



DG MONITORSM

Interconnection Update

This update highlights the programs and events shaping DG interconnection.

The Massachusetts DG Collaborative. Amongst the issues being addressed by the Massachusetts Department of Telecommunications and Energy (DTE) is the use of DG as a possible solution to grid congestion. In June 13, 2002, DTE issued an Order requesting comments on four issues: 1) Do current distribution company interconnection standards and procedures in Massachusetts act as a barrier to the installation of DG; 2) Do current distribution company standby service tariffs act as a barrier to the installation of DG; 3) What is the role of DG with respect to the provision of service by MA distribution companies; 4) What other issues are appropriate for

the Department to consider.

After comments were filed, in which a number of commenters stated that a collaborative initiative was not likely to be effective with issues 2 or 3, the Department conducted a public hearing on August 21, 2002. Following this hearing, the Distributed Generation Collaborative was established by the DTE. In Order 02-38-A, dated October 3, 2002, the Collaborative was charged with focusing on issue one and developing interconnection standards, policies, and procedures that would, with DTE approval, be uniformly applicable to all Distribution Companies by the beginning of 2003. The DTE stated that the development of these interconnection standards and practices should take into *(continued on page 3)*

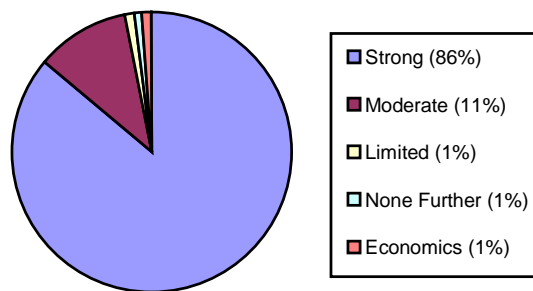
2002 Distributed Generation Survey Results

Throughout 2002, Resource Dynamics Corporation asked the visitors to www.distributed-generation.com to fill out a short survey about DG technologies and applications. These results update the 2001 DG survey (see DG Monitor, Jan-Feb 2001).

As seen in the pie chart to the right, most of the survey respondents were strongly interested in DG (86% claimed strong interest), while 11% claimed moderate interest. Other respondents claimed they had no further interest, were only interested if the economics improve, or had limited interest in DG (1% each). As a consequence, the results are biased towards those with strong interest in DG.

Fuel cells retained their place as the most popular technology, selected by 60 % of respondents.

Interest in Distributed Generation



Microturbines are almost as popular, with 51% of the respondents claiming interest. Reciprocating engines, wind and solar applications each received votes from around 30% of the respondents. Fuel cell hybrids drew significant interest this year (28%), due in part to the growing *(continued on page 4)*

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About the DG Monitor The DG Monitor is a bimonthly publication of the Resource Dynamics Corporation covering the many facets of the emerging Distributed Generation marketplace. Articles both report and interpret the most important items. In addition, the Monitor includes special series on DG technologies, applications, manufacturers, and other issues, providing the reader with a complete picture of these topics over several issues.

Comments or requests for additional information can be addressed to DGMonitor@rdcnet.com, through our website at www.distributed-generation.com, or by contacting Jean Connors at 703/356-1300 x 208.

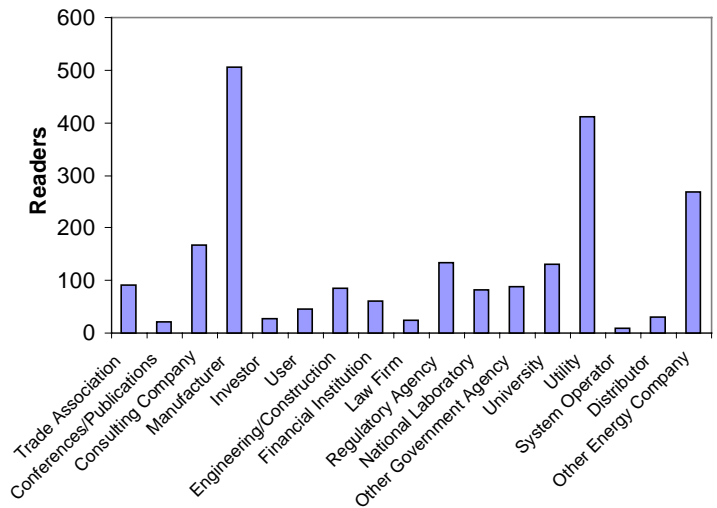
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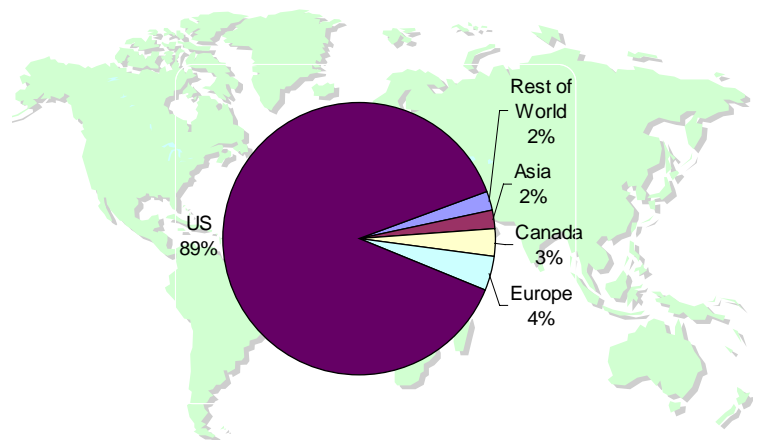
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DG Monitor's Eclectic Readership

As the DG Monitor reaches its 2nd anniversary, we thought you'd like to know what kind of company you are keeping. We have nearly 3,000 subscribers, and more sign up each day. Many copies are forwarded to other colleagues, meaning readership is considerably more than the number of subscriptions. So be sure to send us news and information you would like to share with your colleagues, or any DG related presentations you would like posted within our website's widely-used library.



Many of you are executives or managers. There are also a large number of engineers and other professionals, plus dozens of students exploring DG issues in their thesis or dissertation.



Our readership is predominantly American. This probably reflects both the market and the fact that as an American firm, we meet more of you in the United States. You live in all 50 states, all Canadian provinces, and 46 other countries. We cover the globe, except for Antarctica – any suggestions for filling this gap?

Happy Anniversary DG Monitor! ■

The **Resource Dynamics Corporation (RDC)** creates business solutions that empower clients to compete effectively in changing energy markets. Often, these involve evaluating the role of new technologies. All senior staff have both business and engineering backgrounds, with a distinct focus on strategy implementation. We combine these strengths to create innovative business solutions for energy technologies and markets. **RDC** utilizes an extensive set of tools including proprietary databases and models to develop these solutions.

We develop business solutions in four areas:

- **Distributed Generation**
- **Marketing for Energy Businesses**
- **Strategies for Power Suppliers**
- **Strategies for Energy Purchasers**

RDC has entered its 23rd year. Meeting our clients' needs has always been our top priority and we have consistently delivered outstanding consulting services to enable our clients to reach their goals. Clients include energy companies, consumers, financial institutions, law firms, equipment vendors, trade associations, research organizations, government agencies and international institutions.

For more information, see www.rdcnet.com.

(Update, continued from page 1) consideration the development of simplified, state-wide technical interconnection standards; a state-wide interconnection agreement; standardized interconnection procedures; equipment pre-approval; a time schedule for responding to interconnection applications; a plan to develop and post a generic document describing interconnection procedures; and an administratively efficient dispute resolution process. This Collaborative will not be undertaking other DG issues discussed in the docket such as back-up rates and DG ownership by distribution companies.

The Massachusetts Technology Collaborative (MTC), on behalf of the Renewable Energy Trust, is hosting this distributed generation collaborative forum. The group is facilitated by Raab Associates. So far, the group has met several times in day long meetings. Stakeholders were asked to organize themselves within five interest clusters and to choose representatives. These clusters are: 1) DG providers, 2) electric utilities, 3) customers, 4) government and quasi-government agencies, and 5) public interest groups. The Collaborative's report was originally due on December 16th, at which time the Collaborative filed an Interim Report and requested an extension to file the joint report to the end of February. The request was granted, and the filing date was extended to February 28, 2003.

Meeting summaries, agendas, working documents and other information on work thus far can be accessed at <http://dg.raabassociates.org/> or by entering "02-38" as the docket number on the DTE Enhanced Fileroom.

FERC ANOPR. In their Order, the Massachusetts Department of Telecommunications and Energy requested that the DG Collaborative take into account the Federal Energy Regulatory Commission (FERC) Standardization of Small Generator Interconnection Agreements and Procedures Advance Notice of Proposed Rulemaking (ANOPR), Docket No. RM02-12-000, when developing their proposal.

The FERC process was established on August 16, 2002, when the Commission issued the ANOPR. Most recently, on November 12, 2002, the Commission extended the deadline to file comments on the small generation ANOPR and on the consensus documents to December 20, 2002. Stakeholders who have participated in the

development of the consensus documents were charged with filing statements explaining their various positions on the consensus documents on or before December 9, 2002. The Small Generator Interconnection Coalition Consensus Interconnection Agreement and Application were filed on November 19, 2002. These documents can be accessed at <http://www.ferc.gov/ferris.htm>.

CADER Conference. CADER's (California Alliance for Distributed Energy Resources) 4th Annual International Symposium on Distributed Energy Resources was held on November 10-12, 2002 in San Diego, California. This year's conference focus was "Networking DG - Connectivity and Market Access"; this theme reflects a shift in the market from discussing general DG technology and applications into the details of how to implement and install DG.

Over 250 participants discussed the manner in which, and the extent to which, many interconnection barriers have been resolved during the last year. This includes progress on the IEEE 1547 standard, California's Rule 21, and Texas's Interconnection Guidebook. Day one of the conference explored a consumer-driven vision of DG and Combined Heat and Power (CHP) services that consumers want, and how the grid and connectivity innovations are helping to achieve this vision. The second day focused on financing and its importance to implementing this consumer driven vision.

During the two days, speakers and participants began a new debate on whether regulatory issues might be the next key barrier to address in implementing DG. Keynote speakers suggested that continuing turmoil in the California regulatory process might lead to another power crisis as early as 2004. Plans are underway to hold a 5th Symposium late in 2003. ■

CONFERENCES

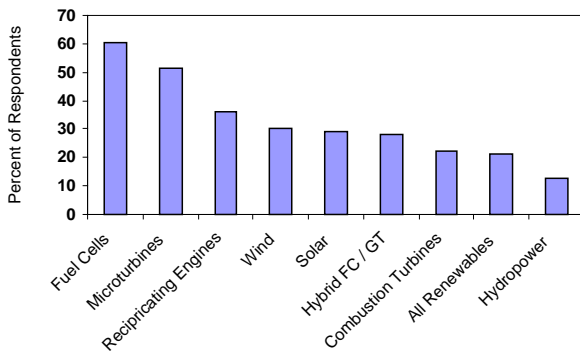
U.S. DOE Thermally Activated Technologies Roadmap Workshop, Dallas-Fort Worth, TX, Jan.7-9, 2003.

U.S. DOE Distributed Energy and Electric Reliability Program Distribution and Interconnection R&D Annual Program Review, Washington, DC, Jan. 21-23, 2003.

Gas Turbines for a National Energy Infrastructure, co-sponsored by IGTI, ASME International, and U.S. DOE, Arlington, VA, Feb, 26-27, 2003.

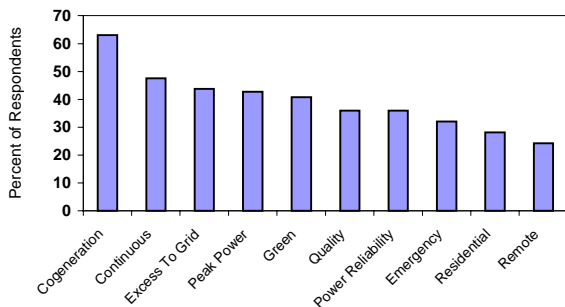
(Survey, continued from page 1) popularity of fuel cells and advances in hybrid engine designs. Finally, hydropower (13%) replaced combustion turbines (22%) as the least popular DG technology. Respondents indicated an interest in other DG technologies: Propane cogeneration systems, modern steam engines, modular nuclear reactors, stirling engines, and biomass technologies were all mentioned at least once. The results from the survey are depicted in the bar graph below.

Interest in Distributed Generation Technologies: 2002



Respondents were most interested in cogeneration/ CHP applications, which were chosen by 63% of survey respondents. Continuous operation, selling excess power to the grid, peak power, and green power applications each received votes from over 40% of the respondents. Of the remaining applications, power reliability and quality were the top vote-getters, followed closely by emergency, residential and remote power applications. Other applications of interest included automotive, network support, wastewater, and landfill gas applications.

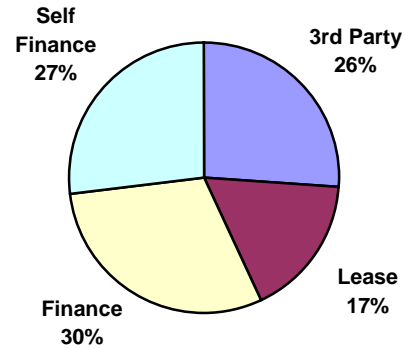
Interest in Distributed Generation Applications: 2002



When asked how they would finance their DG equipment, most respondents indicated they finance their equipment by themselves (27%) or through traditional lending institutions (30%). The percent of self-finance customers is down 15% from the 42%

reported in 2001. More customers are leasing equipment (17%) or partnering with a third party (26%) than last year. The difference in acquisition methods is likely due to 2002's weaker economy.

Method of Acquiring DG Equipment



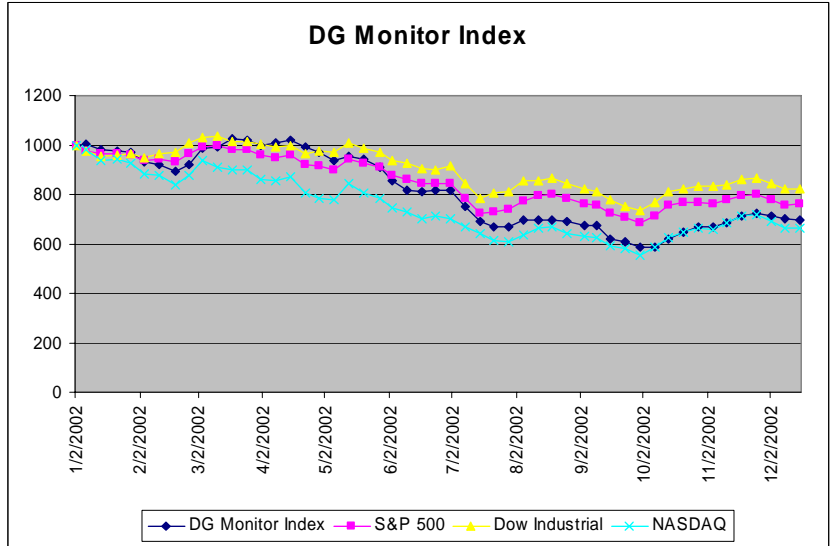
Over half of the respondents were willing to pay a premium between 1%-10% in order to ensure the environmental quality, reliability, and/or security of their product. Some are willing to pay premiums over 10%. Environmental and reliability premiums were the most popular, with 78% of respondents willing to pay some sort of premium. 70% were willing to pay security premiums.

Finally, respondents were asked how DG technologies and economics would have to change for them to consider using DG. Most simply stated that the economics needed to improve, and others indicated that regulations and barriers to market entry need to be removed, interconnection standards need to be improved, or customers must become aware that DG is in fact a viable alternative. One of the greatest barriers is educating the consumer – Mark Ranalli of the Centergy Corporation stated, “When [DG] becomes a heading in the Yellow Pages, that is when the general public will have a better understanding of the concept/ technologies/ applications/ economic benefits.” Another visitor pointed out that without product maturity and availability of a skilled dealer network for product support, emerging DG technologies will never be as popular as their more established alternatives.

The DG survey is an ongoing process, and will be updated annually to gain insight and establish trends. To participate or to view the survey questions, please visit www.distributed-generation.com/survey.htm. ■

The DG Monitor IndexSM

The DG Monitor Index continues to lag the Dow Jones Industrials and the S&P 500, but has pulled back ahead of the NASDAQ. Companies included in the DG Monitor IndexSM include: Active Power (ACPW); American Power Conversion (APCC); AstroPower Incorporated (APWR); Ballard Power Systems (BLDP); Capstone Turbine (CPST); Caterpillar Incorporated (CAT); Cummins Incorporated (CUM); DTE Energy (DTE); Duke Energy Corp (DKE); Emerson Electric (EMR); PlugPower Incorporated (PLUG); Spire Corporation (SPIR); United Technologies (UTX); Williams Energy (WEG); Woodward Governor Company (WGOV)



In the first quarter of next year, there will be major change to the DG Monitor Index. Plug Power Inc. received antitrust clearance from the Federal Trade Commission for its proposed acquisition of H Power Corp. Both Plug Power and H Power are among the 15 companies in the *DG Monitor Index*. Once the merger is complete, the DG Monitor Index will only contain 14 companies and will be adjusted to account for the merger.

Plug Power will acquire fellow fuel-cell company H Power in a stock swap valued at about \$50.7 million. The exchange ratio calls for H Power shareholders to receive about eight-tenths of a Plug Power share for each H Power share. The value to be paid will depend on the amount of H Power's cash, assets and liabilities at the closing date. ■

Interconnection R&D Annual Program Review

The U.S. DOE Distributed Energy and Electric Reliability Program *Distribution and Interconnection R&D Annual Program Review* will take place from January 21-23, 2003 in Arlington, VA. The three day meeting will start off with presentations and discussions on the future role of the distribution and interconnection system. Wednesday and Thursday will center around the Program's strategic roadmapping process.

The Roadmap is being developed as part of the Program's efforts to develop technologies and policies enabling DG to contribute to the distribution system of the future. Speakers will be experts from multiple sectors, and will include Resource Dynamic Corporation CEO, N. Richard Friedman. Mr. Friedman will start off and facilitate the roadmap discussion with and will facilitate the afternoon breakout sessions on that same day. Thursday, Mr. Friedman, who led the development of the IEEE 1547 technical requirements for interconnection, and

is leading the IEEE P1547.2 Application Guide to P1547 Work Group, will give a status report on the P1547 ballot resolution and a presentation and discussion session on P1547.2.

For more information, or to register, contact <http://www.eren.doe.gov/distributedpower/> or ivilina_thornton@nrel.gov

RDC DG NEWS

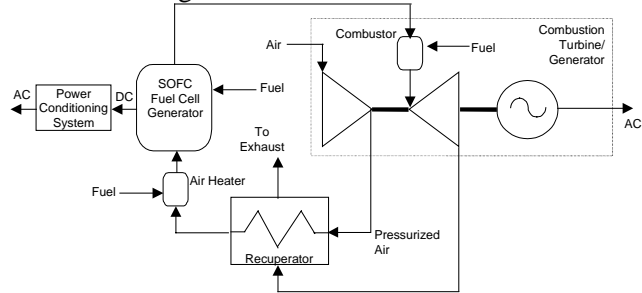
“The Draft Distribution and Interconnection R&D Strategic Roadmap” – presentation by N. Richard Friedman at *U.S. DOE Distributed Energy and Electric Reliability Program Distribution and Interconnection R&D Annual Program Review*, Washington, DC, Jan. 21-23, 2003.

Paul L. Lemar, Jr. will present at the *U.S. DOE Thermally Activated Technologies Roadmap Workshop*, Dallas-Fort Worth, TX, Jan.7-9, 2003.

TECHNOLOGY SERIES: FUEL CELL HYBRIDS

A fuel cell hybrid is created by coupling a small turbine with a fuel cell. Thermal output from the fuel cell is routed to the turbine and used to generate additional power. Solid oxide fuel cells (SOFC) and molten carbonate fuel cells (MCFC) have been utilized in these hybrids. SOFCs and MCFCs are promising emerging generating options that generate high quality thermal output.

As seen in Figure 1, in this example SOFC fuel cell hybrid, the fuel cell thermal output is directed back to the turbine, where energy is extracted and used to power the compressor and a generator. The turbine exhaust is routed to the recuperator, where its waste heat is captured by the pressurized air input to the fuel cell. MCFC-based hybrids employ a somewhat different configuration.



Schematic of SOFC Fuel Cell Hybrid

Though fuel cell hybrids are still in the development phase, the potential market for this technology is promising. This is due in great part to the fact that fuel cell hybrids have the attractive characteristics of all fuel cells – relatively small siting footprint, rapid response to changing loads, very low emissions, quiet operation, and an inherently modular design lending itself to capacity expansion at predictable unit cost with reasonably short lead times. SOFCs and MCFCs are anticipated to have electric efficiencies around 50-60 percent. Hybrids, in turn, have even higher efficiencies (in the 60-70 percent range).

Hybrids can potentially be used in numerous DG applications. Perhaps the most promising market for the hybrid technology is for continuous power and combined heat and power applications. Hybrid’s superior efficiency and low emissions make them suitable for baseload electric generation. Their low emissions also mean that hybrids may be considered a “green” power application. Hybrids can be used for peak shaving as well, though at present these applications are not generally economic.

Fuel cells are currently expensive. Though fuel cell hybrids have lower capital costs when compared to stand-alone fuel cells, meeting the estimated market potential will require these costs to decrease further. As costs falls in the future, hybrids could win out over other DG technologies and the grid as the most competitive option for low cost power in many areas of the country. Projected markets in the near future include commercial building aggregations and municipalities and cooperatives, and these markets offer several GW of potential for hybrids. Hybrids stand to provide substantial net savings to commercial and industrial businesses that employ them.

A follow-up article on the economics of fuel cell hybrids and potential markets for this technology will be provided in the next issue of the DG Monitor. Further details on hybrid market potential and development are available in a newly published report entitled *Fuel Cell Hybrids: Market Assessment and Early Adopter Study*. This study was prepared by the Resource Dynamics Corporation for EPRI, Rolls-Royce Allison and the U.S. Department of Energy. ■

The Installed Base of U.S. Distributed Generation: 2002 Edition Now Available

Resource Dynamics Corporation’s study, *The Installed Base of U.S. Distributed Generation: 2002 Edition* is now available. This report, which estimates the installed DG base in the U.S. to be over 150 GW as of January 2001, provides key, and previously unavailable baseline information to help decision makers at all levels make informed DG policy, regulatory and market decisions.

In the report, the total number of DG units, capacities, generation and thermal outputs are broken out by technology, application, primary fuel, and by their year of installation. Additional regional and industrial breakouts are provided for a subset of the larger generators.

To order the report, click on the Installed Base link at <http://www.distributed-generation.com/> or go directly to http://www.distributed-generation.com/Library/2002_DG_Baseline_Brochure.pdf The report is available for \$995, or for \$750 for orders of 2 or more. Orders received before January 31, 2003 will receive a complimentary copy of Resource Dynamic Corporation’s *Distributed Generation Sourcebook: 2002 Edition*, which provides readers with information on virtually every aspect of DG technologies, applications, and markets.

DG NOTES

Dec 18, 2002 - **Ballard Power Systems Inc.** bought the 18% stake in its stationary power generator subsidiary, Ballard Generation Systems, held by Alstom for \$2.5 million. Ballard last year bought a stake in the unit held by **Ebara** and will purchase a stake held by **FirstEnergy Corp.** It will then own 100 percent of Ballard Generation. Earlier in the month, **Ballard Power Systems** announced a five-year plan that includes a significant reduction in cash consumption, an organizational restructuring, a reduction of 400 employees, and a preliminary agreement from **DaimlerChrysler** and **Ford** to provide combined funding of US \$97 million over the next five years.

Dec 13, 2002 - **Cummins Power Generation** will market, sell and service generator sets and power systems powered by **Kawasaki Gas Turbines-Americas** gas turbines ranging from 1.4 MW to 7 MW in the Americas. In other news, on *Dec 10, 2002* **Kawasaki Gas Turbines-Americas** received an order for Kawasaki's GPB15X generator package for installation at The Reader's Digest Association, Inc. headquarters campus in Pleasantville, N.Y. The package will feature the company's M1A-13X 1.4 megawatt gas turbine, and will be equipped with Catalytica Energy Systems' Xonon Cool Combustion^(TM) system and a high pressure steam absorption chiller designed by Carrier.

Nov 21, 2002 - U.S. consumption of energy produced by solar, wind and other renewable sources last year hit its lowest level in 12 years.

Nov 20, 2002 - Stanford University announced the Global Climate and Energy Project, an alliance of Stanford researchers, scientific researchers from around the world, and private sector companies. To date, **ExxonMobil** plans to invest up to \$100 million; **General Electric**, \$50 million; **E.ON**, \$50 million; and **Schlumberger**, \$25 million to help fund the research. The combined amount, up to \$225 million over the next 10 years, will be used for research into technologies for low emission, high efficiency technologies. Among the energy sources, systems and uses that will be considered are: Advanced transportation systems; Electric power generation systems with lower greenhouse emissions; Production, distribution and use of hydrogen and biomass fuels; Advanced nuclear power technologies; Renewable energy sources; Carbon sequestration, capture and storage; Power storage and transmission; Advanced coal utilization; Combustion science and engineering; Geoengineering; and enabling

infrastructure. Stanford will hold formal legal title to all technology and information derived from this Project, as well as to all patents sought.

Nov 19, 2002 - **GE Power Systems** will acquire **Jenbacher A.G.** of Austria, one of the world's leading suppliers of reciprocating gas engines for power generation. Following the completion of the acquisition, Jenbacher will be integrated with GE Distributed Power, a unit of GE Power Systems.

Nov 12, 2002 - **Plug Power** will acquire **H Power** in a stock-for-stock exchange valued at \$50.7 million.

Ask the DG Monitor

The new column responds to reader's questions about the DG market and DG technologies. Do you have a question for the Monitor? Email askthemonitor@rdcnet.com.

Reader Question: How much DG is there in the United States that is less than 15 kW?

DG Monitor Answer: The DG Monitor defines DG as electric generating units less than 20 MW in size that are located close to the primary load being served or provide grid support. Backup power, including emergency and standby power, are included in this definition, as are remote power, which is DG that is used at places located away from the distribution grid.

Four DG technologies are available in the less than 15 kW size range: Reciprocating engines; Photovoltaics (PV); Wind systems; and fuel cells (just entering the marketplace). A newly released RDC publication, *The Installed Base Of U.S. Distributed Generation*, shows an installed base of 10 million units of reciprocating engines with a total capacity of 47 GW in this size range. Almost all of these reciprocating engines are installed to provide backup power or are used in remote applications. Additionally, there are over a million installed small residential PV systems and probably tens of thousands of smaller wind systems. If one counts smaller PV installations such as highway signs, and phone towers (but not micro-DG such as solar powered calculators or automobile battery chargers), there are considerably more units than this in use. Future versions of *The Installed Base Of U.S. Distributed Generation* will cover PV and wind systems in detail. Fuel cells are included in the publication, but there is currently no installed base in this size range, other than demonstration units. For more information on the publication, see <http://www.distributed-generation.com>.