

2010

Retrofitting the Workforce: Report #4

Energy Storage



TEXAS FOUNDATION FOR INNOVATIVE COMMUNITIES

Good Company
ASSOCIATES

8/31/2010

TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	2
ENERGY STORAGE MARKET OVERVIEW	6
<i>Industry Overview</i>	6
<i>Jobs Forecast</i>	10
EMERGING ENERGY STORAGE GRID APPLICATIONS	11
<i>Uninterruptible Power Supplies</i>	11
<i>Ancillary Services and Transmission System Support</i>	11
<i>Customer Applications and On-site Generation Support</i>	15
<i>Integrating Renewable Generation</i>	17
<i>Power Control Systems</i>	18
WHAT TO TEACH IN A SHORT COURSE	19
ENERGY STORAGE OCCUPATIONS.....	24
<i>Engineers</i>	24
<i>Researchers</i>	24
<i>Electricians</i>	24
<i>Solar Installers/Solar Sales Reps/Renewable Energy System Integrators</i>	24
<i>Facility Managers</i>	25
<i>Utility Linemen and Other Transmission/Distribution Utility Staff</i>	25
<i>Automotive Technicians</i>	26
<i>Mechanical Contractors</i>	26
STANDARDS	27
<i>Institute of Electrical and Electronics Engineers</i>	27
<i>American National Standards Institute</i>	27
<i>National Electrical Code</i>	27
<i>Other Relevant Codes</i>	27
CERTIFICATIONS	29
<i>NABCEP Solar PV Installer Certification</i>	29
<i>NABCEP Solar PV Installer Training</i>	29

<i>Hybrid and Electric Car Training</i>	30
<i>Community Energy Storage Standard</i>	30
APPENDIX A: ENERGY STORAGE COMPANIES	31
APPENDIX B: INVENTORY OF ENERGY STORAGE COMPANIES IN CENTRAL TEXAS	34
<i>Active Power</i>	34
<i>Xtreme Power</i>	34
<i>Valence Technology</i>	35
<i>Exide Technologies</i>	36
<i>ActaCell</i>	36
<i>EEStor</i>	36
<i>Graphene Energy</i>	36
APPENDIX C O*NET OCCUPATIONS RELATED TO ENERGY STORAGE.....	37
<i>Table 1. O*NET Green New and Emerging Occupations Related to Energy Storage</i>	37
APPENDIX D: BIBLIOGRAPHY	39

DRAFT

Acknowledgements

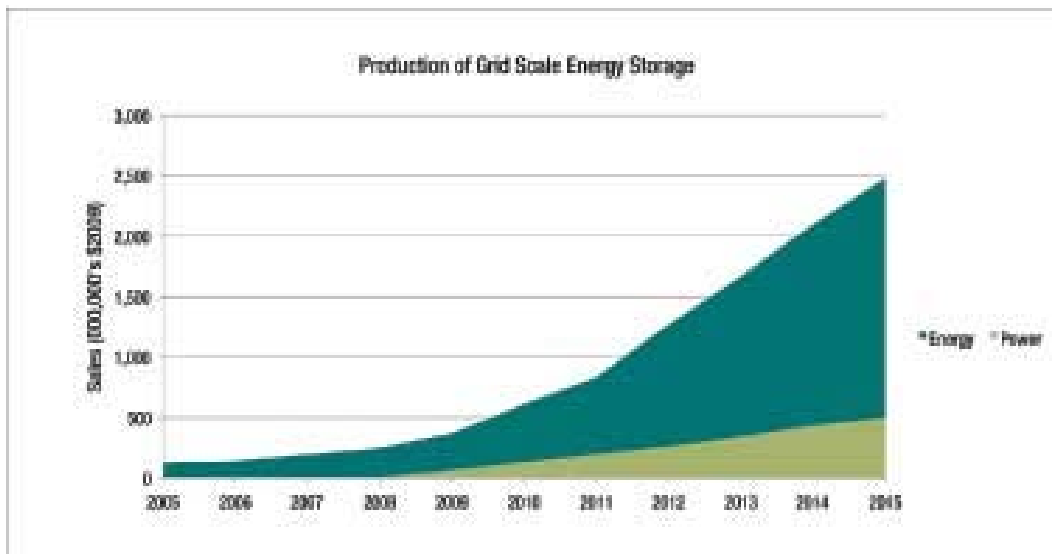
This report is produced as part of a Wagner-Peyser Grant from the Office of the Governor through the Texas Workforce Commission. Our thanks go to the Governor and Brian Owens on his staff, to the Texas Workforce Commissioners, and to Doug Ridge, Kelly Sadler, Shannon Federoff, Rebecca Schroeder, and Joe Yacono on the TWC staff.

This report is designed to offer useful information to Texas' workforce investment boards and community colleges about the availability and potential of green jobs in the Energy Storage industry in Texas as well as to provide details on the workforce training needs of employees in the industry.

Thanks to all members of the Green Jobs Business Council and the Green Corridor Consortium for their participation and interest in this topic. Particular thanks to all those who gave time and expertise to contribute to the report.

EXECUTIVE SUMMARY

Energy storage today represents a very small part of the clean energy economy, but it is growing rapidly. GTM Research estimates that less than 1% of the total market size for energy storage has been reached. It expects 9x growth from 2009-2015¹ (see chart below). Similarly, Pike Research projects a 12x growth to 2018², while NanoMarkets expects the storage market to grow by over 5x from 2012-2016³.



Credit: GTM Research

The market is currently between \$300 and \$400 million and is expected to grow to \$2.5-\$8.3 billion in the 2015-2018 timeframe⁴. The market for rechargeable lithium-ion batteries is expected to grow even larger to \$25 billion (3 trillion yen) by 2014⁵, with over two-thirds of that

¹GTM Research, "Grid Scale Energy Storage: Technologies and Forecasts Through 2015", August 2009. See GTM Research, "Grid Scale Energy Storage: Technologies and Forecasts Through 2015", August 2009. See <http://www.gtmresearch.com/report/grid-scale-energy-storage-technologies-and-forecasts-through-2015> Accessed in August 2010.

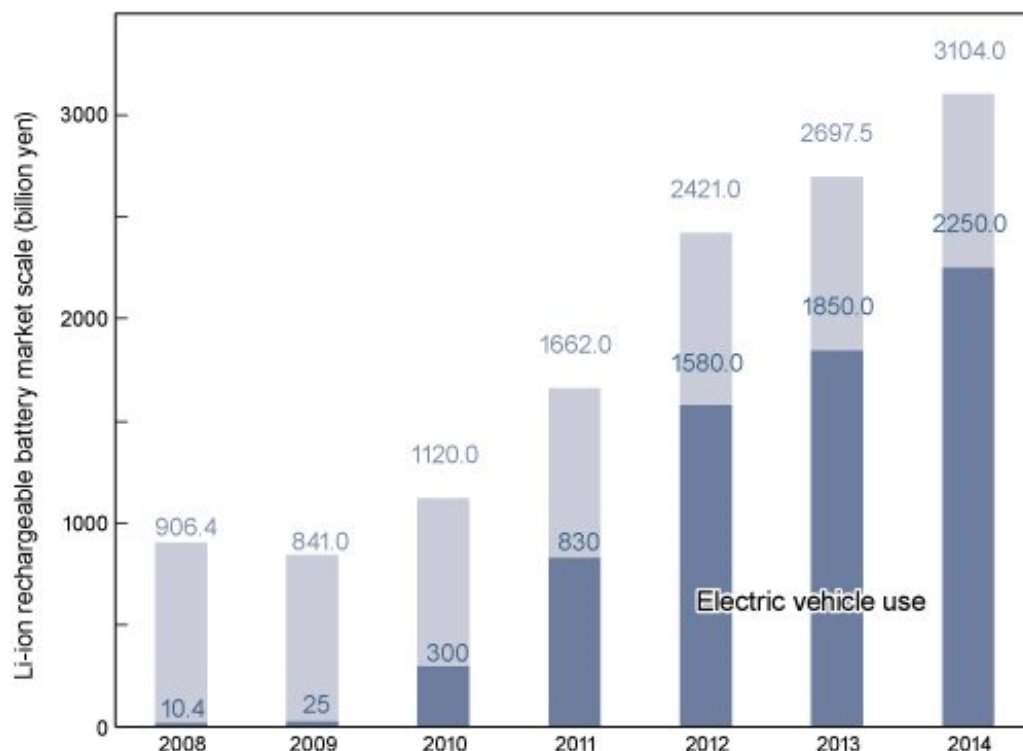
² PikeResearch, "Energy Storage market to Reach \$4.1 Billion in 10 Years", May 2009. See <http://www.pikeresearch.com/newsroom/energy-storage-market-to-reach-41-billion-in-10-years> Accessed in August 2010

³ NanoMarkets "Batteries and Ultra-Capacitors for the Smart Power Grid: Market Opportunities 2009-2016" . See <http://nanomarkets.net/market-reports/report/batteries-and-ultra-capacitors-for-the-smart-power-grid-market-opportunities/> Accessed in August 2010

⁴ This is the range of size projected in the three reports referenced above.

⁵Kariatsumari, Kouji; Kume, Hideyoshi; Yomogita, Hiroki; Keys, Phil. Nikkei Electronics Asia, "A new Era for Li-Ion Batteries". February 2010, See <http://techon.nikkeibp.co.jp/article/HONSHI/20100127/179667/?P=3> Accessed in August 2010

total for EV use (see chart below). This kind of rapid growth will have significant impacts on workforce readiness.



Source: Nektei Electronics Asia

This growth will produce hundreds of new jobs for engineers, electricians, technicians, and renewable energy/smart grid system integrators who install and maintain energy storage resources. Many thousands more in related occupations will need to upgrade their knowledge and skills to understand and work with various types of energy storage. The main occupations affected will be electrical and mechanical engineers, electricians, utility linemen, solar installers, automotive technicians, HVAC technicians, and facility managers.

There is not currently an occupation specifically focused on energy storage as there is for wind and solar energy, although there are companies that specialize in power control systems that connect storage to the grid and end-uses.

Learning to install, maintain, and repair energy storage systems are “enhanced skills” for existing occupations, but will not likely be designated as a distinct “New and Emerging Occupation.”⁶

There are companies emerging which specialize in energy storage system integration and installation, or which plan to build-own-operate storage systems to support the grid or individual utilities. **Specific trainings for various applications at this point are primarily**

⁶ O*NET Resource Center, The Green Economy, <http://www.onetcenter.org/green.html?p=2> Accessed in August of 2010.

provided by the existing and emerging manufacturers who are developing their own networks of qualified design, installation and maintenance.

These companies can provide a variety of different functions. According to the Department of Energy⁷:

Developing technology to store electrical energy so it can be available to meet demand whenever needed would represent a major breakthrough in electricity distribution. Helping to try and meet this goal, electricity storage devices can manage the amount of power required to supply customers at times when need is greatest, which is during peak load. These devices can also help make renewable energy, whose power output cannot be controlled by grid operators, smooth and dispatchable. They can also balance microgrids to achieve a good match between generation and load. Storage devices can provide frequency regulation to maintain the balance between the network's load and power generated, and they can achieve a more reliable power supply for high tech industrial facilities. Thus, energy storage and power electronics hold substantial promise for transforming the electric power industry.

Each of these applications has value, and many storage technologies are capable of delivering multiple benefits at the same time. Market barriers still exist in some potential markets where storage can provide benefits, but regulators are moving to reduce or eliminate impediments to storage implementation. The challenge to storage manufacturers, project developers, system operators, utility staff, and facilities managers is to develop projects with attractive economics.

Energy storage technologies, both familiar technologies like lead-acid batteries and thermal storage systems, as well as evolving new technologies, appear on the verge of taking on new and expanded roles both on the customer site and throughout the electric grid. This report will focus primarily on these emerging applications for both old and new energy storage systems in stationary applications associated with the electric power industry or grid connected electric power use. We will also discuss energy storage technologies associated with hybrid, plug-in hybrid, and fully electric cars, and the electrification of the transportation system.

In the near term, community colleges should create a short course covering the different types of energy storage, and the applications for which each is appropriate. Introduction to the various companies emerging in this space would give students an idea of the size and complexity of the industry, as well as some ideas about how to pursue a career in this fast growing business. The course should include fundamental information about system installation, power control systems, and safety.

Finally, the short course should include instruction with respect to the impact of evolving policy with respect to energy storage and the economics of energy storage systems, two intertwined

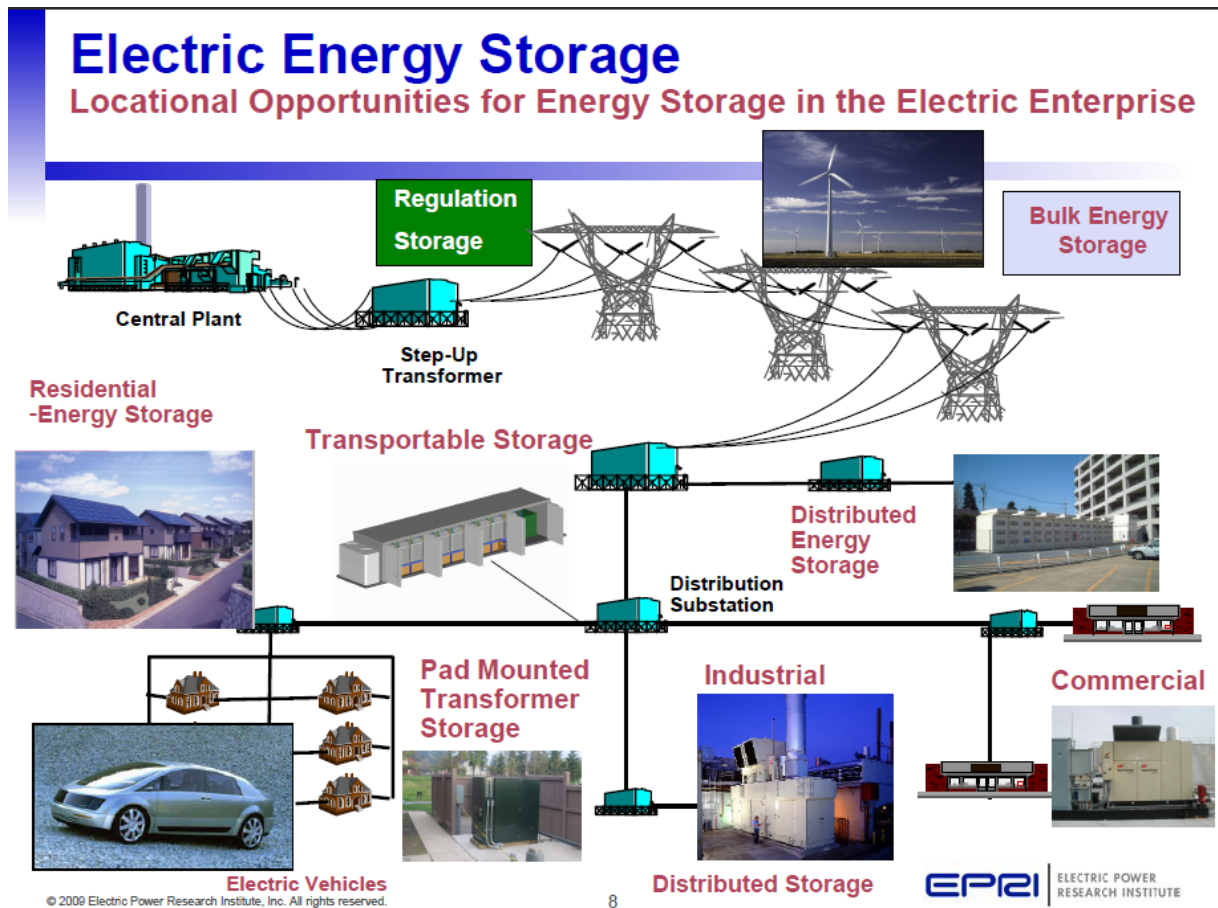
⁷DOE, Energy Storage. <http://www.oe.energy.gov/storage.htm> Accessed in August of 2010

sets of issues. This would also help students make judgments about career goals or choices, and make them more valuable to potential employers who might also be exploring the potential for business development in this space.

ENERGY STORAGE MARKET OVERVIEW

INDUSTRY OVERVIEW

The term “energy storage” encompasses a wide range of technologies and applications, from utility-scale storage at a power plant or substation to storage for electric vehicles, from industrial to residential energy storage applications. The following slide from EPRI depicts the range of opportunities for electricity storage on the grid.



Of the currently installed 22 gigawatts (GW) of stationary electricity storage applications in the US⁸, almost all is at the bulk energy storage level (the top of the figure above), with only a small quantity at the distributed level (middle and bottom of figure above). The vast majority (>95%) of US energy storage is pumped hydroelectric storage, most of it installed between 1930-1980. While some pumped hydro may continue to be installed, there is limited growth opportunity because of the physical requirements (suitable geography and available water) required and significant permitting hurdles.

⁸Pew Center on Global Climate Change, “Electric Energy Storage”. May 2009. See <http://www.pewclimate.org/docUploads/Energy-Storage-Fact-Sheet.pdf>. Accessed in August of 2010.

An alternative form of bulk storage is Compressed Air Energy Storage (CAES). There is one CAES facility in the US, in Alabama, of about 110 megawatts, which has been operated by an electric cooperative for almost 20 years. More recently a Texas project developer sold the development rights of a 2000 MW CAES project in Norton, Ohio, to First Energy.⁹ There is significant potential for CAES in Texas. A 1,000 MW facility in West Texas which could store wind energy produced off-peak for delivery during peak periods has been contemplated for years by Luminant and Shell¹⁰ but has yet to break ground. CAES, like pumped hydroelectric storage, is limited by the availability of suitable geological formations. Most proposed CAES facilities employ salt formations, creating caverns for compressed air in a similar fashion to that currently used by the natural gas industry for storage facilities.

Uninterruptible power systems (UPS) from manufacturers already constitute a multi-billion dollar market and are projected to grow to more than \$10 billion by 2012, with much of its growth driven by the demand for new datacenters.¹¹ The majority of existing storage systems are based on lead-acid battery technology, but this hegemony is being challenged by younger companies with new technologies. Austin's Active Power is making serious inroads into this market with its flywheel technology because of its greater life expectancy and reliability.

The market for electric vehicle batteries, currently dominated by lithium-ion technologies, is expected to grow rapidly over the next six years to more than \$20 billion by 2015.¹² Electric vehicle batteries become grid-connected resources when plugged in, and electric vehicles are likely to be the largest deployment of distributed energy storage resources in the next few years.

Battery technology investments for this market will likely have spill-over benefits for stationary grid applications as well. American Electric Power company predicts grid storage applications will get a boost as auto batteries are switched out of automobiles and repurposed for grid storage.¹³ Batteries that have lost too much storage capacity after repeated cycling to be effective in a mobile environment would still be acceptable in a stationary application where power density was not so critical a concern.

New markets are emerging now for grid applications of energy storage. A recent study completed for the US Department of Energy and Sandia National Laboratories, describes 26 different benefits that can be derived by use of storage on the grid, including on the customer

⁹ Haddington Ventures, L.L.C. press release, 23 Nov., 2009. See <http://www.hvllc.com/en/rel/93/>, accessed August, 2010.

¹⁰Testa, Bridget Mintz, 2008. *Wind In A Bottle*. Power & Energy. See <http://www.memagazine.org/contents/current/features/windina/windina.html> . Accessed August 2010.

¹¹ United States Securities and Exchange Commission, Form 10-K, Active Power, Inc. 2008. See http://www.activepower.com/fileadmin/documents/financial_reports/2008_Form_10K.pdf . Accessed August 2010

¹²Kariatsumari, Kouji; Kume, Hideyoshi; Yomogita, Hiroki; Keys, Phil. Nikkei Electronics Asia, February 2010, "A new Era for Li-Ion Batteries". See <http://techon.nikkeibp.co.jp/article/HONSHI/20100127/179667/?P=3>; <http://files.shareholder.com/downloads/ABEA-3DGN17/745432919x0xS1047469-09-8512/1167178/filing.pdf> . Accessed August 2010

¹³Bjelovuk, George, 18 July 2010. "American Electric Power's Utility-Scale Energy Storage". gridSmart See <http://www.narucmeetings.org/Presentations/Bjelovuk.%20Energy%20Storage%20and%20Renewables.%20NARUC.%207-18-10.pdf> . Accessed August, 2010

site, which offer a mid-range economic benefit of \$228 billion for the US (see pages 20-21 for the list of benefits).¹⁴

The challenge to the market will be finding value propositions which manage to capture or monetize multiple benefits for select applications. Electric storage technologies, at least as applied to grid applications, tend to fall into one of two categories based on their physical and performance characteristics. There are electric storage technologies that provide services utilized to enhance grid reliability; these are generally called ancillary services, such as regulation and frequency support. Some ancillary services are required by grid operators, others are offered into markets (for a full description of ancillary services see pages 10-14). Energy storage can also provide other services like peak shifting, which are not required for reliability but provide significant economic benefits. In other words, some storage applications can store power produced off peak (e.g., energy produced in the middle of the night when demand is low) and deliver it on peak (e.g., in the late afternoon when power is in high demand). These areas of growth will be discussed further later in this report.

The relatively young market for stationary grid-connected storage, though smaller than the mature market for UPS systems and the rapidly growing EV battery market, is nonetheless expected to grow to almost \$2.5 billion in sales over the next six years, with storage capacity expanding from approximately 190 megawatts to 2500 megawatts over the same period¹⁵. Three reports released over the last two years share a common conclusion: an order of magnitude growth over the next 5-8 years:

- GTM Research estimates that the grid storage market is set to grow from roughly \$365 million in 2009 to nearly \$2.5 billion by 2015.¹⁶
- Pike Research estimates that the global energy storage market is poised to grow from \$329 million in 2008 to \$4.1 billion by 2018.¹⁷
- NanoMarkets predicts the market for grid storage will grow from \$1.5 billion in 2012 to \$8.3 billion by 2016, which will mostly be batteries, though ultracapacitors will have their niche applications.¹⁸

¹⁴ Eyer, Jim; Garth, Corey. *Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide*. Sandia Report. February 2010. See <http://prod.sandia.gov/techlib/access-control.cgi/2010/100815.pdf> . Accessed August 2010.

¹⁵ GTM Research, "Grid Scale Energy Storage: Technologies and Forecasts Through 2015", August 2009. See <http://www.gtmresearch.com/report/grid-scale-energy-storage-technologies-and-forecasts-through-2015> . Accessed August 2010.

¹⁶ GTM Research, "Grid Scale Energy Storage: Technologies and Forecasts Through 2015", August 2009. See <http://www.gtmresearch.com/report/grid-scale-energy-storage-technologies-and-forecasts-through-2015> . Accessed August 2010.

¹⁷ PikeResearch, "Energy Storage Market to Reach \$4.1 Billion in 10 Years", May 2009. See <http://www.pikeresearch.com/newsroom/energy-storage-market-to-reach-41-billion-in-10-years> . Accessed August 2010.

¹⁸St. John, Jeff. Greentechgrid. July 2009. See <http://www.greentechmedia.com/articles/read/grid-storage-batteries-and-ultracaps-an-8.3b-market-by-2016> . Accessed August 2010.

Another indication of growth in this market is that energy storage was a strong clean tech investment area in 2009, with at least \$455M invested.¹⁹ In addition to that, over \$200 million in grants were made for grid energy storage from the federal stimulus funds. The DOE Energy Storage program funded 16 energy storage projects under FOA 36 totaling approximately \$185M²⁰ and six programs totaling approximately \$30M were funded under ARPA-E.²¹ Future investments are expected, including a major Energy Regional Innovation Center (E-RIC) opportunity focused on electric storage early next year; total funding would equal \$120 million over the next five years.

In addition to those electricity storage technologies or applications discussed thus far, it can also make sense to use thermal storage to shift the demand for electricity needed for thermal applications, particularly heating and cooling. Thermal storage systems can be paired with air conditioning systems, for example, to make ice at night, and then use the ice to cool building space during peak demand hours. A California study found that total net savings which could be realized using this technology ranged between 8 and 25% of energy used for cooling, because both power plants and air conditioners run more efficiently at night.²²

This application provides the same kind of economic benefits to utilities as charging electric vehicles off peak. Thermal storage has been employed by large commercial building developers or owners to avoid high capacity charges, and capture utility incentives for shifting load off peak. A similar trend for smaller building owners has awaited advanced digital meters and new cooling technology that could be coupled with the split or DX space conditioning units serving 95% of all buildings. That new technology now exists. Heating can also be generated off peak and stored. The most common example of this is a traditional hot water heater.

Finally, a good deal of the training required for the design, installation, operation and maintenance of energy storage systems, except for the specialized internal research on different technologies, involves power control systems (PCS). Control systems are required for safety, and to regulate the power quality coming from storage units, convert the power from the grid to DC, and then invert the power back to AC for applications or interconnection to the grid. This same PCS equipment is needed for distributed renewable energy systems such as solar photovoltaic systems.

Given the growth of both these industries, we would also predict rapid growth for PCS products and services. For example, demand from the alternative energy market will help to

¹⁹ Kanellos, Michael. "Green VC Total: Second Best Year Ever" Greentechmedia. December 2009. See <http://www.greentechmedia.com/articles/read/green-vc-total-second-best-year-ever>. Accessed August 2010.

²⁰ Sandia Labs "Energy Storage Demonstrations" November 2009. See http://www.sandia.gov/ess/About/docs/FOA36_%20storagedemos_11-24-09.pdf. Accessed August 2010.

²¹ Sandia Labs. "ARPA-E Energy Storage Projects" November 2009. See http://www.sandia.gov/ess/About/docs/six_projects_11-2009.pdf. Accessed August 2010.

²² California Energy Commission. "Source Energy and Environmental Impacts of Thermal Energy Storage". February 1996. See http://www.energy.ca.gov/reports/500-95-005_TES-REPORT.PDF. Accessed August 2010

currently the two leading storage technologies capable of supporting the thousands of rapid, shallow charge and discharge cycles required to provide regulation.

Regulatory Issues and Market Barriers: Regulation service has historically been provided by natural gas generation facilities, so ERCOT regulation protocols and regulation dispatch signals are designed around the capabilities of gas generation. Flywheels and lithium-ion batteries are able to respond to regulation signals more quickly than gas generation but have a lower total energy capacity. Regulation protocols, reliability requirements, and dispatch signals need to be modified to take these two differences into account. Requiring a quick response storage device to maintain power output for as long as a gas turbine, without accounting for the value of faster, more flexible response, creates an economic barrier against participation of storage technology in the regulation market.

Because storage can respond to regulation signals more quickly than gas generators, storage can replace traditional generation as a regulation provider, reducing the use of fossil fuels, reducing regulation costs, and improving grid efficiencies. Fossil generators take several minutes to respond to the automatic generation control (AGC) signal governing regulation, during which time the signal may have already changed so that the generator response may be working against the action required by the grid. A study by California ISO shows that regulation provided by energy storage is twice as effective as regulation by fossil fuel generation. This means that an energy storage facility rated at 10 megawatts can do the work of 20 megawatts of regulation by fossil fuel generation. In order to fully enable the benefit that storage can provide to the grid, system operators need to work with storage companies to optimize regulation dispatch signals for the capabilities of energy storage.

Reliability requirements in some markets require that regulation resources be able to provide one hour of continuous energy. The one hour requirement is not a NERC (North American Reliability Council) requirement, nor is it necessary for all regulation resources from a reliability standpoint. Because regulation involves rapid charge and discharge around a baseline energy level, one hour of continuous discharge does not reflect the standard operation of regulation resources during real world use. Lowering the requirement from one hour to fifteen minutes for storage resources would make it more economical for storage to provide regulation service without impacting the reliability of the grid. The Federal Energy Regulatory Commission (FERC) has encouraged market rule changes to enable participation of batteries and flywheels in other markets, and both the NYISO and PJM have adopted market rules to facilitate the participation of quick response storage. New York ISO and the Northeast Power Coordinating Council made this change in December 2008, and other markets around the country are in the process of studying and adopting similar changes.

Work is under way in ISO New England, California ISO, and Midwest ISO to modify regulation operations and dispatch signaling to accommodate the new capabilities offered by storage resources. ERCOT has recently formed a Power Storage Working Group, in response to

programs operated by the investor-owned utilities. As always the viability of these applications depend on finding a business proposition, in which sufficient benefits can be captured, to justify the cost of the installation. Because the utility and/or load-serving entity benefit if storage shifts peak or improves power quality locally, storage may not prove economical to the end user unless these benefits can be compensated in some way. Today, thermal storage may make sense for large commercial customers, who can take advantage of time of use rates and utility incentives for load shifting when they are made available. Deployment of smart meters will help enable smaller customers to explore these options, which may prove viable if load serving entities are able to provide time of use pricing or load shift incentives that reflect total benefits.

Some vertically integrated utilities see energy storage as a utility resource, a potential replacement for peaking generation, which they might own and operate themselves, even at a customer's premise. Storage can simultaneously meet peak demand and provide other T&D support and ancillary services, and it can be located nearer load because it has little or no air emissions. San Antonio's CPS Energy is evaluating a new thermal storage system for smaller commercial customers with EPRI, with this in mind.

Market Forecast: Some Austin solar photovoltaic installers estimate that electric storage is currently installed in about 15% of residential and commercial solar PV installations. With U.S. installed PV capacity predicted to increase from 1,111 MW in 2008 to 5,293 MW in 2013, the growth in solar should drive corresponding growth in storage³⁰. Since PV output peaks at noon (1 PM under daylight savings time) but summer temperatures in regions like Texas peak between 4 PM and 6 PM, lower storage costs combined with the penetration of time of use pricing or other incentives could facilitate the pairing of PV and storage.

The relatively young market for stationary grid-connected storage, though smaller than the mature market for UPS systems and the rapidly growing EV battery market, is nonetheless expected to grow to almost \$2.5 billion in sales over the next six years, with storage capacity expanding from approximately 190 megawatts to 2500 megawatts over the same period³¹.

One initiative that could drive residential distributed energy storage is American Electric Power's (AEP) Community Energy Storage (CES) initiative, which calls for widespread distributed storage installations using lithium-ion batteries recycled from electric vehicles. If implemented, the CES plan could mean hundreds of thousands of residential and commercial storage installations nationwide, although CES is likely a year or two away from use in large-scale pilot projects or commercial deployments. AEP envisions employing used EV batteries, which would be purchased at low cost since they would have little alternative economic value,

³⁰ PRLog Press Release. June 2009. See <http://www.prlog.org/10250298-globaldata-the-us-solar-pv-market-analysis-and-forecasts-to-2013-on-reportsresearchcom.html>. Accessed August 2010.

³¹ GTM Research, "Grid Scale Energy Storage: Technologies and Forecasts Through 2015", August 2009. See <http://www.gtmresearch.com/report/grid-scale-energy-storage-technologies-and-forecasts-through-2015>. Accessed August 2010.

Incidental Benefits

- Benefit #18 – Increased Asset Utilization
- Benefit #19 – Avoided Transmission and Distribution Energy Losses
- Benefit #20 – Avoided Transmission Access Charges
- Benefit #21 – Reduced Transmission and Distribution Investment Risk
- Benefit #22 – Dynamic Operating Benefits
- Benefit #23 – Power Factor Correction
- Benefit #24 – Reduced Generation Fossil Fuel Use
- Benefit #25 – Reduced Air Emissions from Generation
- Benefit #26 – Flexibility

Storage Value Propositions

Introduction

Benefits Aggregation Challenges

- Technical Conflicts
- Operational Conflicts
- Aggregating Benefits among Stakeholders
- Effect on Market Potential

Notable Application Synergies

- Electric Energy Time-shift and Electric Supply Capacity
- Electric Supply Reserve Capacity
- Load Following
- Transmission and Distribution Upgrade Deferral
- Demand Charge Management and Time-of-use Energy Cost Management
- Electric Service Reliability and Electric Service Power Quality

Distributed Energy Storage

- Locational Benefits
- Non-locational Benefits

Storage Modularity

Value Proposition Examples

The Societal Storage Value Proposition

Electricity Storage Opportunity Stakeholders, Challenges, and Drivers

Stakeholders

Challenges

Opportunity Drivers

Notable Developments Affecting Prospects for Storage

- Smart Grid and Electricity Storage Increasing use of Demand Response Resources
- Load Aggregators
- Increasingly Rich Electricity Price Signals
- Tax and Regulatory Incentives for Storage

PikeResearch, "Energy Storage market to Reach \$4.1 Billion in 10 Years", May 2009. See <http://www.pikeresearch.com/newsroom/energy-storage-market-to-reach-41-billion-in-10-years>

PRLog Press Release. June 2009. See <http://www.prlog.org/10250298-globaldata-the-us-solar-pv-market-analysis-and-forecasts-to-2013-on-reportsresearchcom.html>

Sandia Labs "Energy Storage Demonstrations" November 2009. See http://www.sandia.gov/ess/About/docs/FOA36_%20storagedemos_11-24-09.pdf

Sandia Report, SAND2010-0815, printed February, 2010. See <http://prod.sandia.gov/techlib/access-control.cgi/2010/100815.pdf>

St. John, Jeff. Greentechgrid. July 2009. See <http://www.greentechmedia.com/articles/read/grid-storage-batteries-and-ultracaps-an-8.3b-market-by-2016>

Testa, Bridget Mintz, Wind In A Bottle. Power & Energy. 2008. See <http://www.memagazine.org/contents/current/features/windina/windina.html>.

Texas Department of Licensing and Regulation. <http://www.license.state.tx.us/LicenseSearch/licfile.asp>

United States Securities and Exchange Commission, Form 10-K, Active Power, Inc. 2008. See http://www.activepower.com/fileadmin/documents/financial_reports/2008_Form_10K.pdf

WSJ MarketWatch Press Release. August 2010. See http://www.marketwatch.com/story/a123-systems-solidifies-leadership-position-in-delivery-of-lithium-ion-technology-for-the-power-grid-with-order-of-44mw-of-smart-grid-stabilization-systems-sgsstm-2010-08-10?reflink=MW_news_stmp