

GE EYES 60 HERTZ MARKET

BY DICK FLANAGAN



Paul Browning, CEO, GE Thermal Products

SAN FRANCISCO, CA - Power grids are found globally in two frequencies, 50 Hertz in Europe, Asia and Africa and in 60 Hertz in the Americas, Japan, and Saudi Arabia. GE's first launch of its FlexEfficiency technology was to the 50 Hertz market announced at Power-Gen Europe in Milan. (See *World-Gen*, V.23, Number 3, June 2011, "Grid Challenge Met.")

Paul Browning, president and CEO, GE Thermal Products business said, "Today's announcement positions GE with the broadest, most comprehensive gas turbine portfolio, delivering a combination of record-setting efficiency and flexibility. Like its 50 Hertz counterpart, the FlexEfficiency 50 Plant introduced in 2011, the FlexEfficiency 60 Plant is able to rapidly increase or decrease its power output in response to fluctuations in wind and solar power, enabling the integration of more renewable resources onto the power grid." GE also announced that the company has secured nearly \$1.2 billion in new orders

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UTILITY-SCALE PV INVERTERS

BY DR. AMINUL HUQUE, EPRI



More solar power means more photovoltaic (PV) inverters and a growing dependence of the grid on inverter performance and reliability. Roughly 70 gigawatts (GW) of grid-connected solar PV generation capacity were cumulatively deployed worldwide at the end of 2011. And looking ahead, policy, regulatory, and economic factors are expected to further drive rapid and sustained growth in PV for the foreseeable future.

Nearly all future energy scenarios include a significant amount of solar. In fact, most projections of future electricity generation indicate brisk solar growth, resulting in the resource comprising approximately 1% of worldwide capacity in less than 5 years, and double-digit percentages within the next couple of decades.

The increasing share of distributed solar PV is requiring greater attention be paid to PV plant components to assure that PV systems meet

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Our 24th Year

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Some countries have wind.
Some have gas. Others have coal.
That's why one answer is not enough.

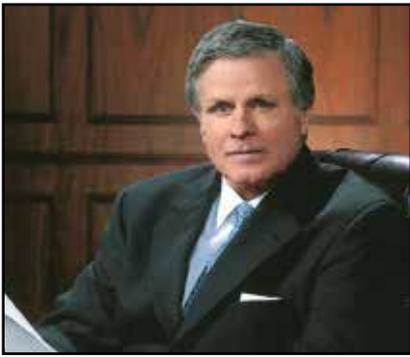
The world's need for energy needs answers for all types of energy.

The nations of the world are not equally blessed with energy resources. Some have oil. Some have wind. Some have powerful rivers. And some need to import their energy from elsewhere. Yet no matter where our energy comes from, one thing is sure, our demand for it increases every day. That's why a single answer is not enough.

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As we help the world move beyond fossil fuels, we continue to tackle climate change by finding ways to make conventional fuels cleaner than ever before. Even as we look towards wind, solar and hydroelectric power, we remain committed to using the planet's scarce resources respectfully, responsibly and efficiently.

The journey to a new kind of energy system needs all types of answers. Answers today, and answers that last.



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On page 1, GE unveiled its new FlexEfficiency 60 power generation portfolio engineered to harness natural gas and enable greater use of renewable energy. The FlexEfficiency 60 will enable utilities to deliver power quickly when it is needed and to ramp down when it is not, balancing the grid cost-effectively. GE also announced that the company has secured nearly \$1.2 billion in new orders for FlexEfficiency 60 technology for projects in the United States, Saudi Arabia and Japan. The \$1.2 billion in new sales is comprised of orders for 19 gas turbines—13 for the 7F 5-series gas turbine and six for the new, larger 7F 7-series gas turbine. FlexEfficiency 60 technology will be manufactured and tested at the world's largest gas turbine manufacturing facility in Greenville, SC. GE's FlexEfficiency 60 Truck Tour begins a 4,000-mile journey over the next four months and will stop in 25 North American cities.

Nearly all future energy scenarios include a significant amount of solar. In fact, most projections of future electricity generation indicate brisk solar growth, resulting in the resource comprising approximately 1% of worldwide capacity in less than 5 years, and double-digit percentages within the next couple of decades. More solar power means more photovoltaic (PV) inverters and a growing dependence of the grid on inverter performance and reliability. Roughly 70 gigawatts of grid-connected solar PV generation capacity were cumulatively deployed worldwide at the end of 2011. And looking ahead, policy, regulatory, and economic factors are expected to further drive rapid and sustained growth in PV for the foreseeable future, Aminul Huque projects on page 1.

Developers continue to submit applications to the CEC for certification of power projects and they continue to be approved following long deliberative reviews and hearings, Lyn Corum shares on page 13. Two 500-MW solar concentration thermal plants are being developed by BrightSource Energy: Hidden Hills and Rio Mesa. Both have preliminary staff reviews on file and are undergoing evidentiary hearings. The 100-MW gas-fired Quail Brush peaker project being developed by Cogentrix Energy in San Diego County has just begun its review. All hold power purchase agreements with utilities. Citing the need for near-term power should the San Onofre Nuclear Power Station remain shut down, the CEC approved the development of the 300-MW Pio Pico Energy Center in September. The project is to be built in southern San Diego County near the border with Mexico. The simple-cycle, gas-fired project, being developed by Apex Power Group at an estimated cost of \$300 million, holds a 20-year power purchase agreement with SDG&E and was designed to satisfy the utility's load requirements.

In "Growth Opportunities in Solar Photovoltaic Operation and Maintenance Market: 2012–2017," Lucintel, a global management consulting and market research firm, projects the global solar PV O&M market "to grow rapidly and reach approximately \$18.4 billion in 2017 with a CAGR of approximately 43 percent over the next five years," David Schroeder writes on page 14. Solar insurance protection combined with a warranty administration program and O&M services offers the most reliable protection against a wide variety of solar project risks.

Solar heating, often overshadowed by photovoltaic systems, is the most cost-effective on-site renewable energy resource. It presents vast opportunity for public and private organizations to save on fossil fuels, cut costs, and reduce carbon emissions, William Guiney tells us on page 15. The technical potential for solar water heating in the United States is about one quadrillion Btu of energy savings per year, worth \$8 billion of energy costs and 50 million to 75 million metric tons of carbon dioxide emissions. Furthermore, some 67 percent of the nation's commercial buildings have rooftops available for solar water heating, according to the National Renewable Energy Laboratory.

Paula Mints of Navigant says on page 16 that it is hard to believe that just a few years ago the PV industry was one, long annual party that began suddenly and seemed destined to continue to no end. During this time interest in the PV industry was avid with investors, journalists and other industries with less exciting markets trying to develop entry strategies for what was the next big thing. After all, electricity demand continues to grow with the population, climate change was accepted by most and the PV industry had plenty of questions looking for answers. These questions, including how to lower cost more rapidly, how to deploy more rapidly, how to innovate more rapidly, how to develop markets more rapidly, encouraged eager new entrants to believe that they had the answers and that the promises of overnight success just might prove true. Most entered believing that the future was not written yet and that the past could easily be ignored.

Over the last few years, significant fundamental shifts have noticeably altered the energy landscape of the nation. Within the gas and power space, new shale resources making abundant low-cost natural gas have radically transformed the supply side of the equation for the power sector. The intensifying competition between coal and gas generators has put downward pressure on the market share of coal, incentivizing early coal-fired plant retirements. The key driver underpinning much of this new state of the market is a significant shift in electric demand growth expectations. Specifically, forward projections for electric demand growth during the next two decades have changed dramatically since 2008. Current projections indicate more than a decade of lost demand growth compared with the 2008 projections, Prajit Ghosh and Hind Farag said on page 17.

Greg Aliff and Marlene Motyka in their Deloitte Study, "reSources 2012", said on page 18 that the recession has heralded a new era of energy frugality that has profoundly changed American energy habits for both businesses

(continued page 12)

EATON DEVELOPS

PITTSBURGH, PA - Eaton Corporation will help develop an underwater, utility-scale energy generation system for the U.S. Navy. The system will utilize a paralleled system of 1MW electric ring generator (ERG) underwater turbines to capture the power of ocean currents to provide Navy land-based and port facilities with a sustainable, reliable source of utility-scale power.

LNG EXPORTED

CAMERON PARISH, LA - GE Oil & Gas will supply gas compression trains for Cheniere Energy's Sabine Pass liquefaction expansion project about 170 miles west of Baton Rouge. Adding liquefaction capabilities will transform the existing Sabine Pass LNG terminal into the first LNG terminal capable of importing and exporting liquefied natural gas in the U.S.

SOLARWORLD TO EPC

HILLSBORO, OR - SolarWorld has begun construction of its 25-megawatt (DC) Desert Star Solar Projects in California's Mojave Desert. The engineering, procurement and construction division of SolarWorld, is overseeing all phases of the projects. Desert Star will rank among California's largest operating crystalline-silicon solar installations.

BECHTEL, SIEMENS TEAM

DALLAS, TX - Panda Sherman Power, LLC has successfully completed the financing on its planned 758-megawatt natural gas-fueled, combined-cycle power plant in Sherman, TX. Goldman Sachs and Credit Suisse arranged the senior debt financing for the plant. The plant will contribute an estimated \$1.7 billion to the area's economy during construction and the facility's first 10 years of operation. Approximately 700-800 jobs will be created.

Panda Power Funds selected a turn-key consortium of Bechtel and Siemens Energy Inc. to build the generation facility. Siemens will provide the power island package including the natural gas turbines, steam turbine, waste heat recovery boilers, and instrument and control systems. Bechtel will be responsible for the engineering and procurement for the balance of the plant, and the installation, construction and commissioning of the facility. Panda Sherman Power will immediately start construction on the 204-acre site and expects commercial operations to begin by the end of 2014.

SMA INKED

TORONTO, CA - SMA has entered into a contract with Canadian independent power producer Northland Power Inc. to equip the company with SMA Medium-Voltage Power Platforms for multiple solar projects in Ontario, Canada, totaling up to 130 MW. Northland is committed to executing its large solar energy portfolio under the Feed-in Tariff (FIT) program, which is part of the Green Energy Act in Ontario. When completed in mid-2014, Northland's solar portfolio will consist of 13 solar farms, each with a capacity of 10 MW.

SIEMENS SUPPORTS

ATLANTA, GA - Siemens Industry has begun to support a multi-million contract with Abengoa, supplying integrated drive technology solutions for Solana, a 280MW facility near Gila Bend, AZ, which will be the world's largest CSP plant. Siemens will provide 18 of its Robicon Perfect Harmony medium voltage drives,

AREVA STORES

ALBUQUERQUE, NM - AREVA Solar is collaborating with Sandia National Laboratories on a new concentrated solar power (CSP) installation with thermal energy storage. The CSP storage project combines AREVA's modular Compact Linear Fresnel Reflector solar design with Sandia Labs' proven molten salt storage system. This will be the first CSP integration with Sandia Labs' Molten Salt Test Loop System.

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PANASONIC MARKS

SAN JOSE, CA - Panasonic Eco Solutions North America announced the availability of the HIT Power® 240S and HIT Power® 235S solar modules in the United States. Panasonic HIT Power® panel power generation output is higher than traditional panels. The name "HIT" comes from "Heterojunction with intrinsic Thin-layer," an original technology of the Panasonic Group

GRID DEMO

LOS ALAMOS, NM - Kyocera, the New Energy and Industrial Technology Development Organization of Japan and a number of other companies announced the start of operations of a state-of-the-art, international smart-grid demonstration project. The project is located at three sites in Los Alamos and Albuquerque.

CSAPR VACATED

WASHINGTON, DC - The DC Circuit Court of Appeals threw out the Agency's so-called Cross-State Air Pollution Rule. The Court castigated the EPA for exceeding its statutory authority attempting to take over the Clean Air Act's "cooperative federalism" approach to air pollution. CSAPR is a regulation to control plant emissions.

URS, GORE JOIN

AUSTIN, TX - URS has joined with W. L. Gore & Associates, Inc. to commercialize a new mercury control technology for the coal-fired power industry. URS has become an authorized integrator of the GORE® Mercury Control System for power applications for the utility industry to comply with standards regulation.

R-R LAUNCHES

HOUSTON, TX - Rolls-Royce launched RB211-Gzero, a retrofit upgrade product that provides users of industrial RB211 aeroderivative gas turbine engines with a nominal power increase of ten per cent. With over 700 units sold, the industrial RB211 gas turbine is available in a power range of 29 to 44 megawatts.

MAGE PILOTS

DUBLIN, GA - MAGE POWERTEC PLUS modules are powering the Solar Demonstration Project at the University of Georgia in Athens. The 19 kW solar-PV rooftop array is located on the former Visual Arts Building which has been refurbished to serve as a living laboratory for the College of Environment and Design. The college will be a crucial academic and research tool in the implementation and development of clean energy sources across campus.

POWER-ONE INTRODUCES

ORLANDO, FL - Power-One introduced its new monitoring solution, AURORA Easy View, a simplified version of the fully-featured AURORA Vision Prime. AURORA Easy View accommodates public and private modes. "The newly introduced AURORA Easy View provides an easy and straightforward way for customers to review their energy performance, allowing users the control they need to optimize the efficiency of their systems," said Paolo Casini, vice president of product marketing at Power-One. Casini is in the Class of 2012.

LG APPROVED

ORLANDO, FL - Three years after its entry to the U.S. market, LG revealed top marks from the National Renewable Energy Laboratory (NREL) for the efficiency rating of its thin-film photovoltaic cell technology. The testing by NREL resulted in the highest independently measured efficiency rating for amorphous silicon based cells of any design.



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SMR STUDIED

CHARLOTTE, NC - Babcock & Wilcox and FirstEnergy Corp. have signed a MOU regarding studies on the potential deployment of the B&W mPower™ small modular reactor in FirstEnergy's service territory. The B&W mPower SMR is an advanced 180 MWe nuclear reactor.

SOLARWORLD INVESTS

HILLSBORO, OR - SolarWorld celebrated its fifth anniversary of expanding and staffing a factory in Hillsboro by investing \$27 million for a total of more than \$600 million. The plant is the only solar factory in the Western Hemisphere that does every manufacturing step.

NAES PARTNERS

ISSAQUAH, WA - NAESsm Corporation has taken over the operations and maintenance (O&M) of the 748 MW Salem Harbor Power Plant. Units 1 and 2 were removed from service in late 2011, with units 3 and 4 scheduled to be shut down in mid-2014.

EX-IM APPROVES

WASHINGTON, DC - The Export-Import Bank of the United States has authorized a \$66.3 million guarantee in favor of UPS Capital Business Credit's loan to Bis Enerji Elektrik Uretim AS (Bis) of Turkey for the export of American power-generation equipment to the Republic of Turkey.

Ex-Im Bank's financing will support more than 160 American jobs in Houston, TX; Wellsville, NY; Orlando, FL; and Lewiston, MA.

Turkey accounted for approximately \$3.8 billion of the Bank's worldwide credit exposure as of the end of FY 2011. In FY 2011 alone the Bank authorized \$2.1 billion in export financing for American goods and services bound for Turkish markets.

Also in FY 2011, the Bank authorized \$2.2 billion in power-generation transactions worldwide.

US SOLAR SPIKES

WASHINGTON, DC - U.S. Solar Market Insight: 2nd Quarter 2012 finds that US solar achieved its second-best quarter in history, having installed 742 megawatts of solar power.

Utility installations hit 477 megawatts in the second quarter, with eight states posting utility installations of 10 megawatts or greater. The US now has 5,700 megawatts of installed solar capacity.

The utility photovoltaic (PV) market will remain strong through the last two quarters of 2012 with 3400 megawatts of utility PV projects currently under construction, and weighted U.S. average system prices 10 percent lower than the previous quarter.

GEH BUILDS

WILMINGTON, NC - GE Hitachi Nuclear Energy's (GEH) Global Laser Enrichment announced receipt of its license from the U.S. Nuclear Regulatory Commission to build a groundbreaking laser enrichment facility on the 1,600-acre site of the company's global headquarters in Wilmington, NC.

A majority of enriched uranium made to produce nuclear fuel in the United States comes from foreign or government-supplemented sources.

REQUEST CFTC

WASHINGTON, DC - With a number of foundational rulemakings still in a state of flux, Edison Electric Institute (EEI), joined by the American Gas Association and the Electric Power Supply Association, filed a request with the Commodities Futures Trading Commission to extend the compliance dates of the regulations implementing the Dodd-Frank Act by a minimum of 12 months.

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REAVES SHARES

JERSEY CITY, NJ - Utilities remain near an historic valuation relative to the broad stock market. The average regulated utility company has a P/E of approximately 15.0x next year's earnings. It has a dividend yield of about 4.2% and can be reasonably expected to grow earnings in the 3-5% range. By comparison the S&P 5001 yields about 2% and trades at 13.5x, with the assumption that the index has a 2013 earnings power of \$108.50, or 7% higher than expected for the current year.

Volatility for the S&P Utilities2 relative to the S&P 500 has come down meaningfully since the financial crisis. Currently, the S&P Utilities 24-month rolling average of standard deviation is about half of that of the S&P 500 – 9.1% vs. 18.8%. We believe that the relatively lower risk by itself could easily explain much of the Utilities' 14% P/E premium, when one thinks of a simple efficient frontier chart.

The other significant theme has been the demand for income in today's low interest-rate environment. Current demographic trends, constrained economic activity and extremely accommodative monetary policy from the Federal Reserve have all conspired, as we are all familiar, to create a situation in which investors have been forced into equities in order to generate real income. The situation has become so acute that, as many have observed, the market for U. S. Treasuries has become the venue of choice for investors wishing to bet on the business cycle, while investors looking for income have to look to the equity market. Among the S&P 500 companies, utilities (and telecommunications stocks, for that matter) offer the highest level of income.

We think all of these factors contribute to the current relative valuation of utilities and we do not see much that interferes with the relationship. We continue to believe that under the status quo incremental investors will continue to find utilities attractive.

US, KOREA TEAM

WASHINGTON, DC - The Korea Photovoltaic Industry Association and the Solar Energy Industries Association announced their formal partnership to strengthen the solar energy industries of both countries and boost the competitiveness of solar energy globally. The organizations will work jointly to promote the healthy and sustainable growth of solar energy markets at home and abroad.

Solar energy employs more than 100,000 Americans who work at more than 5,600 companies located in every state. Cumulative U.S. solar electric capacity now totals more than 5,700 megawatts. Second quarter growth in 2012 was more than double that of 2011.

Korea has taken steps to increase domestic usage of solar power, but its greatest participation in the market today is as a manufacturer and exporter of solar products.

ENERGY STORAGE

AUSTIN, TX - GE Energy Storage and Xtreme Power formalized a strategic alliance to work together to provide cutting-edge energy storage solutions. The alliance combines GE's Durathon* battery technology for grid energy storage systems and Xtreme Power's experience as an integrated energy storage turnkey solutions provider.

ENXCO REBRANDS

SAN DIEGO, CA - enXco, an EDF Energies Nouvelles Company, announced a name change to EDF Renewable Energy. The new brand name is a natural progression of the integration process with the EDF group, the leading electricity company in the world. Ten years ago, EDF Energies Nouvelles, acquired enXco.

EPRI, IAEA COLLABORATE

PALO ALTO, CA - The Electric Power Research Institute announced a three-year collaboration with the International Atomic Energy Agency to promote research into nuclear power plant development, operation, decommissioning, and waste disposal. The collaboration also will enable technical engagement on nuclear plant development.



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CBD LAUNCHES

CAMPBELL, CA - CBD Energy plans to launch its portfolio of renewable energy businesses in the U.S. market. The company recently announced a proposed merger with Westinghouse Solar, Inc. The partnering includes an EPC, 1.4 MW solar project in New Jersey and a joint venture in Italy.

TROJAN ADDS

SANTA FE SPRINGS, CA - Trojan Battery Co. has added a new 140AH 12-AGM battery to its product family. The 12-AGM, 12-volt battery is designed to support a wide range of renewable energy and backup power for industrial and residential applications, especially those found in remote areas.

SCHNEIDER SELECTED

BURNABY, CA - Schneider Electric has been selected by Sonnedix, a global solar independent power producer (IPP), and Yarotek, a developer of utility-scale renewable energy projects in the Americas, to supply 95 Conext Core XC 630 inverters for two solar power plants. The installation is for utility connection to PREPA.

ISOFOTON EXPANDS

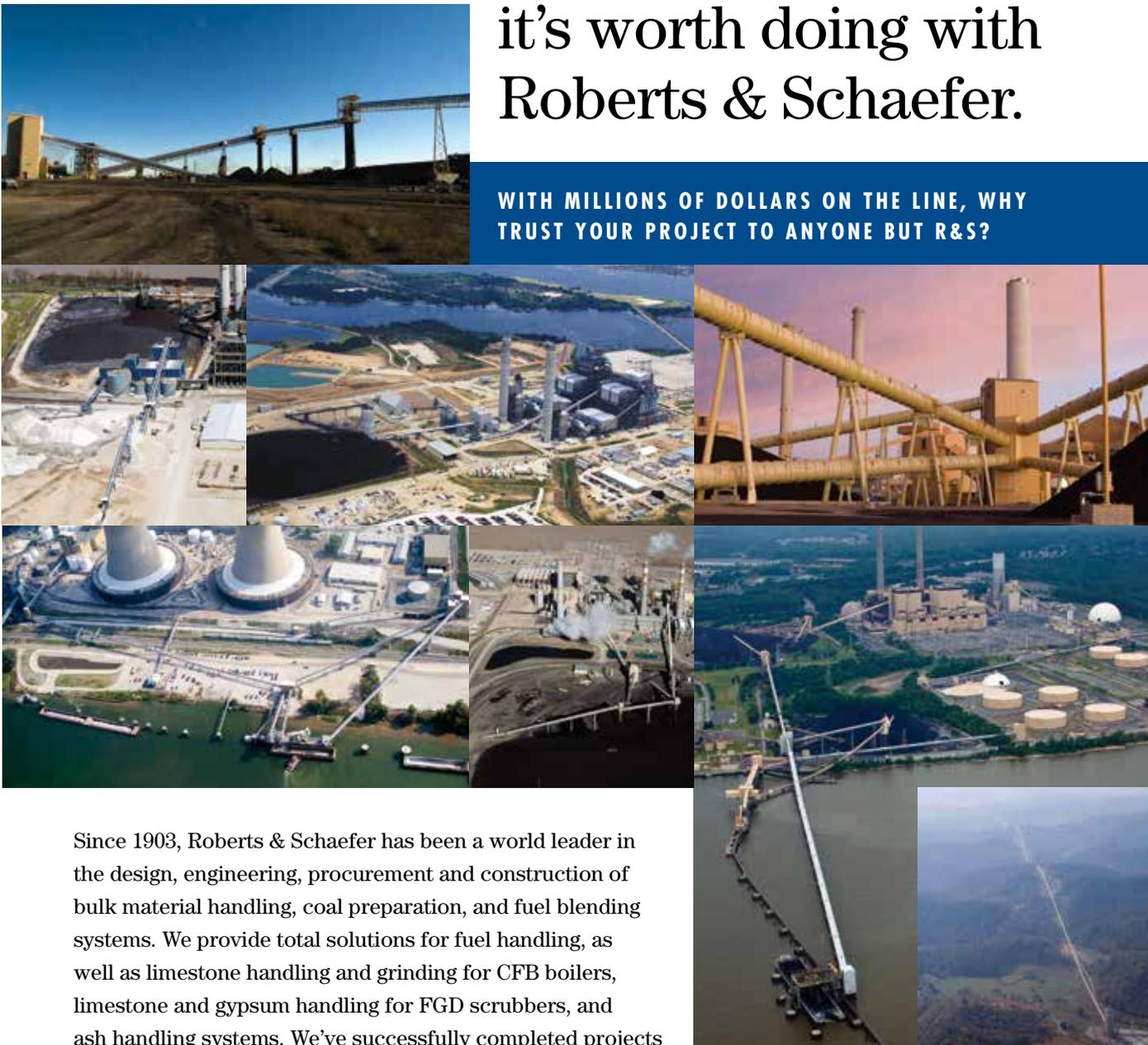
NAPOLEON, OH - ISOFOTON announced the opening of its new manufacturing facility in Napoleon, OH, scheduled to start production in November. The plant has an initial capacity of 50-megawatts, with designs for expanding 300 MW. The plant will initially employ 120 people and as much as 330 when it reaches full capacity.

According to Ángel Luis Serrano, Isofoton's Chief Executive: "We have developed a sound plan for growth in the U.S., a country that will lead the photovoltaic industry over the next ten years. Isofoton North America's new Ohio manufacturing facility is an example of our commitment to the U.S. market, and benefits from the support of key partners, including Samsung, Mercedes AMG, Posco, as well as our highly productive R&D and economic development partnership with the University of Toledo, Ohio. Isofoton plans to become the leader in solar technology solutions for electric vehicles, having recently signed a strategic agreement with the Mercedes AMG Petronas Formula One team."

Isofoton has participated in projects in 60 countries and completed nearly one thousand projects. It recently announced a €40M investment from Samsung for its Malaga, Spain facility, aimed at increasing its production capacity and improving its technological efficiency. Isofoton has already signed to build a 50 MW photovoltaic plant in the Dominican Republic and plans to do another in Ecuador.

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EATON ENHANCES

PITTSBURGH, PA - Eaton Corporation expanded its solar disconnect solutions for commercial and utility PV solar applications, with its new Eaton bi-directional disconnect switches. Eaton is the first in the industry to offer a product that can switch one circuit per pole and remove polarity limitations. The new disconnect switches incorporate the latest switching technology to enhance operator safety, extend equipment life and reduce installation costs in both grounded and ungrounded systems.

YUCCA REVISITED

WASHINGTON, DC - The Nuclear Waste Strategy Coalition issued a statement after the US Court of Appeals for the DC Circuit issued a ruling in the lawsuit by states, local governments, state utility regulators, and others calling for the Court to order the Nuclear Regulatory Commission to resume its licensing process for the Yucca Mountain Nevada repository.

TRADEWIND TEAMS

LENEXA, KS - TradeWind Energy, LLC and Alabama Power Company have entered into a 20 year energy purchase agreement that provides for the delivery of 202 mws from Kansas across five states to communities in Alabama. The Buffalo Dunes Wind Project will represent an approximately \$300 million investment. An estimated 150 new jobs will be created during the construction phase of the project with the fully operational project requiring about 15 new full-time workers. Commercial operation is anticipated in December 2013. This is the third project developed by TradeWind Energy that will deliver energy from the Midwest into the Southeastern United States.

NAES AWARDED

ISSAQUAH, WA - NAES Power Contractors, Inc. has been awarded a GE LM 6000 gas turbine construction project near Soldotna, Alaska. Alaska Electric and Energy Co. has contracted with NAES Power Contractors for Phase 3 of the project. The plant is scheduled to be operational by October 2013.

ESA EXPANDS

LAKE MARY, FL - ESA Renewables announced its expansion into Central America, South America and additional surrounding markets. ESA is seeking strategic partnerships in their effort to bring innovative solar development projects to Central and South America. It is in the process of developing projects consisting of more than 150 megawatts, including a 20 MW installation in the Caribbean.

KYOCERA TO SUPPLY

SCOTTSDALE, AZ - Kyocera Solar will power homes in the Fiji Islands in partnership with Fiji's Department of Energy and the Fifth Pacific Islands Leaders Meeting project (Palm 5) with the goal to bring renewable energy to remote villages of the island nation. To date, 135 kilowatts have been installed and the remaining 270 kilowatts will be completed by the end of the year.

ABB AWARDED

ZURICH, SW - ABB has been awarded a \$60 million order by American Electric Power (AEP) to replace a 30-year-old HVDC back-to-back converter station. The converter station is a part of the Oklaunion HVDC transmission link – an asynchronous interconnection between the Texas (ERCOT) and Oklahoma (SPP) power grids. The new station is expected to be operational in 2014.

UP REPORTS

OMAHA, NE - Union Pacific Railroad achieved its best-ever performance in the Carbon Disclosure Project (CDP) S&P 500 Climate Change Report 2012. The railroad's carbon disclosure score is 87, a 53-percent improvement over last year and higher than 87 percent of all companies. The average disclosure score is 70 for all S&P 500 companies.

HONEYWELL ACQUIRES

MORRIS TOWNSHIP, NJ - Honeywell announced a definitive agreement to purchase a 70 percent stake in Thomas Russell Co. Honeywell's UOP will offer a broad range of products that allow shale and conventional natural gas producers to remove contaminants from natural gas and recover high-value natural gas liquids.

HYPOWER COMPLETES

ORLANDO, FLORIDA - Hypower announced the completion of a utility solar system in Cranbury, NJ. The system with a total of 5.7 Megawatts covers 1,108,500 square feet on four warehouse rooftops interconnected to PSE&G distribution lines. 21,000 solar panels convert sunlight into electricity.



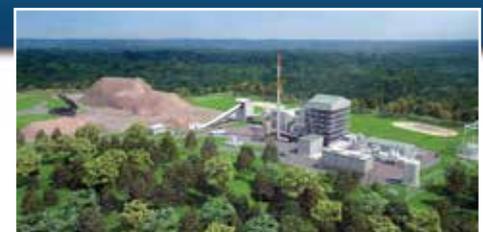
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- Five Biomass Powerplants Now in Detailed Design
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- Detailed Design Now for a 1.2 MGD Industrial Wastewater Desalination Plant
- Completed Design and Startup of a 300 MW Combined Cycle Repowering Project
- Completed Design and Startup of a Concentrating Solar Thermal Power Tower Project
- Owner's Engineer Now for a 4 x LM6000 Simple Cycle Power Plant
- Various Power Plant Service Projects

Some of Our Management Team



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Chairman / CEO



Lou Gonzales
President / COO



Dave Wiker
VP Engineering



Nick Francoviglia
Chief Mech. Eng.



Doug Franks
Mgr. Electrical



Rob Schmitt
Mgr. Mechanical



George Neill
Sr. Project Mgr.



Phil Peterson
Sr. Project Mgr.



Dean Andrisevic
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Rich Carvajal
Sr. Project Mgr.



Dave Kreimer
Sr. Mech. Eng.

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INTERNATIONAL NEWS

AZERBAIJAN

Wärtsilä has been awarded the contract to supply a 384 MW gas power plant to Azerbaijan. The Boyuk Shor power plant located close to the capital Baku, will be operated by Azerenerji JSC, the state-owned utility. Wärtsilä has already supplied seven power plants in Azerbaijan, producing a total of over 860 MW of power generating capacity.

BELGIUM

Westinghouse Electric Company has signed a teaming agreement with Studsvik AB to offer jointly a full range of decommissioning services for nuclear power plants in Europe under the separate brand name of ndcon, Nuclear Decommissioning Consortium. Services will include dismantling, decontamination and waste handling, initially in Germany and Sweden.

BRAZIL

Alstom Renewable Power has signed a letter of intent with Casa dos Ventos, one of the largest Brazilian wind power generation developers, to provide wind turbines for new farms in the state of Rio Grande do Norte. Under this 230 million agreement, Alstom will supply 68 wind ECO 122 wind turbines and operation and maintenance.

BULGARIA

Westinghouse Electric Company has received a contract from the Kozloduy NPP – New Build PLC of Bulgaria to perform a feasibility study on a potential seventh unit at the Kozloduy Nuclear Power Plant.

CHINA

GE will supply five Frame 6FA gas turbine-generators for three power plants in China's Zhejiang Province. All three projects support the provincial government's initiative to develop gas turbine cogeneration plants to replace less efficient coal-fired boilers.

COLUMBIA

Emerson replaced turbine and balance-of-plant controls at the 205-MW, 1 x 1 combined-cycle power generating facility in Cali that was flooded by more than 6 feet of water. The plant began commercial operation in July 2012, just months after the flood occurred.

DENMARK

MAN Diesel & Turbo's medium-speed division in Holeby, Denmark is part of a consortium featuring the Portuguese contractor WinEnergy and Brazil-owned company Zagope, with ENE, the Angola national Electricity Utility, for 49 MAN GenSets.

DENMARK

Siemens began field testing its new 154-meter rotor for the six-megawatt (MW) offshore wind turbine in Østerild. The direct-drive wind turbine is equipped with the world's longest rotor blades measuring 75 meters in length. With a record rotor diameter of 154 meters, each SWT-6.0-154 turbine can produce 25 million kilowatt hours in offshore locations.

GERMANY

More than 4.3 GWp of photovoltaic (PV) systems were installed in Germany during the first half of 2012. This marks an increase of approximately 2.5 GWp compared to the first half of 2011.

IRAQ

Mass Global Investment Company, an independent power producer, has selected GE steam turbine technology to increase the efficiency and the output of the Erbil Power Plant in Iraq's Kurdistan region. In operation since late 2008, the Erbil plant plays a vital role in meeting the growing power needs of Kurdistan.

JAPAN

Kyocera Solar Corporation will provide 30 megawatts of solar modules (approximately 135,000 units) for a utility-scale solar power plant in the northern prefecture of Hokkaido. The project will be designed and constructed by Yonden Engineering Co.



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JORDAN

Amman Asia Electric Power Co. owned by Korea Electric Power Corporation, Mitsubishi Corporation and Wärtsilä Corporation, signed a power purchase agreement with National Electric Power Company of Jordan (NEPCO). According to the 25-year agreement, NEPCO will buy electricity from Amman Asia Electric Power to be fed to the national grid of Jordan.

KENYA

Wärtsilä has signed an Operations & Maintenance (O&M) agreement with Gulf Power Ltd. The agreement is for ten years, and will cover the full operations, maintenance and servicing of the power plant to be built in Athi River, southeast of Nairobi.

RUSSIA

Alstom Thermal Power has signed a long term service contract with JSC Mosenergo for the 420 MW power generating unit #8 at the combined heat and power plant TPP-26, located in Moscow. The contract is valued at more than 100 million. It is the first time such a large scope for a service contract is awarded to an international company in Russia.

SAUDI ARABIA

GE has received a contract to supply eight 7F 5-series gas turbine-generators for the expansion of Saudi Electricity Company's Riyadh Power Plant 12. The project will add nearly 2,000 megawatts of power when it enters commercial operation in 2015.

SWEDEN

Metso has received an order to supply valves and smart instrumentation for the innovative GoBiGas project in the Rya harbor, Gothenburg. GoBiGas is a major project for Göteborg Energi AB that is starting a biomass gasification plant. The plant is currently being built by Metso Power and is the first of its kind in the world. The plant converts biomass into renewable biomethane gas, using the existing natural gas grid for distribution.

THAILAND

IRPC Public Company Limited has signed a contractual service agreement with GE to help ensure a reliable supply of power and steam for IRPC's petroleum and petrochemical plants at an industrial park in Rayong Province.

TURKEY

GE Energy Financial Services completed Turkey's newest wind farm – the Karada Wind Power Plant – through GAMA Enerji A., the GE unit's joint venture with GAMA Holding A. This project is the joint venture's second wind farm in Turkey.

UAE

Siemens Energy Service has been awarded long-term contracts for Dubai Electricity and Water Authority's (DEWA) newest power station in operation, the Jebel Ali M-Station. The facility is a 2,000 megawatt (MW) combined-cycle power plant and a 140 MIGD (million imperial gallons per day) desalination plant and is located in the United Arab Emirates - Dubai. The power station began commercial operation in 2012.

UNITED KINGDOM

GlobalData's latest report predicts that the cumulative installed capacity of renewable energy plants will reach 79 thousand megawatts (MW) by 2025. Wind is expected to be the country's major contributing renewable power source in the future. Solar PV is also expected to exhibit strong growth in the future, climbing from just over one thousand MW in 2011 to 13,338 MW installed capacity in 2025.

UNITED KINGDOM

Alstom has signed an agreement with Rolls-Royce to acquire Tidal Generation Limited (TGL), a wholly owned subsidiary of Rolls-Royce Plc, specializing in the design and manufacture of tidal stream turbines. TGL based in Bristol, UK employs 29.

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RODERICK TO CEO

Westinghouse Electric Company has appointed Danny Roderick to the position of president and chief executive officer. Mr. Roderick most recently served as Senior Vice President, Nuclear Plant Projects, for GE-H.



Danny Roderick

OKUDA PROMOTED

Westinghouse Electric Company announced that Mr. Ken Okuda has been appointed vice president and coordination officer for Westinghouse Nuclear Services, located at Westinghouse headquarters in Cranberry Township, Pa.



Ken Okuda

REC SELECTS

Renewable Energy Corporation appointed Jan Jacob Boom-Wichers, Managing Director, Americas.



Jan Jacob Boom-Wichers

POWELL JOINS

Jim Powell has joined the Air & Waste Management Association as Executive Director.



Jim Powell

EPRI APPOINTS

The Electric Power Research Institute (EPRI) announced the appointment of Mark Crosswhite, the chief operating officer of Southern Company, as a member of its Board of Directors.



Mark Crosswhite

STARK TO CO-CHAIR

Roger D. Stark, a Washington-based partner at Ballard Spahr has been named a co-chair of the American Bar Association's Committee on Renewable, Alternative and Distributed Energy Resources (RADER).



Roger D. Stark

ATKINSON NAMED

Mike Atkinson has been appointed to the Board of Directors of the GridWise Alliance.



Mike Atkinson

SCOTT JOINS

Trish Scott has joined Kirk Key Interlock as a Sales Engineer in the company's Southeast region. Scott, a certified safety engineer, most recently worked at Schneider Electric.



Trish Scott

LAVELLE NAMED

GE announced that John Lavelle has been named vice president, Digital Energy for GE Energy Management.



John Lavelle

INFINIA APPOINTS

Infinia Corporation appointed Joseph Weisiger to its Board of Directors.



Joseph Weisiger

MCLAUGHLIN TITLED

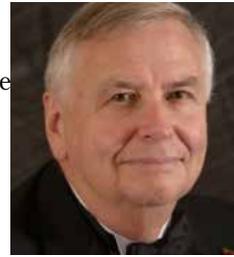
The Babcock & Wilcox Company announced that an employee of its Babcock & Wilcox Nuclear Energy subsidiary, Robert McLaughlin, has been conferred the title of "Fellow" by the American Society of Mechanical Engineers' (ASME) Board of Governors.



Robert McLaughlin

STOVALL JOINS

Jim Stovall has joined Skipping Stone as a Senior Consultant and the Manager of the National Demand Response Directory in Atlanta.



Jim Stovall

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Richard Flanagan, Publisher

FLANAGAN-PUBLISHER'S LETTER

CONTINUED FROM PAGE 3

and consumers. The Deloitte Study has found that improving energy efficiency at American businesses has become as important as brand building as it is to growing the bottom line. Businesses truly are leading the way by targeting average reductions in energy consumption of nearly 25 percent over a period of three to four years. Household consumers are also doubling down on efficiency – 83 percent report that they took extra steps to reduce their electric bill over the past year, and 93 percent say they will use the same amount of electricity or less in the future.

In America today, given the historically low capital costs of wind and solar PV equipment, we see primarily one non-tax related impediment to wider spread utilization of these renewable energy technologies. Namely, the current impact of century old quasi-socialized U.S. regulation of the fossil fuel based thermo-electric generation industry. Regulations which, rather than protect the public, instead protect our power industry to the detriment of the public, and which harms the current economy and the nation's long term economic health. How did this happen, asks Lee Peterson on page 19? The definition of "low cost"

energy resource was manipulated and was built with blinders attached to it. Both PURPA and FERC as well as state PUCs thus came to focus primarily on the "lowest cost means" of providing electricity to ratepayers.

The Electric Power Research Institute has completed tests determining that unmanned aircraft systems, or drones, can be used effectively to assess storm damage on utility distribution systems, Matt Olearczyk tells us on page 20. Conducted at the New Mexico State University Flight Test Center, the tests involved navigating several

aircraft technologies and using high resolution video cameras to transmit images of power lines from a height of 5,000 to 7,000 feet. The tests determined that such images can be used by electric utilities to assess damage and pinpoint its location following a storm. EPRI research is focusing on understanding the types of vehicles and sensor technologies that utilities could use to gather information and images to serve as the source for all the analysis. Drones also could be used to inspect vegetation encroachment and line clearance along power line rights of way.

Rich Flanagan

CONFRONTING POWER NEEDS

BY LYN CORUM, CLASS OF 2003



California power planners shuddered at the thoughts of rolling blackouts in Southern California this past summer when the San Onofre Generating Station shut down in January. SONGS has played a critical role in keeping transmission lines stable and providing power to about eight million people in the corridor between Los Angeles and San Diego. We were lucky, said Robert Oglesby, the executive director at the California Energy Commission, speaking at a public meeting held October 9 by the Nuclear Regulatory Commission and Southern California Edison.

Oglesby said the state had a lot of luck this summer meeting load requirements with no major heat waves and no fires to take out transmission lines which would have increased the stress on electricity demand in that vital corridor. As it was, major transmission lines were upgraded or started up and customers were asked to shed loads.

Furthermore, two retired gas-fired steam generation units in Huntington Beach were brought back on line in June to provide grid stability as replacements for the quiet San Onofre units. However, the Huntington Beach units are losing their air permits in November and there are plans to convert them to synchronous condensers.

The current owner, Edison Mission Energy submitted an application in early October to the CEC to convert the units. Should the application be approved, and its practically a done deal already, work would start on December 1 to decouple the steam turbines from the electric generators thereby allowing the generators to function as electric motors and generate or absorb reactive power as required by the grid. There will be no fuel combustion in either unit. The synchronous condensers would start operating June 1, 2013

Meanwhile, the CEC has been working with the California Public Utilities Commission and the California Independent System Operator to plan for electricity supplies next summer. Preferring to be conservative, they are assuming San

Onofre will not be operating by then.

Once the two Huntington Beach units are retired for good, they will be demolished. The owner of the land underneath the plant, AES, submitted an application to the CEC seeking certification to build the Huntington Beach Energy Project, a 939-MW combined-cycle, air-cooled, gas-fired plant. Readers may recall that EME, in a swap last year, bought the two existing units and their air permits so they could be transferred to its 500-MW Walnut Creek Energy Pak in the City of Industry south of Los Angeles' city center when it begins operating next summer.

CEC review plus construction time means it will take about five years for the new Huntington Beach plant to begin operating and provide power for the region. Huntington Beach will become a critical player for that reason, should San Onofre not to return to service as some critics are demanding.

SAN ONOFRE IS UNPOPULAR

The NRC/SCE meeting on October 9, at which Oglesby spoke, was to inform the community about the ongoing investigation into the steam generator tube wear that had shut San Onofre down in January. It seems the public won. More than 850 people showed up and at one point it appeared to be a battle between critics who were concerned for their safety and SCE employees who work at San Onofre and are convinced the nuclear plant is safe. I suspect the NRC did not change any skeptic's mind.

Elmo Collins, NRC's regional administrator for Region IV, told the sometimes raucous crowd meeting at the St. Regis Monarch Beach Resort in Dana Point near San Onofre that a license amendment, which involves drawn-out evidentiary hearings, is a possibility. SCE submitted a restart plan for San Onofre's unit 2, which had fewer worn generator tubes, and wants to restart that unit within months. Many in the audience were demanding that formal hearings be held rather than reviewing and approving SCE's restart plan. San Onofre-3 has more serious problems and it will wait until the investigation into tube wear is complete.

Friends of the Earth filed a petition at the NRC in June asking it to hold a legally binding hearing to determine whether SCE should get a license amendment before being allowed to operate San Onofre-2 and -3, each with two steam generators that have experienced tube wear.

Collins said that decision will be made after it completes reviewing SCE's response to NRC's March confirmation action letter and its restart plan submitted on October 4. If the restart plan is accepted, it will not require evidentiary hearings, he said. The response to NRC's March letter and restart

plan are available on SCE's website, www.songscommunity.com.

Both Collins and Pete Dietrich, SCE's senior vice president and chief nuclear officer, repeatedly said during the evening meeting their first concern was for public safety.

Collins also said NRC will hold another public meeting to discuss SCE's reports, but would give no timeline of when NRC staff might decide if a licensing renewal was necessary or alternately when SCE could restart San Onofre-2.

DEVELOPMENT CONTINUES APACE

Developers continue to submit applications to the CEC for certification of power projects and they continue to be approved following long deliberative reviews and hearings. Two 500-MW solar concentration thermal plants are being developed by BrightSource Energy: Hidden Hills and Rio Mesa. Both have preliminary staff reviews on file and are undergoing evidentiary hearings. The 100-MW gas-fired Quail Brush peaker project being developed by Cogentrix Energy in San Diego County has just begun its review. All hold power purchase agreements with utilities.

Citing the need for near-term power should the San Onofre Nuclear Power Station remain shut down, the CEC approved the development of the 300-MW Pio Pico Energy Center in September. The project is to be built in southern San Diego County near the border with Mexico.

The simple-cycle, gas-fired project, being developed by Apex Power Group at an estimated cost of \$300 million, holds a 20-year power purchase agreement with SDG&E and was designed to satisfy the utility's load requirements. The contract requires that the plant be operational by the end of May 2014. SDG&E will have dispatch capability. The developer plans to begin construction in the spring of 2013. The Pio Pico Energy Center will be located within an industrial park adjacent to the operating Otay Mesa Energy Center owned by Calpine.

IMPERIAL VALLEY ATTRACTS PROJECTS

In other development news, the Imperial County Board of Supervisors in mid-September approved Ormat's 49.9-MW East Brawley geothermal project to be built north of the city of Brawley, east of San Diego County. The required Environmental Impact Report, which was approved at the same time, took three years to write.

The East Brawley project is slated to be built in an area where plugged and abandoned temperature gradient wells are located, according to the EIR. Ormat has not announced when development would begin.

Ormat already has projects operating in two geothermal fields in Imperial County: there are three plants at the

92-MW Heber complex which sells power to Southern California Edison and the Southern California Power Authority and six plants are at the 54-MW Ormesa complex which sells power to SCE.

Few geothermal plants are being built in California these days. The Los Angeles Department of Water and Power has had plans on paper to develop a geothermal project in partnership with the Imperial Irrigation District for several years. It may start official development in 2015.

In July, the Imperial County Board of Supervisors approved two large, utility-scale solar projects after lamenting that the projects were being developed in southwestern Imperial County where it could not impose transmission fees on the projects. The projects will be building tie lines to connect to the Southwest Power Link, SDG&E's new east-west 500-kW transmission line that began operating in early July.

The Imperial Irrigation District has spent money and effort to build transmission lines in eastern Imperial County to attract solar and additional geothermal projects there, but that hasn't happened given the presence of the Southwest Power Link and its automatic link with the California ISO and power markets to the north.

IID spent much time negotiating large fees with the developers of the two solar projects – LS Power and Tenaska affiliate Tenaska Solar Ventures. LS Power-owned Centinela will pay a \$43,800 canal crossing fee, a \$1.4 million letter of credit to ensure completion of its transmission project and an \$18 million security deposit on a network upgrade project.

Centinela is building a 170-MW photovoltaic project and has signed two 20-year power purchase agreements with SDG&E. It also signed a transmission crossing licensing agreement with IID because the transmission lines will cross IID-owned canals. LS Power is hoping the solar plant will begin producing power in mid-2013.

Tenaska Solar Ventures-owned CSolar won approval to build a 130-MW solar PV project, and will pay \$3.07 million to IID for a transmission line the irrigation district will build. This will allow the project to transmit power to the Southwest Powerlink. CSolar holds a 25-year power purchase agreement with SDG&E.

A driving concern for IID's Board of Directors has been preserving the integrity of the irrigation district's balancing authority. IID has spent several months, if not years, negotiating network upgrades with developers to create project clusters, thereby allowing them to share mitigation fees. It is also finalizing a memorandum of understanding with SDG&E to formalize their working relationship in interconnecting projects.

GUARANTEEING SOLAR PROJECTS

BY DAVID SCHROEDER, ASSURANT



From the birds and the bees to mice and squirrels, uninvited guests are setting up house in solar installations. Ignore them at your own risk.

Insect and pest infestation can damage electrical wiring and lead to grime on panels, reducing power output or, in extreme cases, taking solar photovoltaic (PV) panels or even a solar array offline.

Such seemingly small problems aren't usually top of mind for solar developers or investors when they are thinking about a project development or getting a deal done.

However, long-term maintenance is increasingly a concern for commercial-sized solar projects.

By their very nature, commercial-sized projects are smaller in scope and operate on narrower margins than large-scale installations. This reality combined with the commonly held perception that solar projects require little if any maintenance during their project lifecycle has caused many developers to forgo developing long-term operations and maintenance (O&M) plans.

INCREASED INVESTMENT

Many do not realize the full risks they take by forgoing ongoing O&M, which are standard operating procedures at larger, utility-scale solar projects and power plant facilities.

Increased investment is helping to change the way O&M is viewed by market participants. Lending institutions now seek long-term performance guarantees on their investment and demand to know how the project will be protected during the life of their investment.

Their fears-- no one will be around to oversee and protect their investment long after the ribbon has been cut and they've flipped the switch.

Their concern-- guaranteeing their own rate of return and reducing risks from unexpected disruptions to energy output and project cash flows.

Their demand -- reduce and eliminate the gap between a solar project's

forecasts of performance and reliability and the actual, real-time results.

To address these issues, solar project developers need to look for ways they can reduce project risk and secure cash flows throughout the lifespan of the project. Not only do they need to guard against critters, they need to safeguard the long-term financial investment. Increasingly, O&M services, warranty administration programs and solar insurance are being viewed as possible answers.

Together, these services and products provide the comprehensive protection that investors are demanding.

O&M services are critical to ensuring continuous operations and energy output of commercial-size and utility-sized projects.

Ongoing preventative, corrective and conditional maintenance can lower costs and reduce losses in the event of a disruption. Effective O&M activities also can improve system performance, even above the output estimated during system commissioning, and enhance project profitability.

O&M STRATEGIES

This isn't surprising to anyone who has worked at other power plants. O&M strategies are a normal part of business. In fact, ongoing O&M is mission critical to keeping these facilities online. For many smaller commercial developers in the solar industry, however, it is a difficult idea to embrace. Aside from the financial considerations, they also must deal with a rapidly changing industry and the idea that the solar projects that they once pitched as requiring little to no maintenance now need to be sold with an added layer of protection.

In the long run, however, investing in O&M proves a wise decision and results in overall lower maintenance costs as major equipment malfunctions are reduced or entirely avoided.

Evidence can be found to support this across the Atlantic. The more mature solar market in Europe has recognized the benefit of O&M strategies for decades now. Estimates are that O&M costs on average are 50 to 100 percent higher in Europe than in the United States. Worldwide the emphasis is expected to continue to grow.

In "Growth Opportunities in Solar Photovoltaic Operation and Maintenance Market: 2012-2017," Lucintel, a global management consulting and market research firm, projects the global solar PV O&M market "to grow rapidly and reach approximately \$18.4 billion in 2017 with a CAGR of approximately 43 percent over the next five years."

The key is to develop a quality O&M

program that includes a focus on preventive, corrective and predictive maintenance. Proactive approaches can identify nascent issues in equipment and operations before they take an installation offline. Online, real-time monitoring remote and onsite can identify dips in energy production and allow for quick corrective actions to be taken. Ongoing O&M allows for orderly equipment repair and replacement of critical and non-critical parts.

In addition, yearly panel washing eliminates grime and dirt build up that reduces energy output. It also requires the upkeep of data monitoring systems, the electronics and sensor equipment, and the power generation system.

Beyond solar panels and inverters, O&M ensures that the site location is properly maintained. This includes dealing with insect and pest infestations and adopting wildlife prevention strategies. It also means employing vegetation management techniques and ensuring proper water drainage off the property.

CONSIDERING O&M FIRMS

When considering O&M firms it is important to consider the company's experience and geographical reach. Smaller O&M companies may not have the ability to provide quick service to projects located in a different localities. Due to the unique nature of solar installations, solar projects' O&M requires specialized knowledge to deal with the challenges that may emerge.

For example, experienced professionals may avoid using a lawnmower to tackle a property's vegetation. Sheep often are a preferred and safe alternative to a John Deere mower. Experienced professionals typically also won't be found wielding a bottle of Windex in hand to power clean a solar array's modules. Panel grime, bird debris and slug trails require much more efficient cleaning methods.

In addition, O&M technicians need to be knowledgeable about warranties on each piece of equipment of the installation as they and the manufacturer bear responsibility for warranty compliance. Again, warranties and warranty compliance is critical to maintaining a profitable enterprise.

Manufacturer and extended warranties secure project cash flows during the expected 20-plus years in the lifespan of solar projects. However, solar projects may be challenged in dealing with manufacturers located in the U.S. and overseas to submit claims.

Assurant developed a warranty administration program to reduce those difficulties. Serving as the administrator for the client, Assurant will handle the

claims authorization, payment and management of warranty claims on any piece of warranted equipment in a solar project.

The program provides a single point of contact for all components, regardless of original equipment manufacturer (OEM), and even if that OEM is no longer in business or located abroad. This reduces the overall labor costs of warranty enforcement and also ensures that project repairs are done quickly. For example, if Assurant validates a warranty claim, a check will be cut to the project developer for the repair or service repair will be called to go out to the site. While equipment malfunction is being addressed, Assurant works in the background to be reimbursed by the OEM.

Complementing the warranty administration program is solar project insurance. Assurant Solar Project Insurance offers phase-specific coverage that allows commercial solar developers to simply and easily qualify, launch and protect more projects. Designed for projects in the 100kw to 3MW range, the insurance offering provides comprehensive protection. Designed to satisfy key lender and investor requirements, this coverage is right-sized to reduce excess coverage and inflated costs.

Solar insurance protection combined with a warranty administration program and O&M services offers the most reliable protection against a wide variety of solar project risks.

ABOUT THE AUTHOR

David A. Schroeder is vice president of operations and industry relations for the solar industry at Assurant, Inc., a Fortune 500 company providing specialized insurance products and related services in North America and select worldwide markets. In this role, Schroeder represents Assurant with potential customers and solar industry partners in support of Assurant Solar Project Insurance. He also oversees underwriting, policy administration, claims and customer service.

Prior to joining Assurant, Schroeder headed Project Risk Limited, LLC and served as a risk management and underwriting consultant to various financing parties such as commercial, investment and development banks, credit facilities, insurance companies and income funds. He also was an underwriter with an insurance intermediary specializing in power and energy. In his career, Schroeder has consulted on renewable energy projects with a total electrical generation capacity of 42 gigawatts across 38 countries.

Schroeder graduated from Evangel University with a Bachelor of Science and is a Certified Insurance Counselor.

THE TIME HAS COME

BY WILLIAM T. GUINEY, JOHNSON CONTROLS



Solar heating, often overshadowed by photovoltaic systems, is the most cost-effective on-site renewable energy resource. It presents vast opportunity for public and private organizations to save on fossil fuels, cut costs, and reduce carbon emissions.

The technical potential for solar water heating in the United States is about one quadrillion Btu of energy savings per year, worth \$8 billion of energy costs and 50 million to 75 million metric tons of carbon dioxide emissions. Furthermore, some 67 percent of the nation's commercial buildings have rooftops available for solar water heating, according to the National Renewable Energy Laboratory.

These figures may be merely theoretical, but they illustrate the vast possibilities for solar thermal technology to displace fossil fuels, counteract climate change, and save building and businesses money. Solar Thermal remains the most cost-effective source of on-site renewable energy. Common uses include swimming pool heating, boiler water preheating, domestic water and space heating, air conditioning, and heat for a wide range of commercial and industrial processes.

In the nonresidential sector, applications include hotels, hospitals, prisons, restaurants and cafeterias, government buildings, universities and schools, athletic facilities, manufacturing plants, and laundries.

Solar heating helps users diversify their energy supplies and control future costs. Solar systems can meet 50 to 80 percent of a typical facility's hot-water heating load. Even in northern climates during winter, systems can provide 20 percent or more of water heating requirements. (What matters is the annual performance of a solar heating system not the seasonal performance.)

A commercial solar water heating system with 500 square feet of collector will displace the hot water generated by a small natural-gas-fired boiler, generating 2,281 therms per year and offsetting more than 26,825 pounds of CO₂. On a larger scale, solar thermal energy creates economic development and local jobs in manufactur-

ing, installation, operations and maintenance.

The solar collection technologies are field-proven. In the past 15 years, product research and development and improved manufacturing have created a new generation of simple, reliable, efficient solar water heating systems. Clearly, solar thermal has earned a place in the national and global energy mix. In fact, solar water heating has potential to be the largest contributor in the next growth era of renewable energy and emission reductions.

TAKING THE LONG VIEW

At present, solar thermal technology faces some headwinds, but longer-term trends appear to work in its favor. For the time being, the price of natural gas, the main fuel solar heating displaces, are at low levels as hydraulic fracturing (fracking) operations dramatically increase domestic supplies. At the same time, commodity prices for materials used in solar thermal collectors are rising as the economy improves.

All these conditions are likely to be temporary. Fuel and commodity prices are cyclical by nature. As recently as three years ago, natural gas prices stood near historic highs. Prices may rise again as the U.S. exports more gas, as utilities add gas-fired peaking power plants and replace older, polluting coal-fired power plants used for base load with smaller gas turbines. Also with potential to tip the scale are more production of liquefied natural gas (LNG) for export and wider acceptance of compressed natural gas (CNG) as a fuel for buses, taxis, cars, and a wide assortment of fleet vehicles.

Meanwhile, other trends in markets and government policy tend to brighten prospects for solar thermal energy. The industry continues to develop technologies that make solar heating more efficient. The industry is also developing standardized "plug and play" systems that make procurement more efficient, reduces engineering costs, and simplifies installation.

Solar thermal also fits with a growing trend among organizations to make public commitments to save energy and reduce greenhouse gas emissions. In the Institute for Building Efficiency's 2011 Energy Efficiency Indicator survey, 76 percent of respondents said their organizations had either an energy-reduction or carbon-reduction goal, and 36 percent had both. Renewable energy also contributes points toward green building certification under the U.S. Green Building Council's LEED® program.

A growing number of states now allow solar thermal projects to qualify for utility incentives or may qualify for renewable energy credits (RECs) under their RPS programs.

A typical residential-sized solar water heating system produces 7 to 10 kWh per day, or 3,400 kWh per year, depending on local conditions and type of collector and system design. On average, for each such system installed, 0.5 kW of peak demand is deferred from the utility's load. When a utility solar water heating program like Hawaii's has thousands of solar water heaters displacing electricity, the demand reduction is measured in megawatts.

MORE OPPORTUNITY

The basic technology has existed for more than 100 years, and systems have been proven to last more than 25 years – longer than a conventional water heating systems – at a fraction of the life-cycle cost. Estimates show that tapping the United States' full potential for solar water heating could:

- Save 578 billion cubic feet of natural gas per year – 2.5 percent of the nation's usage.
- Save 35 billion kWh of electricity per year, just under 1 percent of U.S. consumption.
- Prevent 52 million metric tons of carbon dioxide emissions annually, equivalent to the emissions from 13 coal-fired power plants or 9.9 million cars.

The most widespread solar thermal application is water heating. It uses simple components that can be easily integrated with a building heating system. Other solar thermal applications include:

- Pool heating. Solar heating systems can warm indoor or outdoor pools in almost any climate.
- Space heating. Similar to solar water heating systems, these systems generally use more solar collectors, larger storage units, and more sophisticated designs.
- Cooling. Here, solar heating systems are coupled with absorption chillers and use a thermal-chemical sorption process to produce air-conditioning without electricity.

Despite the high potential, solar thermal capacity in the United States lags behind much of the world. For example, on a per-capita basis, the nation ranked 35th globally in solar water heating (excluding swimming pools) – although such installations have increased over the last five years, grew by 10 percent in 2009, and increased by another 5 percent in 2011 despite a slow economy with historically low natural gas prices.

CATCHING THE SUN

Many organizations fail to benefit from solar thermal energy because they do not know the many possibilities it offers. There are three basic levels of solar thermal energy:

- Low-temperature (80 to 100 degrees F) for purposes such as swimming pool

heating and boiler water preheating.

- Medium-temperature (100 to 160 degrees F), largely for domestic/service hot water heating and space heating.
- High-temperature (180 to 350+ degrees F) for industrial processes and air conditioning.

A variety of technologies deliver these levels of solar heating, based on the types of solar collectors.

Flat-plate collectors, used for domestic water heating or space heating. These systems can heat one to two gallons per day per square foot of collector area.

Evacuated tube systems do the same basic work as flat-plate collectors. The performance advantage over flat-plate systems is not significant in warmer climates, except where users desire very hot water, as for a commercial process.

Micro-trough solar heating systems, which use parabolic reflectors to focus sunlight on a receiver, can achieve temperatures from 160 to 350 degrees F. They are used mainly for space heating, industrial process, and solar air conditioning (when coupled to absorption chillers). Knowing the technologies and their limitations is important in selecting the right technology for the job.

SOLAR THERMAL ATTRACTION

Solar water heating systems can be highly cost-effective in facilities that have constant or even intermittent hot-water demands.

Nonresidential solar heating systems generally require professional design and sizing. A key step is to determine the heat or cooling load to be met. In particular, sites like manufacturing plants, commercial laundries, hotel kitchens and restaurants require higher temperatures and appropriate sizing. Determining the feasibility of solar thermal for a given application is largely a straightforward process.

After a thorough facility audit that includes inspections of the roof (if the system will be mounted there), water heater, electrical and plumbing system is complete, commercially available modeling tools can accurately predict the cost of the system, the thermal output, and the economic benefit, measured in time to achieve positive cash flow. A solar thermal energy specialist then can specify the type and size of collector array and other components to meet the heat requirement.

ABOUT THE AUTHOR

As Director of the Solar Heating and Cooling business with Johnson Controls, Inc., William T. Guiney is responsible for solar thermal programs and technologies. He has more than 30 years' experience in the solar industry as a contractor, educator, distributor and manufacturer.

PV — INTO CONSOLIDATION AND BEYOND!

BY PAULA MINTS, NAVIGANT



It is hard to believe that just a few years ago the PV industry was one, long annual party that began suddenly and seemed destined to continue to no end. During this time interest in the PV industry was avid with investors, journalists and other industries with less exciting markets trying to develop entry strategies for what was the next big thing. After all, electricity demand continues to grow with the population, climate change was accepted by most and the PV industry had plenty of questions looking for answers. These questions, including how to lower cost more rapidly, how to deploy more rapidly, how to innovate more rapidly, how to develop markets more rapidly, encouraged eager new entrants to believe that they had the answers and that the promises of overnight success just might prove true. Most entered believing that the future was not written yet and that the past could easily be ignored.

Figure 1 depicts the PV industry's rapid growth from 1996 (82.6-MWp) through 2011 (23.6-GWp).

Ignoring an industry's history can be dangerous and in the case of the photovoltaic industry, history provides some impor-

tant lessons. Periods of strong growth in the photovoltaic industry have been 100% incentive driven. The off-grid (remote) applications grow steadily at a close to normal rate. The grid-connected application, however, requires incentives to stimulate demand and in the PV industry (unlike the conventional energy industry), incentives are designed to initially stimulate growth and then slowly decrease over time. The bottom line is that incentives for PV are not designed to be open ended.

This unstable reality has shaped the personality of the PV industry. Where incentives are available and where these incentives are generous, buying and selling resembles an extreme sport. Markets overheat and incentives rapidly decrease or end altogether. During the 2004 through roughly 2008 period (the healthy FiT period), the solar industry increased capacity significantly. As previously noted, the available FiT markets developed too fast and governments put on the brakes too quickly. Meanwhile, as incentives decreased and manufacturing capacities and inventory levels grew, prices for technology (modules) began crashing, competition became brutal and companies began failing. In the US and Europe allegations of unfair market practices were made against Chinese manufacturers. Meanwhile, as prospects for reasonable (or any) margins faded, panic ensued and the party, while not ending, became a good deal tenuous.

In 2011, the PV industry entered a painful period of consolidation, which even the most optimistic participant could not ignore. Industry pioneers disappeared from the landscape. Bickering broke out and conference exhibition halls shrank. One problem is that the industry grew too big too fast and had no time to adjust to either its successful circumstances or the crash that should have been expected and was

TABLE 1
REGIONAL DEMAND GROWTH 2006-2011 & 2011 SHIPMENTS/INSTALLATIONS (1)

| Region | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | CAGR 2006-2011 | 2011 Install. MWp | % Install. of Demand | 2011 Regional Shipments | MWp Delta Demand /Shipments |
|---------------------------|--------|--------|--------|--------|---------|---------|----------------|-------------------|----------------------|-------------------------|-----------------------------|
| Europe | 1093.9 | 2178.7 | 4338.5 | 6568.0 | 13944.1 | 14854.9 | 68% | 16171.6 | 109% | 1618.9 | 13236.0 |
| % Total | 55% | 71% | 79% | 83% | 80% | 63% | | | | | |
| Asia | 506.1 | 376.8 | 549.2 | 561.8 | 1219.9 | 4267.4 | 53% | 4633.2 | 109% | 17757.4 | -13490.0 |
| % Total | 26% | 12% | 10% | 7% | 7% | 18% | | | | | |
| North America | 226.2 | 318.1 | 395.4 | 553.9 | 1566.2 | 2593.7 | 63% | 1529.0 | 59% | 781.2 | 1812.5 |
| % Total | 11% | 10% | 7% | 7% | 9% | 11% | | | | | |
| West Asia | 67.5 | 76.8 | 87.9 | 79.1 | 52.2 | 471.6 | 48% | 729.6 | 155% | 119.0 | 352.6 |
| % Total | 3% | 3% | 2% | 1% | 0% | 2% | | | | | |
| Oceania | 26.4 | 43.0 | 43.4 | 35.6 | 365.5 | 825.3 | 99% | 742.7 | 90% | 0.0 | 825.3 |
| % Total | 1% | 1% | 1% | 0% | 2% | 4% | | | | | |
| Southeast Asia | 23.8 | 27.7 | 28.9 | 31.7 | 104.4 | 212.2 | 55% | 201.6 | 95% | 3302.8 | -3090.6 |
| % Total | 1% | 1% | 1% | 0% | 1% | 1% | | | | | |
| Latin America | 17.9 | 22.4 | 19.8 | 27.7 | 60.9 | 82.5 | 36% | 74.8 | 91% | 0.0 | 82.5 |
| % Total | 1% | 1% | 0% | 0% | 0% | 0% | | | | | |
| Central & Southern Africa | 15.9 | 21.5 | 19.2 | 23.7 | 17.4 | 33.0 | 16% | 32.7 | 99% | 0.0 | 33.0 |
| % Total | 1% | 1% | 0% | 0% | 0% | 0% | | | | | |
| Middle East | 5.0 | 5.5 | 6.6 | 27.7 | 69.6 | 235.8 | 116% | 233.4 | 99% | 0.0 | 235.8 |
| % Total | 0% | 0% | 0% | 0% | 0% | 1% | | | | | |
| North Africa | 2.0 | 2.5 | 3.0 | 4.0 | 1.7 | 2.8 | 7% | 2.8 | 99% | 0.0 | 2.8 |
| % Total | 0% | 0% | 0% | 0% | 0% | 0% | | | | | |
| Total | 1984.6 | 3073.0 | 5491.8 | 7913.3 | 17402.7 | 23579.3 | 64% | 24351.4 | 103% | 23579.3 | |
| % Total | 100% | 100% | 100% | 100% | 100% | 100% | | | | | |

(1) Columns or rows may not add due to rounding.

the inevitable result of too much success too soon with too few controls applied. Unfortunately, current low prices will give little relief to manufacturers while quality issues in the field may haunt the industry for some time to come.

Table 1 provides an overview of regional growth and share of total demand from 2006 to 2011, along with the five-year compound annual growth rate for this period and installations for 2011. For the several years, there has been significant inventory build-up on the demand side of the industry. Regional examples of this are Europe and Asia. Table 1 also provides insight on which regions are export markets as opposed to import markets. For example, Europe consumed the most PV module product but was primarily an import market, whereas Asia consumed less module product while

exporting >17-GWp.

Figure 2 presents regional installation shares for 2011. Note that Germany continues with the most significant installation shares, though, other regions, notably Japan and China are increasing installation activity.

The current consolidation is causing enmity among friends along with dividing loyalties and straining friendships. Most realize, however, that the industry will emerge from the current situation stronger and more focused, well able to enter the low incentive environment that lies ahead. Going forward, quality should be the focus on the industry, as it has historically been. After all, what could possibly be better than a long-lived (~30 years), reliable, low maintenance, electricity-producing technology for which the fuel (the sun) is free?

Figure 1: PV Industry Growth 1996 - 2011

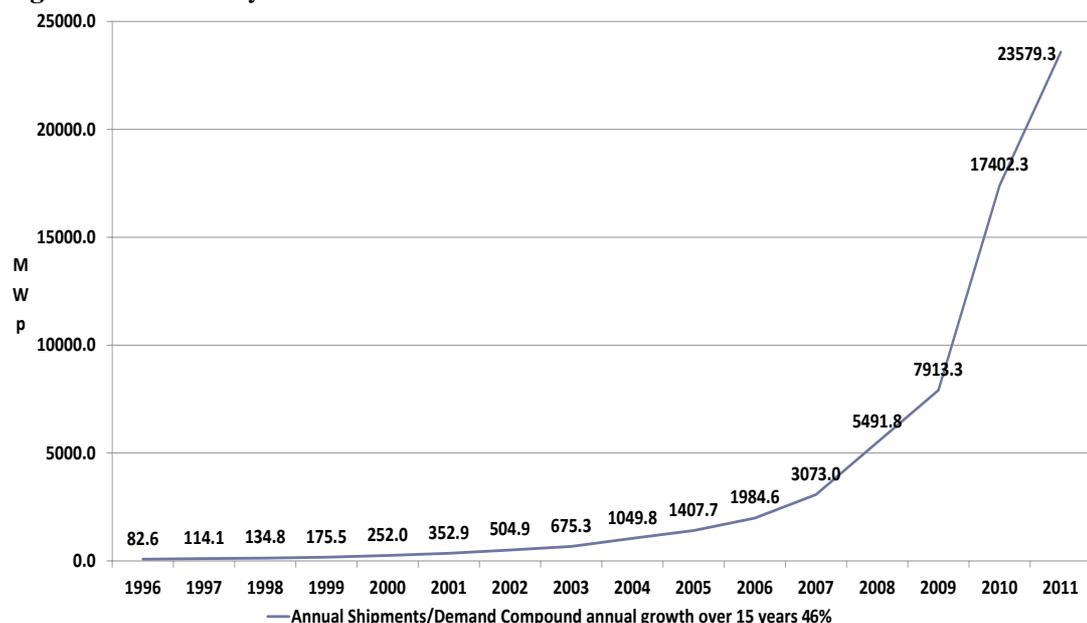
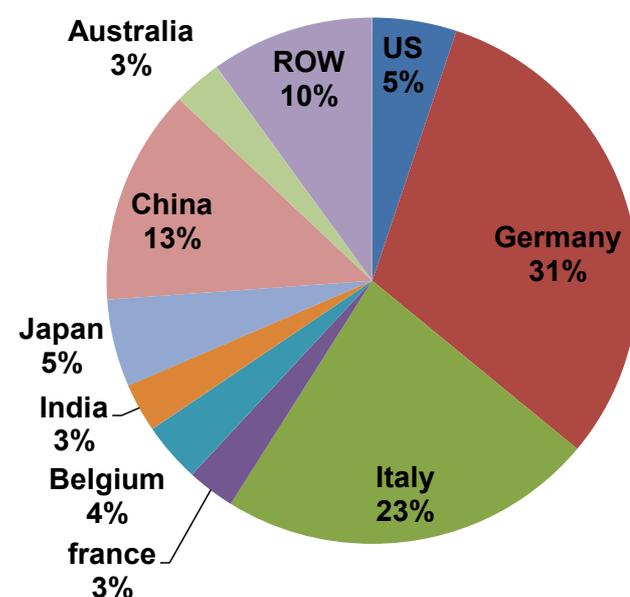


Figure 2: Regional Installation Shares for 2011.



A LOST DECADE OF DEMAND GROWTH

BY PRAJIT GHOSH AND HIND FARAG, WOOD MACKENZIE



Over the last few years, significant fundamental shifts have noticeably altered the energy landscape of the nation. Within the gas and power space, new shale resources making abundant low-cost natural gas have radically transformed the supply side of the equation for the power sector. The intensifying competition between coal and gas generators has put downward pressure on the market share of coal, incentivizing early coal-fired plant retirements. The key driver underpinning much of this new state of the market is a significant shift in electric demand growth expectations. Specifically, forward projections for electric demand growth during the next two decades have changed dramatically since 2008. Current projections indicate more than a decade of lost demand growth compared with the 2008 projections.

In 2008, electric demand was expected to grow at about 1.7 percent per annum during the following 20 years. The crystal ball seems to have not served us well with the Great Recession having rather severe impacts on energy demand. Average annual demand growth is now forecast to be 1.4 percent as a result of the recessionary impacts on gross domestic product (GDP), industrial demand and more importantly, real estate and unemployment - in addition to - a possible behavioral drag on energy demand. In effect, electric energy consumption levels previously expected in 2019 would now not be realized until 2024

(Figure 1), indicating about 5 to 6 years of lost demand growth.

During the same time frame, several federal and state rules were promulgated, mandating energy efficiency standards. For instance, at the federal level, the Energy Independence and Security Act (EISA) of 2007 mandated lighting standards. These lighting standards apply to most common incandescent bulbs, requiring them to be at least 25 percent more efficient starting in 2012. At a state level, 20 states added or expanded their energy efficiency requirements. This strengthening policy support for energy efficiency since 2008 is estimated to reduce energy demand growth to just above 1 percent per annum in the long term. Energy efficiency effectively delays demand growth by another 5 to 6 years.

Thus, in aggregate, more than a decade of demand growth has been lost as a result of the combination of economic forces and energy efficiency initiatives. Demand levels that were previously forecast to be reached by 2019 now would only be reached by 2030.

PRE-RECESSION DEMAND LEVELS: AWAITING THE SIGNPOST

Since the recent recession, Wood Mackenzie estimates that only about 20 states and provinces have reached pre-recession levels with the remainder of North America lagging behind to varying degrees. Aggregate electric sales in the US are expected to reach pre-recessionary levels in late 2013. Lagging loads become apparent when considered along with the fact that real GDP levels have already surpassed pre-recession levels in the fourth quarter of 2011. Demand outlooks appear dim in large parts of North America, especially in the Northeast and along the West Coast. In places at the epicenter of the housing crisis, like Florida, inactive and low-use customers continue to place a drag on demand growth. Conversely, a faster pace of demand growth is expected to be sustained in the western Canadian provinces, ERCOT, and the Southeast region driven by one or a combination of retail customer growth, strengthening industrial demand, limited support for energy efficiency, or a combination of all of these drivers.

Wood Mackenzie expects US power demand to grow by around 1.1 percent on average per annum from 2012 through 2030, far below the historical average growth rate of 1.7 percent per annum. The link between GDP growth and electric sales growth (GDP intensity) is expected to weaken further declining from the current level of approximately 50 percent to about 35 percent by 2030. GDP intensity has been on the decline over the past 20 years due to a combination of the economic restructur-

ing away from manufacturing, productivity improvements, energy efficiency programs and other drivers. This decline is, however, expected to continue at a faster pace going forward (Figure 2).

CHANGING THE GAME: A LOOMING INDUSTRIAL RENAISSANCE?

In recent months, the potential for an impending industrial renaissance and the re-shoring of manufacturing back to the US has been a point of active discussion. Much if not all of this dialogue revolves around the energy sector, namely oil and natural gas production and prices.

Oil Production. Drilling activity in tight oil plays has shown considerable growth in several states, with an upward shift in momentum evident since late 2011, reflecting the switch of activity from dry shale gas plays. Further growth is anticipated with US tight oil production now expected to rise from 1.5 million b/d in 2012 to 4.1 million b/d in 2020, mostly from the Bakken and Three Forks of North Dakota and Eagle Ford in the South Texas.

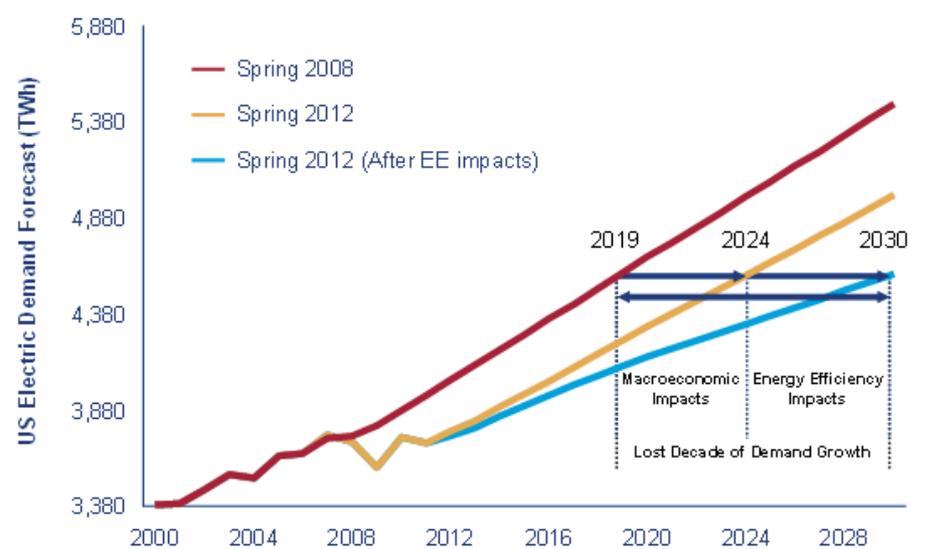
Natural Gas Production. Lower natu-

ral gas prices have resulted in an increase in industrial demand for natural gas. These low gas prices are also expected to motivate a return of future gas intensive industry namely petrochemicals, steel (direct reduced iron), fertilizers, methanol, ammonia, among others. In addition, multiple US LNG liquefaction projects are being developed around the Gulf Coast and East Coast.

The upswing in exploration as well as industrial activity has, to varying degrees, direct impacts as well as indirect impacts on electric demand. Higher electric power demand could be brought about through the infrastructure spending, local GDP/employment changes as well as US level GDP implications of cheaper energy, trade balances, royalties, multiplier effects, and intensity. Direct impacts on grid demand can be uncertain not only because of the speculative nature of future expansion plans but also due to the possibility of large incremental loads setting up captive cogeneration facilities. Indirect impacts are evident at a local level in states like Pennsylvania and Ohio, which are witnessing employment growth that is outpacing that of the nation,

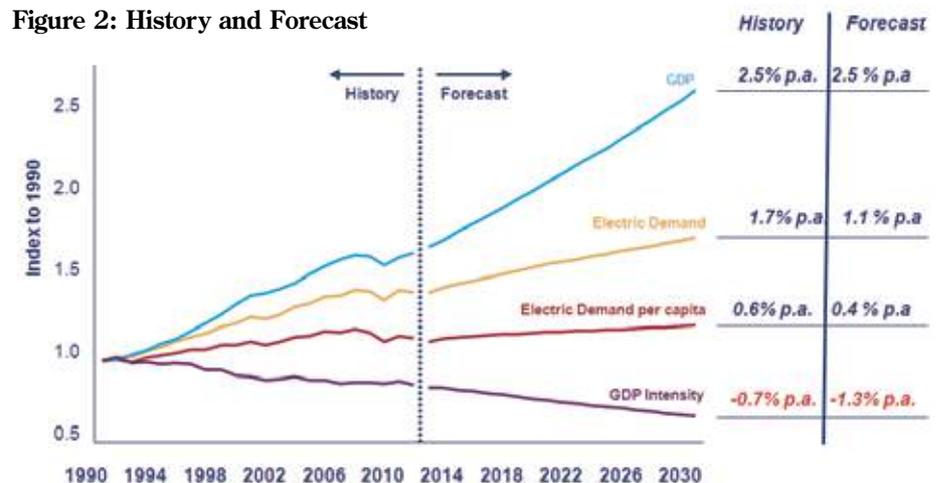
(continued on page 21)

Figure 1: Lost Decade of Demand Growth



Source: Wood Mackenzie North America Power Service

Figure 2: History and Forecast



Source: Wood Mackenzie North America Power Service

BOTTOM LINE VS. BRAND IMAGE

BY GREG ALIFF AND MARLENE MOTYKA, DELOITTE



The recession has heralded a new era of energy frugality that has profoundly changed American energy habits for both businesses and consumers. Using less now may be “the new normal,” from boardroom tables to kitchen tables. In fact, a recent Deloitte study has found that improving energy efficiency at American businesses has become as important as brand building as it is to growing the bottom line.

Businesses truly are leading the way by targeting average reductions in energy consumption of nearly 25 percent over a period of three to four years. Household consumers are also doubling down on efficiency – 83 percent report that they took extra steps to reduce their electric bill over the past year, and 93 percent say they will use the same amount of electricity or less in the future.

The annual survey, “reSources 2012,” found that 9 out of 10 companies have set goals regarding electricity usage and energy management practices, with 66 percent identifying cost-cutting as their primary motivation. Moreover, the survey indicates 85 percent of businesses view reducing electricity costs as essential to staying financially competitive, a 9 percent jump from 2011.

Further, 81 percent view reducing electricity costs as essential to their brand image, 11 percentage points over last year. And more than three-quarters of the organizations surveyed say they are actively promoting their energy efficiency efforts to their customers.

One area of particular traction for more sophisticated levels of energy efficiency is on-site generation. Thirty-five percent of companies surveyed currently generate some of their own electricity supply through renewable sources or cogeneration, and 17 percent report they have plans for future on-site generation. This is up from 21 percent and six percent in 2011, respectively. At the same time, participation in green energy programs offered by electric companies has risen to 37 percent from 30 percent, as awareness and availability of programs have expanded.

Companies are making significant energy-efficiency progress, reporting that they have achieved about 60 percent of their targets for energy savings when it comes to electricity, natural gas, carbon footprint and transport fleets.

It’s going to get tougher, though. Businesses and household consumers alike think they are starting to hit a wall. Well over half (62 percent) of companies report that their energy management goals were “somewhat difficult” to achieve. Moreover, 21 percent say their energy management goals were “very” or “extremely difficult” to achieve compared to 13 percent in the 2011 survey. The low-hanging fruit may have already been picked when it comes to energy efficiency.

CORPORATE TRENDS

The corporate study was based on one-on-one, in-depth qualitative interviews with senior executives, as well as over 600 online interviews with business decision makers across all industries responsible for energy management practices at companies with more than 250 employees.

The study concluded that energy management is no longer just the purview of plant operations or building management; it is increasingly viewed as a strategic business driver.

The questions company executives might logically be asking are: Where do I stand versus my competition? Where do I stand versus my customers and suppliers? And, if I knew the answers and wanted to move “up the curve,” what steps should I be considering?

Most of the top tactics to manage energy consumption and costs require relatively low levels of capital investment. The top five are: installing LED or compact fluorescent light bulbs (CFLs) when incandescent bulbs burn out; changing heating/cooling settings/timers; installing motion/occupancy sensors; replacing out-of-date equipment prior to “end of life” with more energy efficient equipment; and using timers/sensors to control when equipment is powered on.

Eighty percent of companies report that they have become much more sophisticated in managing their electricity costs.

As companies move onto the next stages that require larger investments, capital funding is the number one barrier to future progress, followed by length of payback period.

The 2012 study found that on average, U.S. businesses allocate about 14 percent of their capital spend to energy efficiency programs. When it comes to decisions around capital allocation, size of company appears to have little impact on the relative level or percentage of capital allocated to these programs.

Other challenges such as unexpected complexity and bureaucracy, and lack of dedicated staff also emerged as key obstacles.

Businesses also acknowledge that enabling technology alone is, more often than not, inadequate to help them reach their goals. Six-in-ten agree that “smart technology” currently available is not effective for their own unique circumstances.

The study says there is still a significant human behavior component required for effective energy management. Benefits gained from implementing a sophisticated “smart technology” system may well be negated by counterproductive employee behaviors.

Only about half are actually measuring and verifying their progress toward goals with any regularity, most commonly by tracking and reporting unit costs and usage (54 percent) or maintaining a record of energy management projects (51 percent). Just four-in-ten compare baseline reductions against both internal and external benchmarks (41 percent) or maintain an inventory of internal or external best practices in energy management (39 percent).

Some of the difficulty companies are encountering in monitoring and verifying the success, or lack thereof, of their energy management programs can be attributed to the information technology systems they have in place. Approximately 70 percent are currently using a spreadsheet format, while only two-in-ten have implemented more sophisticated proprietary or third-party software solutions. Moreover, of those that have software systems in place to support their energy management programs, only 41 percent say that what they are using meets their needs extremely or very well.

When it comes to making investments in energy management programs, 61 percent of companies have specific payback period requirements, and they are looking for payback in about four years on average. A similar percentage of companies (57 percent) have a specific internal rate of return (IRR) hurdle that they must meet – those that do are looking for returns of 21 percent on average.

In a period of relatively low energy prices, many potential energy management

projects simply will not reach required payback periods and returns. However, as electricity prices rise and energy efficiency technology advances, the business case for many programs may quickly improve.

Given the capital expenditures required to increase energy efficiency, companies need to have a good sense of where they are at the outset of their energy efficiency efforts. While 90 percent of companies have set energy management goals, there is wide variance in their evolution and sophistication.

The study revealed that companies tend to fall into one of three categories distinguished by their orientation toward and the state of development of their energy management practices.

“Pioneers” have evolved and refined their practices to the point where they now consider them as a source of competitive advantage and brand enhancement. They have already harvested the low-hanging fruit of reduced energy consumption, and are now facing greater capital investment requirements to achieve even higher levels of performance.

“Reactors” operate primarily on the need to reduce cost or waste. They are not generally consumer-facing with their efforts and have relatively little employee communication and engagement.

The largest group, “Engagers,” are newer to energy management and challenged by its complexities and how to prioritize or measure results. Engagers are motivated by the perceived changes around them and the potential regulatory or competitive risks by not improving their practices.

As part of the ongoing research, businesses can go to www.deloitte.com/us/resources and measure their own energy-efficiency efforts against those surveyed for the “reSources 2012” report. Through an online interface, companies can answer several of the study’s questions and then receive a short report comparing their responses against those who participated in the research. The online poll is designed to be a solid predictor of actual achievement against energy management goals – especially when it comes to capital investment, performance measurement and management, and reporting and disclosure.

TRENDS FOR CUSTOMERS

Some 83 percent of consumers reported that they took steps to reduce their electricity consumption over the past year, up from 68 percent in the 2011 study. At the same time, consumers are beginning to feel that they have limited tactics available to them to reduce their consumption further, having already made behavioral changes such as turning off the lights (78 percent), shutting down electronics when not in use

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RENEWABLE ENERGY COSTS

BY LEE J. PETERSON, COHNREZNICK



In America today, given the historically low capital costs of wind and solar PV equipment, we see primarily one non-tax related impediment to wider spread utilization of these renewable energy technologies. Namely, the current impact of century old quasi-socialized U.S. regulation of the fossil fuel based thermoelectric generation industry. Regulations which, rather than protect the public, instead protect our power industry to the detriment of the public, and which harms the current economy and the nation's long term economic health.

How did this happen? The definition of "low cost" energy resource was manipulated and was built with blinders attached to it. Both PURPA and FERC as well as state PUCs thus came to focus primarily on the "lowest cost means" of providing electricity to ratepayers. But a funny thing happened since 1907, the issue of overall macroeconomic impact by public utilities on their respective economies got largely left at the door and the new, industry restricted, legally contrived terminology and formulae that ultimately evolved for "low cost" has today morphed far from the original goal of supporting a "reasonable" public utility corporate return whilst also keeping utility rates "low." Instead, and today, "low cost" is nothing more than a policy fiction that supports a massive annual/permanent cost-shifting with the result being that today, the direct and indirect economic damages due to fossil fuel thermoelectric power production is put squarely onto the pocket books of "external" society without any reasonable accounting for it at the public utility or utility ownership level. Such costs have thus managed to disappear almost as if by magic from the utility balance sheet. And their "cost" is akin to an Enron off-balance-sheet sham.

Such so called "external" costs have for too long been thoroughly removed from the calculations made by PUCs, and by this means, electricity rates are kept lower than they otherwise might be. Yet the burden of those costs has never been removed from society. Rather, the costs have continued to

grow, and we and our families down through the generations have all been paying them every year since the U.S. power industry has been in existence. Regardless of our status as a rate payer or non rate payer. We, and not the utilities, foot the annual bill. And it's billions of dollars.

The present result is that the U.S. operates now with a separate, regulatorily concocted macroeconomic subsidy just for the economic benefit of the public utilities, a subsidy that allows the utilities to operate under the false public appearance of low cost electricity when in fact the actual cost is extremely high to society and paid in cash by society every single year since 1907. Therefore, this subsidy, if halted, could go a long way toward reducing this nations annual federal debt and a good portion of the federal deficit as well. Because it's dollar value far exceeds any renewable energy subsidy and a subsidy which also institutionalizes industry inertia and allows utilities to benefit at the expense of the overall economy to the detriment of the overall U.S. economy.

This critical issue, the actual cost of fossil fuel power, has deeply impacted U.S. economic history and continues to impact the development of renewable energy resources in the U.S. today, albeit in an economically harmful way, so that U.S. elected officials at all levels must now be held responsible for realizing the importance of, and the need for, federal, state and local accountability for the negative economic impacts generated by traditional energy sources. Without this recognition, renewable energy will continue to be discriminated against by U.S. federal, state and local laws and Americans will remain forced to pay more for their electricity than they should.

Recently, in 2011, the U.S. federal government led an effort which dramatically identified the need for a change in U.S. electricity industry policy by establishing the first national standards on mercury, particulate and carbon emissions from power plants.

In addition, significant independent scientific and economic research has begun to focus directly on the external costs of coal-fired power generation; particularly the health care costs associated with exposure to hazardous airborne particulates, ozone (O3), and carbon dioxide (CO2) emissions.

As a result, PUCs in states heavily reliant on coal-power for electricity are now better able to more accurately evaluate the true statewide economic costs of relying on traditional fossil fuel resources versus the alleged higher cost of investing in cleaner or renewable sources as are federal policy makers.

The National Institute of Environmental Health Sciences concluded

that coal consumption is significantly and positively correlated with detrimental health impacts resulting from exposure to particulate matter, and that increased coal consumption is associated with increased infant mortality and decreased life expectancy.

When taken into account at the state level, using the U.S. state of Georgia as an example (given Georgia's high reliance on coal power), the EPA has estimated that Georgians pay no less than between 3.3 and 7 billion dollars annually in aggregate health costs not accounted for in their electricity bill, as a result of unhealthy levels of exposure to PM2.5 and O3. Given that the current population of Georgia is approximately 9.8 million, the EPA estimate translates into every Georgian annually incurring between \$330 and \$800 per year in additional health care costs due to coal-fired power generation with such costs being evenly spread beyond the rate base to the entire citizenry of Georgia annually.

Finally, when the methodology of the CHGE is applied to Georgia, the report estimates the average cost of coal-fired electricity to be 18.17 cents per kWh, when factoring in health impacts due to particulate exposure, and 26.67 cents per kWh, when factoring in the total monetized health impacts.

These numbers are two to three times the current average retail cost of electricity generation in Georgia of 8.8 cents per kWh (EIA, 2010). Note that the retail cost of electricity generation, is used in comparison here, because a full-levelized cost of electricity generation (including health, environmental, resource-use impacts, etc.) has yet to be computed for the state of Georgia.

AN ECONOMIC DRIVER

It turns out, that it's not just bad health policy to perpetuate existing fossil fuel energy policy. If public health damages were all that was going on, we Americans might continue to tolerate the health care and funeral bills and coldly justify the status quo given the over arching reality of needing to reduce as many current economic drags on the nation's citizens suffering under a stumbling economy. Yet as compelling and troubling as all this is from the perspective of the nation's bodily and cognitive health, the real story is not about the harm caused by fossil fuel fired electricity generation to the individual people and families of America, it's not about sickness and early death, but rather, the real story is how America's recessionary economy can both use and benefit from renewable energy as an economic driver but is being prevented from doing so. For it turns out, that this pollution and health problem is so large, and the dollar amounts so significant, that failing to fix this problem is actually a greater drag on our nation's economic recovery

than the impact of the regulations designed to stop it.

For this reason, America is truly on the cusp of an energy economy renaissance but despite what the fossil fuel industry has been advertising, it has far less to do with natural gas. This is because if the U.S. simply reduces the overall amount of fossil fuel sourced electricity it uses (by relying on market ready and existing renewable energy technology like utility scale wind and silicon solar PV) the resultant reductions in air and water pollution impacts on human health will more than pay back any investment in renewable energy. In fact, two good things will happen to both the national and state economies when the U.S. goes all in on renewable electricity generation, particularly with wind and solar and these good things happen IMMEDIATELY.

One, the amount of money citizens in your state pay for the fuel-charge portion of their monthly electric bills should decline. This almost immediately frees up cash for citizens to spend inside their state and local communities, stimulating the local economy including small business, while contributing to a larger positive economic impact, rather than exporting that cash, via the public utility, to those states where the utility purchases its coal and natural gas. A PV solar panel lasts at least 25 years. Avoid fuel cost exports for decades.

Two, and this is the point too often missed by federal and state policy makers and elected officials, the cost savings associated with a healthier population due to reduced air and water pollution is money, investment capital and economic development funding freed up and newly available for other, more productive economic growth opportunities.

The positive economic impact from renewable energy, particularly wind and solar starts with short term job creation and employment to physically construct the wind or solar facility, and results in nearly 3 decades of annual economic savings and economic stimulus on an annually recurring basis. We're talking hundreds of billions of dollars annually. You simply don't get all that positive economic benefit with coal, and natural gas, even if less bad than coal, still uses too much of the nation's water resources both in exploration and electricity production, with nuclear power being the greatest water hog of all.

So, bottom line, renewables like wind and solar offer the largest positive impact on the overall economy of the United States, and the thing preventing renewables from saving the U.S. economy and creating new, permanent jobs is the existing and failed power utility regulations that artificially price electricity well below its real cost.

DOMESTIC DRONES

BY MATT OLEARCZYK, SENIOR PROGRAM MANAGER, EPRI



The Electric Power Research Institute has completed tests determining that unmanned aircraft systems, or drones, can be used effectively to assess storm damage on utility distribution systems.

Conducted at the New Mexico State University Flight Test Center, the tests involved navigating several aircraft technologies and using high resolution video cameras to transmit images of power lines from a height of 5,000 to 7,000 feet. The tests determined that such images can be used by electric utilities to assess damage and pinpoint its location following a storm.

EPRI research is focusing on understanding the types of vehicles and sensor technologies that utilities could use to gather information and images to serve as the source for all the analysis. Drones also could be used to inspect vegetation encroachment and line clearance along power line rights of way.

There are several reasons why unmanned airborne systems could be of value to utilities. Following a storm, airborne technologies equipped with sensors, cameras and a global positioning system (GPS) could be deployed quickly to assess damage to the distribution system. This could enable utilities to assess the damage throughout large geographic areas in a relatively short time, prioritize repair and dispatch crews more quickly and effectively.

DRONE TECHNOLOGY

Transmission line inspections are essential to recognize stressed or at-risk components prior to failure, preventing outages and optimizing maintenance. EPRI evaluated drone technology for transmission inspection in the late 1990s. Tests demonstrated that using fixed and rotary-wing drones for line inspections was sound; however, the sensors used in those tests could not accurately determine the position of individual structures, identify component defects, or assess line conditions. Sensor technologies have advanced significantly and may now provide the capability to perform line inspections effectively.

EPRI is also preparing to evaluate

drones and remote sensing technologies for inspection and condition assessment of overhead transmission lines. As part of this research, functional requirements will be identified for UAS inspection, and market surveys will identify available UAS inspection technologies, inspection services, and their costs. Based on the findings, the project team plans to conduct laboratory and field demonstrations of promising UAS inspection technologies by the end of 2012.

Traditional transmission line inspection methods are costly and labor-intensive. Utilities combine manned aircraft for aerial patrols, walking or driving line patrols, and detailed inspections using bucket trucks or climbing the structures. Drone technologies offer the potential to improve transmission line inspection by providing expanded capabilities, reduced costs, improved safety of personnel and equipment, and increased operational flexibility.

According to the 2008 EEI Reliability Report, 67% of electrical outage minutes were weather related, with contributing factors of lightning 6%, weather 31%, and vegetation 30% (typically due to wind blowing tree branches into distribution lines). While outages do occur on transmission systems, most storm-related outages occur along distribution systems. The cost of storm damage repair can be significant. A survey of 14 electric utilities identified 81 major storms between 1994 and 2004, costing utilities more than \$2.7 billion. In recent years considerable attention has focused on damage assessment of the distribution system so that utilities can prioritize, restore and recover more quickly such events. A significant challenge is to assess the damage assessment quickly, identify and locate parts necessary to perform the repair before the crews are dispatched. This can reduce outage duration and help prioritize restoration to critical parts of the system.

Unmanned air systems may provide utilities with a tool to achieve this goal by helping them assess storm damage, identify damaged structures or components and identify unobstructed routes to the location in order to perform system repair in a timely fashion.

A primary problem with ground assessment is that utility crews cannot reach certain areas, due to downed trees, flooding, local weather or icing or other factors.

THE EPRI ADAM DRONE PROJECT

The EPRI Adam concept was developed to reduce the storm damage assessment process and speed restoration and recovery. Recognizing that damage assessment was the major bottleneck to power restoration after extreme weather.

The Adam prototype system is designed to enable immediate airborne assessment capability for utility Incident

Managers. The system provides high definition streaming video of damaged infrastructure that can be synchronized and integrated with the utility's back office outage management system and graphical information systems. Work crews are generally not dispatched until damage assessment results are collected and analyzed. Live streaming video information equips utilities to dramatically streamline damage assessment.

This research is expected to identify suitable drone technology that could be incorporated into utility storm damage assessment activities.

The Adam Interface is designed to be intuitive and easy-to-use, allowing damage assessors and incident managers to check distribution systems and look for damage. The video screen displays a live video feed and a GIS map of the utility's assets on a split screen.

Using these, a team can spot damaged equipment, locate it by latitude and longitude, record the extent of the damage and identify the equipment and estimate the manpower needed for repair. Damage is documented and disseminated to back-end systems, and operates in a similar fashion to today's hand-held PDA-based systems.

With this information the utility storm response center can plan a more effective response and better allocate stretched resources. Operators can flag hazards requiring an immediate response, such as power lines that could cause harm to person or property.

EPRI is working with New Mexico State University to help advance drone technology for use in the electric industry. Since 1999, the Physical Science Laboratory at New Mexico State University (NMSU) has operated the Unmanned Aircraft Systems Technical Analysis and Applications Center, with the mission of developing safe, reliable unmanned aircraft systems and introducing them into global airspace.

The laboratory has developed drones for the military, and is now applying this expertise for civilian uses. Research into civilian applications includes agriculture, oil and gas exploration, search and rescue, forestry, real estate, and weather forecasting.

Because of stringent FAA regulations governing national airspace, non-military unmanned air systems researchers encounter difficulties in finding the unrestricted airspace necessary for conducting tests.

For all intents and purposes, drones of the size required for commercial use are aircraft, and are subject to the same restrictions concerning equipment, crew training, safety, and licensing. To test the technology, developers must apply to the Federal Aviation Administration (FAA) for a certificate of experimental airworthiness or a certificate of authorization, both of which can

involve a long process with no guarantee of acceptance.

Because Southern New Mexico has an extensive airspace with no population and therefore no risk to the public, the FAA has worked with the center to establish a unique program and develop a UAS Center of Excellence and Flight Test Center, with the certifications for testing. To grant private organizations access to national airspace, they simply sign temporary ownership of the drone to NMSU, which holds a generic certificate of airworthiness allowing the vehicle to fly. In return, the FAA will have access to the flight data that will allow it to draw up a regulatory framework for such aircraft in U.S. airspace.

A challenge with the Adam project is using both existing and emerging information technology (IT) systems. Both drone technology and sensor technology have been used in other applications and industries, but there is a need to develop hardware that will suit the requirements of utilities. However, utility IT systems are unique in scope and in architecture, and there is a huge range of applications. Integrating IT systems will be a crucial part of the process.

Integrating Adam's software with the utility's information technology infrastructure will be crucial in three areas: the outage management system, the geographical information system, and the asset management system. All three of these are important for allowing incident command operators to understand and access situational information in real-time.

UAS TECHNOLOGY

Other industries are applying UAS technology. While the technology is relatively new for civil applications, it has reached maturity through extensive use in military applications. It has established itself as an effective way of gathering data quickly and without risk to crews.

Other industries are investing heavily in video and sensor technologies, software, and hardware, which will benefit the ADAM project. For example, media organizations are leading the way in developing high-resolution, stabilized digital cameras; forestry and agriculture are developing sophisticated, multi-layered GIS systems and integration; and oil and gas companies are showing that the concept of using UAVs for damage assessment is sound.

Next steps for the Adam program will be to fly proof-of-concept missions throughout North America to verify UAS technology can be applied to utility storm damage assessment. EPRI intends on specifying the requirements necessary to deploy the Adam technology and will include both manned and unmanned solutions.

GE EYES 60 HERTZ MARKET CONTINUED FROM PAGE 1

for FlexEfficiency 60 technology for projects in the United States, Saudi Arabia and Japan.

The FlexEfficiency 60 Portfolio will include four gas turbines, the newest being the 7F 7-series. GE also enhanced the highly flexible 7F 5-series. A new 7F 9-series, configured to be the largest and most efficient in the portfolio, and an enhanced 7F 3-series will be available in the future. The FlexEfficiency 60 Portfolio also includes an enhanced D-17 steam turbine, H26 hydrogen-cooled generator and Mark* VI Integrated Control System that can be configured into the FlexEfficiency 60 Combined-Cycle Power Plant. FlexEfficiency 60 technology will be manufactured and tested at the world's largest gas turbine manufacturing facility in Greenville, SC. GE invested \$170 million to develop this full speed, full load test facility.

The \$1.2 billion in new sales is comprised of orders for 19 gas turbines—13 for the 7F 5-series gas turbine and six for the new, larger 7F 7-series gas turbine.

CHUBU ELECTRIC POWER

GE will ship six 7F 7-series gas turbines to Chubu Electric Power Co., Inc.'s Nishi-Nagoya thermal power plant in Nagoya city, Japan. The plant will support the government's initiative for cleaner, more-efficient energy production. It will produce more than 2,300 megawatts in combined-cycle operation. GE will supply the six 7F 7-series gas turbines to Toshiba, the engineering, procurement and construction contractor for the project. The first unit will be shipped in February 2016 with all six turbines expected to be in service by March 2018.

RIYADH POWER PLANT 12

GE will supply eight 7F 5-series gas turbine-generators for the expansion of Saudi Electricity Company's PP12 project, adding more than 1,990 megawatts. PP12 will be the largest air-cooled combined-cycle project in Saudi Arabia using GE's F-class gas turbines and will be the first application of 7F 5-series gas turbines in the region. The gas turbines will burn natural gas provided by the Saudi national oil and gas com-

pany Saudi Aramco. The machines will be equipped with GE's latest dry low NOx combustion technology to reduce emissions, extend maintenance intervals and enable the plant to operate more flexibly.

CHEROKEE PROJECT, COLORADO

Two GE 7F 5-series gas turbines will power the Cherokee project in Denver, which will convert an existing coal plant into a cleaner burning, natural gas combined-cycle facility. The Cherokee repowering project is part of Colorado's Clean Air Clean Jobs Act passed in 2010, which helps retire or retrofit the state's coal plants. The new plant will be owned and operated by the Public Service Company of Colorado, a wholly owned subsidiary of Xcel Energy. GE expects to ship the gas turbines in the fourth quarter of 2013, with commercial operation beginning in the fourth quarter of 2015. The FlexEfficiency 60 Plant will avoid 2.6 million metric tons of carbon emissions per year when compared to an equal-sized coal power plant based on EPA data.

HESS CORPORATION

GE will provide two 7F 5-series gas turbines and a GE D11 steam turbine to Hess Corporation for an upcoming United States project.

CUSTOMER IN WESTERN U.S.

GE will provide one 7F 5-series gas turbine for an industrial application in the Western United States. This new combined-cycle power plant will repower coal fired steam turbines with cleaner, flexible natural gas.

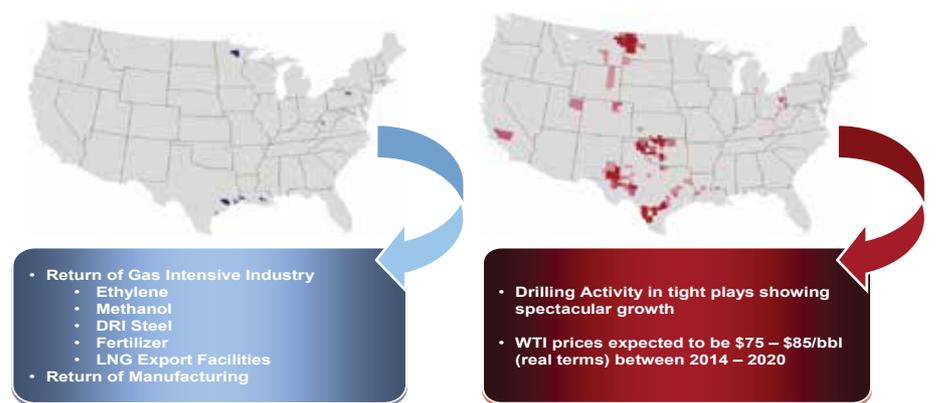
MOBILE EXHIBIT

A custom-designed, 18-wheeler with interactive, state-of-the-art displays and demonstrations of GE's FlexEfficiency 60 power generation portfolio is going on a 4,000 mile, four month road tour to 25 cities to help further educate customers, industry influencers and financiers about the importance of natural gas and mixing it with renewables.

Follow the Truck Tour blog from the road at www.ge-flexibility.com and @GE_CatienTour.

A LOST DECADE OF DEMAND GROWTH CONTINUED FROM PAGE 17

Figure 3: Location of Gas Intensive Industry and Oil Production (Rigs)



Source: Wood Mackenzie North America Power Service, North America Gas Service

largely driven by manufacturing and energy exploration specifically at the Marcellus and Utica shales. The western parts of North Dakota are seeing levels of retail customer growth never witnessed before driven by Bakken boom. In West Texas, the transmission infrastructure is being strained by the increased electric use due to activity in the Permian Basin. Economy wide impacts are complicated by the sheer number of variables, lending itself to considerable uncertainty. So while regional industrial activity does and will have significant implications in certain areas, it remains to be seen if aggregate demand levels could rise to levels that at least partially reverse the lost decade of demand growth.

FINAL THOUGHTS

Over the last few years, electric demand forecasts have been reduced significantly primarily driven by macroeconomic factors and energy efficiency policy programs, implying more than a decade of lost demand growth compared to previous forecasts. Lowering demand growth expectations to this extent has huge implications not only for the power and fuels sectors but also for renewable energy markets and carbon policy going forward. Renewable energy mandates in most markets are expressed as a share of energy requirements. Therefore, the lower energy demand growth forecasts reduce future investment requirements compared to previous outlooks. Projections for carbon emissions from the power sector are also signifi-

cantly lower now, largely driven by the slower demand growth expectations.

The interaction of the slowing demand growth and generous shale gas supply has been rather interesting. If one was to isolate the impacts of reduced load growth, other things being equal, if all lost generation was to be borne by natural gas burn, gas demand could have been lower than previous forecasts by about 5 bcf/d in 2013 and 15 bcf/d by 2030. This would translate to almost a quarter (increasing over time to almost a half) of reduction in expected natural gas demand from the power sector going forward. But other things are seldom equal, and certainly not in this case. While the power generation pie is expected to be much smaller than suggested in the past, natural gas has been claiming an increasingly larger market share primarily at the cost of coal generation.

Multiple downside risks around this outlook still exist from a possible Europe crisis, higher energy efficiency gains, behavioral changes, and distributed generation growth in the form of solar energy. Conversely, a looming industrial renaissance is a potential upside risk driver, the full extent of which is not known at this point. But at this nascent stage, is not significant enough to reverse a slowing trend in demand. Operational and strategic decision making in the power industry will now have to be made in light of these rapid demand changes together with the growing uncertainties.

BOTTOM LINE VS. BRAND IMAGE CONTINUED FROM PAGE 18

(65 percent), or adjusting the thermostat lower in the winter and higher in the summer (61 percent).

Almost 60 percent report changing over to compact fluorescent lights (CFLs). Far fewer have made the financial investments that will be necessary to achieve further incremental savings, including energy efficient appliances (39 percent), energy efficient windows and doors (33 percent), motion sensors (26 percent), and smart power strips (12 percent).

Contrary to what businesses said, concern about the environment appears to be weakening among individuals. They also remain substantially uninformed about their electric utilities, with over 60 percent indicating they do not have an understanding of the resources used to generate their electricity.

POSITIVE TREND

Overall, the encouraging news is that energy management is gaining momentum, in spite of a low-energy-cost environment,

driven by both financial and brand-image incentives. As such, developing and executing effective energy management strategies and programs may, in the long run, be as much about staying in business as it is about having competitive advantage. With this growing trend, business, customers and the environment all win.

ABOUT THE STUDY

The "reSources 2012" survey was completed by Deloitte and The Harrison Group, a strategy and market research firm that polled more than 600 business decision makers across all industries nationwide and more than 2,200 household decision makers.

The study was performed in February and March 2012 and largely reflects the business attitudes and practices related to 2011.

The study sought to provide insights that can be useful in helping organizations make energy-related investment and business decisions, as well as uncover the actions that businesses and households are taking to manage their energy usage and what motivates them to adopt new practices and technologies. It also illuminates the degree to which they are concerned about energy management and what solutions they are turning to today, as well as what offerings may appeal to them in the future.

UTILITY-SCALE PV INVERTERS

DR. AMINUL HUQUE, EPRI

CONTINUED FROM PAGE 1

availability and performance expectations. Inverter reliability is among the solar industry's biggest concerns. Several early PV system performance studies have shown that inverter related issues caused considerable plant downtime. More recently, SunEdison has analyzed trouble calls from its fleet of 500 PV plants with an accumulated 300 MW of capacity. The latest investigation considered ~70% of the company's fleet over an 18-month period—between January 1, 2010 and June 30, 2011—and evaluated about 1,000 failure incidents over ~6,000 system-months. The average plant size for this analysis was 311 kW (plants ranged between 7.2 kW and 9 MW) while the average PV plant age was 19 months, with the oldest systems entering Year 6 of operation. With more than two-thirds of identified failures, inverters represent by far the most likely PV plant component to cause trouble.

A further investigation into the reliability of an inverter's individual sub-components revealed control software as the main cause behind inverter failure and, to a lesser extent, card/board failures (PCBs) as the second most frequent failure area. Software bugs were found to be the primary root cause behind most of the control software issues, while hardware component failures (e.g., power semiconductor components and communications circuit boards) represented the preponderance of hardware failures. Meanwhile, support structures, DC subsystem, and AC subsystem collectively contributed 20% of SunEdison's identified system failures. Parts/materials and construction defects were generally found to be the primary root causes behind the failures in these subsystems. Overall, SunEdison's analysis exposed an underlying connection between PV plant downtime and quality assurance and control in the inverters.

With increased PV inverter deployment there is an increased need to share selection and qualification and documentation best practices that lead to improved plant reliability and uptime. Presently there are no complete performance criteria for grid-connected inverters. IEEE 1547 provides guidelines for interconnect behavior, but this represents only a fraction of the performance concerns harbored by PV system owners. As penetration levels rise, utilities will increasingly need clear, complete specifications that can be easily referenced and broadly supported. Considering the interconnection resemblance and maturity, electricity metering industry specifications can be closely studied to provide insight into the

nature and extent of criteria needed for PV inverters

The full Electric Power Research Institute (EPRI) report this article is based on addresses the need for improved inverter specifications and better developed industry practices for selection, qualification, and product options. Included are samples of technical interconnection requirements used by utilities, a description of the needs for inverter product standards, and an account of industry practices and specification applied to utility grade electricity metering that can provide insight into the criteria needed for PV inverters. Other sections provide an overview and comparison of specifications for utility-scale inverter models, as well as conclusions and recommendations for future work. An appendix includes the various standards and regulations that current utility-scale inverter manufacturers typically refer to in their product specifications.

UTILITY PRACTICES FOR QUALIFYING AND ACCEPTING PV INVERTERS

Electric utilities have focused on the development of distributed generation (DG) interconnection standards that can work for low penetration deployments and also have flexibility for future higher penetration scenarios. These standards have evolved over 25 years and provide specific technical requirements for paralleling DG, including PV and storage, with the utility system. Today we have IEEE standard 1547-2003 and UL 1741. First and foremost interconnection requirements have addressed safety for lineman and the public, equipment protection, and system reliability and power quality. Specifically interconnection standards developed to date include: ensuring safety, reliability, and power quality; applying consistent requirements in an affordable way; streamlining review and approval process; and allowing higher level of DG penetration.

Utility interconnection requirements for PV systems, especially for the utility-scale systems, are continuing to evolve with greater penetration of DG into the distributed grid. IEEE standard 1547-2003 stipulates the basic interconnection rules and several other standards are moving to align more closely to it. However, 1547 is intentionally general, leaving considerable negotiating room for establishing interconnection agreements.

In the future EPRI expects that IEEE will develop new requirements specific to high penetration PV in IEEE P1547.8. This new standard will address changes in the operating requirement from low penetration to high penetration

as DG evolves from very small affect, to more significant impacts on voltage and eventually on energy balance in the electric system.

In the meantime, a number of utilities are preparing for higher penetration of PV and wind energy in their systems. Examples of the diversity in technical requirements and interconnection practices used by a few utilities in U.S are included in the EPRI report.

PERFORMANCE SPECIFICATIONS FOR PV INVERTERS

Utilities need more standard practices for specifying and selecting PV inverters for grid-connected applications. The PV inverter plays an important role as a power conversion device for PV and as a grid-connected generator that makes the handshake with the public power supply. As more of these devices are grid connected, clear requirements and products specified to meet these requirements will be needed. This evolution is also needed to speed up processing of interconnection requests and simplify system acceptance and testing.

There are currently no industry accepted performance specifications for a "utility grade" grid-connected PV inverter product. The concept is well developed for other power conversion equipment such as adjustable speed drives and UPS inverters. Other grid-connected equipment such as revenue meters, relays, transformers, and lightning arresters have well developed product standards. Usually the product rating, functional options and performance expectations are covered in the U.S. by an ANSI or NEMA standard and in Europe as well as other parts of the world by an EU or IEC product standard. As PV penetration levels rise, utilities will increasingly need this kind of clear, widely accepted and easily referenced specification to be broadly supported in available products.

The typical requirements being used by utilities for connecting PV inverters are described in greater detail in the full EPRI report. Referenced standards in specifying PV inverters used is both hardware and power purchase agreements are listed and described in the Appendix. These typically address the interfaces and safety, such as interconnection requirements in IEEE 1547, and premises installation requirements in NFPA NEC Article 690. However, they do not usually address the plant related daily functions, the energy performance, or the life-cycle economics of the inverter. Today utilities tend to specify inverters as if they are third party equipment,

owned and operated by someone other than themselves. Typically there are no PV inverter energy performance criteria that are a well defined industry practice. Usually these performance parameters are either not covered, or left to the system designer or a third party.

We expect the mindset to change when the inverters and PV plants become owned and operated utility assets. With this transition, the criteria will change and requirements are expected to include a lot more on functions, energy performance, and life. Specifications will include more standardization of products and ratings for easier operations and maintenance, focus on energy conversion efficiency, maximum power tracking accuracy, and surge-withstand capability.

CONCLUSION

PV is the fastest growing technology in the electricity generation portfolio, and the PV inverter has proven to be the most critical component in determining plant availability.

As PV penetration levels rise, utilities will increasingly need clear, complete inverter specifications that can be easily referenced and broadly supported. EPRI has published a report that examines current industry practices for specifying PV inverters in grid connected and large scale applications. This report identifies several opportunities to further develop performance and acceptance criteria for PV inverters. In particular, the inverter's energy conversion performance, grid support functionality, and long term durability are all candidates for more detailed specification in utility procurements. Several examples are also provided where utilities have begun developing grid performance requirements.

As a future utility plant asset, the inverter will need to be specified at a level of detail such as revenue meters or transformers.

ABOUT THE AUTHOR

Aminul Huque is a senior project engineer for the integration of distributed renewables group at the Electric Power Research Institute (EPRI).

At EPRI he is involved in the photovoltaic (PV) power conditioning system research including grid interconnection requirements, smart-grid functionality, and product reliability.

Aminul received a Ph.D. in high-temperature electronics from the University of Tennessee in Knoxville, TN in 2010 and M.S. from the Imperial College London, UK, in 2003.

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