larger stakeholders, to be successful it will need to have popular buy-in. But for citizens to fully take advantage of the programs, they'll need to be educated, informed, and impassioned.

These principals are being applied in one city during its earliest stages of development. The city of Masdar in the Middle Eastern state of the United Arab Emirates will be the world's greenest city: the first zero-carbon, zero-waste, car-free city

(Contractmagazine.com 2008, Porter 2008). Solar energy will provide heating, cooling, and clean water for the city of 50,000. Waste streams will be recycled, composted, or used in a waste-to-energy plant. Transportation will be provided by Personal Rapid Transport (PRT) vehicles guided by magnetic rails, similar to those unveiled by Toyota in recent years. The city will also guarantee fair wages for all inhabitants. Most interesting from an energy efficiency perspective, the city will require only 25% of the energy typically required to power a city of its size. This is especially notable because the city will require few sacrifices to achieve this.

The Massachusetts Institute of Technology is advising the city as it plans its Masdar Institute of Science and Technology, modeled on the US MIT. The city will be a hotbed of advanced clean energy science and technology, as well as a living laboratory where thinkers can see their ideas in practice. This element of "learning by doing" is part of why it is so important to see other cities' attempts to become sustainable. Much of the path towards sustainability cannot be planned. It must be learned. But as more large cities undertake this journey, others will be able to learn from them and actually leapfrog ahead. We hope that San Antonio can become the largest and most successful "leap-frog" with much of the same cutting-edge knowledge as Masdar, but practiced in an American way, in a Texan way.

Reinventing CPS Energy

A smooth transition into a Third Industrial Revolution will require new ways of conducting business. As more and more people become actively involved in power production, traditional power producers will adapt their business models, expand service lines, evolve value propositions, and re-examine the level of customer engagement. Utility companies are not exempt from this transition.

Current business models require utility companies to be experts in providing electricity. But in an era where efficiency gains and less power production could replace the higher costs of new generation sources, utility companies must begin to transition from

producing power to managing both energy and high value-added services. As more and more sources of distributed power are introduced, the business opportunities will increasingly lie in routing the traffic in energy grids to connect producers and consumers. Strengthening the core capacities of logistics and supply chain management and learning more about these transactions, opens the opportunity for a nearly infinite number of other value propositions.

As is commonly quoted, "the cheapest electricity is the kilowatt-hour that isn't used." In a time where everyone is looking for the option with the least cost, utility companies and municipalities in partnership with financial institutions will increasingly need to use business models similar to ESCOS, providing up front capital for individual homeowners and businesses to make efficiency installations and begin producing their own power.

The repayment for these investments comes in the form of energy savings. The utility benefits when it can share or completely avoid the higher cost of bringing new generation sources online, while the homeowner receives the benefits of lower energy bills. This multi-stakeholder buy-in also ensures a greater overall interest in understanding energy; which as previously noted, when combined with time of use pricing programs, can significantly affect consumer behavior.

As San Antonio and CPS gain more experience with Third Industrial Revolution models and begin to develop new business plans, they are also building institutional capacity, strengthening their own supply chain, and positioning themselves to offer these services in the future.

Bringing together all four pillars of the Third Industrial Revolution in a unified business plan could make San Antonio and CPS Energy a one stop shop for implementing a Third Industrial Revolution economic game plan in the region. CPS might consider new business opportunities along the entire value chain of a Third Industrial Revolution Infrastructure. With this in mind, CPS Energy and the city should become actively engaged in the business of financing, manufacturing, and servicing the various

components and process that make up the four pillar infrastructure of a Third Industrial Revolution. CPS can begin to transform itself from its traditional role as a producer of power and energy to a full-service provider that engages in business opportunities and partnerships at every stage of the production and delivery process, including the supply chain and logistics.

It should be emphasized that neither CPS nor the city will be able to implement an economic game plan of this magnitude, going it alone. To achieve its objective of becoming America's first Third Industrial Revolution region, the city and CPS will have to secure full customer participation. Common Interest Developments (CIDs), cooperatives, neighborhood associations, etc. are all potential players and partners in the implementation of a Third Industrial Revolution game plan for San Antonio and South Texas. According to Peter Bella, Director of Natural Resources for the Alamo Area Council of Governments, many of the difficulties faced by San Antonio are shared with the surrounding counties. San Antonio should consider positioning itself at the center of a South Texas energy network to bring together utility companies and other energy providers and users with the aim of establishing a Third Industrial Revolution Infrastructure across the entire South Region of Texas.

Mapping the Transition

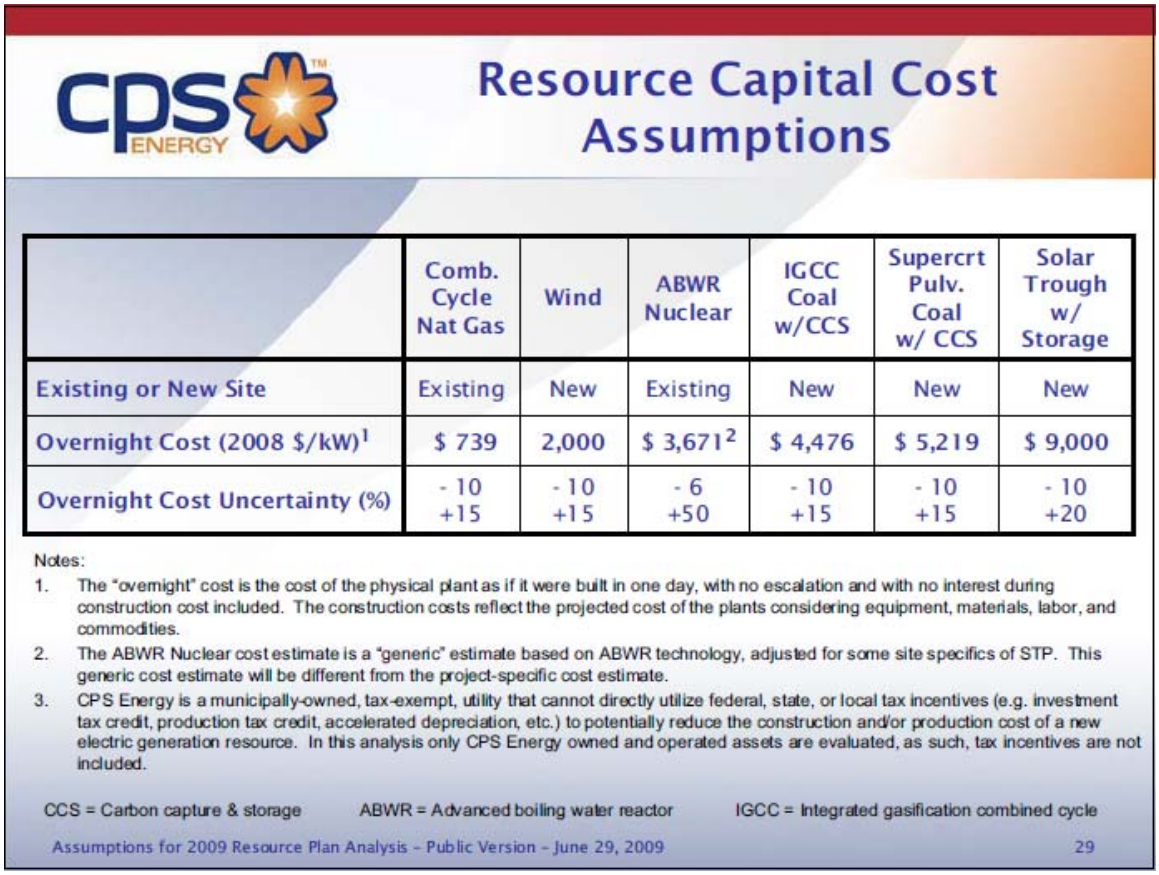
CPS Energy faces an initially difficult quandary. On the one hand it has a strong capacity and presence in the traditional generation of electricity, as it delivers electricity and natural gas at reasonably low costs. On the other hand, it is intelligently examining new ways to move into the Third Industrial Revolution. With a growing population and with many of its existing power plants now planned for retirement in the near future, it must balance the need to provide sufficient energy for all of its consumers - while doing so at the lowest possible cost. It needs to do all of that while also mitigating the impacts of climate change. Both the city and CPS Energy have balanced these priorities quite well thus far. The question must be asked, however, whether "more of the same" will truly

position the entire San Antonio region for the transition into a pattern of sustainable economic development.

New patterns and new opportunities will require questioning old assumptions. Utilities have long counted on load growth and annual sales growth between one and two percent. In fact, this rule of thumb held true in 45 of the last 58 years. But as consumers begin using less energy and producing their own power, there is decline in demand. Utilities around the country are currently going through this learning curve. Power demand in Texas is down 3.2% so far this year, while American Electric Power has seen an electricity demand decline of 4.4%. This decline in demand will also affect long-held assumptions about the profitability of wholesale markets. In the Houston pricing zone, the spot price in June 2008 was $129.48 a megawatt hour; in 2009, it was $61.82.[53]

At the same time, there could be an increase in demand for power as the transportation sector transitions to plug-ins and electric vehicles. In order to bridge this gap, utilities may be considering new power generations options. Assumptions regarding the risks associated with projected costs for these options should be carefully considered. Any investment which ends up costing in the upper range of uncertainty could absorb the discretionary capital that might otherwise be available for investing in sustainable development activities that could contribute to the transition to the Third Industrial Revolution. (See graph below)

[53] Smith, Rebecca. "Electricity Prices Plummet." The Wall Street Journal [New York City] August 12, 2009: A1.



Resource Capital Cost Assumptions

	Comb. Cycle Nat Gas	Wind	ABWR Nuclear	IGCC Coal w/CCS	Supercrt Pulv. Coal w/ CCS	Solar Trough w/ Storage
Existing or New Site	Existing	New	Existing	New	New	New
Overnight Cost (2008 $/kW)[1]	$ 739	2,000	$ 3,671[2]	$ 4,476	$ 5,219	$ 9,000
Overnight Cost Uncertainty (%)	- 10 +15	- 10 +15	- 6 +50	- 10 +15	- 10 +15	- 10 +20

Notes:

1. The "overnight" cost is the cost of the physical plant as if it were built in one day, with no escalation and with no interest during construction cost included. The construction costs reflect the projected cost of the plants considering equipment, materials, labor, and commodities.
2. The ABWR Nuclear cost estimate is a "generic" estimate based on ABWR technology, adjusted for some site specifics of STP. This generic cost estimate will be different from the project-specific cost estimate.
3. CPS Energy is a municipally-owned, tax-exempt, utility that cannot directly utilize federal, state, or local tax incentives (e.g. investment tax credit, production tax credit, accelerated depreciation, etc.) to potentially reduce the construction and/or production cost of a new electric generation resource. In this analysis only CPS Energy owned and operated assets are evaluated, as such, tax incentives are not included.

CCS = Carbon capture & storage ABWR = Advanced boiling water reactor IGCC = Integrated gasification combined cycle

Assumptions for 2009 Resource Plan Analysis - Public Version - June 29, 2009 29

For instance, CPS Energy and San Antonio could create an ongoing program similar to the recent Car Allowance Rebate (CAR) - "Cash for Clunker" - program by providing rebates for upgrading "Clunker" buildings and appliances. Perhaps a program for upgrading homes and businesses with state of the art energy efficiency and renewable energy technologies, if operated at a sufficient scale over time, could cost-effectively cancel the need for investment in traditional supply options. Upgrading the city's building stock would also appreciate the value of the real-estate to the benefit of owners, the city, and CPS.

Perhaps the most important issue to be explored is how to minimize long-term environmental risk. CPS currently projects that over 10 million tons of carbon dioxide (CO2) emissions will be avoided by investments in carbon capture and storage technologies, beginning in the year 2019. These assumptions must also be carefully examined as this is a technology has not yet been shown to be a commercially viable

business activity. A related question is whether there might be management strategies that can defer the planned retirement of the older, less efficient power plants so that the community might buy more time to fully deploy the full set of the four pillar technologies.

While there are uncertainties associated with energy efficiency and distributed renewable energy technologies, the evidence suggests there are even greater uncertainties associated with carbon capture and storage technologies. Nearly everyone in the industry acknowledges that the cost of traditional fossil fuel power generation is becoming more expensive - and will only continue to do so - given the rising energy prices and the projected climate change and emissions policies. On the other hand, the cost of Third Industrial Revolution generation is dramatically decreasing as these technologies reach economies of scale and scope, and as a result of greater learning and production experience.

Two things remain in this report. The first is to review and address several concerns raised by CPS Energy and City staff, both in the April Sustainability Workshop and in on-going communications since that workshop. The second is to recommend a framework to help the City and the region move forward into the Third Industrial Revolution.

Addressing Key Concerns

During the April workshop on Sustainability, CPS Energy and the City Staff (among others) raised a number of thoughtful concerns. The questions they posed were not intended to stymie momentum; rather they were serious questions that needed to be addressed in order to increase the probability of a successful transition to the Third Industrial Revolution. Three of those questions are addressed in some detail here:

Rates Versus Bills

The understandable concern both with ratepayers, and the community more generally, is the potential impact on the cost of energy if San Antonio moves too aggressively to fund investments, which may not prove to be cost effective. In this case, there are three questions that might be asked. First, would the rates go up anyway and would programs like this have a tendency to push costs back down? Second, if the U.S. economy pushes any form of GHG emissions targets, would that have a tendency to push up costs even further? Finally, can the level of energy savings offset higher prices, so that even with higher rates, the total bill might actually decline?

It turns out that there is a strong likelihood that energy prices, from whatever energy resource we choose, are likely to rise. The Energy Information Administration's latest forecast for the U.S. economy is that, on average, real energy prices will rise 50 percent by 2030. At the same time, efficiency improvements and less expensive renewable energy resources can help mitigate these upward pressures on energy prices. In other words, doing nothing at all is likely to place huge demands on all energy resources in ways that almost guarantee significant price increases. Moving the economy onto the path of the Third Industrial Revolution can significantly reduce those upward price pressures for San Antonio, for Texas, and for the US and global economies as a whole.

There is one possible exception, and that is if the US and other nations agree to put a cap on future greenhouse gas emissions. That is likely to place a carbon charge on all fossil-fuel related energy resources. The latest analysis from the US Environmental Protection Agency, for instance, suggests a carbon charge on the order of $30 to $60 per tonne of carbon dioxide emitted in 2030. To see how that might look in terms of electricity prices, for example, it might increase rates (based on US averages) from an average of $0.10 per kilowatt-hour (kWh) to as much as $0.13/kWh - roughly a 30 percent price increase. At the same time, if the nation as a whole made the kinds of investments envisioned by the Third Industrial Revolution, the electricity price might increase by 15 percent to only $0.11/kWh. What this means, then, is that if the overall energy use decreases by 25

percent, the total electricity bill might actually drop by about 18 percent. In many ways then, productive investments in the Third Industrial Revolution today provide a hedge against future price increases while lowering overall energy bills for rate payers.[54] This becomes even more apparent when we recall that the analysis characterized in the early part of the report, and buttressed by the data highlighted in Figures 2 and 3, suggest that it takes money to make money. But investment in the more productive energy system envisioned by the Third Industrial Revolution shows a net positive return for the San Antonio economy.[55]

Financing the Transition

Although we can't be precise or certain about the magnitudes of investment that might be required to lead the San Antonio economy onto the path of the Third Industrial Revolution, a reasonable starting estimate is on the order of $16 to $20 billion between now and 2030 - or $800 million or so investment each year, which is approximately 5% of each year's total economic investment. That is a sufficient investment to help San Antonio meet its 20-20-20 goal by 2020, and push on to 2030 in ways that lower greenhouse gas emissions (perhaps to 50 percent of the levels otherwise projected for the year 2030). While the returns look positive, that is still about 20 times the level authorized by the San Antonio City Council to underwrite CPS Energy's STEP program. So the question naturally arises, how does the community "step up" to that level of investment? And where does that kind of money come from? There is more good news that may help the community move in that direction.

San Antonio already has a strong cluster of financial institutions, and as the seventh largest community in the US, it has the demonstrated skill to raise this kind of capital year after year. As we again suggested in the early part of the report, San Antonio needs an average of about $16 billion per year of routine investment just to keep its normal economy going. This is the money necessary to build roads, schools, hospitals, factories,

[54] This working analysis is based on analytical tools developed by ACEEE (2009).
[55] In fairness, we must point out that there is a wide range of uncertainty in this kind of "futures analysis." But the critical point remains, that doing nothing is almost ensuring dramatically rising energy costs.

and the like - year in and year out. So in its diverse ways, the community is raising the amount of capital that would be needed to fund the entire community's transition to the Third Industrial Revolution each and every year. Or, as it was just stated, if San Antonio diverted the equivalent of just one year's routine investment over a 20 year period - or $800 million per year - and then channeled those dollars into more productive infrastructure, the Third Industrial Revolution would be substantially underway; this means using only 5% of the yearly economic investment to transition into to a Third Industrial Revolution.

Of course an investment of $800 million per year boosts the economy in the short term by creating new business opportunities and employment while laying down the infrastructure for a new industrial revolution with economic benefits to mid century and beyond. The question that San Antonio needs to ask itself is where it wants to be in twenty years from now - in the sunset energies and industries of a Second Industrial Revolution already on life support, or in the emerging sunrise energies and industries of a Third Industrial Revolution? In other words, how should San Antonio use its 16 to 20 billion dollars in annual investment in the local economy? We believe the answer is clear.

As Figure 3 indicates, investments in these kinds of technologies tend to have a much lower risk which, when coupled with a smart business plan, makes them more attractive to investors. At the same time, the many sections of this report highlight a variety of funding mechanisms. The real question is how the community chooses to organize itself to accomplish this task, and what collaborators and financial institutions it believes can do the best job to generate this desired outcome. To that extent, one of the major recommendations already mentioned, and further described below, will be to launch a community-wide transition taskforce to help the Alamo area prioritize both its energy and sustainability goals, and to identify the specific funding mechanisms and partners that will help San Antonio get the job done.

Economic Development

The City's Mission Verde Statement underscores the importance of integrating an economic development perspective into the forward momentum of the Third Industrial Revolution. This means examining the larger effort for its employment and business start up implications. It also means attracting the quality educational programs and the appropriate industry clusters that magnify returns on the community's investment in sustainability. In short, an economic development perspective means building the capacity needed to deliver goods and services in ways that rely on local businesses, local expertise, local resources, and the local labor force. [56]

As it turns out, San Antonio is well-positioned to build its economic development capacity through investments in the Third Industrial Revolution. First, the working analysis to this point suggests a net average benefit of 10,000 jobs per year added to the regional economy. This is the result of the direct investment in the current economic structure of the region. To the extent that San Antonio increases its capacity to provide more of the materials and skills locally, using the Four Pillar investments to empower new local markets, the number of jobs will grow well above the jobs cited above.[57]

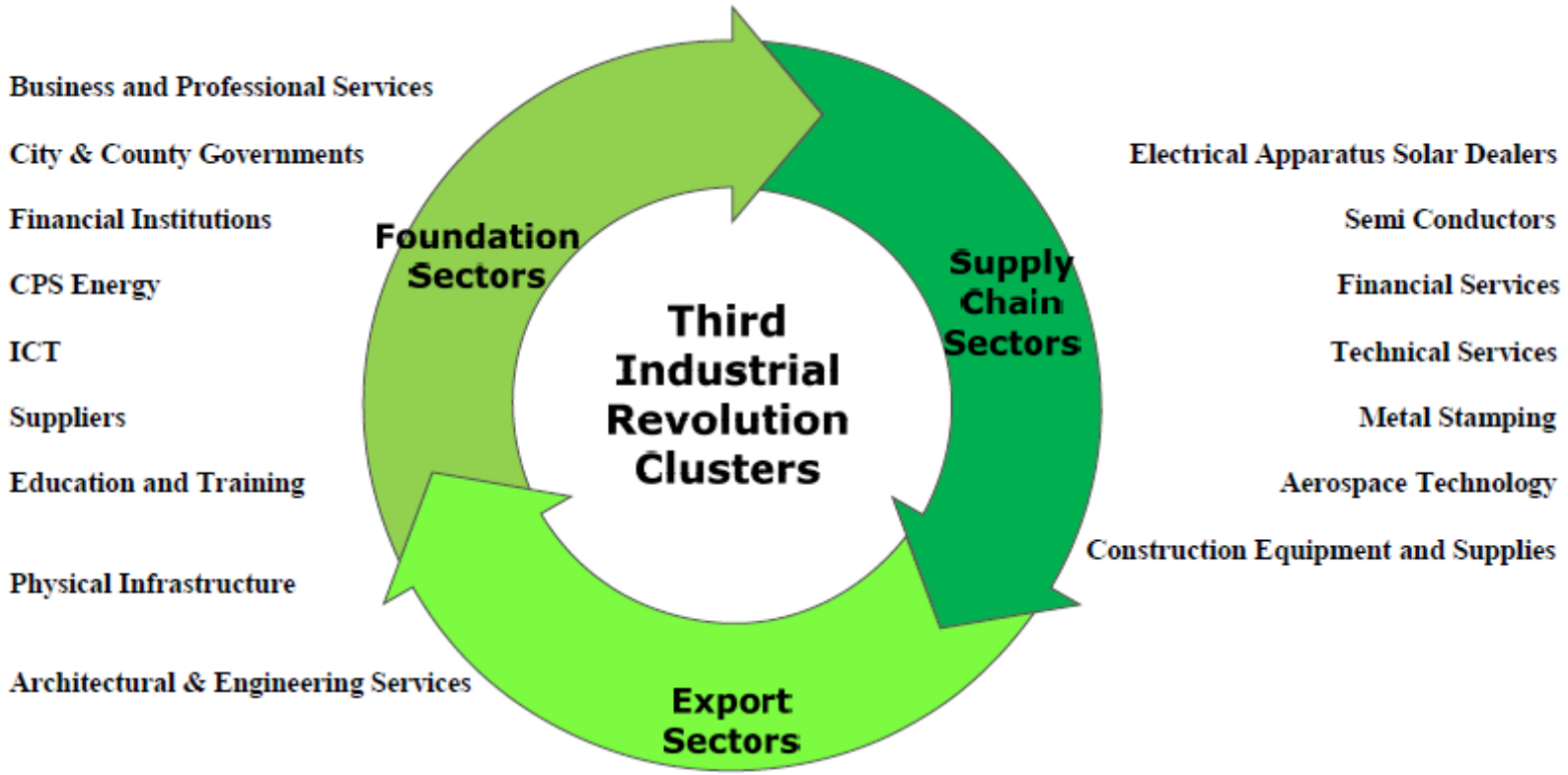
While there is not a strong manufacturing presence in the area economy, there are many existing skills in aerospace engineering and advanced manufacturing; and there are resources available through the Southwest Research Institute and the University of Texas at San Antonio. With these and other strengths, coupled with an investment strategy that is strategically linked to developing San Antonio's internal capacity, the commitment to a

[56] For a further discussion on the planning and implementation of a "Green Jobs" program in San Antonio, please see "Building Green Skills: A Green Jobs Program for San Antonio" by the Council for Adult and Experiential Learning (CAEL 2009) http://www.cael.org/pdf/AGreenJobsProgramforSanAntonio.pdf

[57] This is a critical point from an economic development perspective. If the regional economy now buys an average of 60 percent of its goods and services directly from local producers, merchants, and service providers, then its base economic multiplier – in simplified terms – might be 1/(1-0.60), or 2.50. But if the community uses the investment from the Third Industrial Revolution to stimulate an even greater level of local capacity so that it raises its internal spending from 0.60 to 0.65, then the economic multiplier increases to 1/(1-0.65), or 2.86. This is a 14 percent greater level of local economic activity for the same amount of investment dollars. While not a perfect fit, this rule of thumb would then suggest that the net gain of 10,000 jobs would grow to more like 11,400 jobs.

Third Industrial Revolution provides a game plan to build a sustainable economic development program within the community. This chart below is an especially useful lens to gain some perspective into this opportunity.

With the program activity catalyzed by a commitment to the Third Industrial Revolution, the productive investment begins with the foundation sectors of the San Antonio economy (as shown to the left of the figure). These foundation efforts build the market for the supply chain manufacturers and service providers. As the scale of the market begins to grow, and as more activity "clusters" around the technologies and systems that underpin the Third Industrial Revolution, more expertise and supply chain providers are likely to grow within the Alamo area economy. Finally as the momentum builds and successful projects take hold, new markets outside of the region will turn to the project and engineering expertise as well as the increased production capacity within San Antonio. All of this then lends itself to an even greater business volume to the benefit of the region as supply chain providers also begin to export their own goods and services.

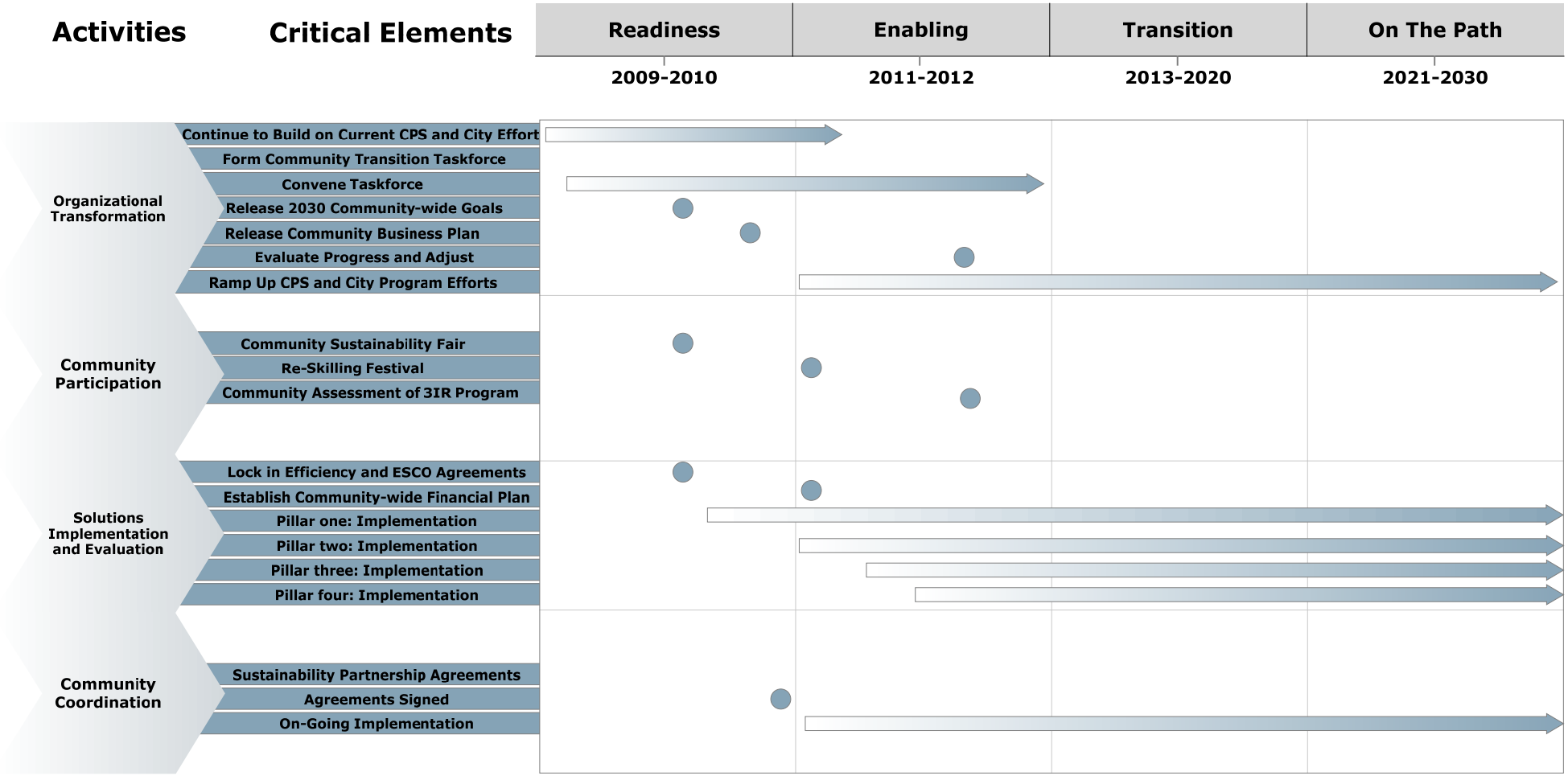

Business and Professional Services
City & County Governments
Financial Institutions
CPS Energy
ICT
Suppliers
Education and Training
Physical Infrastructure
Architectural & Engineering Services
Foundation Sectors
Third Industrial Revolution Clusters
Supply Chain Sectors
Export Sectors
Electrical Apparatus Solar Dealers
Semi Conductors
Financial Services
Technical Services
Metal Stamping
Aerospace Technology
Construction Equipment and Supplies
Balance of System Components
Transmission Equipments
Fiber Optics
Transceivers
Engineering Expertise
Software and Systems Tools

Handing Off the Baton

The CPS Energy Vision 2020 goals and the San Antonio Mission Verde provide a momentum-building foundation. It is one that can enable the City of San Antonio and the Alamo region to invest in and begin the development of a sustainably-based economy. Yet, there are a number of practical issues to be addressed. These range from how to map an implementation plan that reconciles the many different objectives within the community, to extending the CPS Energy Vision 2020 goals so that San Antonio as a whole can more completely fulfill the Mission Verde framework. While there are thorny issues in the implementation of these goals, there are also management solutions that can move the entire community ahead. The distillation of these solutions requires a finer grained assessment - one that melds careful thought with insights from multiple vantage points. It is with this perspective that these next recommendations are described, beginning with the 2020 energy goals set forth for the April 2009 Sustainability Workshop.

As the City of San Antonio and CPS Energy laid out the working agenda of the April Workshop, the intent was to "begin the process of creating an initial roadmap for transitioning the City of San Antonio and CPS Energy into a Third Industrial Revolution infrastructure and economy." The background documents prepared for that workshop further suggested that the goal would be "to assist the City of San Antonio in reaching toward the benchmark of 20-20-20 by 2020." In other words, the workshop might determine whether and how the City might achieve a 20 percent increase in energy efficiency, a 20 percent reduction in greenhouse gas missions, and the generation of 20 percent of its energy needs with renewable forms of energy, all by the year 2020.

Figure 5. Critical Steps in Mapping the Transition



In the three-day executive seminar that followed, a compelling case was laid out for both the need and the opportunity to meet those 2020 benchmarks. The case was supported by presentations from more than two dozen professionals with expertise in energy efficiency and in each of the Four Pillars. In addition, there was a variety of knowledgeable City and CPS staff and many other professionals within the Alamo region who were knowledgeable about systems and technologies that might enable a transition to a sustainable economy. The opportunity for such a transition is further supported by the evidence provided in this report. Yet, there is more hard work to be done if the community is to move past these 2020 goals and transition fully into the Third Industrial Revolution.

Given the context just described, some have appropriately asked: "How might the City and the larger Alamo region move forward with this transition effort?" Figure 5 provides at least an initial road map in this regard. The details include four sets of overall activities or steps. The different activities are then placed within four general phases of effort, beginning with the "Readiness" phase. This first phase generally covers the balance of 2009 and 2010. The next phase is referred to as the "Enabling" phase which includes activities in the years 2011 and 2012. The events to this point have been designed to give San Antonio and the Alamo region the capacity to formally begin the "Transition" years of 2012 through 2020. This period is consistent with the initial planning and work now supported by the CPS Energy Vision 2020 document. Finally, and with ongoing evaluations and adjustments along the full time horizon, the City of San Antonio and its many collaborators and allies would then be on the actual path to the Third Industrial Revolution in the years 2021 through 2030. Each of the four major steps is described next.

Organizational Transformation

As a first step onto the path leading toward the Third Industrial Revolution, the City of San Antonio and CPS Energy must help with the organizational transformation of the larger region. The intent is to better coordinate, manage, and direct the flow of

investments and resources that will help achieve the desired social and economic outcomes. Perhaps the most important recommendation in this regard is to convene a "Transition Taskforce." The members of this taskforce, supported by an appropriate level of consulting services made available within the regional economy, and building on the solid program efforts of the City and CPS Energy to date, would be charged with three specific tasks.

First, the Taskforce would be asked to study and sift through any existing or additional information so that it might provide an optimal business plan and definition of the "20-20-20 by 2020 goals." It would then move beyond the goals for 2020 with a vision and larger set of objectives for the Alamo region by 2030. Even as CPS Energy and the City continue to build momentum with the successful implementation of the STEP program and other initiatives, the Taskforce would release the 2030 Community-wide Goals (covering the entire Alamo Region) some time in the spring of 2010.

Second, after a longer investigation and review of the relevant business and financial perspectives associated with funding the transition to the Third Industrial Revolution, the Taskforce would release the equivalent of a Community Business Plan to lay the groundwork for securing the eventual investments needed between now and 2030. This second taskforce effort presumably would also be supported by adequate expertise and consulting services. The business plan would be released in the Fall of 2010. At that point, both the City of San Antonio and CPS Energy might determine how best to ramp up their existing program efforts to support the larger 2030 goals suggested in the taskforce recommendations.

Third, the taskforce would suggest a set of metrics by which the various goals and programs would be periodically evaluated. At this point, two sets of metrics might be adopted: (i) a set of development benchmarks to gauge the progress of introducing key systems and technologies that may not yet be commercially viable, but which are critical to the longer term success of the Third Industrial Revolution; and (ii) a set of implementation metrics to guide the regular evaluation of program outcomes. The first

major evaluation of the larger transition effort might be expected in 2012, toward the end of the enabling phase.

One further note might be especially appropriate, and that is a comment about the composition and life of the Transition Taskforce. There is no magic number as to the appropriate size of such a taskforce. Rather the focus should be on the availability of expertise within the Alamo region. More specifically, the taskforce should include individuals with skills and expertise in energy efficiency and in each of the Four Pillars, as well as expertise in business development, financial planning, and program implementation. Finally, the membership should include people representing the many different faces and voices of the larger San Antonio community.

Given the critical role played by the Transition Taskforce, the City and CPS might consider one additional recommendation. Rather than merely invite individuals to participate on the taskforce, they might actively recruit and screen potential candidates for eventual membership. Perhaps several dozen potential candidates might participate in a daylong briefing later in 2009 about the efforts to date and about the outcomes of the April 2009 workshop. These potential candidates might then formally apply for membership. Following a screening process set up by the City and CPS, the final selection of members (and perhaps alternates) might then be announced. Their work would begin almost immediately. Depending on the mix of events and outcomes, the responsibilities of the Transition Taskforce might expire at the end of the Enabling Phase, or in 2012 (although not before recommending how work and specific tasks might be expected to continue after dissolution of the taskforce).

Community Participation

However solid and credible the efforts of the Transition Taskforce, a successful transition to the Third Industrial Revolution will not be possible without the enthusiastic backing of the businesses community and the active involvement of the city's consumers. As a means to encourage direct participation and active buy-in from the widest range of

groups and organizations, this step focuses on the direct participation of the full community. The first major event in this regard is a Community Sustainability Fair that is timed just after the release of the 2030 Community-wide Goals in early 2010. The event should be both an announcement of the 2030 goals and a celebration and acknowledgment of the ongoing efforts by the City of San Antonio, CPS Energy and others within the community. The point is both to honor the work that is already being done and to encourage the active involvement of others within the community. The Community Sustainability Fair should be celebratory, informative, and educational; and above all, it should be fun.

Following the release of the Community Business Plan, the City of San Antonio and others should hold what might be termed "a Re-Skilling Festival." This is a multi-day event that focuses on the education, skills, and training that will be needed to ensure a knowledgeable and active workforce - one that can directly participate in the transition to the Third Industrial Revolution. The Re-Skilling Festival might also provide workshops and information on how local households and businesses can participate in and better position themselves to contribute to the full transition. In short, there would be two aspects of the Re-Skilling Festival. The first would focus on job and career skills and the second would focus on personal and community skills.

The last community-wide event in this enabling phase might be a Community Assessment of the Third Industrial Revolution Program. Ideally, this will follow the release of the Transition Taskforce's first formal evaluation of the activities and efforts through mid-2012. This event will signal the transition from a readiness stage of the transition effort to the successful completion of the enabling stage.

Solutions Implementation and Evaluation

Building on the early energy efficiency and renewable energy momentum established by CPS Energy, this step begins to lock in the active implementation and evaluation of the critical elements of the full transition effort. The first element, generally following the

release of the 2030 Community-wide Goals, is the securing of additional sources to expand the level of energy efficiency agreements or programs within the region. This is an effort to slowly increase current program efforts so that, consistent with the community-wide goals, the energy efficiency solution moves from a phase of readiness to one that can further build momentum for the full transition. Among those agreements are the recruiting and approval of what might be termed Super ESCOs within the Alamo region. The energy service firms which have been vetted and approved by the City and CPS Energy can then deliver a greater level of energy efficiency gains than now envisioned in the CPS Energy STEP program, for example.

The next task is to build on both the 2030 Community-wide Goals and the Community Business Plan by establishing additional financial mechanisms that will attract the needed investment into the San Antonio region. Although the roadmap in Figure 5 identifies no specific organizational responsibility, one can imagine that this is an effort that might best be undertaken by the City, CPS Energy and other governmental allies. Finally, each of the Four Pillars will be separately defined, implemented and evaluated at staged intervals in ways that are coordinated with the community goals and business plans.

Community Coordination

Although there is a clear need to directly involve the community in a very large and celebratory way, there is also a need involve the many community members in an organized and coordinated way. This step is designed to enlist the active and direct involvement of the many community groups and organizations by creating sustainability partnership agreements. Again following the release of the 2030 Community-wide Goals and the Community Business Plan, the City and CPS Energy (or perhaps another entity on behalf of the City) would create and secure a set of partnership agreements.

Each set of partnership agreements would be targeted to the many other governmental entities, educational institutions, business and labor organizations, community and church groups, and the wider variety of formal and informal groups that reflect the many social

and economic stakeholders found within the San Antonio region. Much like the various EPA Energy Star partnerships, this effort would provide an especially strong foundation to enhance the probability of a successful outcome for the transition to the Third Industrial Revolution. Since it is inevitable that both the means and the objectives of the transition would evolve over time, one can also imagine such agreements would be dynamic in that they would evolve as the larger transition takes place. Finally, the responsibility of City's many sustainability partners would be to ensure on-going implementation and success of the full transition to the Third Industrial Revolution.

A Final Note

The roadmap described here, and summarized in Figure 5, is presented in full recognition that there is no simple recipe that will ensure San Antonio is able to secure a robust and sustainable economic future. What can be said with confidence, however, is that there is both a need to act and the opportunity to do so. In the words of author and Pastor John Maxwell, "The pessimist complains about the wind. The optimist expects it to change. The leader adjusts the sails." With this report and roadmap now in the hands of the City of San Antonio and CPS Energy, it is our hope that we have at least provided the Alamo region with the means to help adjust the sails.

The evidence is compelling and the opportunity is large. The City of San Antonio and CPS Energy have the means to fully transition the Alamo economy onto the path of the Third Industrial Revolution - if it chooses to do so. And there is every reason to believe that the future health of the area economy depends on making that proactive choice. Moreover by becoming the nation's first city to transition into a Third Industrial Revolution, San Antonio will lead the way for the rest of the country, setting the United States on a path to a sustainable "quality of life" society in the 21st century.

Supplemental Information

American Council for an Energy-Efficient Economy
529 14th Street, N. W., Suite 600 Washington, D.C. 20045 202.507.4000 202.429.2248 www.aceee.org

To: Cris Eugster, PhD
EVP and Chief Sustainability Officer
CPS Energy

From: John A. "Skip" Laitner
Director, Economic and Social Analysis Program

Re: Overview of Methodology on 3rd Industrial Revolution Investment Scale (Draft)

Date: August 2, 2009

This memo follows up your request for background on the methodology we used to estimate the scale of the potential investment necessary to bring down San Antonio (Bexar County) Greenhouse Gas Emissions as shown in Figure 1 (copied below) of the draft report, "San Antonio: Leading the Way Forward to the Third Industrial Revolution." More specifically, we are explaining the methodology that underpins the statement: "Moving San Antonio from a business-as-usual case of a 17 percent increase in overall greenhouse gas emissions, to a transition that greatly reduces emissions will require on the order of 15 to 20 billion dollars of smart investment that can be directed toward this purpose."

The investment figure we cited was in the spirit of providing a broad narrative that might inform CPS Energy and the City of San Antonio about the potential scale of investment that might be needed to bring down the County's total greenhouse gas emissions from some projected level to a figure that would be 20 percent below the forecasted level by 2020 – using some combination of energy efficiency, renewable energy, clean energy technologies, and other non-energy related processes.

In effect, we followed a three-step process in generating the various estimates provided in the draft report: (1) build an emissions projection through the year 2030; (2) find a potential path that would at least provide a 20 percent reduction from the 2020 projection; and then, (3) estimate the potential investment. I describe those more fully below.

Total Greenhouse Gas Emissions Projection for Bexar County through 2030

To give us a starting point in total greenhouse gas (GHG) emissions (including both energy and non-energy related emissions) we used the 2005 estimate from AACOG (2008). We then matched this up with the historical level of personal income for Bexar County published by Woods & Poole (2008). We grew the 2005 level out to 2030 by relying on the Woods & Poole constant dollar projections for Bexar County from 2008 out to 2030. Finally, we anticipated what we might refer to as a normal rate of reduction in the GHG emissions per constant dollar of personal income. This last change generally followed the national rate of reduction of carbon dioxide emissions associated with energy consumption as projected by the Energy Information Administration through 2030 (EIA 2009a). With that we have the following table of key values:

Key Bexar County Data	2008	2030	Annual Growth
Population (1,000s)	1,622	2,260	1.5%
Personal Income (millions of 2006 $)	54,200	102,533	2.9%
Estimated Primary Energy (Trillion Btu)	498	649	1.2%
Estimated GHG Emissions $MMTCO_2e$	27.2	31.8	0.7%

The 20 Percent Energy Reduction by 2020

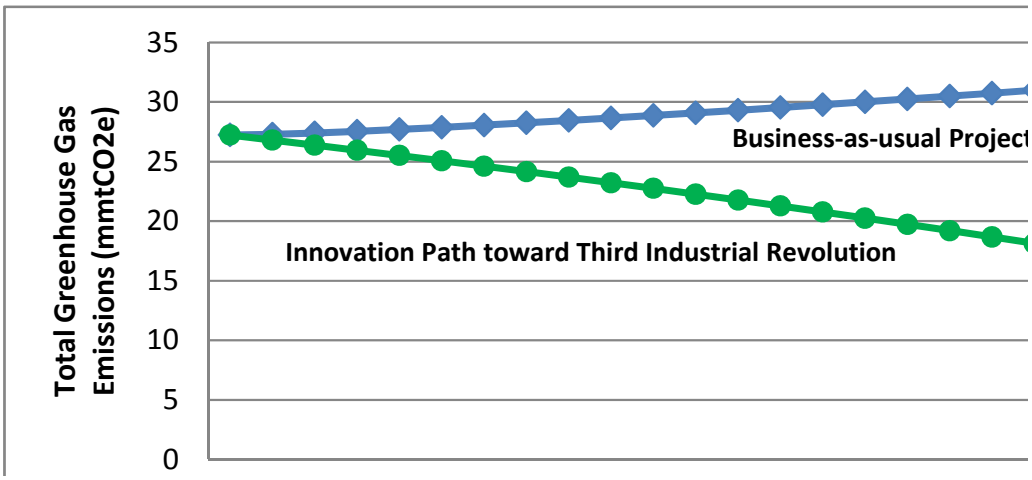
The estimate of the 20 percent energy and related emissions reductions was a straightforward calculation. It generally followed a number of previous estimates of what might be possible economy-wide (see Elliot et al 2007, Laitner et al 2007, AEF 2009, and McKinsey 2009). This resulted in the following values.

Bexar County Energy/GHG	2020	2030	Annual Growth*
Baseline Energy (Trillion Btu)	569	649	1.2%
TIR Energy (Trillion Btu)	455	430	-0.7%
Baseline GHG Emissions ($MMTCO_2e$)	29.3	31.8	0.7%
TIR Emissions ($MMTCO_2e$)	21.8	16.5	-2.3%

* Growth is from the assumed 2008 values shown in the table above.

If this trajectory for the Third Industrial Revolution is followed, then total primary energy demand for Bexar County (including transportation and all non-electricity fuels) in 2030 would be reduced by about 34 percent energy. Total greenhouse gas emissions would be reduced by about 48 percent in 2030. Depending on how we want to assign the credit, it appears that efficiency would provide about 70 percent of the reduction and clean energy technologies and other processes would provide the balance of the reductions by 2030. Of course, the actual path is yet to be decided. Figure 1 below replicates the trajectory originally published in the draft report.

Figure 1. San Antonio Greenhouse Gas Emissions Trajectories 2008-2030



Estimating the Investment Potential

From published sources from the Bureau of Economic Analysis (BEA 2009) we were able to estimate that normal investments to maintain economic activity over the period 1990 through 2008 averaged about 17.8 percent of personal income. By applying that ratio to the projected personal income for Bexar County, we estimated that normal investment in Bexar County would rise from about $9.6 billion in 2008 to about $23.7 billion in 2030 (in constant 2006 dollars). This, of course, includes a huge number of uncertainties but it allows a benchmark against which to compare or understand the magnitude of the investment that might otherwise be required to reduce greenhouse gas emissions.

The total investment required to reduce total greenhouse gas emissions is assumed to be a function of changes in energy use and the carbon intensity of the remaining energy that is used. In effect, energy is also responsible for picking up the non-CO_2 emissions. The basic calculation depends on the starting average price for all primary energy used in 2008, multiplied by an estimated payback period needed to reduce either energy use or the CO_2 intensity that might be associated with energy use. From the Energy Information Administration (2009b) we determined that the average price of all energy in Texas was $16.68 per million Btu. If the equivalent starting payback value for an

investment in emissions reduction is three years in 2009, then the investment to reduced GHG through either a reduced energy use or through a reduced CO_2 intensity for the energy that is used is $50.04 dollars per million Btu (in constant 2006 dollars). If that average payback eventually grows to 7 years then the investment required also grows to $116.76 per million Btu (again in constant 2006 dollars).

The payback of 7 years is a weighted value that assumes efficiency would deliver about 75 percent of the reductions and by 2030 would require an average payback of about 4-5 years, while clean energy technologies, the purchase of emissions offsets, and the improvement of non- CO_2 intensities, responsible for the remaining 25 percent reductions might require an average payback equivalent of 12-15 years. The weighted average payback then becomes about 7 years. We triangulated around these values relying on a variety of sources to inform our estimate (including Lazard 2008, Elliott et al. 2007, AEF 2009, and McKinsey 2009). This was a technique we adapted for the Semiconductor Industry Association in May 2009, for example (see Laitner et al. 2009).

From these data we then estimated the annual investment would have to grow from about $484 million in 2009 to 1.2 billion in 2030 (also in constant 2006 dollars). That is an investment level that represents about 5 percent of total investments required annually in Bexar County over the period 2009 through 2030. Let me highlight three caveats in providing this estimate. First, the estimate does not assumes any so-called "learning" where costs decline because of improved processes; nor does it include economies of scale with expanded ramp up of program effort, and no further innovations in technology and or any dynamic market response (see Knight and Laitner 2009, for example). At the same time, it does not include program costs and diminishing returns. Finally, other assumptions would, of course, change these values.

I hope this gives you a better sense of our assumptions and our overall methodology. Again, it is intended to inform CPS Energy and the City of San Antonio about the scale of investment that might be needed, not at all to prescribe what should be done or what precise mix of technology and/or program solutions should be pursue. I would be happy to discuss this further as you may have additional questions.

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Recommendations from Third Industrial Revolution Global CEO Business Roundtable participants

Acciona Recommendations voluntarily withheld by company

Mission Verde - Concluding remarks from Sustainability Conference

TO: Jeremy Rifkin

COPIES: Al Wynn / CH2M HILL
John Hoffner / CH2M HILL

FROM: Lyell, Kurt/AUS

DATE: May 6, 2009

In the Mission Verde conference in San Antonio in April, 2009, there were several opportunities discussed as part of San Antonio's goal to be a sustainable leader. By committing to renewable energy ahead of the curve, San Antonio hopes to capture some economic benefits of being a leader and developing industry.

Several renewable energy technologies exist and Texas has excellent wind, geothermal, hydroelectric, solar and biomass resources. Using solar PV as an example reference point, there are multiple components of the supply chain that have potential for economic stimulus and creating jobs. Many cities look to solar cell and module manufacturing as the preferred economic development strategy for solar energy; however, in addition to cell manufacturing, there are several other industries that contribute to solar energy's supply chain. Specific examples of the supply chain that require industrial manufacturing include:

- raw silicon processing
- glass manufacturing
- mounting and racking manufacturing
- tracking systems
- inverter production/manufacturing
- electrical components (including inverters, combiner boxes, and specialty balance of system components)
- solar module manufacturing

San Antonio has a long standing history of being a center for creativity and industrialism. San Antonio is blessed with industrial resources such as rail spurs, highways and other infrastructure resources that enable industrial manufacturing. San Antonio's labor pool is well-suited for manufacturing and industrial centers. As such, San Antonio may wish to consider attracting industrial employers that contribute to solar's supply chain.

According to the March issue of Photon International magazine, there is 7.9 GW of annual solar production capacity in the marketplace. Industry experts have predicted that the market could install 7 to 12 GW in 2011, mainly through utility scale projects.[i] Locally, Texas represents one of the largest markets for solar in the United States due to the state's large size, and solar resources.

While module production capacity continues to grow, opportunities exist in the marketplace for ancillary products and services. Manufacturing of structural mounting and tracking systems sticks out as an industry that would match San Antonio's strength's and also enable the needs of the marketplace, both helping to develop Texas' solar industry and retain economic benefits. A single-axis tracking system such as the one in Figure 1 on the right moves with the suns path to increase the solar output of the modules. Navigant Consulting projections show "tracking systems being used in at least 85% of commercial installations greater than 1MW in 2009-2012" [ii]

Figure 1: Single Axis tracking system. Photo Courtesy RayTracker

Almost all solar systems need to be mounted to the ground, or on a roof of a building. Single axis tracking systems have motors and controls to track the sun, and can increase the solar output by up to 28% over a conventional 15° fixed tilt mounting system (see Table 1 below). As such, mounting and tracking systems can play an important role in reducing the cost of solar energy in the Texas region.

Table 1: Effects of tracking systems on Solar Output in San Antonio, TX

System Output vs. Mounting Type				
Mounting type	kWh/kW-dc of capacity *	Capacity Factor	Expected Output from a 1.0 MW-dc solar facility	Improvement from 15 degree fixed mounting (%)
Fixed 15° tilt	1356	15.5	1,356,000	0%
Fixed 30° tilt	1373	15.7	1,373,000	1%
1 axis tracking at 0°	1662	19	1,662,000	23%
1 axis tracking at 20°	1742	19.9	1,742,000	28%
2 axis tracking	1799	20.5	1,799,000	33%

*based on San Antonio weather data with Solar Advisor Model estimates

In conclusion, San Antonio should match its economic development goals with assessments of its strengths as a city, while being aware of the capacities and opportunities in the marketplace.

Cell and module manufacturing represent only a fraction of the supply chain possibilities for renewable energy. Balance of system requirements including solar tracking systems, and specialty services represent multi-billion dollar opportunities. Adoption of balance of system manufacturing has the potential of reducing the cost of solar systems in Texas, as well as creating local jobs.

Recommended Path Forward

Per conversation with Mark Henderson, the general manager of RayTracker, they would be amenable to work with local steel suppliers to manufacture components for a tracking system in San Antonio on a project. Other companies that produce tracking systems would likely have similar views toward partnering with local factories. One way to immediately implement solar capacity, solar jobs, and develop relationship with a tracking manufacturer would be to install a 1 megawatt (MW) distributed generation solar system in San Antonio that uses locally-made tracking systems. Use of locally-made systems should be highlighted and would help set the tone for community support of solar adoption in San Antonio.

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CROSS & COMPANY

May 8, 2009

Mission Verde San Antonio

Situation Analysis and Recommendations for Master Plan

Cushman & Wakefield / Cross & Company / DWH Strategic Advisors

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Thank you for the invitation to attend the April 2009 Mission Verde Sustainability Workshop and hear first-hand the ambitions and commitment of the City of San Antonio (COSA) and City Public Service (CPS) to a forward-thinking vision for energy independence. It was exciting to see a major municipality within the most energy-intensive state in the United States now poised to be the first city in the nation to leapfrog into a position of leadership on sustainable practices and alternative energy.

In particular, we share COSA's and CPS' commitment to the principles of the Four Pillars of the Third Industrial Revolution (TIR), guided by Jeremy Rifkin's narrative, to address the "triple threat" of climate change, energy security and economic transformation. We have partnered extensively with The Office of Jeremy Rifkin in the TIR, having participated in TIR events and projects in Washington, D.C., Brussels, Toronto and now San Antonio. Of all these exciting efforts, San Antonio has quickly achieved the most advanced stage, and it is the most exciting in its prospects for near-term success.

Based on a strong track record in energy efficiency and on-the-ground design, implementation and financing of complex transit-oriented and alternative energy projects, the Cushman & Wakefield team is pleased to present this brief overview of our recommendations to positively impact San Antonio's financial bottom line and reach the TIR goal of reducing energy use and carbon generation by 20% by 2020. We therefore frame our recommendations for COSA, CPS, and CPS customers in terms of San Antonio's TIR strategy, and from the perspective of our expertise in real estate and consulting services.

The goal is to transform existing properties, and plan for new development, via sustainable and profitable investment adhering to the Four Pillars of the Third Industrial Revolution: Renewable Energies, Buildings as Positive Power Plants, Hydrogen Storage, and Smart Grids.

To succeed, all Mission Verde stakeholders must connect a great number of dots. Whether in terms of TIR or sustainable practices in general, our experience in Europe, California, Colorado, New Jersey and elsewhere suggests that alignment of interest and incentives is essential between technologies, utilities, regulatory and political bodies, and real estate owners and tenants, in order to achieve success "at scale."

Real estate is the nexus of all these considerations and opportunities. Commercial buildings are the focus of immediate gains in energy and other natural resource efficiency, as well as the platform for clean energy production and transit-oriented development in the future. We therefore present our recommendations for San Antonio's Mission Verde Master Plan from the perspective of the world's largest independent provider of comprehensive commercial real estate services.

Recommendation: Establish Centralized Project Management

This step is essential given the scope and range of the objectives, the number of moving parts needed for effective implementation across industry sectors, and the multiple constituencies within San Antonio who must be continuously informed. Even with the best technology, an integrated plan will fail without:

- Public Communication – clear, coordinated and persuasive
- Coalition-Building – successful and inclusive
- Buy-In – from major building owners and users
- Ongoing Education – all key constituencies

Additional key steps include coordination of COSA planning with emerging State specifications, both technical and financial, and tracking of State and Federal programs and funding for specific initiatives. This is best achieved by centralized Project Management.

Most of all, by centralizing Project Management, accountability can be ensured for overall project completion to deliver anticipated efficiencies and net positive power targets.

Recommendation: Map a Comprehensive Approach to Achieve Improved Building Efficiency At Scale

Return on Investment (ROI) from increased efficiency is clear. Our extensive retrofit of the Adobe Headquarters project yielded a 121% ROI; ROI for re-lamping projects can be as low as 18 months. There is much low-hanging fruit in San Antonio. Even though 56 buildings have become Energy Star qualified, hundreds remain eligible. At an average historic rate of as much as $260,000 per building, this equates to an available estimated savings of $52 – $78 million for public and private property owners in San Antonio.

Before a specific program for building efficiency can be developed, decisions must be made as to both technical standards and buy-in from key constituents. The primary alternative standards that can be used incrementally include:

1. The Energy Star program: a low-cost alternative sponsored by the EPA which has proved successful on retrofits.

2. LEED: sponsored by the U.S. Green Building Council, a 501(c)3 used mostly for new construction. Going forward, LEED certification for buildings will be subject to a stricter standard; new LEED qualifications take effect later this year.

Regardless of the standard applied, the paradigm shift toward more efficient buildings is already occurring in San Antonio. There are currently 15 LEED-Certified buildings in San Antonio, as well as another 25 LEED registrations, and the number of Energy Star labels awarded in San Antonio

since 1999 (129 for 56 buildings) has ramped up significantly since 2004. Additionally, there are more than 15 sustainable or green commercial real estate projects (conversion or new construction) recently announced as in process in San Antonio.

Major commercial users such as Adobe Systems have particularly compelling results. In San Antonio, Citigroup and The Pearl Brewery redevelopers are among those who have already demonstrated leadership in efficiency. Showcasing information of this kind is itself incentive for owners to consider participating in a comprehensive retrofit program.

However, in every market segment and demographic, buy-in will continue to increase only as the economic case for a Green and Sustainable Economy is made in a properly relatable and quantifiable fashion. In doing so, attention should be paid to specific differences between building types and ownership profiles. For example:

- City, County, State, Federal and Military/Department of Defense (DOD) buildings pose different regulatory and operational challenges to implementation. Cushman & Wakefield and Cross & Company bring experience with unique financing structures for military installations. At the DOD, for example, the Enhanced Use Leasing program (EUL) establishes a public-private partnership where the public entity contributes the building and the private sector brings capital to renovate or redevelop the property for the public sector's use.

- Corporate and institutional (i.e., higher education) players must be engaged in order to maximize overall program impact. This can be done using a variety of financing mechanisms and incentives, as well as by raising awareness of potential ROI and impacts on building valuation.

Property owners and occupiers are most critical, as they must embrace the conversion of existing technology, energy infrastructure, transportation, land use, buildings and land. However, other important constituencies include:

- Voters and CPS rate-payers, who must be effectively informed about and in many cases, formally approve local initiatives.

- The broader business community, who are well positioned to support investment, development and implementation of key initiatives.

The appropriate role for, and relationship with, industry specialists within the community must be determined in order to tap local knowledge and harmonize technical efforts and incentive programs. Potential partners include:

- SA Clean Technology Forum – Michael Burke
- Solar San Antonio – Bill Sinkin
- Texas Commission on Environmental Quality

We therefore recommend that COSA and CPS create a rollout plan for best practices and continued improvement, drawing on input from these constituencies.

It is critical that this plan be not only technically clear and rigorous, but specifically adapted and communicated to the full range of partners who are critical for successful implementation, including with organized opportunities for public comment.

Finally, San Antonio should adopt the best experiences of other jurisdictions throughout the country. As such, we recommend identifying a single point of contact to collect information and direct information-sharing with federal authorities and those from other states, and to be a continuing resource for other TIR cities and countries as they follow San Antonio in the TIR.

Recommendation: Inventory Buildings for Retrofit and Solar Installation

Making the case for transformative upgrades at scale can, in part, go hand in hand with creating the foundation of technical information required for successful implementation at specific building sites. We recommend engaging building owners in a systematic program of energy audits, based on:

- Size & Physical Characteristics
- Tenant/End-user
- Owner
- Energy use

Candidates should also be divided into categories based on their suitability to support specific elements of COSA's TIR strategy. For example:

- Big Box = Solar
- Older and Single Tenant Office Buildings = Re-lamping
- Multi-Tenant Office Buildings of an Older Era = Energy and Management Systems

This inventory will establish a broad baseline of information. For example:

- For each category of building, establish per-square-foot baseline against which to measure success.
- Identify re-lamping and energy management system candidates based on such criteria as age of building, current energy use, etc.
- Identify eligible solar targets based on such criteria as type and age of roof, as well as number of obstructions.

In the interests of both practicality and "leading by example," we recommend that the program initially target CPS and municipally owned or controlled buildings. Key commercial partners should be included as information is shared and resources are made available.

Recommendation: Implement Retrofit Program

Proceeding from the inventorying process, CPS and COSA should be first to undergo retrofits. This will further build a track record of success to help attract corporate/institutional participants.

While implementing measures to increase efficiency, CPS will have the opportunity to build the foundation for a smarter system in the future. In addition to passive improvements, dynamic controls should be installed where technically feasible, in anticipation of automated control during peak periods, and ultimately, the deployment of an interactive grid capable of returning surplus generation from net positive power buildings.

Recommendation: Undertake Roof Leases for Solar Deployment

In tandem with the rollout of the building efficiency program, we recommend that CPS pursue an aggressive program to deploy solar capacity. This complements CPS' historic leadership in wind power in a way that achieves the TIR vision of distributive power by engaging individual property owners.

Cushman & Wakefield, through strategic partner DWH, is currently working with solar developers and interested property owners across the U.S. Over one hundred megawatts (100MW) of solar power production have been proposed in several states for rooftop installations to serve commercial and institutional users.

Recommendation: Advance Best Practices in Solar Financing

Solar power is feasible only when it is financeable. Building on federal programs, New Jersey, Colorado and California offer models of state regulation and incentives that can be modified and adopted to help jump-start solar in San Antonio.

Specifically, we propose a Solar Development Model that requires no capital investment on the part of the property owner or tenant. In outline, this model has the following characteristics:

- Lease the rooftops from property owners and pay rent during the term of occupancy on the roof.
- Finance and build the solar array and required equipment ($5 – $7 million per MW installed).
- Sell power to tenants through a Power Purchase Agreement (PPA).
- Power is typically sold at a reduced rate to the tenants.
- PPA is a long term agreement, typically 10+ years, which allows tenant to better predict and, therefore, manage energy costs.

Cushman & Wakefield and DWH can bring to bear our extensive experience in Best Practice Examples (NJ, CO, CA). Most exciting, however, is the prospect of adapting and developing this model further, based on the specific needs and long-term commitment of COSA and CPS to demonstrate feasibility at scale, and thereby achieve leadership in this area on a national basis.

Indeed, the precedents that currently exist in higher-tax localities have natural limitations. San Antonio is ideally positioned to develop a new financing model, emphasizing the need for all parties – owners, possibly tenants, CPS and COSA – to share in the benefits by helping fund startup costs.

Recommendations: Hydrogen Storage, Smart Grids and Transit-Oriented Development

As a real estate services firm, Cushman & Wakefield offers no recommendations specific to hydrogen storage or vehicle technologies. However, the public policy priorities that drive these technologies also drive transit-oriented development planning and financing, where Cushman & Wakefield and DWH have market-defining expertise.

Although measures to increase building efficiency can deliver dramatic ROI, true transformation of San Antonio's carbon infrastructure will require a comprehensive approach to transportation and future development. As a complement to COSA's TIR strategy, we recommend the following regarding long-term planning:

- Leverage federal resources whether available through stimulus packages or long term programs managed by the Department of Energy, Department of Housing and Urban Development, Department of Commerce, etc.

- Focus on locationally efficient real estate development, particularly Transit Oriented Development (TOD). In addition, land-use, land-acquisition, and highest-and-best-use assessments should be undertaken to maximize the siting of smart grids and smart cars.

- Do not shy away from Brownfield Redevelopment. Innovative risk transfer applications exist to ensure attractive financing, and State and Federal resources are available to create financially viable transactions.

Through DWH Strategic Advisors, Cushman & Wakefield can provide further detail on the applicability of such an approach for San Antonio, whether within the scope of the TIR strategy or as a planning-related complement to it.

Cushman & Wakefield/Cross & Company/DWH Qualifications

Cushman & Wakefield is the largest privately held real estate services firm in the world, with 221 offices in 59 countries, 15,000 employees, and 2007 revenues in excess of $2.1 billion. Cushman & Wakefield manages over 500 million square feet of commercial property on behalf of corporate clients around the world.

Cross & Company is an independently owned and operated Alliance Member of Cushman & Wakefield and is a San Antonio-based, full service commercial brokerage firm with extensive expertise in office and industrial brokerage services, dispositions and acquisitions, plus construction management, development/re-development and investment services. Our many loyal clients include some of the area's top corporations and entrepreneurs. Since 2004, Cross & Company brokers and partners have been involved in more than 826 brokerage transactions valued in excess of $440.5 million. We are currently responsible for the sale, leasing and/or management of over 51 properties totaling approximately 4.3 million square feet. For more information, please see attached, and visit www.cross-co.com.

DWH Strategic Advisors, LLC is a Strategic Partner of Cushman & Wakefield and provides market feasibility, development consulting and sustainability services implementation for Cushman & Wakefield. DWH's core competencies are in transit-oriented development, asset repositioning and optimization (including highest and best use feasibility analysis and area competitiveness analysis), and sustainability services including energy use reduction technologies implementation, solar power development, and brownfields redevelopment. For more information, please see attached.

Cushman & Wakefield is a longstanding partner of **The Office of Jeremy Rifkin**, participating in such events as:

- Brussels – official announcement of TIR as the road map for energy independence in Europe.
- Washington, D.C. – kickoff meeting to bring representatives of the Four Pillars together for first time in the United States.
- Toronto – similar kickoff for Canada scheduled for later this month.
- San Antonio – first concerted effort to create a TIR city in the United States.

Highlights of C&W's Commitment to Sustainability

C&W Environmental Commitments

In December 2008, Cushman & Wakefield, Inc. signed a Memorandum of Understanding (MOU) with the U.S. EPA. We are the first real estate services firm in the U.S. to enter into such an understanding aimed at addressing environmental issues in the commercial real estate sector. The MOU sets out environmental best practices designed to enhance energy efficiency and reduce

carbon footprint, promote water conservation, and minimize waste within C&W's corporate offices and in properties under management in the U.S.

Corporate Initiatives

C&W's Atlanta office achieved a LEED-Gold certification for Commercial Interiors. We are targeting the LEED-Silver level for our new World Headquarters in New York City, where we will be moving in the fall. C&W has also developed a Green Office Tool Kit to support best practices in office sustainability across all branch offices in the U.S.

Client Solutions Services

Energy Efficiency

C&W's energy management strategy includes: analysis of energy consumption, benchmark comparisons, implementation of retro-commissioning procedures and identification of energy conservation opportunities. C&W evaluates all of these opportunities focusing on energy consumption and carbon footprint reduction on behalf of clients.

Utilizing the EPA's Energy Star Program for Commercial Office Buildings, C&W has benchmarked a significant portion of our managed portfolio against this accepted national standard. Utilizing these benchmark scores establishes the baseline for the development of a specific energy strategy for the facility. Initial focus is a low cost / no cost approach by reviewing operational parameters such as temperature set points, schedules for HVAC and lighting, and maintenance routines. An analysis is performed to determine whether or not the current set points or equipment's operational parameters can be changed. As changes are implemented, C&W utilizes the EPA's Energy Star tools to calculate and determine whether or not these changes provide a significant value.

These same tools are used when reviewing the value of energy retrofit projects and capital improvement programs to maintain the integrity of the benchmark throughout the operational life of the facility. The firm encourages its clients to pursue the Energy Star label. By seeking such a designation, our clients can demonstrate energy efficiencies and a reduction in carbon emissions. In 2008, C&W helped clients to earn Energy Star labels for 80 properties under management.

C&W has endorsed BOMA's Seven Point Challenge to reduce the use of natural resources and non-renewable energy sources in commercial buildings. We are working with our clients towards these objectives. The firm is also a Steering Committee member of the *Commercial Real Estate Energy Alliance*.

Green Operations and Maintenance Practices

C&W has developed a set of Green Practice Policies which outline sustainable approaches to pest management, construction, purchasing, cleaning, solid waste management, and no-smoking. The Policies are implemented as appropriate and in consideration of individual clients' approval.

Green Buildings

Globally, C&W's partnership with its clients has resulted in the certification of 6 million square feet pursuant to the LEED rating system, with 36 million square feet registered and in progress.

Property and facility management:
The firm is engaged in individual projects seeking certification under the LEED for Existing Buildings rating system. Five properties under management have achieved LEED-EB certification at the Platinum level. C&W has also registered several properties under management with the U.S. Green Building Council's (USGBC) pilot Portfolio Program. Under this Program, C&W will seek volume certification for participating properties under the LEED for Existing Buildings: Operations & Maintenance Rating System.

Project management:
In addition to the Portfolio Program, the firm is engaged in individual projects seeking certification under the LEED for New Construction and Commercial Interiors rating systems.

Education & Training
C&W personnel receive training on the following:

- Energy Efficiency: EPA Energy Star Portfolio Manager & BOMA BEEP Program
- Green Operations and Maintenance Practices: C&W LEED-EB Pilot Portfolio Program bi-weekly webinars and C&W Green Practice Policies

Awards
Representative awards include:

- Hermes Community and Environment Best Retail Initiative
- BOMA International Earth Award
- CoreNet Global Industry Excellence
- CoreNet Global Sustainability Leadership
- IFMA Sustainable Design and Energy Efficient Projects Award
- Numerous national, state and industry awards

Valuation and Advisory Services
The Green Building & Sustainability Practice group within Valuation Services focuses on cost benefit analyses of green strategies and on identifying the potential impact green applications could have on asset and portfolio value.

LEED Accredited Professionals (LEED AP)
35 C&W professionals have the LEED AP credential.

For more information about C&W's sustainability program, including a video on our award-winning work with Adobe Systems' Headquarters, please visit www.cushwake.com/sustainability and also see attached.

Attachments

Cushman & Wakefield Commitment to Sustainability
Cross & Company Corporate Resume
DWH Strategic Advisors Overview
C&W/C&C/DWH Presentation to the City of San Antonio's April 6, 2009 Sustainability Workshop

California Onsite Generation
Regulatory and Policy Update
www.californiaonsitegeneration.com

Volume 09-04-160 Doug Grandy April 20, 2009

The 21st Century "Green Energy Economic" Paradigm: Agile Energy Systems

America has NO energy policy today. Nor do any of its states or territories, including California. Only the EU (and not all countries comply with it), Japan and The People's Republic of China have national energy policies, programs and financing. The Third Industrial Revolution (Rifkin, 2004) has already begun in the EU and Japan whereby many of these countries have shifted from a fossil fuel energy economy to a renewable energy one along with storage devices and smart sustainable cities (EU, 2007 and Clark, editor, Sustainable Communities, 2009). A consistent, stable and long-term energy policy stabilizes the energy market along with creating jobs and business opportunities, since companies see and understand the multi-year policy as a predictable "road map" in that and related sectors (infrastructures like water, waste, transportation etc).

The California energy crisis, and similar energy crises globally, make it clear that extreme or polarizing public policies: regulate versus de-regulate; public ownership versus privatization / liberalization; are not the answers. Behind these policies are economic theories that provide misleading policy approaches which miss the actual realistic needs of communities and environmental concerns of society itself. Infrastructure systems play the critical role. And they must be a combination of both public and private concern, ownership, finance and operations. Such an approach is known as creating a "civic market" (Clark and Lund, 2001) and need to be "agile systems" that thus encourage and meet public standards and rules for civic market goals such as a renewable energy portfolio standards, economic accounting for societal benefits that include health, welfare and education as well as economic development and job creation.

Agile sustainable energy systems and communities are flexible infrastructure systems that are able to change quickly. An agile system is one that can adapt to change, where innovation is welcomed, rather than opposed. Agile energy systems are resourceful and are adept at developing ways to avoid or to solve conflicts, while deconstructing social-economic barriers that slow down effective solutions to problems.

Agile systems are dynamic and progressive. Agile systems are not limited either from political pressures or constraints from lobbyists and special interests. Instead, such agile systems foster and promote diversity along with dynamic growth from which there is change using knowledge, intellectual capital, financing mechanisms and advanced technologies such as wind power, geothermal, solar thermal, photovoltaic, CHP, fuel cells and hydrogen options together with conservation and load management.

There is not one standard or uniform set of circumstances or technologies that fit all communities and regions. Geothermal is not found everywhere. Nor are sunshine and wind, but the combination of these renewable resources along with new technologies for storage such as fuel cells and flywheels provide for hybrid technologies that create firm base loads and dependable power. Such systems can replace or complement conventional fossil fuel system or be ready in the transition to fully energy independent on-site and distributed energy systems.

Agile energy systems are a combination of local or regional energy systems (including on-site, distributed and self-generation) and central grid systems that will be used in the future, primarily for redundancy and back-up purposes. These agile systems are not particular technologies or market mechanisms, but rather a paradigm shift that can be described as a new civic-market-orientation. Agile sustainable energy systems have the following features:

Integrated Diversity. Using diversified or hybrid integrated renewable energy sources make agile systems less vulnerable to disruption and more reliable especially, because they are less reliant on distant suppliers who are dependent on declining fossil fuels. This diversity also builds in needed redundancy.

Economic Balance. Agile systems emphasize best use of energy, not just the amount of supply and demand. The balance involves promoting conservation, encouraging shifting of energy use to non-peak times and reducing consumption.

Interdependence and interconnection. Agile systems find ways to avoid bottlenecks in delivery and integrate energy usage, which are traditionally separated. For example, co-generation integrates electricity and heat systems. Hydrogen from renewable energy sources pair technologies: e.g. wind-produced electricity can be stored as hydrogen for stationary and transportation fuel.

Spatially appropriate. Agile energy systems are smaller and located on-site for buildings but also for vehicle power. They should locate close to where energy is needed and be coupled with renewable resources. Building specific or on-site generation is critical. Neighborhood scale systems or distributed generation are ideal because they factor in environmental costs, but can be linked to the grid to act as storage for intermittent times of use as well as supply the central grid with renewable energy generation.

Community, Regional and Nation – State. An agile system links the community to regional, national and global societal levels. The agile system is the infrastructure that transmits energy but also supports other infrastructures like transportation, telecom, water and waste.

Social and Public good. Agile systems have people and the public good as their primary goal. This is called the “civic core” or the need for the energy market to be government-driven for the local community and citizens.

In short, agile sustainable energy systems make up the basic infrastructures for the new energy economic paradigm of the 21st Century that makes every community energy independent and carbon (particulates and pollution) free. Stopping climate change and global warming must start at the local community level. Agile systems for every home, work, and leisure activity will soon be the norm.

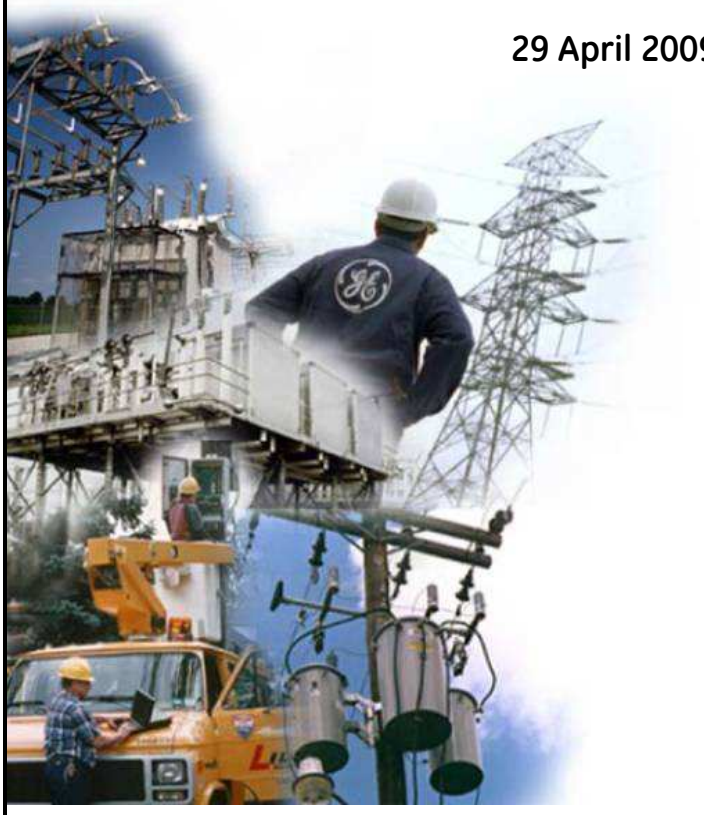
GE Infrastructure
Energy

General Electric's Recommendations to CPS and the City of San Antonio, TX

Presented by

GE Energy T&D

29 April 2009



Overview

Energy technologies can revolutionize efficiency and renewable solutions, and, in the process, the electrical power grid that remains little changed since its inception. While the grid is a marvel in engineering design and may, indeed, be one of mankind's greatest achievements, it has yet to be transformed into a modern grid, a sustainable grid, a truly smart grid that takes advantage of proven, cleaner, cost effective technologies that are available or in development today. GE believes that the Smart Grid is an essential component to addressing the energy demand, security and environmental challenges we face.

Smart Grid is not about doing things much differently to what we are doing today, but more of sharing of communication infrastructures, filling in product gaps, and leveraging existing technologies to a greater extent while driving a higher level of integration to realize the synergies across enterprise integration. As with any other investment, focus should be on how it benefits the shareholder and how it benefits the customer. The Smart Grid is a framework for solutions. It is both revolutionary and evolutionary in nature, because it can significantly change and improve the way we operate the electrical system today, while providing for ongoing enhancements in the future. It represents technology solutions that optimize the value chain, allowing us to squeeze more performance out of the infrastructure we have and to better plan for the infrastructure we will be adding. It requires collaboration among a growing number of interested and invested parties, in order to achieve significant, systems level change. The smart grid will embrace more renewable energy, increase grid efficiency and transfer real-time energy information directly to the consumer – empowering them to make smarter energy choices.

GE's Position and Recommendations on Smart Grid

The Smart Grid is the future of the new power industry and the time is now for making headway with the Smart Grid. The Smart Grid provides enterprise-wide solutions that deliver far-reaching benefits for both utilities and their end customers. Utilities that adopt these Smart Grid technologies can reap significant benefits in reduced capital and operating costs, improved power quality, increased customer satisfaction and a positive environmental impact. With these capabilities come questions: What is the potential of the Smart Grid? Is there one set of technologies that can enable both strategic and operational processes? How do the technologies fit together? How do you leverage benefits across applications? GE Energy can help utilities answer these questions and provide the means to deploy and support long-term, integrated technology solutions.

At GE, our perspective is that the Smart Grid is the integration of electrical and communication infrastructures, and the incorporation of process automation and information technologies with our existing electrical network. Smart Grid is essentially modernizing the 20th century grid for 21st century society.

Of utmost importance are the tangible, quantifiable and meaningful results:

- Improving the utility's power reliability, operational performance and overall productivity
- Delivering increases in energy efficiencies and decreases in carbon emissions
- Empowering consumers to manage their energy usage and save money without compromising their lifestyle

- Optimizing renewable energy integration and enabling broader penetration

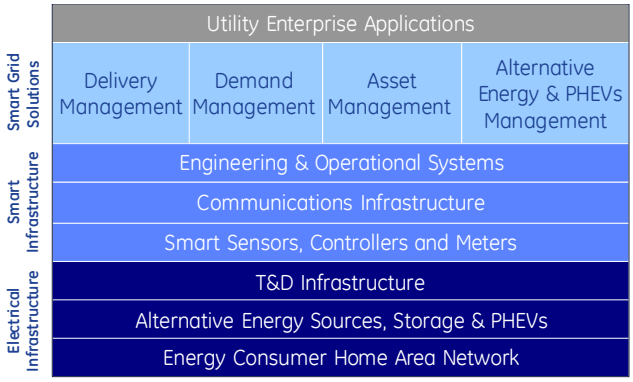
GE understands the end-to-end Smart Grid solution and can supply the enabling technologies. GE Energy's approach to managing change is to facilitate a migration path through a phased implementation approach that will help remove the barrier of organizational thinking, and help CPS and the City of San Antonio to realize incremental benefits while achieving the intended goal of a more comprehensive Smart Grid.

GE's recommendations are based on CPS and the City of San Antonio's initiative of building a 21st Century urban energy infrastructure in San Antonio with distributed energy. To achieve a more rapid deployment of Smart Grid technologies and related recognition of benefits, GE recommends funding solutions around delivery management, demand management, renewables integration and electric and plug-in hybrid electric vehicle integration. Smart grid delivery should not be based on only enabling solutions, but integrated solutions that address business and operating concerns and deliver benefits to both utilities and consumers. 'Shovel ready benefits' that are clearly deliverable, today, are:

- Delivery management - improving grid reliability and operational efficiency through solutions that build more intelligence into the delivery network to monitor power flow in real time, improving voltage control to optimize delivery efficiency and eliminate waste and over-supply – thus, reducing overall energy consumption and related emissions, while conserving finite resources and possibly lowering the overall cost of electricity.
- Demand management - software applications that manage load and demand distribution and helps to empower consumers to manage their energy usage and save money without compromising their lifestyle – encouraging consumers to become smart consumers in smart homes, by giving them access to time of use rates and real time pricing signals that will help them to save 10% on power bills and cut their power use 15% during peak hours (DOE/PNL GridWise). Helps to improving overall electricity system efficiency and reducing number of power plants and transmission lines that will need to be built.
- Renewables integration - enables broader deployment and optimal inclusion of cleaner, greener energy technologies into the grid from localized and distributed resources, including rooftop solar, combined heat and power plants and distributed generation fueled by waste products today (i.e. landfill gas, ADG, waste water) – thereby reducing our nation's dependence on coal and foreign oil and promoting a sustainable energy future
- Electric and plug-in hybrid electric vehicle integration - brings another distributed resource to market, but one at scale - with supporting rates and billing mechanisms, that can help flatten the load profile and reduce the need for additional peaking power plants and transmission lines – potentially reducing the carbon footprint and fostering our energy security and independence

Enabling technologies such as smart devices, communications and information infrastructures and operational software are instrumental in the development and delivery of Smart Grid solutions. As each utility customer begins the Smart Grid journey based upon past actions and investments, present needs and future expectations, the solutions approach provides not only the necessary focus on societal and operational benefits, but also the flexibility for where and how to get started.

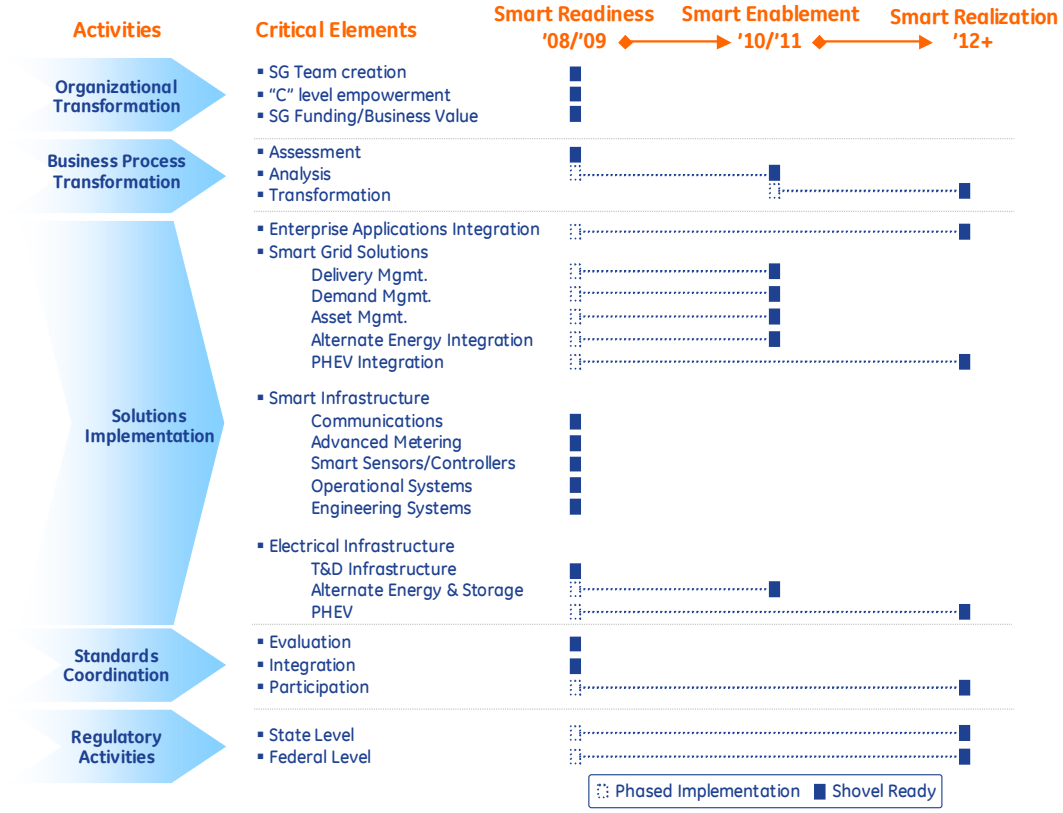
The development of new capabilities, the inclusion of related applications and services along with the enabling technologies and systems integration will be critical to actually fulfilling the grand promise of the Smart Grid. Thus, investment should be directed toward holistic Smart Grid solutions.



So, it is the advanced, sophisticated solutions that include, but are not limited to, enabling technologies that will foster the Smart Grid in both the short and long term, differentiating CPS and the City of San Antonio from other utilities in throughout the country.

Critical Success Factors for Utility Smart Grid Deployments

The figure below represents GE's view on the roadmap required to mobilize smart grid in a typical utility in the electric industry. Technology is not the only driver. Utilities will need to change the way of thinking and the processes to ensure successful deployment. Coordinating efforts are also required in the standards arena.



Utility Organizational Transformation

- Utilities need to change silo thinking and develop strategies that benefit the company as a whole
- Need C level support/sponsorship to make this happen
- Establish SG steering committee, SG strategic roadmap, SG funding for successful implementation

Utility Business Process Transformation

- Realigning business processes to line up with Smart Grid solutions; breaking down organizational barriers, looking at expanded holistic solutions across the utility organization
- Change from infrastructure based processes to incorporate smart grid processes from the back office to the consumer interface and future enabling functions, such as PHEV integration. By planning and designing what have been conventional or traditional T&D infrastructure investments/projects/additions and upgrades with a more holistic and Smart Grid view, utility projects and funding may be viewed in a different light through the eyes of the public utility commissions and speed up the funding process.
- Utilities need to look past isolated solutions and isolated projects and look to strategic partnerships with companies that can provide the breadth of solutions and depth of expertise to successfully support strategic, long-term smart grid investments, with a re-evaluation of "best in class" or "best of breed" away from a hardware or software provider to an integrated "solution" provider or partnership or alliance of providers.
- Utility business model that minimizes risk.

Technology Investments/Implementation/Deployment

- The need for a business case: A Smart Grid program should have a robust business case where numerous groups in the utility have discussed and agreed upon the expected benefits and costs of Smart Grid candidate technologies and a realistic implementation plan.
- A Smart Grid plan should minimize the lag in realized benefits that typically occur after a step change in technology. Smart grid plans should move away from the "pilot" mentality and depend on wisely implemented field trials or "phased deployments" that provide the much-needed feedback of cost, benefit and customer acceptance that can be used to update and verify the business case.
- Look beyond silo solutions to an all encompassing, integrated solution across the utility organization, leveraging benefit and cost synergies of system-wide communications, tightly coupled applications and sharing of data, and synergies related to grid and customer service and reduction of green house gases.\
- Looking at technology investments from a systems point of view. Communications will play an enormous role in the direction of the smart grid, not only from a smart metering perspective, but also utility-wide applications for monitoring, control and consumer interfaces. There will be a greater need for the integration of applications and devices and implications for communications, security, data management, etc. The challenge for utilities will be to recognize the natural process of technology obsolescence and rather than postpone technology decisions, invest wisely in solutions with a prudent deployment plan that will allow smoother and lower cost migrations to new technologies and avoid the need to incur "forklift" costs.
- Move away from Pilots: While current Smart Grid initiatives are driven by regulatory pressure and tend to focus more on the meters as a direct impact on consumers, we are likely to see more technology-rich initiatives after well-proven Smart Grid evaluations ("staged deployments"). Drive for more comprehensive demonstration projects to validate business objectives versus smaller pilot projects associated with one or two of the components which would only validate technology value propositions and not business value propositions

Standards Coordination

- Interoperability, and the need for faster, more comprehensive development of standards, in conjunction with faster, larger scale demonstrations
- Policies, applications, and compliance, with respect to physical and cyber security, data integrity and/or privacy

Conclusions

This is an unprecedented time in the energy industry. With respect to Smart Grid, this is definitely the time to be innovative, agile and willing to make bold moves. We are energized by the focus and momentum now surrounding Smart Grid and the solutions that enable energy efficiency, consumer empowerment and the integration of more renewable energy – solutions that in turn provide economic, environmental and energy security benefits to our nation. While there are many infrastructure investments in advanced metering infrastructure underway or in the process of being evaluated / approved, we encourage CPS and the City of San Antonio not to miss this opportunity to accelerate deployment of additional applications and more comprehensive solutions that will provide the potential benefits available through properly deployed Smart Grid technology.

City of San Antonio/CPS Energy
Sustainability Workshop Summary

Rob Wilhite – Senior Vice President
KEMA, Inc.

Introduction

This document has been developed as a follow-up summary to the City of San Antonio/ CPS Energy's Sustainability Workshop, facilitated by Jeremy Rifkin's Foundation on Economic Trends conducted in April 2009. While KEMA participated in two of the key sessions, this document summarizes key perspectives from Session Six: The Fourth Pillar: Smart Grids and Plug-in Vehicles.

General Background

The smart grid movement is, indeed, well underway in North America and in other select global locations. Unlike other industry transformational efforts (e.g., retail restructuring), this renewed focus on automating our industry's grid infrastructure has received considerable national attention, industry collaboration, and federal support. Within North America, we have witnessed a number of collaborative efforts, such as

- Department of Energy's (DoE) Modern Grid Initiative
- DoE Electricity Advisory Committee and Task Force (formed in 2008)
- GridWise Alliance and GridWise Architecture Council membership growth and recognition
- Key smart grid demonstration projects supported by national labs (e.g., Pacific Northwest National Labs).

Furthermore, a number of utility programs have announced plans for larger-scale demonstration programs, including one (Duke Energy) that has now filed for full deployment in two of its regulated jurisdictions.

With the passage of the Energy Independence and Security Act of 2007[1] (EISA), it is now U.S. policy to support the modernization of the electric transmission and distribution system to maintain reliability and infrastructure protection (as stated in Title XIII: Smart Grid Provisions). This important document also outlined the following measures:

- Smart Grid Technology Research, Development and Demonstration – including matching funds
- State Consideration of Smart Grid – encourages regulatory reviews beyond just advanced metering infrastructure (AMI)
- Smart Grid System Report – due soon.

In addition to this important legislative Act, the recently-signed American Recovery and Reinvestment Act[2] (ARRA) provided the appropriations and tax incentives for stimulating new investment in technology deployment and demonstration projects.

[1] Signed December 19, 2007 by President George W. Bush
[2] Signed Feb. 17, 2009 by President Barack Obama

Smart Grid Defined

However, to move forward, we need to also coalesce on the mission and objectives of grid modernization. To this end, EISA has provided a set of characteristics that enable broader acceptance of the smart grid end-state. These characteristics are adapted from Section 1301: *Statement of Policy on Modernization of Electricity Grid* and are summarized as follows:

(1) Increased use of digital information and controls
(2) Dynamic optimization of grid operations and resources
(3) Deployment and integration of distributed resources
(4) Development and incorporation of demand response
(5) Deployment of ‘‘smart’’ technologies (real-time, automated, interactive)
(6) Integration of ‘‘smart’’ appliances and consumer devices
(7) Deployment and integration of advanced electricity storage and peak-shaving technologies
(8) Provision to consumers of timely information and control options
(9) Development of standards for communication and interoperability of appliances and equipment
(10) Identification and lowering of unreasonable or unnecessary barriers to adoption.

Figure one shows potential smart grid elements.

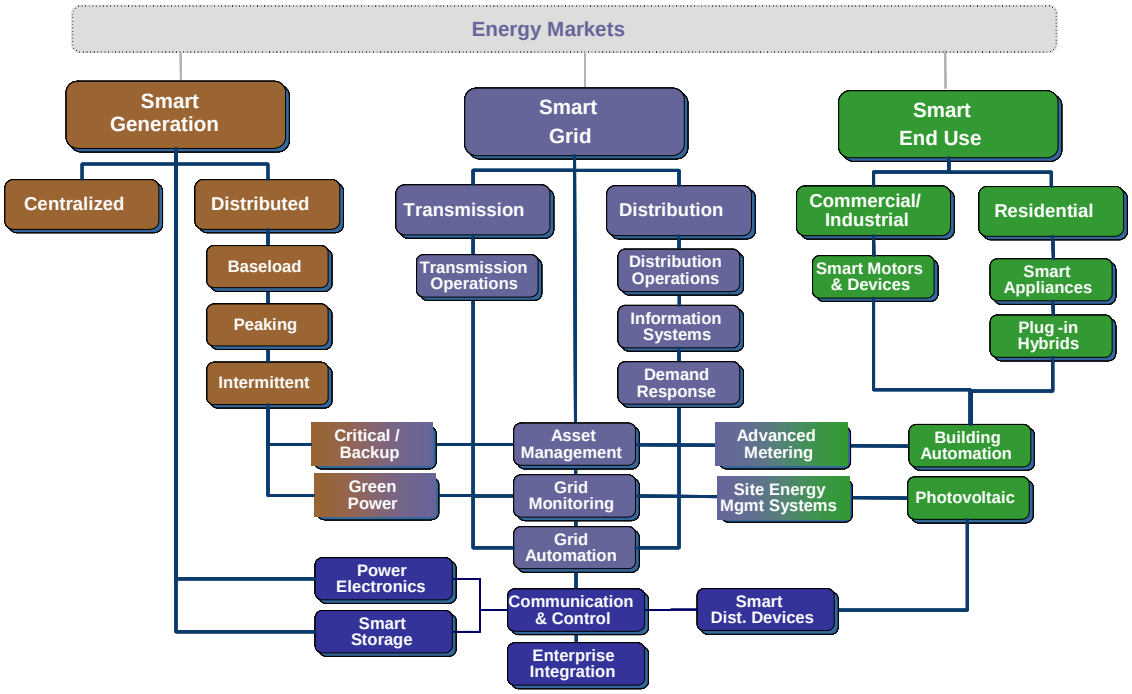


Figure One: Smart Grid System Elements[3]

[3] From the Global Environment Fund and The Center for Smart Energy.

However a single definition of smart grid is not likely to apply to every utility or energy provider, nor would each of the EISA Section 1301 characteristics need to be addressed in equal priority. Regional and local differences in regulatory and policy issues, variations in customer needs and classes served, and distinctions in individual utility strategy and financial positions will all necessitate a specific adaptation to these national guidelines.

As shown in figure one, a number of smart grid elements may clearly align under most definitional perspectives. However, there are numerous "fringe" elements that will cause understandable variations in focus, architectural design, and benefits. Irrespective of the scope of these individual elements, a robust view of smart grid would include the influences of both generation suppliers and consumers (which can also be one and the same).

Choices in specific technology and functional applications are numerous, and would require significant financial investment if deployed simultaneously, which will also contribute to the differences in smart grid definitions among utility service providers. Some of the more common elements that are found in various utility definitions today are outlined in table one.

Power Production	Transmission	Distribution	Consumption
• Distributed generation and energy systems • Distributed energy storage/ renewable energy • Conservation voltage reduction	• Synchronized phasor measurement units (PMUs) • Flexible AC transmission • High voltage DC • Substation energy storage	• Advanced metering infrastructure (AMI) • Line fault sensors • Automated line reclosers • Automated Volt/VAR control • Automated voltage regulators • Automated capacitor banks	• Home area networking • Autonomous demand response (DR) • Smart appliances • Distributed generation • Integration of building controls • Plug-in hybrid electric vehicles • Micro energy storage • Rooftop solar energy • Pre-payment systems • Time-based pricing • Third-party service providers (e.g., DR)

Table One: Selected Smart Grid System Elements

Given the array of choices and potential value creation from each application, one can argue that the degree of disruption and transformation to the utility industry can be significant with these smart grid elements. This becomes especially true as the focus tends toward the consumer side of the traditional value chain. This also suggests that energy providers will need to make strategic decisions on whether they seek to offer these applications and services directly, or foster a third-party market, or both.

Barriers to Adoption

While the movement to modernize the grid is proceeding, industry and individual utility initiatives will no doubt encounter barriers that will need to be addressed. Other than perhaps the obvious constraints of available capital and other key resources, there are several areas that will need to be addressed, as shown in table two.

Smart Grid Adoption Barrier	Stakeholder Activity
Interoperability and standards will be vital to full systems integration for smart grid components	• Numerous industry working groups (e.g., GridWise, OpenAMI, OpenHAN) • Federal focus – DoE, NIST, and FERC
There is a strong interest in enhanced levels of quality assurance for smart grid devices	• Many manufacturers will rapidly ramp up production to unprecedented volumes • Several utilities performing deeper financial analysis and risk management • Includes on-site audits and supplier assessments
With this increased connectivity, a number of security concerns are emerging	• Need to avoid media over-generalization • Numerous vendors adopting existing standards • AMI-SEC System Security Requirements recently introduced to industry
Regulatory or Board acceptance and validation of the business case value	• Regulatory proceedings underway in numerous states, including IN, NY, and OH • FERC-NARUC Smart Grid Collaborative seeking enhanced education and awareness
Consumer acceptance of the value proposition	• Various consumer advocacy groups are quite active • National chains and large customer involvement in regulatory proceedings

Table Two: Major Smart Grid Adoption Barriers

As a practical matter, while there are numerous state and national efforts underway to address these barriers, it is in the best interest of any utility to ensure their own program strategy is focused on local mitigating actions for these and other key risk elements.

San Antonio's Vision

Through its energy arm, CPS Energy, the City has considerable motivation and expertise to move forward with deploying a smart grid plan to support its overall sustainability effort. As outlined in its strategic plan, *Vision 2020*, CPS seeks to: build upon its strong tradition and past successes to transform its business, be recognized for its broader role in society, and provide customers greater control of their energy use and costs.

CPS Energy's *Vision 2020* plan, in concert with the City's overall *Mission Verde* effort, sets forth a vision that encapsulates smart grid as a component to achieve assertive targets in several functional areas of the business, as outlined in table three.

Vision 2020 Focal Point	Selected Targets
Provide Customer Benefits	• Top 5 in JD Power for 10 years by 2020 • 40% of customer base participates in optional pricing programs • 15% participate in Windtricity™ and solar offerings • Residential rates 10% below market prices in the three major competitive markets
Meet the Energy Needs of the Community	• 771 MW+ load growth reduction • Renewable capacity equivalent to 20% peak demand (1200+ MW)
Provide Employee Benefits	• Great Place to Work overall score of 4.20 or better • Continuous improvement culture • Communication that engages • Training has become a core component of our corporate culture
Provide Broader Stakeholder Benefits	• Progress on City Payment structure • Maintain best bond ratings in industry

Table Three: CPS Energy Vision 2020 Key Focal Points and Targets

San Antonio's Challenges

During the Sustainability Workshop, City and CPS Energy staff outlined a number of additional key elements and challenges, including the following:

- CPS Energy will also face the challenge of managing the associated internal business processes in order to achieve intended benefits
- Consumer acceptance will be especially challenging for the City, given its demographics and previous energy program provisions
- While CPS Energy has already demonstrated a technological leadership position relative to demonstrating new applications (e.g., grid sensing devices,

electric vehicles, renewable energy), managing a large-scale smart grid effort will require a roadmap approach to ensure focus is being applied to the most feasible applications and in the right order of priority

- As CPS Energy also serves gas customers, a smart grid strategy should certainly focus on the distribution and consumption of this commodity, as well as clarify the potential value of water services to consumers
- CPS Energy is keen on using two-way communications to enable pricing signals and better inform customers in more efficiently operating their end-use loads and appliances
- CPS Energy's overall focus should ensure alignment with sustainability and economic value creation efforts.

Overall, CPS Energy is seeking guidance on how the pillar of smart grid (and plug-in electric vehicles) fits into its overall energy strategy, its community, and the broader national perspective and policy issues.

Key Recommendations for the City of San Antonio/ CPS Energy

While CPS Energy is currently developing a smart grid strategy, a number of recommendations can be made, given our discussions in the workshop and based on our knowledge of broader national perspectives.

- Leverage the tremendous demonstration project experience that CPS Energy already has. Most of these initiatives will form the basis of an overall path to modernizing the City's electric (and gas) distribution grid. The City/CPS Energy has the advantage of prior knowledge and can reduce learning curve delays.

- Seek valuable information from other utilities already deploying smart grid systems or demonstration projects. The Department of Energy and other key organizations (e.g., GridWise Alliance) are developing databases and information clearinghouses to capture project information across the U.S. to articulate relevant lessons learned. This could enable the City/CPS Energy to avoid potential pitfalls others have experienced.

- Focus on the specific aspects that citizens and specific market demographics bring to the prioritization of various smart grid elements. For example, CPS Energy has historically maintained low retail electric and gas prices; therefore, providing new energy services and time-based rates may require greater customer outreach programs for ensuring broad acceptance and benefits realization.

- Where economic benefit is required to justify smart grid investments, consider leveraging data from near-real time systems that are inherent in potential smart grid architecture for San Antonio. These systems may support new business

models and applications for energy advisory, management, and control services that may not largely exist in the region today. There are many lessons to learn from other industries (e.g., telecommunications, groceries) that have leveraged the value of consumer data and applied new business models.

- Pursue an active position in monitoring and/or influencing standards activities for the smart grid. Key organizations, including the National Institute of Standards and Technology, are charged with developing appropriate standards for device and systems interoperability, as well as cyber-security measures. By being active in these groups, the City/CPS Energy would gain an advantageous position, and mitigate the potential of systems obsolescence as technology is rolled out ahead of the standards process in industry.

- Seek to collaborate with and influence the direction of appliance manufacturers whose products overlap with the City/CPS Energy's smart grid architecture and roadmap plans. A number of these manufacturers are becoming proactive in working with the utility industry to incorporate advanced sensors and control schemes into their products for demonstrations, or as options for future product enhancements.

City of San Antonio – Sustainability Workshop Summary
Energy Efficiency Session

Wendy Tobiasson – KEMA, Inc.

Introduction

This document provides feedback from the energy efficiency group discussions that KEMA participated in with The City of San Antonio/ CPS Energy's Sustainability Workshop. The workshops were held in April, 2009 and facilitated by Jeremy Rifkin's Foundation on Economic Trends. KEMA participated in two of the key sessions and this document outlines our participation in The Energy Efficiency Session.

General Background

The market for energy efficiency programs has increased dramatically in the United States in recent years. While states like California and Wisconsin have had a steady offer of energy efficiency programs and services over the past few decades, other states have had modest levels of activity that are in many cases growing. Additionally, many states that have offered little in the way of energy efficiency programs are launching new programs. As more states regulate higher energy efficiency goals, there are organized energy efficiency programs, national efforts to promote codes and standards, and a general increase in the interest in and activity around energy efficiency. The time is right to capitalize on the energy efficiency opportunities in the San Antonio market.

San Antonio's Goals

The City of San Antonio's energy efficiency goals are substantial. In order meet the goal of reducing energy use by 20% by 2020, the city is going to have to not only invest in both broad based and targeted energy efficiency programs, but also find ways to promote efficiency through a range of other channels. Some other channels beyond traditional energy efficiency programs include:

- Informing customers about energy efficiency opportunities so that they can better understand the goals and their own ability to assist their bottom line and the city
- Promoting standards and regulations that promote and reward efficiency
- Investing in research and development to support the industry and new technologies that can offer further efficiency opportunities
- Finding alternative funding mechanisms to support energy efficiency investments

As it was aptly termed in the session, energy efficiency should be seen as the FIRST fuel. In order to effectively bring renewable resources to market, the best first step is to tackle the energy efficiency opportunities in a building so that the new generation can be sized more conservatively. Thus, while the four key pillars are critical opportunities to tackle the challenges facing our nation, energy efficiency must be a core part of the full solution.

San Antonio's Potential Study

San Antonio contracted with Nexant to develop a potential study which describes the opportunities that are available within the city using traditional energy efficiency

programs and services. That study identified that if San Antonio uses the Aggressive model, they can achieve a 13.5% reduction on their 2008 energy usage. The potential study values are reasonable, the savings are economically logical to target, and while there is a significant amount of work required to motivate customers to make the changes that the study identified, the prospects are being fulfilled across the country in other states and utility service territories.

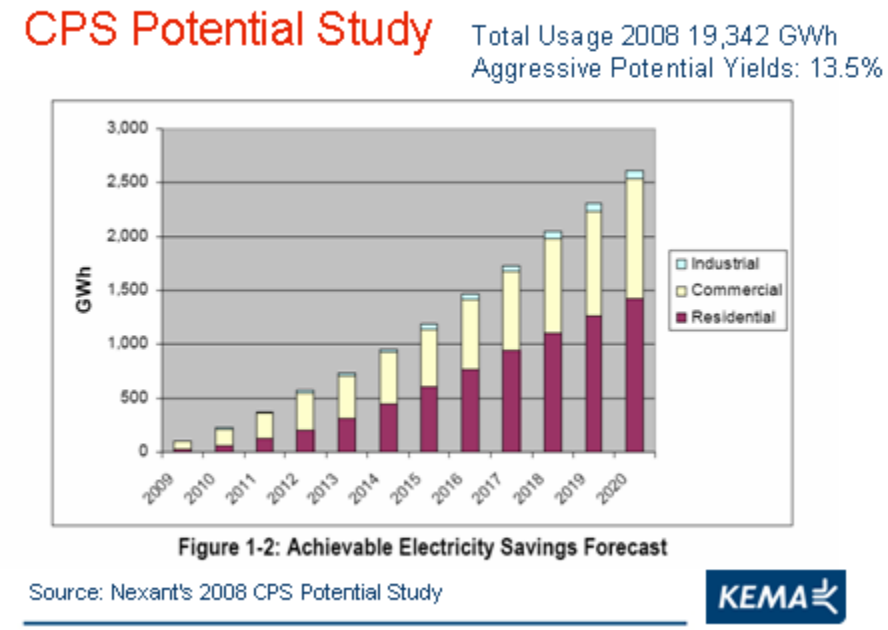


Figure 1-2: Achievable Electricity Savings Forecast

Energy efficiency is a cost effective option for reducing the supply needs of a utility. Even at the aggressive (high) model, the cost per kWh for this resource is far less than the cost of new generation. Using the results from the Nexant study, the resource value of an average annual kWh is approximately $0.55 whereas the resource cost for the aggressive potential is $0.269.

	Economic	Low	Medium	High
Energy Savings (GWh)	5,883	950	1,591	2,618
Demand Savings (MW)	1,332	187	327	569
% of 2008 Usage	30%	5%	8%	14%
% of 2020 Forecast	21%	3%	6%	9%
% of Incr. Measures Cost		25%	50%	75%
Total Resource Cost/kWh		$0.291	$0.275	$0.269
Utility Cost/KWh		$0.180	$0.208	$0.234

Energy Efficiency Programs

The City of San Antonio has launched a series of energy efficiency programs and is considering a range of others in their planning process. These programs will help move the market towards efficiency. One of the misnomers of energy efficiency programs is that over time, the programs get easier, more efficient, and cheaper. While San Antonio

understands that this is not entirely the case, it will be important to develop the political understanding necessary to explain that digging deeper into the efficiency potential will require more targeted programs that in some cases require a higher incentive to move that market. The design of these targeted programs needs to be done carefully to insure that the markets are served in the most cost effective and efficient manner.

The market barriers that create challenges to achieving energy efficiency are listed in the table below along with the strategies that program design and implementation teams can use to help overcome these barriers.

Market Barriers	Program Strategies
Information Search Costs Hassle and Transaction Costs	Educate Customers/Engage Trade Allies Provide Timely Information Leverage Earned Advertising
Performance Uncertainty Asymmetric Information	Third Party Facilitator Fact Sheets Technical Support Services
Split Benefits	Targeted Incentives Standards Building Rating Systems for Owners
Access to Financing	On Bill Financing Performance Contracting

One of the examples of ways to overcome barriers we highlighted in the session was the small commercial market. Small “mom and pop” type stores do not typically have the capital to make large investments in efficiency even if those investments have a seemingly short payback. They face essentially all of the barriers listed. By designing small commercial programs using a direct install model that leverages the contractor market and empowers the customer to make an informed decision with the appropriate level of financial support, a program can much more cost effectively influence this hard-to-reach market. Programs that look at the market in new ways will be an important part of The City of San Antonio’s program in the future.

Other Workshop Topics

The workshop brought into play other ideas such as performance contracting where the City may be able to consider alternative funding sources to help finance energy efficiency. Energy Service Companies who provide performance contracting can provide an opportunity to help manage some of the large scale programs in the community. The group also discussed other financing options such as bonds to support efficiency, or tariff adjustments.

The City will also want to consider ways to leverage opportunities to influence customer’s behavioral habits through education or other outreach activities to help raise awareness of energy efficiency opportunities.

Recommendations for the City of San Antonio/ CPS Energy

- Continue to provide energy efficiency programs to your customers. After the programs have been started and you have a solid set of results, analyze those results carefully to understand which segments of the market are participating most effectively and where The City may need to further influence the market to help promote efficiency in underserved markets.
- Identify niche programs and services that can help reduce market barriers in the hard-to-reach markets. Develop program offers that support those markets and help spread energy efficiency actions across all markets.
- Find ways to avoid stopping funding for efficiency once you have created market momentum. The 20% mandate will require this. In some markets where there is a program with a high level of customer interest, they have had to shut the program down temporarily which sends confusing signals to the market. Develop programs that can maintain momentum.
- Educate customers at all opportunities about what they can do personally to help save energy and save money on their energy bills. Stress the total cost of ownership so that customers understand that a slightly more expensive option that is more efficient ends up saving a lot of money in the long run.
- Consider ways to use performance contracting to effectively manage some of the larger City projects. Performance contracting will provide financing support and may make it possible to do some large scale projects sooner.
- Leverage national programs that help educate customers and push for improvements in codes and standards.
- Consider tariff design or other funding mechanisms that might help fund energy efficiency to reduce the customers' burden in the short terms.

KEMA appreciates the opportunity to participate in this Workshop and is confident that with a strong commitment to energy efficiency programs and other services, San Antonio can positively create the change needed to meet your energy efficiency goals.

Philips Recommendations voluntarily withheld by company

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April 24, 2009

Nicholas Easley
Director of Operations
The Office of Jeremy Rifkin
The Foundation on Economic Trends

RE: Summary of recommendations for San Antonio from Sustainability Workshop

Dear Nick,

Proton was only involved in the part of the workshop pertaining to hydrogen and from the discussions, I would make several recommendations. In general, it is important that the different stakeholders within San Antonio begin to develop a comfort level with hydrogen both in terms of its use as well as its safety. While it was not explicitly stated in the meeting, I am sure there is a hesitancy to push hydrogen just based on the fear of the unknown.

The easiest place to start is within the power plants at CPS. Hydrogen is used at many of the plants in the CPS territory to cool the generators. Optimizing the generation and aspects of the hydrogen system within the power plant environment can not only save money, in terms of fuel costs, but also significantly reduce CO2 emissions. Remember that 44 million tons of CO2 per year are generated at power plants in the United States just due to poor efficiency. Installing an on site hydrogen generator and control system will also allow people to become comfortable with the idea of making their own hydrogen in an application that has real benefits to the utility and the City of San Antonio. It also shows a practical application of hydrogen, offering low technical and political risk in terms of being a successful project. When and as these applications prove successful a logical next step could be to use any excess hydrogen generation capability at the power plants for a local fueling demonstration.

The largest benefit to showcasing hydrogen in a transportation setting is that it immediately forms a method to reach out and touch the local community and begin to assuage their fears about hydrogen. My specific recommendation would be to look at one or two transit busses which are not only rolling billboards for explaining the technology but really engage the community on a very personal level. I would recommend that San Antonio speak with AC Transit in San Francisco about their program and the benefits they have seen.

Now it must be realized from the start that any transportation demonstration project will not be a payback producing endeavor, it will cost money. The Clean Cities program is currently looking at projects just like this around the country funded through stimulus money, and may provide a way to fund all or most of the project.

As it relates to using hydrogen as a storage medium for renewable technologies I would recommend a push on the renewable asset first. There are many financing and grant programs for wind and solar currently on the table or being discussed at the State and Federal levels. By doing one or two high profile projects you can establish an experience base with the asset and first learn the interconnectivity challenges with the grid and the power in the building or location you are installing the asset in. So in effect you are using the grid as your energy storage device, which is not ideal but also realistic as a first step. If the city tries to combine too many different things in one big project it will likely not get off the ground.

Once the renewable assets are up and running then hydrogen can be brought in to the project as a second phase. The hydrogen may be used as a backup for part of the load or as a way to help shift time of day pricing of electricity. The exact use will depend greatly on the size of the renewable asset, the load it is powering and the amount of hydrogen you can store at the site.

These recommendations start with using hydrogen generation in a practical commercial application, branch in to broader exposure and acceptance through a transportation demonstration project and finally demonstrate the linkage between renewable technology and hydrogen.

This approach also dovetails nicely with the realization of the current technology status today. Renewable technologies and even some smart grid technology are ready for large scale deployment today. Hydrogen has many practical applications that can be filled with products today but the transportation and widespread use of hydrogen for energy storage is still developing.

In summary, these steps get wide exposure and advance the use of hydrogen in a prudent way as the technology continues to mature. When wider rollout begins to occur in a few years San Antonio will be standing on the forefront of being a model for implementing the Four Pillars.

Sincerely,

Robert J. Friedland
President & CEO
Proton Energy Systems, Inc.

Q-CELLS INTERNATIONAL USA CORP.

Introduction

The City of San Antonio has the opportunity to lead the nation toward a clean, renewable and sustainably powered economy and Q-Cells appreciates the opportunity to work with the City in its transition to a new renewable energy infrastructure. Included within are recommendations and considerations for the City as it embarks on developing programs and policies to encourage the growth of a clean energy sector. The suggestions that follow are guided by an in-depth study by the European Photovoltaic Industry Association (EPIA) and are based on two fundamental principles they recommend as necessary considerations to build a sustainable renewable energy market: The study concludes that the removal of non-economic barriers and transitional incentive schemes are key components to building successful photovoltaic policy.

Removal of non-Economic Barriers

It is important for San Antonio to consider the impact administrative burdens may have on projects involving PV installations. Lengthy or costly approvals can significantly obstruct the progress and impede on market growth potential. A well coordinated and streamlined approval processes can accelerate project turnover and ensure the continued and steady growth of an industry. In California for example, the solar industry has been supported by the California Public Utilities Commission who oversees interdepartmental cooperation between the various agencies and stakeholders. Regardless of how the City shapes the final administrative and approval processes, transparency and efficiency at the permitting, zoning and interconnection levels are important considerations, as are the financial incentives and policies that they support.

Incentives and Transparency

As can be seen in international and domestic markets such as Germany, New Jersey and California, the most effective means in accelerating PV demand is to establish support schemes and policies that encourage participation from the private and public sectors. The German PV industry is arguably the most successful example of how favorable market conditions can attract investment, grow an industry and transform a nation.

In Germany, a national feed-in-tariff requires utilities to buy solar power from private suppliers for a period of 20 years. As demand grows and prices fall, the declining incentive will eventually force the industry to survive independently, without the help of subsidies. A key to success of the feed in tariff was that guaranteed annual sales provided investors an opportunity to generate predictable returns, upwards of 12%, which attracted investment to projects and subsequently the technology sector as a whole. In 2007, Germany collectively installed 1300 MW of new capacity, up 52% from 2006 for a cumulative total of 3800 MW. The increased demand was met with equal investment in large-scale PV wafer, cell and module manufacturing facilities that now produce over 15% of the world's photovoltaic technology and employ over 40,000 people nationwide.

In addition to the feed-in-tariff, many states in the country have implemented other variations of support programs such as, California's Production Based Incentive (PBI), or

New Jersey's Renewable Energy Credit (REC) market. Both examples, while very different in their approach, have achieved similar results as Germany: the establishment of a thriving industry, increased employment opportunities and outside investment. Looking to existing incentive structures around the world may provide valuable input into the ultimate success of San Antonio's energy programs.

As is evident in Europe and many markets throughout the United States, transparency and favorable incentive programs can be the driving force in creating a self-sustaining industry. It is important that San Antonio considers the long-term viability of its incentives and incorporates measures to avoid overheating the market and puts in place transitional reductions of subsidies to encourage self sufficiency of the markets. Also, transparent and predictable incentive structures will attract the investment capital necessary to support a growing industry.

Conclusion

The unprecedented growth in solar energy witnessed in recent years is only a fraction of what is expected to occur in the next ten years and the opportunities for San Antonio's leadership are limitless. Various approaches to PV market development have been implemented worldwide; however, there are certain foundational principles that have been identified as ways to greatly increase the likelihood of program success. Removing non economic barriers, establishing transitional incentives programs that decrease over time are two of the most important considerations the City should address in the development stages for its future energy policy. In addition, solar companies such as Q-Cells will continue to focus on cost reduction at the manufacturing and system levels and to develop leading technologies that will support policies such as those San Antonio seeks to create. Working closely together, Cities like San Antonio in collaboration with companies like Q-Cells will help lead the nation in the transformation to a clean, renewable and sustainably powered economy.

Siemens Recommendations voluntarily withheld by company

Introduction

The Third Industrial Revolution is conceptually the next economic, geo-political transformation the world will undertake. While the pillars of this revolution are still being defined, the transformational effects will be drastic in many sectors of the present world economy. With the passing of fossil fuels as the staple of the world's energy source realignment, metamorphosis, decline, eradication and decimation of corporations, manufacturers, industries and cultural appetites will be commonplace. The foreshadowing of new growth economies, that are to sustain this revolution in under developed areas of the world, is precipitated upon the belief that there will be a demand for higher levels in standards of living, increased consumerism and the continuous upward spiral of improvement in the quality of man's existence on this earth. While there are many postulations and predictions about the coming new world order, the inconsistency of scientific data, debate within the scientific community, a lack of consensus does not deter the necessity to begin this change now.

During the recent conference on building a new sustainable City of San Antonio, members of the city council, administration and city department heads of the City of San Antonio, leadership and members of the board of directors for City Public

Service, and members of the local scientific community met with academic leaders in the field of energy source transformation, manufacturers of innovative technologies and creative thinkers that are devising new uses of current technologies coupled with innovative behavioral studies, leading multi-national companies that are designing and implementing radically new building design, and those producing drastic reductions in existing building energy indices. The conference was a result of the City of San Antonio and its utility City Public Service commitment to pursue a course toward a new sustainable economic future. Sustainable here is used in a global sense, a community vision for the future growth and development of resources, jobs, transportation, and a mixed energy source not dependent on a volatile and decreasing availability of fossil fuels.

The consensus reached by utilities, governing oversight commissions, and educated rate payers has been simply to use energy more efficiently and waste less energy instead of building more capacity.

Conservation and energy efficiency have proven to be the least expensive means to slowing the requirement for additional capacity in a utility service area experiencing and forecasting extensive growth. As a pre-cursor of the changes to

come, a strong program of energy efficiency and conservation is vital in setting the stage for the advent of the distributed smart grid, building renewable production capacity and developing storage technology to retain spontaneous, variable production to meet the daily load requirements of the community.

A major concern in most communities focused on providing a healthy living environment, stable supply of required resources (energy, water and clean air) and attractive economic opportunities for it citizens, is the aging infrastructure that supports the community. Part of that infrastructure is the existing building stock, public and private. Focus on energy efficiency improvements and enhancements for San Antonio's portfolio of aging facilities, will reduce the need for future expansion of fossil fuel based capacity by CPS. Over the next 30 months a strong program of building renovations financed by utility cost avoidance can build momentum for initiating the implementation of the four pillars of the Third Industrial Revolution

An identified, first step in any approach to revolutionizing the energy supply source is to lessen dependency on the current source, fossil fuels, in a sustainable fashion. As all have agreed for years the least cost increase in capacity is the

nega-watt. For over twenty –five years performance based contracting has and continues to the best value solution for sustainable reduction in facility utility use.

There are two means available to reduce energy use in existing buildings, energy efficiency and conservation. Energy efficiency is derived from proper preventative maintenance, scheduled high time equipment replacement, advances in technologies (lighting, ground-source heating and cooling, natural ventilation), and statutes requiring new equipment efficiency standards. Conservation is simply not consuming what is not required. Conservation can be created in many ways: control of operational hours, temperatures, ambient lighting controls, occupancy sensors; behavioral changes effected by education, rate structures, visible monitoring of consumption, utility load management programs; interruptible rates; better building design and construction; building systems integration and optimization; continuous commissioning of existing systems. This is not an exhaustive list of how to generate nega-watts but the list does serve to recognize that there are many ways to reduce consumption in buildings across a community.

The Case for Verifiable and Sustainable Energy Reductions

Utilities have historically funded incentives that are product (technology) driven. A common program is to incentivize the replacement of residential refrigerators. Another common incentive has been in the realm of weatherization to slow unwanted air infiltration and increase insulation. These programs rely on customer participation and an incentive that will motivate rate payers to plan their purchases, to complete the necessary paperwork and work around individual schedules. Nevertheless these programs have replaced large amount of inefficient equipment.

Commercial, institutional, governmental facilities in San Antonio's aging stock of buildings are prime nega-watt sources. Through a properly conceived approach utilizing current budgets to leverage available dollars and incentives many of these buildings can cost-effectively reduce their energy indices 20 to 30%. There are several means by which this may be accomplished. The owners can use employees to perform the work and fund these improvements out of annual budgets spending several years implementing potential improvements. Owners can hire professional to develop plan and then bid the work out in a traditional procurement process utilizing low bid or best value as the local procurement

statutes require. In both scenarios the changes will be made and after the warranty period all participants are absolved of responsibility for the results of the work accomplished. Once construction is completed and the work is accepted only the owner is responsible for operational efficiency, building system optimization, and a focus on total life cycle cost of the facility. Performance contracting aligns the intent and desires of the owner and the contractor to ensure a long term sustainable operational plan resulting in lower facility life cycle cost.

Performance Contracting

Another means that is used to provide the renovations that will result in energy use reductions utilizing a performance based approach. The promised/contracted results are measured and verified annually to ensure that the economic justification for the building improvements is realized for the owner. In this case, the owner will know the entire cost of the project, the scope of work and the guaranteed results prior to entering into a construction contract. After the warranty period expires the guaranteed performance continues for the agreed to term.

The approach provides monetary impetus to move forward, a team of professionals dedicated to solving problems in the buildings and a long term commitment to the owner to maintain the efficiencies and energy saved for a prolonged period of time. For the governmental, tax based, public sector owners state statutes are in place that guide this process to ensure that there is no unplanned expense during construction and that the project results will be generated.

Performance contracting is normally used to provide a comprehensive approach to renovating energy or utility related systems in existing buildings. Because these projects are comprehensive there are normally several projects included a building. If the owner has multiple buildings there is a possibility that some or all of the buildings should be addressed simultaneously under one contract. The reasoning is that the larger the utility cost for the buildings subject to the contract the more the percentage of savings is worth.

Financing

A preliminary analysis of the owners building portfolio would identify the potential for utility cost reductions. A simple economic scenario could be run to determine the approximate construction cost that the savings would support. For example, very simply, $100K of savings at current utility rates over a 10 year financing term would generate $1M in construction cost and interest payments. A simple return on investment for a project like this would be 6 to 8 years depending on the interest rates for project financing. In Texas the governing statutes allow cities and municipalities to finance performance contracts out to 20 years.

There always has been financing available for public sector entities with average credit ratings or better. The most common financing instruments are contractual obligation bonds and tax exempt municipal leases. City of Dallas has used a revolving low interest loan program offered by the State Energy Conservation Office and a municipal lease. The City of Houston is borrowing dollars internally for their series of projects. Under a Performance Contract repayment can be structured many different ways to meet the financial requirements of the owner.

Solicitation

The state statutes that govern performance contracting in Texas are very directive concerning how owners are to solicit and contract for these projects. There is a competitive process that the owner selects a contractor based on qualifications under the same statue that governs the selections for professional services. Once selected the owner and contractor negotiate an agreement for auditing, analysis, scope design and development and proposal for construction. The owner gives the notice to proceed with the project and the contractor is paid as the project is implemented.

Guaranteed Performance

Once the project is installed to the satisfaction of the owner the warranty period for the labor and equipment begins as does the guaranteed savings period. At the end of each year until the financing term is finished the contractor must demonstrate, through a measurement and verification plan in the contract, the annual savings the project generated. Should the project fail to generate the guaranteed amount in the contract, the contractor reimburses the owner for the shortfall of the savings.

Benefits of Performance Contracting

- A procurement method that aligns the interests of the owner and the contractor. Both want to work to finish on time, on budget. Both want the renovations to perform providing services to the owner and savings for the contractor.
- More work performed faster than using any other method of construction.
- Sole source contractor, responsible for all phase of the project. Responsible to the owner for the work of all trades, sub-contractors, quality of work, performance of the systems for the term of the repayment.
- Ongoing involvement of a 3rd party responsible for ensuring the buildings are operated as specified by the owner in the contract. Remote monitoring of building performance for the purpose of assisting the owner to maintain high levels of efficiency and conservation.
- Continuous commissioning through the remote connection with the contractor that will identify and report variances in schedules, temperatures, overrides quickly to the owner for investigation and return to agreed to status.
- Available project financing at tax exempt rates

Conclusion

As address in the first panel discussion of the conference, energy efficiency and conservation must precede the development of the rest of the program that is envisioned. Performance Contracting is the least cost approach to deliver results in the most expeditious manner, guaranteeing cost avoidance that will pay for the work accomplished. The public, the rate payers, and the City will experience building infrastructure improvements that will enhance comfort and lower utility expenditures – without additional budget increases. This work can be a demonstration to the public of the intent, purpose and will of the City leaders to make a commitment to actions that will beneficially affect their environment without cost to them.

Performance contracting can be started immediately, generating jobs, lowering green house gases, reducing carbon footprint, producing carbon certificates to be used in future cap and trade opportunities, and creating a positive collaborative image of the City and CPS working together NOW to move into the Third Industrial Revolution.

TAC Americas Energy Solutions by Schneider Electric is a national provider of performance based contracting for commercial and public sector facilities. With extensive experience over the past fifteen years TAC‘s Energy Solutions Division has 320 employees dedicated to providing sustainable results for its customers. TAC makes buildings works and delivers enduring performance.