Welcome to the Digital Edition of

RENEWABLE ENERGY WORLD MAGAZINE

A quick start guide to MAXIMIZING our interactive features.

1 **SEARCH** for specific articles or content.

2 Easily **NAVIGATE** through the issue.

3 Click directly on the page to **ZOOM** in or out. Fit the issue to your screen.

4 **SHARE** an article or page via email or social media.

5 **PRINT** any or all pages.

6 **DOWNLOAD** the issue to your desktop.

7 View the table of **CONTENTS** and easily navigate directly to an article.

8 Click **PAGES** to view thumbnails of each page and browse through the entire issue.

9 Easily browse all **BACK ISSUES**

VOLUME 16 | ISSUE 4 | JULY/AUGUST 2013

RENEWABLE ENERGY WORLD MAGAZINE

PV market checkup

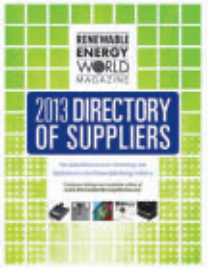
Assessing the Health of the Global Solar PV Industry

PennWell

The Big Question
Are domestic content requirements driving up project costs?
p. 29

US Wind Power
Which states still have opportunities for growth?
p. 56

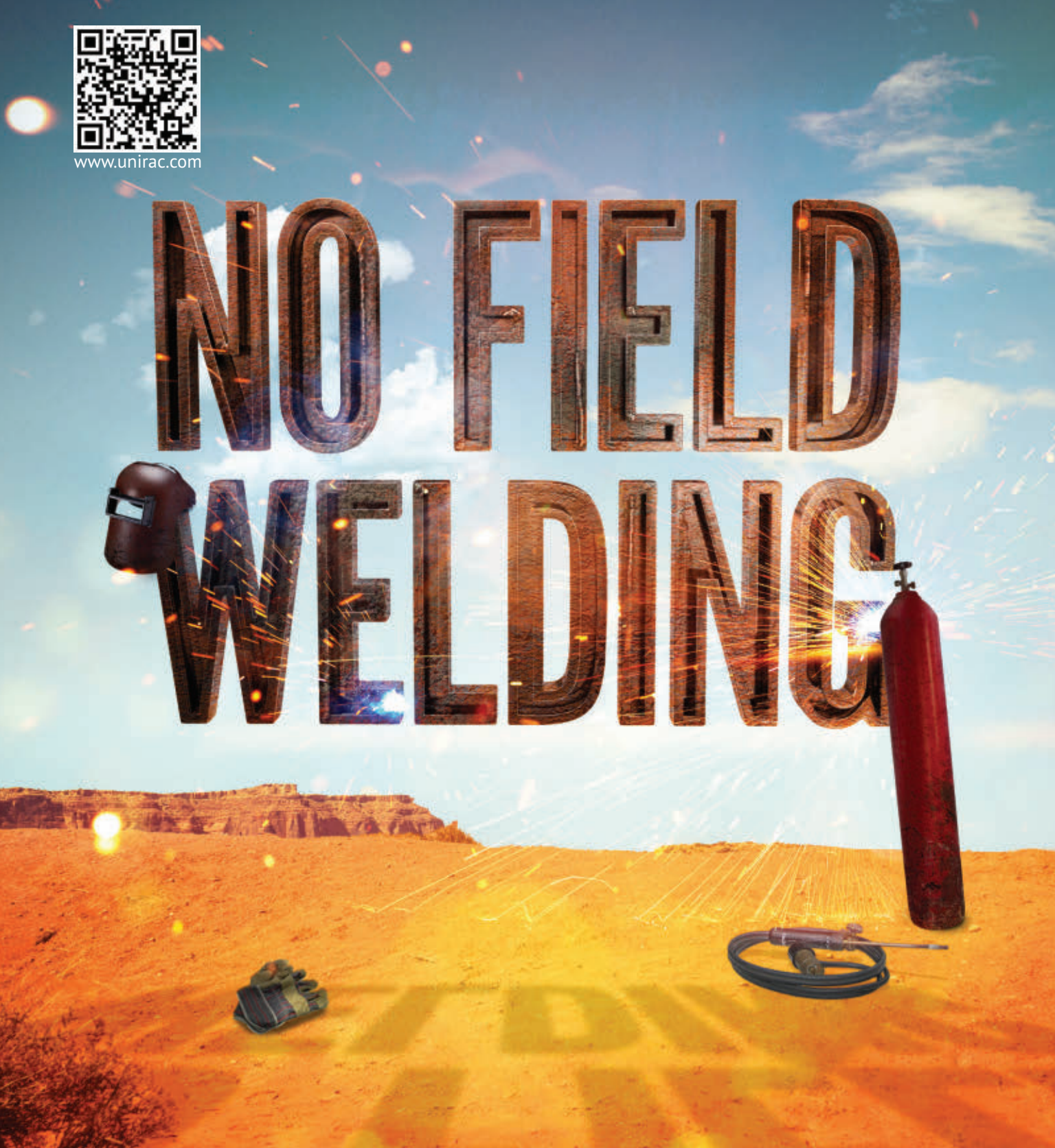
Indian Hydro
How developers are financing projects.
p. 74



« 2013 Directory of Suppliers
Your guide to hundreds of renewable energy companies worldwide.
p. 91

www.unirac.com

NO FIELD WELDING



For more information, enter 1 at REW.hotims.com

INTRODUCING THE UNIRAC

GMT GROUND MOUNT TRACKER

The Power of Simplicity.

UNIRAC

Bright Thinking in Solar

NO AD WILL CONVINCE YOU TO BUY A UTILITY-SCALE INVERTER.

Dave Wojciechowski
Vice President

BUT DAVE MIGHT.
480-643-1919

THE NEW ULTRA 750, 1100, 1500kW UTILITY-SCALE INVERTERS

Even if this ad told you the Ultra has the fastest, multi-mode MPPT algorithm on the market and a maximum efficiency of 98.6% for high energy harvest. Or that its 690V output and modular architecture means significantly lower installation costs and high system availability. Or even that we offer a fully-integrated skid solution, it still might not convince you. Because we know that for a complex utility-scale solar plant you need to be able to have deep technical interaction with people you trust who can help you make smart product decisions. Luckily, we know just the guy.

Listed to UL1741 and 1000VDC rated

power-one®
Renewable Energy Solutions

For more information, enter 2 at REW.hotims.com

KACO new energy.

Join the KACO Threevolution. Simply more.

The new blueplanet 50.0 TL3 three phase inverter.

- UL 1741* listed 1000 VDC with integrated AC and DC disconnection
- Design freedom: 1 or 3 MPP tracker option for shade tolerance
- Nearly 98% CEC efficiency with DC operation range of 200-800

KACO new energy.
We turn passion into power.

The solution for commercial PV systems.

www.kaco-newenergy.com

*pending

contents

PROJECT PROFILE
100 megawatts of CSP in the United Arab Emirates

features

RENEWABLE ENERGY WORLD MAGAZINE

ON THE COVER
Doctor holding a PV panel-covered globe courtesy of Shutterstock.

features

departments & columns

On RenewableEnergyWorld.com

RenewableEnergyWorld.com provides daily news and information to help you stay on your toes.

Visit us on the web to:

- *Comment on a hot news item.*
- *Nominate an outstanding woman for our Power-Gen Woman of the Year Award.*
- *Sign up for an educational webcast.*
- *Check out some of our Total Access partners.*
- *Enter your favorite project to win our Project of the Year Award.*
- *Start blogging.*
- *Register to receive our award-winning e-newsletters.*

Continuous Innovation

Unique features enhance structural integrity and make Solar FlexRack the most cost-effective PV mounting solution on the market.

FlexRack Utility
Ground Mount

Cross Brace
transfers forces from rack to the ground, eliminating any unnecessary stresses

Kicker Brace
stops rotation of top chord of tilt bracket

Connecting Channel
braces the two horizontal rails, which now act as a system instead of individual components

Pre-Assembly
for faster installation

Integrated Features
grounding and wire management

Adjustability
up to 20% E/W slope

20-Year Warranty
best in the business

Installation
full turnkey solution available

VISIT US AT: INTERSOLAR NORTH AMERICA 2013 • Booth #9439
SOLAR POWER INTERNATIONAL • Booth #450

For more information, enter 4 at REW.hotims.com

QUIKQUOTE

Patent Pending SOLAR FLEXRACK™

THE FUTURE IS UNFOLDING...QUICKLY

www.SolarFlexRack.com/REW

TOLL FREE 888-380-8138

A PRODUCT OF Northern States Metals SINCE 1972

Now *THIS* is a Game Changer

Introducing the **3 Phase String** Inverter from Advanced Energy

EFFICIENT & FLEXIBLE PV SYSTEM APPLICATIONS

CAR PORTS

ROOFTOPS

GROUND MOUNTS

Now there's a plug and play solution for a wide range of commercial-scale solar PV projects. Weighing in at only 108 pounds, the **AE 3TL** is easy to install and compatible with many applications and the most challenging system designs. With industry leading efficiency and reliablity, it maximizes energy yield and minimizes maintenance.

Backed by the exceptional service, support, and industry leadership you've come to trust, the AE 3TL is innovation you can bank on. Invest in the game changing power of distributed inverters from Advanced Energy.

AE 3TL AT A GLANCE

- Industry-leading CEC efficiency rating of 98%
- Solves problems of shaded and multi-pitch roofs
- UL 1741 Certified
- kW Ratings from 12-24, 600 V option
- Assembled in the USA
- Basic and premium monitoring options

ADVANCED ENERGY®

ENERGY DELIVERED™

www.advanced-energy.com/ae3tl | sales.support@aei.com | **877.312.3832**

For more information, enter 5 at REW.hotims.com

90°

SHIFT YOUR PERSPECTIVE. WE'LL CHANGE HOW YOU LOOK AT SOLAR.

RENEWABLE ENERGY WORLD MAGAZINE

PUBLISHER James M. Callihan
CHIEF EDITOR David Appleyard
MANAGING EDITOR Jennifer Runyon
ASSOCIATE EDITOR Tildy Bayar
ASSOCIATE EDITOR Meg Cichon
ASSOCIATE EDITOR James Montgomery

EDITORIAL OFFICES
REW Magazine
PennWell Corporation
98 Spit Brook Road, LL-1
Nashua, NH 03062-5737

PRODUCTION
CREATIVE DIRECTOR Meg Fuschetti
PRODUCTION DIRECTOR Mari Rodriguez
SENIOR ILLUSTRATOR Chris Hipp
AUDIENCE DEVELOPMENT MANAGER Emily Martin
AD SERVICES MANAGER Toni Pendergrass
MARKETING COMMUNICATIONS Stephanie Kolodziej

BUYERS GUIDE
DIRECTOR, BUYER'S GUIDE Sue McAdam
ASSISTANT DIRECTOR Jessica Ross
PRODUCTION SPECIALIST Lisa Hollis
SR. DATABASE SPECIALIST Tammy Croft
CUSTOMER SERVICE SPECIALISTS Sandy Taylor , Linda Smith-Quinn, Christine Algie

ADVERTISING
For information on advertising in future issues of the magazine, please contact:
PETER ANDERSEN +1 603 891 9385
DAN HARPER +1 603 891 9361
SANDRA SPENCER +44 1992 656 664

SUBSCRIPTIONS
Renewable Energy World is circulated free to professionals in the renewable energy industry. To start a free subscription visit www.rew-subscribe.com. Professionals outside the renewable energy industry may start a paid subscription. For pricing information visit www.omeda.com/rew or call +1 847-559-7330.

PennWell

CORPORATE OFFICERS
CHAIRMAN Frank T. Lauinger
PRESIDENT AND CEO Robert F. Biolchini
CHIEF FINANCIAL OFFICER Mark Wilmoth

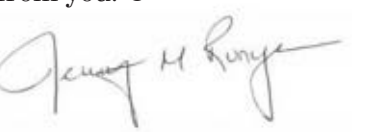
Welcome to the all-new, 100 percent digitally circulated edition of *Renewable Energy World* magazine. We've been working on this transition for many months and we're excited to show you all of the new features that we can now put into these pages.

First, let me explain that we won't be printing any hard copies of this magazine anymore. Even though most of our readers were already receiving this magazine digitally, we're hoping to convince the few holdouts to go digital with our all-new format.

See, most renewable energy supporters believe that clean energy is the wave of the future. You understand the importance (and sometimes difficulty) of getting people to try new technologies. I think digital publishing is also the wave of the future so I'm hoping that you will recognize the value of all-digital magazines and give us a try. No trees will be harvested to make paper for this magazine, no energy will be spent printing it, no carbon emissions will be released from shipping this publication all over the world and we won't be creating a product that will eventually go into a landfill. You have to support that.

Plus, our new digital platform offers some really cool features. Now we can easily track the stories you found most interesting and bring you more of the same. Now, you can see videos — like the one on this page — and slideshows like the one in *The Project* on page 46.

But not everything is different. We're still working with the same great writers and delivering the same great stories that we've been bringing you for the past 16 years. So check it out send me some feedback. I look forward to hearing from you. ◑



Jennifer Runyon, Managing Editor

AWEA

OFFSHORE WINDPOWER® 2013

CONFERENCE & EXHIBITION

October 22–23
Providence, RI

A New Revolution for U.S. Wind Energy

U.S. Offshore wind energy is open for business!

Don't wait – invest in these new opportunities now!

Scan this code with your smartphone to learn more!

WWW.OFFSHOREWINDEXPO.ORG

AWEA

EDUCATIONAL SERIES 2013

Generating power with knowledge

AWEA Wind Power on Capitol Hill
July 9 – 10, 2013 ▸ Washington, DC

AWEA Wind Energy Finance & Investment Seminar
September 9 – 10, 2013 ▸ New York City, NY

AWEA Ohio Wind Energy Summit
September 24, 2013 ▸ Columbus, OH

AWEA OFFSHORE WINDPOWER Conference & Exhibition
October 22 – 23, 2013 ▸ Providence, RI

AWEA Wind Energy Fall Symposium
November 6 – 8, 2013 ▸ Colorado Springs, CO

AWEA Wind Resource & Project Energy Assessment Seminar
December 10 – 11, 2013 ▸ Las Vegas, NV

Scan this code with your smartphone to learn more!

www.awea.org/events

JOIN US at our upcoming events!

For more information, enter 6 at REW.hotims.com

The Future of US Offshore Wind

Jim Montgomery,
Associate Editor

Growing up on the coast of Maine I learned many truths. When offering a French fry to a friendly seagull, beware his 3,000 dive-bombing kin on nearby rooftops. Rare arrowheads and shell fossils await the patient beachwalker. And you'll need a jacket in the early afternoon when the wind off the water picks up.

Lately I've been tracking offshore wind energy in the U.S., attending three webcasts and AWEA's Windpower in Chicago. The potential of this energy source, spanning shallow and deep waters off the Atlantic, Pacific, Gulf Coasts, and the Great Lakes, is estimated to far exceed onshore resources. Plus, our offshore resources are nearer to load centers where energy is needed and costly, and offshore winds are better aligned for electricity demand in the afternoons and evenings.

In 2011 the U.S. Department of Energy (DOE) laid out targets for offshore wind generating capacity: 10 GW by 2020 and 54 GW by 2030. The DOE now says it is launching another round of studies to update its projections for both onshore and offshore U.S. wind energy generation. Navigant Consulting's Bruce Hamilton offers two revised scenarios ranging from 1 to 3.5 GW by 2020 and 10 to 28 GW by 2030. The lower projections might be more realistic given what's in the pipeline, from the long-delayed Cape Wind to Fisherman's Energy in New Jersey and a handful of smaller projects, including some DOE offshore wind demonstrations.

"U.S. offshore wind has tremendous potential but it's also a tremendously massive endeavor," noted Andy Geissbuehler, head of Alstom's North American Wind business. But that's the chicken-and-egg dilemma: commercial surety for offshore wind energy will spur investment and infrastructure, but that infrastructure is needed to get costs down and spur broad demand, particularly in the deeper waters where wind resources, and the costs to tap it, are highest.

Lessons can be learned from Europe's two decades of experience developing and financing offshore wind technologies. Other lessons are being learned here now through innovative foundations, new resource evaluation tools, and efforts to plan wind farms that won't overlap shipping lanes. Supportive state-level policies are also being created to ensure projects have sufficient revenue and access to affordable debt.

Two of those DOE demo projects are in Maine; one is near the fishing/artist enclave of Monhegan Island, which is just a few miles from my childhood home. Maybe I'll go see what they're up to — and I'll remember to bring a jacket. ◑

Earn your Bachelor's degree in Alternative and Renewable Energy Management

Everglades University

"The University has enhanced my level of thinking and given me the ability to use what I have learned in the classroom to display in the field." – *Dwayne Simons, 2011 Graduate, Orlando Campus*

WWW.EVERGLADESUNIVERSITY.EDU

EU Everglades University

- Financial aid is available for those who qualify
- 100% online degree programs are available through the Boca Raton Main Campus
- Small classes with individualized attention

Everglades University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award bachelor's and master's degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404-679-4500 for questions about the accreditation of Everglades University.

For more information, enter 7 at REW.hotims.com

Boca Raton Campus *(Main Campus)*
888.226.0902

Orlando Campus *(Branch Campus)*
866.314.4540

Sarasota Campus *(Branch Campus)*
888.785.8689

Online Division
855.723.9087

Where is the Money for Geothermal Development?

Meg Cichon,
Associate Editor

As someone who follows the geothermal industry, I have seen a growing trend that raises questions about the future of the market. More than ever, business has been moving to developing markets, and as a result, U.S. companies have been making a push to move their business overseas.

With announcements like the recent one from The World Bank stating that it will invest more than $500 million in the developing geothermal market, what does it mean for the rest of the world? After all, although a company may be based in America, according to Karl Gawell, executive director of the Geothermal Energy Association, "you are also selling equipment and operations on the worldwide market."

The U.S. geothermal industry caught a rare win with the passage of a production tax credit (PTC) provision that allows projects to qualify for the incentive as long as they are "under construction" by the end of 2013. But after waiting almost half a year to determine what "under construction" actually means, many projects are still in flux, and since it takes an average of seven years to complete a geothermal project — this leaves plenty of undeveloped megawatts.

Geothermal is considered an especially volatile investment due its high risk during initial resource assessment. For each project, approximately three wells are drilled to determine the resource. Each each well costs between $3 and $6 million and carries a success rate of just about 50 percent. Not surprisingly, this scares most investors away.

On the other hand, since geothermal is a clean baseload energy source with great potential in developing nations, development banks have been hard at work to come up with viable solutions to lower that initial drilling risk.

The Word Bank's investment fund is creating an attractive global market. It is meant to aid the exploration and drilling phases of geothermal projects. Once these phases are done, the bank will call upon developers to establish projects on sites that have proven successful. "It's a matchmaking process," said Pierre Audinet, clean energy program leader of the Energy Sector Management Assistance Program (ESMAP) at The World Bank.

Most U.S. development is sluggish because exploration and drilling are usually funded through the developers' own dollars and/or through public support, Audinet explained. "It's not because the resource is not there, but because it is hard to validate. It takes money, and it takes a big risk appetite." ◑

EUROPE

EU Carbon Emissions Lowest Since 1990

In its 2013 inventory report, the European Environmental Agency (EEA) found that greenhouse gas (GHG) emissions fell by 3.3 percent in the EU in 2011 (latest available data), leading to the lowest emissions level since 1990.

The EU's total GHG emissions in 2011 were 18.4 percent below 1990 levels, according to the report. The UK, France and Germany accounted for almost two-thirds of the reduction, while the largest increases came from Romania, Bulgaria and Spain.

The 2011 emissions drop was due largely to a milder winter compared to 2010, which led to a lower demand for heating, said EEA executive director Jacqueline McGlade. "Nonetheless," she said, "the EU is making clear progress towards its emission targets."

However, she cautioned, "there was an increase in consumption of more carbon-intensive fuels such as coal, while [hydro] production and gas consumption decreased. If Europe is to achieve the transition towards a low-carbon society, it will need sustained investment in technology and innovation." ○

Google Signs Wind PPA in Finland

Technology giant Google has announced plans to power its data center in Hamina, Finland with wind energy from Sweden. The company has signed a 10-year power purchase agreement (PPA) with Swedish developer O2 for the energy from O2's planned 72-MW wind farm at Maevaara, in the Övertorneå and Pajala municipality in northern Sweden, which is slated to feature 24 Nordex 3-MW wind turbines.

O2 has secured 100 percent financing for the project's construction from the investment arm of German insurance company Allianz, which plans to assume ownership when the wind farm becomes operational in early 2015.

The agreement takes advantage of Europe's increasingly integrated electricity market, in particular Scandinavia's shared electricity market and grid system, Nord Pool. Under this system Google can buy the wind farm's electricity output in Sweden and consume the same amount of power, with Guarantee of Origin status, at its data center in Finland.

"Google's decision to purchase the full output of the Maevaara wind farm for its Finnish data center was a key element in our decision to invest in the project," said David Jones, head of renewable energy at Allianz Capital Partners. "Maevaara is our first renewable energy investment in Sweden, and the PPA implemented for this project offers an interesting model for further wind farm development in this market."

Google said it has spent more than $1 billion over the last four years on renewable energy projects in the U.S., Germany and South Africa. The Hamina data center is already carbon-neutral, the company said. ○

Argentina Files WTO Claim Over EU Biodiesel Duties

The EU has imposed provisional anti-dumping duties on biofuels imported from Argentina and Indonesia, its largest biodiesel suppliers, following a complaint by the European Biodiesel Board (EBB).

The duties were set between 6.8 and 10.6 percent for soybean-based imports from Argentina, and between zero and 9.6 percent for palm-oil based Indonesian imports. The EBB has welcomed the provisional duties "as a first positive step," but hopes for "higher duties to counter unfair biodiesel imports" from the two countries.

Argentina has filed a complaint with the World Trade Organization (WTO) over the duties. The Argentina Chamber of Biofuels (CARBIO) called the measures protectionist, stating that "the production of soybean biodiesel in Argentina…meets all the requirements set by the EU, which is why the Argentine industry is the biggest supplier to Europe and is a strategic partner of the EU to promote increased use of renewable energies. … The best way to promote the use of renewable energy is free and open markets, without protectionist practices that benefit only a few companies, hurting all consumers and the environment." Argentina says its biofuel producers are currently running at half-capacity because of the duties.

The EU has 60 days to assess the complaint and take action, after which the WTO could be called to adjudicate. Indonesia has said it may also file a WTO complaint in relation to the duties. ○

First Effects of EU Solar Anti-Dumping Duties Seen

According to European trade commissioner Karel De Gucht, "the ball is now in China's court" after the European Commission voted to impose provisional anti-dumping duties on imported Chinese solar panels, wafers and cells. A provisional duty of 11.8 percent was imposed on 6 June and will be applicable until 6 August, at which point the average duty will increase to 47.6 percent. But Europe hopes to avoid a trade war: De Gucht said the action would "open the door to negotiate an amicable solution through 'price-undertakings' within a short period of time."

Analysis firm IHS predicts that retaliatory Chinese import duties on solar products from the EU and U.S. could cause global prices for solar polysilicon products to rise to $19.50/kg in June and July, up from $16.50/kg in May. But the increase will amount to only 18 percent, falling short of the 30 percent indicator that would represent a major market correction, IHS said, and prices would remain below the key $20/kg mark.

"IHS believes China is likely to impose anti-dumping tariffs with rates ranging from 30 to 50 percent on polysilicon imported from the EU, the U.S. and South Korea," said Glenn Gu, photovoltaics senior analyst at IHS. "However, the impact of the duties will be mitigated by factors including long-term agreements that stabilize pricing as well as efforts by buyers and sellers to bypass the tariffs."

In an initial example of these efforts, major UK solar distributor Segen announced that it has added Hyundai 260-W panels, manufactured in [cont >]

[Anti-Dumping *cont. from p13*] South Korea, to its portfolio, "as part of [its] drive to reduce negative market impact of the anticipated EU anti-dumping tariffs." The company had previously announced that it "will be stocking the Winaico WSP-P6 250-W Poly, a competitively priced panel, manufactured in Taiwan and therefore not subject to the EU tariffs."

Eighteen of the EU's 27 member states voted against the tariffs, while hundreds of European solar companies, 15 regional solar PV associations, and various trade groups warned against the action.

After the announcement, UK energy minister Greg Barker and Swedish energy minister Karin Hatt said in a joint statement that the tariffs "will cause heavy job losses in the wider solar photovoltaic sector across the EU; they will raise the cost to consumers of installing household solar panels by up to 25 percent; and they will have a devastating impact on the viability of solar projects across the EU. They could jeopardize the EU's efforts to meet its own target to produce 20 percent of energy from renewables by 2020." ○

This is an ongoing story; visit RenewableEnergyWorld.com for the latest news on the EU tariffs against Chinese-manufactured PV panels.

MIDDLE EAST & AFRICA

More Than 1 GW of CSP Headed for MENA

The US $7.6 billion Climate Investment Funds (CIF) gave the go-ahead to Algeria, Egypt, Jordan, Libya, Morocco and Tunisia to proceed with an updated version of a sweeping plan to bring an unprecedented 1,120 megawatts (MW) of energy from concentrated solar power (CSP) to the region. The plan will receive US $660 million from the CIF's Clean Technology Fund (CTF) and is expected to leverage nearly US $5 billion from other donors and private financing.

The plan, first endorsed by the CIF in 2009, was reviewed by each country to reflect the political and economic conditions in the region and to build on lessons learned from the plan's first project now underway — the 60-MW Ouarzazate I plant in Morocco.

The revised plan realigns projects in the pipeline based on each country's reassessed needs; focuses on well-performing projects as a measure of the plan's success; and expands the plan to include concentrated solar photovoltaic (CPV) technologies and business models including public sector, public-private partnerships (PPPs), and independent power producers (IPPs).

The original plan projected a total of 895 MW of power, but with the revision the region now expects to achieve 1.12 GW, making it the most ambitious CSP program in the world. The countries have also agreed to request a smaller funding envelope from the original US $750 million to US $660 million including currently funded projects.

CTF allocations in the revised plan are:

- Morocco: CTF US $218M for 300 MW (Ouarzazate II)
- Egypt: CTF US $123M for 100 MW (Kom Ombo)
- Tunisia: CTFUS $62M for 50 MW (Akarit) (may increase to 100)
- Jordan: CTF US $50M for up to 100 MW including CPV
- Technical assistance: CTF US $10M ○

For more on CSP, see our feature story, CSP Key Players Focus on the Desert on page 40.

DRESSER-RAND

Bringing energy and the environment into harmony.®

DISCOVER DRESSER-RAND CAES SOLUTIONS WITH MORE DEPTH.

Dresser-Rand recently purchased certain patents and other intellectual property from Energy Storage and Power LLC, that enhances Dresser-Rand's state-of-the-art compressed air energy storage (CAES) technology.

The purchased intellectual property complements Dresser-Rand's existing intellectual property relating to its ***SMART***CAES™ CAES systems, and enables Dresser-Rand to provide advanced CAES solutions from the smallest to the largest grid scale requirements. The technology enables clients to store bulk electrical power on a utility scale and withdraw it on demand when the power is needed.

Dresser-Rand designed and supplied the entire turbomachinery train and controls for the first CAES plant in North America. The process cycle technology, developed by Dr. Michael Nakhamkin of Energy Storage and Power, is complementary to the compression and power generation turbomachinery Dresser-Rand offers and which has been successfully operating for more than two decades.

Contact us today to learn how Dresser-Rand is uniquely qualified and prepared to deliver turnkey CAES solutions worldwide.

The Americas: (Int'l +1) 713-354-6100 / EMEA: (Int'l +33) 2-35-25-5225
Asia-Pacific: (Int'l +60) 3-2093-6633 / info@dresser-rand.com

Compressors–Turbo & Recip / Steam Turbines / Gas Turbines / Engines / Control Systems / Expanders

» www.dresser-rand.com

For more information, enter 8 at REW.hotims.com

AfDB Expects African Wind Power Capacity To Increase 10-Fold

A report from the African Development Bank (AfDB) said that wind power is expected to increase by a factor of 10 over the next few years. The study showed wind power in the country currently makes up just 1 percent of the energy mix — at just 1 GW — but with 10.5 GW of wind power projects in the pipeline, that number will skyrocket.

According to the report, countries with significant wind power potential include Somalia, Sudan, Libya, Mauritania, Egypt, Madagascar, Kenya and Chad.

There are 76 wind-power projects examined in the report, which also breaks down the projects by technology manufacturers. Gamesa is at the top of the list with an installed capacity of 630 MW for projects in Egypt, Morocco, and Tunisia and the manufacturer's turbines are slated for use in 590 MW of pipeline projects. Vestas' turbines are used in projects in Egypt, Kenya, Morocco, South Africa, Cape Verde, and Algeria totaling about 163 MW of installed capacity.

Nordex is the third most-used wind technology provider with 100 MW of installed capacity in Morocco. Also in Morocco, Alstom is at work on the 100-MW Akhfrennir wind power project with Nareva.

Emelly Mutambatsere, senior research economist at the AfDB and co-author of the study, said in a press release that governments should take a leading role in helping to attract private sector funding for wind projects.

"The public sector is definitely still the leading actor in projects of this type," Mutambatsere said. "However, governments should also be involved as principal partners in order to ensure that projects are implemented successfully."

In more recent interviews Mutambatsere has said that private sector funding is beginning to flow in the region. ○

Sunny South Africa Attracting Solar Inverter Manufacturers

Two major manufacturers are looking to capitalize on the burgeoning South African solar market by opening production centers in the country.

ABB plans to open a new inverter production line at its existing facilities in Johannesburg in 2014. The line for its PVS800 range of central inverters will have a production capacity of approximately 500 megawatts (MW) per year. It will produce 630-kilowatt (kW), 875-kW and 1,000-kW central inverters. The company already produces solar inverters in Estonia, India and China.

In related news, solar technology manufacturer SMA Solar Technology AG will expand its presence in South Africa by setting up a production facility to produce the Sunny Central inverter. The company has already begun preparations on the new line.

Both companies cite the local content requirements as drivers for their decisions to expand manufacturing into the region. ○

For further discussion on local content requirements, don't miss this month's "The Big Question" on page 29.

Kenya Receiving Assistance from Japan on Renewable Energy Development

The Japan International Cooperation Agency (JICA) is working to bring more power that includes renewable energy and better transmission to the people of Kenya. JICA's program aims to strengthen the power supply capacity of Kenya through support of power plants and domestic transmission lines. It also intends to strengthen international transmission lines to realize the Power Pooling Initiative in East Africa.

According to a Nikkei newspaper report, JICA plans to offer technical assistance beginning in September to help Kenya reach its goal of installing 5 GW of geothermal capacity by 2020. The country currently has 200 MW of installed geothermal capacity.

The JICA website indicates that the country is assisting Kenya on several other projects: The geothermal Olkaria I Unit 4&5; the Sondu/Miriu hydropower project; and the Olkaria-Lessos-Kisumu power line.

In addition, JICA is working with Kenya officials on the establishment of a rural electrification model that uses renewable energy. ○

ASIA PACIFIC

India's REC Market Crashes

India's Renewable Energy Certificate (REC) trading fell by 87 percent in May, according to the Indian Energy Exchange (IEX), with sellers outnumbering buyers for the first time. Total trading volume fell to 19,212 compared to 153,130 in May 2012, IEX said in a statement.

The crash is due to a supply glut that is expected to continue as the number of RECs injected into the market keeps pace with or outpaces the number purchased. And in a new development, the solar renewable energy credit (SREC) market, which has hitherto been more resilient than the wider REC market, hit its lowest price to date, said an analysis by RESolve Energy Consultants in Chennai. RESolve noted that buy bids for SRECs fell 76 percent from the previous month.

Hari Manoharan, an analyst with RESolve's solar and wind energy division, expects the SREC supply to increase due to numerous REC-based power projects coming up in Rajasthan, and suggests that unless counter-measures are rapidly taken, the SREC market could suffer the same collapse as the wider market.

Under the nation's renewable energy purchase obligation (RPO), Indian power distribution companies are required to buy 5-10 percent of their electricity from renewable sources or purchase RECs in lieu. Project developers are granted one REC for every 1 MWh generated from renewable sources.

The *Economic Times* newspaper called the poor market showing "a reflection of dwindling interest" in RECs, reporting that developers have accumulated over 21 lakh (2100,000) RECs while barely 2 percent of this amount was sold in May. The IEX said: "Distribution companies and captive power generators did not participate in the market despite the fact that many of these entities are yet to fulfill a large share of their obligation."

[cont >]

[REC Market *cont. from p17*] Penalties for non-compliance with the RPO "have not been enforced to a significant extent," according to Sanjay Chakrabarti, head of Ernst & Young's India cleantech practice. The falling interest in the market is a clear indicator that there is a need for a strict enforcement of RPO regulations by state electricity regulatory commissions, the IEX said. And Suresh Prabhu, a former environment minister and power minister, has said investment in Indian renewable energy is at risk, blaming regulators for their inability to enforce the RPO.

"[The] Renewable Purchase Obligation is part of the Electricity Act itself and regulator has to decide its quantum from time to time. Non-compliance of this obligation will jeopardise investments in [the] renewable sector," Prabhu said. ○

China Says It Will Not Set Carbon Cap

Although several major newspapers of record reported in May that China's National Development and Reform Commission (NDRC) had proposed introducing a cap on greenhouse gases from 2016, the nation says it has no such plan.

The *Financial Times* had reported that Jiang Kejun, a carbon policy researcher with the NDRC, said China was considering an emissions cap for the 13th five-year plan (2016-2020) and was looking into appropriate levels.

Su Wei, China's chief climate negotiator and director-general of the NDRC's department of climate change, dismissed the news reports in a Bloomberg interview while noting that China will uphold its current agreement to cut its carbon intensity (a measure of carbon emissions in relation to economic output) by around 40 percent of 2005 levels by 2020. Su's comments are the first by a senior Chinese negotiator since the reports were published.

"There are lots of ways we can achieve the carbon-intensity target by 2020," Su said. "We would certainly make arrangements in both the 12th and 13th five-year plans to achieve that objective." NDRC has announced plans to launch a carbon trading scheme in Shenzhen, which will cover 638 companies that produce 38 percent of the city's emissions. Six other locations plan to roll out the scheme in before 2014.

China accounts for almost one quarter of global CO2 emissions. ○

Geothermal Energy Set To Take Off in Asia Pacific Region

More than 4 GW of geothermal power capacity are expected to come online worldwide between now and 2018, according to a new report.

The study by Navigant Research reveals that at the moment there are 56 projects in either active drilling or construction stages and all are in the U.S., the Philippines and Indonesia.

And Mackinnon Lawrence, principal research analyst with Navigant, says that the 4 GW figure could be just the tip of the iceberg: "This total includes only projects in advanced stages of development. A significant, though mostly unconfirmed, amount of capacity remains locked up in early-stage projects. As a number of these projects are further developed and their resource potential confirmed, the long-term pipeline — 2017 and later — is expected to expand proportionally."

Navigant states that although the U.S. leads all regions with the largest number of projects in the pipeline, the Asia Pacific has the most reported capacity under development, with 7.4 GW currently in the pipeline, representing 40 percent of the global capacity under development.

Latin America and Africa account for a combined 3.8 GW of additional capacity under development, equal to 20 percent of the global pipeline." ○

Get connected to the sun!

www.multi-contact.com

Solar*line*

Connectors for Renewable Energy

Unchallenged: 1000V UL/1500V TÜV recognized

PV connector MC4-EVO 3 for higher performance

- With innovative integrated sealing system for high protection categories IP65, IP67 and IP68 (1h / 1m)
- The snap-in lock can only be opened with a special tool, providing maximum dependability
- Pre-assembled with conductor cross sections 1,5mm², 2,5mm², 4mm² or 6mm²
- Fully compatible with the original MC4 system

Meet us at the international top events of the PV industry:
www.multi-contact.com > News > Exhibitions

Advanced Contact Technology

Multi-Contact

MC

STÄUBLI GROUP

For more information, enter 9 at REW.hotims.com

Japan's "Third Arrow" Aims for Renewables, Energy Storage

Japanese prime minister Shinzo Abe's latest speech detailing the "third arrow" of his three-pronged economic policy included a pledge of ¥30 trillion (US $302 billion) aimed at boosting competition in the electricity sector and encouraging renewable energy development.

The prime minister endorsed proposals to deregulate the largely fossil fuel-based electricity sector, encourage competition among generators and enable easier distribution of wind and solar power to consumers. He did not mention restarting any of the nuclear plants that have been offline since the Fukushima disaster — something the utilities had been hoping for.

Abe also mentioned fuel cells and batteries for energy storage as aspects of a move to encourage innovation in order to help integrate variable renewables into the grid. He promised to "bring about the potential for such innovations" by unbundling transmission and distribution. And he said environmental assessment processes for renewable energy projects will be "drastically" accelerated, which will stimulate investment.

Nathaniel Bullard, an industry analyst at Bloomberg New Energy Finance (BNEF) in Hong Kong, called the proposed measures "a bold attempt to increase competition and bring in new market players."

Utility shares fell drastically in reaction to the speech in anticipation of a government move to weaken power producers' current monopoly after the upcoming parliamentary election. Japan's 10 regional power companies own more than 70 percent of the nation's generation capacity and control the transmission and distribution networks. BNEF said smaller energy companies such as Marubeni and Softbank, which are planning renewable energy investments, would be strengthened by such a move. ○

Hybrid Wind-Tidal Turbine To Be Installed off Japanese Coast

A hybrid wind-current power generation system will be installed off the Japanese coast later this year, said Tokyo-based Mitsui Ocean Development & Engineering Company (MODEC), the device's developer.

The 500-kW Savonius Keel & Wind Turbine Darrieus, or SKWID, is a hybrid system featuring an omnidirectional Darrieus wind turbine and a Savonius tidal turbine, which share a floating axis. A power generation assembly sits between them at deck level, anchored by a set of rubber mounts to a floating semi-submersible platform. The system will be able to generate power from either or both sources.

The wind turbine will have a hub height of 47 meters (154 feet) and a rotor diameter of 15.2 meters (49 feet), according to the company.

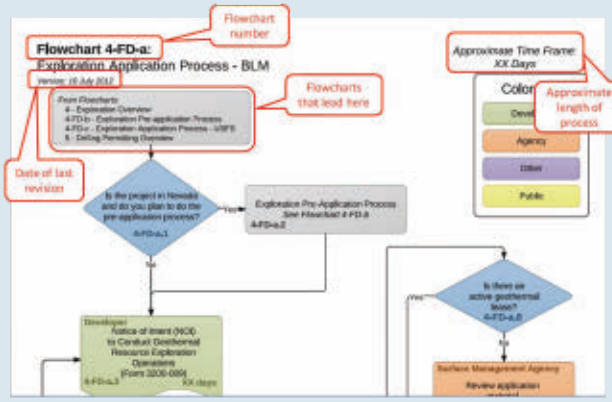
Addressing the issue of stability, the company said the tidal turbine acts as ballast, making the assembly self-righting, and that the location of the generator at deck level creates a low center of gravity as well as offering easy access for operations and maintenance. The Savonius tidal turbine is especially suited to harvesting energy from weak currents, MODEC says, and its rotation can be used to start the wind turbine spinning in low wind conditions.

MODEC is an offshore technology company specializing in floating oil and gas production systems. ○

NORTH AMERICA

DOE Launches Geothermal Regulatory Roadmap

In hopes of reducing one of the more costly and time consuming steps in geothermal project development, the U.S. Department of Energy issued its Geothermal Regulatory Roadmap to "help developers navigate regulatory requirements at every level of government." The DOE charged the National Renewable Energy Laboratory with the task of rounding up key industry representatives and federal, state and local officials to pinpoint areas where development may be streamlined.



In 2011, a DOE report identified permitting as one of the largest barriers to geothermal development. According to industry experts, a geothermal project typically takes seven to eight years to complete, and four of those years are bogged down with permitting red tape. At a recent conference, Karl Gawell of the Geothermal Energy Association called for the industry to come together and deal with the issue. "We don't want to end up in a corner where we are either not building these projects and having climate change come down around our ears, or we are building these projects but [they are] repealed. We need to find somewhere in the middle," he said.

The roadmap includes clear-cut flowcharts with instructions for each step of the development process, whether a project is in the siting phase or drilling phase, and links to necessary documents and forms. The roadmap is currently available for eight geothermal-heavy states: Alaska, California, Hawaii, Idaho, Montana, Nevada, Oregon, and Utah, with Colorado and Texas next in line. DOE hopes the roadmap will help lower development costs and reduce financial risks. ○

Coalition for Renewable Heating and Cooling Forms in Massachusetts

While most incentives focus on renewable energy electricity and fuels, The Northeastern part of the United States has slowly been making inroads to include renewable heating as part of state Renewable Portfolio Standards. Now, a Coalition has formed in Massachusetts to include biomass, solar and geothermal heating in the Massachusetts Alternative Energy Portfolio Standard. SB 1593 was filed in early January 2013 by Sen. Finegold of Andover, Mass.

Following a recent win in New Hampshire, which added thermal energy to its renewable portfolio standard last year, other New England states are noticing the benefits. According to Charlie Neibling, principal and partner of Innovative Natural Resource Solutions and former general manager of New England Wood Pellet, more than 85 percent of U.S. heating oil is consumed in New England, which amounts to about 5 billion gallons per year. Many areas do not have access to natural gas, including large sections of Massachusetts, New Hampshire, Vermont and Maine, and must use pricey heating oil and propane. Many residents and [cont >]

[Massachusetts *cont. from p21*] commercial entities are looking for other options, and renewable heating and cooling has become a logical choice.

As renewable systems are on the rise, consumers aren't the only ones who will benefit, said bill supporters. "Utilities will have more sources from which to purchase their alternative energy supplies, increasing price competition, and will avoid the need to make expensive 'alternative compliance payments' to the state. These market corrections will ultimately reduce costs to electricity ratepayers."

Supporters of the bill include the Massachusetts Forest Alliance, Solar Energy Industries Association, Biomass Thermal Energy Council, and GeoExchange. Legislative action is expected to take place this summer. For continuing coverage, visit RenewableEnergyWorld.com. ○

Department of Interior Approves 520 MW of Solar and Geothermal

The U.S. approved two solar projects and one geothermal plant that will total 520 MW of capacity in Arizona and Nevada. The 100-MW Quartsize Solar Energy project will be located in Arizona, while the 350-MW Midland Solar Project and 70-MW New York Canyon Geothermal Project will be located in Nevada.

According to the Department of the Interior (DOI), each project went through extensive environmental and public review processes in order to minimize environmental and human impacts as part of its "smart-from-the-start" approach to renewable development.

"The President has called for America to continue taking bold steps on clean energy," said the Bureau of Land Management Principal Deputy Director Neil Kornze in a statement. "Our [approach] has helped us do just that, paving the way for responsible development of utility-scale renewable energy projects in the right way and in the right places."

The Quartsize Solar Project will use SolarReserve's concentrating solar power (CSP) technology that uses power towers. Heliostats, the fancy word for mirrors, focus the sun on central towers where the heat is used to make steam and spin turbines to generate electricity. Excess energy is stored in molten salts to be used when needed. This technology is similar to the technology in use at the nearly complete 377-MW Ivanpah project in California led by Brightsource. Though the Obama Administration fast-tracked the project for approval, it has yet to score a power purchase agreement (PPA).

Boulder Solar Power will head up the Midland Solar Project, which will consist of 76 acres of photovoltaic panels and transmission infrastructure. The New York Canyon Geothermal Project will be built by TGP Dixie Development Company, a subsidiary of TerraGen Power. According to the DOI, Boulder Power and TerraGen worked closely with environmental agencies to avoid and minimize environmental impacts, which resulted in reduced land coverage, minimized water resource disturbance, and avoidance of wildlife.

All together the projects are expected to create more than 900 jobs from the construction of the plants through the operation of them. The DOI's Bureau of Land Management has an addition 15 sites slated for review in 2013 and 2014. ○

WTO Upholds Ruling Against Ontario Wind and Solar DCR

After its initial decision in December 2012, the World Trade Organization (WTO) again ruled in favor of Japan and the European Union (EU) over Ontario's domestic content requirements (DCR) for wind and solar projects following a lengthy appeal process.

Japan and the EU filed an initial dispute in 2010, which claimed that Ontario's feed-in tariff (FIT) program included provisions that violated the General Agreement on Tariffs and Trade (GATT). These provisions state that governments are not allowed to require power-generating companies that participate in the FIT program to use a certain percentage of local equipment or services. In order to qualify for the Ontario FIT, projects are required to use 25 percent local content for wind projects and 60 percent for solar.

Ontario said it will comply with the ruling, and has since discontinued its FIT prgram for "large" projects over 500 kW. The program will be replaced with a bidding system, which is similar to what was implemented before the FIT. Up to 900 MW of small-scale projects will be able to use the FIT program though 2018. However, it has not been determined whether the changes will affect existing FIT contracts. ○

The Ontario ruling has sparked a debate within the renewable energy industry: Are these domestic content requirements fair? Find out what industry insiders had to say in "The Big Question" on page 29.

LATIN AMERICA

Tapping Brazilian "Bagasse" for Electricity Production

French company Albioma (née Sechilienne-Sidec) wants to invest 400 million euros (about US $528 million) over the next decade to tap into the confluence of two established and emerging sectors in Brazil: converting sugarcane waste into electricity.

"Bagasse," the crushed cane stalks left over after sugar has been extracted, has an energy content of about 450 kWh/metric ton, which is similar to wood and about half that of coal, but it's sparingly used as an energy source; only about 10 percent of the 500 million metric tons of bagasse produced globally gets converted into energy, notes Reuters. One metric ton of sugar cane yields about 300 kg of bagasse, and Brazil produces 560 million metric tons of sugar cane annually. Brazil could as much as double its biomass electricity generation, to 10-15 percent of its overall energy mix, by better leveraging its bagasse resources.

Several Brazilian firms already are tapping into the promise of bagasse to produce power. Raizen has 13 thermoelectric power plants and total installed capacity of 934 MW in 24 mills, with potential annual electricity of 1.8 million MWh. Others working with bagasse in Brazil include ETH Bioenergia and several domestic arms of French sugar companies.

Enter Albioma, which processes 2 million metric tons/year of bagasse and touted 567 MW of installed capacity in 2012 (and 573.4 GWh power generation as of March 2013) for its "thermic biomass." The firm has been using

bagasse in overseas French territories from Mauritius and Guadalupe, including investing hundreds of millions of euros in a bagasse project in Martinique, and is now negotiating with sugar mills in Brazil to buy out their plants, Reuters says. Long-term contacts with famers, sugar mills, and the state grid take time to negotiate, but financing is "readily available" from the Brazilian Development Bank (BNDES), according to Albioma CEO Jacques Petry, quoted by Reuters. ○

Investors Pair Up for Chilean Wind-Solar Projects

In May of this year Chile exceeded 1 GW of installed capacity of renewable energy, and is on track to possibly achieve 1.3 GW by year's end, according to the Centro de Energías Renovables (CER). More than half of that comes from biomass and nearly a third from hydro. Chile has a growing appetite for renewables, though, with roughly 10.5-GW of projects approved or under assessment.

A new joint venture aims to tack even more onto Chile's renewable energy plate. Global wind and solar developer Mainstream Renewable Power and global emerging market investor Actis have formed a joint venture to develop 600 MW of wind and solar projects in Chile by early 2016, which would increase the country's renewable energy capacity by 3.6 percent. Actis will

invest $290 million as the the majority stakeholder — with a 60 percent share — in Aela Energía and purchase projects that have been developed by Mainstream Renewable Power. Mainstream will continue to manage construction and support operation and maintence of the projects.

The move represents Actis' first investment in Chile, but the company is active elsewhere in the region. It's an investor in Honduras' Cerro de Hula, the largest wind farm in Central America, and manages Energuate, Guatemala's national electricity distribution company. Mainstream's own renewables portfolio in Chile includes more than 3.5 GW of wind and solar projects, about a fifth of its overall global pipeline. The two companies have worked together before. In 2012 Mainstream won three government tenders in South Africa for 238 MW of wind and solar projects that are currently in construction. Actis invested $100 million in the projects, which are due to be operational in early 2014. "This platform is about meeting the needs of offtakers, particularly large-scale industrial consumers in Chile who need top quality projects and competitive electricity prices," stated Mainstream CEO Eddie O'Connor. "The market is looking for independent power producers with strong financial backing, expert local knowledge, and experience in delivering operational assets. This joint venture very much ticks all of these boxes.

O'Connor noted that this Actis collaboration is ideal to accelerate its Chilean project pipeline — and perhaps beyond. "Mainstream has a global pipeline of over 17,000 megawatts of wind and solar projects across four continents," he stated. "This is something we may look to replicate across our other markets." ○

Major Solar Projects in Mexico Move Ahead

Mexico's first double-digit utility-scale solar projects are heading into the pipeline. The first 20-MW phase of Sonora80M's proposed solar park in Hermosillo, located in the northern state of Sonora, is planned to begin construction this year and come online in the first quarter of 2014; ultimately Sonora80M is planning four stages totaling 80 MW of capacity.

The project now has a new offtaker: Ford Motor Company, which has a local stamping and assembly plant, will take 15 percent of the power generated from the project's first phase. Sonora80M Group already had secured 25-year power purchase agreements (PPA) with seven local municipalities: Alamos, Caborca, Splice, Etchojoa, Guaymas, Santa Ana, and Hermosillo. Martifer Solar is contracted for engineering, procurement and construction (EPC) and operations and maintenance (O&M) on the project.

Meanwhile, there's an even bigger project on the horizon on 100 hectares in La Paz, Baja California: Gauss Energía's 30-MW Aura 1, which is being referred to as the biggest solar PV project in all of Latin America. The site will incorporate 132,000 panels on single-axis trackers, with production capacity of 82 GWh/year, and it has a 20-year PPA with Mexico's Comisioón Federal de Electricidad. Construction is slated to be completed in August 2013, with Martifer also doing the work. The company points out that Mexico's largest operating solar project is just 5 MW, and the country's total is just 13 MW of installed solar energy capacity. ○

UN Recognition for Hydro in Brazil, Wind in Uruguay

Two more renewable energy projects in Latin America are recognized under the United Nations' Framework Convention on Climate Change (UNFCCC) and its Clean Development Mechanism (CDM), which was established as part of the Kyoto Protocol to spur implementation of projects that contribute to the reduction of greenhouse gases, and that can also be used as a carbon credit "cap and trade" mechanism.

In Brazil, the 3.75-GW Jirau hydropower plant has been recognized as the largest renewable energy plant under the CDM. Jirau, located on the Madeira River in the northern state of Rondonia, is being developed by GDF Suez, Eletrosul, and Chesf (Mitsui was brought on recently as an investor), and should be commissioned later this year. Its operating permit was granted last year by the Institute of the Environment and Natural Resources (IBAMA).

And in Uruguay, SOWITEC has registered the nation's first CDM program of activities (PoA) for wind energy. The 81-MW, 27-turbine Castillos Norte project in the country's southeast, which will deliver an anticipated 336,000 MWh per year to the national electricity grid. "Our project will be able to supply more than 100,000 households with CO2-free electricity," proclaimed Tabaré Pagliano, director of SOWITEC Uruguay. The company is encouraging other similar local projects to join its CDM PoA, which means they won't have to undergo their own CDM project cycle, helping to reduce costs and speed up approval processes. ○

MOVING ENERGY FORWARD

DISCOVER THE NEW SCIENCE OF SUSTAINABLE ENERGY

From energy generation to distribution, management and usage, we are helping advance new sustainable sources and technologies, making energy cleaner, more reliable and more efficient. Through New Science, UL is working to mitigate sustainable energy risks and safeguard innovation.

JOURNALS. VIDEOS. INFOGRAPHICS. TRENDS.
VISIT UL.COM/NEWSCIENCE

NEW PENNWELL EVENT COMING TO AFRICA

DISTRIBUTECH® AFRICA

Co-located with POWER-GEN AFRICA

EQUIPPING UTILITIES FOR THE FUTURE

17-19 March 2014
Cape Town International Convention Centre
Cape Town, South Africa

INVITATION TO EXHIBIT

The inaugural DistribuTECH Africa is a must attend event for any company involved in the power and water transmission and distribution industry..

With Africa's electricity consumption expected to grow at a rate of 3.4% per year until 2020, DistribuTECH 2013 is expected to play an important role in the expanding market and lead the way in the advancement of the transmission and distribution industry.

This annual forum not only provides the ideal opportunity to address technological challenges, but also launch new products and showcase your company amongst an audience of key decisions makers from leading international operators, manufacturers and suppliers.

BOOK YOUR BOOTH TODAY

For booth and sponsorship enquiries, please contact:

Leon Stone
Exhibit Sales Manager - Rest of the World
T: +44 (0) 1992 656 671
F: +44 (0)1992 656 700
E:leons@pennwell.com

Andrew Evans
Exhibition Sales - Africa
T: +27 (21) 913 5255
F: +27 (0) 86 770 7447
E: andrewe@pennwell.com

WWW.DISTRIBUTECHAFRICA.COM

Owned & Produced by: PennWell

Host Utility Sponsor: Eskom

Presented by: POWERGRID INTERNATIONAL

Supporting Organization: ippf Independent Power Producers Forum

Do Domestic Content Rules Help or Hurt Renewables?

Over the past few years the World Trade Organization (WTO) has been called upon to investigate cases of domestic content rules (DCR, also known as local content rules or LCR) in renewable energy policy. In a more recent case, Ontario was accused of violating trade law by requiring renewable energy developers to purchase a designated amount of locally sourced materials for projects as part of its feed-in tariff (FIT) program. In December 2012, the WTO found these practices to be illegal and upheld its ruling in May after an appeal was issued. Meanwhile, many countries still incorporate similar rules in their incentive programs.

Renewable Energy World asked industry executives to share their thoughts and insights on this controversial question: Do domestic content rules, those that require projects to use a certain amount of services or material that is produced locally, help or hurt the renewable energy industry?

Steve Sawyer
Secretary-General, Global Wind Energy Council

THE LATEST RULING by the WTO on the Ontario FIT is welcomed by the wind industry. In 2012, wind energy grew by nearly 20 percent in Canada, driving over €1.49 billion ($1.95 billion) in investment and creating over 10,500 person-years of employment. The wind industry in Canada installed 936 MW in 2012, bringing total installed capacity to 6.2 GW by the end of the year. We expect a market in the vicinity of 1.5 GW for 2013 and in that same range for the next few years, as Canada seems well on track towards the industry target of 12 GW by 2016. Ontario remains by far the largest provincial market, followed by Quebec and Alberta.

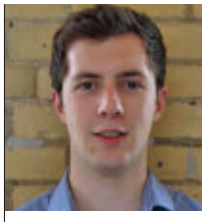
Legal recourse to national practices that distort trade is time-consuming and introduces significant uncertainty for clean energy

Ontario Wind Farm via Shutterstock

investors and manufacturers. In the past decade, we have seen a number of countries use policy mechanisms that include LCR provisions to promote green industry.

Current over-capacity in wind turbine manufacturing means that fulfillment of LCRs merely exacerbates an already severe problem. Ideally, we would like unfettered trade in renewable technologies, but we're a long way from that. But perhaps a middle ground could be found.

The LCR approach for promoting domestic production and employment opportunities can be brought about by a positive incentive scheme, perhaps incentivizing manufacturing tax credits, or an adder on top of the FIT for locally sourced components. But in the interim, the top-down enforcement of LCR is likely to do more harm than good for both the local and the international wind industry and our outlook for a sustainable clean energy future.



Mark Bissegger
Analyst,
ClearSky Advisors

ARE DOMESTIC CONTENT REQUIREMENTS (DCRs) good or bad for the renewable energy industry? That depends, of course, on who you ask. Either way, DCR is here to stay. A protracted dispute over DCR with no clear resolution, however, will be bad for the industry in the long-term.

Whether we like it or not, DCR will be a defining feature of renewable energy procurement for the foreseeable future. Countries will always intervene to protect their own energy interests, and DCRs provide a perceived benefit to the politicians and bureaucrats that introduce them. Those benefits usually consist of some combination of the following:

1. Cheaper/more reliable electricity during peak loads.
2. Increase domestically produced electricity for energy security.
3. Increase employment, innovation, and industry capabilities domestically.
4. Reduce greenhouse gas emissions.

DCRs generally increase costs (hurting #1 above) but help create employment and domestic energy capability (contributing to #2 and 3 above). As such, in many jurisdictions, DCRs provide the necessary political impetus to promote local solar development, which, proponents argue, also helps #4 above.

Disputes over DCR may be necessary to protect interests and a natural element in energy trade. But disputes must be resolved in a reasonable amount of time. If disputes over how countries can best protect their interests in renewable energy development and procurement are allowed to drag on indefinitely, the resulting uncertainty will hurt the industry more than the additional costs of DCRs ever could on its own.

Yogesh Khandelwal
President and CEO, geoAMPS

THE RENEWABLE ENERGY INDUSTRY is both global and local. Individual communities seek the advantages of economic development, jobs, growth of the tax base, and additional revenue for schools, infrastructure and emergency services. The global community is focused on economic development, but also sees the advantages of reduced carbon emissions that are blamed for climate change.

This is what makes the WTO ruling against Ontario's DCR so problematic. To advance the global goal of increasing renewable energy, local needs and concerns must be respected.

While some will argue that everyone should embrace the benefits of renewable energy, the reality is that this is not the case. Wind projects especially are opposed in some communities, even at the neighborhood level. This can force lengthy project delays or abandonment. Adversarial relationships won't achieve ambitious goals for expanding renewable energy.

The WTO ruling jeopardizes Ontario's robust program of installing more than 5,600 MW of new wind energy by 2018. Ontario officials say that the program would create tens of thousands of jobs, attract $16.4 billion in private investment and contribute more than $1.1 billion of revenue to municipalities and landowners in the form of taxes and lease payments.

Ultimately, it will be local communities, not international intervention, that drive the transition from reliance on fossil fuels to utilization of renewable sources to meet the increasing need for energy on a global scale. Local benefits, such as those projected for Ontario, are real incentives to advancing renewable energy, while the WTO's ruling is restrictive.

Mike Dooley
VP of Marketing, AE Solar Energy

ADVANCED ENERGY doesn't view local content laws as having a positive or negative impact on the long-term demand or adoption of renewable energy in a given market. Local content measures on their own are designed to drive local investment and job creation. Any market impact is short lived and limited to the supply side while manufacturers ramp up capacity to meet local content requirements. As a global company, we comply with local content requirements in strategic markets but also believe there is value in having an organic local presence in the regions we service to better meet the needs of our customers and partners. ◑

To lend your voice to future discussions, email megc@pennwell.com for more details.

The Great Solar Debate: Where Does the Global Solar Industry Stand?

VINCE FONT, *Contributing Editor*

With the unsettlingly high number of solar companies filing for bankruptcy, there are many who feel the global solar industry is on rubbery legs. But not everyone's convinced the end is nigh. Some are of the opinion that bankruptcies are endemic of a maturing industry — sort of a "survival of the fittest" scenario that weeds out the weaklings and enables evolutionary leaps to occur. Both views have a sound basis in reality that make it tough to answer the (seemingly) simple question: Is the solar industry healthy or sick?

Taking the pulse of the global solar industry shows an industry half in distress and half healthy. Experts debate solar's sustainability as it exists today and offer some possible future scenarios.

In a recent webcast held by Renewable Energy World aptly named "The Great Solar Debate: Where Does the Global Solar Industry Stand?," three of the industry's best minds came together to answer

lar
d?

The 58-MW Phase 1 of the Copper Mountain Solar Facility in Nevada, USA. *Credit: Sempra Energy*

that question, as well as to discuss and debate the major challenges faced by what is arguably the most embattled energy generation technology on the planet.

Of Bankruptcies and Falling Margins

According to Paula Mints, Founder and Chief Market Research Analyst for SPV Market Research, with a 20-year history studying the solar industry, the spate of bankruptcies along the solar manufacturing chain is bad news — as are the negative operating margins of the top 10 solar PV manufacturers of 2012, which range from -3 percent to -33 percent. *(See table below showing the Top 10 Manufacturers by Operating Margin)*

"In 2012, there was a significant drop in revenues over 2011," Mints said, pointing to a 38 percent decrease in the course of 12 months. "That's not good news if you're selling technology." According to Mints' global data, the average selling price (ASP) of solar technology also plummeted 48 percent from 2011 to 2012.

Minh Le, Director of the Solar Energy Technologies Office for the U.S. Department of Energy, displayed a slightly more optimistic view of the global solar industry, despite the kind of data that could cause consumers to think twice about installing solar panels on their roofs – or potential investors from putting money into what many fear could be a risky proposition. "I'm actually fairly bullish in the long run for solar," Le said, citing some $93 billion of global PV product trade in 2011. He points out that in comparison, the global trade of integrated circuits is approximately $300 billion per year, adding that there exists "tremendous opportunity for continued growth" in the global solar sector.

Jigar Shah, CEO of Jigar Shah Consulting and founder of SunEdison, shares Le's optimism in that regard. "Now that the cost of solar has come down tremendously in 2012, it's disrupted the industry," Shah said. "We're now at a point where a lot of mainstream players see solar as cost effective, so the amount of money being spent on deployment is a lot higher today than it was two years ago."

Shah also downplayed the concern over bankruptcies, indicating that such hiccups are to be expected. "There will be manufacturers that go bankrupt and manufacturers that don't," Shah said. "There will be a lot of folks who go out of business, but

TABLE 1

Top Ten Manufacturers 2012 Ranked by Operating Margin	Operating Margin % (based on Cell/Module Revenues)	2012 Shipments MWp
First Solar	-3%	1875.4
Canadian Solar	-11%	1543.0
GinTech	-12%	1059.0
Trina Solar	-20%	1590.0
Sharp Solar	-20%	1058.0
JA Solar	-22%	1700.0
Yingli	-23%	2297.1
Suntech	-25%	1750.0
Motech	-31%	1274.0
NeoSolar	-33%	910.0
Weighted Average	-17%	

Table Courtesy Paula Mints, SVP Market Research.

DuraTrack™ HZ

When it comes to large-scale arrays, it's time for fixed-rack systems to wake up and smell the coffee. The DuraTrack HZ single axis tracking system adds hours of sunlight thanks to a horizontal axis that follows the sun, and backtracking that helps eliminate shading to deliver maximum production in the early morning and late afternoon. But don't let the elegant design of the DuraTrack HZ system lull you into thinking it doesn't have the brawn to deliver year after year. It's all about less down-time and more sunshine, and that means a fast ROI for you and your customers. Get the tracker that outperforms fixed-rack systems like they're, well, standing still.

ARRAY TECHNOLOGIES

sales@arraytechinc.com | 1.855.TRACKPV (872.2578) | arraytechinc.com

For more information, enter 13 at REW.hotims.com

First Solar's Sarnia power plant in Ontario, Canada. *Credit First Solar.*

there'll be other folks to step in and take their place."

Shah points to various world governments who, over the course of the last decade-and-a-half, have attempted to "buy their way into market share" as evidence that lasting success in the solar industry will not be artificially manufactured, but will emerge organically. "The Japanese decided to buy their way into market share back in 2000," Shah said. "In 2003, the Germans. By 2007, the Chinese decided to buy their way to market share. And now, the Koreans are stepping in. I think you'll see the Koreans over the next five years try to lose as much money as possible trying to figure out how to dominate the industry. The real question is: are we getting the stability point?"

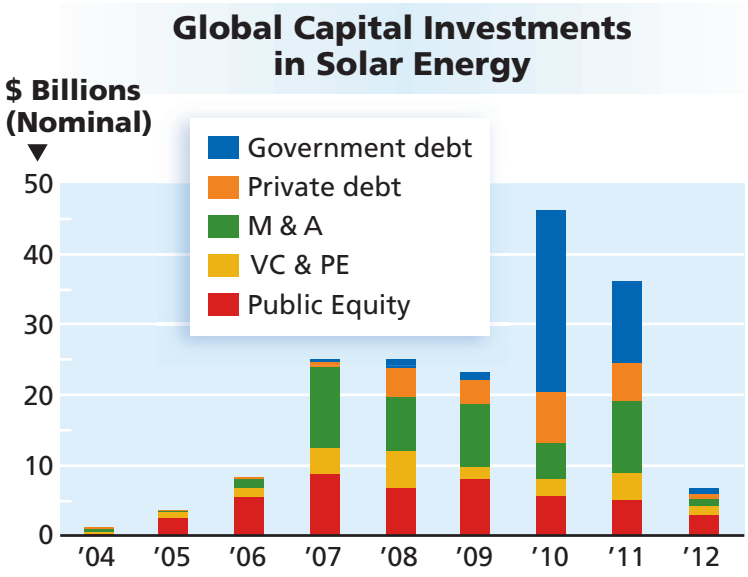
Innovation and Investment: Two Keys to Solar's Survival

All three experts agree on one thing: innovation is crucial to the survival of the solar industry. But what are some of the factors that have the potential to threaten innovation? Mints and Le argued that one of the key issues that can and will play heavily into the equation is the one of global overcapacity — or a lopsided ratio of demand versus actual solar product supply.

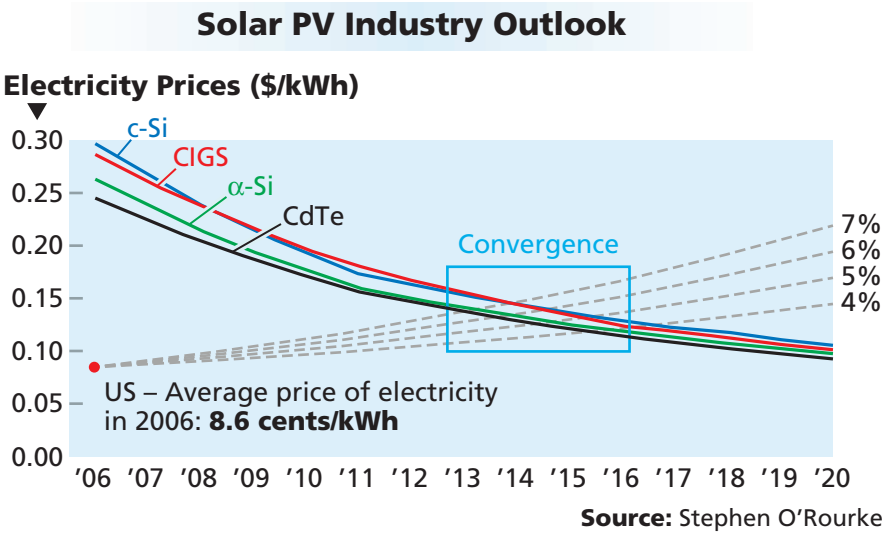
"Current global manufacturing capacity is significantly higher than global demand," Le said. "That means a lot of factories are either not running at full utilization or there are many that are idle or shuttered. We're still in a very significant oversupply situation in the cell and module manufacturing sector, and best projections from analysts continue to suggest that there will be continued oversupply for years to come."

According to Le, low ASPs and negative operating margins might scare away potential investors. This has the potential to result in lost opportunities with respect to the development of cutting edge technologies that could drive production costs down while improving quality. "The challenge is, when

ASPs go down too fast there can also be repercussions in terms of investments," Le said. "Throughout the 2006 to 2011 timeframe, there was significant investment in the solar sector — and in the U.S. solar sector, in particular. But going into 2012, what you saw was a very dramatic decrease." Le said this is a result of investors deciding to remain on the sidelines. "That's very worrisome," he said, "because there needs to be continued technology advances in order to achieve more



Source: Total deals tracked by the BNEF desktop
Note: Government debt is by date that credit lines were extended. Not all of these credit lines are likely to have been drawn down. Investment in companies only, excludes investment directly into solar projects.



Source: Stephen O'Rourke

widespread grid parity for solar energy."

"Innovation costs money," Mints added. "R&D requires investment. It also requires investment on the demand side and I can tell you right now, there's a squeeze those margins too. It's not healthy."

In addition to the issues of cost and innovation, government subsidies — or lack thereof — continue to be just as critical to the growth of the solar industry. "It's not a balanced industry right now," Mints said, noting that conventional energy producers continue to enjoy incentives and subsidies, while those of solar are in seemingly constant jeopardy. "I know those who say there should be no subsidies for any energy. If it were an even playing field, we'd see a completely different battle. I think we'd have less pressure. You never see a conventional energy producer having to fight so hard to keep their direct and indirect subsidies. Just because it has always been that way doesn't mean it always needs to be that way."

Mints stressed that although she supports Department of Energy (DOE) programs that focus on innovation, there remains a great need for continued subsidies. "I don't know that it's time for us to give up the fight on at least pointing out that it's an unfair battle. I also don't like the term grid parity — because if we're at parity with subsidized energy source, how fair is that?"

Solar Demand on the Rise

Regardless of whether the pursuit of solar is the right thing to do for the planet or the smart thing to do for the wallet, none of that really matters if there is no interest among the populace for adopting solar as an alternative to fossil fuel electricity generation. The good news for solar proponents is that demand in the U.S. is rising. According to Le, U.S. deployment of solar was at around 435 MW in 2009. In 2012, those numbers were in excess of 3 GW.

"We expect to see continued growth in the U.S. market in 2013," Le said. "I'm also seeing demand in other regions of the world, including Japan as well as China. China will overtake Europe in terms of being the world leader in demand. That will do wonders in terms of excess manufacturing capacity in the global marketplace."

Shah envisions a time in the near future where the rising cost of conventionally produced electricity will drive both increased demand and participation among those eager to seize upon the inherent cost efficiencies of solar energy. "About 20 percent of electricity globally is sold at over 20 cents per kWh [kilowatt-hour]," Shah said. "Some of that is because it's produced using diesel fuel, and the rest is due to utility mismanagement. This is all expensive electricity that can be better supplied by solar power at today's installation and financing costs," he said.

Shah is convinced that this fact alone is what has been driving "thousands of non-solar electricity experts to enter our industry in 60-70 countries around the world," he said. "They represent the 'barbarians at the gate' and will fuel continued 20 percent annual global MW growth for the solar industry through 2020."

That Old Supply/Demand Problem

Will supply and demand ever be in balance so that all players from manufacturers to installers are happily making a profit and solar panels are slowly but steadily blanketing the earth? Shah isn't convinced that manufacturers need to be "hugely profitable" but said that if panel prices were to remain flat for the next couple of years, by the 2015 or 2016 timeframe, he thinks module manufacturers will have positive gross margins. Mints is more reticent, saying that she'd like to see prices stabilize before she'd be ready to go out on a limb and predict when balance will be achieved. "There's just no visibility on that yet," she said. Le thinks balance will happen more readily for the module manufacturers that are vertically integrated such as First Solar or SunPower, but he doesn't want to guess when total system health will return to the solar industry. "I'll leave that to the financial analysts," he said. ◑

Missed the live debate?

Click here to listen to the archived version of The Great Solar Debate.

CSP Key Players Focus on the Desert

Power generation in hot, dry areas makes CSP a viable solution for desert applications. By expanding into process heat and enhanced oil recovery, the concentrating solar technology is running full steam ahead.

JENNIFER RUNYON, *Managing Editor*

By the end of 2013, the largest solar power plants in the world will be generating power from the sun and they won't be using photovoltaic (PV) technology. Brightsource's 277-MW Ivanpah in California, Areva's 250-MW project in Rajasthan, India and many others are all set to come online by the end of the year. The 100-MW Shams 1 project commenced operation in Abu Dhabi in March. "The outlook for CSP has never been brighter," said Alison Mason, Director of Marketing at SkyFuel.

CSP technology captures solar energy through troughs or mirrors (also called heliostats), which are set on trackers and concentrate the sunlight to generate power. Mainly used in utility-scale power generation projects, the technology also holds promise for other applications, including process heat and enhanced oil recovery operations (see sidebar on page 44). To date, however, the technology has struggled to gain ground. Back in 2010, thousands of megawatts of CSP projects were in the works, but that number was slowly pared down as developers of large utility-scale solar projects switched their technology from CSP to PV because of dropping PV panel prices. Nonetheless, today there are almost 12 GW of CSP projects in some form of development all over the globe and 2.7 GW of operating plants worldwide.

Worldwide Geographical Markets and Applications

CSP companies are targeting sun-drenched countries that have solar incentives on the books, said Mason. She said traditional oil-producing countries are "investing heavily in CSP to free up their oil for sale." In addition, she said SkyFuel is targeting "all markets with incentives for CSP" and named Italy, Turkey, the United States, India, China, Saudi Arabia, Qatar, South Africa, and Chile" as good examples of such markets.

Areva Solar is also targeting the MENA (Middle Eastern and North Africa) countries. According to Jayesh Goyal, Global Vice President

The small "mass-manufactured" heliostat is a major component of eSolar's concentrated solar power technology. *Credit eSolar.*

at Areva Solar, India will play a big role in CSP adoption, as well. "Like Saudi Arabia and other progressive energy markets, India is a global leader in its commitment to the advancement of the solar energy industry, including CSP," he said. India's National Solar Mission calls for the country to install 20 GW of solar energy by 2020. In addition to Areva's 250-MW plant, Goyal said that there are "two more RFP's in India expected this year for a total of 300 MW of new capacity."

"We have our eye on a number of promising markets," said John Van Scoter, President and CEO at eSolar. With GE as a partner, eSolar has muscle behind its technology, and Van Scoter said that the company has been "active in promoting Integrated Solar Combined Cycle (ISCC) projects in major markets." The technology allows a power plant to generate solar power when the sun is shining but switch over to natural gas or coal when solar power can't be produced. "Interest for the ISCC technology has been strong from Saudi Arabia, Kuwait, UAE, Turkey and Australia," he said. Hybrid

Concentrating Solar Power in a Greenhouse or "Trough in a Box"

"I'm not a big believer in CSP for power," said Rod MacGregor, President and CEO of GlassPoint Solar. GlassPoint, a start-up with just two projects under its belt, uses CSP technology in an entirely different way. Instead of capturing the sun's heat to create power, it creates steam for use in Enhanced Oil Recovery (EOR). MacGregor explained that as oil wells are depleted the oil becomes thicker and more expensive to bring to the surface. When wells are abandoned, he said, about 70 percent of the resource is still there. EOR technology pumps steam into the earth around the well in order to heat the oil, which makes it more viscous and therefore easier (and cheaper) to pump.

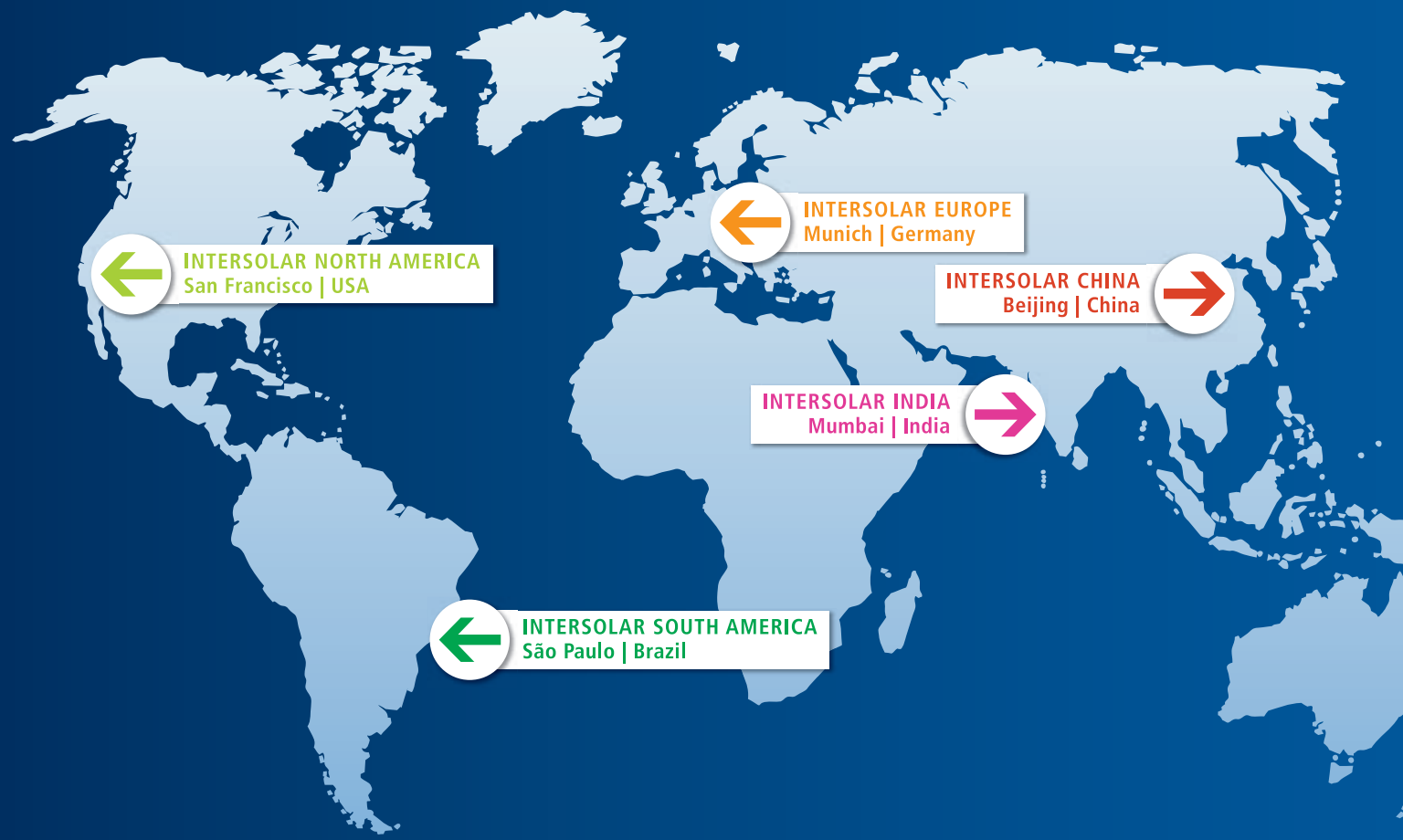
MacGregor said that the economics of solar EOR simply make it the cheapest game in town. Traditional EOR uses liquid natural gas (LNG) to create the steam that is pumped into the ground. Once the LNG price goes over $5.00 per million BTU, solar EOR from GlassPoint is a less expensive option. In the Middle East, where the company just completed a 7-MW EOR with Petroleum Development Oman, LNG sells for around $18 per million BTU, according to MacGregor.

The technology is based on the same principles as traditional CSP but is optimized for use in oil fields. Because troughs are enclosed in a greenhouse-type structure, the steel and concrete that is used in CSP for power plants is reduced significantly. "The biggest cost driver for CSP is wind," MacGregor explained, adding that large troughs are essentially huge sails that need lots of steel and concrete to be firmly attached to the ground. Because GlassPoint's trough is enclosed, the troughs are lighter and hang from the ceiling, so capital costs are reduced. Operations and maintenance costs are also reduced because the greenhouses are automatically cleaned with windshield-washer type technology. Greenhouses have a 100-year history and as such have benefitted from years of technological improvements, said MacGregor.

MacGregor believes that, at least for power generation, PV technology is winning over CSP — for now. But, he doesn't think that means CSP technology isn't viable at all. Keep your eye out for more innovative applications of CSP technology in the next few years. GlassPoint is certainly an application to watch. ◑

inter solar
connecting solar business

The World's Leading Exhibition Series for the Solar Industry



3,000 exhibitors | 100,000 visitors | Most international solar event series with b2b focus | Meet the decision makers who are shaping the solar market | Stay informed about the latest technological innovations | Get connected at exclusive networking events | Meet renowned speakers at the world-class conferences | Benefit from the events in the world's key solar markets

SEPT 18–20 2013	NOV 12–14 2013	MAR 26–28 2014	JUNE 04–06 2014	JULY 08–10 2014
www.intersolar.net.br	www.intersolar.in	www.intersolarchina.com	www.intersolar.de	www.intersolar.us

INTERSOLAR SOUTH AMERICA	INTERSOLAR INDIA	INTERSOLAR CHINA	INTERSOLAR EUROPE	INTERSOLAR NORTH AMERICA

The 110-MW Crescent Dunes Project. *Credit SolarReserve.*

plants such as these are able to provide firm, dispatchable power, explained Van Scoter, which increases its attractiveness to utilities and "improves CSP's cost competitiveness," he added. Areva's Goyal agreed, explaining that his company is installing its Compact Linear Fresnel Reflector (CLFR) solar steam generators at a coal plant in Australia. He said that the CLFR technology would increase plant output by up to 44 MW and do so at a lower cost than building a standalone 44-MW plant.

CSP technology can also be coupled with energy storage, one of the hottest topics in the renewable energy industry this year. Plants that include energy storage with molten salt can store solar power and dispatch it in the early evening and into the night. Tex Wilkins from the CSP Alliance thinks this application could make PV, which is often viewed as a threat to CSP, a complimentary technology. "The ability of CSP with storage to dispatch its power to the grid in the early morning and evening can combine with daytime PV to spread out the use of solar power from the time people get up early in the morning until they go to bed late at night," he explained.

SkyFuel's parabolic trough concentrating solar collector. *Credit SkyFuel.*

Wilkins said that in five years most CSP plants will include energy storage. Van Scoter from eSolar said in five years he expects that most CSP projects will include molten salt or ISCC technology. "There is also a high potential for projects involving industrial process heat, EOR and desalination," he said.

All CSP experts said that utilities are just beginning to recognize CSP's value — a renewable energy able to provide base load, dispatchable power. According to SkyFuel's Mason, "This attribute of CSP is its main differentiator from PV and wind, and will ensure its increasing uptake in the power market." ◑

2 – 4 October 2013
IMPACT Exhibition & Convention Centre
Bangkok, Thailand

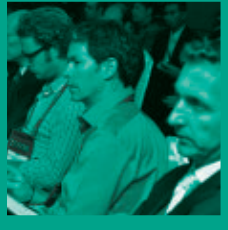
www.renewableenergyworld-asia.com

RENEWABLE ENERGY WORLD CONFERENCE & EXPO –ASIA–

ADVANCING ASIA'S ENERGY FUTURE

Renewable Energy World Asia, co-located with POWER-GEN Asia, is the region's leading exhibition and conference dedicated to the power generation, renewable energy and transmission and distribution industries.

Attracting 7,000 delegates and attendees from over 60 countries from South East Asia and around the world, nowhere else gives you the opportunity to reach and meet senior executives and industry professionals in one place at the same time, providing key networking and business opportunities. The Renewable Energy World Asia conference has become the major annual platform for the renewable and alternative energy industry to discuss the topics and issues of today.



JOINT OPENING KEYNOTE SESSION – WEDNESDAY 2 OCTOBER 2013 – 9AM

- Dr. Twarath Sutabutr, Deputy Director-General, Department of Alternative Energy Development and Efficiency, Thailand
- Governor of Electricity Generating Authority of Thailand, Thailand
- Dr. Piyasvasti Amranand, Chairman, Energy for Environment Foundation, Thailand
- Mr. Markus Lorenzini, Head of Energy Sector, ASEAN Pacific Cluster, Siemens, Indonesia

TOPICS DISCUSSED AT THE CONFERENCE INCLUDE:

- Renewable Energy Strategy
- Renewables Technology
- Hydropower

LEADING INDUSTRY EXHIBITION

Discover new ideas, technologies and developments at the region's foremost exhibition for the conventional power and renewable energy generation industries from leading companies and suppliers from around the world.

EXHIBITION OPENING HOURS:

Wednesday 2 October 2013:	10:30 – 18:00
Thursday 3 October 2013:	10:00 – 18:00
Friday 4 October 2013:	10:00 – 16:00

EARLY BIRD DISCOUNT – SAVE OVER 10% – REGISTER TODAY

Register yourself and your colleagues by 6 September 2013 as conference delegates and benefit from the Early Bird Discount Rate, plus free entry to the exhibition. There is no better place to meet the key decision makers in the renewable energy industry.

VIEW THE PRE SHOW GUIDE AT WWW.RENEWABLEENERGYWORLD-ASIA.COM

JOIN US IN BANGKOK, THAILAND ON 2 - 4 OCTOBER 2013

OWNED AND PRODUCED BY: PennWell

PRESENTED BY: Renewable Energy World Magazine

SUPPORTED BY: PEi Power Engineering International, cospp, HRW

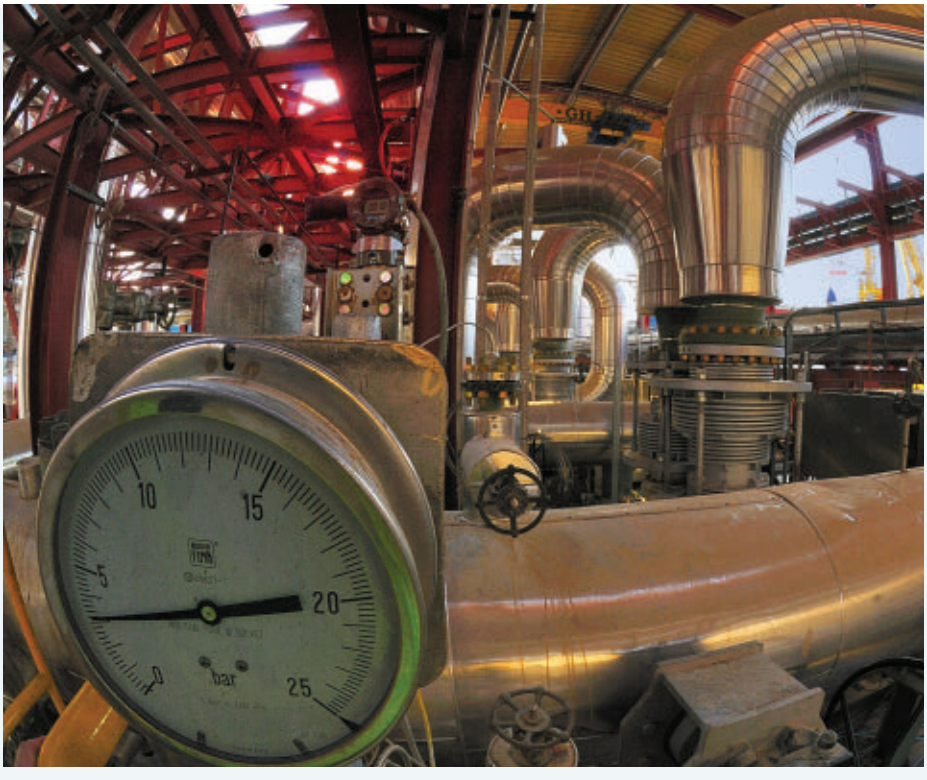
CO-LOCATED WITH: POWER-GEN ASIA

SUPPORTING ORGANIZATIONS: Department of Alternative Energy Development and Efficiency, Ministry of Energy; TGO

UAE Solar Plant is a Middle East Milestone

Earlier this year the first large-scale solar project in the United Arab Emirates began operation. The 100-MW concentrating solar power (CSP) plant, a partnership between the UAE's Masdar, France's Total and Spain's Abengoa, covers 2.5 square kilometers [0.96 square miles] and is the largest CSP plant in the world.

Shams 1 serves as an example that even the most oil-rich countries in world see renewable energy as an important part of the energy mix. "Through Masdar, the UAE is redefining the role it plays in providing the world with energy. From precious hydrocarbons exports to sophisticated renewable energy systems, we are balancing the energy mix and diversifying our economy — moving toward a more sustainable future," said Sultan Ahmed Al Jaber, CEO of Masdar at the opening ceremonies in March.



Top: Heat transfer fluid heater. Bottom: A portion of the 130 km of closed-loop pipes.
Next page: Solar collectors and booster heaters (top), Ariel View of the Solar Field (bottom).

By the Numbers

285 Number of **Football Fields** the Project Covers

20,000 Number of Households **Powered** by the Project

Installed **Capacity** of the Project **100MW**

Mirrors in the Desert **258,000**

Doing Good by Doing Solar

In developed nations, we see solar power as an alternative to conventional energy and a way to fight climate change. But in poor countries solar reveals itself as even more — as a way out of some of the world's darkest humanitarian problems. Here are some of the dramatic ways solar is changing lives in places like Haiti and Africa.

BY ELISA WOOD, *Correspondent*

For those of us who live in communities traversed by power lines, it's hard to imagine life without electricity. But large swaths of the globe remain without this modern necessity. About one-fifth of the world, or 1.3 to 1.6 billion people, live in energy poverty, mostly in sub-Sahara Africa and parts of Asia, and to a smaller extent in Latin America and the Middle East.

The basics in an electrified society — food, modern medical care, a lit path at night — come only with great effort for the powerless, if they come at all. Filling up a glass with water takes the energy-rich seconds; for the energy-poor it may require a full day of walking.

Fortunately, awareness is growing about energy poverty among those who can do something about it — the famous and influential. And

Solar panels in the Kalale District of Benin, West Africa help power pumps and drip irrigation systems enabling the villagers to grow food year-round. *Credit: Solar Electric Power Association.*

the solution they often adopt is solar energy.

Oprah Winfrey has solarized schools in Africa. Grammy-winning reggae band Steel Pulse donated record sales for solar in Haiti. The Bill & Melinda Gates Foundation put up money for researchers to develop a solar-powered portable toilet, an effort to prevent the deaths of 1.5 million children linked to poor sanitation. The William J. Clinton Foundation has helped fund a range of projects in Haiti, including solar lights for a resettlement community with 168 deaf families. And the UN Secretary-General last year launched the 'Sustainable Energy for All' initiative that strives to eradicate energy poverty worldwide by 2030, and do so with clean resources like solar.

"I am excited to see changes that are taking place at the high political level. For a long time, energy was not on people's radar," said Robert Freling, executive director of Solar Electric Light Fund (SELF).

If anyone is aware of the long struggle to raise awareness about energy poverty, it is Freling. Well before most others focused on energy poverty — more than two decades ago — SELF was installing solar panels in rural outposts. The organization has completed solar projects in more than 20 countries, partnering along the way with many governments, institutions, businesses and foundations.

Among the many forms of energy, why is solar so often the choice to serve the energy poor? First, it is clean and can help displace the polluting and dangerous energy sources now used — dung, wood and charcoal for stoves, kerosene lamps, and diesel generators. It is also a universal form of energy; the sun is everywhere and photovoltaic panels can be easily installed to capture it. Solar requires no construction of massive power lines and no trucking or piping of fossil fuels, all difficult in parts of the world that lack roads and basic infrastructure.

Solar and Nourishment

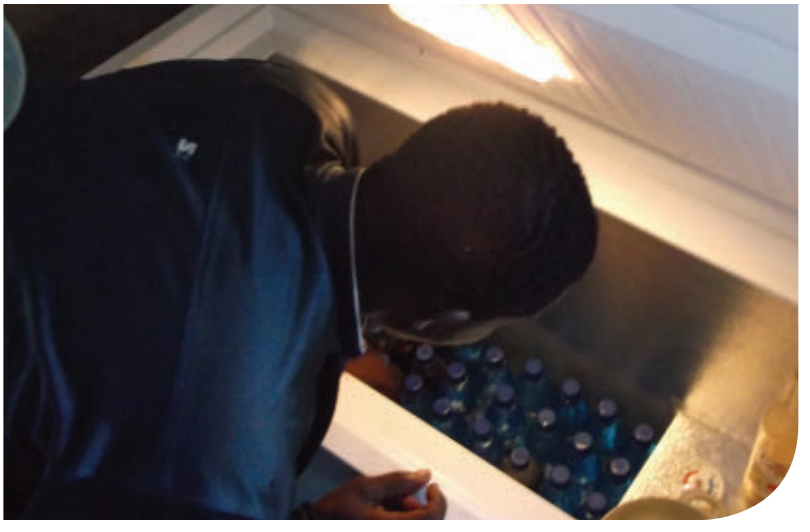
Operating under the motto 'energy is a human right,' SELF initially focused just on electrification through solar. But now the

organization employs a broader mission, what it calls a whole village development model, which tackles critical problems in a community that solar can solve. As a result, SELF has helped develop drip irrigation systems for farming and brought modern medical care, refrigeration, online learning, microenterprise, and other life-changers to developing communities.

Malnutrition is widespread in the Kalalé District of Benin, West Africa, where SELF began a pilot project in 2007. "There we have managed to do something that is addressing a very, very basic human need — and that is to eat," Freling said. Sitting down for a needs assessment of the community, "their number one concern turned out to be food security, or lack thereof."

Kalalé is considered to be one of the poorest parts of the world. The 104,000 people who live in the district's 44 villages face particular hardship from November to April, the region's dry season when local food production comes to a near halt.

SELF is helping two villages through what it calls the Solar Market Garden, an approach the organization has pioneered to help communities overcome food scarcity and gain income from sale of crops. Solar pumps and electrified drip irrigation systems



In Haiti, energy giant NRG, in partnership with Haitian solar company ENERSA, provided solar panels to help power refrigerators so that commercial fishermen could keep their daily catch fresher for a longer period. This allowed them to sell their fish at market prices rather than try to unload the fish quickly before it spoiled. *Credit: ENERSA.*

spare the farmers, largely women, from walking long distances to fill gourds with water to irrigate the fields. The women now spend half as much time watering.

"Prior to our intervention, these fields were largely barren during the six-month dry period. Now, year-round they are growing all kinds of leafy green vegetables," Freling said.

The families consume about one-fifth of the food; the remainder can generate income. As a result of the solar project, the women have gained both economic and psychological strength, exhibiting optimism and a new entrepreneurial spirit, according to Freling.

The organization has recently expanded the pilot to eight additional villages in Benin, and hopes the Solar Market Garden will eventually become a model for the developing world.

Solar and Livelihood

In parts of Haiti, fishermen must travel far out to sea in non-motorized boats because the near-shore waters are overfished. The return back to shore with their catch can be long. They must sell the fish immediately or else it will spoil, since they have no power and therefore no refrigeration. As a result, by the end of the day they are willing to sell the fish well below market prices.

NRG Energy, the largest independent generating company in the U.S., is helping the fishermen as one of its many projects in Haiti. (The company also has solarized medical facilities and schools, as well as food production facilities.) NRG partnered with ENERSA, a Haitian solar company, which offered the fishermen loans for electrified freezers. With the new tool, the fishermen can develop better business models — and an important source of protein for Haiti does not go to waste.

"We have a lot of innovative technology. The real joy is translating it in such a way that it works for that culture so that it can thrive," said Jennifer Brunelle, head of global giving for NRG Energy.

A 13.5-kW array at the headquarters of Rebuilding Together Peninsula is expected to save the non-profit $100,000 in energy costs. *Credit: Everybody Solar.*

But it is not only the developing world that benefits from the idea of doing good by doing solar. The concept also is gaining traction in the U.S.

San Francisco-based Everybody Solar helps non-profits install solar panels at a low cost, so that they can cut back on their energy bills and channel the savings to their mission. Everybody Solar recently raised $34,000 through crowd funding for its first project, a 13.5-kW array for the headquarters of Rebuilding Together Peninsula (RTP), which does home retrofit projects for low-income families. The solar panels are expected to save RTP $100,000 in energy costs. Everybody Solar hopes its approach will be used as a model for non-profits throughout the U.S.

The work of SELF, NRG Energy, ENERSA, Everybody Solar and others may point out a new direction for the solar industry. For years, the industry has been growing by leaps and bounds as modern societies increasingly embraced the technology a way to aid a planet in need. But more and more, solar is showing itself as a way to aid people in need. Solar, it turns out, is not just an environmentalist, but also a humanitarian. This is an argument for solar that even environmental naysayers can embrace, and it's one that might benefit the industry as renewable energy becomes increasingly politicized. We can expect to hear more about how solar is doing good in the coming months and years. ◑

HydroVision® RUSSIA

Conference & Exhibition

4 - 6 March 2014 | Expocentre, Moscow, Russia

Promoting Modernization Efficiency and Innovation

INVITATION TO PARTICIPATE

HydroVision Russia, co-located with Russia Power, provides an ideal setting to explore business opportunities, meet new partners, suppliers and the industry's most influential decision-makers. The 2013 event combined with Russia Power attracted over 5,500 attendees from 64 countries.

Featuring a busy exhibition floor with the pre-eminent organisations from the Russian and international hydropower sector HydroVision Russia offers excellent networking opportunities.

Why should you exhibit at HydroVision Russia 2014

- Be part of the largest hydro event in Russia
- Discover new products and the latest technology
- Learn about helpful services and new solutions
- Connect with leading decision makers and luminaries in the hydro power market
- Interact with hydro experts from Europe, Latin America, North America, and the Middle East
- Network and meet high profile professionals and peers gathered in one place
- Gain knowledge, market updates and insight from speakers throughout the world, including Austria, Brazil, Canada, Czech Republic, France, Germany, Georgia, Pakistan, Russia, Spain, Switzerland, and USA
- Gain insight and key updates about potential hydro resources that can be developed
- Gain the knowledge and tools needed for designing, operating, controlling, and refurbishing power plants
- Find ways to save money and work better

Accompanying the exhibition is a thought provoking conference programme developed by practitioners from the industry for the industry.

SUBMIT AN ABSTRACT FOR HYDROVISION RUSSIA
DEADLINE FOR SUBMISSIONS – FRIDAY 2 AUGUST 2013

The Advisory board of HydroVison Russia is now accepting abstracts for its 2014 conference. Why not apply your know-how of business strategies and technological advances by submitting an abstract for HydroVison Russia 2014 and impart your knowledge alongside the leading decision-makers in the Russian hydraopower industry.

For information on Themes and Topics and how to submit your abstract, please visit the HydroVision Russia event site **www.hydrovision-russia.com** and select the Conference tab.

Join us at HydroVision Russia and be part of an established event that continues to influence the hydroelectric industry.

For queries relating to the conference, please contact:

Mathilde Sueur
Conference Manager
T: +44 1992 656 634
F: +44 1992 656 700
E: Mathildes@pennwell.com

For information on exhibiting and sponsorship at HydroVision Russia, please visit www.hydrovision-russia.com or contact:

Worldwide:
Amanda Kevan
T: +44 (0) 1992 656 645
F: +44 (0) 1992 656 700
E: amandak@pennwell.com

Tom Marler
T: +44 (0) 1992 656 608
F: +44 (0) 1992 656 700
E: tomm@pennwell.com

Russia and CIS:
Natalia Gaisenok
T: +7 495 249 49 15
F: +7 495 249 49 15
E: nataliag@pennwell.com

Svetlana Strukova
T: +7 495 249 49 15
F: +7 495 249 49 15
E: svetlanas@pennwell.com

Owned and Produced by: PennWell, HRW

Presented by: Hydro Review, Renewable Energy World Magazine

Supported by: RusHydro, НП Гидроэнергетика России

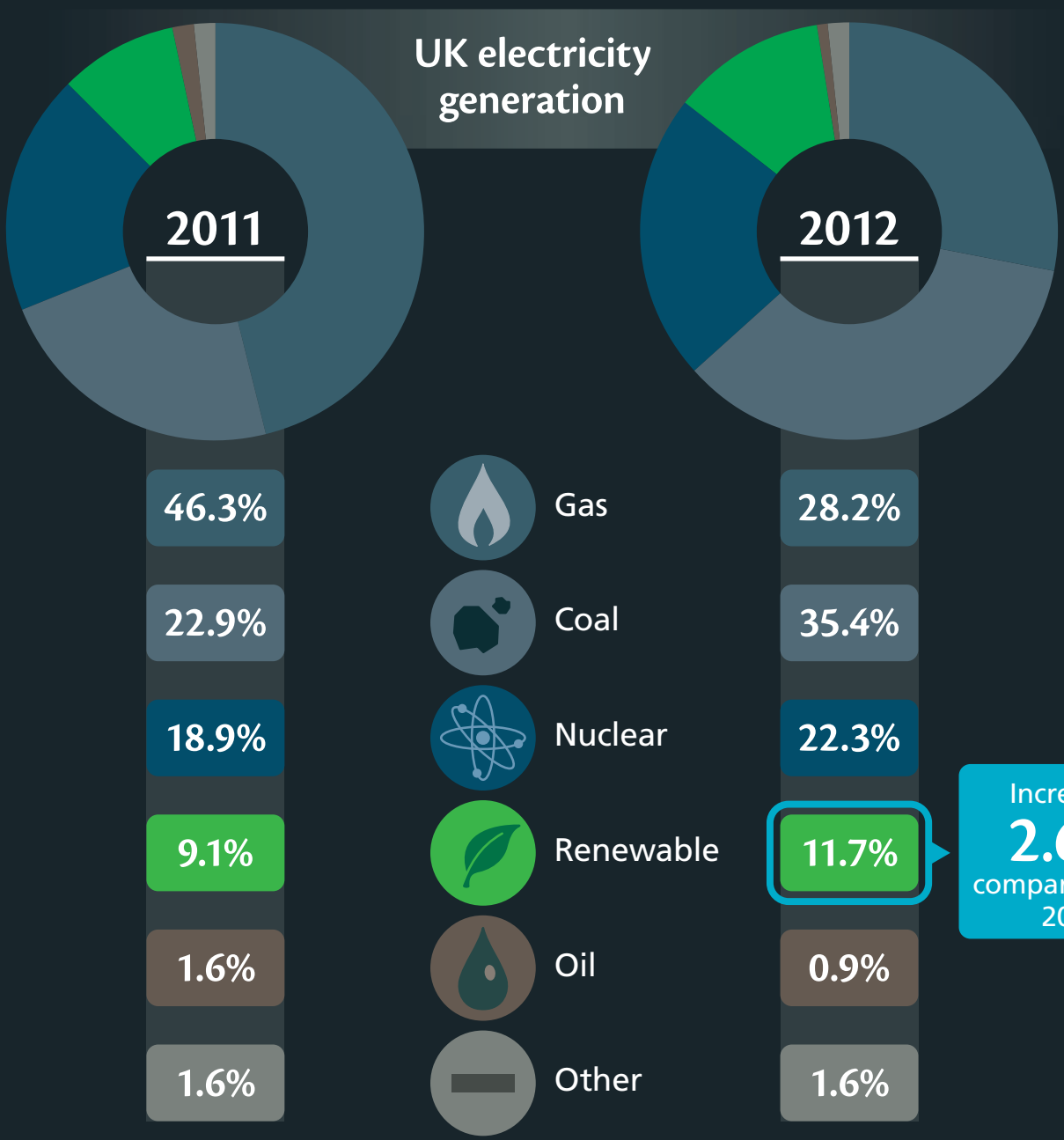
www.hydrovision-russia.com

Co-located with: Russia Power – A POWER-GEN EVENT

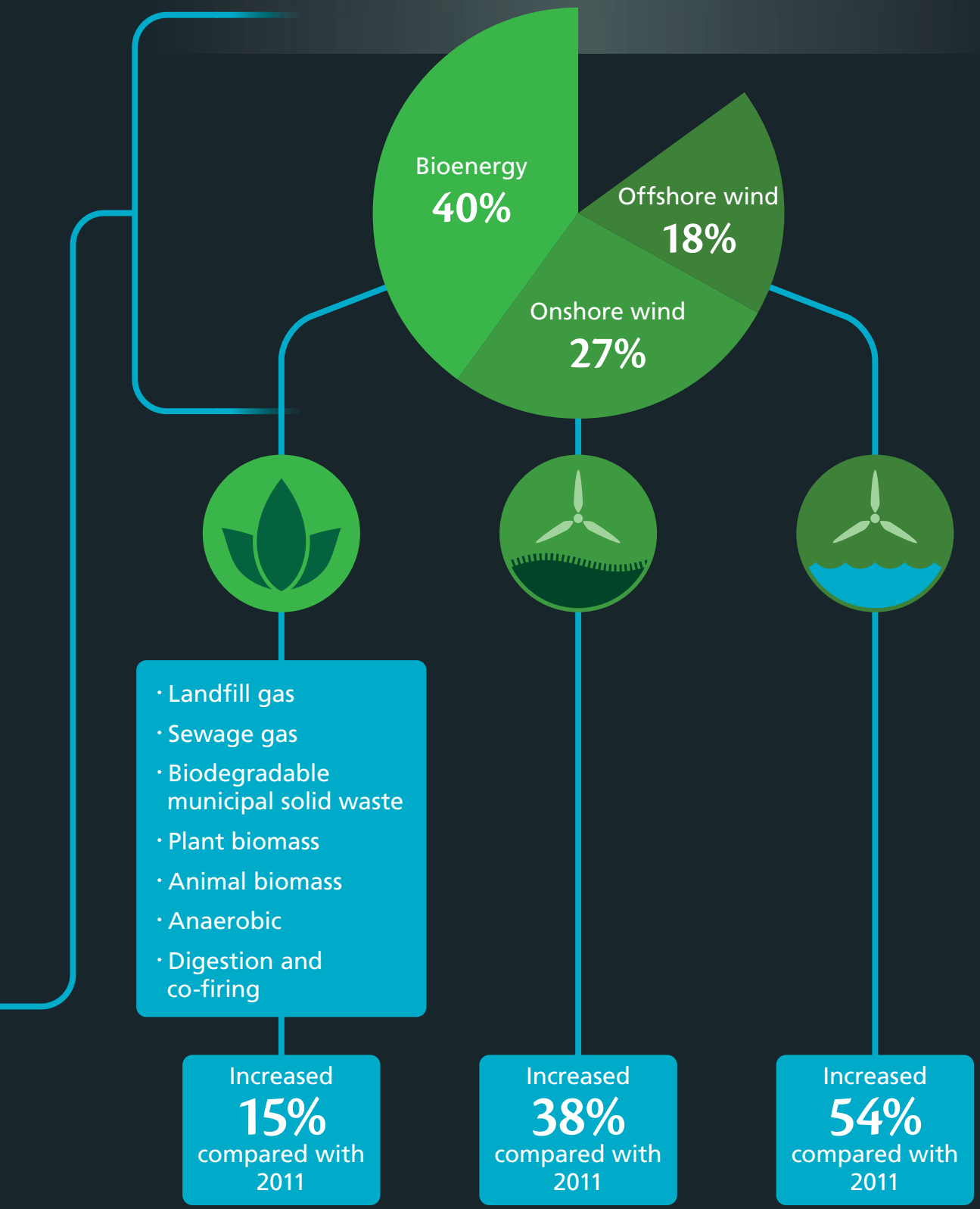
data points

UK renewable energy use rises in 2013

The newest statistics on the UK's energy use cover the period from July to September 2012



Electricity generated by renewables

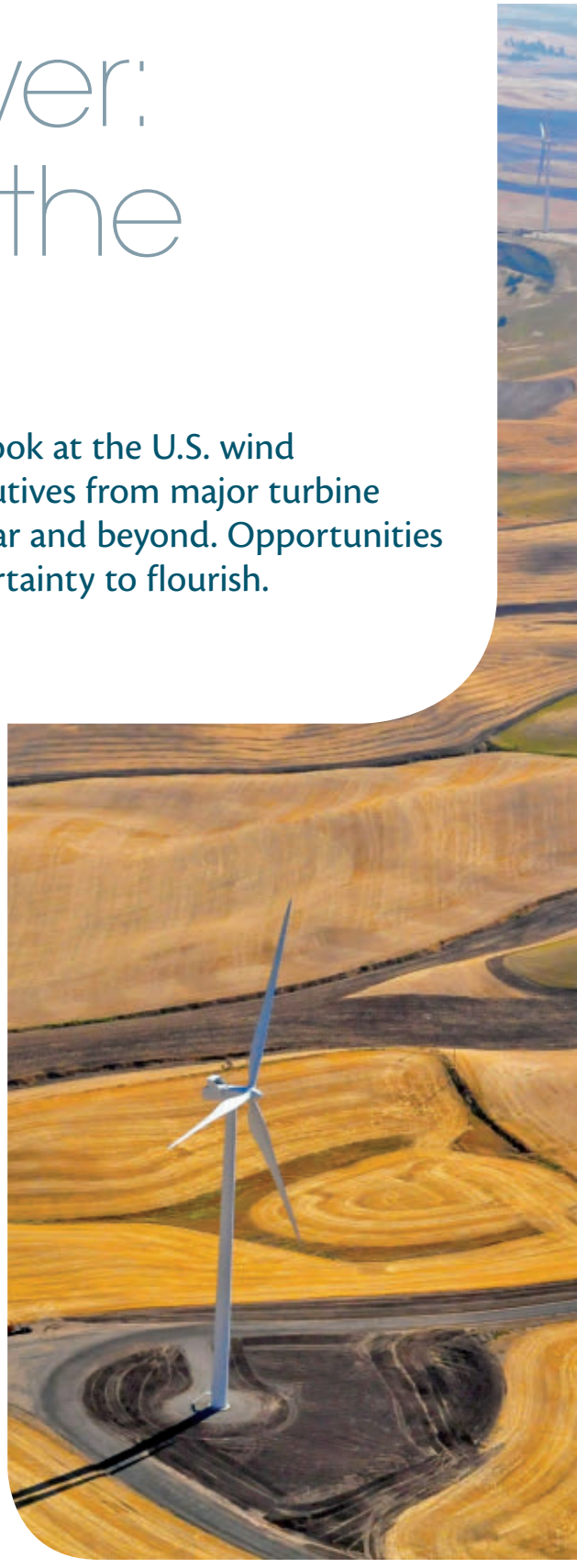


Source: GreenDealAccredited.com

US Wind Power: The State of the Market

Halfway through 2013, we're taking a look at the U.S. wind power market and where (and if) executives from major turbine manufacturers expect to see progress this year and beyond. Opportunities for growth do exist, but the market needs certainty to flourish.

JIM MONTGOMERY, *Associate Editor*



No doubt 2012 was a blowout year for wind energy in the U.S. The final count showed that roughly 13 gigawatts (GW) of new capacity was installed, representing more than 40 percent of all energy installed in the country during the year. Nine states now get 10 percent or more of their electricity from wind, according to the American Wind Energy Association (AWEA). But keep in mind, more than half of that surge of wind energy capacity came in the final weeks of 2012 in a rush to get projects completed ahead of the expiring production tax credit (PTC), and some of that was pulled in from 2013 planning. The PTC's uncertainty and eventual last-minute renewal, and clarifications recently issued about its minimum qualification criteria, have set the stage for 2013 to start off slow and rev up again later this year, though likely nowhere near 2012's surge.

Even so, the U.S. ranks "number one or number two" for the best growth market of any region for wind energy, proclaimed Chris Brown, sales president for the U.S. and Canada for wind turbine OEM Vestas. Anne McEntee, newly hired VP of rival GE's renewable energy business, which does large chunk of its wind

The 105-MW Palouse Wind in Whitman County, Washington. *Credit: First Wind.*

business domestically, agreed that U.S. wind energy "has a bright future" and is "a long-term sustainable business."

Where Is the US Wind Market Growing?

So where are the hotspot growth opportunities in the U.S. for wind energy? Judging by the execs and industry watchers we've been talking with and listening to, it's a combination of where the wind resources are best, which states have the most aggressive renewable energy mandates and which have the highest electricity prices. That casts a pretty wide net around some familiar territory: Texas, the Southwest Power Pool (SPP, i.e. all of Kansas and Oklahoma, plus parts of New Mexico, Texas, Arkansas, Louisiana, Missouri, and Nebraska), the Northeast, and states in the Midwest such as Ohio and Michigan.

Andy Lubershane, senior analyst for IHS' Emerging Energy Research unit, points to "some very low wind prices, in the $30/MWh range on a levelized basis, in several regions" including just about all of the SPP, plus Eastern Colorado, Texas, and the Upper Midwest.

"The Texas market is still very strong," as is the market in Indiana, Michigan, certain parts of Michigan, and Colorado, acknowledged Vestas' Brown. Ilya Hartmann, CEO of Acciona Energy North America, likewise invoked California and the Northeast.

Iowa is another prime target. MidAmerican Energy has invested around $4 billion in the state, and this spring pledged to spend another $1.9 billion for 1 GW of additional capacity there. The rate-regulated utility expects to own and operate more than 3.3 GW of wind generation capacity in Iowa by January 2016, and could generate more than a third of its power through wind, according to a company spokesperson.

The Eco Grove wind farm in Stephenson County, Illinois. *Credit: Acciona North America.*

"New England has some challenges," offered Dave Wilby, First Wind's VP of state policy, speaking in a panel discussion at the AWEA Windpower conference in Chicago in early May. "Siting is tough [and] the resources are not close to the load." Nevertheless, looking several years out, he foresees the potential for a handful of very large wind PPAs across the Northeastern states.

Another market trend is in projects that seek to tap slower wind speeds, with newer turbine technologies built specifically to take advantage of them. While this opens up new development areas, eventually these will require acceptance of a different price point, Brown pointed out. "We have to think where we can make the most money, and think through the highest possible outcomes given where we are," he said. "Large turbines don't have the luxury of picking their markets. It's more of a demand constraint than a supply constraint."

In nine western states there's another emerging window of opportunity for wind energy, thanks to more

than 4.2 GW of announced coal power retirements over the next six years, pointed out Sarah Cottrell Propst, executive director with the Interwest Energy Alliance, in the aforementioned AWEA Windpower panel discussion. Wind energy will have to prove itself against natural gas and get utility buy-in for replacement and future regulatory costs, and existing transmission must be able to be repurposed for clean energy, she explained.

Life After the PTC

With the one-year extension of the PTC now set to expire at the end of 2013, everyone agrees that for the industry to flourish, it must break away from the start-stop nature of a tax credit that is granted and then taken away. But the question remains: what is the endgame scenario? Is there hope to break out of that cyclicality?

"At the moment the industry is in a very operational mode," said Andy Geissbuehler, general manager and head of Alstom's North American Wind business. "Everyone is consumed by having capacity available to fulfill safe-harbor requirements" by April 2014. "Once all the safe-harbor requirements are met, then they'll sit back and say, 'what do we do next?'"

Brown agrees. "Right now nobody's looking at the next wave of wind farm installations," he said, and "how to capture the largest percentage of the current market."

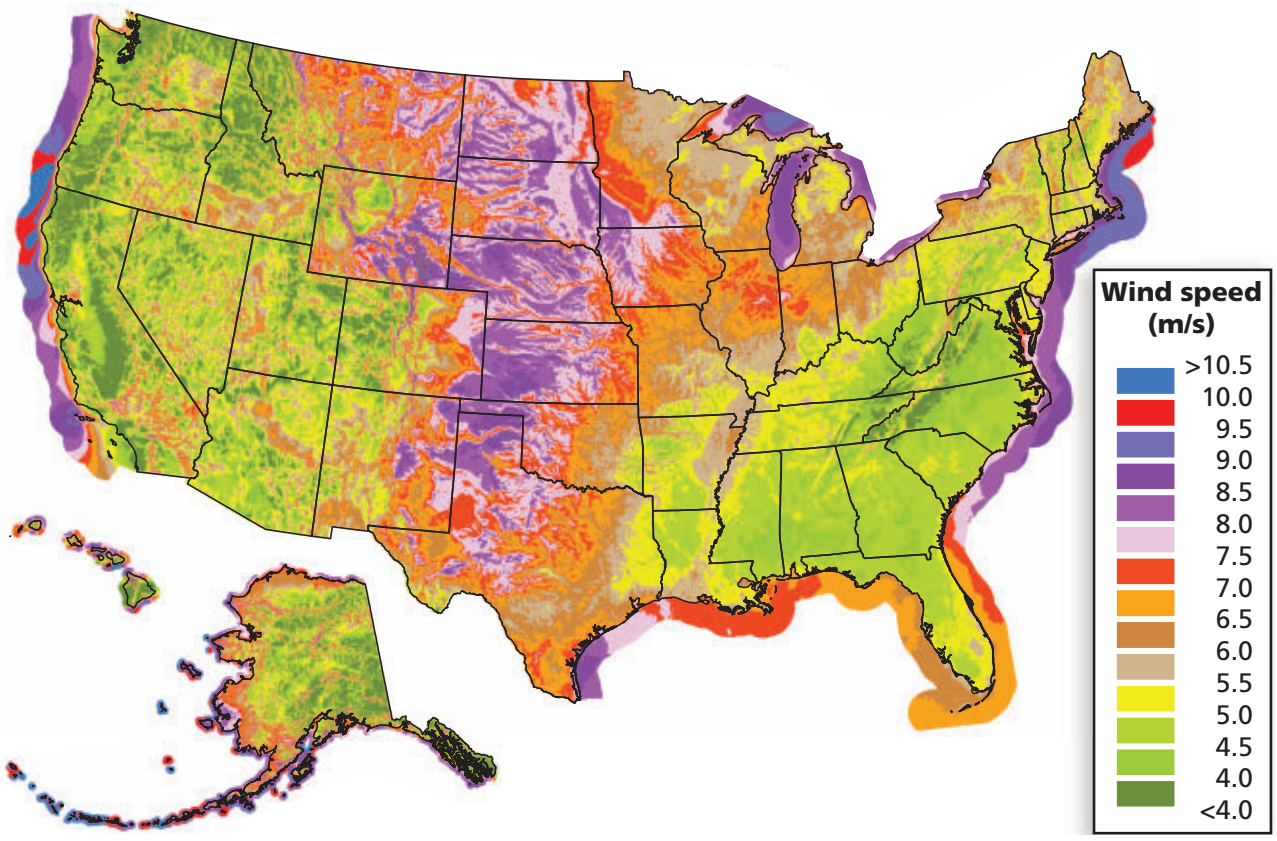
Other stakeholders believe there is growing momentum to look beyond the current PTC's lifetime. "Wind plant developers are taking a step back and reevaluating how they build wind energy plants," with an eye toward making them more competitive with other energy sources such as natural gas-fired generation, noted Dan Girard, director of renewable energy and energy storage at S&C Electric Company. "Finding ways to redesign and re-engineer plants in order to reduce engineering, design, and construction costs — as well as the overall plant lead time — is a priority."

Developers also will begin including a mix of energy supplies instead of a single fuel or energy source on a plant site — from wind to solar to natural gas, and increasingly energy storage — to give them more flexibility and control in selling electricity, Girard added. "This approach truly represents a rethinking of what constitutes a generating plant," he said.

Alstom's Geissbuehler likewise thinks that OEMs, developers and utilities need to maintain "a healthy portfolio of various sources of energy," both within renewables and those who have business in

Macho Springs wind farm in New Mexico. *Credit: Vestas.*

United States - Land-based and Offshore Annual Average Wind Speed at 80 m



Credit: AWS TruePower (resource estimates) and NREL (map).

coal or gas. "The portfolio approach is the most successful way to deal with knowns, and unknowns."

As wind projects move forward with PTC compliance and enter the offtaking stage, some developers may encounter an environment with limited opportunities favoring those who can absorb low power-purchase agreements (PPAs). Unfortunately, the days of developing a project and later securing an offtaker are gone, said Vestas' Brown. By the end of this year, many projects in development "will have a home [offtaker], or [the developers] won't have a project," he said. One out of four developers jostling for a company's RFP will get chosen; "those others won't be done."

Acciona's Hartmann predicts "a very active acquisition market" over the next 18 months with investors from equity, infrastructure, and pension funds shopping for operating projects as long-term investments to hedge against potentially rising natural gas and wholesale electricity prices. At the same time, developers frustrated with federal policy uncertainty will likely sell projects, or entire portfolios, to investors willing to bet on an upswing in electricity prices in the longer term, he said.

As always, that policy uncertainty continues to hold the U.S. wind industry back. "It's time to step back and really determine the long-term viability of the [domestic] wind industry," Brown said. Growth will continue, at least for the foreseeable future, but developers, utilities and OEMs will remain challenged by tax credits that come and go. Amidst all the optimism for U.S. wind energy, Brown urges a healthy dose of realism: "Let's not confuse activity with progress." ◑

Protecting Wind Turbines in Extreme Temperatures

Wind farm developers must consider the environment in which their turbines will operate and make wise decisions about how their selected technology will function in all expected and unexpected weather conditions.

MICHAEL A. STOUT, *Vice President, Engineering, Falcon Electric*

As renewable energy sources continue to gain momentum and drive the electrical grid to a more intelligent and reliable source of power, integrating the right components and peripheral systems are essential to reliability. As most renewable systems are located in outdoor and potentially harsh environments, critical attention must be paid to the suitability and robustness of the equipment to be installed in these environments. Since this equipment is only as reliable as its power source, backup power is often required in addition to the utility power source.

As an example, wind turbine control systems (*see Figure 1*) are essential to the turbine's operation and safety. The function of these systems provides vital control of the turbine and incorporates power sensitive state-of-the-art electronics that demand absolute reliability. Yet, they are installed in locations subject to every form of weather conditions — from the extreme lows of the arctic to excessive heat of the desert.

Figure 1. Wind turbine control panel.

The most essential function of a wind turbine control system is the continuous control of wind turbine blade speed and braking. In most new turbines, the pitch of the blades controls the output frequency of the AC power being generated in addition to bringing the blades to a complete stop in high wind conditions. An electronically controlled braking system assures the blades are locked in a stopped state. Should the brakes be applied before the rotor speed is below allowed braking speed, the brakes would be damaged. Without these vital controls, the wind turbine blade rotational speed could reach a runaway condition, causing the complete destruction of the entire turbine. Adjacent property damage and loss of life could

also result. A power backup system is necessary to assure these vital control systems remain viable in the event of the loss of the primary utility power source.

To achieve the full functionality of the wind turbine and ensure the safe, reliable generation of power, a large number of electrical and electronic equipment elements are required. These include:

- Main control computer, I/O modules, relays and components for monitoring and control of the wind turbine.
- Equipment dedicated to the continuous remote monitoring of wind turbine operation.
- The Hub computer to control pitching of blades.
- Frequency converter, yaw motor protection systems.
- Power converter (full or dual-fed), filters, phase compensation electronics.
- UL-listed, wide-temperature range online uninterruptible power supplies (UPS).
- Communications computer, network and SCADA-monitoring and control equipment.
- High-voltage, medium-voltage and low-voltage distribution control equipment.

As stated earlier, a wind turbine's location can make it subjectable to extreme temperatures swings, typically from -30ºC (-22 ºF) to 55ºC (131ºF). All of the electronic equipment and circuits installed in the turbine must be designed to operate reliably over the entire temperature range. A source of backup power is essential, so the online UPS designed into the system must be rated for these harsh temperature environments. Further, due to its key function, it must have been specifically designed to provide years of operation while operating over the entire temperature range. As the UPS is located in the nacelle at the top of the turbine tower with the rest of the equipment, humidity and condensation can be another factor affecting reliability. Conformal coating of circuit boards is required to protect circuitry on the board from becoming shorted out by moisture condensing on the board. These environmental factors demand the use of a special UPS.

Batteries – The Weakest Link

A standard off-the-shelf UPS is designed for 0°C to 40°C office or computer room environments; therefore its reliability and ability to survive in a high humidity environment is suspect. Batteries in these standard systems are typically not rated for the higher temperatures that are often encountered. At these high temperatures, battery life can be reduced by as much as 90 percent.

Figure 2. Falcon's UL, cUL and CE-listed SSG Series UPS in a NEMA enclosure.

The majority of UPS products rated under 10 kVA use valve regulated lead-acid (VRLA) batteries to provide backup energy. Due to identical battery chemistries and like construction, most battery manufacturers' specifications are very similar. Battery manufacturers rate their

Slideshow: Examples of wind farms in extreme weather. All images via Shutterstock.

1. Wind Turbines in Snowy Landscape
2. Wind Farm in Cracked Desert
3. Wind Farm in Thunderstorm
4. Offshore Wind Turbine
5. Wind Farm at Sunset
6. Snowy Wind Farm at Night in Germany

projected battery service life with the battery operating in a 25°C environment.

However, newer technology VRLA batteries can now yield a four-year life at 50°C and up to 12 years at a 25°C room temperature per the battery manufacturers stated service life projections.

Higher temperatures cause the acid-based battery chemistry to become more active, accelerating destructive factors inside each battery cell. However, very low temperatures slow down the chemical reactions and impair the batteries' ability to deliver current. This results in a substantially shortened UPS battery runtime when compared with the stated battery runtimes, which are typically stated with the UPS operating at 25°C.

To meet the demand for wide-temperature range UPS and power conversion products, a few manufacturers are designing products that not only survive in these difficult environments, but offer superior performance. For these new products, the cost of ownership is reduced through robust design and by reducing the number of battery replacements over the UPS's typical 12-15 year service life. Robust industrial-grade, wider-temperature range products may be found in standalone UPS units or in prepackaged turnkey NEMA rated enclosure systems (*see Figure 2*). Direct from the manufacturer, these systems are ready for immediate installation and operation, reducing the associated project engineering and installation costs.

Word to the Wise Wind Farm Developer

Never use a UPS that is not rated for the temperatures to be encountered in the installed environment. If you require a UPS that will be used in an extreme operating temperature environment and are confused by some manufacturer's specifications, verify the UPS has a UL listing stating the wide temperature range desired. Using a UPS outside the stated UL-listed temperature range can invalidate the UL listing status. This can lead to reliability, code enforcement and product liability problems. ◑

Alternative Fuels

STEAM & HOT WATER BOILERS

Hurst BOILER & WELDING COMPANY, INC

HURST BOILER & WELDING CO., INC.

Biogas
Biomass
Natural Gas
Propane Gas
Biodiesel
Digestion
Landfill Gas
Pellet Fuels

learn more...

hurstboiler.com

tel: 229.346.3545

A conversation w/ VP Tommy Hurst

View video at:

http://www.hurstboiler.com/video/326

Finland Looks to the Future of Bioenergy

Supported by abundant forest resources, Finnish bioenergy companies don't have to look far for feedstock. But in a move to define its low-carbon future, the nation's energy companies are undertaking ambitious research programs to develop future biofuels.

TILDY BAYAR, *Associate Editor*

Finland is, above all, a land of abundant, and growing, forests. "We produce 100 cubic meters of wood per year, while 50 cubic meters per year is harvested. We have more forest than we can use," said Jukka Leskelä, director of power generation for trade body Energiateollisuus, or Finnish Energy Industries. So it's no surprise that, given an almost complete lack of indigenous fossil fuel resources, high per-capita energy consumption, and a long-running forest management program already in place, Finland is investing in biomass and biofuels in a big way as it looks to define its future energy mix.

The nation's once-powerful forest industry has fallen on hard times, noted Leskelä. Although Finland has traditionally supported a thriving paper and pulp industry, demand for paper products has dropped, leading to factory closures. This is good news for the bioenergy sector; wood that was already slated for harvesting is now available for other uses.

The nation offers impressive support for bioenergy: a grant for 30 percent of investment in anaerobic digestion plants and 28 percent for compressors, an electricity tariff (which varies based on market price) plus €0.50/MWh if the project reuses the heat it generates. There is also a government target to replace 10 percent of the country's natural gas with biogas by 2025.

30 percent of customers at Gasum's filling stations choose the biogas option. *Credit: Tildy Bayar.*

Leskelä admits that "renewable" in Finland means bioenergy, and indeed wood-based biomass underpins over 75 percent of the nation's planned activities to meet its 2020 climate targets. But Finland is also a high-tech economy and, in addition to an impressive 9 GW of planned wind capacity by 2020 (albeit no solar and no policy support for it), there is

In 2012 Neste Oil produced 1.7 million tonnes of biofuel from 2.4 million tonnes of waste animal fat. *Credit: Tildy Bayar.*

a good deal of research into biofuels and other new biomass-based energy solutions, much of it undertaken by fossil fuel companies looking to cash in on Finland's dual need to gain energy independence and meet European climate targets.

Biogas

For example, Finnish natural gas supplier Gasum, which controls the national market and owns the gas pipelines in southern Finland, is working on a number of renewable solutions including waste-based fuel from anaerobic digestion, new energy crops, "bio-SNG" (wood-based synthetic biogas created through gasification), and liquefied biogas (LBG) produced in one of the company's liquefied natural gas (LNG) plants.

Gasum aims to become Finland's leading biogas provider, said Pasi Torri, head of biogas and renewables. Currently the company's biogas is used to fuel Helsinki city buses, airport buses and service trucks, and is available in 18 filling stations across Finland. (Finnish filling stations have been required to offer a biogas option since 2011.) Torri said 30 percent of customers at these filling stations choose biogas over both gasoline and the cheaper option, natural gas (also offered by Gasum), which is half the price of gasoline. Biogas is 7 percent more expensive than natural gas. Gasum calculates the CO_2 savings of wood-based biogas at around 93 tonnes compared to gasoline.

The company's waste-based fuels are made from wastewater sludge, bio-waste from households and restaurants, and some industrial waste. Torri said the processes that turn these raw materials into biofuel use about 10 percent less energy than fossil fuel processing plants, depending on the process.

Gasum also plans to experiment with growing energy crops in the Kuovola region. Torri said these crops will be planted in rotation by farmers who usually grow cereal crops. But in Finland, using forest industry residues as feedstock makes more economic sense than growing energy crops. For example, Gasum plans a 200-MW gasification plant in Joutseno for forest chips and bark. Torri explained that a forest industry company already owns the land, so the plant will work with its waste products. Gasum will invest €3-4 million in the plant, along with a €300 million grant from the EU.

Compared to buying heavily taxed natural gas from Russia, it is much cheaper to make this kind of investment in biogas, said Torri. Customers are willing to pay a premium price for green energy, he said, but he acknowledges that biogas initially will be more expensive because it's new. Gasum has a cost advantage, however, because it already owns the pipelines through which it plans to send biogas across Finland to power households and industry.

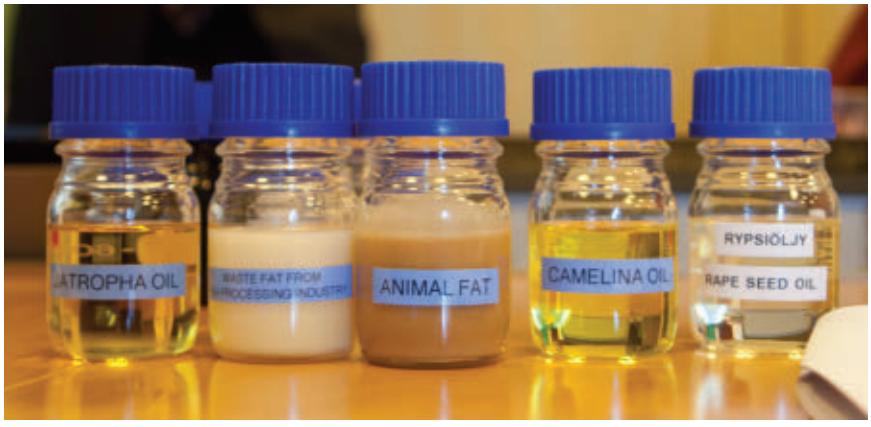
Renewable Biodiesel

Neste Oil, another Finnish company with a focus on bionenergy, was originally a traditional oil refiner that branched out into LNG. In 2007, the company started looking at developing biofuels. In Q1 2013, Neste made its first profit from renewable fuels: in that period Neste said it made €26 million in revenue from its renewables alone. "There are better margins on the renewables side," said Petri Lehmus, vice president of research and technology.

The central focus of Neste's R&D platform is developing new feedstocks and refining existing ones, said Lehmus. Last autumn the company launched its ProDiesel, containing a minimum of 15 percent of what the company calls renewable diesel (to distinguish it from biodiesel).

Renewable diesel can be used as a drop-in fuel, Lehmus said, and is targeted at the aviation market, with a number of fuel solutions currently being tested by aviation partners. While Neste's biodiesel is composed of vegetable oil that reacts with methanol to produce esters, renewable diesel removes the oxygen from vegetable oil to create aromatic-free diesel fuel. You can only mix up to 7 percent of traditional biodiesel with gasoline, said Lehmus, but Neste says it can mix unlimited amounts of renewable diesel because it is so pure.

"We are following feedstock issues very carefully in relation to different markets," said Lehmus. Among the feedstocks Neste uses or is testing are familiar substances such as palm oil, jatropha oil, camelina and rapeseed oil, but also experimental



Neste Oil's research is focused on developing a flexible feedstock base from multiple sources. *Credit: Tildy Bayar.*

feedstocks such as algae oil, bacteria oil, purified/rendered animal fat and waste fat from the fish processing industry.

"We are buying most of the animal fat that's available," he continued.

Neste predicts that global annual demand for biodiesel and renewable diesel will grow to 41 million tonnes by 2020, and it is putting its R&D money behind that belief. So is Gasum, with its investment of €20.5 million in biogas production, new transmission networks and new vehicle filling stations.

In Finland, supported by a forest industry providing ample feedstock for all, such optimism is easy. But Finnish companies are looking beyond the bountiful local present to the global future of bioenergy. ◑

Is Fracking for Enhanced Geothermal Systems the Same as Fracking for Natural Gas?

Advocates for both natural gas and geothermal are up in arms over whether fracking for enhanced geothermal systems should be scrutinized with the same parameters as natural gas.

MEG CICHON, *Associate Editor*

The U.S. geothermal industry recently scored a big win when its first enhanced geothermal system (EGS) project went online in April. ORMAT was able to stimulate a previously unproductive well at its Desert Peak project with EGS technology — injecting fluid into a well to reopen cracks and create a resource reservoir — and found an additional 1.2 megawatts (MW) of capacity. Renewable energy experts applauded the project, dubbing it a "game-changer" and a "shining moment" for the industry.

Though the project represents a breakthrough for EGS technology and the geothermal industry in general, EGS has come under fire, with opponents accusing it as being just as dangerous as oil or natural gas hydraulic stimulation, commonly known as fracking. While traditional geothermal energy is viewed as clean renewable energy, could EGS technology, with its similar "fracking methodology," coupled with its rocky past, come under the same intensive scrutiny as natural gas fracking?

Drilling at AltaRock's Newberry EGS Demonstration Project in Bend, Oregon. *Credit: AltaRock.*

EGS and Earthquakes

Perhaps the most notorious EGS project is one that was never completed in Basel, Switzerland — constructed on a known seismic fault and suspended in 2006 when it generated earthquakes that reportedly caused millions of euros in damage to local infrastructure. The project was cancelled in 2009 after several reports said that if continued, it would cause more earthquakes and would lead to

AltaRock's Newberry EGS Demonstration site during stimulation. The pool holds fresh cold groundwater that was pumped down the 10,000 ft well during stimulation. *Credit: AltaRock.*

more damage each year.

"It's easy to generate a lot of fear. You can scare people about things without providing much solid information," said David Stowe, communications director at AltaRock. "The Basel story is dredged up over and over again — but we have learned from it, and it is pretty easy to put safeguards in place that will severely minimize risk."

Since its cancelation, many have pointed to the Basel project as a reason to avoid EGS altogether. However, the U.S. Department of Energy (DOE) remained undeterred, and developed geothermal-induced seismicity protocol and further stringent safety measures with Lawrence Berkley National Labs to prevent major seismic events — the only protocol in place for any sub-surface energy industry, according to Doug Hollet, director of the DOE geothermal energy program.

The DOE has been working on several EGS projects, including AltaRock's innovative Newberry project in Bend, Oregon. To ensure that the Newberry project does not cause significant seismic events, AltaRock has implemented rigorous protocols and created an advanced microseismic network system of about 20 seismometers that surrounds the project both on the surface and in wells 1,000 feet below the earth. The seismometers pick up the sounds that fractures make when they grow, triangulate and then displays the location of the fracture zone on a computer screen — AltaRock has its own modeling software for this, said Stowe.

"We have engineers outside monitoring pumps, two or three geologists on the command trail monitoring computer screens, and additional monitoring equipment," explained Stowe. "It's an intricate operation."

In natural gas, seismic activity is not the major concern when it comes to the fracking process. According to Stowe, the reinjection of the spent working fluid causes the most problems. "It creates a huge bulge when you re-inject all this water; pressure builds and the earth moves to compensate for that, which can

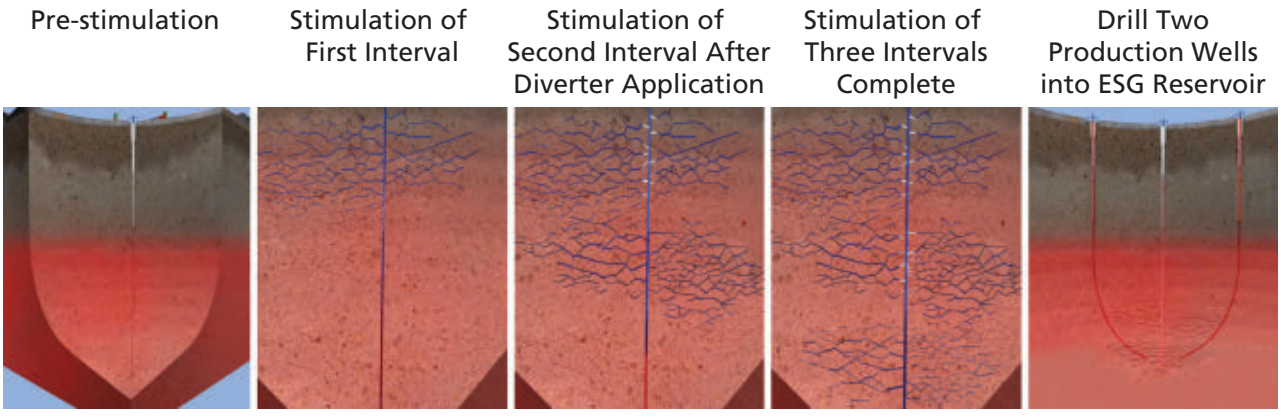
cause a seismic event," said Stowe — adding, however, that this isn't a common occurrence.

According to Andrew Place, interim director and president of the Center for Sustainable Shale Development, seismicity is more of a concern for EGS due to the ongoing nature of the technology, whereas natural gas enters a site, fracks for the resource and moves on. "[For natural gas] the strong concern is for disposal wells, and if you don't site them carefully and drill in a close proximity to an existing fault that is highly stressed, you could set off a substantial seismic event," he said. This can be avoided with pre-drill modeling to ensure the avoidance of fracture networks and monitoring for seismic events — similar to the precautions already being taken at the Newberry project site.

Fracking vs Slipping

According to Hollett, the fundamental difference between natural gas fracking and EGS fracking is the injection process. The oil and gas industry injects water and a proppant (a mix of sand and chemicals), at a very high pressure of around 9,000 psi or more, which breaks though the rock and holds the cracks open; otherwise they would close when the fluid stops flowing.

EGS, however, uses water, and sometimes acid, to shear the rock and cause a "slip." "You're trying to make two rock faces slide past each other slightly, which creates a little bit more space between them," said Lauren Boyd, EGS program manager at the DOE. This is where fractures or weaknesses in the rock likely



AltaRock's EGS process creates several zones in a single well. *Credit: AltaRock.*

existed already and were plugged by mineral deposits over time. Boyd compared the process to putting an ice cube in a glass of hot liquid: "cracks will form where there are existing deformities in the ice, which is similar to what happens in the subsurface with closed fractures," she said.

As for long-term effects, "we are talking about very small fractures very deep in the earth — there is really little or negligible long-term impact there," said Hollett.

Contamination Concerns

Since many believe EGS technology to be similar to natural gas fracking, the same concerns about leakage, spills and resulting groundwater and soil contamination exist for both technologies. After all, according to Popular Mechanics, in the past two years alone, natural gas fracking has caused numerous surface spills including several projects that have contaminated groundwater.

AltaRock plans to combat these problems at the Newberry project by using a multizone stimulation process. Water is injected into a single well at a pressure of about 2,000 psi to stimulate cracks in the rock, which eventually spider out to create a "zone." Once a zone is complete, pressure is dropped to 1,000 psi and a diverter made of biodegradable plastic (similar to plastic developed that allows water bottles to biodegrade in landfills) is injected into the well to "gum up" the cracks, according to Stowe. Pressure is then increased to 2,000 psi to start a new fracture zone, and then a new batch of diverter is made to plug up holes at hotter temperatures. The process repeats until all zones are created, and water flow is then stopped to allow the well to heat up. It takes about one week for the diverter to break down into water and CO_2, which is eventually used to generate power once the plant is built, said Stowe.

According to several experts, many of the issues related to natural gas fracking can be prevented with the same type of proper protocol and procedures in use at the Newberry project. For example, in 2011 Chesapeake Energy reportedly lost control of a well in Pennsylvania. The well cracked, spilled and contaminated a nearby stream — this could have been prevented by using stronger cement and casings to ensure an impermeable seal.

The natural gas industry is slowly realizing that it needs to reduce these issues to gain public confidence, said Stowe, so it is working with state regulators to create some of the same regulations that exist for geothermal. Texas became the

first state to require companies to reveal what is in its fracking solutions. And more recently, Illinois passed some of the "toughest fracking regulations" in the U.S., and will require companies to reveal chemicals used and test groundwater before and after fracking. "The best way to get around issues is to adequately fund state agencies, employ smart people with decades of experience, gain support from the surrounding regulatory framework and a commitment from the Environmental Protection Agency," said Place.

Though there are far fewer EGS projects compared to the thousands in natural gas, Hollett is confident that if the geothermal sector follows best practices, drills wells properly and works with regulatory agencies, it will mitigate the potential for any adverse environmental impacts.

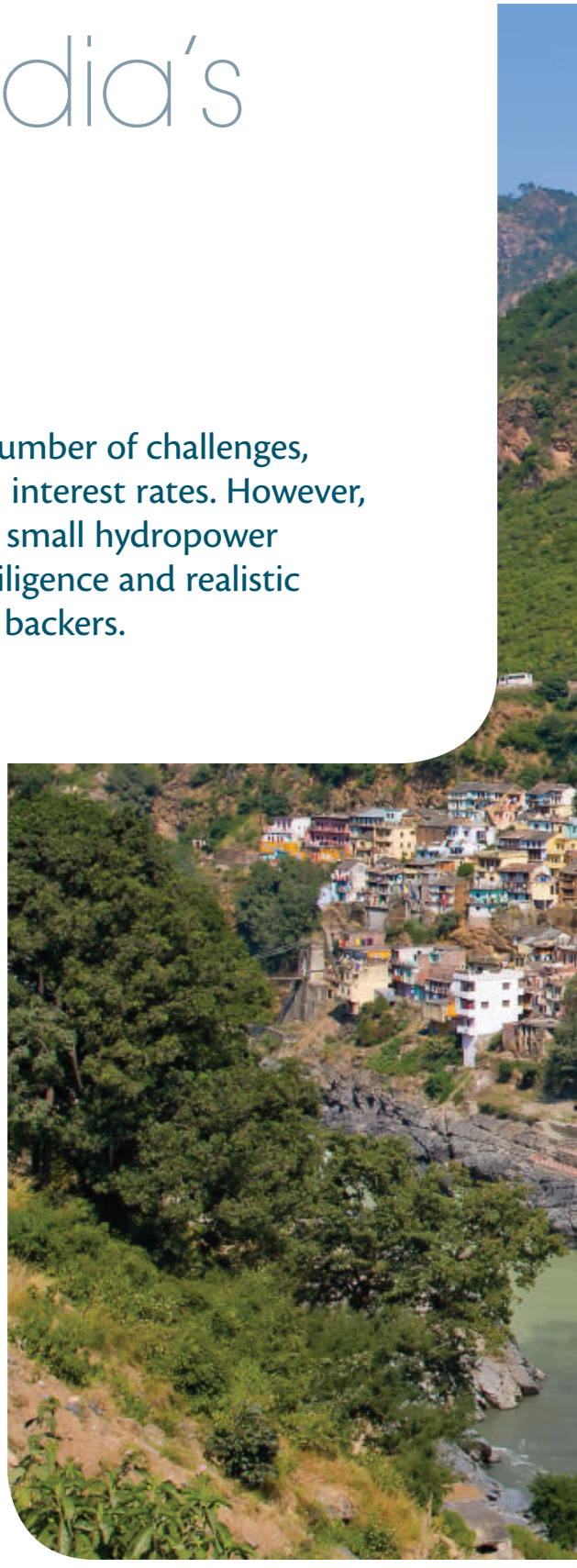
Place agrees, and points out that both technologies have potential risks, neither of which are served well by avoiding them. Though there are different risk pathways, he said, risks are risks, and the industries not only needs strong regulations, but strong practices and responsible development — it "goes hand-in-hand" for both technologies.

"At Newberry [regulations are] rigorous — that's how it should be, and that's okay. Fracking should be completely safe, and if it isn't then someone is doing a sloppy job," said Stowe. "I'm hopeful that the natural gas industry will [work to create regulations and protocols], because in my opinion fracking is here to stay — I don't see it going anywhere any time soon." ◑

Financing India's Small Hydro Capacity

Project investment in India is facing a number of challenges, not least of which are prohibitively high interest rates. However, there are opportunities to develop successful small hydropower projects based on cash flow, a detailed due diligence and realistic expectations from both developers and their backers.

DAVID APPLEYARD, *Chief Editor*



India's scope for hydropower development is vast. Close to 150 GW of theoretical potential exists in the country today, with an estimated 84 GW of economically exploitable capacity, according to figures from the Central Electricity Authority (CEA). Simultaneously, there is a large population of rural poor with no access to grid electricity, an existing peak load deficit estimate at around 10 percent and a rapidly growing economy — and with it an associated increase in power demand.

Indeed, India's economy reportedly grew at its slowest pace in a decade during the 2012-2013 financial year, but still clocked up a 5 percent growth rate over the year. Prime Minister Manmohan Singh reportedly expressed confidence that the country's economy would bounce back to an "8 percent growth rate."

CEA projects electricity demand to increase by around 40 percent by 2016-2017 and just about double by 2021-2022.

However, there are a number of structural issues that impact on the country's ability to develop large capital-intensive projects like large-scale hydropower

The confluence of the Alaknanda River and Bhagirathi River in Uttarakhand, India via Shutterstock.

and as a result a good deal of attention has been focused on the development of small hydropower capacity, deemed projects with a nameplate output of 25 MW or less.

Authorities report that there is significant potential for hydropower development on this scale. Figures from the responsible agency, the Ministry of New and Renewable Energy (MNRE), estimate the potential for power generation in the country from such plants at over 15 GW.

Recognizing that small hydropower projects can play a critical role in improving the overall energy scenario of the country and in particular for remote and inaccessible areas, the Ministry aims to harness at least half of the potential in the country over the next decade to bring the installed capacity of small hydro to about 7 GW by the end of 12th Plan in 2017. In August 2012, the Minister of New and Renewable Energy, Dr. Farooq Abdullah, said that during the 11th Plan, a capacity of 1,419 MW of small hydro was added compared to 536 MW during the 10th Plan.

Some 967 small hydro projects with an aggregate capacity of 3,632 MW have been installed in India to the end of April 2013, with 24 states announcing a policy to invite private sector bodies to set up projects. In addition, 281 small hydro projects with an aggregate capacity of 1,061 MW are also under construction in various states.

MNRE said it is providing Central Financial Assistance to set up small/micro hydro projects both in the public and private sectors while financial support is also given to the state

Ganges river in the Himalayas mountains in Uttarakhand, India via Shutterstock.

governments for the identification of new potential sites, including surveys and the preparation of detailed project reports, and renovation and modernization of old projects. In 2012-2013 some Rs.1.6 billion [US $28 million] of funding was released under the Small Hydro Power (SHP) Program.

Driving Private Investment

Given the vast potential and obvious drivers for demand, why has India been so hesitant when it comes to execution? While some would point to the strength of country's coal lobby, a more pertinent point is the key to all energy development: economics.

Shedding light on this theme, the recent HydroVision India Conference and Exhibition heard from Anchit Gupta, director of business development at Focal Energy, a global investment group specializing in small hydro and solar installations with more than 300 MW of projects in its pipeline. Gupta said the company is primarily looking at a steady cash flow from income generating assets.

When considering investing in a hydropower development, Gupta explained that a good partner with honesty and integrity is the most important element, together with projections and adequate contingencies within the project plan.

However, the cost of debt and the interest rate on capital is a major influence, and Gupta said that even though the company is an equity investor, it maintains focus on capital rates rather than equity returns. This, he says, is the most pressing issue for renewable energy and infrastructure development in India.

"With a larger operating portfolio we can go out and get much cheaper debt, but until then the focus is on projects which are profitable with adequate cash flow, considering the risks involved," he explained.

He presented a typical example of a project deal with a debt-to-equity ratio of 70:30, a typical interest rate of 14 percent and a repayment period of eight years. In this case "around 22 percent of total project cost in the first year is outflow to service debt. Most projects are not generating that kind of cash flow in the first few years," he said. "That is one of the most pressing issues for renewable energy in India."

He added that a realistic assessment of revenue is critical. "One of the challenges [is that] projects are more often than not over-advertised with under-estimation of revenue project costs and over-estimations of energy production potential. We have a benchmark for a 30 percent haircut and so far we been spot on. You could say that Indian developers are consistently inconsistent in over-estimating generation potential."

Valuing Projects

Aside from the cost of debt, Gupta also points out that project valuations can be an issue in the small hydropower sector. "The other challenge we face is the valuation expectations by developers. They expect they're going to get the same valuations as projects they may hear about in the market," he said. Focal Energy, he added, "focuses on a very thorough and aggressive due diligence process. For example, developers may say, 'the tariff is going to be increased in two months' — well, we can wait for two months and see what happens. Whatever is there and can be supported is what we rely on."

Giving further insights into the company's due-diligence process, Gupta explained that they keep an eye on projects that they didn't invest in "to give us a benchmark for evaluating the opportunity we have come across," he said. "We also know that there are enough projects available for us to invest in, and if we walk away we don't sweat it."

Gupta explained how to create a win-win situation in developing small hydropower. "We do spend a lot of time on the ground in order to fully understand the developer and local issues," he said, adding that key issues are a strict adherence to budgets and timelines, reliable cash flow and accurate project valuations. He also addressed the changing nature of small hydro developers, saying that there are very good and hard-working entrepreneurs in India who are prepared to stand behind agreements no matter what, but there is a need to overcome the family business approach, accepting that experts can come in and that standards need to change with a different perception of the risks involved, which comes from experience.

"Most [developers] plan so that everything is going to be perfect, but we say 'not everything will be perfect you need to plan for contingencies,'" Gupta said. "Working with a long-term partner some say, 'initially it was very hard for us, but now we see the value on this approach.'"

In terms of attracting foreign investment to small hydropower projects in India, Gupta said that a fundamental issue is the regulatory environment that "keeps changing from time to time." But he also said that there are potentially big gains for companies who can take the risk. "There is a big need for foreign capital looking for credible income generating assets. And there are huge capital needs for infrastructure projects in India; I believe there is the groundwork for creating win-wins." ◑

Are Beer and Cigarettes the New Bioenergy?

BRUCE DORMINEY, *Correspondent*

Don Draper and fellow "Mad Men" would likely be horrified, but alcohol and tobacco — long joined at the hip by chain smokers and heavy drinkers — are countering the U.S.' current aversion to excess by rebranding themselves as new sources of bio-energy.

Tobacco Plants via Shutterstock.

Tobacco, which has suffered declining market share and price yields for decades in the U.S., could reinvent itself as a genetically-altered biomass for production of biodiesel, bio-gasoline, or bio-jet fuels.

The spirits industry, meanwhile, is already using their industrial beer and liquor byproducts to generate bioenergy as a means of offsetting operational costs.

The U.S. Department of Energy's (DOE) Advanced Research Projects Agency-Energy (ARPA-E) is spending $4.9 million on a three-year program that aims to produce gasoline, diesel and jetfuel from tobacco. The DOE, along with partners at Lawrence Berkeley National Laboratory (LBNL), the University of California at Berkeley, and the University of Kentucky in Lexington, envision producing a genetically-engineered tobacco plant that has almost a third of its dry weight in hydrocarbons.

The group has been working on the project for more than a year and by early 2015, hopes to have engineered the plants to produce biofuels efficiently and directly in their leaves. By some estimates, a thousand acres of genetically-engineered tobacco could yield more than a million gallons of biofuel. That's in contrast to the normal arduous task of biofuel production involving microbial reduction of sugars into biofuel.

"Algae already makes alkane and turpenoid oils, used for biofuels like biodiesel or bio-jet," said Peggy Lemaux, a plant microbial biologist at the University of California at Berkeley and a principal investigator on the ARPA-E project. "Thus, by installing algal genes in tobacco leaf tissue, we can make these oils in tobacco and extract them directly from the green leaf biomass in a straightforward process."

The Magic Hat Brewery in Burlington, VT

The aim is to engineer existing tobacco plants for more efficient carbon uptake so that photosynthesis will trigger the creation of these much sought-after hydrocarbon oils.

"We have produced these oils in tobacco," said Lemaux. "But we are still not at the levels that we need to be able to compete with ethanol. But we know that can [happen]."

Historically grown in wide neat rows to ensure the highest quality product not the most quantity, farmers who wanted to grow tobacco for biofuels would flip that model.

"We could produce quite a bit of tonnage per acre if we didn't plant it in [the] wide rows of today," said Michael Moore, a tobacco extension agronomist at the University of Georgia's Agricultural Extension Service, who notes this year the state will harvest 11,000 acres of tobacco. "We're harvesting only the leaves with a statewide average of 2,400 pounds per acre. But we could vary our plant population from the current 7,000 plants per acre to 200,000 per acre easily enough."

Tobacco farmers are already very supportive of this project, says Lemaux, who adds that with the exception of China, conventional tobacco markets are diminishing. She says tobacco also offers growers more flexibility in planting than switchgrass or miscanthus, noting that from year to year, tobacco farmers can switch out tobacco for another crop.

"The farmer will get the [new] seeds from the University of Kentucky," said Lemaux. "Planting may be a little closer than normal, but the harvesting will be similar. We will extract [oil] from green biomass, so we won't be drying it."

Even so, tobacco's future as a biofuel is not just whether it can compete with ethanol, but also whether it can compete with growers who are already growing and harvesting their crops for conventional tobacco companies.

Lemaux says that one reason ARPA-E chose tobacco for a project is precisely because, unlike corn grown for ethanol, tobacco has never been a food crop.

With tobacco, Lemaux says, there will never be a dilemma over whether to use it for food or for fuel, as has been the case with corn. She even predicts that within in 20 years, tobacco grown for dipping, chewing or smoking could be supplanted by tobacco grown solely as a biofuel source.

Alcohol and Bioenergy

Where there's tobacco, there is also usually beer. In this instance, however, the brewing industry is further ahead in creating new sources of bioenergy.

Magic Hat Brewing Company is a case in point. This South Burlington, Vt. brewery, which makes about 200,000 barrels of beer per year, is now using a large part of its spent waste to create biogas. Although the average brewery generates five parts of waste for every one

part of beer, Magic Hat has a two-to-one waste to product ratio.

As Eric Fitch, a mechanical engineer and the CEO and founder of Purpose Energy in Arlington, Ma., explains, up until the company began its bioenergy endeavor, most of the waste byproduct was trucked off site for use as livestock feed or for pet food.

Since June 2011, an anaerobic digester designed and manufactured by Purpose Energy has been supplying the brewery with 220 kW of biogas-generated electricity.

"We have three different bioreactors integrated into one tank at Magic Hat," said Fitch. "Solids go into the first tank and break down into soluble sugars and acids. Then those sugars and acids go into the second and third reactors and are converted into methane biogas."

Fitch says his company's system takes Magic Hat's waste and reduces the cost of byproduct remediation by over 60 percent. The methane gas that is produced is, in turn, run into a power plant that makes heat and electricity used in the brewery. As a result, Fitch estimates that magic hat has replaced about a third of its fossil fuel-derived electricity with renewable biogas.

Such concepts are also familiar to the Alaskan Brewing Company.

At 1,000 miles north of Seattle in the far-flung southeast Alaska panhandle, there's little or no livestock on the Alexander archipelago. Thus, for nearly two decades, the Juneau-based Alaskan Brewing Company has shipped its spent grain to Pacific Northwest farmers and ranchers to use primarily as feed for their cattle.

But since February of this year, the craft brewer, which distributes throughout 14 western states including Alaska, has been using its dried spent wheat, malt and barley grain to fire the brewery's boiler kettles, says Andy Kline, communications manager at the Alaskan Brewing Company.

As a result, the brewery, which produces 140,000 barrels of beer annually, projects its 4,500 tons of annual spent grain fuel will save over 1.5 million gallons of fuel oil over the next 10 years, while reducing the company's fuel oil consumption by 70 percent.

It's likely that we'll see more brewers figure out that recycling their waste and using it as energy helps to bring down production costs. But tobacco as biofuel may be a harder sell to farmers used to growing the crop for generations of smokers. The idea might just need the marketing smarts of a latter-day Don Draper. ◑

What About My Single Malt?

Helius CoRDe ltd., a U.K.-based bioenergy joint venture between Helius Energy, Rabo Project Equity, and the Combination of Rothes Distillers Limited (CoRD) announced this spring that it had opened a $95 million biomass co-generation plant in the small town of Rothes, Scotland. The plant will combust leftover draff (a whisky byproduct) from the Glenrothes whisky distillery plus wood chips in a 7.2-MW combined heat and power plant that will produce electricity, heat and Pot Ale Syrup, a product that can be used as animal feed.

HydroVision® INTERNATIONAL

July 23-26, 2013
Colorado Convention Center
Denver, Colorado
www.hydroevent.com

Dear Colleagues,

As hydropower gains momentum in the global pursuit of clean, renewable energy alternatives, opportunities for development are on the rise. More and more countries are placing hydro at the forefront of their future energy plans. How can we continue on this path to growth among the other renewable choices? Perhaps more importantly, how can renewables work together to achieve growth? Hydropower, as a clean, renewable and reliable option, can lead the way.

I invite you to join me — along with thousands of other hydro professionals — in Denver, Colorado, USA, for a week of informative hydropower-focused meetings, workshops, technical tours, an extensive conference program and the world's largest exhibition of hydro products and services at the largest gathering of your colleagues this year: HydroVision International 2013. Please join us the week of July 22, 2013 for HydroVision International. I look forward to seeing you.

Sincerely,

Marla Barnes
Publisher and Chief Editor, Hydro Group
PennWell Corporation

Ocean/Tidal/ Stream Power

WEDNESDAY, JULY 24, 2013

SESSION 1D - All About Wave, Tidal and In-Stream Hydrokinetics
SESSION 2D - The Pathway to a Mature Marine Hydrokinetics Industry

THURSDAY, JULY 25, 2013

SESSION 3D - Coastal Grid Connection: Challenges for Marine Projects?
SESSION 4D - Technology and Project Status: Tidal and In-Stream
SESSION 5D - Wave Energy Technology and Project Status

FRIDAY, JULY 26, 2013

SESSION 6D - Opportunities and Constraints for Small and Rural Applications
SESSION 7D - All Things Environmental: Review, Compliance and Resources

Among the 11 tracks featured at HydroVision International, an entire seven-session panel presentation track will cover the Ocean/Tidal/Stream Power market.

This year's Ocean/Tidal/Stream Power track is designed to provide a wealth of educational content to registrants, including the mechanics, current development and challenges in the fields of wave, tidal and inland hydrokinetic energy. In the session that kicks off the three-day program, expert panelists and moderators will discuss the full spectrum of wave and tidal energy issues, while answering audience questions.

"There will be no question too simple, and this session will provide a perfect opportunity for people in the hydro industry to learn more about all aspects of wave and tidal," says Tim Mundon, senior engineer at Kleinschmidt Associates and co-track chair for the Ocean/Tidal/ Stream Power track.

This track provides an educational overview of the global environment for development in the ocean, tidal, and stream power markets. After years of embryonic development, technologies are making significant progress. This track will bring you up to date on the status of development in this market and challenges that still need to be overcome.

Each of the sessions combines solid content with perspective from industry experts such as Jason Busch, executive director of the Oregon Wave Energy Trust, and Robert Thresher, research fellow at the National Renewable Energy Laboratory, who will speak on wave and tidal energy, respectively.

In addition to a rich content program, HydroVision International features an exhibit hall with more than 320 companies who work in the hydroelectric market.

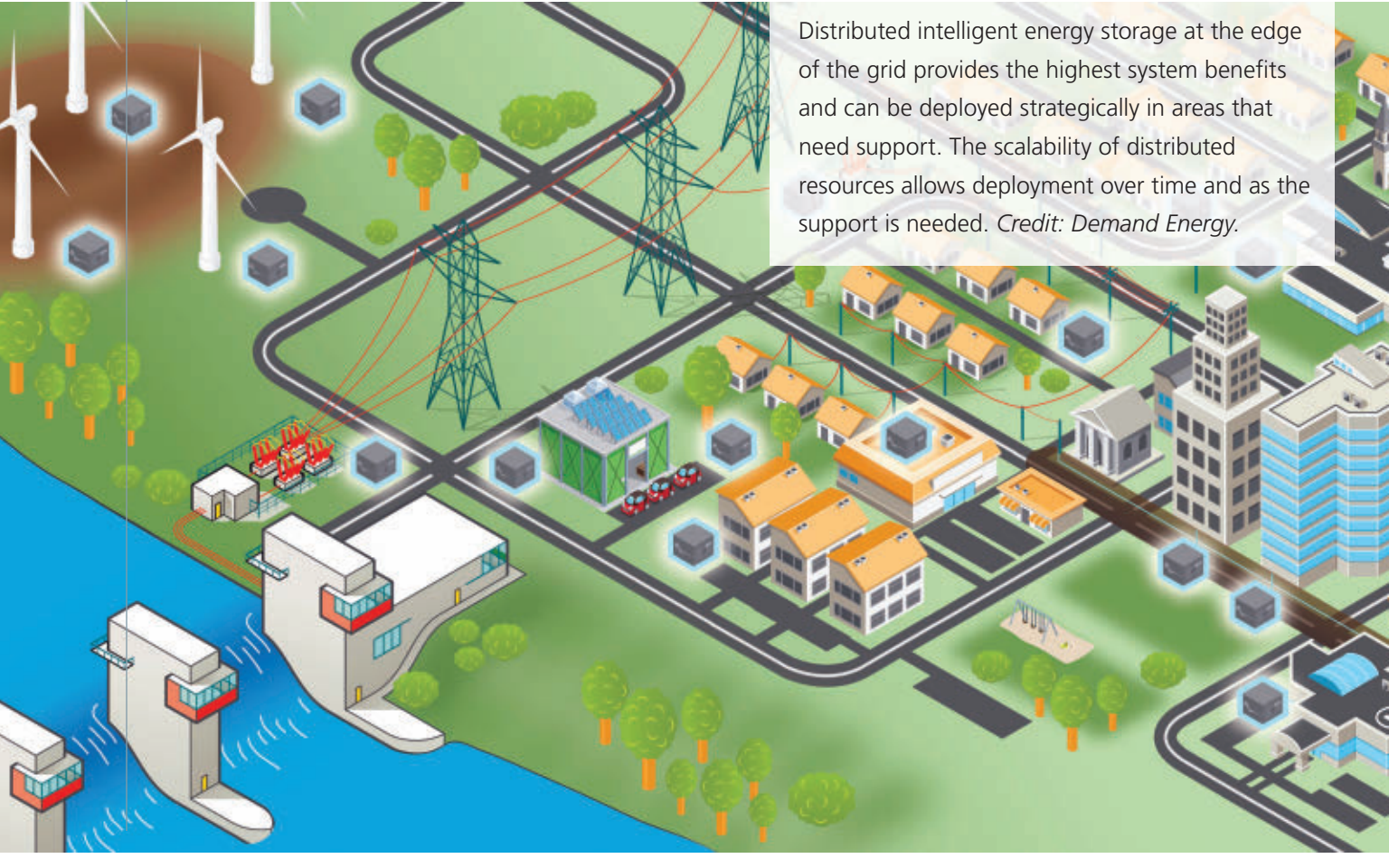
For more information on the Ocean/Tidal/Stream Power track, and to choose which courses fit your needs, CLICK HERE.

The Case for Distributed Energy Storage

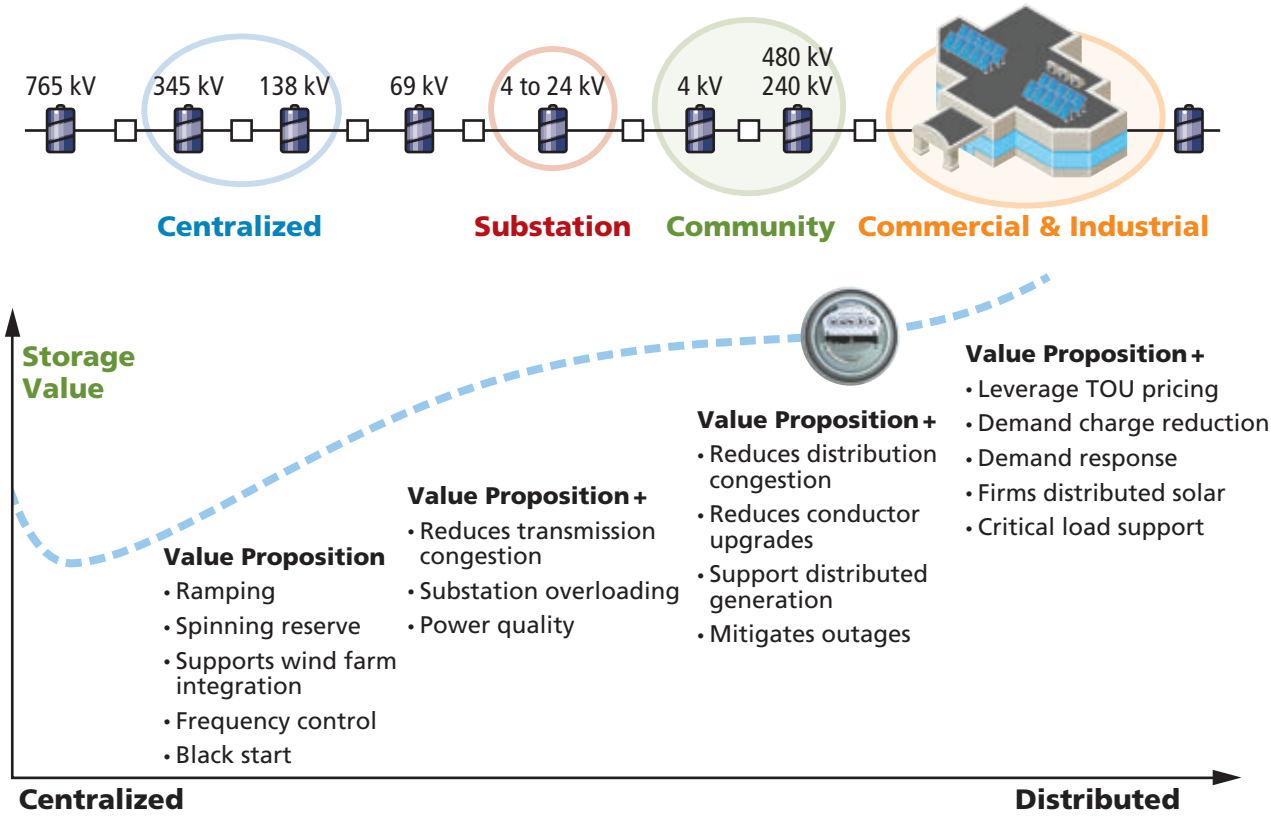
If costs come down enough, energy storage has the potential to significantly alter the grid as we know it.

JAMES MONTGOMERY, *Associate Editor*

There's a fundamental dichotomy in U.S. energy infrastructure. Power is mostly produced from resources inland, but most of the consumption is in the major population centers along the east and west coasts. Thus, we have a spiderweb of transmission and distribution (T&D) systems to get power from where it's generated to where it's consumed. As those load centers increasingly demand more energy, significant investments in transmission infrastructure are needed — but building out addition transmission creates congestion at the load centers, according to experts. Creating enough T&D to satisfy peak demand and avoid congestion would be like building a 32-lane highway to combat rush-hour traffic: for two hours a day it would be well used but the



Distributed intelligent energy storage at the edge of the grid provides the highest system benefits and can be deployed strategically in areas that need support. The scalability of distributed resources allows deployment over time and as the support is needed. *Credit: Demand Energy.*



Energy storage's value increases as approaches the edge of the grid and the customer's load, with economic benefits accruing to both the utility and the end-user. *Credit: Demand Energy, inspired by KEMA's locational value of energy storage perspective.*

other 22 hours it would be overkill. And utilities dislike underutilized investments.

Enter energy storage. "In theory, to provide stability, you put energy storage where the instability is," said Rick Luebbe, CEO of Energ2. Steve Minnihan, senior analyst at Lux Research, agrees; all things being equal in terms of $/kWh costs and architectures, "the most value is putting [energy storage] where you have the highest volatility." Of course the reality is that costs (and prices) are not equalized; there are different costs for utilities to put in large centralized energy storage facilities, compared with putting lots of batteries in smaller installations further out on the grid.

Thus, the key to energy storage, many argue, is putting it at the very edge of the grid where it can optimize generation, transmission, and distribution, from integration of renewable energy generation to demand response programs, and can better respond as grid back-up power in the event of storms and disasters. "The highest economic value [of energy storage] is not at the substation but at the edge, improving distribution losses and performance in the supply chain," explained Doug Staker, VP of business development for Demand Energy.

A Home Everywhere

Energy storage can solve many problems all along the energy supply chain: T&D deferral, demand response, power quality & reliability, frequency control, and mitigation of solar and

wind energy intermittency. Because of this, the desired end goal influences where an energy storage technology is best placed.

"In some cases there are transmission constraints that could benefit from energy storage, and in some cases it makes sense for the energy storage to be sited near the system load" to reduce system losses, explained Frank Novachek, director of corporate planning for Xcel Energy. The utility holding company has been involved with a number of energy storage demonstration projects, from a wind energy/battery installation in Minnesota to the Solar Technology Acceleration Center (SolarTAC) in Colorado. He also emphasizes the need to view and operate energy storage as a resource that supports the grid system, and not solely to support renewable generation.

Much of S&C Electric Company's 150-MWh of energy storage worldwide is at the substation level and used for peak shaving, backup power supply, in microgrids, and for capital deferral. The company also is a big proponent of "community energy storage" (CES) at the edge of the grid where it can best manage the effects of distributed renewable energy resources, and will be even more important with growing adoption of electric vehicles and residential renewable energy installations.

"Right now utilities aren't well equipped to meet the sudden increase in power demand associated with charging electric vehicles, nor do utilities have a way to address the effects of distributed resources, such as unpredictable increases in electric demand if the output of these resources suddenly drops," explained Dan Girard, S&C's director of renewable energy and energy storage. "Where energy storage is closer to the load, it can be particularly effective at managing the effects of distributed renewable energy resources, and thus protect power quality and grid stability." Deploying distributed energy storage in a building-block approach "may be particularly valuable as the industry gains more experience in applying and operating energy storage systems," he added.

A Classic Example

Applications for energy storage are "dizzying," acknowledged Steve Hellman, president of Eos Energy Storage. "You can make a case for centralized storage at the point of generation," he said, but "we're of the opinion that there's a strong and compelling case on a distributed basis." Eos Energy Storage is undertaking a "sub-utility-scale" pilot project with ConEdison, starting with a study of how its batteries could be used to reduce peak load or manage voltage regulation, and all of the integration touchpoints needed in a real-world environment: wrapping the DC battery system with an inverter, all power conversion systems, communications platforms and controls, etc.

"What we're evaluating most is distribution upgrade deferral," he said, installing energy storage for "pretty standard peak shaving." Deploying that energy storage in the load center, he explained, "allows you to effectively debottleneck all that upstream transmission infrastructure" — monetizing the value of that battery, the energy arbitrator, and the infrastructure investment. ConEd is also exploring energy storage as voltage regulation at the end of the distribution line, leveling out variability.

The project is part of a broader go-to-market strategy, dubbed "Genesis," where Eos hopes to work closely with six or seven major utilities to understand their energy needs and incorporate those requirements into its product development processes. While NRG, for example, sees energy storage as a merchant

asset on the grid in a more centralized power plant application, ConEd is a "perfect partner" for distributed energy storage because it operates one of the most complex distribution systems in the country, Hellman said: the vast majority of it is underground, and costs soar to $1 million per city block to upgrade it — assuming it's even feasible to shut down an entire block and dig up and replace everything.

New York City is a classic example of densified energy consumption and congestion problems, agreed Staker.

It's not easy to increase the size of the conduit feeder system running underground into the city, and running kilometers of transmission is inefficient and impractical due to line loss. Utilities analyze the peak load on the distribution feeder and determine when it's more efficient to move up to the next size of conductor — they're already incentivized to utilize the capital employed in generation and transmission capabilities. But if they can timeshift energy into the system, and cash it in on the edge of the grid and use it locally, "that can be a better optimization method," Staker explained. And aggregating points of storage across an entire city — 30-40 buildings in Manhattan, say, controlled and managed to benefit the building owners as well as ConEd — "that *is* utility-scale."

A Commodity Like Oil

That terminology, "utility-scale" and "grid-scale," illustrates another problem, suggested Erick Petersen, VP of marketing at Demand Energy — it "is deceiving" and represents "a classic utility mindset" that frames the discussion as a centralized service

Xcel Energy's wind-to-battery project in Minnesota. *Credit: Xcel Energy.*

Demand Energy Storage units in the field. *Credit: Demand Energy.*

and thus centralized control. "It assumes and creates the persona that it's 100 MWh of storage in one big central location," rather than recognizing how energy is used and where it is located, he said. Storage on a distributed basis "can get to grid-scale very quickly" and "is significantly more robust" than upstream centralized grid-scale storage assets, he said.

Whether energy storage is defined as distributed or grid-level is "kind of an artificial differentiation," offered Eos' Hellman. Like any other commodity, electricity should be managed and stored throughout its supply chain, he believes, as a buffer wherever there's a change in scale (e.g., wholesale/bulk to smaller volume) or in time (e.g., a day or a month to the next day or month). Typically such management is too expensive in an electricity supply chain that must instantaneously match supply and demand, but as storage technology costs come down "you can expect to see it in just about any instance where electricity is being transformed in time or space." He compares it to, of all things, oil — it's stored at the wells as crude, in bulk distribution centers at various points along its supply chain during the refining process, and at the end of the line where demand needs it at gas stations and then inside cars and homes and businesses.

But it's on the customer side of the meter where Staker sees the real benefit of energy storage: reducing consumers' energy used during peak times, reducing demand charges for commercial customers, and a reduced load that benefits the grid, which will ultimately help grid operators focus more on utilization and not asset capitalization. "It's just another tool in the tool bag," he said. ◑

Renewable Energy Training Events

Here we offer a sampling of short renewable energy educational events and certificate programs throughout the world.

Renewable Power Economics
Green Power Academy
London, UK
July 8-9, 2013

Solar Electric Installer Training
Solar Energy International
Colorado, USA and Online
July and August, 2013

The Green Power Mini MBA and International Bioenergy School
Green Power Academy
Rio de Janeiro, Brazil
August, 2013

Basics of Wind
everblue
Online and On-demand

Biomass One-day Course
Coventry University, UK or Edinburgh Napier University, Scotland or Online
The European Energy Centre
Offered Year-Round

SMA Regional Forums
SMA America, LLC
Various Locations, USA
July and August, 2013

Ground Source Geothermal Installer Training
CleanEdison
Various Locations, USA
July and August, 2013

Solar PV Installer Boot Camp Training + NABCEP Entry Level Exam Prep
Heatspring Learning Institute
Various Locations, USA and Online
July and August, 2013

If you would like your training event to considered for inclusion in this listing, please email REWNews@Pennwell.com subject line: Education and Training.

the Last WORD

As Solar Costs Drop, Energy Storage Solutions Take Center Stage

Energy storage has emerged as the next big opportunity for the solar industry. With significant improvements in PV technology and balance-of-system innovations, the solar industry has dramatically reduced both commercial and residential solar system costs in the last year — leading to a substantial increase in the amount of solar connected to the grid in the U.S. The U.S. solar industry achieved impressive growth in 2012, and there is no slowdown in sight. In 2013, EuPD Research projects that the U.S. will add approximately 3.9 GW of new solar capacity.

However, solar energy, as well as wind energy, relies on an intermittent energy source and output fluctuates based on the weather. This presents several challenges for utilities, independent power producers and solar project developers alike. First, variable power generation limits the utility applications of solar technology, since customers demand energy access 24 hours a day — not merely when the sun is shining. Second, the U.S. power grid is not yet well equipped to handle surges or quick declines in power supply or demand leaving many utilities unsure about solar power's impact on the grid.

Commercialized energy storage solutions solve these problems and will play a pivotal role in ensuring the solar market's continued growth. The more solar that is integrated into the grid, the greater the need for energy storage solutions because it improves the quality and reliability of the renewable energy solar supply, and eases the grid integration of solar systems. Further, energy storage transforms PV plants into controllable power systems that can meet demand at all times of the day. Recent technology developments, coupled with favorable policies and support schemes, are accelerating the widespread adoption of energy storage, which in the U.S. could reach 4 GW by 2016.

Energy storage innovations will be displayed this month at Intersolar North America in a special exhibition segment, and leaders will gather to discuss incentive programs and the market landscape during four conference sessions dedicated to the topic.

For the solar industry to continue making gains globally, energy storage solutions must continue to advance. Just as PV technology improvements led to a significant drop in total solar system costs and a dramatic jump in U.S. installations, further improvements in storage technologies will open up opportunity for the solar industry to expand and meet more of our energy needs. ◑

Markus Elsässer is the founder and CEO of Solar Promotion, an internationally operating, private trade fair company with a focus on renewable energy and energy efficiency. Under Markus's leadership Solar Promotion International's flagship event series, Intersolar, has grown to more than 3,500 exhibitors and 120,000 visitors.

RENEWABLE ENERGY WORLD MAGAZINE

2013 DIRECTORY OF SUPPLIERS

The Global Resource for Technology and Applications in the Renewable Energy Industry

Company listings are available online at
www.RenewableEnergyWorld.com

www.PowerGenerationWeek.com

POWER GENERATION WEEK

4 Events. 5 Days. 1 Roof.

NOVEMBER 12–14, 2013 | ORANGE COUNTY CONVENTION CENTER | ORLANDO, FL, USA

Covering every aspect of the power generation industry, POWER-GEN International, NUCLEAR POWER International, Renewable Energy World Conference & Expo North America and POWER-GEN Financial Forum converge in 2013 to form POWER GENERATION WEEK. Benefit from five days packed with pre-conference workshops, technical tours, over 70 conference sessions, panel discussions, three exhibition days and multiple networking events. Like never before, you'll have access to nearly every facet of the market – all under one roof.

Owned & Produced by PennWell | Presented by POWER Engineering | Supported by PennEnergy NPI Nuclear Power International Magazine HYDRO REVIEW RENEWABLE ENERGY WORLD.COM

CATEGORIES LISTINGS INDEX

CATEGORY LISTINGS

COUNTRY CODES USED IN THE CATEGORY LISTINGS

Algeria	DZ
Argentina	AR
Australia	AU
Austria	AT
Barbados	BB
Belgium	BE
Bulgaria	BG
Canada	CA
China	CN
Cook Islands	CI
Curaçao	CC
Cyprus	CY
Denmark	DK
Finland	FI
France	FR
Germany	DE
Greece	GR
India	IN
Indonesia	ID
Ireland	IE
Israel	IL
Italy	IT
Japan	JP
Kenya	KE
Korea	KP
Lithuania	LT
Malaysia	MY
Malta	MT
Mauritania	MR
Mexico	MX
Morocco	MA
Namibia	NA
New Zealand	NZ
Norway	NO
Pakistan	PK
Poland	PL
Portugal	PT
Romania	RO
Russian Federation	RU
Singapore	SG
Slovak Republic	SK
Slovenia	SI
South Africa	ZA
Spain	ES
Sweden	SE
Switzerland	CH
Taiwan	TW
Tanzania	TZ
Thailand	TH
The Netherlands	NL
Tunisia	TN
Turkey	TR
Uganda	UG
United Kingdom	UK
United States	US

BIOFUELS FOR TRANSPORT

BIODIESEL

BGF Europe SA (AR)
EcoCorp (US)
Energy Technology Advisors (US)
Hydrasep Inc (US)
Joseph Oat Corp (US)
National Biomass Association - NBA (BG)
PRé Consultants BV (NL)
Proplan Ltd (CY)
Prosonix Corp (US)
Targray Technology International Inc (CA)

ETHANOL PRODUCTION

ETA Florence Renewable Energies (IT)
Hydrasep Inc (US)
John Crane (US)
M-E-C Co (US)
PRé Consultants BV (NL)
Prosonix Corp (US)
Recovered Energy Inc (US)
Targray Technology International Inc (CA)
Vooner FloGard Corp (US)

BIOMASS AND ENERGY-FROM-WASTE

APPLICATIONS

BIOGAS PLANTS

Abou Walid Group (TN)
Ameresco Inc (US)
EcoCorp (US)
Gas Compressors Ltd (UK)
Hocking County Community Improvement Corp (US)
Ingvar Ingrids AB (SE)
National Biomass Association - NBA (BG)
Omex Environmental Ltd (UK)
Progetto Energia Srl (IT)
Proplan Ltd (CY)
Prosonix Corp (US)
SENER (ES)
Siempelkamp Maschinen-und Anlagenbau GmbH & Co KG (DE)
Solar Turbines (US)
Sunspun Enterprises Pty Ltd (AU)
E Van Wingen NV (BE)

BIOGAS UTILISATION

Abou Walid Group (TN)
Combustion Technologies Pvt Ltd (IN)
EcoCorp (US)
ETW Energietechnik GmbH (DE)
Precision Combustion Inc (US)
Sunspun Enterprises Pty Ltd (AU)

CATCH CROP UTILISATION

National Biomass Association - NBA (BG)

CONSTRUCTION

Battic Door Energy Conservation Products (US)
CH2M HILL (US)
Continental Biomass Industries Inc - CBI (US)
Fisher Tank Co (US)
Gibraltar Chimney International (US)
Matan International Group Ltd (UK)
Milestones Building and Design (US)
S&B Engineers and Constructors (US)
Z-LASER Optoelektronik GmbH (DE)

ENERGY FORESTRY

BGF Europe SA (AR)
Conversion And Resource Evaluation Ltd (UK)
DEE Development Engineers Ltd (IN)
Justsen Energiteknik A/S (DK)
Nuergy Biomass (UK)
Saxlund International Ltd (UK)
West Salem Machinery Co (US)

ENERGY-FROM-WASTE PROJECTS

Abou Walid Group (TN)
Baumgarte Boiler Systems GmbH (DE)
Börger GmbH (DE)
Bright Management Associates Ltd (UK)
Combustion Energy and Steam Specialists Ltd - CESS (UK)
Continental Biomass Industries Inc - CBI (US)
Dresser-Rand (US)
Ecoling Partner AG (CH)
EMGroup BV (NL)
Eneco Systems Inc (CA)
Etudes Chimiques et Physiques - ECP (FR)
FCC Environment (UK)
Hocking County Community Improvement Corp (US)
Hurst Boiler & Welding Co Inc (US)
See ad page 64
Hydrasep Inc (US)
IMERYS (US)
Jansen Combustion and Boiler Technologies Inc (US)
JWG Consulting Ltd (UK)
Lithuanian Energy Institute - LEI (LT)
METHASYN EG (CH)
Metrologie et Gestion d'Environnement - MGE (BE)
Murphy International Development LLC (US)
Outotec Energy Products (US)
PHG Energy (US)
Pipal Ltd (KE)
Pratt & Whitney Power Systems (US)
PRM Energy Systems Inc - PRME (US)
Recovered Energy Inc (US)
RUD Chain Inc (US)
Saxlund International Ltd (UK)
Schenck Process (UK)
SENER (ES)
Sir Robert McAlpine Ltd (UK)
Solar Energy Advocacy (UG)
Spilling Energie Systeme GmbH (DE)
Sunspun Enterprises Pty Ltd (AU)
Taylor Keogh Communications (UK)
VendorAZ (PK)
Veolia Environmental Services Plc (UK)
Voith Turbo BHS Getriebe GmbH (DE)
Water Recycle Group Australia Pty Ltd (AU)
WEIMA America Inc (US)
West Salem Machinery Co (US)
Willett and Son Bristol Ltd (UK)
Wolf Material Handling Systems (US)

ENERGY STORAGE

Warren & Baerg Manufacturing Inc (US)

GASIFICATION

Combustion Technologies Pvt Ltd (IN)
Eneco Systems Inc (CA)
Hurst Boiler & Welding Co Inc (US)
See ad page 64

Nuergy Biomass (UK)
Outotec Energy Products (US)
PHG Energy (US)
PRM Energy Systems Inc - PRME (US)
Vooner FloGard Corp (US)
Warren & Baerg Manufacturing Inc (US)

INCINERATION
Detroit Stoker Co (US)
EMGroup BV (NL)
Etudes Chimiques et Physiques - ECP (FR)
FCC Environment (UK)
IMERYS (US)
International Chimney Corp (US)
Siempelkamp Maschinen-und Anlagenbau GmbH & Co KG (DE)
Warren & Baerg Manufacturing Inc (US)

LANDFILL GAS MONITORING
LFG Consult (DK)

LANDFILL GAS UTILISATION
ETW Energietechnik GmbH (DE)
Gas Compressors Ltd (UK)
Ingvar Ingrids AB (SE)
LFG Consult (DK)
LumaSense Technologies Inc (US)
Precision Combustion Inc (US)
Veolia Environmental Services Plc (UK)

OTHER
Airoflex Equipment (US)
BMH Technology Oy (FI)
ElectraTherm Inc (US)
Enertegic (US)
Golden Eagle Technologies LLC (US)
Rotork Plc (UK)

PEAT MANAGEMENT
International Peat Society (FI)

REFUSE-DERIVED FUELS
BGF Europe SA (AR)
Detroit Stoker Co (US)
Dresser-Rand (US)
Hurst Boiler & Welding Co Inc (US)
See ad page 64
Hydrasep Inc (US)
IMERYS (US)
Jansen Combustion and Boiler Technologies Inc (US)
PRM Energy Systems Inc - PRME (US)
Proplan Ltd (CY)
Sunspun Enterprises Pty Ltd (AU)
Wolf Material Handling Systems (US)

WOOD-WASTE UTILISATION
Abou Walid Group (TN)
Bioenergy Technology Ltd (UK)
Bright Management Associates Ltd (UK)
Collinson Plc (UK)
Conversion And Resource Evaluation Ltd (UK)
EMGroup BV (NL)
FCC Environment (UK)
IMERYS (US)
Jeffrey Rader (US)
Justsen Energiteknik A/S (DK)
Kyoto Energy Pte Ltd (SG)
Nuergy Biomass (UK)
Outotec Energy Products (US)
PRM Energy Systems Inc - PRME (US)
Spilling Energie Systeme GmbH (DE)
Voith Turbo BHS Getriebe GmbH (DE)
WEIMA America Inc (US)
West Salem Machinery Co (US)
Wolf Material Handling Systems (US)

EQUIPMENT

AEROBIC DIGESTERS
Energy Technology Advisors (US)
Warren & Baerg Manufacturing Inc (US)
Water Recycle Group Australia Pty Ltd (AU)

ANAEROBIC DIGESTERS
CBT Wear Parts Inc (US)
Energy Recovery Solution (CA)
Fisher Tank Co (US)
Hocking County Community Improvement Corp (US)
Prosonix Corp (US)
Sunspun Enterprises Pty Ltd (AU)
Vooner FloGard Corp (US)
Water Recycle Group Australia Pty Ltd (AU)

BALERS
CBT Wear Parts Inc (US)
Eurobalers Ltd (UK)
Pöttinger Entsorgungstechnik GmbH & Co KG (AT)
Presona AB (SE)

BOILERS
Aguidrovert Solar SL - Energia Termica Fotovoltaica Y Biomasa (ES)
Ansaldo Caldaie SpA (IT)
Baumgarte Boiler Systems GmbH (DE)
Biomass Briquette Systems LLC (US)
Bono Energia SpA (IT)
Cleaver-Brooks Engineered Boiler Systems (US)
Ebner Vyncke (US)
ERI (Energy Recovery International) (US)
FlaktWoods (US)
Global Energy Solutions Inc (US)
The Green Electrician Group (UK)
Hurst Boiler & Welding Co Inc (US)
See ad page 64
Jansen Combustion and Boiler Technologies Inc (US)
John Crane (US)
Justsen Energiteknik A/S (DK)
KARA Energy Systems BV (NL)
Metso Power (US)
NATCOM (CA)
Nuergy Biomass (UK)
Outotec Energy Products (US)
Thorne International Boiler Services Ltd (UK)

BRIQUETTERS
Biomass Briquette Systems LLC (US)
Dresser-Rand Co Ltd (UK)
National Biomass Association - NBA (BG)
Pöttinger Entsorgungstechnik GmbH & Co KG (AT)
Warren & Baerg Manufacturing Inc (US)
WEIMA America Inc (US)

CHIPPERS
Boerger Pumps Asia Pte Ltd (SG)
CBT Wear Parts Inc (US)
Continental Biomass Industries Inc - CBI (US)
Haas Recycling GmbH (DE)
Pallmann Maschinenfabrik GmbH & Co KG (DE)
WEIMA America Inc (US)
West Salem Machinery Co (US)

COMBUSTORS
EMGroup BV (NL)
Justsen Energiteknik A/S (DK)
KARA Energy Systems BV (NL)
Outotec Energy Products (US)
Precision Combustion Inc (US)
Saxlund International Ltd (UK)

COMPACTORS
Pöttinger Entsorgungstechnik GmbH & Co KG (AT)
Presona AB (SE)

COOKING STOVES, BIOMASS-FIRED
Bioenergy Technology Ltd (UK)

DISINTEGRATORS AND SHREDDERS
Boerger Pumps Asia Pte Ltd (SG)
CBT Wear Parts Inc (US)
Herbold Meckesheim GmbH (DE)
Jeffrey Rader (US)
Magnetic Div Global Equipment Mktg Inc (US)
Pallmann Maschinenfabrik GmbH & Co KG (DE)
WEIMA America Inc (US)

ENGINES
Interdevelopment Inc (US)
Lloyd Dynamowerke GmbH & Co KG (DE)
Siempelkamp Maschinen-und Anlagenbau GmbH & Co KG (DE)
Spilling Energie Systeme GmbH (DE)
Yanmar America (US)

FEEDING EQUIPMENT
Boerger Pumps Asia Pte Ltd (SG)
Continental Biomass Industries Inc - CBI (US)
Detroit Stoker Co (US)
Jeffrey Rader (US)
KEITH Manufacturing Co (US)
Magnetic Div Global Equipment Mktg Inc (US)
Omex Environmental Ltd (UK)
Saxlund International Ltd (UK)
Schenck Process (UK)
West Salem Machinery Co (US)

FLUE GAS CLEANERS
Bioenergy Technology Ltd (UK)
Combustion Technologies Pvt Ltd (IN)
FlaktWoods (US)
Justsen Energiteknik A/S (DK)
KARA Energy Systems BV (NL)

GAS GENERATORS
DFME Sp zoo (PL)
Hocking County Community Improvement Corp (US)
James Troop and Co Ltd (UK)
Kelburn Engineering (UK)

GASIFIERS
Global Energy Solutions Inc (US)
Organics Asia Co Ltd (TH)
Outotec Energy Products (US)
PHG Energy (US)
PRM Energy Systems Inc - PRME (US)

HANDLING PLANTS
Jeffrey Rader (US)
National Conveyors Co Inc (US)

HARVESTERS
CBT Wear Parts Inc (US)
Global Energy Solutions Inc (US)

LANDFILL GAS
Castrol Lubricants (UK)
FCC Environment (UK)

Gas Compressors Ltd (UK)
James Troop and Co Ltd (UK)
Kelburn Engineering (UK)
Organics Asia Co Ltd (TH)

METERS
icenta Controls Ltd (UK)
Moisttech (US)
Siemens Industry Inc, Solutions Automation and Drive Technologies (US)

OTHER
Airoflex Equipment (US)
Comptus (US)
CPS Environmental (UK)
Haas Recycling GmbH (DE)
International Chimney Corp (US)
International Generator Technical Community (US)
Magnetic Div Global Equipment Mktg Inc (US)
ORBIS Corp (US)
Pallmann Maschinenfabrik GmbH & Co KG (DE)
Pöttinger Entsorgungstechnik GmbH & Co KG (AT)
RUD Chain Inc (US)
Siempelkamp Maschinen-und Anlagenbau GmbH & Co KG (DE)

STOKERS
Detroit Stoker Co (US)
Global Energy Solutions Inc (US)
Jeffrey Rader (US)
Justsen Energiteknik A/S (DK)
Nuergy Biomass (UK)

STORAGE CONTAINERS
Aire Industrial (US)
Collinson Plc (UK)
Fisher Tank Co (US)
Justsen Energiteknik A/S (DK)
KARA Energy Systems BV (NL)
National Conveyors Co Inc (US)
ORBIS Corp (US)
Tank Connection Affiliate Group (US)

TURBINES
Bioenergy Technology Ltd (UK)
Bono Energia SpA (IT)
Compressor Controls Corp - CCC (US)
Dresser-Rand (US)
Global Energy Solutions Inc (US)
International Power Machinery Co (US)
MAN Diesel & Turbo SE (DE)
Spilling Energie Systeme GmbH (DE)
Stork Turbo Blading (US)
Turbine Controls Ltd (UK)
Z-LASER Optoelektronik GmbH (DE)

SERVICES

CONSULTANCY
Antares Group Inc (US)
APT Consulting Group Co Ltd (TH)
AquaBioTech Group (MT)
Bioenergy Technology Ltd (UK)
BMH Technology Oy (FI)
Bridgestone Associates Ltd (US)
Cambridge Project Development Inc (US)
Continental Biomass Industries Inc - CBI (US)
Darley & Associates (UK)
DEE Development Engineers Ltd (IN)
E4tech (CH)
E4tech (UK)
EA Technology (Europe) Ltd (UK)
Ecoling Partner AG (CH)
Ecostrat and General Biofuel (CA)
Energy4All Ltd (UK)
ETA Florence Renewable Energies (IT)
Freesen and Partner GmbH (DE)
INFRASTRUKTUR & UMWELT Professor Böhm und Partner (DE)
Ingvar Ingrids AB (SE)
InterEnergy Srl (IT)
Jansen Combustion and Boiler Technologies Inc (US)
Kyoto Energy Pte Ltd (SG)
LFG Consult (DK)
Lithuanian Energy Institute - LEI (LT)
Navigant (US)
NIRAS A/S (DK)
North Energy Associates Ltd (UK)
Progetto Energia Srl (IT)
Proplan Ltd (CY)
Ramboll (DK)
Recovered Energy Inc (US)
RJM Associates (US)

CONTRACT R&D
Bright Management Associates Ltd (UK)
CEESE-ULB (BE)
Conversion And Resource Evaluation Ltd (UK)
CPS Environmental (UK)
LFG Consult (DK)

DESIGN
Ameresco Inc (US)
Conversion And Resource Evaluation Ltd (UK)
Dresser-Rand Co Ltd (UK)
EcoCorp (US)
Harris Group Inc (US)
Jansen Combustion and Boiler Technologies Inc (US)
LFG Consult (DK)
PDR Associates (Renewable) Inc (US)
RUD Chain Inc (US)
Spilling Energie Systeme GmbH (DE)
STEJASA Agregados Industriales SA (ES)
Wolf Material Handling Systems (US)

DOCUMENTATION
Write_on (UK)

ENVIRONMENTAL STUDIES
Aquatech International Corp (US)
CH2M HILL (US)
CSD Ingenieure AG (CH)
International Peat Society (FI)
Metso Power (US)
Odotech Inc (CA)

FEASIBILITY STUDIES
APT Consulting Group Co Ltd (TH)
Cambridge Project Development Inc (US)
CEESE-ULB (BE)
CH2M HILL (US)
Darley & Associates (UK)
DEE Development Engineers Ltd (IN)
Dulas Ltd (UK)
Ecostrat and General Biofuel (CA)
Eneco Systems Inc (CA)
Harris Group Inc (US)
INFRASTRUKTUR & UMWELT Professor Böhm und Partner (DE)
Kyoto Energy Pte Ltd (SG)
LFG Consult (DK)
Metso Power (US)
Outotec Energy Products (US)
Recovered Energy Inc (US)
Water Recycle Group Australia Pty Ltd (AU)
Wolf Material Handling Systems (US)

FINANCIAL ADVICE
The Black Emerald Group (UK)
Morrison & Kibbey Ltd (US)
Vireo Energy Financial (US)

INFORMATION
Ecostrat and General Biofuel (CA)
Energy4All Ltd (UK)
Freesen and Partner GmbH (DE)
International Peat Society (FI)
Motiva Oy (FI)
Swedish Bioenergy Association (SE)

INSTALLATION
Burkhalter (US)
CH2M HILL (US)
CPS Environmental (UK)
Dresser-Rand Co Ltd (UK)
Dulas Ltd (UK)
Ecoling Partner AG (CH)
Gibraltar Chimney International (US)
The Green Electrician Group (UK)
Saxlund International Ltd (UK)
T4 Sustainability Ltd (UK)

INSURANCE
Ecostrat and General Biofuel (CA)
GCube Insurance Services Inc (US)

MAINTENANCE
Alpine Components (UK)
James Troop and Co Ltd (UK)
Metso Power (US)
NAES Corp (US)
PLI LLC (US)
S&B Engineers and Constructors (US)

MONITORING
Bright Management Associates Ltd (UK)
LFG Consult (DK)
Opsis AB (SE)

OPERATING
Ameresco Inc (US)
Bright Management Associates Ltd (UK)
Cambridge Project Development Inc (US)
Metso Power (US)
NAES Corp (US)

OTHER
Airoflex Equipment (US)
Baumgarte Boiler Systems GmbH (DE)
EcoCorp (US)
Golden Eagle Technologies LLC (US)
IMERYS (US)

OWNERSHIP
Kyoto Energy Pte Ltd (SG)

PRODUCT SOURCING
Alturdyne (US)
British Green Ltd (UK)
Ecostrat and General Biofuel (CA)
Renewable Energy Corp Ltd (UK)

PROJECT MANAGEMENT
APT Consulting Group Co Ltd (TH)
Boyle Energy Services & Technology (US)
Cambridge Project Development Inc (US)
CSD Ingenieure AG (CH)
DEE Development Engineers Ltd (IN)
JWG Consulting Ltd (UK)
LFG Consult (DK)

Parsons Brinckerhoff (UK)
Proplan Ltd (CY)
Recovered Energy Inc (US)

SOFTWARE
SimTech Simulation Technology (AT)

TESTING
Alpine Components (UK)
TESEO SpA (IT)

TRAINING
Freesen and Partner GmbH (DE)

TURNKEY CONTRACTORS
Aquatech International Corp (US)
Cambridge Project Development Inc (US)
CH2M HILL (US)
CPS Environmental (UK)
DEE Development Engineers Ltd (IN)
EMGroup BV (NL)

COGENERATION

APPLICATIONS

AGRICULTURE
Abou Walid Group (TN)
Alturdyne (US)
CFE (MX)
CH2M HILL (US)
EC Power A/S (DK)
Milestones Building and Design (US)
Pipal Ltd (KE)
Seawater Greenhouse Ltd (UK)
Voith Turbo BHS Getriebe GmbH (DE)
Wavelength Electronics Inc (US)
Willett and Son Bristol Ltd (UK)

COMMERCIAL BUILDINGS
EC Power A/S (DK)
Kyoto Energy Pte Ltd (SG)
Milestones Building and Design (US)
Power Panel Inc (US)

HOSPITALS
Atilgan Danismanlik Energy (TR)
EC Power A/S (DK)
Solar Turbines (US)

HOTELS
Solar Turbines (US)

INDUSTRIAL PLANTS
CH2M HILL (US)
Clyde Bergemann Bachmann Inc (US)
Helmick Corp (US)
Jonas Inc (US)
Milestones Building and Design (US)
Pipal Ltd (KE)
Progetto Energia Srl (IT)
Solar Turbines (US)
Southwest Research Institute (US)
Universidad Autonoma Metropolitana-Iztapalapa - UAMI (MX)

LEISURE CENTRES
EC Power A/S (DK)

OTHER
CH2M HILL (US)
Clyde Bergemann Bachmann Inc (US)
Golden Eagle Technologies LLC (US)
SSS Clutch Co Inc (US)
UT99 AG Oil Mist Eliminators (CH)
Voith Turbo BHS Getriebe GmbH (DE)

SMALL-SCALE DOMESTIC
Alturdyne (US)
EC Power A/S (DK)
Golden Eagle Technologies LLC (US)

STEAM GENERATION
BGF Europe SA (AR)
Detroit Stoker Co (US)
John Crane (US)
Jonas Inc (US)
KARA Energy Systems BV (NL)
Pipal Ltd (KE)
Spilling Energie Systeme GmbH (DE)
UT99 AG Oil Mist Eliminators (CH)

EQUIPMENT

BOILERS
Biomass Briquette Systems LLC (US)
Bono Energia SpA (IT)
Bosch Industriekessel GmbH (DE)
Cleaver-Brooks Engineered Boiler Systems (US)
Ebner Vyncke (US)
ERI (Energy Recovery International) (US)
FlaktWoods (US)
Helmick Corp (US)
Indiana Gratings Pvt Ltd (IN)
NATCOM (CA)
Outotec Energy Products (US)
Rely (UK) Precision Castings (UK)
Siempelkamp Maschinen-und Anlagenbau GmbH & Co KG (DE)
Thorne International Boiler Services Ltd (UK)
West Pomerenian University of Technology (PL)

CONTROL GEAR
DEIF (UK) Ltd (UK)
Turbine Controls Ltd (UK)

ENGINES
Clyde Bergemann Bachmann Inc (US)
ETW Energietechnik GmbH (DE)
MTU Friedrichshafen GmbH (DE)
See ad page 67
Spilling Energie Systeme GmbH (DE)
UT99 AG Oil Mist Eliminators (CH)
Yanmar America (US)

GAS COMPRESSORS
Atlas Copco Construction Mining Technique USA LLC (US)
Dresser-Rand (US)
Dresser-Rand Co Ltd (UK)
See ad page 15
ETW Energietechnik GmbH (DE)
Gas Compressors Ltd (UK)
John Crane (US)
MAN Diesel & Turbo SE (DE)
Neuman & Esser USA Inc (US)
Schutte & Koerting (US)
Vooner FloGard Corp (US)

GENERATORS
Atlas Copco Construction Mining Technique USA LLC (US)
Babcock Power Inc (US)
BRUSH Turbogenerators Inc (US)
CFE (MX)
Clyde Bergemann Bachmann Inc (US)
DFME Sp zoo (PL)
Eneco Systems Inc (CA)
GenerPro AB (SE)
Green Orkney Tours (UK)
Helmick Corp (US)
International Generator Technical Community (US)
Leroy Somer (FR)
Lloyd Dynamowerke GmbH & Co KG (DE)
Mersen France Amiens (FR)
MTU Friedrichshafen GmbH (DE)
See ad page 67
National Electric Coil (US)
Power Panel Inc (US)
E Van Wingen NV (BE)
Yanmar America (US)

HEAT EXCHANGERS
AMWEI Thermistor (CN)
Babcock Power Inc (US)
Energy Recovery Solution (CA)
Heatec Inc (US)
Joseph Oat Corp (US)
Lapesa Grupo Empresarial SL - LAPESA (ES)
Rely (UK) Precision Castings (UK)
Super Radiator Coils (US)
UNEX Scambio Termico Srl (IT)

METERS
AMWEI Thermistor (CN)
DEIF (UK) Ltd (UK)
LUDECA Inc (US)

OTHER
AEGIS Bearing Protection Rings (US)
American Crane & Equipment Corp (US)
Baltimore Aircoil International NV - BAC (BE)
Clyde Bergemann Bachmann Inc (US)
Conax Technologies (US)
Craft Bearing Co Inc (US)
Defitec SPRL (BE)
Electroswitch (US)
GenerPro AB (SE)
Gibraltar Chimney International (US)
Glaunach GmbH (AT)
H&L Instruments LLC (US)
Indiana Gratings Pvt Ltd (IN)
International Chimney Corp (US)
ITH Engineering Inc (US)
Kingsbury Inc (US)
Neuman & Esser USA Inc (US)
Rely (UK) Precision Castings (UK)
Solectria Renewables LLC (US)
UT99 AG Oil Mist Eliminators (CH)

PACKAGED PLANTS
Alturdyne (US)
Bowman Power Group Ltd (UK)
ETW Energietechnik GmbH (DE)
Hurst Boiler & Welding Co Inc (US)
See ad page 64
Project Risk Ltd (US)
Rely (UK) Precision Castings (UK)

PIPING
Biomass Briquette Systems LLC (US)
Croll-Reynolds Engineering Co Inc (US)

SWITCHGEAR
AMWEI Thermistor (CN)
Electroswitch (US)
Maven Power (US)
Phoenix Electric Corp (US)

TURBINES
ap+m (US)
Bowman Power Group Ltd (UK)
Burns & McDonnell (US)
BWD Turbines Ltd (CA)

Clyde Bergemann Bachmann Inc (US)
Continental Field Systems Inc (US)
Defitec SPRL (BE)
Dresser-Rand (US)
Dresser-Rand Co Ltd (UK)
See ad page 15
Eneco Systems Inc (CA)
Everest Sciences Inc (US)
Green Orkney Tours (UK)
HITEC Sensor Solutions Inc (US)
International Power Machinery Co (US)
MAN Diesel & Turbo SE (DE)
Maven Power (US)
Spilling Energie Systeme GmbH (DE)
SSS Clutch Co Inc (US)
Stork Turbo Blading (US)
UT99 AG Oil Mist Eliminators (CH)
West Pomerenian University of Technology (PL)

VALVES
Clyde Bergemann Bachmann Inc (US)
Flowserve Corp (US)
John Crane (US)
Rely (UK) Precision Castings (UK)
Rotork Plc (UK)
Schutte & Koerting (US)
STEJASA Agregados Industriales SA (ES)

SERVICES

CERTIFICATION
Romanian Energy Regulatory Authority - ANRE (RO)

CONSTRUCTION
Burns & McDonnell (US)
CH2M HILL (US)
Dresser-Rand Co Ltd (UK)
See ad page 15
Ebner Vyncke (US)
Gibraltar Chimney International (US)
Hyundai Heavy Industries (KP)
Milestones Building and Design (US)
Niagara Worldwide (US)
S&B Engineers and Constructors (US)
E Van Wingen NV (BE)

CONSULTANCY
Advanced Engineering Srl (IT)
Antares Group Inc (US)
Bridgestone Associates Ltd (US)
BSRIA Ltd (UK)
Burns & McDonnell (US)
Continental Field Systems Inc (US)
Conversion And Resource Evaluation Ltd (UK)
Darley & Associates (UK)
E4tech (CH)
E4tech (UK)
Electroswitch (US)
Enertegic (US)
Environmental Alternatives Inc (US)
EscoVale Consultancy Services (UK)
Forecast International (US)
Golden Eagle Technologies LLC (US)
Integrated CHP Systems Corp (US)
Jonas Inc (US)
Metrologie et Gestion d'Environnement - MGE (BE)
Ramboll (DK)
RJM Associates (US)
Romanian Energy Regulatory Authority - ANRE (RO)
Valentin Software (Dr Valentin EnergieSoftware GmbH) (DE)
Vireo Energy Financial (US)

CONTRACT ENERGY MANAGEMENT
Atilgan Danismanlik Energy (TR)

CONTRACT R&D
Forecast International (US)
Integrated CHP Systems Corp (US)

DESIGN
Aquatech International Corp (US)
Babcock Power Inc (US)
Burns & McDonnell (US)
CH2M HILL (US)
Dresser-Rand Co Ltd (UK)
See ad page 15
Ebner Vyncke (US)
Golden Eagle Technologies LLC (US)
Harris Group Inc (US)
Integrated CHP Systems Corp (US)
PDR Associates (Renewable) Inc (US)
Phoenix Electric Corp (US)
Progetto Energia Srl (IT)
Spilling Energie Systeme GmbH (DE)
Turbine Controls Ltd (UK)

DOCUMENTATION
PanGlobal Training Systems Ltd (CA)

FEASIBILITY STUDIES
The Cool Solutions Co (US)
CSD Ingenieure AG (CH)
Harris Group Inc (US)
Integrated CHP Systems Corp (US)
Maven Power (US)

FINANCIAL ADVICE
Burns & McDonnell (US)
Energy4All Ltd (UK)
Morrison & Kibbey Ltd (US)
Vireo Energy Financial (US)

INSTALLATION
Burkhalter (US)
Century Elevators (US)
Continental Field Systems Inc (US)
Dresser-Rand Co Ltd (UK)
See ad page 15
Ebner Vyncke (US)
Hyundai Heavy Industries (KP)
Maven Power (US)
Phoenix Electric Corp (US)
E Van Wingen NV (BE)

MAINTENANCE
ap+m (US)
BWD Turbines Ltd (CA)
Century Elevators (US)
Clyde Bergemann Bachmann Inc (US)
Continental Field Systems Inc (US)
Dresser-Rand (US)
Dresser-Rand Co Ltd (UK)
Gibraltar Chimney International (US)
International Generator Technical Community (US)
LUDECA Inc (US)
NAES Corp (US)
PLI LLC (US)
Square Two Lubrication Ltd/ Memolub HPS Lubricators (UK)
Thorne International Boiler Services Ltd (UK)
Turbine Controls Ltd (UK)
E Van Wingen NV (BE)

MONITORING
Alpine Components (UK)
cmc Instruments GmbH (DE)
DEIF (UK) Ltd (UK)
EA Technology (Europe) Ltd (UK)
Golden Eagle Technologies LLC (US)
Meggitt Sensing Systems (CH)
Muis Controls Ltd (CA)
SimTech Simulation Technology (AT)
SymCom Inc (US)
Water Weights Inc (US)

OPERATING AND OWNERSHIP
Atilgan Danismanlik Energy (TR)
Javno Podjetje Energetika Ljubljana doo (SI)

OTHER
Aquatech International Corp (US)
Clyde Bergemann Bachmann Inc (US)
Environmental Alternatives Inc (US)
Forecast International (US)
GenerPro AB (SE)

PLANT PACKAGING
Everest Sciences Inc (US)
Gas Compressors Ltd (UK)

PROJECT MANAGEMENT
Aquatech International Corp (US)
Atilgan Danismanlik Energy (TR)
Boyle Energy Services & Technology (US)
CH2M HILL (US)
Hyundai Heavy Industries (KP)
Integrated CHP Systems Corp (US)
Parsons Brinckerhoff (UK)

SOFTWARE
Fluke Corp (US)
SimTech Simulation Technology (AT)
Turbine Controls Ltd (UK)
Valentin Software (Dr Valentin EnergieSoftware GmbH) (DE)

TARIFF ANALYSIS
PDR Associates (Renewable) Inc (US)

TESTING
BWD Turbines Ltd (CA)
Cressall Resistors (UK)
Fluke Corp (US)
SimTech Simulation Technology (AT)
TESEO SpA (IT)
Water Weights Inc (US)

TRAINING
Global Training Solutions Inc (CA)
Industrial Training Consultants Inc (US)
Lithuanian Energy Institute - LEI (LT)

TURNKEY CONTRACTORS
Mortenson Construction (US)
SENER (ES)
VendorAZ (PK)

DISTRICT HEATING EQUIPMENT

BOILERS
Biomass Briquette Systems LLC (US)
Bono Energia SpA (IT)
Bosch Industriekessel GmbH (DE)
Cleaver-Brooks Engineered Boiler Systems (US)
Edwards Hot Water (AU)

ERI (Energy Recovery International) (US)
FlaktWoods (US)
The Green Electrician Group (UK)
Hurst Boiler & Welding Co Inc (US)
See ad page 64
Justsen Energiteknik A/S (DK)
NATCOM (CA)
SAC Boiler Plant Ltd (UK)
Thorne International Boiler Services Ltd (UK)

CONDENSERS
Enerquip LLC (US)

FLUE GAS CLEANERS
FlaktWoods (US)
Justsen Energiteknik A/S (DK)

GENERATORS
Combustion Energy and Steam Specialists Ltd - CESS (UK)
Lloyd Dynamowerke GmbH & Co KG (DE)
Yanmar America (US)

HEAT EXCHANGERS
Babcock Power Inc (US)
Edwards Hot Water (AU)
Enerquip LLC (US)
Heatec Inc (US)
Hurst Boiler & Welding Co Inc (US)
See ad page 64
Lapesa Grupo Empresarial SL - LAPESA (ES)
Solarnetix Inc (CA)
Super Radiator Coils (US)
UNEX Scambio Termico Srl (IT)
West Pomerenian University of Technology (PL)

HEAT METERS
AMWEI Thermistor (CN)
Carlos Bertschi Srl (AR)

HEAT PUMPS
The Green Electrician Group (UK)

HEAT STORAGE INSTALLATIONS
The Cool Solutions Co (US)

OTHER
AEGIS Bearing Protection Rings (US)
Glaunach GmbH (AT)
Kelburn Engineering (UK)
M-E-C Co (US)

PUMPS
Boerger Pumps Asia Pte Ltd (SG)
CPS Environmental (UK)
Flowserve Corp (US)
SAC Boiler Plant Ltd (UK)
Sulzer Pumps Ltd (CH)
Yanmar America (US)

STEAM TURBINES
Dresser-Rand (US)
Dresser-Rand Co Ltd (UK)
Hurst Boiler & Welding Co Inc (US)
See ad page 64
Spilling Energie Systeme GmbH (DE)
Stork Turbo Blading (US)
Super Radiator Coils (US)

VALVES
STEJASA Agregados Industriales SA (ES)

WATER TREATMENT PLANTS
Bono Energia SpA (IT)
SAC Boiler Plant Ltd (UK)
Square Two Lubrication Ltd/ Memolub HPS Lubricators (UK)

SERVICES

CONSTRUCTION
S&B Engineers and Constructors (US)

CONSULTANCY
Advanced Engineering Srl (IT)
The Cool Solutions Co (US)
Darley & Associates (UK)
ETA Florence Renewable Energies (IT)
NIRAS A/S (DK)
North Energy Associates Ltd (UK)
Ramboll (DK)

DESIGN
Babcock Power Inc (US)
Solarnetix Inc (CA)
STEJASA Agregados Industriales SA (ES)

DOCUMENTATION
Dynamic Systems Inc (US)
PanGlobal Training Systems Ltd (CA)

FEASIBILITY STUDIES
Dynamic Systems Inc (US)
ETA Florence Renewable Energies (IT)
PDR Associates (Renewable) Inc (US)

FINANCIAL ADVICE
The Black Emerald Group (UK)

HEAT DELIVERY TESTS
Lithuanian Energy Institute - LEI (LT)
SAC Boiler Plant Ltd (UK)

INSTALLATION
Babcock Power Inc (US)
The Green Electrician Group (UK)

MAINTENANCE
Dresser-Rand (US)
Flowserve Corp (US)
PLI LLC (US)
Pratt & Whitney Power Systems (US)
SAC Boiler Plant Ltd (UK)

MONITORING
Muis Controls Ltd (CA)

OPERATION
SAC Boiler Plant Ltd (UK)

OWNERSHIP
Javno Podjetje Energetika Ljubljana doo (SI)

PROJECT MANAGEMENT
Matan International Group Ltd (UK)

TRAINING
SAC Boiler Plant Ltd (UK)

TURNKEY CONTRACTORS
Justsen Energiteknik A/S (DK)
Pratt & Whitney Power Systems (US)

WATER TREATMENT
Near East University (TR)

GENERAL SERVICES

SERVICES

CONSULTANCY
Array Technologies Inc (US)
See ad page 35
Brandis Ltd (UK)
Brite Energy Solutions (US)
British Antarctic Survey (UK)
Bureau Veritas North America Inc (US)
Clarke Energy Associates (BB)
Compressor Controls Corp - CCC (US)
The Cool Solutions Co (US)
Crystal Group Inc (US)
Dynamic Systems Inc (US)
E4tech (CH)
E4tech (UK)
Electric Power Production From Magnetic Tapes (GR)
Energy4All Ltd (UK)
Energy & Development Group - EDG (ZA)
Energy Institute (UK)
Energy Technology Advisors (US)
Envect Inc (US)
Environmental Alternatives Inc (US)
GO Topeka Economic Development (US)
GustoMSC (NL)
Henkel Corp (US)
HWP-hullmann Willkomm & Partner - GbR (DE)
INFRASTRUKTUR & UMWELT Professor Böhm und Partner (DE)
INNOTRONIKS (US)
Jonas Inc (US)
Lightning Eliminators & Consultants Inc (US)
Met Office (UK)
Metrologie et Gestion d'Environnement - MGE (BE)
Motiva Oy (FI)
Navigant (US)
Niagara Worldwide (US)
Norconsult AS (NO)
O'Donnell Consulting Engineers (US)
P2 (US)
PennEnergy Research (US)
PRé Consultants BV (NL)
Progetto Energia Srl (IT)
Project Risk Ltd (US)
Ramboll (DK)
Red Acoustics Ltd (UK)
RJM Associates (US)
Sargent & Lundy LLC (US)
Solar Consulting Services - SCS (US)
Solar Energy Advocacy (UG)
Southwest Research Institute (US)
Structural Integrity Associates Inc (US)
SunStar Strategic (US)
System One (US)
T4 Sustainability Ltd (UK)
Telepower Australia (AU)
Viking Equipment Finance (US)
Vireo Energy Financial (US)
Virtus Energy Research Associates (US)
White Design Associates Ltd (UK)

CONTRACT R&D
Advanced Optics Inc (US)
Agricultural Technology Centre (CA)
British Antarctic Survey (UK)
CEESE-ULB (BE)
Energy Environmental Technical Services Ltd - EETS (UK)
METHASYN EG (CH)
O'Donnell Consulting Engineers (US)
Precision Combustion Inc (US)
ProSim Inc (US)
SAC Boiler Plant Ltd (UK)
Seawater Greenhouse Ltd (UK)
Southwest Research Institute (US)
Telepower Australia (AU)
WIP-Munich (DE)
See ad page 73

DESIGN
Ameresco Inc (US)
Ampirical Solutions LLC (US)
Array Technologies Inc (US)
See ad page 35
Breaux Consulting (US)
British Antarctic Survey (UK)
BZ Products Inc (US)
CDM Smith (US)
CEM Design Architects (US)
Crystal Group Inc (US)
GustoMSC (NL)
Harris Group Inc (US)
Henkel Corp (US)
HITEC Sensor Solutions Inc (US)
Lightning Eliminators & Consultants Inc (US)
National Instruments (US)
O'Donnell Consulting Engineers (US)
P2 (US)
Phoenix Electric Corp (US)
Precision Combustion Inc (US)
Quanta Power Generation (US)
Sargent & Lundy LLC (US)
Southwest Research Institute (US)
STEJASA Agregados Industriales SA (ES)
Telepower Australia (AU)
White Design Associates Ltd (UK)

ENERGY AUDITS
Agricultural Technology Centre (CA)
Ameresco Inc (US)
Clarke Energy Associates (BB)
Fundashon Antiyano Pa Energia - FAPE (CC)
Matan International Group Ltd (UK)
Motiva Oy (FI)
P2 (US)

ENERGY PLANNING
Brite Energy Solutions (US)
Electric Power Production From Magnetic Tapes (GR)
METHASYN EG (CH)
Met Office (UK)
Sahara Wind Inc (MA)

EQUIPMENT MAINTENANCE
American Crane & Equipment Corp (US)
Century Elevators (US)
Delta Rigging & Tools (US)
Henkel Corp (US)
SPX Bolting Systems (US)

EQUIPMENT RENTAL
Century Elevators (US)
Delta Rigging & Tools (US)
Dust Control Technology (US)
SPX Bolting Systems (US)

FEASIBILITY STUDIES
Atilgan Danismanlik Energy (TR)
British Antarctic Survey (UK)
CDM Smith (US)
The Cool Solutions Co (US)
E4tech (CH)
E4tech (UK)
Electric Power Production From Magnetic Tapes (GR)
Energy & Development Group - EDG (ZA)
Energy Technology Advisors (US)
GustoMSC (NL)
Harris Group Inc (US)
HWP-hullmann Willkomm & Partner - GbR (DE)
INFRASTRUKTUR & UMWELT Professor Böhm und Partner (DE)
Maven Power (US)
Met Office (UK)
Minder Energy Consulting (CH)
Osiris Hydrographic and Geophysical Projects Ltd (UK)
PennEnergy Research (US)
ProSim Inc (US)
Quanta Power Generation (US)
Sargent & Lundy LLC (US)
White Design Associates Ltd (UK)

FINANCE
The Black Emerald Group (UK)
Energy Technology Advisors (US)
The Hartford Financial Services Group Inc (US)
Pipal Ltd (KE)
SunStar Strategic (US)
Viking Equipment Finance (US)
Vireo Energy Financial (US)

FINANCIAL ADVICE
The Black Emerald Group (UK)
Clarke Energy Associates (BB)
Crystal Group Inc (US)
Energy4All Ltd (UK)
Energy Technology Advisors (US)
SunStar Strategic (US)

INFORMATION
British Antarctic Survey (UK)
Dynamic Systems Inc (US)
Electric Power Production From Magnetic Tapes (GR)
Energy Institute (UK)
Energy Technology Advisors (US)
European Small Hydropower Association - ESHA (BE)
Freesen and Partner GmbH (DE)
Henkel Corp (US)
International Generator Technical Community (US)
International Peat Society (FI)
ISES Norway - Norsk solenergiforening (NO)
Motiva Oy (FI)
National Biomass Association - NBA (BG)
National Instruments (US)
P2 (US)
PennEnergy Research (US)
Rijkert Knoppers Tekstproducties (NL)
Romanian Energy Regulatory Authority - ANRE (RO)
SunStar Strategic (US)
Swedish Bioenergy Association (SE)
White Design Associates Ltd (UK)

INSURANCE
GCube Insurance Services Inc (US)
Project Risk Ltd (US)
SolarInsure Inc (US)

LUBRICATION
Castrol Lubricants (UK)
ExxonMobil (BE)

OELCHECK GmbH (DE)
Square Two Lubrication Ltd/ Memolub HPS Lubricators (UK)

MONITORING
cmc Instruments GmbH (DE)
Energy Technology Advisors (US)
FOSS NIRSystems Inc (US)
InduSoft Inc (US)
Meggitt Sensing Systems (US)
Meggitt Sensing Systems (CH)
National Instruments (US)
Opsis AB (SE)
Red Acoustics Ltd (UK)
SAC Boiler Plant Ltd (UK)
SymCom Inc (US)
System One (US)
Telepower Australia (AU)
WIP-Munich (DE)
See ad page 73

OTHER
A123 Systems (US)
Advanced Optics Inc (US)
American Crane & Equipment Corp (US)
Bureau Veritas North America Inc (US)
Crystal Group Inc (US)
Energy Technology Advisors (US)
Everglades University (US)
See ad page 10
Fujian Morstar New-Energy Tec LLC (CN)
GO Topeka Economic Development (US)
Henkel Corp (US)
Herbold Meckesheim USA (US)
Lightning Eliminators & Consultants Inc (US)
Nortek UK (UK)
Northern State Metals (US)
See ad page 5
ONE Sothebys International Realty (US)
See ad page 68
PES UK Ltd (UK)
Process Equipment - Barron Industries (US)
Quality Two-Way Radios (US)
Rittal Corp (US)
Schweitzer Engineering Laboratories Inc (US)
Solar FlexRack (US)
Solar Promotion International GmbH (DE)
See ad page 43
Southwest Research Institute (US)
Stichting Bakens Verzet (NL)
SunStar Strategic (US)
Technidea Corp (US)
Timber Wolf LLC (US)
Vaisala (US)

PRODUCT SOURCING
Crystal Group Inc (US)
Energy Technology Advisors (US)
Omex Environmental Ltd (UK)
PumpScout (US)

PROJECT MANAGEMENT
CDM Smith (US)
Century Elevators (US)
Electric Power Production From Magnetic Tapes (GR)
Energy & Development Group - EDG (ZA)
INFRASTRUKTUR & UMWELT Professor Böhm und Partner (DE)
Norconsult AS (NO)
P2 (US)
PES UK Ltd (UK)
Quanta Power Generation (US)
Sahara Wind Inc (MA)
Stichting Bakens Verzet (NL)
WIP-Munich (DE)
See ad page 73

SOFTWARE
Dynamic Systems Inc (US)
F-Chart Software (US)
Fluke Corp (US)
Global Training Solutions Inc (CA)
InduSoft Inc (US)
Met Office (UK)
National Instruments (US)
PRé Consultants BV (NL)
ProSim Inc (US)
PumpScout (US)
Schneider Electric (US)
Seawater Greenhouse Ltd (UK)
Valentin Software Inc (US)
WIP-Munich (DE)
See ad page 73

TESTING
Agricultural Technology Centre (CA)
BWD Turbines Ltd (CA)
Fluke Corp (US)
FOSS NIRSystems Inc (US)
Inspecteam Hydro (UK)
Lightning Eliminators & Consultants Inc (US)
Met Office (UK)
National Instruments (US)
O'Donnell Consulting Engineers (US)
Red Acoustics Ltd (UK)
Telepower Australia (AU)

TRAINING
BWD Turbines Ltd (CA)
Clarke Energy Associates (BB)
Energy Institute (UK)
Freesen and Partner GmbH (DE)
Fundashon Antiyano Pa Energia - FAPE (CC)
Global Training Solutions Inc (CA)
Industrial Training Consultants Inc (US)
International Generator Technical Community (US)
Lightning Eliminators & Consultants Inc (US)
Lithuanian Energy Institute - LEI (LT)
Mersen France Amiens (FR)
Niagara Worldwide (US)
PDR Associates (Renewable) Inc (US)
Rich Hessler Business Development (US)
SAC Boiler Plant Ltd (UK)
Schools and Homes Energy Education Project/Solar-Active (UK)
Suleyman Demirel Universitesi (TR)
Technological Educational Institute of Crete (GR)
Tom Jardine (UK)
White Design Associates Ltd (UK)

GEOTHERMAL

APPLICATIONS

DIRECT USE HEATING
Hocking County Community Improvement Corp (US)

OTHER
Contec GmbH Industrieausruestungen (DE)
Deprofundis SARL (FR)
White Design Associates Ltd (UK)

POWER GENERATION
Combustion Energy and Steam Specialists Ltd - CESS (UK)
ElectraTherm Inc (US)
John Crane (US)
Murphy International Development LLC (US)
OFS (US)
See ad page 23
Pratt & Whitney Power Systems (US)
Vooner FloGard Corp (US)

EQUIPMENT

CONDENSERS
Joseph Oat Corp (US)
Schutte & Koerting (US)

DIRECT-USE COOLING WATER SYSTEMS
Deprofundis SARL (FR)

DIRECT-USE HEAT EXCHANGERS AND PUMPS
Lapesa Grupo Empresarial SL - LAPESA (ES)
Schutte & Koerting (US)

DOWNHOLE LOGGING EQUIPMENT
Eijkelkamp Agrisearch Equipment (NL)
Technidea Corp (US)

EXPLORATION EQUIPMENT
Atlas Copco Construction Mining Technique USA LLC (US)

OTHER
AEGIS Bearing Protection Rings (US)
Atlas Copco Construction Mining Technique USA LLC (US)
Frako Capacitors (US)
Glaunach GmbH (AT)
Kelburn Engineering (UK)

POWER GENERATION EQUIPMENT
ABB Oy Motors and Generators (FI)
Combustion Energy and Steam Specialists Ltd - CESS (UK)
ElectraTherm Inc (US)
MKS Instruments Inc (US)
National Electric Coil (US)
Roxtec Inc (US)
Stork Turbo Blading (US)

PUMPS
Boerger Pumps Asia Pte Ltd (SG)
Flowserve Corp (US)
ITT Industrial Process (US)

VALVES
Flowserve Corp (US)

SERVICES

AQUIFER ASSESSMENT
CSD Ingenieure AG (CH)

CHEMICAL TREATMENT
Etudes Chimiques et Physiques - ECP (FR)

CONSULTANCY
Enertegic (US)
Instituto de Energías Renovables UNAM (MX)
Minder Energy Consulting (CH)

DESIGN
Ampirical Solutions LLC (US)
CEM Design Architects (US)

EQUIPMENT SUPPLIES
Kelburn Engineering (UK)
PES UK Ltd (UK)
PLI LLC (US)
TUF TUG Products (US)

FEASIBILITY STUDIES
Minder Energy Consulting (CH)

GEOLOGY SURVEYS
CSD Ingenieure AG (CH)

INSTALLATION
Burkhalter (US)
Prudent Living Inc (US)

MAINTENANCE
National Electric Coil (US)
PLI LLC (US)

MONITORING
Opsis AB (SE)

OTHER
canadian association for renewable energies (we c.a.r.e.) (CA)
Everglades University (US)
See ad page 10
GET ENERGY Gerhard Brandel MA (DE)

SOFTWARE
The Solar Design Co (UK)
Valentin Software (Dr Valentin EnergieSoftware GmbH) (DE)

TRAINING
GSE Systems Inc (US)
TUF TUG Products (US)

HEAT RECOVERY

APPLICATIONS

COMMERCIAL BUILDINGS
Energy Recovery Solution (CA)
Solar Turbines (US)

DOMESTIC BUILDINGS
Battic Door Energy Conservation Products (US)

HOSPITALS
Gibraltar Chimney International (US)

INDUSTRIAL PLANTS
Pratt & Whitney Power Systems (US)
Universidad Autonoma Metropolitana-Iztapalapa - UAMI (MX)
West Pomerenian University of Technology (PL)

LABORATORIES
Gibraltar Chimney International (US)

OTHER
White Design Associates Ltd (UK)

SCHOOLS
Gibraltar Chimney International (US)

EQUIPMENT

AIR-HANDLING UNITS
Ingvar Ingrids AB (SE)
Munters Corp (US)
Solarnetix Inc (CA)
Super Radiator Coils (US)

DUCTING
Enerquip LLC (US)

EXHAUST AIR FANS
Aerovent (US)
Twin City Fan & Blower (US)

HEAT EXCHANGERS
Energy Recovery Solution (CA)
Enerquip LLC (US)
Hurst Boiler & Welding Co Inc (US)
See ad page 64
Munters Corp (US)
Process Technology (US)
Schutte & Koerting (US)
Super Radiator Coils (US)
UNEX Scambio Termico Srl (IT)

HEAT PIPES
Munters Corp (US)

HEAT PUMPS
Sulzer Pumps Ltd (CH)

HEAT RECOVERY UNITS
Ansaldo Caldaie SpA (IT)
Cleaver-Brooks Engineered Boiler Systems (US)
Dresser-Rand (US)
Dresser-Rand Co Ltd (UK)
ElectraTherm Inc (US)

Energy Recovery Solution (CA)
ERI (Energy Recovery International) (US)
Hamon Deltak Inc (US)
Heatec Inc (US)
Ingvar Ingrids AB (SE)
Munters Corp (US)
NATCOM (CA)

HUMIDIFIERS AND DEHUMIDIFIERS
Munters Corp (US)

OTHER
Organics Asia Co Ltd (TH)

WASTE HEAT BOILERS
Cleaver-Brooks Engineered Boiler Systems (US)
Combustion Energy and Steam Specialists Ltd - CESS (UK)
ERI (Energy Recovery International) (US)
Hamon Deltak Inc (US)
Hurst Boiler & Welding Co Inc (US)
See ad page 64
NATCOM (CA)
Thorne International Boiler Services Ltd (UK)

WASTE INCINERATION
Ansaldo Caldaie SpA (IT)
Combustion Technologies Pvt Ltd (IN)
JWG Consulting Ltd (UK)

SERVICES

BUILDING AIR LEAKAGE SURVEYS
Alpine Components (UK)
Battic Door Energy Conservation Products (US)

CONSULTANCY
Advanced Engineering Srl (IT)
Battic Door Energy Conservation Products (US)
Darley & Associates (UK)
Environmental Alternatives Inc (US)
InterEnergy Srl (IT)
Jonas Inc (US)
O'Donnell Consulting Engineers (US)
Structural Integrity Associates Inc (US)

CONTRACT R&D
EA Technology (Europe) Ltd (UK)

DESIGN
Hamon Deltak Inc (US)
Harris Group Inc (US)
PDR Associates (Renewable) Inc (US)

ENERGY AUDITS
Universidad Autonoma Metropolitana-Iztapalapa - UAMI (MX)

FEASIBILITY STUDIES
Combustion Energy and Steam Specialists Ltd - CESS (UK)
Harris Group Inc (US)
Metrologie et Gestion d'Environnement - MGE (BE)
ProSim Inc (US)

FINANCIAL ADVICE
The Black Emerald Group (UK)

INSTALLATION
Battic Door Energy Conservation Products (US)
Gibraltar Chimney International (US)
Hamon Deltak Inc (US)

MAINTENANCE
Gibraltar Chimney International (US)
Hamon Deltak Inc (US)
PLI LLC (US)

MONITORING
Alpine Components (UK)
Structural Integrity Associates Inc (US)

OTHER
Environmental Alternatives Inc (US)

PROJECT MANAGEMENT
Boyle Energy Services & Technology (US)
Combustion Energy and Steam Specialists Ltd - CESS (UK)
Murphy International Development LLC (US)

SOFTWARE
Global Training Solutions Inc (CA)

TRAINING
Global Training Solutions Inc (CA)
Industrial Training Consultants Inc (US)
Universidad Autonoma Metropolitana-Iztapalapa - UAMI (MX)

HYDROPOWER APPLICATIONS

ENERGY STORAGE

HYDRO-ELECTRIC SCHEMES
Asian Phoenix Resources Ltd (CA)
Dulas Ltd (UK)
Fish Guidance Systems Ltd (UK)
GUGLER Water Turbines GmbH (AT)
Microhydropower.net (NL)
POSjoman Hydrotech Consulting (CA)
PXL Seals (FR)
Tom Jardine (UK)
Waterwheel Factory (US)

MICRO AND MINI HYDRO SCHEMES
Abraham Solar Equipment (US)
Ampair (UK)
Asian Phoenix Resources Ltd (CA)
Auroville Energy Products (IN)
British Green Ltd (UK)
Canyon Industries Inc (US)
CFE (MX)
Eclectic Energy Ltd (UK)
Enviro - Energy Technologies Inc (CA)
Fish Guidance Systems Ltd (UK)
PT Gerbang Multindo Nusantara (ID)
GUGLER Water Turbines GmbH (AT)
Microhydropower.net (NL)
Platypus Power (AU)
Renewable Energy Corp Ltd (UK)
Renewables for Development - RforD (DE)
The Solar BiZ (US)
Verdant Power Inc (US)
Waterwheel Factory (US)

OTHER
Enertegic (US)
Microhydropower.net (NL)
Waterwheel Factory (US)

RIVER HYDRO SCHEMES
Energy4All Ltd (UK)
Fish Guidance Systems Ltd (UK)
GUGLER Water Turbines GmbH (AT)
Microhydropower.net (NL)
Norconsult AS (NO)
Verdant Power Inc (US)
Water Recycle Group Australia Pty Ltd (AU)

EQUIPMENT

CABLING
American Wire Group (US)
Indiana Gratings Pvt Ltd (IN)
Roxtec Inc (US)

CONTROL GEAR
Auroville Energy Products (IN)
Dependable Turbines Ltd (CA)
Phoenix Electric Corp (US)
Wasserkraft Volk AG - WKV (DE)

GEARS
Voith Turbo BHS Getriebe GmbH (DE)
Voith Turbo GmbH & Co KG (DE)

GENERATORS
ABB Oy Motors and Generators (FI)
Asian Phoenix Resources Ltd (CA)
Dependable Turbines Ltd (CA)
DFME Sp zoo (PL)
ELIN Motoren GmbH (AT)
Leroy Somer (FR)
Lloyd Dynamowerke GmbH & Co KG (DE)
Mersen France Amiens (FR)
National Electric Coil (US)
Platypus Power (AU)
Wasserkraft Volk AG - WKV (DE)
Water Recycle Group Australia Pty Ltd (AU)

HEIGHT GAUGES
Technidea Corp (US)

HIGH-HEAD TURBINES
Akzo Nobel Performance Coatings Co Ltd (CN)
Asian Phoenix Resources Ltd (CA)
Canyon Industries Inc (US)
Dependable Turbines Ltd (CA)
GUGLER Water Turbines GmbH (AT)
Newmills Engineering (UK)
Wasserkraft Volk AG - WKV (DE)
Water Recycle Group Australia Pty Ltd (AU)
Weir American Hydro (US)

HYDRAULIC RAMS
ITH Engineering Inc (US)

LOW-HEAD TURBINES
Asian Phoenix Resources Ltd (CA)
Canyon Industries Inc (US)
Dependable Turbines Ltd (CA)
GUGLER Water Turbines GmbH (AT)
Newmills Engineering (UK)
Weir American Hydro (US)

OTHER
AEGIS Bearing Protection Rings (US)
American Crane & Equipment Corp (US)
Fish Guidance Systems Ltd (UK)
Frako Capacitors (US)
Glaunach GmbH (AT)
International Paint Ltd (UK)
ITH Engineering Inc (US)
Magnetic Div Global Equipment Mktg Inc (US)

MTS Sensor Technologie GmbH & Co KG (DE)
Openchannelflow (US)
Tech Products Inc (US)
WINDSL Ltd (IL)

POWERHOUSES
Combustion Technologies Pvt Ltd (IN)
Deprofundis SARL (FR)

REMOTE MONITORING EQUIPMENT
Campbell Scientific Ltd (UK)
Carlos Bertschi Srl (AR)
Comptus (US)
Eijkelkamp Agrisearch Equipment (NL)
Electroswitch (US)
H&L Instruments LLC (US)
LUDECA Inc (US)
Meggitt Sensing Systems (CH)
TESEO SpA (IT)
Wasserkraft Volk AG - WKV (DE)

WATER HEIGHT GAUGES
Carlos Bertschi Srl (AR)
Openchannelflow (US)

SERVICES

CERTIFICATION
Romanian Energy Regulatory Authority - ANRE (RO)
Water Weights Inc (US)

CONSTRUCTION
POSjoman Hydrotech Consulting (CA)

CONSULTANCY
Ampirical Solutions LLC (US)
Deprofundis SARL (FR)
Frako Capacitors (US)
MWH Global (US)
Navigant (US)
NIRAS A/S (DK)
Norconsult AS (NO)
POSjoman Hydrotech Consulting (CA)
Renewables for Development - RforD (DE)
Search Hydro Ltd (UK)
Structural Integrity Associates Inc (US)
Tom Jardine (UK)
Water Recycle Group Australia Pty Ltd (AU)

CONTRACT R&D
Deprofundis SARL (FR)
Inset (RU)
Platypus Power (AU)

DESIGN
Canyon Industries Inc (US)
Casco Systems LLC (US)
CDM Smith (US)
Inset (RU)
MWH Global (US)
Orbital2 Ltd (UK)
POSjoman Hydrotech Consulting (CA)
PXL Seals (FR)
Search Hydro Ltd (UK)
Weir American Hydro (US)

DOCUMENTATION
Inset (RU)
Microhydropower.net (NL)
Write_on (UK)

EQUIPMENT AND COMPONENT SUPPLIERS
Canyon Industries Inc (US)
Dependable Turbines Ltd (CA)
Fish Guidance Systems Ltd (UK)
PT Gerbang Multindo Nusantara (ID)
Magnetic Div Global Equipment Mktg Inc (US)
Weir American Hydro (US)

FEASIBILITY STUDIES
Inset (RU)
MWH Global (US)
PDR Associates (Renewable) Inc (US)
POSjoman Hydrotech Consulting (CA)
Search Hydro Ltd (UK)
Water Recycle Group Australia Pty Ltd (AU)

FINANCIAL ADVICE
The Black Emerald Group (UK)
Tom Jardine (UK)

INSTALLATION
Burkhalter (US)
Platypus Power (AU)
POSjoman Hydrotech Consulting (CA)
Prudent Living Inc (US)
PXL Seals (FR)
Search Hydro Ltd (UK)

MAINTENANCE
Continental Field Systems Inc (US)
Inset (RU)
NAES Corp (US)
National Electric Coil (US)
Platypus Power (AU)
PLI LLC (US)
POSjoman Hydrotech Consulting (CA)

MONITORING
Meggitt Sensing Systems (CH)
Muis Controls Ltd (CA)
Water Weights Inc (US)

OTHER
Aire Industrial (US)
European Small Hydropower Association - ESHA (BE)
Everglades University (US)
See ad page 10
GCube Insurance Services Inc (US)
National Hydropower Association (US)

PRODUCT SOURCING
POSjoman Hydrotech Consulting (CA)
PumpScout (US)

PROJECT MANAGEMENT
Boyle Energy Services & Technology (US)
Inset (RU)
MWH Global (US)
POSjoman Hydrotech Consulting (CA)
Renewables for Development - RforD (DE)
Search Hydro Ltd (UK)

SOFTWARE
Casco Systems LLC (US)
PumpScout (US)

TESTING
Cressall Resistors (UK)
Inspecteam Hydro (UK)
Water Weights Inc (US)

TRAINING
GSE Systems Inc (US)
Industrial Training Consultants Inc (US)
Mersen France Amiens (FR)
Norconsult AS (NO)
Water Recycle Group Australia Pty Ltd (AU)

UPGRADING
Inset (RU)
MWH Global (US)
POSjoman Hydrotech Consulting (CA)

PASSIVE SOLAR

APPLICATIONS

AIR CONDITIONING
CFE (MX)
Pfannenberg Inc (US)

COOLING
Acpsol Energia Solar SL (ES)
ETS Energy Store LLC (US)
Pfannenberg Inc (US)
Seawater Greenhouse Ltd (UK)
Suleyman Demirel Universitesi (TR)

DAYLIGHTING
Almeco Solar (DE)
INNOTRONIKS (US)
Seawater Greenhouse Ltd (UK)
University of Valladolid - UVA (ES)

HEATING
Breaux Consulting (US)
Suleyman Demirel Universitesi (TR)

OTHER
Acpsol Energia Solar SL (ES)
Enertegic (US)
International Solar Energy Society - ISES (DE)
SEADS Solar (US)
Solar Illuminations (US)
White Design Associates Ltd (UK)

PASSIVE VENTILATION
Suleyman Demirel Universitesi (TR)

SOLAR NEIGHBOURHOOD DESIGN
BEAR Architecten BV (NL)
ETS Energy Store LLC (US)
Solar Illuminations (US)

EQUIPMENT

CURTAIN WALLING SYSTEMS
PES UK Ltd (UK)

HEAT STORAGE
Near East University (TR)

OTHER
Frako Capacitors (US)
Hollaender Manufacturing (US)
Solar Illuminations (US)

PASSIVE SOLAR WATER HEATERS
Advanced Solar Voltaic Sdn Bhd (MY)
Integrated Solar LLC (US)
Solairgen (US)
Sun King Inc (US)

SOLAR AIR HEATING PANELS
ETS Energy Store LLC (US)
Near East University (TR)

TRANSPARENT INSULATION
AI Technology Inc (US)

SERVICES

CONSULTANCY
Advanced Engineering Srl (IT)
BEAR Architecten BV (NL)
Breaux Consulting (US)
BSRIA Ltd (UK)
InterEnergy Srl (IT)

Malaviya Solar Energy Consultancy (IN)
Michael Stavy Energy Economist (US)
T4 Sustainability Ltd (UK)

DESIGN
Breaux Consulting (US)
CEM Design Architects (US)
Construire en Mélèze (FR)
PowerPod Corp (US)
Stellar Sun (US)

FEASIBILITY STUDIES
North Energy Associates Ltd (UK)

FINANCIAL ADVICE
The Black Emerald Group (UK)
CEESE-ULB (BE)

INSTALLATION
Acpsol Energia Solar SL (ES)

MONITORING
Muis Controls Ltd (CA)
OAI (US)

OTHER
GET ENERGY Gerhard Brandel MA (DE)
International Solar Energy Society - ISES (DE)
Solar Illuminations (US)
Solar Promotion International GmbH (DE)
See ad page 43

PRODUCT SOURCING
ETS Energy Store LLC (US)

TESTING
OAI (US)

TRAINING
Rich Hessler Business Development (US)

PHOTOVOLTAICS

APPLICATIONS

BATTERY CHARGING
Abraham Solar Equipment (US)
Atlantis Energy Systems Inc (US)
Auroville Energy Products (IN)
BC Renewable Innovations LLC (US)
Blue Sky Energy (US)
BZ Products Inc (US)
Clean Energies (MA)
CPL Energy Systems (UK)
Diamond Flashlights Inc (US)
EFACEC Sistemas de Electrónica SA (PT)
Energies Services - ENERSER (MR)
Kaushal Solar Equipments (P) Ltd (IN)
R&G Energy Systems (NZ)
SolarOne Solutions Inc (US)
Suleyman Demirel Universitesi (TR)
Sunrnr of Virginia Inc (US)
Tamura Corp (US)
US Battery (US)

BATTERY CHARGING (MARINE)
Advanced Solar Voltaic Sdn Bhd (MY)
BZ Products Inc (US)
ETS Energy Store LLC (US)
SolarOne Solutions Inc (US)
Superwind GmbH (DE)
Techno Sun SLU (ES)
US Battery (US)

BUILDING FACADES
Centrosolar AG (DE)
Esdec (ClickFit) (NL)
GB-Sol Ltd (UK)
Hocking County Community Improvement Corp (US)
InterPhases Solar Inc (US)
JENOPTIK I Lasers & Material Processing (DE)
M & Architects Consulting Environment (MX)
Multi-Contact AG (CH)
See ad page 19

BUILDING INTEGRATION
Atlantis Energy Systems Inc (US)
BEAR Architecten BV (NL)
Centrosolar AG (DE)
Energy Environmental Technical Services Ltd - EETS (UK)
GB-Sol Ltd (UK)
Mobasolar USA (US)
SEADS Solar (US)
Solar Design Associates LLC (US)
Solarexpo (IT)
Third Sun Solar and Wind Power Ltd (US)
WIP-Munich (DE)
See ad page 73

CATHODIC PROTECTION
BZ Products Inc (US)
Suleyman Demirel Universitesi (TR)

CONSUMER PRODUCTS
Agni Solar Systems Pvt Ltd (IN)
Esdec (ClickFit) (NL)
INPRO Solar Systems (DE)
InterPhases Solar Inc (US)
Solar Energy Advocacy (UG)
Solaris Energy Systems (IE)
SolarOne Solutions Inc (US)
SolarShop (UK)

COOLING
AI Technology Inc (US)
Near East University (TR)

DESALINATION
DWC DecRen Water Consult (DE)
Instituto Tecnológico de Canarias - ITC (ES)
Malaviya Solar Energy Consultancy (IN)

ENERGY STORAGE
Demand Energy (US)
EaglePicher Technologies LLC (US)

GRID-CONNECTED SYSTEMS
Atlantis Energy Systems Inc (US)
Burnham & Sun (US)
Centrosolar AG (DE)
Centrosolar America Inc (US)
Day4 Energy Inc (CA)
Dynatex SA (CH)
Enviro - Energy Technologies Inc (CA)
Fronius Canada Ltd (CA)
Geospec Enterprises (IN)
Going Solar (AU)
Hocking County Community Improvement Corp (US)
Ing-Buero fuer Alternative Antriebe und Erneuerbare Energien (DE)
InterPhases Solar Inc (US)
Kyocera Solar Pty Ltd (AU)
Lake Michigan Wind & Sun Ltd - LMWS (US)
Multi-Contact AG (CH)
See ad page 19
Murphy International Development LLC (US)
Orion Solar Racking (US)
Parker Hannifin (US)
Positive Energy Solar (US)
PV-plan (DE)
Quanta Power Generation (US)
Renewable Energy Technology Group Ltd (US)
Shoals Technologies Group (US)
SMA America LLC (US)
Solairgen (US)
Solarexpo (IT)
SolarShop (UK)
Solera Sustainable Energies Co Ltd (CA)
Sunera Distribution Pte Ltd (SG)
SunPower-Tenesol (FR)
Third Sun Solar and Wind Power Ltd (US)
UL Underwriters Laboratories (US)
See ad page 27
Universidad Autonoma Metropolitana-Iztapalapa - UAMI (MX)
University of Valladolid - UVA (ES)

HYBRID SYSTEMS
Centrosolar America Inc (US)
CFE (MX)
EaglePicher Technologies LLC (US)
EV Solar Products Inc (US)
Malaviya Solar Energy Consultancy (IN)
METHASYN EG (CH)
SEADS Solar (US)
The Solar BiZ (US)
Solar Design Associates LLC (US)
Solartronic SA de CV (MX)
Stellar Sun (US)
Studer Innotec SA (CH)
Superwind GmbH (DE)
Techno Sun SLU (ES)
VendorAZ (PK)

IRRIGATION
Near East University (TR)
Solar Water Technologies (US)

LIGHTING
Acpsol Energia Solar SL (ES)
Agni Solar Systems Pvt Ltd (IN)
BC Renewable Innovations LLC (US)
Blue Sky Energy (US)
Currin Corp (US)
Diamond Flashlights Inc (US)
Energies Services - ENERSER (MR)
Enviro - Energy Technologies Inc (CA)
Geospec Enterprises (IN)
PT Gerbang Multindo Nusantara (ID)
INNOTRONIKS (US)
Kaushal Solar Equipments (P) Ltd (IN)
Patriot Solar Group (US)
PT Sundaya Indonesia (ID)
Solar Electric Power Co - SEPCO (US)
Solaris Energy Systems (IE)
SolarOne Solutions Inc (US)
SolarShop (UK)
Solartronic SA de CV (MX)
Sol Inc (US)
Suleyman Demirel Universitesi (TR)
TWR Lighting Inc (US)
WIP-Munich (DE)
See ad page 73
Z-LASER Optoelektronik GmbH (DE)

MONITORING STATIONS
Draker (US)
Patriot Solar Group (US)
Solar Electric Power Co - SEPCO (US)

NAVIGATIONAL AIDS
GB-Sol Ltd (UK)

OTHER
Auxin Solar LLC (US)
BZ Products Inc (US)
DEHN Inc (US)
FLEXcon (US)
Raytek Corp (US)
Saint-Gobain Ltd (UK)
White Design Associates Ltd (UK)
Z-LASER Optoelektronik GmbH (DE)

PV CELL/MODULE MANUFACTURING EQUIPMENT
AI Technology Inc (US)
Auxin Solar LLC (US)
Comdel Inc (US)
CRTSE - Semiconductor Technology for Energetic (DZ)
Dark Field Technologies Inc (US)
Hocking County Community Improvement Corp (US)
Indium Corp (US)
JENOPTIK I Lasers & Material Processing (DE)
PV Insider (UK)
Solarexpo (IT)
Sputnik Engineering AG (SolarMax) (CH)
See ad page 89

PV-HYDROGEN APPLICATIONS
Instituto de Energías Renovables UNAM (MX)
InterPhases Solar Inc (US)
Solar Tracking by SolaRichard (US)

REFRIGERATION
Esdec (ClickFit) (NL)
Near East University (TR)
The Solar BiZ (US)
Suleyman Demirel Universitesi (TR)
WIP-Munich (DE)
See ad page 73

ROOF TILES
Centrosolar AG (DE)
ETS Energy Store LLC (US)
InterPhases Solar Inc (US)
M & Architects Consulting Environment (MX)

RURAL ELECTRIFICATION
Atlantis Energy Systems Inc (US)
Clean Energies (MA)
Dynatex SA (CH)
Energies Services - ENERSER (MR)
Energy & Development Group - EDG (ZA)
INENSUS GmbH (DE)
Malaviya Solar Energy Consultancy (IN)
PT Sundaya Indonesia (ID)
Renewables for Development - RforD (DE)
SMA America LLC (US)
Solar Energy Advocacy (UG)
Solarexpo (IT)
Solar Pro Mexico (MX)
Solar Water Technologies (US)
Studer Innotec SA (CH)
Techno Sun SLU (ES)

SECURITY FENCING
INPRO Solar Systems (DE)

SOLAR-POWERED BOATS
Schools and Homes Energy Education Project/Solar-Active (UK)

SOLAR-POWERED CARS
Hocking County Community Improvement Corp (US)
Ing-Buero fuer Alternative Antriebe und Erneuerbare Energien (DE)
INPRO Solar Systems (DE)
InterPhases Solar Inc (US)
Schools and Homes Energy Education Project/Solar-Active (UK)
Slovak University of Technology Bratislava (SK)

SPACE TECHNOLOGY
Breaux Consulting (US)
INPRO Solar Systems (DE)
InterPhases Solar Inc (US)

STAND-ALONE SYSTEMS
Abraham Solar Equipment (US)
Agni Solar Systems Pvt Ltd (IN)
Array Technologies Inc (US)
See ad page 35
Atlantis Energy Systems Inc (US)
BC Renewable Innovations LLC (US)
Blue Sky Energy (US)
Burnham & Sun (US)
CPL Energy Systems (UK)
Currin Corp (US)
Dynatex SA (CH)
Energy & Development Group - EDG (ZA)
Enviro - Energy Technologies Inc (CA)
EV Solar Products Inc (US)
InterPhases Solar Inc (US)
Kaushal Solar Equipments (P) Ltd (IN)
Mobasolar USA (US)
Positive Energy Solar (US)
PT Sundaya Indonesia (ID)
Silk Road Solar Africa (US)
Slovak University of Technology Bratislava (SK)
Solar Design Associates LLC (US)
Solar Electric Power Co - SEPCO (US)
Solar Electric Specialists Ltd (NZ)
Solarexpo (IT)
SolarShop (UK)
Sol Inc (US)
Stellar Sun (US)
SunPower-Tenesol (FR)
Sunrnr of Virginia Inc (US)

TELECOMMUNICATIONS
Blue Sky Energy (US)
Clean Energies (MA)
Ingenieria de Equipos de Control SL - INDECON (ES)
InterPhases Solar Inc (US)
The Solar BiZ (US)
Studer Innotec SA (CH)
SunPower-Tenesol (FR)

VACCINE AND MEDICAL REFRIGERATION
Advanced Solar Voltaic Sdn Bhd (MY)
Centrosolar AG (DE)
Energy & Development Group - EDG (ZA)

WATER PUMPING
Abraham Solar Equipment (US)
Agricultural Technology Centre (CA)
DWC DecRen Water Consult (DE)
Energies Services - ENERSER (MR)
Geospec Enterprises (IN)
Instituto de Energías Renovables UNAM (MX)
Kaushal Solar Equipments (P) Ltd (IN)
Near East University (TR)
Positive Energy Solar (US)
The Solar BiZ (US)
Solar Electric Power Co - SEPCO (US)
Solar Electric Specialists Ltd (NZ)
Solar Water Technologies (US)
Stichting Bakens Verzet (NL)
SunPower-Tenesol (FR)
Terrasol (NA)

EQUIPMENT

ARRAY SUPPORT STRUCTURES
AET - Applied Energy Technologies (US)
Array Technologies Inc (US)
See ad page 35
Burnham & Sun (US)
Cantsink Manufacturing (US)
Conergy Inc (US)
EcoFasten Solar (US)
Esdec (ClickFit) (NL)
Ideematec Deutschland GmbH (DE)
Legrand (US)
LINAK US Inc (US)
Northern State Metals (US)
See ad page 5
Orion Solar Racking (US)
PanelClaw Inc (US)

Solairgen (US)
Solar FlexRack (US)
Sunera Distribution Pte Ltd (SG)
Unirac Inc (US)
See ad page CV2
Venture Mfg Co (US)

ARRAYS
Advanced Solar Voltaic Sdn Bhd (MY)
EMCORE Corp (US)
Enviro - Energy Technologies Inc (CA)
EOPLLY USA Inc (US)
Hollaender Manufacturing (US)
Kemery Co (US)
Kyocera Solar Pty Ltd (AU)
Lake Michigan Wind & Sun Ltd - LMWS (US)
LINAK US Inc (US)
R&G Energy Systems (NZ)
Solabat SL (ES)
Solar Illuminations (US)
Solar Tracking by SolaRichard (US)
Solar Water Technologies (US)
Solera Sustainable Energies Co Ltd (CA)
Stellar Sun (US)
Titan Tracker (ES)

BATTERIES
Conergy Inc (US)

Diamond Flashlights Inc (US)
EFACEC Sistemas de Electrónica SA (PT)
Fullriver Battery USA (US)
Mobasolar (FR)
OPAL-RT Technologies (CA)
Rolls Battery Engineering (CA)
See ad page 37
Solairgen (US)

The Solar BiZ (US)
Solar Bob Ltd (CI)
Trojan Battery Co (US)

CABLING

American Wire Group (US)
Centrosolar AG (DE)
Conergy Inc (US)
K-Sun Corp (US)
Multi-Contact AG (CH)
See ad page 19
Shoals Technologies Group (US)
SOURIAU (US)
Stellar Sun (US)
Venture Mfg Co (US)

CELLS

AIXTRON Inc (US)
Canadian Solar USA Inc (US)
CVD Equipment Corp (US)
Day4 Energy Inc (CA)
Elettrorava SpA (IT)
EMCORE Corp (US)
EOPLLY USA Inc (US)
ETS Energy Store LLC (US)
Global Wedge Inc (US)
Mersen France Amiens (FR)
Motech Industries Inc (TW)
Para-Coat Technologies Inc (US)
PV Insider (UK)
ReneSola (US)
Schools and Homes Energy Education Project/Solar-Active (UK)
Slovak University of Technology Bratislava (SK)
Solabat SL (ES)
SolData Instruments (DK)

CHARGE CONTROLLERS

Auroville Energy Products (IN)
BC Renewable Innovations LLC (US)
Blue Sky Energy (US)
BZ Products Inc (US)
Enviro - Energy Technologies Inc (CA)
Ingenieria de Equipos de Control SL - INDECON (ES)
Morningstar Corp (US)
OPAL-RT Technologies (CA)
Solar Systems Australia (AU)
Solartronic SA de CV (MX)
Studer Innotec SA (CH)
Suleyman Demirel Universitesi (TR)

COATING EQUIPMENT

AIXTRON Inc (US)
CRTSE - Semiconductor Technology for Energetic (DZ)
Elettrorava SpA (IT)
IK4-Tekniker Research Centre (ES)

CONCENTRATORS

EMCORE Corp (US)
Global Wedge Inc (US)
Science Applications International Corp (US)
Titan Tracker (ES)

DATA LOGGERS

Campbell Scientific Ltd (UK)
Centrosolar AG (DE)
Draker (US)
Fronius Canada Ltd (CA)
HIOKI EE Corp (JP)
Optosolar GmbH (DE)
Shoals Technologies Group (US)
Symmetron Electronic Applications (GR)
WIP-Munich (DE)
See ad page 73

ELECTROLYSERS

Para-Coat Technologies Inc (US)

ENERGY STORAGE

EaglePicher Technologies LLC (US)
ReneSola (US)
Solaredge Technologies (US)

GENERATOR CONTROLLERS

DEIF (UK) Ltd (UK)

HELIOSTATS

SOURIAU (US)
Titan Tracker (ES)

INGOTS

Targray Technology International Inc (CA)

INVERTERS

Advanced Energy (US)
See ad page 6
ASP AG (CH)
Auroville Energy Products (IN)
Auxin Solar LLC (US)
Bonfiglioli USA (US)
Burnham & Sun (US)
Centrosolar AG (DE)
Conergy Inc (US)
EFACEC Sistemas de Electrónica SA (PT)
Electronic Drives & Controls (US)
Empire Clean Energy Supply (US)
Fronius Canada Ltd (CA)
KACO new energy GmbH (DE)
See ad page 2
KACO new energy Inc (US)
Kemery Co (US)
Kolektor Magma doo (SI)
Kyocera Solar Pty Ltd (AU)
Mobasolar (FR)
Morningstar Corp (US)
Motech Industries Inc (TW)
Nova Electric (US)
OPAL-RT Technologies (CA)
Orion Solar Racking (US)
Parker Hannifin (US)
Patriot Solar Group (US)
Phoenix Solar AG (DE)
Power-One Inc (US)
See ad page 1
ReneSola (US)
SMA America LLC (US)
Solabat SL (ES)
Solairgen (US)
The Solar BiZ (US)
Solaredge Technologies (US)
Solar Electric Specialists Ltd (NZ)
Solar Pro Mexico (MX)
Solar Systems Australia (AU)
Solar Tracking by SolaRichard (US)
Solartronic SA de CV (MX)
Solera Sustainable Energies Co Ltd (CA)
Sputnik Engineering AG (SolarMax) (CH)
See ad page 89
Stellar Sun (US)
Studer Innotec SA (CH)
Techno Sun SLU (ES)

LOW-VOLTAGE DC EQUIPMENT

BC Renewable Innovations LLC (US)
Diamond Flashlights Inc (US)
Electronic Drives & Controls (US)
Kepco Inc (US)
Kolektor Magma doo (SI)
PT Sundaya Indonesia (ID)
Shoals Technologies Group (US)
Solaris Energy Systems (IE)
Solar Systems Australia (AU)
Tamura Corp (US)

MODULES

Atlantis Energy Systems Inc (US)
Canadian Solar USA Inc (US)
Centrosolar AG (DE)
Centrosolar America Inc (US)
Clean Energies (MA)
Conergy Inc (US)
CRTSE - Semiconductor Technology for Energetic (DZ)
Day4 Energy Inc (CA)
EMCORE Corp (US)
Empire Clean Energy Supply (US)
Energy Environmental Technical Services Ltd - EETS (UK)
Enviro - Energy Technologies Inc (CA)
EOPLLY USA Inc (US)
Esdec (ClickFit) (NL)
GB-Sol Ltd (UK)
Global Wedge Inc (US)
Kemery Co (US)
Kyocera Solar Pty Ltd (AU)
Mobasolar (FR)
Motech Industries Inc (TW)
Phoenix Solar AG (DE)
Power Panel Inc (US)
ReneSola (US)
Slovak University of Technology Bratislava (SK)
Solabat SL (ES)
Solar Bob Ltd (CI)
Solar Pro Mexico (MX)
SolarShop (UK)
Solar Systems Australia (AU)
Solera Sustainable Energies Co Ltd (CA)
Sunera Distribution Pte Ltd (SG)

MONITORING EQUIPMENT

Advanced Energy (US)
See ad page 6
Bonfiglioli USA (US)
Dark Field Technologies Inc (US)
Delta Ohm (IT)
Draker (US)
EFACEC Sistemas de Electrónica SA (PT)
Eko Instruments Co Ltd (JP)
Fronius Canada Ltd (CA)
HIOKI EE Corp (JP)
Ingenieria de Equipos de Control SL - INDECON (ES)
KACO new energy GmbH (DE)
See ad page 2
KACO new energy Inc (US)
MKS Instruments Inc (US)
Power-One Inc (US)
See ad page 1
PV Measurements Inc (US)
PV-plan (DE)
Raytek Corp (US)

Shoals Technologies Group (US)

Solaredge Technologies (US)
Tamura Corp (US)
University of Valladolid - UVA (ES)

MOUNTING SYSTEMS HARDWARE

AET - Applied Energy Technologies (US)
BURNDY (US)
Cantsink Manufacturing (US)
EcoFasten Solar (US)
Empire Clean Energy Supply (US)
EXOSUN (US)
Ideematec Deutschland GmbH (DE)
Kemery Co (US)
Legrand (US)
LINAK US Inc (US)
PanelClaw Inc (US)
Quick Mount PV (US)
Shoals Technologies Group (US)
Solabat SL (ES)
Solar Clam-P (US)

SolarDock (US)
Unirac Inc (US)
See ad page CV2
Venture Mfg Co (US)

OTHER
BZ Products Inc (US)
Comdel Inc (US)
Dark Field Technologies Inc (US)
Day4 Energy Inc (CA)
DEHN Inc (US)
FLEXcon (US)
Frako Capacitors (US)
Hollaender Manufacturing (US)
LumaSense Technologies Inc (US)
MTS Sensor Technologie GmbH & Co KG (DE)
Process Technology (US)
Saint-Gobain Ltd (UK)
Solar Pathfinder (US)
Venture Mfg Co (US)

PUMPS
The Solar BiZ (US)
Solar Systems Australia (AU)
Solar Water Technologies (US)
Stichting Bakens Verzet (NL)
Sulzer Pumps Ltd (CH)
Terrasol (NA)

SOLAR RADIATION MEASURING
Campbell Scientific Ltd (UK)
Comptus (US)
Delta Ohm (IT)
Eko Instruments Co Ltd (JP)
GB-Sol Ltd (UK)
Optosolar GmbH (DE)
PV Measurements Inc (US)
Solar Consulting Services - SCS (US)
Solar Pathfinder (US)
SolData Instruments (DK)
Symmetron Electronic Applications (GR)
University of Valladolid - UVA (ES)
WIP-Munich (DE)
See ad page 73

TESTING EQUIPMENT
Atlas Material Testing Technology (US)
CRTSE - Semiconductor Technology for Energetic (DZ)
Dark Field Technologies Inc (US)
Delta Ohm (IT)
Energy Environmental Technical Services Ltd - EETS (UK)
HIOKI EE Corp (JP)
Kepco Inc (US)
MKS Instruments Inc (US)
OAI (US)
OPAL-RT Technologies (CA)
Optosolar GmbH (DE)
PV Measurements Inc (US)
Slovak University of Technology Bratislava (SK)
Wavelength Electronics Inc (US)

TRACKING SYSTEMS
Ideematec Deutschland GmbH (DE)
Unirac Inc (US)
See ad page CV2

WAFERS
Canadian Solar USA Inc (US)
EMCORE Corp (US)
Para-Coat Technologies Inc (US)
ReneSola (US)
Targray Technology International Inc (CA)

SERVICES

CERTIFICATION
Auxin Solar LLC (US)
CRTSE - Semiconductor Technology for Energetic (DZ)
ImagineSolar (US)
Midwest Renewable Energy Association - MREA (US)
North American Board of Certified Energy Practitioners - NABCEP (US)
UL Underwriters Laboratories (US)
See ad page 27

CONSULTANCY
3E (BE)
Advanced Engineering Srl (IT)
Antares Group Inc (US)
APT Consulting Group Co Ltd (TH)
Atlantis Energy Systems Inc (US)
Blackline Power (CA)
Bridgestone Associates Ltd (US)
BSRIA Ltd (UK)
Currin Corp (US)
Dynatex SA (CH)
E4tech (CH)
E4tech (UK)
EA Technology (Europe) Ltd (UK)
EcofinConcept GmbH (DE)
Elettrorava SpA (IT)
EscoVale Consultancy Services (UK)
EV Solar Products Inc (US)
GI Garrad Hassan North America (CA)
Going Solar (AU)
HWP-hullmann Willkomm & Partner - GbR (DE)
ImagineSolar (US)
Ing-Buero fuer Alternative Antriebe und Erneuerbare Energien (DE)
Juwi Holding AG (DE)
Lotus Energy Inc (US)
M & Architects Consulting Environment (MX)
Minder Energy Consulting (CH)
Mobasolar USA (US)
Navigant (US)
Novator Advanced Technology Consulting (DK)
Parsons Brinckerhoff (UK)
Phoenix Solar AG (DE)
PRé Consultants BV (NL)
PV Insider (UK)
PV Measurements Inc (US)
PV-plan (DE)
SEADS Solar (US)
Solar Consultants Ltd (UK)
Solar UK Ltd (UK)
Michael Stavy Energy Economist (US)
Sunera Distribution Pte Ltd (SG)
Virtus Energy Research Associates (US)

CONTRACT R&D
BEAR Architecten BV (NL)
Elettrorava SpA (IT)
HWP-hullmann Willkomm & Partner - GbR (DE)
INPRO Solar Systems (DE)
Novator Advanced Technology Consulting (DK)
SEADS Solar (US)
Solar Tracking by SolaRichard (US)
Tanzania Renewable Energy Association - TAREA (TZ)

DATA LOGGING
Shoals Technologies Group (US)

DESIGN
Ampirical Solutions LLC (US)
Auxin Solar LLC (US)
Blackline Power (CA)
CEM Design Architects (US)
Conergy Inc (US)
Currin Corp (US)
Enviro - Energy Technologies Inc (CA)
ETA Florence Renewable Energies (IT)
EXOSUN (US)
groSolar (US)
Harris Group Inc (US)
Ingenieria de Equipos de Control SL - INDECON (ES)
Instituto de Energías Renovables UNAM (MX)
InterEnergy Srl (IT)
Kemery Co (US)
Lotus Energy Inc (US)
M & Architects Consulting Environment (MX)
Mobasolar (FR)
Patriot Solar Group (US)
PV-plan (DE)
PVsyst SA (CH)
See ad page 71
SAGE Energy Inc (CA)
Savco Solar Energy (CY)
Silk Road Solar Africa (US)
Solar Consultants Ltd (UK)
Solar Electric Power Co - SEPCO (US)
Solar Electric Specialists Ltd (NZ)
Solar Systems Australia (AU)
Solar UK Ltd (UK)
SOLON (US)
Sundance Solar Designs (US)
Third Sun Solar and Wind Power Ltd (US)
Unirac Inc (US)
See ad page CV2
University of Valladolid - UVA (ES)
Valentin Software Inc (US)
WIP-Munich (DE)
See ad page 73

DOCUMENTATION
Write_on (UK)

FEASIBILITY STUDIES
Clarke Energy Associates (BB)
Clean Energies (MA)
EXOSUN (US)
Harris Group Inc (US)
Ing-Buero fuer Alternative Antriebe und Erneuerbare Energien (DE)
Minder Energy Consulting (CH)
PowerPod Corp (US)
Science Applications International Corp (US)
Solar Consultants Ltd (UK)
Solar Consulting Services - SCS (US)
Virtus Energy Research Associates (US)

FINANCIAL ADVICE
Conergy Inc (US)
Greenpower Capital (US)
Morrison & Kibbey Ltd (US)
PV Insider (UK)
Solar Consultants Ltd (UK)
WIP-Munich (DE)
See ad page 73

INFORMATION
Atlantis Energy Systems Inc (US)
Clean Energies (MA)
Elettrorava SpA (IT)
EV Solar Products Inc (US)
International Solar Energy Society - ISES (DE)
ISES Norway - Norsk solenergiforening (NO)
JENOPTIK I Lasers & Material Processing (DE)

North American Board of Certified Energy Practitioners - NABCEP (US)
PV Insider (UK)
PVsyst SA (CH)
See ad page 71
RenewableEnergyWorld.com (US)
Solar Systems Australia (AU)

INSTALLATION

Aurora Energy Inc (US)
Blackline Power (CA)
Blattner Energy (US)
Dulas Ltd (UK)
PT Gerbang Multindo Nusantara (ID)
groSolar (US)
ImagineSolar (US)
Lake Michigan Wind & Sun Ltd - LMWS (US)
Lotus Energy Inc (US)
Mobasolar (FR)
Mobasolar USA (US)
Mortenson Construction (US)
Phoenix Solar AG (DE)
Positive Energy Solar (US)
PowerPod Corp (US)
PPC Solar (US)
Prudent Living Inc (US)
Quanta Power Generation (US)
SAGE Energy Inc (CA)
S&B Engineers and Constructors (US)
Savco Solar Energy (CY)
Silk Road Solar Africa (US)
Solar Pro Mexico (MX)
Solar Systems Australia (AU)
Solar Tracking by SolaRichard (US)
Solar UK Ltd (UK)
Solera Sustainable Energies Co Ltd (CA)
SOLON (US)
Sun King Inc (US)
T4 Sustainability Ltd (UK)
Third Sun Solar and Wind Power Ltd (US)
Unirac Inc (US)
See ad page CV2

MAINTENANCE

Advanced Energy (US)
See ad page 6
Construire en Mélèze (FR)
Energies Services - ENERSER (MR)
EV Solar Products Inc (US)
groSolar (US)
Juwi Holding AG (DE)
Lotus Energy Inc (US)
SAGE Energy Inc (CA)
Sulzer Pumps Ltd (CH)
Sunera Distribution Pte Ltd (SG)

MONITORING

3E (BE)
Ingenieria de Equipos de Control SL - INDECON (ES)
KACO new energy GmbH (DE)
See ad page 2
KACO new energy Inc (US)
Phoenix Solar AG (DE)
PV-plan (DE)
Shoals Technologies Group (US)
Solaredge Technologies (US)
Solar Pro Mexico (MX)
SOLON (US)
Sputnik Engineering AG (SolarMax) (CH)
See ad page 89
Tanzania Renewable Energy Association - TAREA (TZ)
University of Valladolid - UVA (ES)

OTHER

canadian association for renewable energies (we c.a.r.e.) (CA)
Everglades University (US)
See ad page 10
FLEXcon (US)
GCube Insurance Services Inc (US)
GET ENERGY Gerhard Brandel MA (DE)
International Solar Energy Society - ISES (DE)
ISES Norway - Norsk solenergiforening (NO)
North American Board of Certified Energy Practitioners - NABCEP (US)
Saint-Gobain Ltd (UK)
Savco Solar Energy (CY)
Solar Promotion International GmbH (DE)
See ad page 43

PRODUCT SOURCING

Conergy Inc (US)
Mobasolar USA (US)
R&G Energy Systems (NZ)
Solar Consultants Ltd (UK)
Stellar Sun (US)

PROJECT MANAGEMENT

APT Consulting Group Co Ltd (TH)
Atlantis Energy Systems Inc (US)
Blackline Power (CA)
Blattner Energy (US)
Conergy Inc (US)
EcofinConcept GmbH (DE)
groSolar (US)
M & Architects Consulting Environment (MX)
PowerPod Corp (US)
SOLON (US)
Sputnik Engineering AG (SolarMax) (CH)
See ad page 89
Stichting Bakens Verzet (NL)
Sundance Solar Designs (US)
SunPower-Tenesol (FR)
Third Sun Solar and Wind Power Ltd (US)

SOFTWARE

Centro de Estudios de la Energia Solar - Censolar (ES)
F-Chart Software (US)
PV Measurements Inc (US)
PVsyst SA (CH)
See ad page 71
The Solar Design Co (UK)
Sputnik Engineering AG (SolarMax) (CH)
See ad page 89
Valentin Software (Dr Valentin EnergieSoftware GmbH) (DE)
Valentin Software Inc (US)

SUPPLIERS OF SYSTEMS AND COMPONENTS

Aguidrovert Solar SL - Energia Termica Fotovoltaica Y Biomasa (ES)
Blackline Power (CA)
British Green Ltd (UK)
Centrosolar America Inc (US)
Conergy Inc (US)
Day4 Energy Inc (CA)
DEIF (UK) Ltd (UK)
Diamond Flashlights Inc (US)
EFACEC Sistemas de Electrónica SA (PT)
Energy Environmental Technical Services Ltd - EETS (UK)
EXOSUN (US)
Global Wedge Inc (US)
Going Solar (AU)
groSolar (US)
Kyocera Solar Pty Ltd (AU)
LINAK US Inc (US)
Lotus Energy Inc (US)
Multi-Contact AG (CH)
See ad page 19
Orion Solar Racking (US)
PanelClaw Inc (US)
Patriot Solar Group (US)
Positive Energy Solar (US)
PowerPod Corp (US)
PT Sundaya Indonesia (ID)
Renewable Energy Corp Ltd (UK)
Semikron Inc (US)

Shoals Technologies Group (US)

The Solar BiZ (US)
Solaredge Technologies (US)
Solar Systems Australia (AU)
SOLON (US)
Sputnik Engineering AG (SolarMax) (CH)
See ad page 89
Sundance Solar Designs (US)
Tamura Corp (US)
Techno Sun SLU (ES)
Terrasol (NA)
Unirac Inc (US)
See ad page CV2

TESTING

ImagineSolar (US)
Instituto de Energías Renovables UNAM (MX)
JENOPTIK I Lasers & Material Processing (DE)
PV Measurements Inc (US)

TRAINING

Atlantis Energy Systems Inc (US)
Centro de Estudios de la Energia Solar - Censolar (ES)
Centrosolar AG (DE)
Centrosolar America Inc (US)
Currin Corp (US)
EXOSUN (US)
ImagineSolar (US)
Ing-Buero fuer Alternative Antriebe und Erneuerbare Energien (DE)
Midwest Renewable Energy Association - MREA (US)
Orion Solar Racking (US)
PVsyst SA (CH)
See ad page 71
Quick Mount PV (US)
Rich Hessler Business Development (US)
SMA America LLC (US)
The Solar Design Co (UK)
Solar Systems Australia (AU)
Sputnik Engineering AG (SolarMax) (CH)
See ad page 89

SOLAR THERMAL

APPLICATIONS

AIR CONDITIONING

Acpsol Energia Solar SL (ES)
Para-Coat Technologies Inc (US)
Pfannenberg Inc (US)
Seawater Greenhouse Ltd (UK)

COMBINED SYSTEMS

Metrologie et Gestion d'Environnement - MGE (BE)
Project Risk Ltd (US)
Robin Sun (FR)

COOLING SYSTEMS

Acpsol Energia Solar SL (ES)
Parker Precision Cooling Systems (US)

CROP DRYING

Construire en Mélèze (FR)
Solar Energy Advocacy (UG)
Suleyman Demirel Universitesi (TR)

DESALINATION
DWC DecRen Water Consult (DE)
PT Gerbang Multindo Nusantara (ID)
Instituto de Energías Renovables UNAM (MX)
Seawater Greenhouse Ltd (UK)

DISTRICT HEATING
Edwards Hot Water (AU)
EnerWorks Inc (CA)
Para-Coat Technologies Inc (US)
Solarnetix Inc (CA)

DOMESTIC HOT WATER
Advanced Solar Voltaic Sdn Bhd (MY)
AO Smith (US)
Aurora Energy Inc (US)
Burnham & Sun (US)
Clean Energies (MA)
Construire en Mélèze (FR)
Edwards Hot Water (AU)
Energies Services - ENERSER (MR)
Energy & Development Group - EDG (ZA)
EnerWorks Inc (CA)
F-Chart Software (US)
Free Hot Water (US)
Integrated Solar LLC (US)
Kaushal Solar Equipments (P) Ltd (IN)
Lapesa Grupo Empresarial SL - LAPESA (ES)
Near East University (TR)
R&G Energy Systems (NZ)
RESOL - Elektronische Regelungen GmbH (DE)
Schools and Homes Energy Education Project/Solar-Active (UK)
SolarRoofs.com (US)
Solar Supplies UK Ltd (UK)
Solar UK Ltd (UK)
Stellar Sun (US)
Varmeco GmbH & Co KG (DE)

ENERGY STORAGE
Demand Energy (US)

INDUSTRIAL PROCESS HEAT
EnerWorks Inc (CA)
F-Chart Software (US)
Free Hot Water (US)
Going Solar (AU)
Kaushal Solar Equipments (P) Ltd (IN)
SOLARHOT (US)

LARGE SCALE WATER HEATING
Agni Solar Systems Pvt Ltd (IN)
Edwards Hot Water (AU)
EnerWorks Inc (CA)
Free Hot Water (US)
Geospec Enterprises (IN)
Solarnetix Inc (CA)
SolarRoofs.com (US)

OTHER
Aurora Energy Inc (US)
Raytek Corp (US)

PACKAGED SYSTEMS
AO Smith (US)
Edwards Hot Water (AU)
Integrated Solar LLC (US)
Solaris Energy Systems (IE)
Solar Supplies UK Ltd (UK)

POWER GENERATION
Boyle Energy Services & Technology (US)
PDR Associates (Renewable) Inc (US)
Pratt & Whitney Power Systems (US)
Project Risk Ltd (US)
Torresol Energy (ES)

SELF-ASSEMBLY SYSTEMS
SOLARHOT (US)

SPACE HEATING
Agni Solar Systems Pvt Ltd (IN)
Edwards Hot Water (AU)
Enviro - Energy Technologies Inc (CA)
Free Hot Water (US)
Lake Michigan Wind & Sun Ltd - LMWS (US)
Varmeco GmbH & Co KG (DE)

STOVES
Instituto de Energías Renovables UNAM (MX)

SWIMMING POOL SYSTEMS
ETS Energy Store LLC (US)
F-Chart Software (US)
Kaushal Solar Equipments (P) Ltd (IN)
Sun King Inc (US)

EQUIPMENT

ABSORBER SURFACES
Almeco Solar (DE)
DWC DecRen Water Consult (DE)
Thermafin Manufacturing (US)

ANTI-CORROSION ADDITIVES
AI Technology Inc (US)

COLLECTORS
Acpsol Energia Solar SL (ES)
Aguidrovert Solar SL - Energia Termica Fotovoltaica Y Biomasa (ES)
AO Smith (US)
Aurora Energy Inc (US)
Clean Energies (MA)
Edwards Hot Water (AU)
Empire Clean Energy Supply (US)
EnerWorks Inc (CA)
Heliodyne Inc (US)
Integrated Solar LLC (US)
International Association of Plumbing and Mechanical Officials (US)
Kaushal Solar Equipments (P) Ltd (IN)
Malaviya Solar Energy Consultancy (IN)
Power Panel Inc (US)
Robin Sun (FR)
The Solar BiZ (US)
SolarRoofs.com (US)
Solar UK Ltd (UK)
Solcan (CA)
Stellar Sun (US)
Sun King Inc (US)
Varmeco GmbH & Co KG (DE)

CONCENTRATORS
Global Wedge Inc (US)
Science Applications International Corp (US)

CONTROLLERS
Dynatex SA (CH)
Electronic Drives & Controls (US)
Empire Clean Energy Supply (US)
EnerWorks Inc (CA)
Heliodyne Inc (US)
Process Technology (US)
RESOL - Elektronische Regelungen GmbH (DE)
Solarnetix Inc (CA)
Varmeco GmbH & Co KG (DE)
WIP-Munich (DE)
See ad page 73

HEAT EXCHANGERS
Enerquip LLC (US)
EnerWorks Inc (CA)
Heliodyne Inc (US)
Joseph Oat Corp (US)
Pfannenberg Inc (US)
Process Technology (US)
UNEX Scambio Termico Srl (IT)

HEAT PIPES
Acpsol Energia Solar SL (ES)

HEAT STORAGE
IK4-Tekniker Research Centre (ES)
Power Panel Inc (US)
Solar Bob Ltd (CI)

HEAT TRANSFER EQUIPMENT
EnerWorks Inc (CA)
Heatec Inc (US)
Heliodyne Inc (US)
Process Technology (US)
Solarnetix Inc (CA)
Thermafin Manufacturing (US)

HELIOSTATS
Eko Instruments Co Ltd (JP)
IK4-Tekniker Research Centre (ES)
Science Applications International Corp (US)
SOURIAU (US)

MONITORING EQUIPMENT
Eko Instruments Co Ltd (JP)
EnerWorks Inc (CA)
Heliodyne Inc (US)
Muis Controls Ltd (CA)
Optosolar GmbH (DE)

OTHER
Legrand (US)
MTS Sensor Technologie GmbH & Co KG (DE)
Solar Pathfinder (US)
SOURIAU (US)
Tech Products Inc (US)
Venture Mfg Co (US)

PUMPS
AO Smith (US)
Flowserve Corp (US)
HAWE Hydraulik SE (DE)
Stellar Sun (US)
Sulzer Pumps Ltd (CH)

REFLECTORS
Almeco Solar (DE)

SELECTIVE ABSORBER SURFACES
IK4-Tekniker Research Centre (ES)
Write_on (UK)

SOLARIMETERS
Eko Instruments Co Ltd (JP)
Solartronic SA de CV (MX)

SOLAR RADIATION MEASURING
Delta Ohm (IT)
Eko Instruments Co Ltd (JP)
Optosolar GmbH (DE)
PV Measurements Inc (US)
Solar Consulting Services - SCS (US)
Solar Pathfinder (US)
SolData Instruments (DK)
WIP-Munich (DE)
See ad page 73

STORAGE TANKS
Aguidrovert Solar SL - Energia Termica Fotovoltaica Y Biomasa (ES)
AO Smith (US)
Fisher Tank Co (US)
Kaushal Solar Equipments (P) Ltd (IN)
Lapesa Grupo Empresarial SL - LAPESA (ES)
SolarRoofs.com (US)
Sun King Inc (US)
Tank Connection Affiliate Group (US)
Varmeco GmbH & Co KG (DE)

TEMPERATURE MEASURING EQUIPMENT
Eijkelkamp Agrisearch Equipment (NL)
Elan Technical Corp (US)
Electronic Drives & Controls (US)
Raytek Corp (US)
RESOL - Elektronische Regelungen GmbH (DE)
S-Products Inc (US)
Wavelength Electronics Inc (US)

THERMOSIPHONING SYSTEMS
Edwards Hot Water (AU)
Kaushal Solar Equipments (P) Ltd (IN)
LumaSense Technologies Inc (US)
Solcan (CA)

THERMOSTATS
RESOL - Elektronische Regelungen GmbH (DE)

TRANSPARENT INSULATION
AI Technology Inc (US)

VALVES
Eko Instruments Co Ltd (JP)
Flowserve Corp (US)
HAWE Hydraulik SE (DE)
International Association of Plumbing and Mechanical Officials (US)
RESOL - Elektronische Regelungen GmbH (DE)
Solar Bob Ltd (CI)

SERVICES

CERTIFICATION
International Association of Plumbing and Mechanical Officials (US)
Midwest Renewable Energy Association - MREA (US)

CONSULTANCY
Almeco Solar (DE)
Antares Group Inc (US)
BEAR Architecten BV (NL)
Boyle Energy Services & Technology (US)
Bridgestone Associates Ltd (US)
BSRIA Ltd (UK)
Centro de Estudios de la Energia Solar - Censolar (ES)
Clean Energies (MA)
ETS Energy Store LLC (US)
Going Solar (AU)
HWP-hullmann Willkomm & Partner - GbR (DE)
Malaviya Solar Energy Consultancy (IN)
Parsons Brinckerhoff (UK)
PennEnergy Research (US)
Renewables for Development - RforD (DE)
Sargent & Lundy LLC (US)
Science Applications International Corp (US)
Seawater Greenhouse Ltd (UK)
SOLARHOT (US)
Solarnetix Inc (CA)
Solar Supplies UK Ltd (UK)
Solcan (CA)
Michael Stavy Energy Economist (US)
Tanzania Renewable Energy Association - TAREA (TZ)
Virtus Energy Research Associates (US)
WIP-Munich (DE)
See ad page 73

CONTRACT R&D
Almeco Solar (DE)

DESIGN
Acpsol Energia Solar SL (ES)
Aurora Energy Inc (US)
Boyle Energy Services & Technology (US)
CEM Design Architects (US)
Free Hot Water (US)
Lake Michigan Wind & Sun Ltd - LMWS (US)
Seawater Greenhouse Ltd (UK)
Silk Road Solar Africa (US)
Solar Design Associates LLC (US)
Solcan (CA)
Sundance Solar Designs (US)
Valentin Software Inc (US)

FEASIBILITY STUDIES
North Energy Associates Ltd (UK)
Solar Consulting Services - SCS (US)
Solarnetix Inc (CA)
WIP-Munich (DE)
See ad page 73

FINANCIAL ADVICE
Clean Energies (MA)

INSTALLATION
Acpsol Energia Solar SL (ES)
Boyle Energy Services & Technology (US)
DWC DecRen Water Consult (DE)
Prudent Living Inc (US)
Silk Road Solar Africa (US)
Solar Bob Ltd (CI)
Solaris Energy Systems (IE)
SolarRoofs.com (US)
Sundance Solar Designs (US)
T4 Sustainability Ltd (UK)

MAINTENANCE
Construire en Mélèze (FR)
Energies Services - ENERSER (MR)
Flowserve Corp (US)
PLI LLC (US)
Sulzer Pumps Ltd (CH)
Torresol Energy (ES)

MONITORING
Instituto de Energías Renovables UNAM (MX)
WIP-Munich (DE)
See ad page 73

OTHER
canadian association for renewable energies (we c.a.r.e.) (CA)
GET ENERGY Gerhard Brandel MA (DE)
International Solar Energy Society - ISES (DE)
Solar Promotion International GmbH (DE)
See ad page 43

PRODUCT SOURCING
SOLARHOT (US)
Solar Supplies UK Ltd (UK)

PROJECT MANAGEMENT
Boyle Energy Services & Technology (US)
DWC DecRen Water Consult (DE)
Schneider Electric (US)
SENER (ES)
SOLARHOT (US)

REPAIR
R&G Energy Systems (NZ)
Sulzer Pumps Ltd (CH)

SOFTWARE
Centro de Estudios de la Energia Solar - Censolar (ES)
InduSoft Inc (US)
Seawater Greenhouse Ltd (UK)
The Solar Design Co (UK)
Valentin Software (Dr Valentin EnergieSoftware GmbH) (DE)
Valentin Software Inc (US)
WIP-Munich (DE)
See ad page 73

SUPPLIERS OF EQUIPMENT AND COMPONENTS
Aguidrovert Solar SL - Energia Termica Fotovoltaica Y Biomasa (ES)
British Green Ltd (UK)
Eko Instruments Co Ltd (JP)
Northwire Inc (US)
Renewable Energy Corp Ltd (UK)
SENER (ES)
Solarnetix Inc (CA)
Solar Supplies UK Ltd (UK)
Solcan (CA)
Technidea Corp (US)

TESTING
Boyle Energy Services & Technology (US)
Instituto Tecnológico de Canarias - ITC (ES)
International Association of Plumbing and Mechanical Officials (US)

TRAINING
Centrosolar America Inc (US)
GSE Systems Inc (US)
International Association of Plumbing and Mechanical Officials (US)
Midwest Renewable Energy Association - MREA (US)
Rich Hessler Business Development (US)
The Solar Design Co (UK)
Tanzania Renewable Energy Association - TAREA (TZ)

WAVE AND TIDAL ENERGY

EQUIPMENT

GENERATORS
ABB Oy Motors and Generators (FI)
DFME Sp zoo (PL)
Wave Dragon ApS (DK)

OFFSHORE DEVICES
Akzo Nobel Performance Coatings Co Ltd (CN)
Combustion Energy and Steam Specialists Ltd - CESS (UK)
Dresser-Rand (US)
EFACEC Sistemas de Electrónica SA (PT)
Joseph Oat Corp (US)
Wave Dragon ApS (DK)

OTHER
Aire Industrial (US)
Cressall Resistors (UK)
ETS Energy Store LLC (US)
icenta Controls Ltd (UK)

IMO Group of Cos (DE)
International Paint Ltd (UK)
LINK Tools International (USA) Inc (US)
Parker Hannifin (US)

PUMPS
PumpScout (US)
Sulzer Pumps Ltd (CH)

TURBINES
Mammoet Wind A/S (DK)
Square Two Lubrication Ltd/ Memolub HPS Lubricators (UK)
Verdant Power Inc (US)
Wave Dragon ApS (DK)

VALVES
Flowserve Corp (US)

WAVE HEIGHT GAUGES
MTS Sensor Technologie GmbH & Co KG (DE)
Nortek UK (UK)

SERVICES

COMPUTER MODELLING
The European Marine Energy Centre (EMEC) Ltd (UK)
Met Office (UK)

CONSULTANCY
Aquastructures (NO)
EscoVale Consultancy Services (UK)
ESS Ecology (UK)
Green Orkney Tours (UK)
Met Office (UK)
Verdant Power Inc (US)
WIP-Munich (DE)
See ad page 73

CONTRACT R&D
The European Marine Energy Centre (EMEC) Ltd (UK)
Verdant Power Inc (US)

DESIGN
Aquastructures (NO)
Casco Systems LLC (US)
Orbital2 Ltd (UK)
PXL Seals (FR)
Sir Robert McAlpine Ltd (UK)
Verdant Power Inc (US)
Wave Dragon ApS (DK)

ENVIRONMENTAL MONITORING
ESS Ecology (UK)
The European Marine Energy Centre (EMEC) Ltd (UK)
NIRAS A/S (DK)
Osiris Hydrographic and Geophysical Projects Ltd (UK)
Verdant Power Inc (US)

FEASIBILITY STUDIES
Combustion Energy and Steam Specialists Ltd - CESS (UK)
The European Marine Energy Centre (EMEC) Ltd (UK)
Orbital2 Ltd (UK)
Osiris Hydrographic and Geophysical Projects Ltd (UK)
Verdant Power Inc (US)

FINANCIAL ADVICE
Morrison & Kibbey Ltd (US)

INSTALLATION
Verdant Power Inc (US)

OTHER
canadian association for renewable energies (we c.a.r.e.) (CA)
ContiTech AG (DE)
GET ENERGY Gerhard Brandel MA (DE)
National Hydropower Association (US)
Taylor Keogh Communications (UK)
Wave Dragon ApS (DK)

PROJECT MANAGEMENT
ContiTech AG (DE)
Sir Robert McAlpine Ltd (UK)
Verdant Power Inc (US)

WAVE MEASUREMENTS
The European Marine Energy Centre (EMEC) Ltd (UK)
Met Office (UK)
Nortek UK (UK)
Osiris Hydrographic and Geophysical Projects Ltd (UK)

WIND ENERGY

APPLICATIONS

BATTERY CHARGING
Ampair (UK)
CPL Energy Systems (UK)
Eclectic Energy Ltd (UK)
Marlec Engineering Co Ltd (UK)
Penn-Union Corp (US)
Sunrnr of Virginia Inc (US)
US Battery (US)
Windurance (US)

ENERGY STORAGE
Demand Energy (US)
EaglePicher Technologies LLC (US)
Parker Precision Cooling Systems (US)

GRID-CONNECTED SYSTEMS
ABB Oy Motors and Generators (FI)
Ampair (UK)
Bosch Rexroth Monitoring Systems GmbH (DE)
CFE (MX)
Dulas Ltd (UK)
EFACEC Sistemas de Electrónica SA (PT)
Eneco Texas LLC (US)
Eologica (NL)
ExxonMobil (BE)
Hocking County Community Improvement Corp (US)

HYTORC (US)

Malaviya Solar Energy Consultancy (IN)
Orbital AS (DK)
Parker Hannifin (US)
Power Conversion (DE)
Prowind Energy Ltd (NZ)
Renewable Energy Technology Group Ltd (US)
SAXOVENT Ökologische Investments GmbH & Co KG (DE)
SIEB & MEYER AG (DE)
Siemens Wind Power A/S (DK)
Solar Design Associates LLC (US)
UL Underwriters Laboratories (US)
See ad page 27
Vestas Wind Systems A/S (DK)

HYBRID SYSTEMS
Energies Services - ENERSER (MR)
EscoVale Consultancy Services (UK)
Geospec Enterprises (IN)
Instituto de Energías Renovables UNAM (MX)
Malaviya Solar Energy Consultancy (IN)
Marlec Engineering Co Ltd (UK)
PitchWind Systems AB (SE)
Renewables for Development - RforD (DE)
Solartronic SA de CV (MX)
WIP-Munich (DE)
See ad page 73

LIGHTING
BayWa re Rotor Service GmbH (DE)
CPL Energy Systems (UK)
INNOTRONIKS (US)
Pfannenberg Inc (US)
TWR Lighting Inc (US)
Z-LASER Optoelektronik GmbH (DE)

MARINE
Eclectic Energy Ltd (UK)
Marlec Engineering Co Ltd (UK)
Nortek UK (UK)

OFFSHORE WIND
A2SEA A/S (DK)
ABB Oy Motors and Generators (FI)
BGB Engineering Ltd (UK)
DEWI GmbH - a UL Co (DE)
EFACEC Sistemas de Electrónica SA (PT)
Eneco Texas LLC (US)
ExxonMobil (BE)
FLiDAR (BE)

HYTORC (US)

IMS Ingenieurgesellschaft GmbH (DE)
JWG Consulting Ltd (UK)
Nextwind (US)
OFS (US)
See ad page 23
Osiris Hydrographic and Geophysical Projects Ltd (UK)
Parker Precision Cooling Systems (US)
Power Conversion (DE)
Ramboll (DK)
Siemens Wind Power A/S (DK)
Sir Robert McAlpine Ltd (UK)
SSB Wind Systems GmbH & Co KG (DE)
Taylor Keogh Communications (UK)
TWR Lighting Inc (US)
Vestas Wind Systems A/S (DK)
West Pomerenian University of Technology (PL)

OTHER
Akzo Nobel Performance Coatings Co Ltd (CN)
Bosch Rexroth Monitoring Systems GmbH (DE)
DEHN Inc (US)
ExxonMobil (BE)
International Paint Ltd (UK)
Manitoba HVDC Research Centre (CA)
METHASYN EG (CH)
Multi-Contact AG (CH)
See ad page 19
Osiris Hydrographic and Geophysical Projects Ltd (UK)

SAXOVENT Ökologische Investments GmbH & Co KG (DE)
SSB Wind Systems GmbH & Co KG (DE)
Walter Stauffenberg GmbH & Co KG (DE)
Taylor Keogh Communications (UK)
White Design Associates Ltd (UK)

PUMPING
Agricultural Technology Centre (CA)
CFE (MX)
Energies Services - ENERSER (MR)
Eologica (NL)
John Crane (US)
Near East University (TR)
Solartronic SA de CV (MX)

SEAWATER DESALINATION
Instituto Tecnológico de Canarias - ITC (ES)
PitchWind Systems AB (SE)
WIP-Munich (DE)
See ad page 73

STAND-ALONE SYSTEMS
Abraham Solar Equipment (US)
BGB Engineering Ltd (UK)
CPL Energy Systems (UK)
Eclectic Energy Ltd (UK)
Enviro - Energy Technologies Inc (CA)

HYTORC (US)

Instituto Tecnológico de Canarias - ITC (ES)
Marlec Engineering Co Ltd (UK)
Parker Precision Cooling Systems (US)
Solar Electric Specialists Ltd (NZ)
Sunrnr of Virginia Inc (US)
Vector Systems Inc (US)

TELECOMMUNICATIONS
EFACEC Sistemas de Electrónica SA (PT)
Eneco Texas LLC (US)
InduSoft Inc (US)
OFS (US)
See ad page 23
PitchWind Systems AB (SE)
Solartronic SA de CV (MX)
TWR Lighting Inc (US)

EQUIPMENT

BATTERIES
A123 Systems (US)
EaglePicher Technologies LLC (US)
Fullriver Battery USA (US)
US Battery (US)

BLADE PROTECTION
BayWa re Rotor Service GmbH (DE)
Malaviya Solar Energy Consultancy (IN)
Vestas Wind Systems A/S (DK)

BLADES
BayWa re Rotor Service GmbH (DE)
LAP GmbH Laser Applikationen (DE)
Sika Corp (US)
See ad page25, 39
UL Underwriters Laboratories (US)
See ad page 27
Vestas Wind Systems A/S (DK)

BRAKES
Cressall Resistors (UK)
INENSUS GmbH (DE)
Tribco Inc (US)
Windurance (US)

CABLING
American Wire Group (US)
K-Sun Corp (US)
LEINE LINDE SYSTEMS GmbH (DE)
Northwire Inc (US)
Roxtec Inc (US)
SOURIAU (US)

CLUTCHES
Tribco Inc (US)
Voith Turbo GmbH & Co KG (DE)

CONTROLLERS
Orbital AS (DK)
Superwind GmbH (DE)
UL Underwriters Laboratories (US)
See ad page 27
Vector Systems Inc (US)
Windurance (US)

COUPLINGS
BURNDY (US)
Voith Turbo GmbH & Co KG (DE)

DATA LOGGERS
Casco Systems LLC (US)
INENSUS GmbH (DE)
L&R Ingenieria (AR)
Navigant's BTM Consult (DK)
Solartronic SA de CV (MX)
Symmetron Electronic Applications (GR)

DIRECTION AND WINDSPEED SENSORS; ANEMOMETERS
Comptus (US)
Delta Ohm (IT)
Eijkelkamp Agrisearch Equipment (NL)
FLiDAR (BE)
INENSUS GmbH (DE)
Navigant's BTM Consult (DK)
Symmetron Electronic Applications (GR)
Vaisala (US)
Wavelength Electronics Inc (US)

DIRECTION VANES
Eijkelkamp Agrisearch Equipment (NL)
Solartronic SA de CV (MX)
Vaisala (US)

FOUNDATIONS
IMS Ingenieurgesellschaft GmbH (DE)
Mortenson Construction (US)
Sika Corp (US)
See ad page 39, 25

GEAR UNITS
Bonfiglioli USA (US)
IMO Group of Cos (DE)
Voith Turbo GmbH & Co KG (DE)

GENERATORS
ABB Oy Motors and Generators (FI)
DFME Sp zoo (PL)
Eclectic Energy Ltd (UK)
ELIN Motoren GmbH (AT)
IntelLiDrives Inc (US)
LEINE LINDE SYSTEMS GmbH (DE)
Leroy Somer (FR)
Lloyd Dynamowerke GmbH & Co KG (DE)
Mersen France Amiens (FR)
Power Conversion (DE)
SPX Bolting Systems (US)
Square Two Lubrication Ltd/ Memolub HPS Lubricators (UK)
Sunrnr of Virginia Inc (US)
VendorAZ (PK)

HORIZONTAL AXIS LARGE TURBINES (>1 MW)
Siemens Wind Power A/S (DK)
UL Underwriters Laboratories (US)
See ad page 27
Windbrokers Europe BV (NL)

HORIZONTAL AXIS MEDIUM TURBINES (100 KW TO 1 MW)
Murphy International Development LLC (US)
Prowind Energy Ltd (NZ)
VendorAZ (PK)
Windbrokers Europe BV (NL)

HORIZONTAL AXIS OTHER
Vestas Wind Systems A/S (DK)

HORIZONTAL AXIS SMALL TURBINES (5 TO 99 KW)
Ampair (UK)
CFE (MX)
PitchWind Systems AB (SE)
UL Underwriters Laboratories (US)
See ad page 27
Wind Simplicity Inc (CA)

HORIZONTAL AXIS VERY SMALL TURBINES (<5 KW)
Ampair (UK)
Marlec Engineering Co Ltd (UK)
Superwind GmbH (DE)
Wind Simplicity Inc (CA)

HUBS
LEINE LINDE SYSTEMS GmbH (DE)

HYDRAULIC SYSTEMS
HAWE Hydraulik SE (DE)
HYDAC Technology Corp (US)
Walter Stauffenberg GmbH & Co KG (DE)

INVERTERS
ABB Oy Motors and Generators (FI)
Bonfiglioli USA (US)
EFACEC Sistemas de Electrónica SA (PT)
Electronic Drives & Controls (US)
LEINE LINDE SYSTEMS GmbH (DE)
Nova Electric (US)
Parker Hannifin (US)
Power Conversion (DE)
Powernet Oy (FI)
SIEB & MEYER AG (DE)
SMA America LLC (US)
UL Underwriters Laboratories (US)
See ad page 27

MASTS
INENSUS GmbH (DE)
Symmetron Electronic Applications (GR)

MONITORING EQUIPMENT
Campbell Scientific Ltd (UK)
cmc Instruments GmbH (DE)
Comptus (US)
ERLPhase Power Technologies (CA)
H&L Instruments LLC (US)
HIOKI EE Corp (JP)
HYDAC Technology Corp (US)
L&R Ingenieria (AR)
LUDECA Inc (US)
Meggitt Sensing Systems (US)
Meggitt Sensing Systems (CH)
Nortek UK (UK)
OPAL-RT Technologies (CA)
Puleo Electronics Inc (US)
Siemens Wind Power A/S (DK)
Walter Stauffenberg GmbH & Co KG (DE)
TESEO SpA (IT)
Wavelength Electronics Inc (US)
WINDSL Ltd (IL)

OTHER
AEGIS Bearing Protection Rings (US)
Akzo Nobel Performance Coatings Co Ltd (CN)
American Crane & Equipment Corp (US)
BGB Engineering Ltd (UK)
ContiTech AG (DE)
Cressall Resistors (UK)
DEHN Inc (US)
ERLPhase Power Technologies (CA)
ExxonMobil (BE)

IMO Group of Cos (DE)
International Paint Ltd (UK)
ITH Engineering Inc (US)
LAP GmbH Laser Applikationen (DE)
LEINE LINDE SYSTEMS GmbH (DE)
LINK Tools International (USA) Inc (US)
MTS Sensor Technologie GmbH & Co KG (DE)
Parker Precision Cooling Systems (US)
PLI LLC (US)
Power Conversion (DE)
Powernet Oy (FI)
RUD Chain Inc (US)
SPX Bolting Systems (US)
SSB Wind Systems GmbH & Co KG (DE)
Tamura Corp (US)
Technidea Corp (US)
Tech Products Inc (US)
Tensar International Ltd (UK)
TUF TUG Products (US)

TORQUE-LIMITING DRIVES
Voith Turbo GmbH & Co KG (DE)

TOWERS
BURNDY (US)
TWR Lighting Inc (US)

VERTICAL AXIS SMALL TURBINES (5 TO 99 KW)
CFE (MX)
Collinson Plc (UK)
UL Underwriters Laboratories (US)
See ad page 27

SERVICES

CERTIFICATION
Midwest Renewable Energy Association - MREA (US)
Romanian Energy Regulatory Authority - ANRE (RO)
WindGuard North America Inc (US)

CONSULTANCY
3E (BE)
Airfoils Inc (US)
Ansys UK Ltd (UK)
Antares Group Inc (US)
Aquastructures (NO)
Bosch Rexroth Monitoring Systems GmbH (DE)
Bridgestone Associates Ltd (US)
BSRIA Ltd (UK)
Bureau Veritas North America Inc (US)
DEWI GmbH - a UL Co (DE)
Disgen Holdings (US)
DUWET Danish University Wind Energy Training (DK)
EA Technology (Europe) Ltd (UK)
EcofinConcept GmbH (DE)
Eneco Texas LLC (US)
Energy4All Ltd (UK)
Eologica (NL)
EscoVale Consultancy Services (UK)
ESS Ecology (UK)
Fundashon Antiyano Pa Energia - FAPE (CC)
Gl Garrad Hassan North America (CA)
Global Wind Power A/S (DK)
IMS Ingenieurgesellschaft GmbH (DE)
InterEnergy Srl (IT)
Juwi Holding AG (DE)
Malaviya Solar Energy Consultancy (IN)
Manitoba HVDC Research Centre (CA)
Met Office (UK)
Navigant (US)
Navigant's BTM Consult (DK)
Nextwind (US)
NIRAS A/S (DK)
Novator Advanced Technology Consulting (DK)
Orbital2 Ltd (UK)
Parsons Brinckerhoff (UK)
PennEnergy Research (US)
PitchWind Systems AB (SE)
Prowind Energy Ltd (NZ)
Ramboll (DK)
Renewables for Development - RforD (DE)
Sander + Partner (DE)
Sargent & Lundy LLC (US)
SAXOVENT Ökologische Investments GmbH & Co KG (DE)
Michael Stavy Energy Economist (US)
Structural Integrity Associates Inc (US)
TechnoCentre éolien (CA)
TUF TUG Products (US)
Vestas Wind Systems A/S (DK)
Virtus Energy Research Associates (US)
WA Vachon & Associates Inc (US)
WindGuard North America Inc (US)
Wind Prospect Ltd (UK)

CONTRACT R&D
Airfoils Inc (US)
CEESE-ULB (BE)
DEWI GmbH - a UL Co (DE)
HITEC Sensor Solutions Inc (US)
Novator Advanced Technology Consulting (DK)
Sahara Wind Inc (MA)
Sander + Partner (DE)
TechnoCentre éolien (CA)

DATA ANALYSIS
3E (BE)
Bosch Rexroth Monitoring Systems GmbH (DE)
Eologica (NL)
FLiDAR (BE)
Fundashon Antiyano Pa Energia - FAPE (CC)
Met Office (UK)
Osiris Hydrographic and Geophysical Projects Ltd (UK)
Sander + Partner (DE)

DATA LOGGING
L&R Ingenieria (AR)
Meggitt Sensing Systems (US)
Met Office (UK)
WA Vachon & Associates Inc (US)

DESIGN
Airfoils Inc (US)
Ampirical Solutions LLC (US)
Aquastructures (NO)
BGB Engineering Ltd (UK)
Casco Systems LLC (US)
GustoMSC (NL)
HYDAC Technology Corp (US)
IMS Ingenieurgesellschaft GmbH (DE)
Instituto de Energías Renovables UNAM (MX)
Nextwind (US)
Orbital2 Ltd (UK)
Orbital AS (DK)
PDR Associates (Renewable) Inc (US)
PXL Seals (FR)
Ramboll (DK)
RES Americas (US)
Savco Solar Energy (CY)
Siemens Wind Power A/S (DK)
Sir Robert McAlpine Ltd (UK)
Walter Stauffenberg GmbH & Co KG (DE)
Wind Prospect Ltd (UK)
Windurance (US)

DISTRIBUTION
AC Tool Supply (US)
British Green Ltd (UK)
Energies Services - ENERSER (MR)

HYTORC (US)

Renewable Energy Corp Ltd (UK)
SSB Wind Systems GmbH & Co KG (DE)
Walter Stauffenberg GmbH & Co KG (DE)

DOCUMENTATION
Write_on (UK)

ENVIRONMENTAL IMPACT ASSESSMENT
CDM Smith (US)
Community Windpower Ltd (UK)
ESS Ecology (UK)
Gl Garrad Hassan North America (CA)

FEASIBILITY STUDIES
Aquastructures (NO)
Ologica (NL)
Green Orkney Tours (UK)
GustoMSC (NL)
Juwi Holding AG (DE)
JWG Consulting Ltd (UK)
Manitoba HVDC Research Centre (CA)
Met Office (UK)
Navigant's BTM Consult (DK)
Near East University (TR)
Nextwind (US)
North Energy Associates Ltd (UK)
Osiris Hydrographic and Geophysical Projects Ltd (UK)
Prowind Energy Ltd (NZ)
Ramboll (DK)
RES Mediterranean (FR)
Sander + Partner (DE)
Vestas Wind Systems A/S (DK)
WindGuard North America Inc (US)
Wind Prospect Ltd (UK)

FINANCIAL ADVICE
Energy4All Ltd (UK)
Interdevelopment Inc (US)
Met Office (UK)
Morrison & Kibbey Ltd (US)
WA Vachon & Associates Inc (US)
Wind Prospect Ltd (UK)

INFORMATION
Motiva Oy (FI)
Osiris Hydrographic and Geophysical Projects Ltd (UK)
TechnoCentre éolien (CA)
Windfair (DE)

INSTALLATION
A2SEA A/S (DK)
BayWa re Rotor Service GmbH (DE)
Blattner Energy (US)
Burkhalter (US)
Delta Rigging & Tools (US)
IMS Ingenieurgesellschaft GmbH (DE)
Mammoet Wind A/S (DK)
Mortenson Construction (US)
PES UK Ltd (UK)
Prudent Living Inc (US)
SAGE Energy Inc (CA)
Sahara Wind Inc (MA)
Savco Solar Energy (CY)
Siemens Wind Power A/S (DK)
System One (US)
Total Wind A/S (DK)
Vestas Wind Systems A/S (DK)

INSURANCE
GCube Insurance Services Inc (US)

MONITORING
3E (BE)
AC Tool Supply (US)
Bosch Rexroth Monitoring Systems GmbH (DE)
Bureau Veritas North America Inc (US)
cmc Instruments GmbH (DE)
L&R Ingenieria (AR)
LUDECA Inc (US)
Meggitt Sensing Systems (US)
Orbital AS (DK)
Siemens Wind Power A/S (DK)
System One (US)
Vaisala (US)
Vestas Wind Systems A/S (DK)
WA Vachon & Associates Inc (US)

OTHER
Akzo Nobel Performance Coatings Co Ltd (CN)
American Wind Energy Association (US)
See ad page 8
BGB Engineering Ltd (UK)
canadian association for renewable energies (we c.a.r.e.) (CA)
Danish Wind Energy Group (DK)
Energy4All Ltd (UK)
Everglades University (US)
See ad page 10
IMS Ingenieurgesellschaft GmbH (DE)
International Paint Ltd (UK)
PLI LLC (US)
RES Americas (US)
SAXOVENT Ökologische Investments GmbH & Co KG (DE)
SPX Bolting Systems (US)
Taylor Keogh Communications (UK)
Total Wind A/S (DK)
Vaisala (US)
Windfair (DE)
WindGuard North America Inc (US)

PLANNING PERMISSION
Community Windpower Ltd (UK)
ESS Ecology (UK)
Gl Garrad Hassan North America (CA)
Juwi Holding AG (DE)
Ramboll (DK)
RES Mediterranean (FR)

PRODUCT SOURCING
AC Tool Supply (US)
PDR Associates (Renewable) Inc (US)
Windurance (US)

PROJECT MANAGEMENT
Blattner Energy (US)
Community Windpower Ltd (UK)
EcofinConcept GmbH (DE)
Gl Garrad Hassan North America (CA)
Global Wind Power A/S (DK)
IMS Ingenieurgesellschaft GmbH (DE)
NAES Corp (US)
Navigant's BTM Consult (DK)
RES Mediterranean (FR)
Sahara Wind Inc (MA)
System One (US)
Total Wind A/S (DK)
Wind Prospect Ltd (UK)

REPAIR
A2SEA A/S (DK)
BayWa re Rotor Service GmbH (DE)
SAGE Energy Inc (CA)
Siemens Wind Power A/S (DK)
SSB Wind Systems GmbH & Co KG (DE)
Total Wind A/S (DK)
Vestas Wind Systems A/S (DK)

SITE EVALUATION
CFE (MX)
Community Windpower Ltd (UK)
FLiDAR (BE)
Fundashon Antiyano Pa Energia - FAPE (CC)
IMS Ingenieurgesellschaft GmbH (DE)
Juwi Holding AG (DE)
Met Office (UK)
Mortenson Construction (US)
Osiris Hydrographic and Geophysical Projects Ltd (UK)
Sander + Partner (DE)

SOFTWARE
Ansys UK Ltd (UK)
L&R Ingenieria (AR)
Manitoba HVDC Research Centre (CA)
Orbital AS (DK)
TESEO SpA (IT)

TESTING
AC Tool Supply (US)
Airfoils Inc (US)
Bureau Veritas North America Inc (US)
HITEC Sensor Solutions Inc (US)
TechnoCentre éolien (CA)
UL Underwriters Laboratories (US)
See ad page 27

TRAINING
AC Tool Supply (US)
DEWI GmbH - a UL Co (DE)
DUWET Danish University Wind Energy Training (DK)
Industrial Training Consultants Inc (US)
Manitoba HVDC Research Centre (CA)
Mersen France Amiens (FR)
Met Office (UK)
Tanzania Renewable Energy Association - TAREA (TZ)
TUF TUG Products (US)

TURBINE DESIGN
IK4-Tekniker Research Centre (ES)
Nextwind (US)
Siemens Wind Power A/S (DK)
Superwind GmbH (DE)
WA Vachon & Associates Inc (US)
ZF Wind Power Antwerpen NV (BE)

TURBINE TESTING
cmc Instruments GmbH (DE)
DEWI GmbH - a UL Co (DE)
HITEC Sensor Solutions Inc (US)
Instituto Tecnológico de Canarias - ITC (ES)
Siemens Wind Power A/S (DK)

UPGRADING
Orbital AS (DK)

WIND FARM DEVELOPMENT
Community Windpower Ltd (UK)
EcofinConcept GmbH (DE)
Eneco Texas LLC (US)
FCC Environment (UK)
Global Wind Power A/S (DK)
Green Orkney Tours (UK)
Juwi Holding AG (DE)
Prowind Energy Ltd (NZ)
RES Americas (US)
RES Mediterranean (FR)
SAXOVENT Ökologische Investments GmbH & Co KG (DE)

WIND TUNNEL ANALYSIS
Airfoils Inc (US)
WindGuard North America Inc (US)

A-Z COMPANIES DIRECTORY

20|20 Business Insight
Dundee, Scotland, UK,
www.2020projectmanagement.com

3E
Brussels, Belgium, www.3e.eu

A123 Systems
Waltham, MA, USA,
www.a123systems.com

A2SEA A/S
Fredericia, Denmark, www.a2sea.com

ABB Oy Motors and Generators
Helsinki, Finland, www.abb.com

Abou Walid Group
Tunis, Tunisia, www.abouwalid-group.com

Abraham Solar Equipment
Pagosa Springs, CO, USA,
www.abrahamsolar.com

Acpsol Energia Solar SL
Malaga, Spain, www.acpsol.com

AC Tool Supply
Mesa, AZ, USA, www.aikencolon.com

Advanced Engineering Srl
Milano, Italy, www.advancedengineering.it

Advanced Optics Inc
Pewaukee, WI, USA,
www.advancedoptics.com

Advanced Solar Voltaic Sdn Bhd
Kuala Lumpur, Malaysia,
www.solarvoltaic.com

AEGIS Bearing Protection Rings
Mechanic Falls, ME, USA,
www.est-aegis.com

Aerovent
Minneapolis, MN, USA, www.aerovent.com

AET - Applied Energy Technologies
Clinton Township, MI, USA,
www.aetenergy.com

Agni Solar Systems Pvt Ltd
Pune, Maharashtra, India,
www.agnisolar.com

Agricultural Technology Centre
Lethbridge, AB, Canada,
www.agric.gov.ab.ca

Aguidrovert Solar SL - Energia Termica Fotovoltaica Y Biomasa
Zaragoza, Spain, www.aguidrovert.com

Aire Industrial
Meridian, ID, USA, www.aireindustrial.net

Airfoils Inc
Port Matilda, PA, USA, www.airfoils.com

Airoflex Equipment
Muscatine, IA, USA,
www.airoflexequipment.com

AI Technology Inc
Princeton Junction, NJ, USA,
www.aitechnology.com

AIXTRON Inc
Sunnyvale, CA, USA, www.aixtron.com

Akzo Nobel Performance Coatings Co Ltd
Shanghai, China, www.international-pc.com

Alexandria Industries
Alexandria, MN, USA,
www.alexandriaindustries.com

Allied Industrial Marketing
Cedarburg, WI, USA,
www.alliedindustrialmarketing.com

Allied Moulded Products Inc
Bryan, OH, USA, www.alliedmoulded.com

Almeco Solar
Bernburg, Germany, www.almecosolar.com

Alpine Components
East Sussex, UK,
www.alpine-components.co.uk

Alturdyne
El Cajon, CA, USA, www.alturdyne.com

Ameresco Inc
Framingham, MA, USA,
www.ameresco.com

American Crane & Equipment Corp
Douglassville, PA, USA,
www.americancrane.com

American Safety Flag
East Providence, RI, USA,
www.americansafetyflag.com

American Wind Energy Association
Washington, DC, USA, www.awea.org
Is a national trade association of the US wind energy industry and the organiser of the annual AWEA WINDPOWER conference and exhibition.
See ad page 8

American Wire Group
Hallandale, FL, USA, www.buyawg.com

Ampair
Milborne St Andrew, Dorset, UK,
www.ampair.com

Ampirical Solutions LLC
Mandeville, LA, USA, www.ampirical.com

AMWEI Thermistor
Shenzhen, Guangdong, China,
www.amwei.com

ANDRITZ AG
Graz, Austria, www.andritz.com

Ansaldo Caldaie SpA
Gallarate, (VA), Italy, www.ansaldoboiler.it

Ansys UK Ltd
Sheffield, UK, www.ansys.com

Antares Group Inc
Landover, MD, USA,
www.antaresgroupinc.com

AO Smith
Ashland City, TN, USA, www.hotwater.com

ap+m
Boynton Beach, FL, USA,
www.apm4parts.com

APT Consulting Group Co Ltd
Pakgret, Nonthaburi, Thailand,
www.aptthailand.net

AquaBioTech Group
Targa Gap, Mosta, Malta, www.aquabt.com

Aquastructures
Trondheim, Norway,
www.aquastructures.no

Aquatech International Corp
Canonsburg, PA, USA, www.aquatech.com

Arkema Inc
King of Prussia, PA, USA,
www.arkema-inc.com

Array Technologies Inc
Albuquerque, NM, USA,
www.arraytechinc.com
Manufactures Duratrack-HZ solar trackers for utility applications, and Wattsun solar trackers for small commercial and residential applications.
See ad page 35

Asian Phoenix Resources Ltd
Victoria, BC, Canada, www.powerpal.com

ASP AG
Uznach, Switzerland, www.asp-ag.com

Atilgan Danismanlik Energy
Istanbul, Turkey, www.eskoenergy.com

Atlantis Energy Systems Inc
Poughkeepsie, NY, USA,
www.atlantisenergy.com

Atlas Copco Construction Mining Technique USA LLC
Commerce City, CO, USA,
www.atlascopco.us

Atlas Copco Mafi-Trench Co LLC
Santa Maria, CA, USA,
www.atlascopco-gap.com

Atlas Material Testing Technology
Chicago, IL, USA, www.atlas-mts.com

Aurora Energy Inc
Columbia, MD, USA,
www.aurora-energy.com

Auroville Energy Products
Auroville, Tamil Nadu, India,
www.aep-auroville.com

Auxin Solar LLC
San Jose, CA, USA, www.auxinsolar.com

Babcock Power Inc
Danvers, MA, USA,
www.babcockpower.com

Baltimore Aircoil International NV - BAC
Heist-op-den-Berg, Belgium,
www.baltimoreaircoil.eu

Battic Door Energy Conservation Products
Mansfield, MA, USA, www.batticdoor.com

Baumgarte Boiler Systems GmbH
Bielefeld, Germany, www.baumgarte.com

BayWa re Rotor Service GmbH
Basdahl, Germany, www.baywa-re.com

BC Renewable Innovations LLC
Chelsea, MI, USA, www.bcrenewable.com

BEAR Architecten BV
Gouda, The Netherlands, www.bear-id.com

BGB Engineering Ltd
Lincolnshire, UK, www.bgbengineering.com

BGF Europe SA
Buenos Aires, Argentina,
www.bgfeurope.copm

Bioenergy Technology Ltd
East Sussex, UK, www.bioenergy.org

Biomass Briquette Systems LLC
Chico, CA, USA,
www.biomassbriquettesystems.com

Biomass Magazine
Grand Forks, ND, USA,
www.biomassmagazine.com

The Black Emerald Group
London, UK, www.blackemerald.com

Blackline Power
Owen Sound, ON, Canada,
www.blacklinepower.com

BLATTNER ENERGY

Blattner Energy
392 County Rd 50, Avon, MN 56310 USA,
TEL: 1-320-356-7351,
info@blattnerenergy.com,
www.blattnerenergy.com
Delivers complete engineering, procurement, and construction services to owners and developers of renewable energy projects across the US with more than 18,000 MW installed.

Blue Leaf Environmental
Ellensburg, WA, USA,
www.blueleafenviro.com

Blue Sky Energy
Vista, CA, USA, www.blueskyenergyinc.com

BMH Technology Oy
Rauma, Finland, www.bmh.fi

Boerger Pumps Asia Pte Ltd
Singapore, www.boerger.com

Bonfiglioli USA
Hebron, KY, USA, www.bonfiglioliusa.com

Bono Energia SpA
Peschiera Borromeo (MI), Italy,
www.bono.it

Börger GmbH
Borken-Weseke, Germany,
www.boerger.com

Bosch Industriekessel GmbH
Gunzenhausen, Germany,
www.bosch-industrial.com

Bosch Rexroth Monitoring Systems GmbH
Dresden, Germany,
www.boschrexroth.de/windenergy

Bowman Power Group Ltd
Southampton, UK,
www.bowmanpower.com

Boyle Energy Services & Technology
Concord, NH, USA, www.boyleenergy.com

Brandis Ltd
Surrey, UK, www.brandis.co.uk

Bravo Communications Inc
San Jose, CA, USA, www.bravobravo.com

Breaux Consulting
Leander, TX, USA,
www.selfsufficientintexas.com

Bridgestone Associates Ltd
Chadds Ford, PA, USA, www.brdgstn.com

Bright Management Associates Ltd
Fareham, UK,
www.bright-management.co.uk

Brite Energy Solutions
Curtis, NE, USA, 1-308-367-4542

British Antarctic Survey
Cambridge, Cambridgeshire, UK,
www.antarctica.ac.uk

British Green Ltd
High Wycombe, UK, www.britishgreen.com

BRUSH Turbogenerators Inc
Houston, TX, USA, www.brush.eu

BSRIA Ltd
Berks, UK, www.bsria.co.uk

Bureau Veritas North America Inc
Sacramento, CA, USA,
www.bureauveritas.com

Burkhalter
Columbus, MS, USA, www.burkhalter.net

BURNDY
Manchester, NH, USA, www.burndy.com

Burnham & Sun
Ft Collins, CO, USA,
www.burnhambeck.com

Burns & McDonnell
Kansas City, MO, USA, www.burnsmcd.com

BWD Turbines Ltd
Ancaster, ON, Canada,
www.bwdturbines.com

BZ Products Inc
St Louis, MO, USA, www.bzproducts.net

CalRecovery Inc
Concord, CA, USA, www.calrecovery.com

Cambridge Project Development Inc
Miami, FL, USA,
www.cambridgeprojectdev.com

Campbell Scientific Ltd
Leicestershire, UK, www.campbellsci.co.uk

canadian association for renewable energies (we c.a.r.e.)
Ottawa, ON, Canada, www.renewables.ca

Canadian Solar USA Inc
San Ramon, CA, USA,
www.canadian-solar.com

Cantsink Manufacturing
71 First Ave, Lilburn, GA 30047 USA,
TEL: 1-678-280-7453, info@cantsink.com,
www.cantsink.com
Manufactures and installs helical piles. The engineers design multi-helix piles that provide support for loose or sandy soil and customised brackets to attach the piles to solar panel supports.

Canyon Industries Inc
Deming, WA, USA, www.canyonhydro.com

Canyonwest Cases LLC
Fountain Hills, AZ, USA,
www.canyonwestcases.com

Carlos Bertschi Srl
Buenos Aires, Argentina,
www.bertschi.com.ar

Casco Systems LLC
Cumberland Center, ME, USA,
www.casco-systems.com

Castrol Lubricants
Wiltshire, UK, www.castrol.co.uk

CBT Wear Parts Inc
Richland Center, WI, USA,
www.cbtwearparts.com

CDM Smith
Cambridge, MA, USA, www.cdmsmith.com

CEESE-ULB
Brussels, Belgium, www.ulb.ac.be/ceese

CEM Design Architects
Rockville, MD, USA, www.cemdesign.com

Centro de Estudios de la Energia Solar - Censolar
Mairena del Aljarafe, Sevilla, Spain,
www.censolar.org

Centrosolar AG
Hamburg, Germany, www.centrosolar.com

Centrosolar America Inc
Scottsdale, AZ, USA,
www.centrosolaramerica.com

Century Elevators
Webster, TX, USA,
www.centuryelevators.com

Ceres Technology Advisors Inc
Needham, MA, USA, www.cerescom.net

CFE
Boca del Río Veracruz, Mexico,
www.cfe.gob.mx

CH2M HILL
Atlanta, GA, USA, www.ch2m.com

Chemviron Carbon
Feluy, Hainaut, Belgium,
www.chemvironcarbon.com

Chint Power Systems America
Pleasanton, CA, USA,
www.chintpower.com/na

Chromalox
Pittsburgh, PA, USA, www.chromalox.com

CivicSolar
San Francisco, CA, USA, www.civicsolar.com

Clarage
Pulaski, TN, USA, www.clarage.com

Clarke Energy Associates
St Thomas, Barbados,
www.clarkeenergyassociates.com

Clean Energies
Casablanca, Morocco, 212-661-742680

Clean Harbors
Norwell, MA, USA, www.cleanharbors.com

ClearDrain
Willingboro, NJ, USA,
www.cleardrainusa.com

Cleaver-Brooks Engineered Boiler Systems
Lincoln, NE, USA, www.cleaverbrooks.com

Clyde Bergemann Bachmann Inc
Auburn, ME, USA, www.cbbachmann.com

cmc Instruments GmbH
Eschborn, Germany,
www.cmc-instruments.de

Collinson Plc
Preston, UK, www.collinson.co.uk

Combustion Energy and Steam Specialists Ltd - CESS
Orkney Islands, UK, www.cess.co.uk

Combustion Technologies Pvt Ltd
Pune, India,
www.combustion-technologies.com

Comdel Inc
Gloucester, MA, USA, www.comdel.com

Commonwealth Dynamics Inc
Portsmouth, NH, USA,
www.comdynam.com

Community Windpower Ltd
Frodsham, Cheshire, UK,
www.communitywindpower.co.uk

Compressor Controls Corp - CCC
Des Moines, IA, USA, www.cccglobal.com

Comptus
Thornton, NH, USA, www.comptus.com

Conax Technologies
Buffalo, NY, USA,
www.conaxtechnologies.com

Conergy Inc
Denver, CO, USA, www.conergy.us

Connexion
Buffalo Grove, IL, USA,
www.connexiones.com

Construire en Mélèze
Embrun, France,
www.eric-boissel.blogspot.com

Contec GmbH Industrieausruestungen
Bad Honnef, Germany,
www.contec-umwelt.de

Continental Biomass Industries Inc - CBI
Auburn, NH, USA, www.cbi-inc.com

Continental Field Systems Inc
Savannah, GA, USA, www.cfsusa.net

ContiTech AG
Hannover, Germany, www.contitech.de

Conversion And Resource Evaluation Ltd
Holywood, County Down, UK,
www.care.demon.co.uk

The Cool Solutions Co
Lisle, IL, USA, www.coolsolutionsco.com

CPL Energy Systems
Cantebury, Kent, UK,
www.cplenergysystems.co.uk

CPS Environmental
Nottingham, UK, www.cpsenv.com

Craft Bearing Co Inc
Newport News, VA, USA,
www.craftbearing.com

Cressall Resistors
Leicester, Leicestershire, UK,
www.cressall.com

Croll-Reynolds Engineering Co Inc
Monroe, CT, USA, 1-203-371-1983

CRTSE - Semiconductor Technology for Energetic
Alger-Gare, Algeria, www.crtse.dz

Crystal Group Inc
Hiawatha, IA, USA, www.crystalrugged.com

CSD Ingenieure AG
Liebefeld/Bern, Switzerland, www.csd.ch

CST Industries
Lenexa, KS, USA, www.cstindustries.com

Currin Corp
Midland, MI, USA, 1-989-835-7387

Custom Engineering Co
Erie, PA, USA, www.customeng.com

CVD Equipment Corp
Ronkonkoma, NY, USA,
www.cvdequipment.com

Daikin America Inc
Orangeburg, NY, USA,
www.daikin-america.com

Danish Wind Energy Group
Silkeborg, Denmark, www.dk-wind.com

Dark Field Technologies Inc
Orange, CT, USA, www.darkfield.com

Darley & Associates
Lincolnshire, UK,
www.energyfromwaste.com

Day4 Energy Inc
North Vancouver, BC, Canada,
www.day4energy.com

DEE Development Engineers Ltd
Haryana, India, www.deedevelopment.com

Defitec SPRL
Waterloo, Belgium, www.defitec.com

DEHN Inc
Ft Pierce, FL, USA, www.dehn-usa.com

DEIF (UK) Ltd
Stockport, Cheshire, UK, www.deif.com

Delta Ohm
Caselle di Selvazzano, (PD), Italy,
www.deltaohm.com

Delta Rigging & Tools
Pearland, TX, USA, www.deltarigging.com

DEMAND energy
Take charge.

Demand Energy
24001 E Mission Ave, Suite 102, Liberty Lake, WA 99019 USA, TEL: 1-888-519-5332, info@demand-energy.com, www.demand-energy.com
Offers intelligent energy management and storage, enabling commercial/industrial users, utilities, and microgrid operators to improve reliability, optimise renewables capacity, and take control of electricity usage and costs.

Dependable Turbines Ltd
Surrey, BC, Canada, www.dtlhydro.com

Deprofundis SARL
Paris, France, deprofundis.com

DeTect Inc
Panama City, FL, USA, www.detect-inc.com

Detroit Stoker Co
Monroe, MI, USA, www.detroitstoker.com

DEWI GmbH - a UL Co
Wilhelmshaven, Germany, www.dewi.de

DFME Sp zoo
Wroclaw, Poland, www.dfme.pl

Diamond Flashlights Inc
Blaine, WA, USA, www.flash-lights.com

Disgen Holdings
Lakewood, CO, USA, 1-303-531-5523

DIS-TRAN Steel LLC
Pineville, LA, USA, www.distran.com

DIS-TRAN Wood Products LLC
Pineville, LA, USA, www.distran.com

Draker
Burlington, VT, USA,
www.drakerenergy.com

Dresser-Rand
Houston, TX, USA, www.dresser-rand.com

Dresser-Rand Co Ltd
Peterborough, Cambridgeshire, UK,
www.dresser-rand.com
Designs, manufactures, installs and commissions reciprocating gas compressors and steam turbines. The company has experience in providing equipment for refineries, petrochemical plants, FPSO vessels, power generation plants and marine applications.
See ad page 15

DRIE-D Americas
Grimsby, ON, Canada, www.drie-d.com

Dulas Ltd
Powys, UK, www.dulas.org.uk

Duraflex Inc
Cary, IL, USA, www.duraflexinc.com

Dust Control Technology
Peoria, IL, USA, www.dustboss.com

DUWET Danish University Wind Energy Training
Herning, Denmark, www.duwet.dk

DWC DecRen Water Consult
Trier, Germany, www.dwc-water.com

Dynamic Systems Inc
Redmond, WA, USA, www.a-barcode.com

Dynatex SA
Renens, VD, Switzerland, www.dynatex.ch

E4tech
London, UK, www.e4tech.com

E4tech
Lausanne, Switzerland, www.e4tech.com

EaglePicher™ Technologies, LLC
An OM Group Company

EaglePicher Technologies LLC
C and Porter Sts, PO Box 47, Joplin, MO 64802 USA, TEL: 1-417-623-8000, inquiry.technologies@eaglepicher.com, www.eaglepicher.com
Produces batteries and energy storage systems for defense, space, commercial, medical and grid-scale and renewable energy industries. Is an OM Group company.

EA Technology (Europe) Ltd
Cheshire, UK, www.eatechnology.com

Eaton
Moon Township, PA, USA,
www.eaton.com/water

Ebner Vyncke
Wadsworth, OH, USA,
www.ebnervyncke.com

Eclectic Energy Ltd
Ollerton, Nottinghamshire, UK, www.eclectic-energy.co.uk

EcoCorp
Arlington, VA, USA, www.ecocorp.com

EcoFasten Solar
Morrisville, VT, USA, www.ecofastensolar.com

EcofinConcept GmbH
Hueckelhoven, Germany, www.ecofinconcept.de

Ecoling Partner AG
Volketswil, Switzerland, www.ecoling.ch

e-con Systems India Pvt Ltd
Chennai, Tamil Nadu, India, www.e-consystems.com

Ecostrat and General Biofuel
Toronto, ON, Canada, www.ecostrat.com

EC Power A/S
Hinnerup, Denmark, www.ecpower.eu

Edwards Hot Water
Welshpool, Perth, WA, Australia, www.edwards.com.au

EFACEC Sistemas de Electrónica SA
Moreira Maia, Portugal, www.efacec.pt

Eijkelkamp Agrisearch Equipment
Giesbeek, The Netherlands, www.eijkelkamp.com

Eko Instruments Co Ltd
Tokyo, Japan, www.eko-eu.com

Elan Technical Corp
Fairfield, CT, USA, www.elantechnical.com

ElectraTherm Inc
Reno, NV, USA, www.electratherm.com

Electric Power Production From Magnetic Tapes
Kallithea, Athens, Attiki, Greece, www.energynews.gr

Electronic Drives & Controls
Parsippany, NJ, USA, www.electronicdrives.com

Electroswitch
Weymouth, MA, USA, www.electroswitch.com

Elettrorava SpA
Venaria Torino, Italy, www.elettrorava.com

ELIN Motoren GmbH
Preding/Weiz, Austria, www.elinmotoren.at

Ellwood City Forge
Ellwood City, PA, USA, www.ellwoodcityforge.com

EMCORE Corp
Albuquerque, NM, USA, www.emcore.com

EMGroup BV
Geleen, The Netherlands, www.emgroup.nl

Empire Clean Energy Supply
Bohemia, NY, USA, www.empirecleanenergy.com

Eneco Systems Inc
Vancouver, BC, Canada, www.eneco.ca

Eneco Texas LLC
Newfane, VT, USA, www.warp-eneco.com

Energies Services - ENERSER
Nouakchott, Mauritania, 222-3630 23 28

Energy4All Ltd
Cumbria, UK, www.energy4all.co.uk

Energy & Development Group - EDG
Cape Town, South Africa, www.edg.co.za

Energy Environmental Technical Services Ltd - EETS
Pontypridd, Wales, UK, www.eets.co.uk

Energy Institute
London, UK, www.energyinst.org

Energy Recovery Solution
Dollard-Des Ormeaux, QC, Canada, www.energyrecoverysolution.com

Energy Technology Advisors
Palo Alto, CA, USA, www.ufto.com

Enerquip LLC
Medford, WI, USA, www.enerquip.com

Enertech Solar
Gold Coast, Australia, www.enertechsolar.com.au

Enertegic
Southport, CT, USA, www.enertegic.com

EnerWorks Inc
Woodstock, ON, Canada, www.enerworks.com

EngineerSupply
Lynchburg, VA, USA, www.engineersupply.com

Envect Inc
Pleasanton, CA, USA, www.envect.com

Enviro - Energy Technologies Inc
Markham, ON, Canada, www.enviro-energytech.com

Environmental Alternatives Inc
Keene, NH, USA, www.eai-inc.com

Eologica
Schoonhoven, The Netherlands, www.eologica.com

EOPLLY USA Inc
San Bruno, CA, USA, www.eoplly.us

ERI (Energy Recovery International)
Lincoln, NE, USA, www.cleaverbrooks.com

ERLPhase Power Technologies
Winnipeg, MB, Canada, www.erlphase.com

EscoVale Consultancy Services
Surrey, UK, www.escovale.com

Esdec (ClickFit)
Deventer, The Netherlands, www.click-fit.com

ESS Ecology
Edinburgh, UK, www.ess-ecology.com

ETA Florence Renewable Energies
Florence, Italy, www.etaflorence.it

ETS Energy Store LLC
Briarcliff Manor, NY, USA, www.greenlivingguy.com

Etudes Chimiques et Physiques - ECP
La Ferte St Aubin, France, www.glidarc-tech.com

ETW Energietechnik GmbH
Moers, Germany, www.etw-energie.de

Eurobalers Ltd
Crowthorne, Berks, UK, www.eurobalers.com

The European Marine Energy Centre (EMEC) Ltd
Orkney, UK, www.emec.org.uk

European Small Hydropower Association - ESHA
Brussels, Belgium, www.esha.be

Everest Sciences Inc
Tulsa, OK, USA, www.everestsciences.com

Everglades University
Boca Raton, FL, USA, www.evergladesuniversity.edu
Offers alternative and renewable energy management with courses in solar energy and photovoltaics, energy and the environment, alternative energy safety, nuclear energy, wind energy, geothermal energy, hydroelectric energy, and managing an alternative energy project.
See ad page 10

EV Solar Products Inc
Chino Valley, AZ, USA, www.evsolar.com

EXOSUN
South San Francisco, CA, USA, www.exosun.net

ExxonMobil
Machelen, Belgium, www.exxonmobil.com

FCC Environment
Northampton, Northamptonshire, UK, www.fccenvironment.co.uk

F-Chart Software
Madison, WI, USA, www.fchart.com

Fisher Tank Co
Leesville, SC, USA, www.fishertank.com

Fish Guidance Systems Ltd
Hampshire, UK, www.fish-guide.com

FlaktWoods
Niles, MI, USA, www.flaktwoods.com

FLEXcon
Spencer, MA, USA, www.flexcon.com/pv

Flexitallic Ltd
Cleakheaton, UK, www.flexitallic.eu

FLiDAR
Oostende, Belgium, www.flidar.com

Flowserve Corp
Raleigh, NC, USA, www.flowserve.com

Fluke Corp
Everett, WA, USA, www.fluke.com

Forecast International
Newtown, CT, USA, www.forecastinternational.com

FOSS NIRSystems Inc
Laurel, MD, USA, www.foss-nirsystems.com

Frako Capacitors
Cedarburg, WI, USA, www.alliedindustrialmarketing.com

Free Hot Water
San Jose, CA, USA, www.freehotwater.com

Freesen and Partner GmbH
Alpen, Germany, www.freesen.de

Fronius Canada Ltd
Mississauga, ON, Canada, www.fronius.ca

Fuchs Lubritech
Harvey, IL, USA, 1-913-441-7143

Fujian Morstar New-Energy Tec LLC
Fuzhou, Fujian, China, www.morstar.com

Fullriver Battery USA
Camarillo, CA, USA, www.fullriverdcbattery.com

Fundashon Antiyano Pa Energia - FAPE
Willemstad, Curaçao, 599-9-8696970

FWT LLC
Ft Worth, TX, USA, www.fwtllc.com

Gaia Human Capital Consultants
New York, NY, USA, www.gaiahumancapital.com

Gas Compressors Ltd
Tonbridge, Kent, UK, www.gascompressors.co.uk

GB-Sol Ltd
Cardiff, Wales, UK, www.gb-sol.co.uk

GCube Insurance Services Inc
Newport Beach, CA, USA, www.gcube-insurance.com

GenerPro AB
Vasteras, Sweden, www.generpro.com

geoAMPS
Powell, OH, USA, www.geoamps.com

Geospec Enterprises
Gurgaon, Haryana, India, www.geospec.in

PT Gerbang Multindo Nusantara
Jakarta, DKI, Indonesia, www.gerbangmultindo.co.id

GET ENERGY Gerhard Brandel MA
Dietzenbach, Germany, www.get-energy.net

Gibraltar Chimney International
Tonawanda, NY, USA, www.gibraltarchimney.com

Glaunach GmbH
Klagenfurt, Austria, www.glaunach.com

Gl Garrad Hassan North America
Montreal, QC, Canada, www.gl-garradhassan.com

Global Energy Solutions Inc
Naperville, IL, USA, www.globalenergychicago.com

Global Training Solutions Inc
Mississauga, ON, Canada, www.globaltrainingsolutions.ca

Global Wedge Inc
Tustin, CA, USA, www.globalwedge.com

Global Wind Power A/S
Thisted, Denmark, www.globalwindpower.com

GlobVision Inc
St Laurent, QC, Canada, www.globvision.com

Going Solar
Carlton, VIC, Australia, www.goingsolar.com.au

Golden Eagle Technologies LLC
Golden, CO, USA, www.goldeneagletechnologies.com

GO Topeka Economic Development
Topeka, KS, USA, www.gotopeka.com

The Green Electrician Group
Nantwich, Cheshire, UK, www.thegreenelectrician.co.uk

Green Orkney Tours
Stromness, UK, www.greenorkneytours.com

Greenpower Capital
Burbank, CA, USA, www.greenpowercap.com

groSolar
White River Junction, VT, USA, www.grosolar.com

GSE Systems Inc
Sykesville, MD, USA, www.gses.com

GUGLER Water Turbines GmbH
Goldworth, Austria, www.gugler.com

GustoMSC
Schiedam, The Netherlands, www.gustomsc.com

Haas Recycling GmbH
Dreisbach, Germany, www.haas-recycling.de

Hamon Deltak Inc
Plymouth, MN, USA, www.hamonusa.com

H&L Instruments LLC
North Hampton, NH, USA, www.hlinstruments.com

Hans von Mangoldt Reactors
Cedarburg, WI, USA, www.mangoldt.com

Harris Group Inc
Denver, CO, USA, www.harrisgroup.com

The Hartford Financial Services Group Inc
Hartford, CT, USA, www.thehartford.com

HAWE Hydraulik SE
Muenchen, Germany, www.hawe.de

Heatec Inc
Chattanooga, TN, USA, www.heatec.com

Heliodyne Inc
Richmond, CA, USA, www.heliodyne.com

Helmick Corp
Fairmont, WV, USA, www.helmickcorp.com

Henkel Corp
Rocky Hill, CT, USA, www.henkelna.com

Herbold Meckesheim GmbH
Meckesheim, Germany, www.herbold.com

Herbold Meckesheim USA
Slatersville, RI, USA, www.herboldusa.com

Highway Products Inc
White City, OR, USA,
www.800toolbox.com

HIOKI EE Corp
Ueda, Nagano, Japan, www.hioki.com

Hi-Tech Controls
Centennial, CO, USA,
www.hitechcontrols.com

HITEC Sensor Solutions Inc
Littleton, MA, USA, www.hitecorp.com

HL Insulation Ltd
Tampere, Finland, www.hlinsulation.com

Hocking County Community Improvement Corp
Logan, OH, USA,
www.lhcommercepark.com

Hollaender Manufacturing
Cincinnati, OH, USA, www.hollaender.com

Hurst Boiler & Welding Co Inc
Coolidge, GA, USA, www.hurstboiler.com
Provides biomass steam boilers, hot water boilers and direct-fired STAG units for alternative solid fuel systems. Custom manufactures engineered packaged boilers and boiler systems and biomass boiler systems and integrated automated PLC controls.
See ad page 64

hvGrid-tech Inc
Gormley, ON, Canada,
www.hvgrid-tech.com

HWP-hullmann Willkomm & Partner - GbR
Hamburg, Germany,
www.hwp-hullmann-willkomm.de

HYDAC Technology Corp
Bethlehem, PA, USA, www.hydacusa.com

Hydrasep Inc
Hernando, MS, USA, www.hydrasep.com

HYTORC
333 Rt 17 N, Mahwah, NJ 07430 USA, TEL: 1-201-512-9500, info@hytorc.com, www.hytorc.com
Delivers safe and simple bolting systems to assure joint integrity. With over 40 years of experience, many innovations in torque and tensioning systems have come from the company. The engineering team continues to push the limits to deliver the best equipment possible. There is no bolting challenge that they cannot solve.

Hyundai Heavy Industries
Seoul, Korea, www.hhi.co.kr

icenta Controls Ltd
Wilton, Wiltshire, UK, www.icenta.co.uk

Ideematec Deutschland GmbH
Wallerfing, Germany, www.ideematec.com

IK4-Tekniker Research Centre
Eibar Gipuzkoa, Spain,
www.tekniker.es/en/oferta-tecnologica/energias_renovables

ImagineSolar
Austin, TX, USA, www.imaginesolar.com

IMERYS
Roswell, GA, USA, www.imerys-aurora.com

IMO Group of Cos
Gremsdorf, Germany, www.imo.de

Impact Technical Services Ltd
Leicester, UK,
www.impacttechnicalservices.co.uk

IMS Ingenieurgesellschaft GmbH
Hamburg, Germany, www.ims-ing.de

Imtek Environmental Corp
Alpharetta, GA, USA, www.noodor.com

Indiana Gratings Pvt Ltd
Mumbai, Maharashtra, India,
www.indianagroup.com

Indium Corp
Clinton, NY, USA, www.indium.com

InduSoft Inc
Austin, TX, USA, www.indusoft.com

Industrial Training Consultants Inc
Pelham, AL, USA, www.itctrng.com

INENSUS GmbH
Goslar, Lower Saxony, Germany,
www.inensus.com

INFRASTRUKTUR & UMWELT Professor Böhm und Partner
Darmstadt, Germany, www.iu-info.de

Ing-Buero fuer Alternative Antriebe und Erneuerbare Energien
Erlangen, Germany,
www.alternative-antriebe.de

Ingenieria de Equipos de Control SL - INDECON
Zaragoza, Spain, www.indecon.es

Ingvar Ingrids AB
Ludvika, Sweden, www.ingrids.se

INNOTRONIKS
Santa Clara, CA, USA,
www.innotroniks.com

In-Place Machining Co Inc
Milwaukee, WI, USA, www.inplace.com

INPRO Solar Systems
Eurasburg, Germany, www.inprosolar.de

Inset
St Petersburg, Russian Federation,
www.inset.ru

Inspecteam Hydro
Godstone, Surrey, UK,
www.inspecteam-hydro.com

Instituto de Energías Renovables UNAM
Temixco, Morelos, Mexico,
www.cie.unam.mx

Instituto Tecnológico de Canarias - ITC
Santa Lucía, Gran Canaria, Las Palmas, Spain, www.itccanarias.org

Instrumenttjenesten A/S - ITAS
Aas, Norway, www.it-as.no

Integrated CHP Systems Corp
Princeton, NJ, USA, www.ichps.com

Integrated Solar LLC
Phoenix, AZ, USA,
www.integratedsolar.com

IntelLiDrives Inc
Philadelphia, PA, USA,
www.intellidrives.com

Interdevelopment Inc
Washington, DC, USA,
www.interdevelopment.com

InterEnergy Srl
Rome, (RM), Italy, www.interenergy.it

International Association of Plumbing and Mechanical Officials
Ontario, CA, USA, www.iapmo.org

International Chimney Corp
Buffalo, NY, USA,
www.internationalchimney.com

International Generator Technical Community
Columbus, OH, USA,
www.generatortechnicalforum.org

International Paint Ltd
Tyne & Wear, UK,
www.international-pc.com

International Peat Society
Jyväskylä, Finland, www.peatsociety.org

International Power Machinery Co
Cleveland, OH, USA, www.intlpwr.com

International Solar Energy Society - ISES
Freiburg, Germany, www.ises.org

InterPhases Solar Inc
Moorpark, CA, USA, www.interphases.com

IRT Integrated Rectifier Technologies Inc
Edmonton, AB, Canada,
www.irtrectifier.com

ISES Norway - Norsk solenergiforening
Skjetten, Norway, www.solenergi.no

ITH Engineering Inc
McHenry, IL, USA, www.ith.com

ITT Industrial Process
Seneca Falls, NY, USA,
www.ittindustrialproducts.com

James Troop and Co Ltd
Runcorn, Cheshire, UK,
www.jamestroop.co.uk

Jansen Combustion and Boiler Technologies Inc
Kirkland, WA, USA, www.jansenboiler.com

Javno Podjetje Energetika Ljubljana doo
Ljubljana, Slovenia, www.energetika-lj.si

JDR
Littleport, Cambridgeshire, UK,
www.jdrglobal.com

Jeffrey Rader
Duncan, SC, USA, www.terrasource.com

JENOPTIK I Lasers & Material Processing
Jena, Thuringia, Germany,
www.jenoptik.com/lm

Jet-Vac Systems Ltd
Port Talbot, West Glamorgan, UK,
www.jetvacsystems.com

John Crane
Morton Grove, IL, USA,
www.johncrane.com

Jonas Inc
Pomfret, MD, USA, www.steamcycle.com

Joseph Oat Corp
Camden, NJ, USA, www.josephoat.com

Justsen Energiteknik A/S
Brabrand, Denmark, www.justsen.dk

Juwi Holding AG
Wörrstadt, Germany, www.juwi.com

JWG Consulting Ltd
London, UK, www.jwgconsulting.com

KACO new energy GmbH
Neckarsulm, Germany,
www.kaco-newenergy.de
Specialises in PV inverters and monitoring systems as well as in power supply systems for rail and industrial applications.
See ad page 2

KACO new energy Inc
Grass Valley, CA, USA,
www.kaco-newenergy.com

KARA Energy Systems BV
Almelo, The Netherlands,
www.kara-greenenergy.com

Kaushal Solar Equipments (P) Ltd
Pune, India, www.kaushalsolar.com

KCF Technologies
State College, PA, USA, www.kcftech.com

KEITH Manufacturing Co
Madras, OR, USA,
www.keithwalkingfloor.com

Kelburn Engineering
East Kilbride, UK, www.kelburneng.co.uk

Kemery Co
Strawberry Plains, TN, USA,
www.kemerysolar.com

Kepco Inc
Flushing, NY, USA, www.kepcopower.com

Kingsbury Inc
Philadelphia, PA, USA, www.kingsbury.com

Kolektor Magma doo
Ljubljana, Slovenia,
www.kolektormagma.com

K-Sun Corp
Somerset, WI, USA, www.ksun.com

Kugler of America Ltd
Somers, CT, USA,
www.kuglerofamerica.com

Kyocera Solar Pty Ltd
North Ryde, NSW, Australia,
www.kyocerasolar.com.au

Kyoto Energy Pte Ltd
Singapore, www.kyotoenergy.net

Lake Michigan Wind & Sun Ltd - LMWS
Sturgeon Bay, WI, USA,
www.windandsun.com

L&R Ingenieria
Rio Gallegos, Santa Cruz, Argentina,
www.lyr-ing.com

Lapesa Grupo Empresarial SL - LAPESA
Zaragoza, Spain, www.lapesa.es

LAP GmbH Laser Applikationen
Lueneburg, Germany, www.lap-laser.com

Lee Enterprises Alternative & Renewable Fuels Consulting Inc
Sherwood, AR, USA,
www.lee-enterprises.com

Legrand
Mascoutah, IL, USA, www.legrand.us

LEINE LINDE SYSTEMS GmbH
Hamburg, Germany, www.ll-systems.com

Leroy Somer
Angouleme, France, www.leroy-somer.com

LFG Consult
Viborg, Denmark, www.lfgconsult.com

Lightning Eliminators & Consultants Inc
Boulder, CO, USA,
www.lightningprotection.com

LINAK US Inc
Louisville, KY, USA, www.linak-us.com

Lincoln Lubrication Systems
1 Lincoln Way, St Louis, MO 63120-1578 USA, TEL: 1-314-679-4207, brenda.hendricks@skf.com, www.lincolnindustrial.com
Provides lubrication solutions for renewable energy production. From wind turbine to hydropower and geothermal applications, the company's products help avoid expensive, unplanned repairs and downtime.

LINK Tools International (USA) Inc
Chicago, IL, USA, www.linktools.com

Lithuanian Energy Institute - LEI
Kaunas, Lithuania, www.lei.lt

Lloyd Dynamowerke GmbH & Co KG
Bremen, Germany, www.ldw.de

Lotus Energy Inc
Hudson, NY, USA, www.lotusenergy.com

Lubrication Engineers Inc
Ft Worth, TX, USA, www.lelubricants.com

LUDECA Inc
Doral, FL, USA, www.ludeca.com

LumaSense Technologies Inc
Santa Clara, CA, USA,
www.lumasenseinc.com

Magnetic Div Global Equipment Mktg Inc
Boca Raton, FL, USA,
www.globalmagnetics.com

Malaviya Solar Energy Consultancy
Pune, India, www.malaviya.in

Mammoet Wind A/S
Aalborg, Denmark, www.mammoet.com

M & Architects Consulting Environment
Aguascalientes, Ags, Mexico,
52-55-5519-9027

MAN Diesel & Turbo SE
Augsburg, Germany,
www.mandieselturbo.com

Manitoba HVDC Research Centre
Winnipeg, MB, Canada, www.pscad.com

Marcel Equipment Ltd
London, ON, Canada,
www.marcelequipment.com

Marlec Engineering Co Ltd
Northamptonshire, UK, www.marlec.co.uk

Maryn International Ltd
Calgary, AB, Canada,
www.maryninternational.com

Matan International Group Ltd
Liverpool, UK, www.matan.co.uk

Maven Power
Houston, TX, USA, www.mavenpower.com

M-E-C Co
Neodesha, KS, USA, www.m-e-c.com

Meggitt Sensing Systems
Fribourg, Switzerland,
www.vibro-meter.com

Meggitt Sensing Systems
Germantown, MD, USA,
www.wilcoxon.com

Mersen France Amiens
Amiens, France, www.mersen.com

METHASYN EG
Cham, Zug, Switzerland,
www.methasyn.com

Met Office
Devon, UK,
www.metoffice.gov.uk/renewables

Metrologie et Gestion d'Environnement - MGE
Chaumont-Gistoux, Belgium,
www.mgesolutions.com

Metso Power
3430 Toringdon Way, Suite 201, Charlotte, NC 28277 USA, TEL: 1-704-541-1453, info.power@metso.com, www.metso.com/energy
Provides engineering capabilities including EPC, coal and biomass-fired CFB and BFB boilers and power plants, lifetime support, including chemical cleanings, manufacturing, 3-D laser, parts, plant maintenance, outage, and related services.

Microhydropower.net
Ruurlo, The Netherlands,
www.microhydropower.net

Midwest Renewable Energy Association - MREA
Custer, WI, USA, www.midwestrenew.org

Milestones Building and Design
Bellingham, WA, USA,
www.mbdbuildings.com

Minder Energy Consulting
Oberlunkhofen, Switzerland,
www.minder-energy.ch

MKS Instruments Inc
Andover, MA, USA, www.mksinst.com

Mobasolar
Horbourg-Wihr, Alsace, France,
www.mobasolar.com

Mobasolar USA
Pleasanton, CA, USA, www.mobasolar.com

Moisttech
Moorpark, CA, USA,
www.moimoisttech.comsttech.com

Morningstar Corp
8 Pheasant Run, Newtown, PA 18940 USA, TEL: 1-215-321-4457, info@morningstarcorp.com, www.morningstarcorp.com
Supplies solar charge controllers and inverters. Sets new standards in performance, quality, reliability and extended battery life.

Morrison & Kibbey Ltd
Bronxville, NY, USA, 1-917-653-3017

Mortenson Construction
Minneapolis, MN, USA,
www.mortenson.com/industry_renewableenergy.aspx

Motech Industries Inc
Xinshi Dist, Tainan City, Taiwan,
www.motechsolar.com

Motiva Oy
Helsinki, Finland, www.motiva.fi

MTS Sensor Technologie GmbH & Co KG
Luedenscheid, Germany,
www.mtssensor.com

MTU Friedrichshafen GmbH
Friedrichshafen, Germany,
www.mtu-online.com
Manufactures large diesel engines and complete propulsion systems. Together with MTU Onsite Energy, the company is one of the leading brands of Tognum.
See ad page 67

Muis Controls Ltd
St Albert, AB, Canada,
www.muiscontrols.com

Multi-Contact AG
Allschwil, Switzerland,
www.multi-contact.com
Provides standard connectors and customised solutions for various industries, automation, medical technology, test and measurement, renewable energies, and photovoltaic connector systems.
See ad page 19

Munters Corp
Amesbury, MA, USA, www.munters.us

Murphy International Development LLC
Georgetown, CT, USA,
www.murphyintldev.com

MWH Global
Broomfield, CO, USA,
www.mwhglobal.com

NAES Corp
1180 NW Maple St, Suite 200, Issaquah, WA 98027 USA, TEL: 1-425-961-4700, sales@naes.com, www.naes.com
Provides operations, maintenance and repair, technical support, and staffing services to the renewable power generation industry, including wind, hydro, biomass and solar.

NATCOM
St Leonard, QC, Canada,
www.cleaverbrooks.com

National Biomass Association - NBA
Plovdiv, Bulgaria, www.bgbiom.org

National Conveyors Co Inc
East Granby, CT, USA,
www.nationalconveyors.com

National Electric Coil
Columbus, OH, USA,
www.national-electric-coil.com

National Hydropower Association
Washington, DC, USA, www.hydro.org

National Instruments
Austin, TX, USA, www.ni.com

Navigant
1200 19th St NW, Suite 700, Washington, DC 20036 USA, TEL: 1-202-973-2400, inquiries@navigant.com, www.navigant.com/energy
Provides consulting assistance to public power companies, investor-owned utilities, financial entities, government organisations, nonregulated power suppliers, pipeline companies, large energy customers, law firms and other energy industry players.

Navigant's BTM Consult
Copenhagen, Denmark,
www.navigantresearch.com

Near East University
Mersin, Turkey, www.neu.edu.tr

Neuman & Esser USA Inc
Katy, TX, USA, www.neuman-esser.com

Newmills Engineering
Co Antrim, UK,
www.newmillsengineeering.com

Nextwind
St Augustine, FL, USA,
www.nextwindinc.com

Niagara Worldwide
Niagara, WI, USA,
www.niagaraworldwide.com

NIRAS A/S
Allerod, Denmark, www.niras.com

Norconsult AS
Sandvika, Norway, www.norconsult.com

Nord-Lock Inc
Elk Grove Village, IL, USA,
www.nord-lock.com

Nortek UK
Hants, UK, www.nortekuk.co.uk

North American Board of Certified Energy Practitioners - NABCEP
Clifton Park, NY, USA, www.nabcep.org

North Energy Associates Ltd
Stocksfield, Northumberland, UK,
www.northenergy.co.uk

Northern State Metals
Youngstown, OH, USA,
www.extrusions.com
Provides full-service aluminum extrusion and extruded products with locations in West Hartford, CT and Youngstown, OH. Serves the entire US and also exports to countries worldwide. The expert staff, along with complete state-of-the-art fabrication and finishing facilities, can handle almost any job.
See ad page 5

Northwire Inc
Osceola, WI, USA, www.northwire.com

Nova Electric
Bergenfield, NJ, USA,
www.novaelectric.com

Novator Advanced Technology Consulting
Gilleleje, Denmark,
www.danbbs.dk/~novator

Nuergy Biomass
Kirknewton, West Lothian, UK,
www.nuergy.com

OAI
685 River Oaks Pkwy, San Jose, CA 95134 USA, TEL: 1-408-232-0600, sales@oainet.com, www.oainet.com
Offers Class AAA solar simulators, I-V testers, solar power meters, and solar array testers. Has over 35 years technical experience in generating, measuring, and producing light.

O'Donnell Consulting Engineers
Bethel Park, PA, USA,
www.odonnellconsulting.com

Odotech Inc
Montreal, QC, Canada, www.odotech.com

OELCHECK GmbH
Brannenburg, Germany, www.oelcheck.de

OFS
55 Darling Dr, Avon, CT 06001 USA, TEL: 1-860-678-0371, ofs@ofsoptics.com, www.ofsoptics.com
Specialises in optical fibre design for highly customised applications. Develops focused fibre solutions to meet the needs of established and growing industries.
See ad page 23

OILES Deutschland GmbH
Ober-Moerlen, Germany, www.oiles.de

O'Leary Public Relations
Dunfermline, Fife, UK,
www.olearyrmpr.co.uk

Omex Environmental Ltd
Norfolk, UK, www.omex.co.uk

ONE Sothebys International Realty
Maimi, FL, USA, 1-305-773-9470
Provides connections as a south Florida real estate agent. Agent Karen Dornbusch leverages innovation, experience and international impact, along with the company's referral service, to connect buyers and sellers globally. The collaboration between realty and auction house leverages the brand's rich history, heritage and sophistication to enhance market perceptions about the properties represented.
See ad page 68

Onsite hv Solutions Americas Inc
Gormley, ON, Canada,
www.hvgrid-tech.com/business-units/testing-diagnostics

OPAL-RT Technologies
Montreal, QC, Canada, www.opal-rt.com

OpCon Technologies Inc
San Francisco, CA, USA,
www.opcontech.com

Openchannelflow
Boise, ID, USA, www.openchannelflow.com

Opsis AB
Furulund, Sweden, www.opsis.se

Optosolar GmbH
Merdingen, Germany, www.optosolar.com

ORBIS Corp
Oconomowoc, WI, USA,
www.orbiscorporation.com

Orbital2 Ltd
Leamington Spa, Warwickshire, UK,
www.orbital2.com

Orbital AS
Skjern, Denmark, www.orbital.dk

Orengine International
Lavagna, (GE), Italy, www.orengine.com

Organics Asia Co Ltd
Patum Thani, Thailand, www.organics.com

Orion Solar Racking
Commerce, CA, USA,
www.orionsolarracking.com

Osiris Hydrographic and Geophysical Projects Ltd
Wirral, UK, www.osirisprojects.co.uk

Outotec Energy Products
Coeur d'Alene, ID, USA,
www.energyproducts.com

P2
Yorba Linda, CA, USA,
www.p-2.com/products

P4Q
Santa Fe, NM, USA, www.suntrackpro.com

PA Consulting Group
Denver, CO, USA, www.paconsulting.com

Pallmann Maschinenfabrik GmbH & Co KG
Zweibrücken, Germany, www.pallmann.eu

PanelClaw Inc
North Andover, MA, USA,
www.panelclaw.com

PanGlobal Training Systems Ltd
Calgary, AB, Canada,
www.powerengineering.org

Para-Coat Technologies Inc
Johnstown, PA, USA,
www.pctconformalcoating.com

Parker Hannifin
Charlotte, NC, USA,
www.parker.com/gridtie

Parker Precision Cooling Systems
10801 Rose Ave, New Haven, IN 46774 USA, TEL: 1-509-552-5112, precision.cooling@parker.com, www.parkerprecisioncooling.com
Specialises in advanced two-phase evaporative liquid cooling thermal solutions to enable high-powered wind turbine systems and solar inverters and related energy storage power conversion cooling solutions for renewables.

Parsons Brinckerhoff
Newcastle upon Tyne, UK,
www.pbworld.com

Patriot Solar Group
Albion, MI, USA,
www.patriotsolargroup.com

PDR Associates (Renewable) Inc
East Brunswick, NJ, USA,
www.pdrassocs.com

PennEnergy Research
1421 S Sheridan Rd, Tulsa, OK 74112 USA, TEL: 1-800-345-4618, pennenergyresearch@pennwell.com, www.pennenergyresearch.com
Offers new and improved research options for energy professionals. Combines research from well-known brands. The premiere industry source for actionable data and information, custom research and consulting.

Penn-Union Corp
Edinboro, PA, USA, www.penn-union.com

Perpetual Energy Systems
Woodland Hills, CA, USA,
www.goperpetual.com

PES UK Ltd
Leicestershire, UK, www.pesukltd.com

Pfannenberg Inc
Lancaster, NY, USA,
www.pfannenbergusa.com

PHG Energy
Antioch, TN, USA, www.phgenergy.com

Phoenix Electric Corp
Boston, MA, USA, www.pec-usa.biz

Phoenix Solar AG
Sulzemoos, Germany,
www.phoenixsolar-group.com

Pipal Ltd
Nairobi, Kenya, www.pipal.com

PitchWind Systems AB
Askim Gothenburg, Sweden,
www.pitchwind.com

Platypus Power
Smithfield, QLD, Australia,
www.platypuspower.com.au

PLI LLC
Racine, WI, USA, www.memolub.com

Positive Energy Solar
Santa Fe, NM, USA,
www.positiveenergysolar.com

POSjoman Hydrotech Consulting
Burnaby, BC, Canada, 1-604-219-1732

Pöttinger Entsorgungstechnik GmbH & Co KG
Grieskirchen, Austria,
www.poettinger-oneworld.at

Power Conversion
Berlin, Germany,
www.ge-energy.com/electrifyingchange

Powernet Oy
Vantaa, Finland, www.powernet.fi

Power-One Inc
Phoenix, AZ, USA, www.power-one.com
Provides high-efficiency "green" power solutions, including renewable energy.
See ad page 1

Power Panel Inc
Detroit, MI, USA, www.powerpanel.com

PowerPod Corp
Olathe, CO, USA, www.powerpod.com

PPC Solar
Taos, NM, USA, www.ppcsolar.com

Pratt & Whitney Power Systems
East Hartford, CT, USA, www.pw.utc.com

Precision Combustion Inc
North Haven, CT, USA,
www.precision-combustion.com

PRé Consultants BV
Amersfoort, The Netherlands, www.pre-sustainability.com

Presona AB
Tomelilla, Sweden, www.presona.com

PRM Energy Systems Inc - PRME
Hot Springs, AR, USA, www.prmenergy.com

Process Equipment - Barron Industries
Pelham, AL, USA, www.processbarron.com

Process Technology
Mentor, OH, USA, www.processtechnology.com

Progetto Energia Srl
Roma, Italy, www.progettoenergia.com

Project Risk Ltd
Westmoreland, TN, USA, www.linkedin.com/in/davidschroeder

Proplan Ltd
Nicosia, Cyprus, www.proplan_cyprus.com

ProSim Inc
Philadelphia, PA, USA, www.prosim.net

Prosonix Corp
Milwaukee, WI, USA, www.pro-sonix.com

Prowind Energy Ltd
Auckland, New Zealand, www.prowindenergy.com

Prudent Living Inc
Windsor, VT, USA, prudentliving.com

Psychsoftpc
Quincy, MA, USA, www.psychsoftpc.com

PT Sundaya Indonesia
Sentul, West Java, Indonesia, www.sundaya.com

Puleo Electronics Inc
Lynbrook, NY, USA, www.annunciator.com

PumpScout
Tacoma, WA, USA, www.pumpscout.com

PureTemp LLC
Plymouth, MN, USA, www.puretemp.com

PV Insider
London, UK, http://news.pv-insider.com

PVinsights
Taipei City, Taiwan, http://pvinsights.com/indexUS.php

PV Measurements Inc
Boulder, CO, USA, www.pvmeasurements.com

PV-plan
Stuttgart, Germany, www.pv-plan.de

PVsyst SA
Satigny, Geneva, Switzerland, www.pvsyst.com
Offers software for the study and simulation of photovoltaic systems (grid-connected, stand-alone and pumping). It can use meteo data from many sources, treats near shadings, tracking, big systems, and all losses. Results are provided as a detailed report, specific graphs and tables, as well as data export for use in other software.
See ad page 71

PXL Seals
Bellegarde-sur-Valserine, Ain, France, www.pxlseals.com

Quality Two-Way Radios
Temecula, CA, USA, www.quality2wayradios.com

Quanta Power Generation
5445 DTC Pkwy, Suite 1200, Greenwood Village, CO 80111 USA, TEL:1-303-459-8300,sales@quantapower.net, www.quantapower.net
Provides full engineering and construction services with the flexibility of single service or complete project management.

Quick Mount PV
Walnut Creek, CA, USA, www.quickmountpv.com

Ramboll
Copenhagen S, Denmark, www.ramboll.com/energy

Ramboll
Copenhagen S, Denmark, www.ramboll.com/wind

R&G Energy Systems
Rotorua, New Zealand, www.rgenergysystems.com

Raytek Corp
Santa Cruz, CA, USA, www.raytek.com

RBI Solar Inc
Cincinnati, OH, USA, www.rbisolar.com

Recovered Energy Inc
Pocatello, ID, USA, www.recoveredenergy.com

Red Acoustics Ltd
Preston, Lancashire, UK, www.redacoustics.co.uk

Rely (UK) Precision Castings
Glasgow, UK, www.rely.co.za

ReneSola
San Francisco, CA, USA, www.renesola.com

Renewable Energy Corp Ltd
Maidenhead, UK, www.renewableenergy.co.uk

Renewable Energy Technology Group Ltd
Snoqualmie, WA, USA, www.retgltd.com

RenewableEnergyWorld.com
98 Spit Brook Rd, Nashua, NH 03062 USA, TEL: 1-603-891-0123, support@renewableenergyworld.com, www.renewableenergyworld.com
Provides renewable energy news and information, webcasts, banner and e-newsletter advertising. Website offers product and company directories, job postings, events calendar, commentary, blogs and much more.

Renewables for Development - RforD
Soest, Germany, www.rford.org

RES Americas
Broomfield, CO, USA, www.res-americas.com

RES Mediterranean
Avignon, Vaucluse, France, www.res-med.eu

RESOL - Elektronische Regelungen GmbH
Hattingen, Germany, www.resol.com

Rich Hessler Business Development
Culver City, CA, USA, www.richhessler.com

Rijkert Knoppers Tekstproducties
BK's Hertogenbosch, The Netherlands, www.rijkertknoppers.nl

Rittal Corp
Urbana, OH, USA, www.rittal.us

RJM Associates
Easley, SC, USA, www.rjmmfg.com

Robin Sun
Strasbourg, France, www.robinsun.com/en

Rolls Battery Engineering
Springhill, NS, Canada, www.rollsbattery.com
Manufactures premium flooded and sealed deep-cycle lead acid batteries in 2V, 4V, 6V, 8V and 12V models for renewable energy markets around the world.
See ad page 37

Romanian Energy Regulatory Authority - ANRE
Bucharest, Sect 2, Romania, www.anre.ro

Ronan Engineering Co
Valencia, CA, USA, www.ronan.com

Ronan Measurments
Florence, KY, USA, www.ronanmeasure.com

Rotork Plc
Bath, Somerset, UK, www.rotork.com

Roxtec Inc
Tulsa, OK, USA, www.roxtec.com

RR Projects
Tullamore, Ireland, www.rrprojects.net

RUD Chain Inc
Hiawatha, IA, USA, www.rudchain.com

SAC Boiler Plant Ltd
Lincoln, UK, www.sacbp.co.uk

SAGE Energy Inc
Windsor, NS, Canada, www.sage-energy.ca

Sahara Wind Inc
Rabat, Morocco, www.saharawind.com

Saint-Gobain Ltd
Avon, UK, www.saint-gobain.co.uk

S&B Engineers and Constructors
Houston, TX, USA, www.sbec.com

Sander + Partner
Munich, Germany, www.sander-partner.com

Sargent & Lundy LLC
Chicago, IL, USA, www.sargentlundy.com

Savco Solar Energy
Nicosia, Cyprus, www.savcosolar.com

Saxlund International Ltd
Southampton, UK, www.saxlund.co.uk

SAXOVENT Ökologische Investments GmbH & Co KG
Berlin, Germany, www.saxovent.de

Schenck Process
Doncaster, UK, www.schenckprocess.co.uk

Schneider Electric
West Kingston, RI, USA, www.apc.com

Schools and Homes Energy Education Project/Solar-Active
Sheffield, UK,
www.pluggingintothesun.org.uk

Schutte & Koerting
Trevose, PA, USA, www.s-k.com

Schweitzer Engineering Laboratories Inc
Pullman, WA, USA, www.selinc.com

Science Applications International Corp
San Diego, CA, USA, www.saic.com

Scipar Inc
Williamsville, NY, USA, www.scipar.com

SEADS Solar
Harrington, ME, USA,
www.seadsoftruth.webs.com

Sealcon
Centennial, CO, USA, www.sealconusa.com

Search Hydro Ltd
Castle Douglas, UK, 44-1644-450-670

Seawater Greenhouse Ltd
London, UK,
www.seawatergreenhouse.com

Semikron Inc
Hudson, NH, USA, www.semikron.com

SENER
Tres Cantos, Madrid, Spain, www.sener.es

Sensor Developments Inc
Lake Orion, MI, USA, www.sendev.com

Shoals Technologies Group
1400 Shoals Way, Portland, TN 37148 USA, TEL: 1-615-451-1400, sales@shoals.com, www.shoals.com
Manufactures balance of systems solutions. Through innovation and diversification, the company has grown exponentially since its founding in 1996. Maintains a diverse portfolio of PV balance of systems products, including, combiner/re-combiner boxes, disconnecting combiner boxes, custom harnessing solutions, junction boxes, PV wire, in-line fuses, racking and PV monitoring solutions.

SIEB & MEYER AG
Lueneburg, Germany, www.sieb-meyer.com

Siemens Energy, Power Generation
Orlando, FL, USA,
www.usa.siemens.com/energy

Siemens Industry Inc, Solutions Automation and Drive Technologies
Hauppauge, NY, USA,
www.sea.siemens.com

Siemens Wind Power A/S
Brande, Denmark,
www.siemens.com/windpower

Siempelkamp Maschinen-und Anlagenbau GmbH & Co KG
Krefeld, Germany, www.siempelkamp.com

Sika Corp
Madison Heights, MI, USA,
www.usa.sika.com
Offers products and solutions to the wind turbine industry from the foundations of the turbine to fabrication of the blades.
See ad page 25, 39

Silk Road Solar Africa
Seattle, WA, USA,
www.silkroadsolarafrica.com

SimTech Simulation Technology
Graz, Austria, www.simtechnology.com

Sir Robert McAlpine Ltd
Hemel Hempstead, Herts, UK,
www.sir-robert-mcalpine.com

Slovak University of Technology Bratislava
Bratislava, Slovak Republic, www.stuba.sk

SMA America LLC
Rocklin, CA, USA, www.sma-america.com

Solabat SL
Valencia, Spain, www.solabat.com

Solairgen
Dahlonega, GA, USA, www.solairgen.com

The Solar BiZ
Glenwood, NM, USA, www.thesolarbiz.com

Solar Bob Ltd
Rarotonga, Cook Islands, 682-55063

Solar Clam-P
Philadelphia, PA, USA,
www.solarclam-p.com

Solar Consultants Ltd
Edinburgh, UK,
www.linkedin.com/in/igarner

Solar Consulting Services - SCS
Colebrook, NH, USA,
www.solarconsultingservices.com

Solar Design Associates LLC
Harvard, MA, USA, www.solardesign.com

The Solar Design Co
Machynlleth, Powys, UK,
www.solardesign.co.uk

SolarDock
Wilmington, DE, USA, solardock.com

Solaredge Technologies
3347 Gateway Blvd, Fremont, CA 94538 USA, TEL: 1-877-360-5292, infona@solaredge.com, www.solaredge.us
Provides an end-to-end distributed solar power harvesting and PV monitoring solution, maximising the power generation of residential, commercial and large-scale PV system installations by up to 25%.

Solar Electric Power Co - SEPCO
Stuart, FL, USA, www.sepco-solarlighting.com

Solar Electric Specialists Ltd
Canterbury, New Zealand, www.gosolar.co.nz

Solar Energy Advocacy
Kampala, Uganda, www.bidnetwork.org/en/member/ssengoobaismail

The Solar Energy Society - UK-ISES
Abingdon, UK, www.uk-ises.org

Solarexpo
Belluno, Italy, www.solarexpo.com

SolarFlairLighting.com
Sagamore Beach, MA, USA, www.solarflairlighting.com

Solar FlexRack
Youngstown, OH, USA, www.solarflexrack.com

SOLARHOT
Raleigh, NC, USA, www.solarhot.com

Solar Illuminations
Ft Myers, FL, USA, www.solarilluminations.com

SolarInsure Inc
Costa Mesa, CA, USA, www.solarinsure.com

Solaris Energy Systems
Macroom, Co Cork, Ireland, www.solaris-energy.com

Solarnetix Inc
Toronto, ON, Canada, www.solarnetix.com

SolarOne Solutions Inc
Needham, MA, USA, www.solarone.net

Solar Pathfinder
Linden, TN, USA, www.solarpathfinder.com

Solar Pro Mexico
Merida, Yucatan, Mexico, www.solarpro.com.mx

Solar Promotion International GmbH
Pforzheim, Germany, www.intersolar.us
Produces the exhibition and conference, Intersolar North America, that takes place annually in San Francisco's Moscone Center and has developed into the premier platform for the solar industry in North America. The exhibition focuses on the areas of photovoltaics, PV production technologies, energy storage and solar thermal technologies.
See ad page 43

SolarRoofs.com
Carmichael, CA, USA, www.solarroofs.com

SolarShop
Basingstoke, Hampshire, UK, www.solarshop.co.uk

Solar Supplies UK Ltd
Nottingham, UK, www.solarsuppliesuk.co.uk

Solar Systems Australia
Gaven, QLD, Australia, www.solarsystemsaustralia.com.au

Solar Tracking by SolaRichard
Tacoma, WA, USA, www.solarrichard.com

Solartronic SA de CV
Cuernavaca, Morelos, Mexico, www.solartronic.com

Solar Turbines
San Diego, CA, USA, www.solarturbines.com

Solar UK Ltd
Northiam, East Sussex, UK, www.solaruk.net

Solar Water Technologies
Fredericksburg, TX, USA, www.solarwater.com

Solcan
London, ON, Canada, www.solcan.com

SolData Instruments
Silkeborg, Denmark, www.soldata.dk

Solectria Renewables LLC
Lawrence, MA, USA, www.solectria.com

Solera Sustainable Energies Co Ltd
Pickering, ON, Canada, www.soleraenergies.com

Sol Inc
Palm City, FL, USA, www.solarlighting.com

Solmetric Corp
Sebastopol, CA, USA, www.solmetric.com

SOLON
Tucson, AZ, USA, www.solon.com

Sonnergy Ltd
Abingdon, UK, www.sonnergy.com

SOURIAU
York, PA, USA, www.souriau-industrial.com

Southwest Research Institute
San Antonio, TX, USA, www.swri.org

Spilling Energie Systeme GmbH
Hamburg, Germany, www.spilling.de

S-Products Inc
Fairfield, CT, USA, www.s-products.com

Sputnik Engineering AG (SolarMax)
Biel, Switzerland, www.solarmax.com
Manufactures grid-connected solar inverters. Under the name SolarMax, the company has developed, produced and sold inverters for more than 20 years for every system, from photovoltaic plants on single-family homes whose kilowatt output is modest, to the solar power plants whose output is measured in megawatts.
See ad page 89

SPX Bolting Systems
Pasadena, TX, USA, www.spxboltingsystems.com

Square Two Lubrication Ltd/Memolub HPS Lubricators
Shropshire, UK, www.s2lube.com

SSB Wind Systems GmbH & Co KG
Salzbergen, Germany, www.ssbwindsystems.de

SSS Clutch Co Inc
New Castle, DE, USA, www.sssclutch.com

Standard Bank
Johannesburg, South Africa, www.standardbank.com

Walter Stauffenberg GmbH & Co KG
Werdohl, Germany, www.stauff.com

Michael Stavy Energy Economist
Chicago, IL, USA, www.michaelstavy.com

STEJASA Agregados Industriales SA
Madrid, Spain, www.stejasa.es

Stellar Sun
Little Rock, AR, USA, www.stellarsun.com

Steritool Inc
Jacksonville, FL, USA, www.steritool.com

Stichting Bakens Verzet
Wieringerwerf, The Netherlands, www.flowman.nl

Stork Turbo Blading
Ithaca, NY, USA, www.he-machinery.com

Structural Integrity Associates Inc
San Jose, CA, USA, www.structint.com

Studer Innotec SA
Sion, Switzerland, www.studer-innotec.com

Suleyman Demirel Universitesi
Isparta, Turkey, www.unienerji.com

Sulzer Pumps Ltd
Winterthur, Switzerland, www.sulzer.com

Sundance Solar Designs
Olathe, CO, USA,
www.sundancesolardesigns.com

Sunera Distribution Pte Ltd
Singapore, www.suneradistribution.com

Sun King Inc
Kahului, HI, USA, www.sunkinghawaii.com

SunPower-Tenesol
La Tour de Salvagny, France,
www.sunpowercorp.com

Sunrnr of Virginia Inc
Port Republic, VA, USA, www.sunrnr.com

Sunspun Enterprises Pty Ltd
Windsor, VIC, Australia, www.sunspun.net

Superluming Co Ltd
Shenzhen, Guangdong, China,
www.superluming.com

Super Radiator Coils
Chaska, MN, USA,
www.superradiatorcoils.com

Superwind GmbH
Bruehl, Germany, www.superwind.com

Swedish Bioenergy Association
Stockholm, Sweden, www.svebio.se

SymCom Inc
Rapid City, SD, USA, www.symcom.com

Symmetron Electronic Applications
Gerakas, Attiki, Greece, www.symmetron.gr

System One
Pittsburgh, PA, USA,
www.systemoneservices.com

T4 Sustainability Ltd
Derbyshire, UK, www.t4sltd.co.uk

Tamura Corp
Escondido, CA, USA, www.tamuracorp.com

Tank Connection Affiliate Group
Parsons, KS, USA,
www.tankconnection.com

Tanzania Renewable Energy Association - TAREA
Dar Es Salaam, Tanzania, www.tarea-tz.org

Targray Technology International Inc
Kirkland, QC, Canada, www.targray.com

Tatsoft
Houston, TX, USA, www.tatsoft.com

Taylor Keogh Communications
London, UK, www.taylorkeogh.com

Technidea Corp
Escondido, CA, USA, www.ziplevel.com

TechnoCentre éolien
Gaspe, QC, Canada, www.eolien.qc.ca

Technological Educational Institute of Crete
Chania, Crete, Greece,
www.chania.teicrete.gr

Techno Sun SLU
Valencia, Spain, www.technosun.com

Tech Products Inc
Staten Island, NY, USA,
www.techproducts.com

Telepower Australia
Rowville, VIC, Australia,
www.telepower.com.au

Tensar International Ltd
Blackburn, UK, www.tensar.co.uk

Terrasol
Windhoek, Namibia, 264-61-239454

TESEO SpA
Druento, Italy, www.teseo.net

Thaker SimTech LLC
Canaan, NH, USA, www.thakerllc.com

Thermafin Manufacturing
Jacksonville, FL, USA, www.thermafin.com

Third Sun Solar and Wind Power Ltd
Athens, OH, USA, www.thirdsunsolar.com

Thorne International Boiler Services Ltd
Wolverhampton, UK, www.tibsltd.com

Timber Wolf LLC
Charlotte, NC, USA,
www.timberwolfhandcleaner.com

Titan Tracker
Toledo, Spain, www.titantracker.es

Tom Jardine
Worcester, UK, 44-1886-830-085

Torresol Energy
Tres Cantos, Madrid, Spain,
www.torresolenergy.com

Total Wind A/S
Brande, Denmark, www.totalwind.com

Tribco Inc
Cleveland, OH, USA, www.tribco.com

Trojan Battery Co
Santa Fe Spring, CA, USA,
www.trojanbatteryre.com

TUF TUG Products
Moraine, OH, USA, www.tuf-tug.com

Turbine Controls Ltd
Leicester, UK, www.tcluk.net

Twin City Fan & Blower
Minneapolis, MN, USA, www.tcf.com

TWR Lighting Inc
Houston, TX, USA, www.twrlighting.com

UL Underwriters Laboratories
Northbrook, IL, USA, www.ul.com
Offers manufacturers in the renewable energy businesses a combination of technical and regulatory expertise that will help them through the certification process in the most effective way possible.
See ad page 27

UNEX Scambio Termico Srl
Bussolengo, (VR), Italy, www.unexsrl.com

Unirac Inc
Albuquerque, NM, USA, www.unirac.com
Manufactures a range of mounting structures for PV arrays with industry-leading technology and a breadth of product solutions and services designed to meet the needs of any type of solar installation.
See ad page CV2

Universidad Autonoma Metropolitana-Iztapalapa - UAMI
Iztapalapa, Mexico, www.izt.uam.mx

University of Central Lancashire
Lancashire, UK, www.uclan.ac.uk

University of Valladolid - UVA
Valladolid, Spain, www.uva.es/renova

US Battery
Corona, CA, USA, www.usbattery.com

UT99 AG Oil Mist Eliminators
Andelfingen, Zürich, Switzerland, www.ut99.ch/en

Vaisala
Louisville, CO, USA, www.vaisala.com/energy

Valentin Software (Dr Valentin EnergieSoftware GmbH)
Berlin, Germany, www.valentin.de

Valentin Software Inc
31915 Rancho California Rd, Suite 200-285, Temecula, CA 92591 USA, TEL: 1-858-777-5526, info@valentin-software.com, www.valentin-software.com
Develops solar PV, thermal design, and heat pumps simulation and sales software for more than 20 years.

E Van Wingen NV
Evergem, Belgium, www.vanwingen.be

Varmeco GmbH & Co KG
Kaufbeuren, Bayern, Germany, www.varmeco.de

Vector Systems Inc
McKinney, TX, USA, www.vectorsystems-usa.com

VendorAZ
Lahore, Pakistan, www.vendoraz.com

Venture Mfg Co
Dayton, OH, USA, www.venturemfgco.com

Veolia Environmental Services Plc
London, UK, www.veoliaenvironmentalservices.co.uk

Verdant Power Inc
New York, NY, USA, www.verdantpower.com

Vestas Wind Systems A/S
Randers, Denmark, www.vestas.com

Viking Equipment Finance
Minneapolis, MN, USA, www.vikingequipmentfinance.com

Vireo Energy Financial
Malibu, CA, USA, www.vireoenergy.com

Virtus Energy Research Associates
Austin, TX, USA, www.vera.com

Voith Turbo BHS Getriebe GmbH
Sonthofen, Germany, www.bhs-getriebe.de

Voith Turbo GmbH & Co KG
Voithstr 1, Crailsheim 74564 Germany, TEL: 49-7951-32-0, industry@voith.com, www.voith.com
Supplies variable-speed drives, variable-speed wind turbine gearbox WinDrive, fluid couplings, torque converters, turbo gear units, highly felxible couplings, hydraulic systems, Hirth couplings, torque-limiting couplings and universal joint shafts.

Vooner FloGard Corp
4729 Stockholm Ct, Charlotte, NC 28273 USA, TEL: 1-704-552-9314, info@vooner.com, www.vooner.com
Supplies cone port liquid ring vacuum pumps in 316L stainless steel for geothermal power plants to extract noncondensable gases. Performance tests are according to HEI specifications.

VTX Solutions
Singapore, www.vtxsolutions.webs.com

Warren & Baerg Manufacturing Inc
Dinuba, CA, USA, www.warrenbaerg.com

Wasserkraft Volk AG - WKV
Gutach, Germany, www.wkv-ag.com

Water Recycle Group Australia Pty Ltd
Canberra, ACT, Australia, www.waterrecycle.com.au/hydro.htm

Water Weights Inc
Montclair, CA, USA, www.waterweightsinc.com

Waterwheel Factory
Franklin, NC, USA, www.waterwheelfactory.com

WA Vachon & Associates Inc
Manchester, MA, USA, 1-978-526-4315

Wave Dragon ApS
Copenhagen N, Denmark, www.wavedragon.net

Wavelength Electronics Inc
Bozeman, MT, USA, www.teamwavelength.com

WEIMA America Inc
Ft Mill, SC, USA, www.weimaamerica.com

Weir American Hydro
York, PA, USA, www.weirpowerindustrial.com

The Westex Group
Rockville, MD, USA, www.westexgroup.com

West Pomerenian University of Technology
Szczecin, Poland, www.zut.edu.pl

West Salem Machinery Co
Salem, OR, USA, www.westsalem.com

White Design Associates Ltd
Bristol, UK, www.white-design.com

Willett and Son Bristol Ltd
Bristol, UK, 44-1179-262-231

Windbrokers Europe BV
Barneveld, The Netherlands, www.windbrokers.com

Windfair
Hamburg, Germany, www.windfair.net

WindGuard North America Inc
Springfield, VA, USA, www.windguard.de/english

Wind Prospect Ltd
Bristol, UK, www.windprospect.com

Wind Simplicity Inc
Toronto, ON, Canada, www.windsimplicity.ca

WINDSL Ltd
Migdal Ha'Emek, Israel, www.wind-sl.com

Windurance
Coraopolis, PA, USA, www.windurance.com

WIP-Munich
München, Germany, www.wip-munich.de
Offers a range of services covering all fields of renewable energy technologies.
See ad page 73

Wolf Material Handling Systems
Elk River, MN, USA, www.wolfmhs.com

Write_on
Camberley, UK, www.write-on.co.uk

Yanmar America
Adairsville, GA, USA, us.yanmar.com

Zeeco Inc
Broken Arrow, OK, USA, www.zeeco.com

ZF Wind Power Antwerpen NV
Lommel, Belgium, www.zf.com/windpower

Ziehl-Abegg AG
Künzelsau, Germany, www.ziehl-abegg.com

Z-LASER Optoelektronik GmbH
Freiburg, Germany, www.z-laser.com

COMPANIES BY COUNTRY/STATE

Algeria
CRTSE - Semiconductor Technology for Energetic

Argentina
BGF Europe SA
Carlos Bertschi Srl
L&R Ingenieria

Australia
Edwards Hot Water
Enertech Solar
Going Solar
Kyocera Solar Pty Ltd
Platypus Power
Solar Systems Australia
Sunspun Enterprises Pty Ltd
Telepower Australia
Water Recycle Group Australia Pty Ltd

Austria
ANDRITZ AG
ELIN Motoren GmbH
Glaunach GmbH
GUGLER Water Turbines GmbH
Pöttinger Entsorgungstechnik GmbH & Co KG
SimTech Simulation Technology

Barbados
Clarke Energy Associates

Belgium
3E
Baltimore Aircoil International NV - BAC
CEESE-ULB
Chemviron Carbon
Defitec SPRL
E Van Wingen NV
European Small Hydropower Association - ESHA
ExxonMobil
FLiDAR
Metrologie et Gestion d'Environnement - MGE
ZF Wind Power Antwerpen NV

Bulgaria
National Biomass Association - NBA

Canada
Agricultural Technology Centre
Asian Phoenix Resources Ltd
Blackline Power
BWD Turbines Ltd
canadian association for renewable energies (we c.a.r.e.)
Day4 Energy Inc
Dependable Turbines Ltd
DRIE-D Americas
Ecostrat and General Biofuel
Eneco Systems Inc
Energy Recovery Solution
EnerWorks Inc
Enviro - Energy Technologies Inc
ERLPhase Power Technologies
Fronius Canada Ltd
GI Garrad Hassan North America
Global Training Solutions Inc
GlobVision Inc
hvGrid-tech Inc
IRT Integrated Rectifier Technologies Inc
Manitoba HVDC Research Centre
Marcel Equipment Ltd
Maryn International Ltd
Muis Controls Ltd
NATCOM
Odotech Inc
Onsite hv Solutions Americas Inc
OPAL-RT Technologies
PanGlobal Training Systems Ltd
POSjoman Hydrotech Consulting
Rolls Battery Engineering
SAGE Energy Inc
Solarnetix Inc
Solcan
Solera Sustainable Energies Co Ltd
Targray Technology International Inc
TechnoCentre éolien
Wind Simplicity Inc

China
Akzo Nobel Performance Coatings Co Ltd
AMWEI Thermistor
Fujian Morstar New-Energy Tec LLC
Superluming Co Ltd

Cook Islands
Solar Bob Ltd

Curaçao
Fundashon Antiyano Pa Energia - FAPE

Cyprus
Proplan Ltd
Savco Solar Energy

Denmark
A2SEA A/S
Danish Wind Energy Group
DUWET Danish University Wind Energy Training
EC Power A/S
Global Wind Power A/S
Justsen Energiteknik A/S
LFG Consult
Mammoet Wind A/S
Navigant's BTM Consult
NIRAS A/S
Novator Advanced Technology Consulting
Orbital AS
Ramboll
Siemens Wind Power A/S
SolData Instruments
Total Wind A/S
Vestas Wind Systems A/S
Wave Dragon ApS

Finland
ABB Oy Motors and Generators
BMH Technology Oy
HL Insulation Ltd
International Peat Society
Motiva Oy
Powernet Oy

France
Construire en Mélèze
Deprofundis SARL
Etudes Chimiques et Physiques - ECP
Leroy Somer
Mersen France Amiens
Mobasolar
PXL Seals
RES Mediterranean
Robin Sun
SunPower-Tenesol

Germany
Almeco Solar
Baumgarte Boiler Systems GmbH
BayWa re Rotor Service GmbH
Börger GmbH
Bosch Industriekessel GmbH
Bosch Rexroth Monitoring Systems GmbH
Centrosolar AG
cmc Instruments GmbH
Contec GmbH Industrieausruestungen
ContiTech AG
DEWI GmbH - a UL Co
DWC DecRen Water Consult
EcofinConcept GmbH
ETW Energietechnik GmbH
Freesen and Partner GmbH
GET ENERGY Gerhard Brandel MA
Haas Recycling GmbH
HAWE Hydraulik SE
Herbold Meckesheim GmbH
HWP-hullmann Willkomm & Partner - GbR
Ideematec Deutschland GmbH
IMO Group of Cos
IMS Ingenieurgesellschaft GmbH
INENSUS GmbH
INFRASTRUKTUR & UMWELT Professor Böhm und Partner
Ing-Buero fuer Alternative Antriebe und Erneuerbare Energien
INPRO Solar Systems
International Solar Energy Society - ISES
JENOPTIK I Lasers & Material Processing
Juwi Holding AG
KACO new energy GmbH
LAP GmbH Laser Applikationen
LEINE LINDE SYSTEMS GmbH
Lloyd Dynamowerke GmbH & Co KG
MAN Diesel & Turbo SE
MTS Sensor Technologie GmbH & Co KG
MTU Friedrichshafen GmbH
OELCHECK GmbH
OILES Deutschland GmbH
Optosolar GmbH
Pallmann Maschinenfabrik GmbH & Co KG
Phoenix Solar AG
Power Conversion
PV-plan
Renewables for Development - RforD
RESOL - Elektronische Regelungen GmbH
Sander + Partner
SAXOVENT Ökologische Investments GmbH & Co KG
SIEB & MEYER AG
Siempelkamp Maschinen-und Anlagenbau GmbH & Co KG
Solar Promotion International GmbH
Spilling Energie Systeme GmbH
SSB Wind Systems GmbH & Co KG
Superwind GmbH
Valentin Software (Dr Valentin EnergieSoftware GmbH)
Varmeco GmbH & Co KG
Voith Turbo BHS Getriebe GmbH
Voith Turbo GmbH & Co KG
Walter Stauffenberg GmbH & Co KG
Wasserkraft Volk AG - WKV
Windfair
WIP-Munich
Ziehl-Abegg AG
Z-LASER Optoelektronik GmbH

Greece
Electric Power Production From Magnetic Tapes
Symmetron Electronic Applications
Technological Educational Institute of Crete

India
Agni Solar Systems Pvt Ltd
Auroville Energy Products
Combustion Technologies Pvt Ltd
DEE Development Engineers Ltd
e-con Systems India Pvt Ltd
Geospec Enterprises
Indiana Gratings Pvt Ltd
Kaushal Solar Equipments (P) Ltd
Malaviya Solar Energy Consultancy

Indonesia
PT Gerbang Multindo Nusantara
PT Sundaya Indonesia

Ireland
RR Projects
Solaris Energy Systems

Israel
WINDSL Ltd

Italy
Advanced Engineering Srl
Ansaldo Caldaie SpA
Bono Energia SpA
Delta Ohm
Elettrorava SpA
ETA Florence Renewable Energies
InterEnergy Srl
Orengine International
Progetto Energia Srl
Solarexpo
TESEO SpA
UNEX Scambio Termico Srl

Japan
Eko Instruments Co Ltd
HIOKI EE Corp

Kenya
Pipal Ltd

Korea
Hyundai Heavy Industries

Lithuania
Lithuanian Energy Institute - LEI

Malaysia
Advanced Solar Voltaic Sdn Bhd

Malta
AquaBioTech Group

Mauritania
Energies Services - ENERSER

Mexico
CFE
Instituto de Energías Renovables UNAM
M & Architects Consulting Environment
Solar Pro Mexico
Solartronic SA de CV
Universidad Autonoma Metropolitana-Iztapalapa - UAMI

Morocco
Clean Energies
Sahara Wind Inc

Namibia
Terrasol

New Zealand
Prowind Energy Ltd
R&G Energy Systems
Solar Electric Specialists Ltd

Norway
Aquastructures
Instrumenttjenesten A/S - ITAS
ISES Norway - Norsk solenergiforening
Norconsult AS

Pakistan
VendorAZ

Poland
DFME Sp zoo
West Pomerenian University of Technology

Portugal
EFACEC Sistemas de Electrónica SA

Romania
Romanian Energy Regulatory Authority - ANRE

Russian Federation
Inset

Singapore
Boerger Pumps Asia Pte Ltd
Kyoto Energy Pte Ltd
Sunera Distribution Pte Ltd
VTX Solutions

Slovak Republic
Slovak University of Technology Bratislava

Slovenia
Javno Podjetje Energetika Ljubljana doo
Kolektor Magma doo

South Africa
Energy & Development Group - EDG
Standard Bank

Spain
Acpsol Energia Solar SL
Aguidrovert Solar SL - Energia Termica Fotovoltaica Y Biomasa
Centro de Estudios de la Energia Solar - Censolar
IK4-Tekniker Research Centre
Ingenieria de Equipos de Control SL - INDECON
Instituto Tecnológico de Canarias - ITC
Lapesa Grupo Empresarial SL - LAPESA
SENER
Solabat SL
STEJASA Agregados Industriales SA
Techno Sun SLU
Titan Tracker
Torresol Energy
University of Valladolid - UVA

Sweden
GenerPro AB
Ingvar Ingrids AB
Opsis AB
PitchWind Systems AB
Presona AB
Swedish Bioenergy Association

Switzerland
ASP AG
CSD Ingenieure AG
Dynatex SA
E4tech
Ecoling Partner AG
Meggitt Sensing Systems
METHASYN EG
Minder Energy Consulting
Multi-Contact AG
PVsyst SA
Sputnik Engineering AG (SolarMax)
Studer Innotec SA
Sulzer Pumps Ltd
UT99 AG Oil Mist Eliminators

Taiwan
Motech Industries Inc
PVinsights

Tanzania
Tanzania Renewable Energy Association - TAREA

Thailand
APT Consulting Group Co Ltd
Organics Asia Co Ltd

The Netherlands
BEAR Architecten BV
Eijkelkamp Agrisearch Equipment
EMGroup BV
Eologica
Esdec (ClickFit)
GustoMSC
KARA Energy Systems BV
Microhydropower.net
PRé Consultants BV
Rijkert Knoppers Tekstproducties
Stichting Bakens Verzet
Windbrokers Europe BV

Tunisia
Abou Walid Group

Turkey
Atilgan Danismanlik Energy
Near East University
Suleyman Demirel Universitesi

Uganda
Solar Energy Advocacy

United Kingdom
20|20 Business Insight
Alpine Components
Ampair
Ansys UK Ltd
BGB Engineering Ltd
Bioenergy Technology Ltd
Bowman Power Group Ltd
Brandis Ltd
Bright Management Associates Ltd
British Antarctic Survey
British Green Ltd
BSRIA Ltd
Campbell Scientific Ltd
Castrol Lubricants
Collinson Plc
Combustion Energy and Steam Specialists Ltd - CESS
Community Windpower Ltd
Conversion And Resource Evaluation Ltd
CPL Energy Systems
CPS Environmental
Cressall Resistors
Darley & Associates
DEIF (UK) Ltd
Dresser-Rand Co Ltd
Dulas Ltd
E4tech
EA Technology (Europe) Ltd
Eclectic Energy Ltd
Energy Environmental Technical Services Ltd - EETS
Energy Institute
Energy4All Ltd
EscoVale Consultancy Services
ESS Ecology
Eurobalers Ltd
FCC Environment
Fish Guidance Systems Ltd
Flexitallic Ltd
Gas Compressors Ltd
GB-Sol Ltd
Green Orkney Tours
icenta Controls Ltd
Impact Technical Services Ltd
Inspecteam Hydro
International Paint Ltd
James Troop and Co Ltd
JDR
Jet-Vac Systems Ltd
JWG Consulting Ltd
Kelburn Engineering
Marlec Engineering Co Ltd
Matan International Group Ltd
Met Office
Newmills Engineering
Nortek UK
North Energy Associates Ltd
Nuergy Biomass
O'Leary Public Relations
Omex Environmental Ltd
Orbital2 Ltd
Osiris Hydrographic and Geophysical Projects Ltd
Parsons Brinckerhoff
PES UK Ltd
PV Insider
Red Acoustics Ltd
Rely (UK) Precision Castings
Renewable Energy Corp Ltd
Rotork Plc
SAC Boiler Plant Ltd

Saint-Gobain Ltd
Saxlund International Ltd
Schenck Process
Schools and Homes Energy Education Project/Solar-Active
Search Hydro Ltd
Seawater Greenhouse Ltd
Sir Robert McAlpine Ltd
Solar Consultants Ltd
Solar Supplies UK Ltd
Solar UK Ltd
SolarShop
Sonnergy Ltd
Square Two Lubrication Ltd/ Memolub HPS Lubricators
T4 Sustainability Ltd
Taylor Keogh Communications
Tensar International Ltd
The Black Emerald Group
The European Marine Energy Centre (EMEC) Ltd
The Green Electrician Group
The Solar Design Co
The Solar Energy Society - UK-ISES
Thorne International Boiler Services Ltd
Tom Jardine
Turbine Controls Ltd
University of Central Lancashire
Veolia Environmental Services Plc
White Design Associates Ltd
Willett and Son Bristol Ltd
Wind Prospect Ltd
Write_on

United States

Alabama
Industrial Training Consultants Inc
Process Equipment - Barron Industries

Arizona
AC Tool Supply
Canyonwest Cases LLC
Centrosolar America Inc
EV Solar Products Inc
Integrated Solar LLC
Power-One Inc
SOLON

Arkansas
Lee Enterprises Alternative & Renewable Fuels Consulting Inc
PRM Energy Systems Inc - PRME
Stellar Sun

California
Advanced Energy
AIXTRON Inc
Alturdyne
Auxin Solar LLC
Biomass Briquette Systems LLC
Blue Sky Energy
Bravo Communications Inc
Bureau Veritas North America Inc
CalRecovery Inc
Canadian Solar USA Inc
Chint Power Systems America
CivicSolar
Energy Technology Advisors
Envect Inc
EOPLLY USA Inc
EXOSUN
Free Hot Water
Fullriver Battery USA
GCube Insurance Services Inc
Global Wedge Inc
Greenpower Capital
Heliodyne Inc
INNOTRONIKS
International Association of Plumbing and Mechanical Officials
InterPhases Solar Inc
KACO new energy Inc
LumaSense Technologies Inc
Mobasolar USA
Moisttech
OAI
OpCon Technologies Inc
Orion Solar Racking
P2
Perpetual Energy Systems
Quality Two-Way Radios
Quick Mount PV
Raytek Corp
ReneSola
Rich Hessler Business Development
Ronan Engineering Co
Science Applications International Corp
SMA America LLC
Solaredge Technologies
SolarInsure Inc
SolarRoofs.com
Solar Turbines
Solmetric Corp
Structural Integrity Associates Inc
Tamura Corp
Technidea Corp
Trojan Battery Co
US Battery
Vireo Energy Financial
Warren & Baerg Manufacturing Inc
Water Weights Inc

Colorado
Abraham Solar Equipment
Atlas Copco Construction Mining Technique USA LLC
Burnham & Sun
Conergy Inc
Disgen Holdings
Golden Eagle Technologies LLC
Harris Group Inc
Hi-Tech Controls
Lightning Eliminators & Consultants Inc
MWH Global
PA Consulting Group
PowerPod Corp
PV Measurements Inc
Quanta Power Generation
RES Americas
Sealcon
Sundance Solar Designs
Vaisala

Connecticut
Croll-Reynolds Engineering Co Inc
Dark Field Technologies Inc
Elan Technical Corp
Enertegic
Forecast International
The Hartford Financial Services Group Inc
Henkel Corp
Kugler of America Ltd
Murphy International Development LLC
National Conveyors Co Inc
OFS
Pratt & Whitney Power Systems
Precision Combustion Inc
S-Products Inc

Delaware
SolarDock
SSS Clutch Co Inc

District of Columbia
American Wind Energy Association
Interdevelopment Inc
National Hydropower Association
Navigant

Florida
American Wire Group
ap+m
Cambridge Project Development Inc
DEHN Inc
DeTect Inc
Everglades University
LUDECA Inc
Magnetic Div Global Equipment Mktg Inc
Nextwind
ONE Sothebys International Realty
Siemens Energy, Power Generation
Solar Electric Power Co - SEPCO
Solar Illuminations
Sol Inc
Steritool Inc
Thermafin Manufacturing

Georgia
Cantsink Manufacturing
CH2M HILL
Continental Field Systems Inc
Hurst Boiler & Welding Co Inc
IMERYS
Solairgen
Yanmar America

Hawaii
Sun King Inc

Idaho
Aire Industrial
Openchannelflow
Outotec Energy Products
Recovered Energy Inc

Illinois
Atlas Material Testing Technology
Connexion
The Cool Solutions Co
Duraflex Inc
Dust Control Technology
Fuchs Lubritech
Global Energy Solutions Inc
ITH Engineering Inc
John Crane
Legrand
LINK Tools International (USA) Inc
Nord-Lock Inc
Sargent & Lundy LLC
Michael Stavy Energy Economist
UL Underwriters Laboratories

Indiana
Parker Precision Cooling Systems

Iowa
Airoflex Equipment
Compressor Controls Corp - CCC
Crystal Group Inc
RUD Chain Inc

Kansas
CST Industries
GO Topeka Economic Development
M-E-C Co
Tank Connection Affiliate Group

Kentucky
Bonfiglioli USA
LINAK US Inc
Ronan Measurments

Louisiana
Ampirical Solutions LLC
DIS-TRAN Steel LLC
DIS-TRAN Wood Products LLC

Maine
AEGIS Bearing Protection Rings
Casco Systems LLC
Clyde Bergemann Bachmann Inc
SEADS Solar

Maryland
Antares Group Inc
Aurora Energy Inc
CEM Design Architects
FOSS NIRSystems Inc
GSE Systems Inc
Jonas Inc
Meggitt Sensing Systems
The Westex Group

Massachusetts
A123 Systems
Ameresco Inc
Babcock Power Inc
Battic Door Energy Conservation Products
CDM Smith
Ceres Technology Advisors Inc
Clean Harbors
Comdel Inc
Electroswitch
FLEXcon
HITEC Sensor Solutions Inc
MKS Instruments Inc
Munters Corp
PanelClaw Inc
Phoenix Electric Corp
Psychsoftpc
Solar Design Associates LLC
SolarFlairLighting.com
SolarOne Solutions Inc
Solectria Renewables LLC
WA Vachon & Associates Inc

Michigan
AET - Applied Energy Technologies
BC Renewable Innovations LLC
Currin Corp
Detroit Stoker Co

FlaktWoods
Patriot Solar Group
Power Panel Inc
Sensor Developments Inc
Sika Corp

Minnesota
Aerovent
Alexandria Industries
Blattner Energy
Hamon Deltak Inc
Mortenson Construction
PureTemp LLC
Super Radiator Coils
Twin City Fan & Blower
Viking Equipment Finance
Wolf Material Handling Systems

Mississippi
Hydrasep Inc

Missouri
Burns & McDonnell
BZ Products Inc
EaglePicher Technologies LLC
Lincoln Lubrication Systems

Montana
Wavelength Electronics Inc

Nebraska
Brite Energy Solutions
Cleaver-Brooks Engineered Boiler Systems

Nevada
ElectraTherm Inc

New Hampshire
Boyle Energy Services & Technology
BURNDY
Commonwealth Dynamics Inc
Comptus
Continental Biomass Industries Inc - CBI
Environmental Alternatives Inc
H&L Instruments LLC
RenewableEnergyWorld.com
Semikron Inc
Solar Consulting Services - SCS
Thaker SimTech LLC

New Jersey
AI Technology Inc
ClearDrain
Electronic Drives & Controls
HYTORC
Integrated CHP Systems Corp
Joseph Oat Corp
Nova Electric
PDR Associates (Renewable) Inc

New Mexico
Array Technologies Inc
EMCORE Corp
P4Q
Positive Energy Solar
PPC Solar
The Solar BiZ
Unirac Inc

New York
Atlantis Energy Systems Inc
Conax Technologies
Daikin America Inc
Empire Clean Energy Supply
ETS Energy Store LLC
Gaia Human Capital Consultants
Gibraltar Chimney International
Indium Corp
International Chimney Corp
ITT Industrial Process
Kepco Inc
Lotus Energy Inc
Morrison & Kibbey Ltd
North American Board of Certified Energy Practitioners - NABCEP
Pfannenberg Inc
Puleo Electronics Inc
Scipar Inc
Siemens Industry Inc, Solutions Automation and Drive Technologies
Stork Turbo Blading
Tech Products Inc
Verdant Power Inc

North Carolina
Flowserve Corp
Metso Power
Parker Hannifin
SOLARHOT
Timber Wolf LLC
Vooner FloGard Corp
Waterwheel Factory

Ohio
Allied Moulded Products Inc
Ebner Vyncke
geoAMPS
Hocking County Community Improvement Corp
Hollaender Manufacturing
International Generator Technical Community
International Power Machinery Co
National Electric Coil
Northern State Metals
Process Technology
RBI Solar Inc
Rittal Corp
Solar FlexRack
Third Sun Solar and Wind Power Ltd
Tribco Inc
TUF TUG Products
Venture Mfg Co

Oklahoma
Everest Sciences Inc
PennEnergy Research
Roxtec Inc
Zeeco Inc

Oregon
Highway Products Inc
KEITH Manufacturing Co
West Salem Machinery Co

Pennsylvania
Airfoils Inc
American Crane & Equipment Corp
Aquatech International Corp
Arkema Inc
Bridgestone Associates Ltd
Chromalox
Custom Engineering Co
Eaton
Ellwood City Forge
HYDAC Technology Corp
IntelLiDrives Inc
KCF Technologies
Kingsbury Inc
Morningstar Corp
O'Donnell Consulting Engineers
Para-Coat Technologies Inc
Penn-Union Corp
ProSim Inc
Schutte & Koerting
Solar Clam-P
SOURIAU
System One
Weir American Hydro
Windurance

Rhode Island
Herbold Meckesheim USA
Schneider Electric

South Carolina
Fisher Tank Co
Jeffrey Rader
RJM Associates
WEIMA America Inc

South Dakota
SymCom Inc

Tennessee
AO Smith
Clarage
Heatec Inc
Kemery Co
PHG Energy
Project Risk Ltd
Shoals Technologies Group
Solar Pathfinder

Texas
Breaux Consulting
BRUSH Turbogenerators Inc
Century Elevators
Delta Rigging & Tools
Dresser-Rand
FWT LLC
ImagineSolar
InduSoft Inc
Lubrication Engineers Inc
Maven Power
National Instruments
Neuman & Esser USA Inc
S&B Engineers and Constructors
Solar Water Technologies
Southwest Research Institute
SPX Bolting Systems
Tatsoft
TWR Lighting Inc
Vector Systems Inc
Virtus Energy Research Associates

Vermont
Draker
EcoFasten Solar
Eneco Texas LLC
groSolar
Prudent Living Inc

Virginia
Craft Bearing Co Inc
EcoCorp
EngineerSupply
Sunrnr of Virginia Inc
SunStar Strategic
WindGuard North America Inc

Washington
Blue Leaf Environmental
Canyon Industries Inc
Demand Energy
Diamond Flashlights Inc
Dynamic Systems Inc
Fluke Corp
Jansen Combustion and Boiler Technologies Inc
Milestones Building and Design
NAES Corp
PumpScout
Renewable Energy Technology Group Ltd
Schweitzer Engineering Laboratories Inc
Silk Road Solar Africa
Solar Tracking by SolaRichard

West Virginia
Helmick Corp

Wisconsin
Advanced Optics Inc
Allied Industrial Marketing
CBT Wear Parts Inc
Enerquip LLC
F-Chart Software
Frako Capacitors
Hans von Mangoldt Reactors
In-Place Machining Co Inc
K-Sun Corp
Lake Michigan Wind & Sun Ltd - LMWS
Midwest Renewable Energy Association - MREA
Niagara Worldwide
ORBIS Corp
PLI LLC
Prosonix Corp

Renewable Energy World Calendar July and August 2013

Selected multi-day conferences, expos and events for the Renewable Energy Industry

Clean Energy Expo China (CEEC)
Beijing, China
July 3-5, 2013
Koelnmesse China Co. Ltd.
P. +86/10/6590-7766
E. r.lam@koelnmesse.cn
W. www.koelnmesse.cn

Intersolar North America
San Francisco, CA, USA
July 8-11, 2013
Solar Promotion International GMBH
P. +49 7231 58598-22
W. http://www.intersolar.us/

GeoPower Africa
Dar es Salaam, Tanzania
July 16-17, 2013
GreenPower Conferences
P. +44 (0)20 7099 0600
E. samantha.coleman@greenpowerconferences.com
W. http://www.greenpowerconferences.com/

HydroVision International 2013
Denver, CO, USA
July 23-26, 2013
Pennwell Corporation
P. +1 918 831 9160 or 888 299 8016 (US Only)
E. registration@pennwell.com
W. http://www.hydroevent.com/

The 2013 Pellet Fuels Institute Annual Conference
Ashville, NC, USA
July 28-30, 2013
Pellet Fuels Institute
P. 703 522 6778
E. pfimail@pelletheat.org
W. http://pelletheat.org/events/pfi-annual-conference/

The Renewable Energy Storage Symposium
San Diego, CA, USA
July 31-August 2, 2013
Active Communications International
P. +1 (312) 780-0700
W. http://www.wplgroup.com/aci/conferences/us-ges1-energy-storage.asp

ICOLD 2013
Seattle, WA, USA
August 12-16, 2013
United States Society on Dams
P. 303-628-5430
W. http://icold2013.org

GulfSol 2013
Dubai, UAE
September 3 - 5, 2013
Gattaca Communications
P. + 44 (0) 203 239 6759
E. enquiry@gattacaltd.com
W.: www.gulfsol.com

Electric, Power & Renewable Energy Indonesia 2013
Jakarta, Indonesia
September 4-7, 2013
PT Pamerindo Indonesia
P. +62 21 3162001
E. wiwiek@pamerindo.com
W. www.pamerindo.com

Biomass Pellets Trade and Power
Seoul, South Korea
September 9-10, 2013
Center for Management Technology
P. +65 6346 9218
E. hafizah@cmtsp.com.sg
W. http://www.cmtevents.com/aboutevent.aspx?ev=130929&

Advertiser's Index *Scan the QR code for information on the products and services found in this issue.*

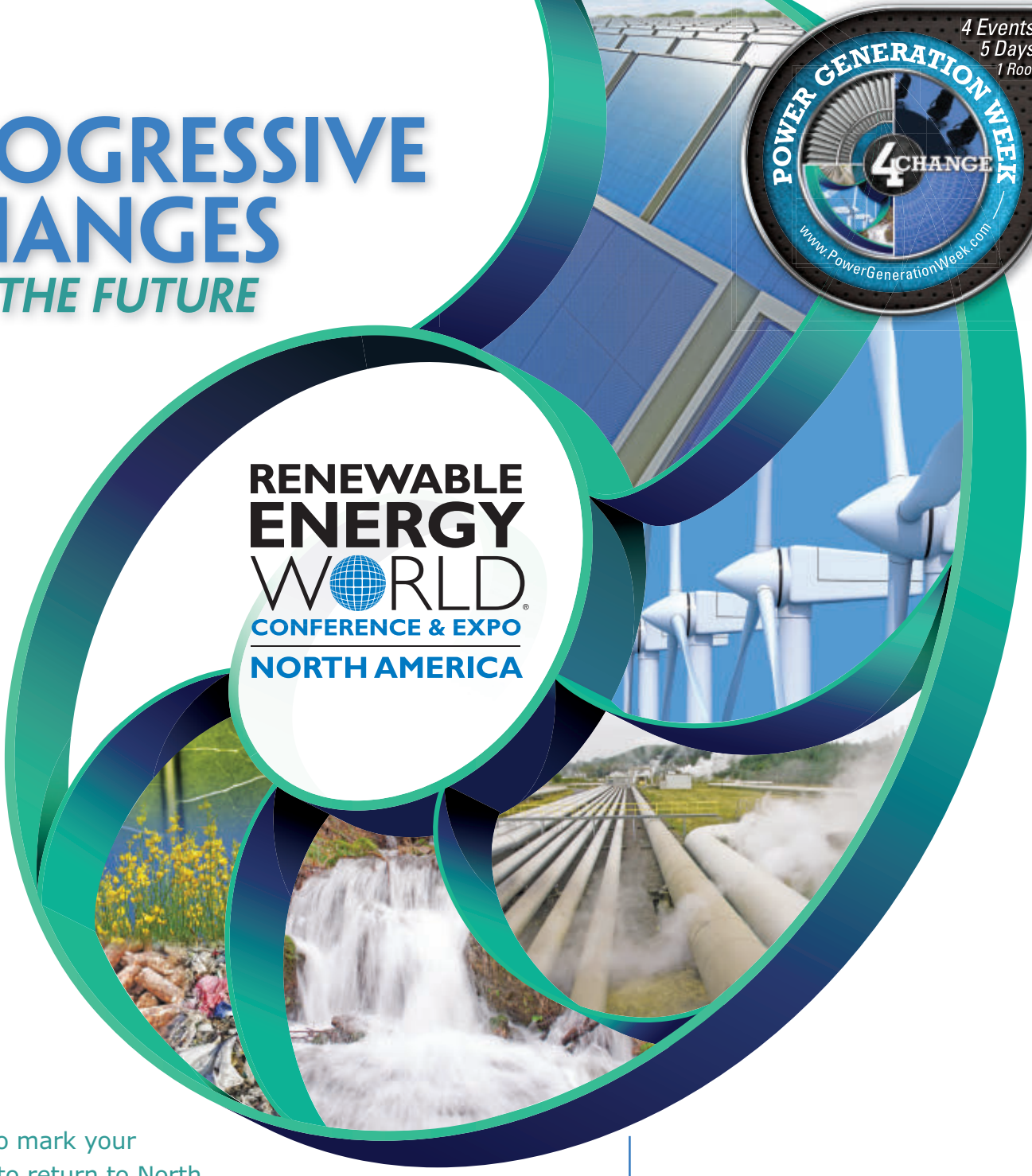
PROGRESSIVE CHANGES
FOR THE FUTURE

4 Events. 5 Days. 1 Roof.

POWER GENERATION WEEK

4CHANGE

www.PowerGenerationWeek.com



RENEWABLE ENERGY WORLD CONFERENCE & EXPO NORTH AMERICA

Be sure to mark your calendar to return to North America's most influential all-renewable event November 12-14 in the Orange County Convention Center – Orlando, FL. Once again, we'll be co-locating with POWER-GEN International – bringing renewable energy to the forefront of the mainstream energy industry.

Nov. 12-14, 2013
Orange County Convention Center
Orlando, FL

Learn more & register @ RenewableEnergyWorld-Events.com

Owned & Produced By: PennWell

Co-located With: POWER-GEN International

Presented By: Renewable Energy World Magazine

Supported By: Power Engineering, Hydro Review, PennEnergy

Media Sponsor: RenewableEnergyWorld.com

NEW THIS YEAR! HydroVision Brasil Is Offering Online Hotel And Conference Registration In Portuguese!

HydroVision® BRASIL

24-26 September 2013

Transamerica Expo Center | São Paulo, Brasil

www.hydrovisionbrasil.com

Early Registration Discount:
TO SAVE R$ 200.00 (US$100*) REGISTER BY 16 August 2013!

CONFERENCE SESSION SPOTLIGHT:

JOIN US – As we delve into the hottest topics and tackle the biggest issues in the Global Hydro Market:

- Hot Topics in Hydro in Latin America
- Ideas in Action! Success Stories at Small- and Medium-Sized Hydro Projects throughout the World
- Tools for Managing Your Business in a Challenging Market
- Hydromechanical & Lifting Equipment: Sharing Lessons Learned & Best Practices
- Overcoming Social and Environmental Challenges during Hydro Development
- Perspectives of Hydro Construction Companies: A Special Roundtable Discussion
- Modernization and Rehabilitation: Improving What We Already Have

For the complete list of conference sessions, visit www.hydrovisionbrasil.com

CO-LOCATED EVENTS:

POWER-GEN BRASIL

Completing POWER-GEN's Global Network which attracts over 70,000 power professionals worldwide, POWER-GEN Brasil futher enhances HydroVision Brasil's conference and exhibition offerings, bringing in exhibitors and decision-makers from the mainstream.

DISTRIBUTECH® Brasil

As transmission and distribution capabilities have become one of Brazil's top energy priorities, the 2nd installment of DistribuTECH Brasil has responded by bringing together the sharpest minds from around the globe to the region to discuss the most relevant innovations, topics and challenges throughout all facets of the industry.

GET COMPLETE ACCESS TO ALL 3 CONFERENCES & EXHIBIT HALLS

For as low as R$ 1,000.00 (US$500*)!

Take advantage of our TOTAL ACCESS PASS Today!

Owned & Produced by: PennWell® DO BRASIL

Host Utility: Furnas

Presented by: HRW Hydro Review Worldwide | HYDRO REVIEW | RENEWABLE ENERGY WORLD MAGAZINE

*The US$ converted rates are approximate and provided as a courtesy. All fees are billed in R$