

# WORLD-GENERATION

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## CLASS OF 2013



**Mario Azar**  
SIEMENS



**Todd Carter**  
PANDA



**Dave Walsh**  
MITSUBISHI



**Keith Manning**  
ZACHRY



**Udo Zirn**  
HITACHI



**Mike Dooley**  
AE



**Tracy Anderson**  
3M



**Ben Driver**  
REFUSOL



**John LaRue**  
CORPUS CHRISTI



**Karl Fessenden**  
GE



**Jason You**  
LG ELECTRONICS USA



**Uwe Schmiemann**  
SOLAR TURBINES



**Zhe Jiang**  
UPSOLAR



**Roger Stark**  
BALLARD SPAHR



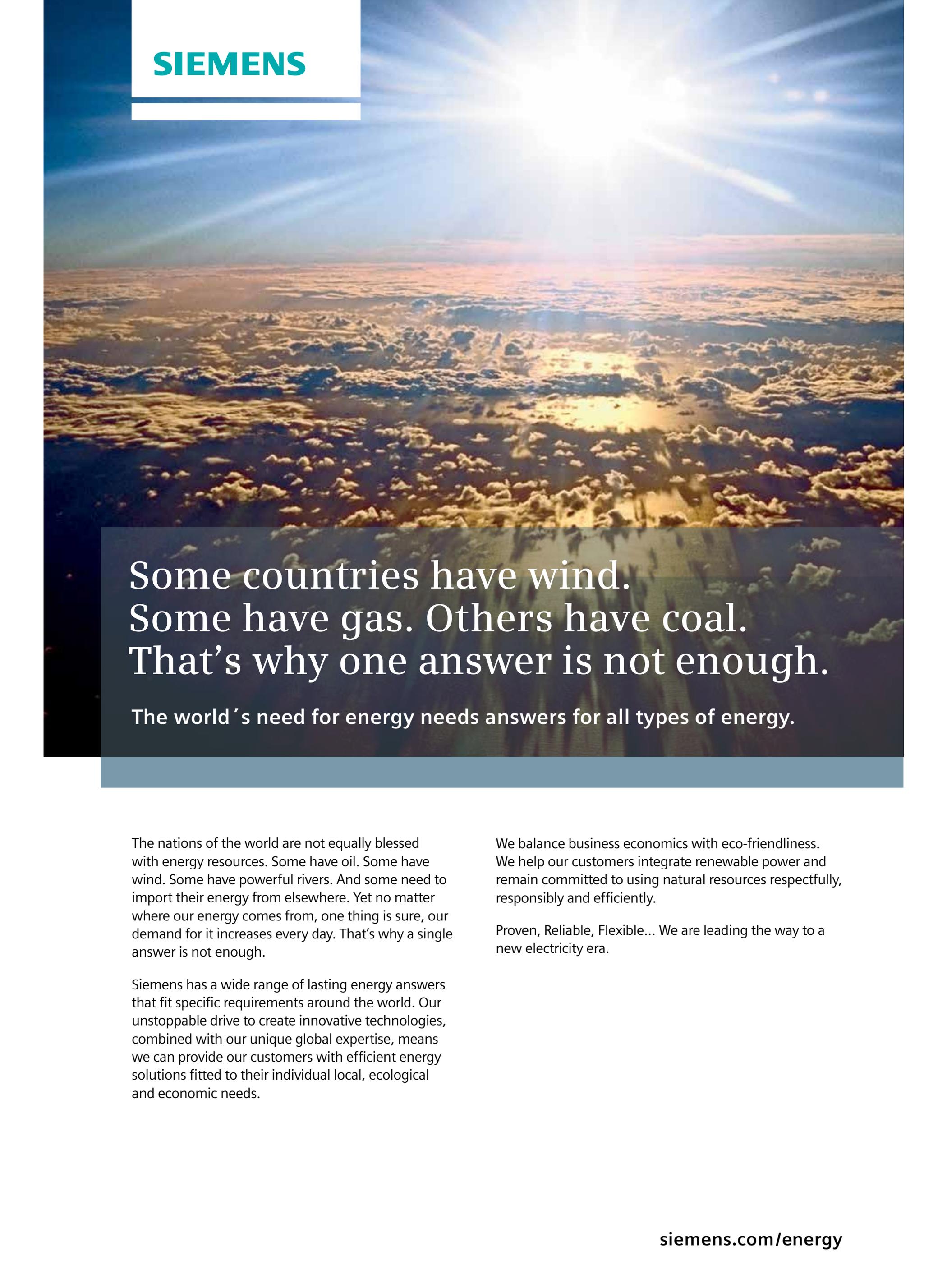
**Joe Thomas**  
MAGE



**Alex Salmond**  
SCOTLAND

FEBRUARY/MARCH 2013  
VOLUME 25 - NUMBER 1  
*Our 25th Year*

PUBLISHER'S LETTER	pg. 3
MARIO AZAR, SIEMENS	pg. 4
TODD CARTER, PANDA	pg. 5
DAVE WALSH, MITSUBISHI	pg. 6
KEITH MANNING, ZACHRY	pg. 7
UDO ZIRN, HITACHI	pg. 8
MIKE DOOLEY, AE	pg. 9
TRACY ANDERSON, 3M	pg. 10
BEN DRIVER, REFUSOL	pg. 11
JOHN LARUE, CORPUS CHRISTI	pg. 12
KARL FESSENDEN, GE	pg. 13
JASON YOU, LG ELECTRONICS USA	pg. 14
UWE SCHMIEMANN, SOLAR TURBINES	pg. 15
ZHE JIANG, UPSOLAR	pg. 16
ROGER STARK, BALLARD SPAHR	pg. 17
JOE THOMAS, MAGE	pg. 18
ALEX SALMOND, SCOTLAND	pg. 19



**SIEMENS**

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.

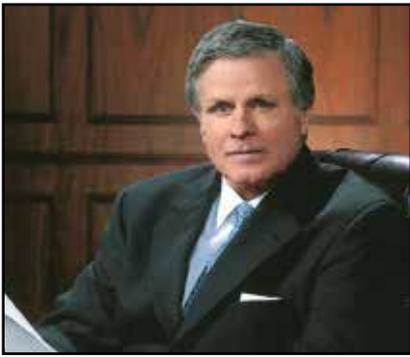
The nations of the world are not equally blessed with energy resources. Some have oil. Some have wind. Some have powerful rivers. And some need to import their energy from elsewhere. Yet no matter where our energy comes from, one thing is sure, our demand for it increases every day. That's why a single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

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Dick Flanagan

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*The Class of 2013 studies the changing energy landscape, from the shale gas revolution to the solar revolution to the industrial internet revolution, and everything in between. You'll enjoy reading what the executives are doing to navigate their companies through these challenging times.*

*We are pleased and proud to present our 14th Class of the Millennium.*

*Mario Azar profiles Siemens Flex-Plant™ portfolio serving diverse markets in the Americas on page 4. He sees the US market shifting to independent developers competing for off-take agreements. In Latin America, Siemens opened offices in Mexico and Brazil.*

*Panda Power Funds Todd Carter tells us on page 5 that their mission statement is "Evolve or Die." Since its founding in 2010, Panda is developing the Sherman and Temple Generating station in Texas. It has developed the 20 megawatt Pilesgrove Solar Farm.*

*Dave Walsh outlines Mitsubishi Power Systems Americas growth over the past 12 years on page 6. It involved building manufacturing facilities in Orlando, FL, Savannah, GA and Houston, TX. Walsh also commented on the Pratt-Whitney Power Systems acquisition.*

*Keith Manning on page 7 sees a huge increase in petrochemical, process and power industry projects from the shale gas revolution expected to surge in the next five years. Zachry recently acquired J. V. Industrial Companies, bringing Zachry's workforce to over 20,000 at hundreds of sites. Zachry's Freeport LNG project is moving forward with detailed design and construction set for 2014.*

*Hitachi Power Systems Americas Udo Zirn believes that 10 to 12 combined cycle plants will be built in the US each year over the next five years, both greenfield and brownfield. He further states on page 8 that the plants will be smaller combined cycle plants, replacing municipal and coop coal plants smaller than 200 megawatts.*

*With over 6,995 units and more than 14 million available operational field hours, Advanced Energy's uptime averages 99.77 percent, Mike Dooley shares on page 9. Advanced Energy partners with the DOE on the SEGIS-AC program to test and develop new technologies for challenges facing high PV penetration into today's electrical grid.*

*3M's Renewable Energy Division was formed in 2009 to take advantage of breakthrough innovations to create new products in renewable energy, Tracy Anderson tells us on page 10. In solar, they're increasing watts from panels. In wind they introduced a bonding adhesive for wind turbine blades and in transmission 3M's ACCR technology can double the capacity of overhead lines.*

*REFUsoL is manufacturing its three-phase inverters in Greenville, SC, Ben Driver said on page 11. The inverters meet ARRA, Section 1605 provisions. It will begin manufacturing large central inverters by the end of the year. The Greenville plant was opened last year and is ISO 9001 and ISO 14001 certified.*

*The discovery of the Eagle Ford shale oil deposits has dramatically lifted the fortunes of the Port of Corpus Christi, John LaRue tells us on page 12. The port is blessed with 20,000 acres of land, deep water channels and good rail and road connections to handle the expected increase in traffic.*

*The world is on the threshold of a new era of innovation and change with the rise of the industrial internet, Karl Fessenden predicts on page 13. The industrial internet starts with embedding sensors and other advanced instrumentation in an array of machines. GE estimates \$32 trillion in economic activity from the industrial internet.*

*Jason You addresses ongoing challenges in solar including space limitation, lighter weight for panels and racking systems. LG Electronics USA introduced three innovative technologies outlined on page 14 to meet these objectives and continue the impressive growth in solar expected to rise 70 percent in 2013.*

*Over eight million electrical utility customers lost power during Hurricane Sandy, Uwe Schmiemann tells us on page 15. He gives examples of CHP plants keeping the power on at hospitals, universities and Atlantic City casinos.*

*Upsolar offers PV modules systems and power plants in more than 20 countries, Zhe Jiang shares on page 16. His target is to sustain a healthy growth rate between 20-30 percent each year and is exploring new manufacturing partnerships in Germany, Italy and Greece.*

*Roger Stark writes on page 17 that renewables need a policy framework that acknowledges their central role in achieving resource diversity, energy security and environmental sustainability. With suitable policy reforms, renewables promise to keep the U.S. on a path to a balanced resource portfolio. Without such reforms, we risk sliding into an all gas economy, with all the fuel price volatility and peak air risks that come with it.*

*Joe Thomas comments on Mage Solar's policy of partnering with integrators, financing brokers and Solar Bridge to bring its modules to market on page 18. Mage also operates a Solar Academy that has graduated over 1,000 students from around the world.*

*World-Gen was invited by Scottish Development International to attend the "Offshore Wind and Supply Chain Conference and Exhibition" in Aberdeen in January. Prime Minister Alex Salmond spoke of how Scotland leads the EU in reducing greenhouse gas emissions. He reset the renewable target at 50 percent by 2015, and 100 percent by 2020 on page 19.*

*Dick Flanagan*

## MARIO AZAR



*President  
Siemens Energy Solutions Americas*

Mario Azar is a graduate of the University of North Carolina with a degree in Electrical Engineering. His career in the energy industry started in 1990 as a Quality Engineer at the Charlotte Turbine/Generator Plant for Westinghouse Electric Power Generation.

He has held a variety of responsibilities during his 20+ year tenure at Siemens including China Joint Venture Operations, Long Term Service Program Operations-Europe/ASIA/Mid-East Region, Head of Global Major Projects and Head of Service Programs Marketing.

In 2008, Azar was named President of Siemens Energy Solutions Americas, responsible for the Power Plant Solutions and EPC business in North and Latin America.

### WORLD-GEN: HOW DOES SIEMENS ENERGY SOLUTIONS FIT INTO THE SIEMENS ARCHITECTURE GLOBALLY?

**Mario Azar:** Siemens has four sectors: Energy, Healthcare, Industry and Infrastructure and Cities. The Solutions business falls under the Fossil Power Generation division within the Energy Sector. This is the same division responsible for development and manufacture of power generation equipment—gas turbines, steam turbines, generators and control systems. We are well positioned as a business to leverage the latest Siemens technology, along with purchased hardware, to develop complete engineered solutions. We are also positioned well to bring what we are seeing in the market back to the engineering and manufacturing community, maintaining that link to our customers. Given the diversity of the markets we serve, this is key.

### WORLD-GEN: HOW MANY PRODUCTS IN 60 HZ CAPP DOES “SOLUTIONS” OFFER?

**Mario Azar:** The simple answer is we offer an endless number of products based on the customer’s project needs. Our portfolio extends from simple and combined cycle turnkeys to engineered thermal and power islands. This portfolio is based on pre-engineered design

packages proven in past applications but is flexible to adapt to specific project needs. We are able to customize projects through self-performance of plant engineering, procurement, transportation, construction management and commissioning.

Our Flex-Plant™ portfolio consists of engineered solutions incorporating the latest fast-start and environmentally responsible technology. This level of engineering allows for tailored solutions but is still based on proven applications. We find this business model reduces the unknowns associated with large-scale and very complex projects.

As we see the market, particularly in the US, shift to independent developers competing for off-take agreements, this approach is well received from a risk management perspective and increases the ability to obtain financing.

### WORLD-GEN: PLEASE HIGHLIGHT “SOLUTIONS” OFFERING TURNKEY POWER PLANTS.

**Mario Azar:** We have the ability to align our portfolio with the needs of our customers. We can participate through engineered thermal island supply through to turnkey when appropriate. In the case of a turnkey project, we can provide the project wrap including the technology guarantees as well as project completion guarantees necessary to make the project work. For every project, we bring the integrated cycle, offering high efficiency as well as other practical plant advantages – like fast-start capability, operational flexibility and environmental responsibility. As our scope increases to a turnkey level, the risk we hold also increases in the form of project guarantees. With this model, the overall project risk held by the customer diminishes.

The turnkey or Engineer, Procure, and Construct (EPC) approach is not always the answer. We also provide engineered thermal islands which are constructed in partnership with Architect Engineers (AEs) to ensure our customer has the best solution possible. There are a number of examples where this model has worked well as an alternative to turnkey supply. If you look at what we have in the project execution pipeline in the Americas today where we have engineered thermal island responsibility, about 25% of these projects are turnkey or consortium participation by Siemens. The balance is direct supply to project owner or to AEs.

### WORLD-GEN: PLEASE EXPLAIN HOW SIEMENS CLEAN RAMP TECHNOLOGY ENABLES THE FLEX-PLANT™ 30 TO STAY IN EMISSIONS COMPLIANCE WHILE LOAD FOLLOWING RENEWABLES.

**Mario Azar:** This is a good example of integrating our manufactured equipment into the plant design to meet the needs of our customers. We see the increase in

renewable energy sources causing power plants to ramp far more frequently to balance the grid load. A challenge that results is maintaining low average emissions with the frequently ramping plant. The advantage of being the gas turbine OEM as well as plant designer is that we can modify the way the gas turbine is controlled to optimize how it works together with the rest of the plant. The emissions system doesn’t have to follow the gas turbine – it can anticipate the gas turbine because they are being controlled together. We call this feature Clean-Ramp™, where integrated control technology is used to determine what the gas turbine is going to be emitting at any given time and respond to it proactively. We see this as an important feature for our markets such as California, Texas and possibly Brazil where wind generation is an increasing part of the energy mix in an environmentally conscious area. Clean-Ramp integrates the operation of the combined cycle to maintain low NOX and CO out of the stacks while ramping. Therefore, you can ramp more frequently and more quickly with less environmental impact.

### WORLD-GEN: PLEASE PROFILE THE SGT6-8000H AND SGT6-5000F GAS TURBINES.

**Mario Azar:** The SGT6-5000F engine has an exceptional operational record over a 15-year, 4.7+ million fleet hour history. Since its introduction in 1993, we continued to improve its performance, reliability, and operational flexibility to reduce emissions and life cycle costs. In 2008, we started production of the latest upgraded version of the SGT6-5000F. The capabilities of this newest offering include a dual-fuel gas turbine which can deliver 150MW of power within 10 minutes. It has an Ultra Low NOx combustion system and is designed for extended maintenance intervals.

The SGT6-8000H engine is a 60 Hz version of the SGT5-8000H, which is the first gas turbine in the world to exceed 60% efficiency in combined cycle. The 60 Hz version began operation in 2012 at a Florida plant and has a growing fleet, with over 150,000 operating hours expected by the end of 2015. The SGT6-8000H was developed using a Siemens robust design and validation process, which included running a full scale engine at base load power in our gas turbine testing facility in Berlin, Germany. The 50 and 60 Hz engines were designed together and have common combustion systems. The SGT-8000H fleet is growing steadily, with over 20 engines ordered to date. One SGT6-8000H gas turbine can supply enough electricity for over 275,000 U.S. households, and when used in a combined cycle configuration, 410,000 households.

### WORLD-GEN: PLEASE UPDATE THE ACTIVITIES AT THE NEW CHARLOTTE FACILITY.

**Mario Azar:** 60 Hz Markets, especially the US, are key to Siemens, which

drove us to expand the production facility within the region. In 2011, the Siemens Charlotte Energy Hub expanded its facility, adding gas turbines to its portfolio and essentially doubling its workforce. The expansion combines the manufacture of GT, ST and Generators under one roof. We also co-located our engineering resources alongside the manufacturing operation, bringing the product and technical expertise closer to our customers.

### WORLD-GEN: PLEASE LIST THE SIEMENS AMERICAS PROJECTS ENTERING COMMERCIAL OPERATION IN 2013 AND EXPECTED IN 2014 AND BEYOND.

**Mario Azar:** Let me back up to the 2012 highlights. Obviously we are proud of the Lodi Energy Center, which is the first Flex-Plant that reached commercial operation. For 2013, we’ll have three Siemens turnkey plants come online, Malacas Simple Cycle, and Santo Domingo Simple Cycle, both in Peru; as well as the Planta Generadora La Caridad I Combined Cycle plant in Mexico.

In 2013, we are responsible for the engineered thermal island for approximately 15 power generation projects in the Americas. This includes commissioning two additional 1x1 Flex-Plant™ combined cycle blocks at NRG’s El Segundo plant in California.

In 2014, we’ll commission two more 2x1 Blocks of Flex-Plant™ Combined Cycle generation in the ERCOT region – with Panda Power Funds in Temple and Sherman, Texas. We are looking forward to commissioning additional Flex-Plant™ blocks currently in the pipeline for 2015.

Globally, Siemens Energy Solutions has close to forty new thermal island projects in execution.

### WORLD-GEN: WHERE ARE THE MARKETS HEADED IN THE AMERICAS?

**Mario Azar:** In the US, shale gas is transforming the energy markets with natural gas prices at historic lows. We expect modest new build growth in FY2013/ FY2014, with the strongest growth in Texas and the Northeast. Coal generation retirements and environmental legislation can greatly influence the market as well. Demanding Renewable Portfolio Standards will also dictate increased renewable power generation in certain states. Reliable, flexible, on demand generation will be needed to supplement the renewables. Our Flex-Plant™ technology is a proven answer to this challenge.

In Latin America, each country is driven by different factors. In Brazil, there is a great demand on their power auctions for renewables, and we are talking to customers about our Flex-Plant technology to provide reliable backup and grid stability. In Mexico, we see a stable regulated market driven by government planning, and a growing renewable segment.

Venezuela and Argentina will need to start

*(continued page 7)*

## TODD CARTER



Senior Partner and founding President,  
Panda Power Funds

Todd Carter is the Senior Partner and founding President of the Panda Power Funds. Under his leadership, the firm raised \$420 million in capital commitments in its first fund during the height of the recent economic recession. Since then, he has overseen the financing of approximately \$1.7 billion in energy assets.

He served as President of Panda Energy from September 2007 until April 2010 and from 2000 to October 2006. From October 2006 to August 2007, Mr. Carter served as President and Chief Executive Officer of Panda Ethanol. He has been employed by Panda Energy and its affiliates for 19 years. From 1999 to 2000, Mr. Carter served as Senior Vice President of Corporate Finance. From 1997 to 1999, Mr. Carter served as Senior Vice President of International Business Development. He holds a Bachelor of Arts degree in Economics from The University of Texas at Austin.

### WORLD-GEN: WHEN AND WHERE WAS PANDA POWER FUNDS ESTABLISHED AND WHAT'S THE MISSION STATEMENT?

**Todd Carter:** Panda Power Funds is headquartered in Dallas, Texas with offices in Houston and New York City. The firm was established in 2010 by the former senior management and energy professionals of Panda Energy International, whose roots go back to 1982. We have a banner hanging in our board room which displays our mission statement: "Evolve or die."

### WORLD-GEN: PLEASE PROFILE HOW THE PANDA SHERMAN GENERATING STATION WAS FINANCED.

**Todd Carter:** The Sherman project was financed with a combination of equity, derived from Panda's private equity fund and other outside co-investors, and debt. The Sherman financing occurred two months after our Temple financing which was seen as a breakthrough for the U.S. banking market.

### WORLD-GEN: HOW WILL PANDA SHERMAN INCREASE ERCOT'S RESERVES WHEN IT ENTERS COMMERCIAL OPERATION IN 2014?

**Todd Carter:** The Sherman plant will add 758 MWs of generating capacity to the ERCOT grid. Equally important, it will add clean, natural gas-fueled generating capacity.

### WORLD-GEN: HOW WILL THE PLANT CONTRIBUTE TO THE AREA'S ECONOMY DURING AND AFTER CONSTRUCTION?

**Todd Carter:** Impact Data Source of Austin, Texas calculated that the plant will contribute \$1.7 billion to the area's economy during construction and the first ten years of operation. It will create 700-800 jobs at the peak of construction and create an estimated 27 skilled jobs to operate the facility and 45 indirect jobs within the community to support the plant. The Sherman project will also bring a great deal of economic development to North Texas without burdening the area for additional municipal services.

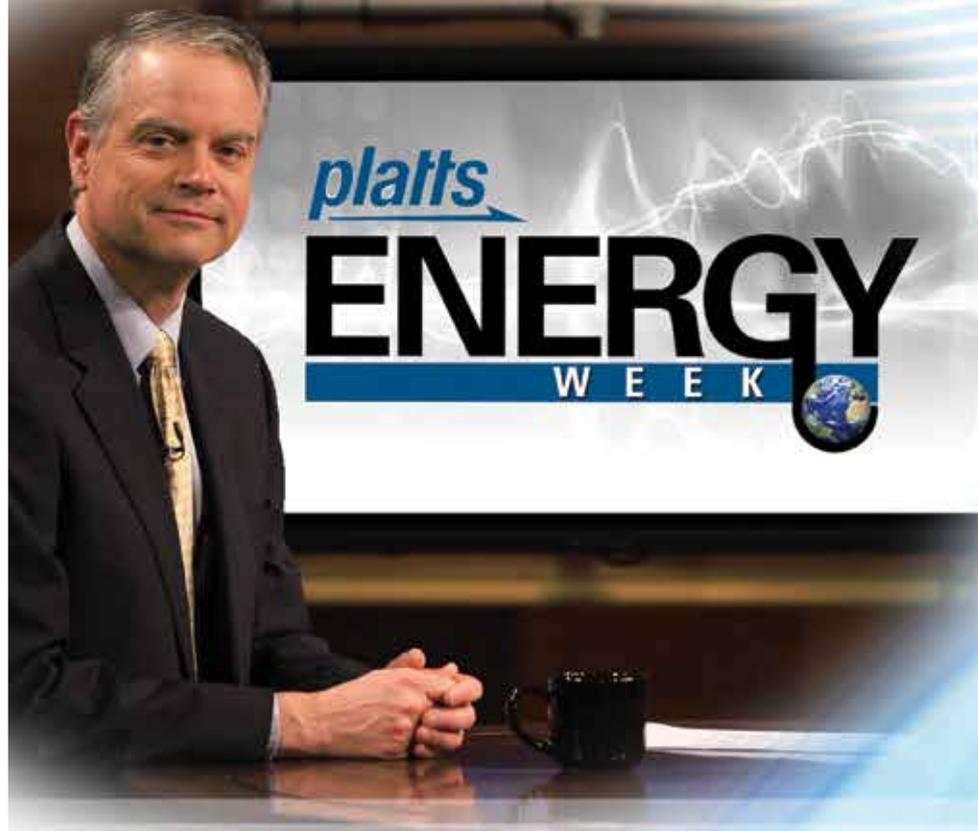
### WORLD-GEN: PANDA SHERMAN WILL BE BUILT BY A TURNKEY CONSORTIUM.

### PLEASE TELL US HOW THEY WERE CHOSEN?

**Todd Carter:** A turn-key consortium of Bechtel and Siemens Energy was chosen to build the Sherman facility based on a number of factors. These included their experience; ability to complete the project on time and on budget; their generating technology; and competitiveness. At the end of the day, we also had to be confident not only in their individual abilities, but also in their ability to work together. Based on what we've seen so far, it's turned out to be a good decision.

(continued page 20)

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## DAVE WALSH



Senior Vice President  
Mitsubishi Power Systems, Americas

### WORLD-GEN: WHEN DID MITSUBISHI POWER SYSTEMS AMERICAS, INC. ESTABLISH ITS HEADQUARTERS IN FLORIDA AND PLEASE OUTLINE ITS GROWTH OVER THESE YEARS?

**David Walsh:** In 2001, we established Mitsubishi Power Systems Americas, Inc. (MPSA) headquarters in Lake Mary, FL. and have currently evolved to 1,700 employees in this hemisphere. The company also began its official service support with the Orlando Service Center (OSC), a 225,000 square foot facility in Orlando, FL. The facility provides gas and steam turbine parts, repair, and support services to fossil, geothermal and nuclear power generating plants throughout the Western Hemisphere, as well as manufacturing component parts for gas and steam turbines. Additionally, we established a key office in Newport Beach, CA.

In 2007, MPSA built a combustion turbine blade and vane manufacturing center in Orlando, FL.

Then, in 2009, construction began on our Savannah Machinery Works (SMW), a 500,000 square foot state-of-the-art manufacturing and service facility in Savannah, GA. This facility manufactures and services Mitsubishi G and J class gas turbines for customers in the US and abroad. It also provides services to a wide variety of steam and gas turbine generator rotors and major stationary parts. The J-series turbine being manufactured there, and in Japan, is currently the most powerful and efficient gas turbine in the world.

In 2010, we finalized our gas turbine component manufacturing section in Savannah. And in 2011, we completed a large gas turbine and steam turbine service and manufacturing center there as well. MPSA also relocated our Houston outage and tooling center to a larger facility, with plans to expand its operations to include rotor and stationary parts service capability and a fossil outage training center.

Last year, we also completed the steam turbine assembly area at our Savannah facility.

### WORLD-GEN: WAS THE GROWTH ORGANICALLY OR BY ACQUISITION?

**David Walsh:** MPSA's growth has been entirely organic as demonstrated by the significant corporate investment made in offices and facilities throughout the US.

### WORLD-GEN: WHAT ADVANCEMENTS IN TECHNOLOGY ARE GAME CHANGERS?

**David Walsh:** Our parent company, Mitsubishi Heavy Industries, Ltd. (MHI) is constantly involved in the development and commercialization of key technology advancements. However, MHI's most signif-

icant technology impact has been the successful design, development, and validation of very large frame (over 270 MW), highly efficient (over 61%) gas turbine generators to support the predicted GTCC generation capacity growth. Additionally, we are confident that Mitsubishi's fleet of M501G series (78 units) and M501J series (19 units) gas turbines will continue to prove the operational reliability and flexibility of our technology in the coming decades.

### WORLD-GEN: THE INDUSTRY HAS DELIVERED MAJOR BREAKTHROUGHS IN LOWERING EMISSIONS. PLEASE COMMENT

### ON MITSUBISHI'S CONTRIBUTIONS.

**David Walsh:** MHI has substantially reduced CO2 emissions by increasing its gas turbine and combined cycle efficiency. This achievement is not restricted to natural gas combined cycles, but also applies to the highest efficiency in IGCC and steel mill residue gases.

### WORLD-GEN: HOW DOES THE RECRUITMENT MARKET LOOK TO MITSUBISHI?

**David Walsh:** MPSA takes a multi-faceted approach to recruitment. We seek to recruit the finest talent available in the

(continued page 20)

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*Efficiency and reliability are the life cycle results of Mitsubishi's evolutionary disciplines that yield leadership in power generation products and services around the world.*

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- Combined Cycle Efficiency of 61.5% LHV  
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with 18 more units currently booked as of 2013.

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## KEITH D. MANNING



Executive Vice President  
Zachry Holdings, Inc.

### SHALE GAS BOON CREATES MAJOR MARKET DRIVER

With the upsurge of the shale gas revolution in the United States, the petrochemical, process and power industries could see a huge increase in new projects. As abundant fuel feeds the market, the possibility of energy independence and reinvigoration of the U.S. manufacturing base beckons.

“This means big opportunities for not only oil, gas and power owners, but the engineers, constructors and service providers ready to design, build and maintain the plants needed to meet the emerging demand—particularly along the Gulf Coast,” said Keith Manning, executive vice president for Zachry Holdings, Inc.

Just a few counties away from Zachry, headquartered in San Antonio, Texas, sits the Eagle Ford Shale, an area now booming with activity above and below ground as oil and gas companies stake their claim to the plentiful fuel source released by the technical breakthroughs in fracking.

### EAGLE FORD SHALE

The Eagle Ford Shale reaches across 25 Texas counties, with more than 60 percent of drilling rigs operating in only five of those counties (La Salle, Karnes, McMullen, Gonzales and DeWitt). Eagle Ford’s proximity to the Gulf Coast where 70 percent of U.S. petrochemical capacity exists, is a major driver to this entire phenomenon.

For a company like Zachry that services both the petrochemical and power industries, the possibilities are exciting. Announced projects from major players in the petrochemical space like Exxon, Dow, CPChem, Sasol and others include grassroots ethane crackers, downstream derivative projects and even world-scale gas to liquid projects.

“We are seeing a tremendous amount of petrochemical expansion opportunities. This will drive more projects and increase industrial demand for power along with it. We expect the

industrial power load to grow in the Gulf Coast through ‘behind the fence’ power opportunities as well as traditional utility-scale opportunities in ERCOT,” Manning pointed out.

As it relates to power, shale gas comes at an opportune time when many coal jobs are winding down due to environmental concerns and restrictions, and Fukushima-related issues are causing a slowdown in global nuclear construction.

“Combined-cycle, natural gas-fired projects will continue to be the go-to technology for new, utility-scale power generation as demand starts picking up, and will also create IPP interest,” Manning explained. “We expect many more of these types of projects to emerge.”

This process has already begun, as evidenced by some of the first large-scale natural gas plants under construction, including Zachry’s Cape Canaveral and Riviera Beach projects both for top power producer, Florida Power and Light (FPL).

The twin projects, similar but located on different sites, will together power 500,000 homes upon completion in 2013 and 2014. Zachry is providing full EPC efforts on both of these jobs. The combined 2,500-MW Cape Canaveral and Riviera Beach gas modernizations, located on 42 acres and 21 acres respectively, will use the latest in Siemens combustion turbine technology to limit carbon emissions.

“We are confident that as older coal plants shut down, we will see a good stream of combined cycle projects coming up for new generation,” Manning underscored.

Additionally, Zachry is constructing a major 3X1 combined-cycle project for Dominion Energy in Warren County, VA. Not only is this plentiful form of natural gas influencing power producers to build new, utility-scale, combined-cycle, gas-fired plants, it is also driving industrial load co-generation facilities for both power and steam.

Another dynamic market in addition to utility-scale, combined-cycle plants; reinvigoration of large petrochemical projects; and co-gen projects, is the possibility of LNG export facilities. The renewal of this market in the past several years also has direct ties to shale gas production.

### LNG PROJECT

Projects like Zachry’s Freeport LNG project, a joint venture with CB&I, are in the works. The two-train project is moving forward with detailed design and construction set for 2014. Zachry and CB&I will build the two LNG liquefaction trains (each rated at 4.4 million tons per year (mtpa)) and corresponding pretreatment facilities to be located near the existing Freeport LNG Regasification Terminal.

“These industry trends related to the shale gas are expected to surge in

the next five years,” Manning projected. “This calls for prudence and planning, particularly in areas such as technical engineering resources, craft labor recruitment and project selections.”

Companies like Zachry must prepare their most important resources, their people, for such an industry surge, as well as ensure that the right processes and initiatives exist to succeed in the coming years.

### HIRE THE BEST

At Zachry, some key initiatives underway include their “Hire the Best” program; an enhanced focus on engineering capabilities with strategic Design Center locations; a strengthening of global major procurement; an emphasis on crucial strategic relationship development with OEMs and technology providers; and a clear commitment to expanding craft supervision and labor base.

As part of this bolstering of top talent, Zachry recently acquired JV Industrial Companies, a Houston-based industry leader serving clients in the refining and petrochemicals sector. With the addition of JVIC, Zachry’s workforce of 20,000 at hundreds of nationwide sites will provide a wide range of services including engineering, construction, maintenance, turnarounds and fabrication, as well as a number of highly specialized services.

“This new market dynamic created by shale gas could employ many more craft workers and assist in a recovering U.S. economy. Whether the projects are combined-cycle natural gas, petrochemical, co-generation or LNG, technical and craft resources will be a key element to a thriving industry,” Manning said.

Another result of this expansion includes petrochemical companies choosing to build their plants here in the United States with the added benefit of higher predictability of project outcome.

For the first time in a long time, the possibility of energy independence and the invigoration of domestic manufacturing is a real possibility.

“The combination of U.S. power and process is looking very exciting over the next five years,” Manning shared in conclusion. “We hope to benefit as a company from the shale gas revolution, and additionally this is exciting for our craft workers, engineers and the industry as the entire American economy could rise with this tide.”

### ABOUT KEITH D. MANNING

Keith D. Manning is the executive vice president, Enterprise Strategic Development for Zachry Holdings, Inc. Zachry is a privately held business engaged primarily in the engineering, construction and maintenance of large industrial projects and facilities in the United States. Based in San Antonio, Texas, the company participates in a

wide range of the energy sector including traditional and renewable power, petrochemical, refining, forest products and nuclear. Keith’s primary responsibilities include corporate strategy and growth of the ZHI core business units, including engineering, construction and industrial services in the U.S. energy markets. He is additionally responsible for corporate marketing, enterprise-wide business development oversight and senior-level client and partner management. He serves on the board of directors of Zachry Holdings, Inc. and is Chairman of Zachry Nuclear, Inc.

Keith is a 34-year veteran of Zachry, and began his career as construction engineer on a major Gulf Coast petrochemical project. In previous roles, Keith served as senior vice president/manager of the process division, director of business development and materials control manager on several projects.

Keith holds a Bachelor of Business Administration degree in management from Texas A&M University and attended Duke University’s Advanced Management Program. He is currently on the executive board of the Construction Industry Institute, and is a member of the board of directors for Catholic Charities of San Antonio and the Valero Alamo Bowl. He and his wife Sharon have two grown children.

## MARIO AZAR

CONTINUED FROM PAGE 4

ramping up to support the growing energy needs. In Chile, environmental drivers are limiting coal and hydro generation. The demand growth by mining companies in the north grid, and availability of relatively low cost and transportable natural gas internationally, are driving the demand for power as we see more private developers interested in thermal power generation.

### WORLD-GEN: WHAT CHALLENGES DO YOU ANTICIPATE IN THESE NEW MARKETS AND CAN SIEMENS SERVICE THESE NEW AREAS?

**Mario Azar:** We’re paying attention to the differences in the markets and we are adjusting our strategies to be able to meet these challenges. Recently, we have opened offices in Mexico and Brazil, with an office in Chile soon to follow, to be more responsive to the local needs in these regions. We are very proud of our diverse portfolio. As an OEM, we go to our customers with a full portfolio of products so we can offer our customer equipment only through our products channel and engineered thermal or power islands all the way to full turnkey through our solutions channel.

## UDO ZIRN



Manager of Turbine Systems  
Hitachi Power Systems America

Udo Zirn is the Manager of Turbine Systems for Hitachi Power Systems America (HPSA), which operates out of Basking Ridge, N. J. Zirn is responsible for all aspects of business development, including proposal preparation, contract negotiations, and product management. Moreover, Zirn is responsible for steam cycle performance evaluations and optimizations. Some of his recent projects have included Rodemacher #3 for CLECO, Elm Road #1 and #2 for WEPCO, and Trimble County #2 for LG&E. He has worked on proposals for other projects being developed by Duke, Florida Power & Light, Dominion Power, Nevada Power and others.

Zirn serves as the lead for all technical and commercial exchanges with the client and with the Japanese engineering and factory teams during the business development phase of combustion turbine and steam turbine projects. He is responsible for determining market requirements through direct customer contact, recommending associated product developments, driving the implementation of new product development, and preparing the product proposals.

Before joining HPSA, Zirn worked at Black & Veatch Energy as the head of the Thermal Performance Section, responsible for plant performance testing and performance guarantees among other duties. He has published numerous papers in proceedings and journals and holds a patent involving energy recovery from flue gas pollution control equipment. He has been involved in projects worldwide and has supervised engineers not only in the United States but also in China and India.

Zirn is a native of Germany. He received his Master of Science degree in nuclear and energy engineering from the University of Arizona, and also holds a Diplom-Ingenieur degree (German equivalent of M.S.) in mechanical engineering from the University of Stuttgart, Germany. He also participated in the Executive Business Acumen Program run by the Olin School of Business at Washington University in St. Louis.

## TURBINE PRODUCTS

HPSA offers both steam and gas turbines. The steam turbine product line covers 100-1,000MW for fossil fuel plants and up to 1,600 MW for nuclear plants, while the gas turbine product line covers 15-100MW turbines. Over the last ten years HPSA focused less on gas turbine and combined cycles and more on supercritical coal plants. The steam turbine generator for the Genesee Generating Station in Alberta, Canada, for EPCOR went online in 2005, followed by the steam turbine supplied for the Walter Scott Junior Unit 3 Facility for MidAmerican in Council

Bluffs, Iowa, two more turbines for the Elm Road Project for WEPCO, a turbine for the Trimble County Project for LG&E, and a turbine for the Rodemacher Project for CLECO.

EPCOR was so pleased with the Hitachi turbine provided at their Genesee Facility that it recently ordered a duplicate for their Keepphills plant.

Besides the large turbine generator projects mentioned above, Zirn's group also supplied small turbine drives to drive the boiler feed pumps in a number of coal plants. Zirn says that HPSA has been quite successful in placing these turbine drives.

As the U. S. market is shifting from

coal fired power generation to gas fired power generation, HPSA is shifting its focus, too. When HPSA anticipated the rise in demand of gas-fired plants, it began to adjust its existing steam turbine design so that it would fit readily into the combined cycle market. It did so by designing standardized steam turbines especially to fit U.S. market demands, that is, keyed to U.S. market parameters for steam pressures, temperatures, operating characteristics etc. This standardization enabled Hitachi to take advantage of component multi-purchasing agreements to drive down the price. "Our steam turbines for  
*(continued page 21)*

## HITACHI INTRODUCES NEW COMBUSTION TURBINE TECHNOLOGY

HITACH GAS TURBINE PRODUCT LINE – 60 HZ				
ITEM	UNIT	H-15	H-25	H-80
Output	MW	16.9	32	99.3
Efficiency	%(LHV)	34.4	34.8	37.5
Heat Rate	Btu/kWh	9,950	9,806	9,100
Exhaust Flow	lb/h	420,000	767,000	2,262,000
Exhaust Temp	°F	1,047	1,042	986

ISO Conditions (Sea Level, 59°F, 60% RH), Natural Gas Firing

**HITACHI HAS DEVELOPED SEVERAL NEW MODELS** including a 100 MW combustion turbine (Hitachi H-80), and several upgrades of the mature H-25 combustion turbine technology, ranging from 32–42 MW. Hitachi's combustion turbine lineup is ideal for upgrading/replacing existing simple cycle and combined cycle combustion turbines. Nominal combined cycle outputs of 140 MW or 285 MW are achievable with the H-80 combustion turbine in 1x1 or 2x1 plant arrangements. Learn more from Hitachi Power Systems America.

**HITACHI POWER SYSTEMS AMERICA, LTD.**  
645 Martinsville Road, Basking Ridge, NJ 07920  
power.info@hal.hitachi.com Tel: 908-605-2800  
www.hitachipowersystems.us

**HITACHI**  
Inspire the Next

## MIKE DOOLEY



Vice President of Marketing  
Advanced Energy

Advanced Energy (AE) is a public company founded in 1981 in Fort Collins, CO and has two other major sites in Bend, OR and Shenzhen, China. The company's solar energy commercial unit, known as AE Solar Energy, has manufacturing facilities based in the United States. It also has an international presence with manufacturing facilities in Canada and China and sales, design and service locations in Germany and Taiwan.

### WORLD-GEN: PLEASE DECONSTRUCT LEVELIZED COST OF ENERGY (LCOE) DRIVERS INTO CRITICAL COMPONENTS.

**Mike Dooley:** Reducing the LCOE of photovoltaics (PV) systems has been the focus of industry leaders throughout the solar ecosystem, from manufacturing equipment makers to solar integrators.

LCOE can be broken down simply as a PV system's lifetime costs compared to its lifetime energy production.

For the lifetime costs, module, balance of system (BoS), inverter, installation, financing, and operation and maintenance (O&M) are all drivers.

For energy production, the key factors are insolation (sun exposure), temperature co-efficiency, inverter load ratio, inverter efficiency, and system uptime.

Per these drivers, the solar inverter plays a huge role in both increasing production and lowering costs, to drive a lower overall LCOE for project stakeholders.

### WORLD-GEN: WHAT'S AE SOLAR ENERGY'S DIFFERENTIATING STRATEGY?

**Mike Dooley:** AE Solar Energy differentiates by aspiring to be a trusted partner to our customers. Our line of products and services allows EPCs and solar project stakeholders to offer projects with a lower LCOE and confidence that their solar energy system will deliver on long-term production goals.

We do this by consistently delivering the key products and services that EPCs and solar project stakeholders have come to expect from a solar inverter manufacturer and dedicated partner: highly-

reliable inverters, complementary BoS products, leading O&M services, and unsurpassed customer service.

A specific example in how AE Solar Energy improves LCOE is uptime, a big factor for our customers when they are evaluating solar inverters. With 6,995 units and more than 14 million available operational field hours, AE Solar Energy's uptime is at an average of 99.77 percent. That uptime means our customers get better production and a lower LCOE than with many other options on the market.

AE Solar Energy is also one of the most bankable partners on the market. With more than 30 years of leadership in delivering innovative energy solutions, combined with a legendary reputation for customer service, and a strong balance sheet, we are a trusted partner to solar project developers, financiers and beneficiaries around the globe.

### WORLD-GEN: HOW DOES AE SOLAR ENERGY REDUCE SOLAR INVERTER COSTS?

**Mike Dooley:** It's a great question. Reducing costs is one of the biggest issues in the solar inverter space, because as module prices continue to drop, other costs including the inverter make up a greater percentage of the system cost.

One strategy we've taken is modifying our manufacturing strategy and building additional manufacturing facilities within emerging solar markets. Our Ontario facility is a good example of that. Additionally, we have applied the concept of "design for manufacturability," to design our solar inverter products that can be produced more cost-effectively, without sacrificing performance.

What's also important to note for solar and inverters is that LCOE is a more important metric than upfront cost, because it incorporates upfront cost, but also lifetime costs and production output. Inverters are one of the more complex components in a solar installation, so they're directly tied to O&M and production. AE Solar Energy has a terrific track record as one of the most reliable inverter manufacturers, but it's important that we also focus on maximizing uptime, to ensure PV projects are delivering on projected energy goals. We ensure this with our O&M services, SafeGuard and SiteGuard, and a leading mean time to repair (MTTR), to mitigate any potential inverter failures.

### WORLD-GEN: CAN YOU TELL US SOME WAYS TO LOWER PVLCOE, SPECIFIC TO INVERTER DESIGN AND SERVICES?

**Mike Dooley:** There are a number of ways to lower LCOE in terms of both hard and soft costs. The list could go on, but for AE Solar Energy and inverter design and services, we feel there are eight key areas to look at:

- Shorten home-run conductor length—

Standard configurations require every conductor to be ran back to the inverter. By connecting sub-arrays, EPCs can reduce conductor length, therefore reducing material costs.

- Do not replace inverter in year 10—Many financial models call for an inverter to be replaced in 10 years. With an advanced warranty and annual maintenance, inverters can be utilized for longer, reducing costs further.
- Consolidate content—Whether at the skid or inverter level, utilizing a plug-and-play strategy with pre-engineered systems will reduce labor costs.
- Consolidate O&M providers—For national solar players with projects in various markets, picking one O&M provider can reduce soft costs through economies of scale.
- Strengthen warranty Terms and Conditions—Not all warranties are created equal, and without reviewing and strengthening the terms and conditions (T&C's), project stakeholders can incur a lot of unexpected cost. Things like shipping cost, travel cost for technicians, and additional parts and materials are often not covered in standard warranties. Reviewing T&C's thoroughly can help reduce costs and eliminate unexpected costs in the future.
- Increase inverter load ratio—As more modules are added to systems, an increased ratio allows for better power production throughout the daily production cycle of a solar energy system.
- Maximize inverter efficiency—As with load ratio, a higher inverter efficiency means the system gets more out of your PV assets.
- Maximize inverter availability—By reducing the amount of failures, and shortening MTTR, power production increases and LCOE is lowered further.

The industry is always finding new ways to squeeze out costs, but these are good features to review when evaluating inverters, as well as BoS, O&M and other products and services.

### WORLD-GEN: PLEASE UPDATE THE SOLAR ENERGY GRID INTEGRATION SYSTEMS (SEGIS) STAGE THREE CONTRACT WITH DOE AND SANDIA NATIONAL LABORATORIES.

**Mike Dooley:** AE Solar Energy has worked closely with the DOE, Sandia National Laboratories, and other partners as part of the Solar Energy Grid Integration Systems Advanced Concepts (SEGIS-AC) program. The program is designed to test and develop new technologies for challenges facing high PV penetration into today's electrical grid.

Two issues being focused on are voltage concerns given the intermittency of solar, and the challenges associated with distributed generation (versus centralized). To address this, the SEGIS-AC program investigated a variety of functionalities, including:

- Local scheduling capability,
- Voltage support functionality,
- Closed loop point-of-interconnect control, and
- Phasor Measurement Unit- (PMU-) based island detection.

The program uses a systems-based approach to mitigate the voltage concerns caused by the intermittent nature of solar. In terms of the challenge associated with distributed generation, further developments, again as part of the SEGIS-AC program, leveraging wide-area information for optimizing aggregate-geographically and electrically distributed-PV resource response are being demonstrated to highlight the values to the broader electrical system.

AE Solar Energy is continuing to collaborate with the DOE and other partners around the SEGIS-AC program.

### WORLD-GEN: HOW MANY O & M SITE LOCATIONS ARE IN THE US?

**Mike Dooley:** We're proud of our O&M track record. We provide long-term system service support solutions to make sure that PV systems are operating at peak efficiency. We support more than 180 sites in North America, which amounts to 350 MW.

### WORLD-GEN: HAS PV REACHED GRID PARITY?

**Mike Dooley:** Grid parity has been the holy-grail for the solar industry, as cost remains the number one barrier to wide-scale adoption. Grid parity is not a single point in a market but rather function of many variables. If your metric is comparing solar to building a new gas plant that is a very different point than comparing to an existing coal plant. Also many markets have tiered pricing that enables customer to install solar for less than they are paying for electricity at the higher tiered rates. In certain parts of the country, we are hitting grid parity, including Hawaii and parts of California, because there is strong sun exposure and retail electricity prices are high.

The Institute for Local Self Reliance has a handy map here, which shows a variety of charts and demonstrates that certain areas could hit grid parity on a multi-megawatt scale: <http://www.ilsr.org/projects/solarparitymap/>

According to this chart, right now, without subsidies, California, Hawaii and other states carry major potential for grid parity.

### ABOUT MIKE DOOLEY

Mike Dooley joined Advanced Energy, Solar Energy in April of 2011. He has more than 20 years of leadership and program executive experience, with a background in start-ups, solar players, and Fortune 100 companies.

Dooley has significant solar experience, having most recently led product

(continued page 20)

## TRACY ANDERSON



Director of Energy Generation  
3M Renewable Energy Division

It is a cliché to say the sun never sets on the 3M Company's renewable energy projects around the world, or on any of its operations in more than 70 countries. But it is pertinent to stress that when the sun is up, 3M's culture of innovation and technical prowess has enabled scientists and engineers to better capture the potential of solar energy.

Ongoing research at 3M has improved the technology for light concentration, reflection and redirection to provide maximum capacity and cost-savings for glass-based and solar panel generation systems. The goal of the engineering activity coming out of its labs, however, is not solely cost-cutting. "Our efforts are broad based," says Tracy Anderson, who heads up the energy generation business in 3M's Renewable Energy Division. "The primary objective of our research and development is to increase the watts produced from the panels."

For the last 30 years, 3M researchers have pioneered films, coatings and materials that have advanced the technology of solar and wind energy generation. The company's achievements have boosted these segments of the renewable energy market to new levels of efficiency and viability.

Breakthroughs in the development of materials for a wide range of industries, however, are nothing new for the century-old St. Paul-based company.

For over a hundred years, 3M has laid the groundwork for the development of thousands of innovative products – some were newly invented to meet the needs and demands of emerging new markets like renewable energy; others adapted for existing technologies and industries. One was accidentally created: when a 3M chemist looking for a super strong adhesive found an incredibly weak, pressure sensitive formulation of acrylate copolymer microspheres which had a whole new sphere of market potential. Post it Notes.

"Our tool box is pretty big," Anderson says. He is referring to 3M's overall 40 or so divisions and their numerous patented technologies and products: "The technology belongs to everyone at

3M." This interdivisional access to talent and technology is an important factor in the company's ability to mix and match seemingly unrelated technologies to continually create and roll out state of the art products, materials and techniques that can be used in emerging markets and industries.

### SPECIAL UNIT

In 2009 when it announced the formation of its 3M Renewable Energy Division, the company noted its coatings, film, tape adhesive and optical technologies had spurred breakthrough innovations to create new products and applications in renewable energy to meet ever-changing marketplace demands. At the time, Michael Roman, the vice president and general manager of the new division said, "The operation will serve the renewable energy market globally and bring the best products and technologies from a single source to customers worldwide." He went on to say 3M's leadership will spread the company's next-generation products to the global marketplace where customers will reap the benefits of having one face that can provide solutions, when the need is of the utmost importance.

Since then, 3M's Renewable Energy Division has made good on its mission to reduce costs and, more importantly, increase watts and carry current generated by wind and solar sources for power grids worldwide.

As the director of the energy generation group within the relatively new division, Anderson is one of the "faces" 3M customers are getting accustomed to – and that's one of the reasons he was selected for *World-Generation's* Class of 2013 leaders in the energy and power generation industry.

Beyond its endeavors to develop new products, Anderson's group has boosted the capabilities of existing technologies to maximize 3M's responsiveness to the ever changing and evolving renewable energy industry. It is producing special films that work better than glass to redirect light to dead spots on solar panels. His team of scientists and engineers are also perfecting films for cool mirrors that can reflect more light on silicon crystals while filtering out ultraviolet radiation. Additionally 3M has extensive experience in anti-soiling coatings to minimize and prevent dirt build up on equipment and apparatus.

### WIND SECTOR

In the wind sector of the renewable industry, 3M Company has built a reputation for having the go-to technology for protecting the leading-edge on turbine blades and streamlining their aerodynamics. No surprise there. For decades, 3M has supplied aviation and aerospace engineers with wide array of aircraft sealants, structural adhesives and surface coatings. Its polyurethane tape products and

materials top the specification lists of all blade manufacturers.

"Blade surface erosion and icing cause problems for wind turbine blade efficiency," says Anderson. "In a stiff wind, blade speed can top 200 miles per hour, and even the tiniest specs of dust can damage the leading edge and airfoil surface."

Recently, 3M introduced a high-performance bonding adhesive for wind turbine blades – specifically its 3M Wind Blade Bonding Adhesive W1101. The product offers improved mechanical properties, including increased toughness which promotes better crack resistance. Additionally W1101 exhibits 200 percent higher peel strength and 75 percent higher fracture energy compared to standard industry adhesives.

### MOVING ELECTRICITY

In the last several years, utilities and power generating companies around the world have increased demand for 3M's Aluminum Conductor Composite Reinforced (ACCR) power transmission lines. Designed to replace ACSR (aluminum conductor steel reinforced) and ACSS (aluminum conductor steel supported) transmission cables on existing structures, 3M's ACCR technology can double the capacity of conventional overhead lines.

While Anderson's energy generation group focuses its attention on products and materials for solar, wind, hydro and geothermal generating technologies, he is nevertheless excited about 3M's Company's overall role in significantly boosting the capacity of distribution and transmission systems. Before taking on his current duties with the Renewable Energy Division, Anderson was involved in the engineering and development projects resulting in 3M's ACCR expertise.

"As global power grids are being updated," Anderson says, "power companies and utilities are specifying our ACCR technology – in China, Brazil, Europe and Canada – because they can double transmission capacity, and they don't have to rebuild the towers."

For its advanced ACCR product, 3M developed a unique composite material used in the core, which comprises wire strands of high purity aluminum reinforced with aluminum fibers. The outer, current carrying wires are stranded from hardened aluminum zirconium alloy. "It has the same strength as similar size steel core conductors," Anderson points out, "but is much lighter."

Compared to same-diameter steel core conductors, 3M ACCR experiences half the thermal expansion resulting in less sag and more conductivity at high energy levels. It has a higher strength-to-weight ratio, and operates at temperatures up to 200 degrees C (continuous) and 240 degrees C (emergency) for up to 1,000 hours-cumulative. It retains a high level of performance over decades of high

temperature use, and is stable in a wide range of environmental conditions.

### EXPANDING TOOL KIT

For more than a century the key to 3M's success has been its ability to recognize and appreciate new ideas, and to capture their potential, transforming them into thousands of ingenious products. "It's amazing to look at the breadth of tools and materials we have on hand that allows us to continue to develop a never ending stream of technologies," Anderson reiterates.

When the final assembly of a wind turbine or an array of solar panels or miles of transmission line come on stream delivering renewable energy to millions of people in all corners of the earth, these systems might not display a visible 3M manufacturer's stamp or hallmark. But 3M engineers, scientists and all of its 88,000 employees worldwide know it is the sum of all the parts that really makes a product – and they know they have made quite a few of those components for the renewable energy industry.

### ABOUT TRACY ANDERSON

Tracy Anderson has served as Director for 3M's Renewable Energy Generation business since 2009. Before that, Mr. Anderson led the development and commercialization of a new class of overhead conductors that doubles the capacity of existing transmission lines. This revolutionary transmission solution is now deployed in critical applications throughout the world.

Mr. Anderson has significant experience in the area of utility power delivery and renewable energy having worked extensively with electric utilities and the renewable energy industry during his twenty five year career. He has provided congressional testimony on energy issues at both the federal and state levels and has served as a member of the National Governors Association Energy Task Force, the Minnesota Governors Advisory Panel on Energy, and as an Industrial Advisor to Institute for Renewable Energy and the Environment.

He participated as a member providing early input to the U.S. Department of Energy Sunshot initiative and has served in a number of industry advisory roles. Mr. Anderson also serves on the Board of Directors for EnerVault Corporation and the National Renewable Power Manufacturers organization.

Mr. Anderson holds BS and MS degree's from the Institute of Technology, University of Minnesota and has been awarded patents for his early work on the 3M High Capacity Conductor.

His work has been recognized through a number of awards including the IEEE Showcase of Innovation, TEKNE Innovation Award and the R&D 100 Award.

## BEN DRIVER



CEO  
REFUSOL

### WORLD-GEN: WHEN AND WHERE WAS REFUSOL FOUNDED AND ARE YOU A SUBSIDIARY OF A PARENT COMPANY?

**Ben Driver:** Refusol was founded in Germany 1965. We are part of the Prettl Group.

### WORLD-GEN: PLEASE PROFILE YOUR PARENT COMPANY.

**Ben Driver:** The Prettl Group, headquartered in Germany, is a one billion dollar plus group of companies focused on electronic and electrical manufacturing.

### WORLD-GEN: PLEASE UPDATE THE PROGRESS AT THE GREENVILLE, SC PLANT AFTER ITS FIRST YEAR OF OPERATION.

**Ben Driver:** We have upgraded our test equipment and added new quality and logistics people to support the operation. We also completed ISO audits which makes us both ISO 9001 (quality) and ISO 14001 (environmental) certified.

### WORLD-GEN: WHAT INVERTERS ARE BEING MANUFACTURED AT GREENVILLE AND ARE THEY ISO 9001-2000 CERTIFIED?

**Ben Driver:** We manufacture three-phase string inverters in Greenville and they are ISO 9001-2000 certified. There are 5 models: 10kw-208v; 12kw-480v; 16kw-480v; 20kw-480v; and 24kw-480v. In Q4 2013, we will begin manufacturing our larger central inverters, which today are manufactured in Europe.

### WORLD-GEN: HAVE THE INVERTERS MET THE GUIDELINES FOR THE "BUY AMERICAN" PROVISIONS OF THE ARRA, SECTION 1605?

**Ben Driver:** Yes. The inverters meet ARRA, section 1605.

### WORLD-GEN: PLEASE LIST YOUR REFERENCE PROJECTS IN THE US AND IN EUROPE.

**Ben Driver:** VF Corporation  
Outdoor Campus – 1MW install: 4 building rooftops and 12 carport structures utilizing 39 REFUSol inverters  
Santa Cruz City Hall & Police Station  
O2 Energy in North Carolina  
IEEE in Piscataway, NJ – 100kW install with 4 inverters  
Hawaii, Puerto Rico job, Dominican Republic.  
Very large military base coming up.

### WORLD-GEN: PLEASE DETAIL THE SOLARPARK MEURO PROJECT RECENTLY AWARDED THE 2012 SOLAR PROJECT OF THE YEAR BY PENN WELL.

**Ben Driver:** REFUSol equipped the installation with a nominal power of 70 MW of solar inverters across with 2,540 string inverters REFUSol 020K and 38 central inverters REFUSol 333K. The central inverter REFUSol 333K lowers the total system costs of solar plants and industrial rooftop installations significantly. Due to the high input voltage of the REFUSol 333K longer strings can be realized, which leads to lower losses within the string but at the same power and performance level. The higher output voltage of 690 V allows the simultaneous operation of several devices on one transformer. The REFUSol 020K string inverter can be integrated within solar installations in various ways to achieve maximum yields.

### WORLD-GEN: REFUSOL PARTNERED WITH AMPT AND PLEASE LET US KNOW THE RESULTS IN LOWERING PV SYSTEM COSTS.

**Ben Driver:** Results are preliminary as new systems are yet to be deployed but by operating in AMPT mode, which optimizes DC, we are able to increase power output by 25% with only modest additional cost thereby reducing dollar per watt by 15%.

### WORLD-GEN: WHAT ARE YOUR WARRANTY OPTIONS?

**Ben Driver:** Our standard warranty is 5 years extendable to 20 years total. Most of our customers opt for the 10 year warranty.

### WORLD-GEN: CAN YOU SHARE THE LESSONS LEARNED FROM REFUSOL DISTRIBUTED VS. CENTRALIZED POWER GENERATION IN MIXED ROOFTOP AND CARPORT PV SYSTEMS RECENTLY REPORTED?

**Ben Driver:** There are many lessons learned but most salient are cost savings, energy savings, and reliability & uptime: 1) Total cost of system with string inverter is significantly less than with central inverters, primarily driven by a lower BoS (Balance of System) Cost; 2) On average, the distributed system produced 2 – 3 % more energy per year than the decentralized system and ; 3) when a unit fails, replacement is rapid and less critical ( 24kw vs. 500kw downtime). Further, we discovered by putting units up on roofs or under carports, developer saves space, avoids costly pads with security fencing, mandatory signage, and additional insurance cost. This is especially true in public buildings and schools.

### WORLD-GEN: PLEASE TELL US ABOUT THE MONITORING OPTIONS WITH REFULOG AND MODBUS?

**Ben Driver:** Our customers have two options for their monitoring needs. The first one is our proprietary web application called REFUlog. It is a very inexpensive yet fully operational and reliable way of monitoring their plant. For customers who prefer to work with a 3rd party monitoring provider we have the REFUSol

Modbus Solution, as long as the protocol used is Modbus.

### WORLD-GEN: HAS PV REACHED GRID PARITY?

**Ben Driver:** PV has reached grid parity in specific markets with high energy costs and/or solar friendly programs, such as no or low cost permitting, innovative financing, and electricity pricing structures (i.e. FIT's). Some places where we have reached grid parity are Hawaii and Puerto Rico.

### ABOUT BEN DRIVER

Refusol Inc., named Ben Driver Chief Executive Officer (CEO) of North America. Refusol, based in San Jose, CA, is a division of Prettl Corporation of Metz, Germany. Refusol produces sophisticated solar inverters and grid management systems for the commercial and utility sectors. Prior to joining Refusol, Mr. Driver was General Manager of Wind To Power Systems Inc., a Hudson Clean Energy Fund Company. W2PS is a power electronics company, which provides solutions to renewable energy integration. Prior to W2PS, he was Senior Director of Worldwide Sales at Xantrex Technology. Xantrex, now Schneider Renewable, is a leader in the renewable energy business. Previous to Xantrex, Mr. Driver was Vice President and General Manager of the Calibration Instrument Business of the Ametek Corporation. The division produces high-end electronic calibration equipment for national standards labs, military, utilities, and process industries. Mr. Driver has over 25 years of sales and marketing and general management experience in the renewable, electrical, and instrument industries with St. Gobain, the Okonite Company, and Eaton. Mr. Driver holds Management and Liberal Arts degree from California State University.

## REFUSOL INSTALLATIONS

Customer	Site	Status of Install	Installation
Solus Energy	IEEE, Piscataway, NJ	Complete	117kW rooftop, 4 REFUSol inverters
Positive Energy	Santa Fe Community Conv Ctr	Complete	90kW Rooftop with REFUSol 20K inverters (5)
Charlottesville High School	Charlottesville High School	Complete	100kW 20K (5) on rooftop producing 5,000 – 6,000W
Rosendin	Multiple schools in Southern California	Complete	Multiple schools, multi MW
Sunlight Electric	VF Corp./The North Face	Complete	1MW, 4 rooftops, 12 carports, 39 inverters
Swenson Solar	Santa Cruz City Hall & Police annex	Complete	Carport installs at both locations, 21 inverters total
J+E Figueroa	Puerto Rico	Complete	80kW project
Vista Solar	Uesugi Farms, Gilroy, CA	Complete	644kW Ground mount, 28 inverters
Chevron	Santa Cruz Project	Complete	Rooftop & Ground mount install, 8 inverters
Vista Solar	Fremont, CA	Under construction	1MW, 35 inverters
Desert Solar	Apple Valley	Under construction	Multi school project
Green Seal	Puerto Rico	Under construction	500 kW rooftop, 22 inverters
Dynamic Solar	Estes Express Lines, Elkton, MD	Complete	308kW rooftop install, 12 inverters
IEC	Visalia, CA	Under construction	Multiple schools, multi MW
Nameste Solar	RTD Denver Commercial, Denver, CA	Under construction	600kW, 22 inverters

## JOHN LARUE



Executive Director  
Port of Corpus Christi

The nomination of John LaRue, Executive Director of the Port of Corpus Christi Authority, Corpus Christi, Texas as a member of World Gen's Class of 2013 may seem a bit strange to our readers. What involvement in power generation would justify the selection of a member of the seaport industry?

Transportation related entities are generally the users of energy; bunker fuel for vessel power, diesel fuel for trucks, electricity for trains and a variety of power sources for port operations. Seaports are the conduits for energy sources, the transfer stations for energy resources such as liquefied gases, fuels and coal and the handling of commodities for the construction of pipelines. All of this fits into the business plan of the Port of Corpus Christi and the architect of the plan, John LaRue. However, there is much more.

The Port of Corpus Christi, is located in Nueces and San Patricio Counties along the Gulf of Mexico, East of Houston and 143 miles South of San Antonio, Texas. In 1920, the County petitioned the US Congress to authorize the Corps of Engineers to create a deep water port in the general area and after some study, they chose to locate the port in Corpus Christi. The Port of Corpus Christi Authority was created in the early 1920's to take advantage of this opportunity. Their mission; to construct and oversee port infrastructure along the City's waterfront and manage the overall development of facilities and cargo opportunities. At that time, the Port was primarily an outlet for the areas' cotton shipments and Lead from Mexican smelters in Monterrey. Shortly after, oil companies and dry bulk shippers such as Southern Alkali Corporation, a subsidiary of Pittsburgh Plate Glass Company located in Corpus Christi to take advantage of the deep water berths. The Port grew steadily through the next sixty years.

In April of 1994, the Port of Corpus Christi Authority selected John LaRue as its new Executive Director. John grew up in Reading, PA in an area recognized for its coal mining and rail activity. He graduated from Villanova with both BA and MA degrees in Political Science. Most of his time since then has been in the Port industry. In 1986, John was appointed Executive

Director of the Philadelphia Port Corporation and in 1990, he was appointed as the Executive Director of the newly formed Philadelphia Regional Port Authority.

The move to Corpus Christi was significant in that he was the Executive Director of a Port which at that time was in reasonable contention for status as a major east coast container port. As history will demonstrate, John's decision was significant as the fortunes of Corpus Christi have had a positive trend while the fate of Philadelphia has not. The Port of

Philadelphia has not been fortunate enough to be connected with any of the elements that are driving the Port of Corpus Christi of late.

Since moving to Corpus Christi 18 years ago, John has developed his ability to manage a port during trying times and now the Port is thriving. He may enjoy the record for the longest tenure as an Executive Director of a port in this modern era. John is active in his industry both locally, state wide and nationally. He is a member of the Port Industries of Corpus

Christi group and presently serves as the treasurer of this organization. He is on the Board of the San Antonio Free Trade Alliance and he is the Chairman of the State of Texas Department of Transportation Port Advisory Committee and is a member of their working group on the Panama Canal. He also serves on the Board of the International Refrigerated Transport Association and the Board of Directors of the American Association of Ports Authorities.

*(continued on page 16)*



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## KARL FESSENDEN



President & CEO, Power Generation Services  
GE Power & Water

The old adage about “knowledge is power” never has been more relevant than it is for today’s energy industry. In the power industry, the advent of the Industrial Internet is bringing into sharper focus the concept of using massive amounts of data to enable power producers to squeeze more productivity, value and flexibility out of their existing equipment.

More than ever, there is a need today for data to enable power producers to make faster, smarter decisions about the way they operate their power plants. This need is well served by the development of the Industrial Internet, which integrates minds and machines to make installed assets smarter.

### A NEW ERA OF INNOVATION

“The world is on the threshold of a new era of innovation and change with the rise of the Industrial Internet. It is taking place by the convergence of the global industrial system with the power of advanced computing, analytics, low-cost sensing and new levels of connectivity permitted by the Internet. The deeper meshing of the digital world with the world of machines holds the potential to profoundly transform the global industry, and in turn many aspects of our daily lives, including the way many of us do our jobs,” said Karl Fessenden, vice president – Power Generation Services for GE Power & Water.

“These innovations promise to bring greater speed and efficiency to our power generation industry, as well as aviation, rail transportation, oil and gas development and health care delivery. It holds the promise of stronger economic growth, better and more jobs and rising living standards, whether in the U.S. or China, in a megacity in Africa or in a rural area in Kazakhstan,” Fessenden added.

Three key elements embody the essence of the Industrial Internet:

**Intelligent machines** – New ways of connecting the world’s myriad machines, facilities, fleets and networks with advanced sensors, controls and software applications

**Advanced analytics** – Harnessing the combined power of physics-based analyt-

ics, predictive algorithms, automation and deep domain expertise in material science, electrical engineering and other key disciplines required to understand how machines and larger systems operate

**People at work** – Connecting people, whether they are at work in industrial facilities or elsewhere, at any time to support more intelligent design, operations and maintenance, as well as higher quality service and safety

The Industrial Internet starts with embedding sensors and other advanced instrumentation in an array of machines from the simple to the highly complex. This enables the collection and analysis of an enormous amount of data, which can be used to improve machine performance and inevitably the efficiency of the systems and networks that link them. Even the data itself can become “intelligent,” instantly knowing which users it needs to reach.

This marriage of machines and analytics offers the potential for widespread benefits. GE estimates the technical innovations of the Industrial Internet could be directly applied in industrial sectors accounting for more than \$32 trillion in economic activity.

One area where the power of the Industrial Internet is certain to have a significant impact is in the power plant services sector. GE believes there is approximately \$150 billion of waste in the industries it serves that can be addressed through new service offerings, from fuel efficiency to asset utilization. For example, a one percent increase in fuel efficiency across the world’s combined-cycle gas turbine fleet would generate an annual savings of \$4.4 billion for its customers. Extending maintenance intervals 10 percent across this global fleet of turbines can deliver another \$1 billion in annual savings.

### HARNESSING THE INDUSTRIAL INTERNET WITH POWER GENERATION

“Today, our services business supports customers who are operating their power plants much differently from the way they expected to when they first purchased their assets,” Fessenden said. “During the last gas turbine bubble, from 1998 to about 2003, there was significant growth in natural gas-fired turbines. These assets now are more than 10 years old and factors including deregulation and integrating renewable power to the grid have placed a new demand on machines for more flexible operation, along with high efficiency and reliability.”

This environment demands enhancements and upgrades to these gas turbines, as power producers seek to extract more value and performance from their existing assets. For years, GE has been collecting data from the world’s largest installed fleet of gas turbines. “By interpreting the vast repository of ‘intelligence’ at our disposal, we now have a deeper and more comprehensive understanding of how our customers need to operate their machines. This data is the foundation for many of the new

service solutions and products we are developing to satisfy our customers’ most urgent requirements and to create more value for them,” Fessenden noted.

GE’s FlexEfficiency\* Advantage Advanced Gas Path (AGP) solution, which improves gas turbine performance and operational flexibility, is an example of how data can be used to design new products or enhance existing technology to meet changing customer needs. GE engineers, armed with millions of hours of turbine operating data, developed the AGP solution to deliver more output, operational efficiency and availability to the grid for its gas turbine customers.

AGP upgrade technology lies at the heart of GE’s FlexEfficiency Advantage. This advanced hardware is complemented by a platform of software technology called OpFlex\* solutions to broaden the operating range of installed gas turbines with performance improvements in output and fuel efficiency. This solution also enables customers to benefit from longer maintenance intervals and lower lifecycle maintenance costs by extending gas turbine asset and part life.

“By marrying advanced hardware and software, GE’s FlexEfficiency Advantage is our platform for applying the power of the Industrial Internet to develop and deliver robust power generation solutions. It enables customers to deploy 21st century technology to their installed power generation assets and current operational demands. This combination, along with systems-level understanding of our customers’ assets, allows us to deliver modern-day efficiency and output while maintaining low emissions,” Fessenden said.

### PUTTING “BIG DATA” TO WORK

Since installing its first heavy duty gas turbine in 1949, GE has amassed more than 25 terabytes of OEM engineering data, plus more than 93 million hours of real-world operating data. Access to huge amounts of data, complemented by the expertise to interpret this information, plays a pivotal role in GE’s services business delivering customized solutions to customers that have disparate operational needs.

Data analysis helps lay the foundation for designing not only integrated product and service solutions, but also individual components of those solutions such as next-generation gas turbine parts. The amount of experience and knowledge available today can translate into parts that often are able to perform longer and more effectively than the original gas turbine components they are replacing.

For example, GE’s new AGP stage one turbine buckets, nozzles and shrouds are designed for reliability and better performance, while achieving longer maintenance intervals (32,000 hours vs. 24,000 hours) compared to the previous generation 7F 3-series hardware. These upgrades, combined with further improvements to the rest of the system, help to reduce overall life cycle costs of ownership by enabling

the plant operator to skip an entire hot gas path inspection.

As the power of fleet-wide operational data analysis becomes increasingly apparent, customers are beginning to realize more fully how data gathered by GE can benefit them. Performance information collected via remote monitoring and diagnostics is quickly analyzed and converted into useful reports, including recommendations on operating parameters. In addition, GE’s MyFleet\* plant performance monitor provides customers with access to key plant performance data, and shows them how their equipment is performing against their peers in the industry.

“By studying vast amounts of real-time performance data, we are able to understand how customers are running their machines and use that knowledge to look into the future,” according to Fessenden. “For example, there are instances when we can give our customers advance alerts when operating trends indicate the need for maintenance may be approaching, rather than simply relying on traditional maintenance cycles, thus heading off potential problems. Often, serious problems that might result in outages and lost operational time can be addressed and resolved before they impact plant performance.”

### SUCCESS STORIES

A real-world example of how GE is tapping into Industrial Internet capabilities to help customers’ power plants perform with more efficiency and predictability is Korea Southern Power Company (KOSPO), South Korea’s largest electric utility. KOSPO installed AGP technology on six 7F 3-series gas turbines at its Shinincheon plant to support the region’s population growth and economic expansion.

The upgrade has increased total incremental output by 130 megawatts (MW) and has reduced NOx from 20 ppm to 9 ppm. The additional capacity also is playing an integral role in ensuring the region’s grid stability by elevating its reserve power margin, which had dipped as low as 4 percent during peak demand periods. By applying data analytics to millions of hours of 7F gas turbine fleet operating data, GE developed the AGP solution which makes customer assets like KOSPO’s smarter and more adaptable to their operating environment.

Another example of how GE is applying its data intelligence to customize a customer solution is the Emirates Aluminium (EMAL) smelter complex in Abu Dhabi. An expansion project of EMAL’s facility will include upgrades to existing gas turbine assets that is expected to result in lower emissions through installation of GE’s Dry Low NOx 2.6+ (DLN) combustion technology. This technology will help position EMAL to support the UAE’s goal to achieve cleaner and more efficient industrial growth.

DLN 2.6+ upgrade technology was developed by analyzing millions of hours

(continued on page 14)

## JASON YOU



Director of U.S. Solar Business  
LG Electronics USA

The solar industry continued its impressive growth in 2012 but there are still challenges and obstacles that we as an industry must overcome to ensure a more sustainable future. Manufacturers continue to wrestle with innovation while still offering a flexible design for contractors. As a collaborative industry, new products have been created that enhance our ability to increase installations, create better products, and educate the larger market on the potential for solar energy. At LG Electronics, we continue to think about the end-user but also about the contractors we work with directly to make their shared goals a reality. The engineers continue to innovate and collaborate and the outlook has never been brighter.

According to the Energy Information Administration, the amount of solar energy produced in the United States has risen 500 percent in 2012 alone. This is a massive boost in renewable energy that is being produced. Of course this shows the growing interest but also that more contractors are pushing for solar in their projects. The Solar Energy Industry Association expects solar panel installation to rise nearly 70 percent this year and, if the trend continues, expect the dependency on other forms of energy to decrease, leading to a much brighter future.

"Witnessing this growth has been extremely motivating for my team because we can see what we're doing is making an impact," Jason You, Director of U.S. Solar Business, LG Electronics USA, said. "However, we realize there are still some challenges we need to overcome if we're going to continue this impressive growth."

One of the issues is the ongoing challenge of space limitations for both residential and commercial applications. While the growth of the solar industry continues to be exponential, businesses and consumers struggle to find the space to expand their solar usage. LG Electronics is working to solve this problem by creating high-efficiency solar modules that have the same durability and size as existing modules, but yield a higher wattage than any other module available on the market.

LG went to work to create a module that would be easier for contractors to work with but also provide best-in-class

efficiency. LG Electronics' new MonoX™ NeoN premium series solar module is the third-generation of its high-performance, high-efficiency solar energy solutions lineup. Released in 2012, the MonoX™ NeoN demonstrates LG's innovation and commitment to the future of sustainable building. Boasting a 60-cell panel design, the module has a higher maximum high-efficiency output of 300W with 18.3 percent module efficiency and uniquely combines LG's N-Type cell manufacturing technology into one cutting edge unit. LG believes this will aid contractors in installing solar units in a variety of situations in which space is a major obstacle.

The energy increase from previous models is based on three innovative LG technologies. First, LG's selective emitter technology improves the solar cell efficiency and simplifies the manufacturing process. Second, fine line electrodes have been created via significant improvements in the screen-printing process. The resulting broader light absorption area generates a greater amount of power. Finally, LG's own "surface passivation" technology reduces the electrical loss at the solar cell surface. With LG's advanced surface treatment technology absorbing more sunlight, the power output of the photo-conversion function is much greater than conventional multicrystalline solar cells.

"We listened to our customers and our partners and the result is the new module," You said. "We believe this is a big step for us in creating modules that meet the power needs of our customers but are also flexible enough for designers to make them work in a variety of buildings and setups."

Another significant issue is that solar panels continue to be challenging and, sometimes, tedious for contractors. In the United States, there are numerous racking systems that all require different training and education. This makes solar panels a more difficult installation than other systems. To combat this, LG has developed a lighter panel that can be carried by one individual instead of two. Further, our panels fit into any conventional racking system, eliminating the education installers would need on various systems.

That "ease of install" concept has continued with the new LG line. The MonoX NeoN is easier to install and meets regulatory requirements for installation by one person opposed to two, which will have a direct impact on installation costs. With a weight of just 16.8kg, the new modules are proven to demonstrate outstanding durability against external pressure up to 5400 Pa. The product features clamp guideline marks on the frame indicating where the mechanical load can be maximized, fixed cable hooks attached on either side of the frame for stability, and 2-way grounding holes on either the rear or the side depending on installation settings. The corner of the module has been re-designed to provide better grips and safety for handling.

These advancements in solar technology were developed through LG's

solar module test lab, which received full certification from both Underwriters Laboratory and the TÜV, a first in the solar industry. The lab continues to speak with contractors and designers to determine how to best build future technologies. It is the ongoing collaboration that has led to advancements in the space and in order to continue this forward momentum, influencers need to continue to work together to find the best solutions. LG Electronics maintains an attitude that the best ideas come from close collaboration and take customers feedback into account when developing solar technology.

As the economy begins to pull out of the recession, expect to see home building rise and a need for more sustainable energy to offset costs. This is an excellent time for investment in solar energy so that homes are built with these technologies in mind. Most states have their own regulations concerning solar installations so rather than dealing with retrofits later, educating contractors as well as consumers on the options and cost benefits of solar investment is key in building a more sustainable future. Also, there are even more options for consumers today with the advent of leasing programs for solar installations that allow homeowners to enjoy the benefits of solar energy without the dramatic upfront costs associated with their installation. It's a matter of educating consumers on their options and the benefits they can expect with their investment. Every time the industry innovates, whether technically or financially, is a leap forward for sustainable technology.

"Moving forward, we believe it is important to remember that everyone in the industry is working toward the same goal. Share knowledge, discuss innovation, be passionate about the work you do and help each other derive solutions from the problems that solar technology faces," You said. "This is an industry ripe for continued innovation and every step forward is another step in the right direction for a sustainable future."

## ABOUT JASON YOU

JaeSung "Jason" You has more than 13 years in the solar industry with over 10 of those years spent with LG Electronics. Jason has experience not only within sales and marketing, but also with the actual R&D and management of solar systems. Jason at one point was the Project Manager for the construction of a 14MW solar plant where he learned the detailed process of making solar energy production more efficient. Since then, Jason has led groups in North America, Europe and Korea in developing their own solar marketing strategies including setup and sales force training. Jason has spent the last three years in charge of the North American Solar business where he setup the division from scratch and established the entry strategy for the North American solar market for LG Electronics.

## KARL FESSENDEN

CONTINUED FROM PAGE 13

of operating data from various GE sources including its Monitoring & Diagnostics Center in Atlanta, GA, and Combustion Testing Lab in Greenville, S.C. The DLN 2.6+ combustion system also incorporates advanced controls technology that helps enable customers like EMAL to lower emissions and operate more flexibly.

## PUSHING BOUNDARIES

The potential impact of Industrial Internet technologies spans almost half of the global economy and more than half of the world's energy. In a host of industries including power generation, linking intelligent devices facilities, fleets and networks with people at work or on the move will offer new possibilities in process optimization, increased productivity and efficiency.

"Innovation has always been the single most powerful ingredient to help us create more with less, to ease constraints, to help improve living standards for larger and larger numbers of people. The Industrial Internet holds the potential to drive the next wave of innovation for the world by pushing even further the boundaries of minds and machines," Fessenden concluded.

Karl is President & CEO of GE's Power Generation Services business. He is responsible for developing and delivering a global services strategy that offers electric utility customers the technology, knowledge and insight they need to manage the entire lifecycle of their power plants, ultimately providing reliable power to people around the world.

He joined GE Energy in 2005 as General Manager of Parts & Repair Services for gas and steam turbines, as well as generators. In 2010, he was promoted to General Manager of GE's Contractual Services business, leading a team of 1600+ employees in over 100 locations globally and overseeing a portfolio of \$35B in long-term services agreements. In 2011, he was promoted to his current role and also named an Officer of the General Electric Company.

Prior to joining GE, Karl held engineering roles with Pratt & Whitney in Hartford, Connecticut, as well as sales & marketing roles with Air Products in Allentown, Pennsylvania.

He holds a Bachelor of Science degree in mechanical engineering from the University of Vermont, as well as a Master's degree in management from the Hartford Graduate Center of Rensselaer Polytechnic Institute in Connecticut.

Karl is the executive sponsor of GE's Corporate Leadership Staff and actively involved in several of GE's affinity network groups. He is also actively involved with the March of Dimes as an Executive on the Atlanta Leadership Committee. Karl, his wife Mary and son Stephen Sang live in Atlanta, Georgia.

## UWE SCHMIEMANN



*Marketing Manager  
Solar Turbines Incorporated*

Hurricane Sandy was the largest hurricane on record in the Atlantic with a diameter of 1,100 miles. It is also estimated to be the costliest Atlantic Hurricane ever. When Sandy hit landfall on the 29th of October, it caused major damage in the Mid-Atlantic and Northeastern United States. Despite early warnings and preparation for the hurricane, 24 states were in some way affected by Sandy. Damages are estimated to be nearly \$66 billion. Calculating the losses due to business interruption will likely cause the estimate to grow far higher.

The damage caused by the hurricane to the affected areas led to the collapse of the public transportation system, including roads, tunnels, bridges, trains, subways, parking lots, and even air travel. The failure of the electricity infrastructure caused major interruptions to the power supply, causing problems with the water supply, sewers, electrical grids, and telecommunications.

At the peak of the storm, over eight million electrical utility customers lived in darkness and had no heat or hot water. The power outage continued, not only for several hours, but for days and weeks.

“One way to ensure a reliable power and heat supply for your business is to operate your own power plant to generate the electricity and heat you need,” said Uwe Schmiemann. These types of plants are referred to as combined heat and power plants sometimes referred to as cogeneration plants.

Besides providing reliable and cost effective power, CHP plants are also considered to be friendly to the environment due to their high efficiency, which reduces the production of greenhouse gases. Additionally, the major fuel source of a CHP plant is natural gas, the cleanest of all fossil fuels.

CHP plants are highly efficient. The typical efficiency of a CHP plant is at least 70 percent and can be as high as 80 percent. In comparison, a coal-fired power plant operates at a mere efficiency in the mid 30 percent range.

Larger combined cycle turbine plants are typically below 50 percent efficient. The conventional driver for a CHP plant is gas-fired turbines. Due to a high exhaust

temperature and flow, gas turbines are able to generate a huge amount of heat, which can then be converted to steam, hot water, chilled water, and/or electricity.

During Hurricane Sandy, industrial and commercial businesses and universities and hospitals that had installed a gas turbine driven combined heat and power plant were in a much better position than those who relied on the utility grid.

While the grid was incapacitated, the entities with their own power supply were able to operate in island mode, meaning they could operate independent of the grid. There are many examples of businesses that have highly efficient, gas turbine driven generator sets that continued to provide services to their customers with electric power, as well as steam and hot water, during the hurricane.

“Solar Turbines has installed several gas fired turbine generators sets in the hurricane affected area. These gas turbine generator sets provided critical power and heat to facilities such as hospitals, universities, and factories, keeping them up and running and their power and heat source secure,” explained Schmiemann.

The response to the performance of the equipment from customers with a gas turbine system from Solar Turbines was extremely positive. A few examples of those customer’s experiences with a Solar® gas turbine combined heat and power system during Hurricane Sandy are shared with you in this article.

### NEW YORK UNIVERSITY (NYU)

NYU operates a 10 MW combined heat and power plant in New York City. The plant utilizes two 5MW Taurus™ 60 gas turbine generator sets that not only provide electricity but deliver heat that would otherwise go to waste. The power plant system serves power and steam to a major portion of the campus, including the larger buildings, as well as most of the Washington Square campus in Manhattan. The units operated well during the storm. “Our cogen is up and running,” said John J. Bradley, the university’s assistant vice president for sustainability, energy and technical services.”

### DANBURY HOSPITAL

Danbury Hospital in southwestern Connecticut is a 371 bed comprehensive regional medical center. The hospital utilizes a Solar Turbines 4.5 MW Mercury™ 50 gas turbine and three MW’s of standby generators. During the storm, the facility operated without any loss of power and despite most of the businesses in the surrounding area being without power for several days, Danbury Hospital still had lights and heat, according to Plant Manager, Kevin Naurus. The CHP facility enabled the hospital to be fully functional during the storm and continued conducting business and providing the critical and necessary health care necessary for patients.

### HUNTERDON DEVELOPMENTAL CENTER

The Hunterdon Cogeneration facility, located in Clinton, NJ, is powered by a 4.5 MW Centaur® 50 gas turbine generator set from Solar Turbines. The turbines are operated by Noresco and are utilized to provide power and heat to both a health services complex with living facilities and a correctional facility. During the storm, power was out in the area for several days, but the Solar gas turbine generator driven CHP plant was able to operate in island mode, continuing to power the complex.

### PEPCO MIDTOWN THERMAL ENERGY PLANT

Pepco’s Atlantic City, New Jersey’s 5.7 MW CHP plant is powered by a Taurus™ 60 gas turbine generator set and is located only a few blocks from the Atlantic Ocean - directly in the center of Hurricane Sandy. According to John Howell, Pepco’s Maintenance Manager who was at the facility during the storm, the plant operated extremely well and was able to continue providing needed power to the local area, including chilling and heating.

The Pepco plant provides power to high profile, mission critical facilities, such as Ceasers, Bally’s Park Place, Bally’s Wild West, Claridges, Trump Plaza, Trump Taj Mahal, and the Atlantic City Convention Center. Many of these hotels helped house their own employees, local residents, and travelers during and after the storm.

These examples underline the importance and need of decentralized power plants that can continue to provide power and heat to people and keep businesses running, even during catastrophic conditions. And gas turbines provide this power with the lowest green house gas emissions, making them an environmentally friendly solution to the security of the businesses, infrastructure, and people of the country.

Even though the electric grid was down, the gas supply for these generators was never in jeopardy. Reported gas leakages were related to the low pressure gas distribution system, which could easily be isolated. The main gas supply system, which typically supplies gas to the gas turbine generator sets, was never in danger. “These stories illustrate that the combination of gas and highly efficient self generation is a winning solution to ensure that the lights stay on, even during the worst of times,” Schmiemann shared. Solar gas turbines run in the dark and help secure an efficient and stable energy supply even during catastrophes and security threats to the world.

Another advantage of decentralized CHP plants is that they avoid the need for high-voltage transmission lines. Excess capacity can be supplied to the utility grid and can support the local utilities. Furthermore, a decentralized

distribution system also minimizes the black-out risk in bigger areas.

During events, such as unscheduled maintenance or natural disasters like Hurricane Sandy, the decentralized network can be asked to operate in island mode prior to the event. Because the network is isolated, only a smaller area would be affected if damage occurred to the distribution system within the network.

Overall, these examples show that the businesses who invested in decentralized CHP plants were much better off than those businesses relying on the traditional power supply from a centralized power plant.

Beyond the economical advantage of CHP systems, gas turbine CHP systems also supply reliable power and heat when the grid is down. Other benefits include economic dispatch, flexibility to complement renewable energy, heating and cooling solutions, security, and the opportunity to control your power costs.

There are many unavoidable personal and infrastructure challenges when a disaster like Hurricane Sandy strikes. Businesses close, people face relocation, injuries and personal loss occurs, and communication becomes difficult. These challenges are hard on people and businesses.

There are solutions now. All of the cases cited, and many more, have a robust and secure energy supply. Those businesses kept their lights on and the people inside were warm and secure. What happened during Hurricane Sandy is a reminder to companies that they need to take into account the potential consequences of not having a secure energy supply.

This tragedy will enter the history books and become a distant memory – until the next one. Don’t let your business or your clientele be left standing in the dark.

### ABOUT UWE SCHMIEMANN

Uwe Schmiemann is the Marketing Manager for the Power Generation Marketing business at Solar Turbines Incorporated. Prior to Uwe’s marketing manager position, he worked as a sales engineer for Solar’s oil and gas business in central Europe. Before coming to Solar Turbines, Uwe held positions with Solar’s parent company, Caterpillar, including Regional Sales Manager for Asia and Australia, where he was responsible for the Caterpillar Motoren (formerly MaK) large reciprocating engine power plants. Prior to his employment with Caterpillar, Uwe was with the Krupp-Hoesch-Krupp Group in Kiel, Germany. Uwe earned his Diploma in Engineering from the University of Wuppertal in Manufacturing Technology and a Masters Degree in Engineering Economics from the University of Applied Sciences in Bochum, Germany.

## ZHE JIANG



Chief Executive Officer  
Upsolar

Zhe Jiang has more than a decade of experience in the renewable energy industry. Prior to founding Upsolar in 2006, Jiang served as Group Controller at EDF (Électricité de France) Energies Nouvelles, Europe's largest developer of renewable energy facilities, where he oversaw EDF-EN's acquisition of enXco, Inc. Under Jiang's leadership, Upsolar has grown from a VC-backed startup to a multinational corporation with a presence in more than 20 countries. He received a Bachelor of Arts in Business Administration from Tongji University of China and a Master of Economics from Reims Management School of France.

### WORLD-GEN: WHEN AND WHERE WAS UPSOLAR LAUNCHED AND HOW WAS IT FUNDED?

**Zhe Jiang:** Upsolar was founded in Hong Kong in 2006 and launched in 2007. The company was created with the goal of offering a high quality PV product with an affordable cost structure and an asset-light flexible operation model in technology and location of production. Today, under this operation model, Upsolar offers PV modules, systems and power plants in more than 20 countries around the world.

### WORLD-GEN: WHAT'S YOUR MISSION STATEMENT?

**Zhe Jiang:** Upsolar's mission is to provide high-quality solar modules at competitive prices for customers around the world. By controlling each stage of the production flow, identifying the most efficient and innovative technology, and deploying on-the-ground teams dedicated to serving customers, Upsolar demonstrates its commitment to delivering modules with the best quality-to-cost ratio on the market.

### WORLD-GEN: PLEASE EXPLAIN UPSOLAR'S "EXCELLENCE AT EACH STEP" QUALITY ASSURANCE PROCESS AND THE COMPREHENSIVE LIFE CYCLE

### ASSESSMENT OF YOUR PRODUCTION PROCESSES.

**Zhe Jiang:** Our "Excellence at Each Step" process begins at Upsolar's Test and Development Center in Shanghai, where a team of PV experts performs meticulous testing on all module components before selecting the top-tier performers as its suppliers. The next level of testing evaluates modules' ability to withstand extreme environments to optimize both performance and durability.

When the modules are confirmed to operate at Upsolar's high standards, the company proceeds with commercial-scale production. To keep manufacturing lean and efficient, Upsolar works closely with trusted partners around the world. We also station quality control experts at our satellite manufacturing facilities to provide assistance and oversee each step of production. After one final round of sample testing, Upsolar's modules are dispatched to our customers worldwide.

Our Life Cycle Assessment is a fundamental step in assessing the sustainability of our operations. In early 2011, we enlisted a third-party agency to complete a comprehensive lifecycle assessment (LCA) to determine environmental impact of our modules and develop strategies for improvement. Results from our LCA showed that each of our polycrystalline silicon modules contributes 1.101 kg/kWc of carbon emissions over its lifetime.

By quantifying the environmental impact of our operations, we can ensure we are keeping in line with industry standards. As one of the first Chinese module manufacturers to embark on such an endeavor, we are especially proud of preliminary results that are comparable with international competitors in the space.

### WORLD-GEN: DID YOU MEET AND EXCEED YOUR GOAL OF SHIPPING 500 MWS IN 2012? WHAT IS YOUR GOAL FOR 2013 AND BEYOND?

**Zhe Jiang:** We shipped cumulatively more than 500MW of high quality PV products by the end of 2012. Our target is to sustain a healthy growth rate of about 20-30% every year.

### WORLD-GEN: HAS UPSOLAR EXPANDED TO USE LOCALLY SOURCED COMPONENTS AND PLEASE NAME THE COUNTRIES REPRESENTED AND HAS UPSOLAR ACHIEVED CERTIFICATION IN THOSE COUNTRIES?

**Zhe Jiang:** Upsolar's local production platforms include:

Portugal – Upsolar established a manufacturing platform in Portugal with annual capacity of up to 30 MW

Upsolar is currently exploring new manufacturing partnerships in Germany, Italy and Greece to produce up to 10 MW capacity each month

Certifications include:  
Upsolar has received "Made in EU" Certification from ICIM which qualifies Upsolar's modules for feed-in-tariffs in Italy and France

In Japan, Upsolar has received J-PEC Certification, which assures that Upsolar products can be installed on residences and commercial facilities in Japan and qualify for government solar subsidies.

### WORLD-GEN: WHAT DIFFERENTIATES UPSOLAR'S BUSINESS MODEL FROM OTHERS?

**Zhe Jiang:** Two main categories of module suppliers dominate the PV landscape today: the traditional manufacturer model and the Original Equipment Manufacturer (OEM) model, each with their own distinct and well-known advantages as well as disadvantages. Upsolar's business model is essentially a hybrid of the two, taking the best that each model has to offer and fusing them together to create an 'asset light' manufacturing model. We outsource our production while maintaining tight control over our cost and quality, and the result is — at any given time — the best solar solution on the market today.

### WORLD-GEN: WHAT FLEXIBILITY HAS BEEN BUILT IN?

**Zhe Jiang:** Staying competitive in the PV industry requires us to carefully follow technology developments and monitor global demand for renewable energy. By leasing our manufacturing tools, we are able to respond rapidly to customer needs and changing market conditions. Furthermore, we specialize in offering a full range of products that can be customized to meet varying performance needs and aesthetic preferences.

### WORLD-GEN: HOW DO YOU SEE THE PV MARKET IN THE NEXT 3 TO 5 YEARS?

**Zhe Jiang:** Despite a current climate of relative uncertainty, the long-term outlook for solar is strong. In fact, the annual growth of the PV market will likely continue to be much higher than traditional industries. Every year, more and more countries throw their support behind PV energy generation. Emerging economies such as South America, China and India are especially promising markets.

### WORLD-GEN: HAS PV REACHED GRID PARITY?

**Zhe Jiang:** The cost of grid parity is different depending on a region's sun irradiation level and traditional energy resources. In some countries/regions of high sun irradiation and expensive energy prices – Australia, California, Southern Italy, Brazil, Mexico – PV is close to or has reached grid parity.

## JOHN LARUE CONTINUED FROM PAGE 12

Corpus Christi is blessed with a number of critical elements that contribute to the success of a port. The obvious elements, supportive Board of Commissioners and community; experienced staff, deep water channel and berths with plans for additional depths and available property for expansion seem to be there. The tangible elements, availability of a market, availability of land, transport access including water, road access, and rail access, are musts for the continuing development of a port and they are also being developed at Corpus Christi.

John LaRue and his staff have been able to put together all of these elements to present a cohesive strategic plan. An excellent financial future will be sealed with the sale or lease of property to a number of tenants knocking on the door and the Port is moving toward this goal. Revenues from leases as well as tariffs for both import and export shipments will solidify the Port's financial strength and the future looks very bright in this respect.

The Port is blessed with 20,000 acres of land, deep water channels that will soon become deeper, Three Class I railroads, good road access and most importantly, the development of an opportunity created for them some 80 years ago, in the Patricio oil fields. The actual lynchpin to all of the Port's plans is defined by three words, "Shale", "Shale Oil" and "Fracking".

If you look up the words shale, shale oil and fracking, you might find two and not the last, depending upon the age of your dictionary. Shale is "A rock formed of hardened clay that splits easily into thin layers." Shale oil is "Oil distilled from a hard shale containing veins of a greasy organic solid." Fracking as far as can be defined, may be a derivative of the word Fractal, "An irregular line or plane, formed of an infinite number of irregular sections and having fraction dimensions." Fracking according to one source is drilling down into shale oil veins and then drilling a series of horizontal wells to tap into the veins."

In the 1930's, large oil deposits in San Patricio, Nueces County and neighboring counties were discovered and in a short while, petroleum and petroleum products became king at the Port of Corpus Christi. Some 80 years later, it is this development near San Patricio that is again the key to the present growth at the Port and in a sense brings John LaRue to World Generation. The sense that a seaport like Corpus Christi can have as big an impact on the energy resources of an area, state and nation is significant. The discovery of the Eagle Ford shale oil deposits 65 miles north of Corpus Christi has brought about a reincarnation of the oil boom in Texas and has dramatically lifted the fortunes of the Port of Corpus Christi and the industries surrounding the port.

(continued on page 20)

## ROGER STARK



Partner  
Ballard Spahr

Everyone knows that we need an “all of the above” energy sector. This cliché coincides with increasing public awareness of greenhouse gases and their effects on climate change. The discredited “peak oil” theory (i.e., the idea that oil production has peaked and is now in decline) is morphing into a “peak air” theory, where the tipping point for catastrophic climate change is either approaching or has already occurred. These developments illustrate an emerging theme: energy and environmental policies are inextricably linked—they must work together or not at all.

Some may conclude that further growth in renewable resources deployment is assured. However, a closer look suggests a different picture, where hurdles to further renewable energy development fall into two categories:

- Resource Economics; and
  - Markets and Government Interventions.
- Consider each of these in turn.

## ECONOMIC CHALLENGES

Hydrocarbon fuel prices are volatile—rapid spikes and crashes are to be expected. Also, prices for different hydrocarbon fuels often move in unison, thereby making real-time fuel-switching virtually impossible. This volatility, and our historical dependence on imported oil, provide compelling reasons for diversifying away from hydrocarbon fuels.

By contrast, the shale gas boom has created powerful incentives to build more natural gas power plants. Gas prices began falling in 2008, went slightly below \$3.00/MMBtu in 2012, and will likely continue to be depressed for some time. As of this writing, gas prices are hovering at about \$3.50/MMBtu. (It is generally accepted that gas prices below \$4.00/MMBtu do not allow producers to recover their production costs.)

Electricity generated from natural gas is nearly at parity with the price of electricity generated from coal, in part because coal plants are generally older and less efficient than gas plants. Yet the price of most renewable energy resources remains sufficiently high to make them uncompetitive without tax or other economic subsidies. (The price of electricity from nuclear plants is higher still due to,

among other things, persistent negative associations with toxicity and longevity of nuclear waste.)

Renewable energy provides the best environmental profile, perhaps even the best overall economic value when environmental benefits are taken into consideration. However, because those benefits are not being priced, the economics of natural gas present a persuasive, perhaps compelling, case for building more gas fired generation.

## MARKETS AND GOVERNMENT INTERVENTIONS

Heavily polluted cities like Beijing highlight the wide range of health and safety issues associated with air pollution, yet there is still no calculus for pricing the benefits of clean air or the costs of hydrocarbon emissions. The inability to monetize pollution costs perpetuates the fallacy that hydrocarbon plant emissions are cost-free and further disadvantages renewable resources. State efforts to fill this gap have come up short.

When New Jersey enacted a statute offering subsidies for new gas power plant construction, it was challenged by incumbent generators and the regional transmission organization (RTO) on grounds that subsidies are tantamount to market manipulation. FERC subsequently endorsed the RTO’s position and carved out a limited exception for wind and solar projects (without addressing how subsidies for other renewables resources would be viewed). California’s renewable energy mandate and low carbon fuel standard are also encountering opposition, albeit on somewhat different grounds (those disputes are still in early stages).

Thus, state subsidies are off limits (at least for renewables other than wind or solar), leaving open questions about mandates and other market interventions for renewables. If gas is the cheapest fuel and gas plants are the most efficient fuel users, outlawing subsidies moves us further toward an approach that dictates a “buy what’s cheap today” strategy. (It also may violate principles of cooperative federalism, but it will be years, perhaps decades, before that issue is settled.)

Challenges to state incentives only increase pressures to buy what’s cheap today at the expense of long-term diversity considerations. States use economic incentives to compete for jobs and investors. Without state subsidies, or a national policy for energy diversity, it is difficult to counter the argument that building more gas-fired plants is the economically competitive thing to do. As a result, the current framework may result in substituting one incumbent fossil fuel (gas) for another (coal), thereby promoting overreliance on gas fired power plants while reducing renewable energy’s market share.

On top of these challenges, the forces supporting recent growth in renewables are on the wane. Part of the problem relates to the expiration of stimulus incentives and the hurdles associated with unbundling the environmental and energy

benefits of renewable resources. In addition, grid management issues relating to wind and solar projects are matters of growing concern and demand management initiatives are displacing renewable energy projects by suppressing the need for new generating capacity.

Most of the economic stimulus provisions of the American Re-investment and Recovery Act have now expired. A renewal of the Production Tax Credit for wind energy was signed this past January, but it appears that the delays and uncertainties surrounding that renewal have reduced the volume of wind projects under development. Solar deployments continue apace, but there is a sense that there will be fewer and smaller utility scale solar projects.

The need to integrate large scale solar and wind facilities into the grid creates technical challenges. In some respects, the problem is analogous to turning the dispatch curve upside down because intermittent renewables have “must-run” requirements but lack the stable output of a base-loaded plant. The result is a growing generation fleet providing energy quantities that change with the weather.

When wind or solar plants are not producing, larger thermal plants must ramp up production to fill the gap. Most base load plants are not built for constant ramping. In Europe, where gas prices remain at higher levels, this fact is causing some utilities to revert to coal fired generation. In the U.S., renewables are being paired with fast ramping gas generation to provide the grid with ramping capacity, load support and ancillary services.

New technologies, from fast-ramping combustion units to battery storage, may emerge to fill these needs. However, it remains to be seen whether markets will attract ramping capacity on their own, or whether some form of non-subsidy incentive will be required to attract these services. As one might imagine, the development of market based solutions implicates a wide range of stakeholders and gives rise to some novel and complex issues. In any event, these issues threaten to further restrict renewable energy development.

## CONCLUSIONS

Just as hydraulic fracturing makes it possible to lift vast quantities of previously inaccessible shale gas, other game changing technologies may yet emerge to level the playing field for renewables. For now, however, economic and policy factors are both trending in favor of more gas-fired generation in the U.S., leading to a search for new renewables markets.

Some renewable energy sponsors and manufacturers are looking to Latin American and the Caribbean as a source of new projects. The presence of higher power prices, remote off-grid operations (e.g., in extractive industries) and extensive solar and wind resources in the region assure significant demand for renewables in these markets for some time to come. The emission credits from such projects may ultimately be traded under the Kyoto Protocol

or its successor if that initiative overcomes the current spate of stakeholder disputes.

There is also a growing trend towards smaller “distributed” energy projects, using both thermal and renewable resources, that can be managed through a smart grid. Distributed energy projects provide both load serving and security benefits by making the grid less dependent on a few central station plants. They also allow for synergistic pairing of thermal and renewable energy resources. If competitively priced, these projects will become an important component of the 21st Century grid and are a likely source of continuing demand for renewables.

Renewables are the single most important source of clean energy, yet they continue to struggle against economic and policy headwinds. Without policy reforms or continuing government support, economic factors and lack of a level playing field continue to hamper the growth of renewable resources. Legal challenges to government subsidies and technical integration issues present additional hurdles to growth.

Renewables need a policy framework that acknowledges their central role in achieving resource diversity, energy security and environmental sustainability. With suitable policy reforms, renewables promise to keep the U.S. on a path to a balanced resource portfolio. Without such reforms, we risk sliding into an “all gas” economy, with all the fuel price volatility and “peak air” risks that come with it.

## ABOUT ROGER STARK

Roger D. Stark is a partner at Ballard Spahr LLP. For more than 20 years, Mr. Stark has advised clients on the structuring and financing of a wide assortment of domestic and international energy projects, including traditional, renewable, and clean technology projects and related financings that were firsts in the industry. He is Co-Chair of the ABA’s Renewable, Alternative and Distributed Energy Committee and a Co-Chair of the ABA/ACORE Seminar/Teleconference Series on renewable energy issues. Mr. Stark previously served on the Board of the Independent Power Producers of New York and the Chilean Chamber of Commerce. He frequently speaks at industry conferences and has published numerous articles in industry publications.

Representative projects Mr. Stark has worked on include:

In 2012, he represented a multinational wind energy manufacturer in the acquisition of an approximately 440 MW wind project in Central America.

In 2009-10, he represented a South American national oil company in a proposed restructuring of a large energy generation facility co-located with an oil refinery on the island of Curacao, and in a proposed project financing.

In 2009, he led the team that acted as Program Counsel to the U.S. Department of Energy.

## JOE THOMAS



President & CEO  
MAGE Solar USA

Headquartered in Dublin, Georgia, MAGE Solar USA delivers residential, commercial, agricultural, and utility scale solar energy applications to customers throughout the Americas. It has installed 150 MW of photovoltaic solar systems in the three years since its founding in 2009. Its revenue turnover in 2010 was \$350 million.

Joe Thomas, president and CEO of MAGE Solar US said, "Solar is a technology readily available in a fledgling market. Most people don't understand it, and don't understand what it can do for them." He said the company's mission is to provide solar to homes, businesses and industry to supplement their energy needs and reduce costs for its buyers.

Privately held, MAGE Solar USA is a subsidiary of MAGE SOLAR AG, part of the MAGE Industry Holding Group, a 40-year old company headquartered in Ravensburg, Germany. In addition to desalination technology and construction businesses among others, the parent company markets its solar products world-wide and has sales in the Benelux countries, Spain, Slovakia, North Africa, Middle East, Central and South America, Caribbean, Virgin Island, and Australia.

Thomas said the company does not sell directly to customers but instead to integrators who market to and install solar systems for customers. He said, "We develop partnerships with the integrators but do not have exclusive relationships with them."

Thomas agreed the solar industry is suffering from an oversupply of products. That in addition to advancements in technology, is driving prices down to the point where solar is competitive with other fossil fuel sources. "Yes, it [the market volatility] has caused difficulty for us," Thomas said.

In the beginning, getting into the business was sexy, but it is now starting to stabilize with companies leaving the business, he said. "The supply and demand issues are starting to take care of themselves," he added. "We won't see the market prices continue to decline at the rate we saw in the last two years but as the technology improves we'll see some price decline," Thomas said.

MAGE assembles the various components that make up its polycrystalline and monocrystalline solar PV modules in its production facility in Dublin, Georgia which was opened last summer. The current line has a capacity of 40 MW of UL-listed and ARRA-compliant solar modules and provides "clean collar" jobs to many workers that have been suffering through the economic downturn in the region. Thomas said the plans are to ramp up production to 800 MW in the near future to meet industry demands.

MAGE markets a series of PV modules ranging from 240 Watts to 300 Watts under the MAGE POWERTEC PLUS brand for residential, commercial, agricul-

tural and utility scale solar applications. All products offer MAGE's 30-year 80% power output guarantee.

Last July, MAGE introduced the POWERTEC PLUS AC module that integrates the DC-to-AC microinverter into the module frame, thereby eliminating the need for one central inverter or multiple string inverters. The pre-installed, fully insulated AC-cable can be plugged into the AC-cable connector of the adjacent module, creating an easy-to-install module, making it truly "plug and play." This technology was developed through a partnership with SolarBridge Technologies.

Thomas said there will continue to be advances in efficiencies. For example,

the POWERTEC PLUS 240/6 PL AC module, introduced last September, has microinverters on each module allowing single monitor monitoring. It produces 25% more energy than alternative systems, according to MAGE. Individual modules produce varying amounts of electricity which a central inverter averages out. But the microinverter will pick up the variations in output and send it on to the wires. With a web-based management system for 24/7 monitoring, it is an ideal system for homes and small businesses. Its size can be increased as needed.

*(continued on page 20)*

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## ALEX SALMOND



First Minister of Scotland

If you measure the progress to date against the European environment agency scale, Scotland already leads Europe in terms of greenhouse gas reductions, a reduction of 22.8% over the 20 years from 1990, higher than any member country in the European Union and 50% higher than the average of the European Union in terms of reductions.

"We exceeded our interim target of producing 31% of Scotland's electricity demand by renewables by 2011 and we've set a new interim target of 50% by 2015," Alex Salmond said. "At present, onshore wind and hydro are obviously the two largest sources of that energy, but events in the last year demonstrate as we look to the future, offshore wind and marine entitled power will start to play an increasingly important role."

European Union member states are now at a total of 100 gigawatts of onshore wind capacity. It took 33 years to reach that point, once technology became practical and commercially viable. Marine Scotland is considering applications for offshore wind farms which have the potential to generate more than 4 gigawatts of electricity, which would be equivalent to around 40% of Scotland's net electricity demand.

Climate change targets which have cross-party support in the parliament are very important. "It's why we established a target of producing 100% of net electricity demand for renewable sources by 2020 and why we set that interim target of 50% by 2015 a few months ago," Salmond explained.

"There has been much debate about whether the UK government should embrace a decarbonization target for Scotland's electricity consumption as part of the energy bill. The Scottish government has argued strongly that it should. "We disagree with the current plan to delay setting a target until 2016 at the earliest," Salmond underscored.

The Scottish government will publish a RFP2 to meet carbon reduction targets. In 2010 Scotland emitted almost 350 grams of carbon dioxide for every kilowatt hour of electricity generated and was lower in 2011. By 2030 Scotland will emit only 50 grams of carbon dioxide for each kilowatt hour of electricity generated, a reduction of more than 80%. Salmond continued: "The

green energy revolution produces three benefits: it'll be good for the environment; it'll provide energy security for Scotland and the other nations of these islands, and it'll bring jobs and investment to the country. All three are crucial."

Scotland has the potential to be a world leader in all stages of marine energy, from technological development to manufacturing to the generation of electricity. "That potential will only be realized across the country if we revitalize our port infrastructure. That's why we established a seventy million pound national renewable infrastructure fund in 2010," Salmond pointed out.

Just as the technical barriers with

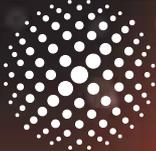
the North Sea oil were overcome, Salmond sees the technical barriers for offshore wind being overcome. Scotland has the research skills, the engineering expertise, the natural resources to make it a world leader in offshore wind, pioneering new technologies which will power Scotland and the rest of the world in the future, establishing a manufacturing basis for turbines, for blades, for gear boxes, and exporting surplus energy across the European continent. "As the offshore wind industry takes off, it has the potential by the end of the next decade to create up to 28 thousand jobs in Scotland and to indirectly support many thousands more," Salmond emphasized in conclusion.

## ABOUT ALEX SALMOND

Salmond is the leader of the Scottish National Party and First Minister of Scotland. He was born in Linlithgow in 1954. He attended Linlithgow Academy before studying at St. Andrew's University, where he graduated with a joint honors MA in Economics and History.

He was first elected as MP for Banff & Buchan in 1987 and was elected as National Convener for the Scottish National Party in 1990.

He made political history after becoming the first nationalist to be elected First Minister of Scotland on May 16, 2007.



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## JOHN LARUE CONTINUED FROM PAGE 16

Two additional elements impacting the handling of oil and natural gas will be the ability to handle the largest vessels possible to carry it. The completion of the Panama Canal project and the Port of Corpus Christi's dredging project will open the door for larger vessels to handle the oil and LNG. This will allow larger individual shipments to move from the Port, through the canal to the Far East, a fact that will entice an ever increasing list of customers.

As the oil deposits are exploited, the fortunes of the Port will increase. As a result of this activity, they sold 1,000 acres to Occidental Petroleum. Occidental will produce LNG for export and the boom will begin with the movement of materials through the Port for the construction phase as well. At the same time, the Port has plans for significant rail expansion at the Western end of the ship channel. This will provide new rail access to the main line, new railcar storage and the ability to form unit trains near the Port. The Port is poised for increases in not only bulk commodities, but breakbulk, ro-ro and containerized cargoes.

What is significant about what is going on at the Port of Corpus Christi is that the number of major projects they are now managing, could be divided into thirds and each third would be a major agenda for three ports, choking each one of them. The Corpus Christi agenda seems endless:

### CHANNEL IMPROVEMENTS FOR THE LA QUINTO CHANNEL EXTENSION.

Eco system restoration for community protection and secure residences including, creation of wetlands, grasses,

fish and bird habitat and other wild life restoration.

Channel deepening from 45' to 52', creation of barge slips and channel widening.

The vast majority of the industrial projects will be on private land, sold by the Port and not projects on Port held land.

Sale of Port land in significant amounts (1,000 Acres to Occidental Petroleum) for private 500 acres of port land for industrial development, steel handling, containers all in the hands of private investors including rail, utilities, dock space.

Public/private/partnerships.  
Rail partnership with the State of Texas.

Expansion with pick-up at the main rail access.

New rail access and storage capacity. Rail storage capacities will handle up to 15K to 18K cars per year.

Creation of businesses to support Fracking including the movement of huge amounts of sand in and out of the port and local handling.

Creation of Barge moorings and loading/unloading.

The location of a huge Chinese pipe manufacturing facility to include the sale of the land to build the factory, logistics of moving materials into the Port, construction of the plant, and moving the finished product out.

The number of projects that are on his plate do not seem to faze John LaRue. He and his staff have designed these projects to meld together as a master plan that will carry the Port well into the new Millennium. There is planning, there is hard work and there is good fortune. The Port of Corpus Christi seems to have all three.

## JOE THOMAS CONTINUED FROM PAGE 18

MAGE is also partnering with financing brokers, such as DeLage Landen, CIT and Renewable Energy Equipment Leasing to offer financing options for installers, homeowners and businesses. For example, the company recently announced a financing package in partnership with Greenavations Power, a solar consulting group, and Renewable Energy Equipment Leasing to fund a 1.1-MW solar PV system at Dublin City High School in Georgia. The school's utility costs will be reduced about 40%.

MAGE operates a Solar Academy to provide training options for installers and other industry professionals. It is also offering courses in convenient online formats in addition to its standard, classroom-based curriculum. Within the past 15 months, the MAGE Solar

Academy has trained over 1,000 students from all over the world through a variety of courses to fill the demand for qualified, well-trained workers. Thomas said the academy is also training firemen, inspectors, politicians, and homeowners.

"As people understand more about solar in terms of internal rate of return, from a financial perspective it's an asset they will save money with from the first day you turn it on, in contrast to buying a car," Thomas said.

Thomas was born and raised in the rural heart of Georgia. With experience in multi-million dollar production portfolios and international manufacturing before starting up the new company in 2009, Thomas has become a passionate and tireless spokesperson for solar energy. He was recently honored with the "Georgia Solar Advocate Award" by the Georgia Solar Energy Association.

## MIKE DOOLEY CONTINUED FROM PAGE 9

development and product management at SunPower.

Dooley has a Bachelor of Science in chemical engineering from University of New Hampshire, and a Master of Business Administration in marketing from Golden Gate University in San Francisco.

## TODD CARTER CONTINUED FROM PAGE 5

### WORLD-GEN: WAS SIEMENS CHOSEN FOR THE UNIQUELY DESIGNED TEXAS ELECTRICITY MARKET?

**Todd Carter:** Siemens was chosen because their technology fit the dynamics of the Texas electricity market. Their quick-start turbines, which can deliver 50% of power within 10 minutes of startup and 100% of power within 30 minutes, is ideally suited for a state which has more (intermittent) wind energy than any other state in the country. Their turbines are also better at supplying power during high temperature conditions which is ideal for Texas' hot summers.

### WORLD-GEN: PLEASE UPDATE THE PROGRESS AT THE PANDA TEMPLE GENERATING STATION IN TEMPLE, TEXAS.

**Todd Carter:** The Temple project is currently tracking ahead of schedule and is about 35% complete. Engineering and procurement are rapidly drawing to a close and major equipment delivery will begin in April.

### WORLD-GEN: WILL THE PANDA PILESGROVE SOLAR FARM BE THE MODEL FOR FUTURE SOLAR FARMS?

**Todd Carter:** I can't say that it will be the model for the industry. I can say that it is our present model for any future solar farms that we may build. The Pilesgrove solar farm was utility-scale in size (20-MWs or 77,000 solar panels) and was economically supported by solar renewable energy credits. Those are things we would look for in any future project. We also had a good experience in jointly developing Pilesgrove with New York ConEdison Development. We would consider such an arrangement in the future as well.

### WORLD-GEN: HOW DOES PANDA GIVE BACK TO THE COMMUNITY?

**Todd Carter:** Well, we really don't like publicly displaying our good deeds. We know, however, that the communities operate in need to know that we give back to the community. So, I'd just say that we are very big on sponsoring local initiatives and tend to focus on charities which help provide a safe place and an education to children. Let's leave it at that.

## DAVID WALSH CONTINUED FROM PAGE 6

marketplace, placing a special emphasis on recruiting from those areas where our facilities are located. We also take a proactive approach in developing our future workforce by encouraging students to seek careers in the power generation industry. MPSA has an award-winning internship program that immerses college students in the company's daily operations. From nearly 280 college interns to date, we've hired over 40 into full-time positions following their graduation in areas that include engineering, information technology, and finance. All of our employees are encouraged to continue development of their skills through classroom and on the job training programs.

### WORLD-GEN: PLEASE UPDATE THE PRATT & WHITNEY POWER SYSTEMS ACQUISITION ANNOUNCED TO THE PRESS AT POWER-GEN.

**David Walsh:** The Pratt & Whitney Power Systems (PWPS) acquisition represents MHI's ongoing pursuit of strategic growth opportunities to provide customers with a more diverse portfolio of innovative power generation products and services. This acquisition enables MHI to address anticipated growth from its industrial gas turbine (IGT) services business. With the addition of PWPS's capabilities in aero-derivative turbines, Organic Cycle turbines, and gas turbine components, Mitsubishi will be able to meet a broader range of equipment needs for power producers worldwide. The PWPS acquisition closing is expected to occur later this Spring.

### ABOUT DAVE WALSH

Dave Walsh is the senior executive responsible for Mitsubishi Power Systems Americas Fossil business Sales and Marketing, service, and project execution activity in the Western Hemisphere.

Mr. Walsh is an officer in Mitsubishi Power Systems, Inc., and has responsibility for Sales and Marketing of new fossil power generation projects and services, and project execution including related sourcing and engineering activity. Mr. Walsh was previously responsible for the development and management of Mitsubishi Power Systems North American Service and Manufacturing activity. The Fossil Power Systems Business includes simple and combined cycled combustion turbine supply, steam turbine supply including geothermal applications, conventional and combined cycled applications, the SCR business, and related services including those for nuclear steam turbine & generators as well as long-term combustion turbine service programs.

Previously, he held various executive positions with Westinghouse Electric Corporation in Pittsburgh, Chicago, and

*(continued page 22)*

## UDO ZIRN CONTINUED FROM PAGE 8

combined cycle are made in modularized sections,” explains Zirn, “so we can offer more of a cookie-cutter type, lower-priced turbine without sacrificing customer requirements. Naturally we can modify any portion of the standardized sections to meet specific demands.”

“We believe we have been a leader in anticipating the recent surge in natural gas fuel for electric generation, and we have developed products accordingly,” says Zirn. “The weak economy dampened projects but now development is picking up and we are ready for what the market is demanding.”

Zirn and HPSA believe that 10 to 12 combined cycle plants will be built in the United States each year over the next five years, both greenfield and brownfield. The government’s prediction for electricity growth is about 1% a year for the next 25 years. This plus the fact that the typical coal plant is over 40 years old bodes well for natural gas plants. Some coal retirements will be swift; already there has been announcement of 47GW (239 units) of coal plant capacity retirement, 85% of which is to be retired by 2015. Partly coal plant closing owes to lower gas prices but also proposed emissions controls – some utilities feel it makes more sense for some plants to shut down the coal generation and replace it with gas rather than pay for the emissions control equipment add-ons.

Hitachi’s gas turbines, as mentioned, cover a unit output range of nominal 15 MW to 100 MW and can be used in simple cycle, combined cycle and cogeneration applications. While these unit sizes are not large enough to satisfy the U. S. market demand for large (>300 MW) combined cycle plants, Zirn and HPSA expect an increasing market of smaller combined cycle plants. A reason is that many of the announced coal plant retirements are municipal and co-op coal plants smaller than 200MW. The affected municipalities and co-ops could, of course, merely buy power from somewhere else, but may consider building on the old footprints and these are likely to be smaller combined cycle plants that would need the size of gas turbines HPSA offers. “We believe we are very well positioned for this impending smaller combined cycle market,” Zirn says.

Another opportunity Zirn sees is for simple-cycle gas turbines, historically used for peaking demand. Many of these existing simple cycle plants include older General Electric combustion turbines. Hitachi’s turbines fit onto existing GE foundations and can operate with the existing turbine auxiliary equipment but are more powerful and efficient. This makes them the perfect replacement for Frame 5 and Frame 7EA type turbines. “The annual fuel savings for the owner can be significant”, Zirn points out.

“So that is the market we see for Hitachi in the United States and which we are going to pursue over the next five

years,” says Zirn. “We don’t see expansion in coal or nuclear, mainly owing to emissions control, permitting difficulties and public wariness stemming from the Fukushima trouble in Japan. However, if such plants were to be designed and put out to bid, we would be ready to supply turbines for those efforts.”

### STEAM TURBINE DETAILS

HPSA steam turbines are manufactured at Hitachi Works in Japan. All are constructed using highly sophisticated materials and techniques.

Hitachi’s standardized combined cycle steam turbine is a three pressure,

reheat, tandem compound, condensing design that is suitable for main steam pressures of up to 2,400 psi and main steam/reheat steam temperatures of up to 1,100 F. They are suitable for the bottoming cycle of any advanced F-class, G-class, or H/J-class combined cycle.

Hitachi research regarding steam turbines has been focused on the development of longer last stage blades as well as higher steam pressures and temperatures for supercritical power plants.

Hitachi’s latest last stage blade development for 60 Hz fossil fuel applications is the 50-inch titanium blade. However, the U.S. market has historically been more conservative than some Asian markets,

wanting to see newly developed components proved for a number of years before putting them to work here. Moreover, in several ways steel for these last-stage blades is better suited to the combined cycle market, Zirn points out, though, when a customer wants titanium last-stage blades, Hitachi can build turbines that way. In the United States, the longest blades HPSA expects to sell in the near future is the mature 40-inch steel blade. Zirn says that if an interest develops in longer last stage blades to be placed in prospective U.S. power plants and upgrades, HPSA is ready to provide those blades.

(continued page 22)



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## UDO ZIRN CONTINUED FROM PAGE 21

Supercritical power plant applications have traditionally required turbines withstanding steam temperatures of up to 1100 °F. Now some plants are operating at 1150° F and Hitachi is developing steam turbines capable of dealing with steam as hot as 1300° F and pressures as high as 4000 psi. Zirn says these turbines should be ready for commercial applications by the end of this decade.

Zirn says material acquisition is typically not a problem but certain components, such as advanced rotor forgings and titanium last-stage blades have historically been items that can result in longer lead-times for the delivery.

### COMBUSTION TURBINES DETAILS

Hitachi's combustion turbine product line includes the models H-15 (17MW), H-25 (32MW), and H80 (100MW). In addition, a >40MW upgrade of the H-25 will be released shortly. All combustion turbines are heavy-duty type designs, capable of firing natural gas or distillate oil and suitable for simple cycle or combined cycle applications (Zirn points out that the H-80 distillate oil-firing capability is still under development and expected to be completed next year.) All Hitachi gas turbines can be supplied with dry low Nitrous Oxide (NOx) combustors.

In addition to the applications in the power industry, Zirn points out that Hitachi's turbines are also well suited for the process/petroleum industry, which often uses synthetic gases and mechanical drives, i.e. applications where the turbine is used to drive the shaft of a pump or other equipment, rather than a generator. Hitachi's combustion turbines have a high degree of fuel flexibility and, moreover, the H-50 and H-80 combustion turbines are a two-shaft design, which makes them suitable and attractive for mechanical drive applications.

Besides ongoing research to improve the efficiency of its combustion turbines, Hitachi is working on the development of new models and upgrades that will be added to the portfolio of combustion turbines. Zirn also sees a governmental drive to lower NOx emissions from power plants. So Hitachi is continuously working on achieving lower combustion turbine emissions in order to allow customers to save money by not having to install back-end scrubbing equipment, especially for simple cycle turbines.

### TODAY AND TOMORROW

At the moment, Zirn is heavily involved in writing steam turbine and combustion turbine proposals for simple cycle and combined cycle projects that interest Hitachi. It had not been so actively bidding for combined cycle until

recently as its focus was on completion of the modularizing and standardizing efforts.

Zirn makes mention of the fact that Mitsubishi and Hitachi will be combining their thermal businesses early next year. An integration committee composed of members from the two companies is working out the details. "We don't have much information yet on how this is going to be integrated," Zirn says. "We'll just have to wait on the decision of the integration committee. But considering how advanced the products of both companies are, we do know that the turbines offered by the new company are going to be outstanding products for the market."

## DAVID WALSH CONTINUED FROM PAGE 20

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- General Manager of U.S. Industrial

service and renewal parts business.

- Strategic Development Director, Power Generation Business.
- CFO responsibility, International and U.S. service operations.

Previously with Arthur Andersen & Co., Pittsburgh  
Education: BS Commerce, University of Virginia and Graduate Study, Finance, Northwestern University

Mr. Walsh is a Board Member of Enterprise Florida, and previously has been a Board member of The Seminole County Foundation for Public Education, and The Seminole State College of Florida Foundation. Resides in Winter Springs, Florida with his wife Terri.



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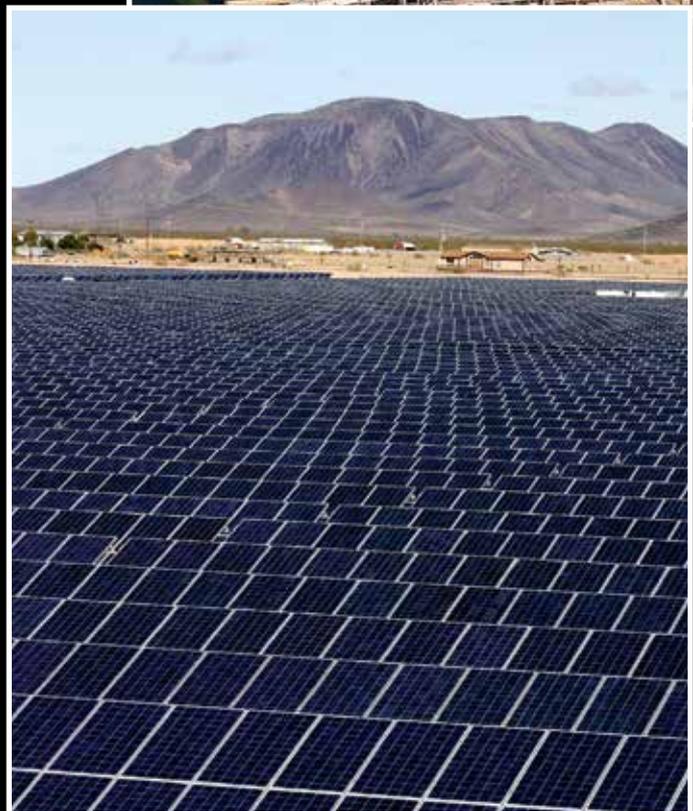
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