IEA INTERNATIONAL ENERGY AGENCY 15

PV POWER

Newsletter of the IEA Photovoltaic Power Systems Programme

OCTOBER 2001

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BedZED, one of the projects supported under the UK's PV Domestic Field Trial makes innovative use of semi-transparent modules. See P3 for news of national PV deployment initiatives. [PHOTO COURTESY OF BP SOLAR]

RAY OF SUNSHINE AMIDST THE ENERGY CRISIS

California has had little to cheer about since the deregulation of its electricity market, but Sacramento Municipal Utility District (SMUD) is helping put the sun back into the Sunshine State.

SMUD has been a strong proponent of PV technology since 1993 when it launched its 'PV Pioneers' initiative. Keen to learn from PV customer field trials, but with minimal risk to its clients, the utility identified a number of homeowners who were willing to offer their roofspace for residential PV generators. SMUD installed, maintained operated and owned these early PV pioneers systems, but now homeowners have the opportunity to buy their own system via the utility which provides financing and helps buy-down system prices through bulk-purchasing.

The Sacramento District now has over 9 MW of grid connected PV installed under SMUD's various schemes, with a further 6 MW due for completion by the end of 2003. As well as some 750 residential PV Pioneers each with 2 - 4 kW systems on their rooftops, there are a further 70 larger SMUD-supported systems on roofs and façades of commercial buildings, parking structures and free-standing arrays.

SMUD is now cooperating with local residential building developers to offer PV equipped new-build homes. 150 kW is expected to be installed under such schemes this year, and there is a very high level of interest amongst house buyers for PV-ready housing packages.

Thanks in large part to the Utility's backing of PV technology, installed system costs in Sacramento have been slashed by 75 % in the last 8 years to around 4,5 USD/W. This is expected to fall by a further third over the next two years. More affordable PV systems coupled with customer concerns about reliability of conventional power supplies have resulted in a surge of interest in rooftop PV systems throughout California. SMUD has had to drastically increase its own sales and order processing teams, and contract additional installers to handle the extra demand.

The PV Pioneer programme was expected to service up to 200 rooftop system orders this year. Already potential orders for 2001 have reached 1 500 systems.

Earlier this year SMUD's endeavours were honoured with a first prize in the Energy Globe Awards. The Awards which recognise outstanding initiatives in the field of energy efficiency and renewable energy attracted some 1 200 entries in 2001.

Contact: SMUD. Tel: +1 888 732 5501

ELECTRICITY CRISIS COULD BE TO PV'S BENEFIT

In 1994 deregulation of the Californian electricity industry seemed like a great idea: generation and transmission/distribution would be separated; in the liberalised market the new generators would have to compete to sell their power to the utilities via a two-tier pool arrangement. The utilities would inevitably opt for the lowest priced power which would have generators battling to under-bid each other, driving down the pool price and making for a buyers market.

The bulk of the generated power would be offered on a day-to-day basis to the first tier of the pool (the California Power Exchange – CPE). Last minute power purchases needed to balance supply and demand statewide would be managed through the second tier (the Independent System Operator – ISO).

The three main utilties were persuaded to sell off their generation plant, mainly to companies from outside the state, helped by a USD 16,5 billion sweetener to cover 'stranded losses' (investments in uneconomic nuclear plant which would not be recoverable).

Initially all seemed to be working well. Customers saw a 10 % drop in the retail price, capped until March 2002, as the utilities expected the pool prices to fall. Within a matter of months, however, some of the power producers apparently began to withold power from the CPE, thereby engineering a supply shortage which the ISO had no option but to overcome. The same producers were then able to offer their top-up power to the ISO at exhorbitant prices. California's problem was not helped by drought-induced hydro-power shortages in neighbouring North-Western States. Caught between the capped retail market and the free-floating pool, the utilities suffered massive losses, even to the extent of bankruptcy claims in one case.

With the forthcoming retail price cap removal, customers' bills seem certain to increase. In combination with attractive rebates from the California Energy Commission and various solar buy-down initiatives it looks like the Sunshine State is on the verge of a PV boom.

PV-HYBRID IS A REAL LIFE SAVER

Under any circumstances coping with diabetes is likely to be distressing and problematic. Imagine then how young Sayid Salame and his parents must have felt to learn that, in order to survive, Sayid would require insulin injections every few hours for the rest of his life.

The Salame's are a poor Bedouin family living in a shack 5 km from the nearest town of Tel-Sheva in Israel. Their home has no mains electricity connection so a stand-alone generation system is required to power a refrigerator which will maintain a fresh, long-term reserve of insulin.

It is vital that the power supply to the refrigerator is never interrupted so a PV-wind hybrid system providing 8 days battery capacity was proposed by PV system designers from the Ben-Gurion National Solar Energy Centre. Two Solarex 55 Wp modules charge the 140 Ah 12 V deep cycle battery. A 400 W Southwest Windpower Air 403 wind turbine ensures that there is no lack of energy during winter. The system powers a 78 litre, 12 volt low energy fridge/freezer which has been supplemented with a further 60 cm of external insulation to further reduce the energy consumption. Two energy efficient lamps were also included in the system which was funded by the Israeli Juvenile Diabetes Association to provide some extra benefit for the family.

Training was provided to Basma, the boy's father, so that he can tell when excess power is available for the lighting system, and when power is running low. After a year of operation and several follow-up visits by the designers, the system continues to perform well and there has never been a power shortage.

Under normal circumstances, the USD 4 000 that the system cost would seem expensive for a few lights and a refrigerator, but for the Salame's it must seem like a small price.

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IEA

GROWING SUPPORT FOR ROOFTOP INITIATIVES

After what was effectively a two and a half year sales vacuum created by the premature announcement of a rooftop PV subsidy programme, the Italian scheme is now underway.

The Italian Environment Ministry is providing ITL 40 billion (USD 19 million) for the year up to April 2002, to be supplemented by a 42 % contribution from regional governments. This is expected to result in the installation of 2 000 systems at 75 % subsidy. The subsidy is capped at ITL 15,5 million (USD 7 400) per kW for systems between 1 and 5 kW, while larger systems up to 20 kW will be eligible for up to ITL 14 million (USD 6 700) per kW.

In total some 5 000 new systems could be installed by the end of 2002, although the budget for FY 2002 is not yet confirmed. Korea is also on the verge of commencing an ambitious subsidy programme that could see 30 MW of PV installed on residential rooftops by the end of 2006. For the first 1 000 investors or two years of the five year programme, a subsidy of two-thirds of the installed costs, equivalent to KRW30 million (USD 23 000) for a typical 3 kW system, may be available. Thereafter systems will be financed via low interest loans in combination with a preferential buy-back rate of 400 KRW/kWh (0,3 USD/kWh). The Korean government, which has a target to meet 2 % of the nation's electricity requirement from renewables by 2003, anticipates that the programme can contribute towards a 60 % reduction in installed prices and help cut PV generation costs in half by 2006.

Meanwhile in the UK, a second phase of the PV Domestic Field Trial (DFT) was announced in May. DFT2 will add a further GBP 3,4 million (USD 4,9 million) to the GBP 1,4 million committed under phase one which commenced in 2000. The DFT is viewed as a learning opportunity for utilities, building developers and other players. Again the funds will meet up to 100 % of the system installed costs and are expected to result in a further 300 residential PV systems to add to the 166 (220 kWp) supported under the first phase. Installation of three of the nine projects supported under DFT1 has been completed, pending commissioning.

Rumours abound of a follow-on 70 000 rooftop initiative, but as yet this is unconfirmed by UK government officials.

PVPS PERFORMANCE DATABASE – A UNIQUE TOOL

An updated version of the PV systems Performance Database was released by PVPS Task 2 (Operational Performance, Maintenance & Sizing of PV Systems) in July.

The Performance Database contains high quality data of some 260 monitored PV plants worldwide with a combined capacity of more than 7 MW. Much of the data have been gathered under various national demonstration programmes in the PVPS member countries, including Austrian and German (1 000) Rooftop Programmes, the French Rural Electrification Programme, EU Thermie, Japanese Sunshine & Field Test Programmes and various Swiss demonstration programmes. The plants cover the range of application types – centralised power stations, domestic uses, rural electrification and professional applications – as well as grid-connected, stand-alone and hybrid configurations. The diverse global location of the systems provides information on PV operation under a wide variety of climatic conditions.

The 4kW grid-connected two-axis tracking system 'EIC2ax' in Israel is one of 260 plants held on the PVPS Performance Database.

The new database features simplified procedures for data export to common spread sheet packages, improved filter and sort criteria to assist navigation within the database and an easy search tool to help locate information on a specific plant. Data import and export facilities have been expanded including automatic calculations of annual results. The tool can be used to check the operational behaviour of existing PV plants and to generate a performance report expressed in standard quantities to enable cross-comparison between different systems and different system types. In addition to annual irradiation and system output data for each plant, other useful performance indices, such as reference and final yields, system losses, performance ratio and array, inverter and system efficiencies are recorded.

This collection of such a variety of high quality operational data provides a unique tool for PV system performance analysis. The database application is designed for use by industry, utilities, manufacturers, system designers, installers and educational establishments and can be downloaded free-of-charge via Task 2 on the PVPS website, or can be purchased on CD-ROM for EUR 20 (USD 18,5).

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INTERNATIONAL SURVEY – RECORD GROWTH

In response to demands for ever faster but equally reliable market status data, the International Survey Report for the year 2000 is now available

Data from the 20 countries participating in the PVPS Programme (PVPS-20) shows a record increase in installed capacity, up 37 % from the 1999 figure to 192 MW. This compares very favourably to the growth rates of 20 - 31 % recorded by PVPS between 1992 and 1999. As in 1999, the large-scale, heavily subsidised rooftop programmes in Japan and Germany dominate the results with Japanese installations accounting for 109 MW and new German generation capacity exceeding 44 MW. Japan has also usurped Switzerland as the country with the most installed PV per capita (2,5 W/cap).

Unsurprisingly the influence of Japanese and German programmes in recent years is also reflected in the application segmentation, with 61 % (437 MW) of the cumulative installed generation capacity now grid-connected. In 1992 when PVPS began monitoring developments in PV applications the figure was 29 %. Over 90 % of the grid-connected capacity is now in distributed generation systems, and while the off-grid annual market growth rate has been in the low teens and declining for the past three years, the grid-connected market has risen from 42 % to 58 % over the same period. Nevertheless, for 13 of the participating countries, off-grid systems still account for the majority of total capacity installed to date. Indeed in Australia, Canada, France, Finland, Israel, Korea, Mexico, Norway and Sweden off-grid PV exceeds 90 % of total installed capacity.

PV-HYBRIDS ON THE HORIZON

The PV Horizon workshop on PV-Hybrid Systems took place in Montréal on September 10th, 2001.

Organised by the CANMET Energy Diversification Research Laboratory, Canada's PV research centre, in collaboration with PVPS Tasks 3 (stand-alone and hybrid systems) and 9 (cooperation for development), the workshop was attended by over 65 participants from Canada, the US, Europe, Japan and Australia. The meeting focused on identifying R&D priorities for PV-Hybrids, with a view towards establishing a roadmap of the critical technical advances required to accelerate developments in this important field. Panel members and participants discussed issues on current applications and market potential, international experience with hybrid systems, and R&D opportunities to advance the state of the art.

The workshop heard that there are many applications of PV-Hybrid Systems all over the world that have been established as the least cost option for providing basic electricity supply. Proper system design to match user requirements is the most important factor to consider in planning such projects, although proper selection of proven and tested components is equally important and regular maintenance of the system and components is a must.

The participants noted that for successful PV Hybrid implementation systems should be used for small loads, typically <15 000 kWh/a. Community Power, Village power, Multi-user Solar Grids and RESCOs (Rural Energy Service Companies) all need extensive consultation with users / stakeholders during planning, and proper management of operations is vital to ensure meaningful cooperation and positive results. It was also noted that successful projects are often headed by a local 'Champion' who knows the technology and all associated issues and can sell his project to decision makers.

Proceedings summarising the workshop presentations and discussions will be available shortly.

Contact: Farah Seriff, CANMET-EDRL
e-mail: farah.sheriff@nrcan.gc.ca

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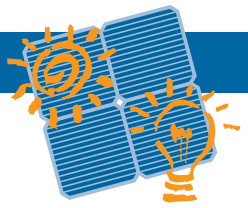
37% growth



Interestingly, the demand for new generation capacity in PVPS-20 and worldwide has largely been met by crystalline silicon modules, and so far the much anticipated boom in thin film production has not materialised. In fact production of amorphous silicon modules in the PVPS countries fell by approximately 20 % in 2000 compared to the previous year. PVPS-20 module production, which accounts for 85 - 90 % of the worldwide total was up 42 % over the year to approach 238 MW. Of this 57 % was manufactured in Japan, 24 % in the USA, 17 % in Europe and the remainder mainly in Australia. The relatively low production capacity utilisation of 61 % is likely to be a reflection of a rapidly growing industry in which bottlenecks in component supply chains can be expected and for which facilities are in the process of being built, but are not fully operational.

The 2000 ISR records a slight fall in inverter prices for grid-connected applications. However, system prices were largely stagnant and indeed some markets showed slight price increases over the year, influenced by high demand compared to supply availability. In terms of employment, it is estimated that PV related R&D, manufacturing and support services (e.g. installation and maintenance) may account for 21 000 labour places in the participating countries. Hard copies of the 2000 ISR (Report no. IEA-PVPS T1-10:2001) can be requested from Task 1 national contacts (see page 7). Readers may also be interested to learn that the report can be downloaded from the PVPS website. Much of the data, including the source National Survey Reports that form the basis of the ISR, are also available online at the PVPS website. See page 6 for more information or visit www.iea-pvps.org.

2000

PVPS NEWS

TASK 9-CIDA COOPERATION

Following on from the Task 9 workshop in Jakarta in March 2001, organised in collaboration with the Swiss Economic Cooperation Agency and the ASEAN Centre for Energy, Task 9 held a workshop with the Canadian International Development Agency and Natural Resources Canada in Ottawa on the 14th September. This workshop was held as a part of the ongoing programme of providing support to, and cooperating with, bilateral and multi-lateral organisations.

The objectives of the meeting were to inform participants on the design of PV power systems and to provide an overview of successful applications of PV deployment in developing countries and an analysis of the potential pitfalls. The workshop also reviewed Canadian capabilities in the provision of PV systems in developing countries.

The workshop was attended by over 50 participants, some 25 from CIDA, and others from CANMET and the Canadian PV industry. Feedback

from the participants has been very positive.

Proceedings from the event will be made available via Task 9 on the PVPS website. www.iea-pvps.org

BUILDING WITH PV

The rapidly expanding market for PV technology, particularly the growing dominance of grid-connected systems in the urban environment presents exciting opportunities for product designers.

During the Sustain 2001 Conference in Amsterdam in May, PVPS Task 7 (PV in the Built Environment) held a workshop to bring PV and building experts together to discuss the emerging markets for new and innovative building products and to identify what potential customers require from the new components.

The workshop comprised a series of presentations from some of the leading BIPV innovators who gave insights into their new product developments, followed by breakout 'brainstorming' sessions. These focussed on specific market sectors: façades; large-scale utility systems; do-it-yourself products; glazed atria and large-scale housing.

The workshop proceedings summarising the presentations and breakout sessions are available for download from Task 7 via the PVPS main website: www.iea-pvps.org

PVPS WEBSITE OVERHAUL

The PVPS website has recently been revamped to make navigation within the site easier and to introduce some useful new facilities.

Visitors can now easily find the latest reports and other products, as well as information about the status of PV in each of the countries participating in the programme. The new statistics area gives a snapshot graphical representation of annual installed generation capacity in each of the PVPS countries.

www.iea-pvps.org

WORKSHOP ANNOUNCEMENT

Impacts of PV Penetration on Distribution Networks

24-25 January 2002, Arnhem, The Netherlands

Since 1994, PVPS Task 5 has been developing and verifying technical requirements for safe and reliable connection of dispersed PV systems to electricity networks. Recent research activity has focused on islanding problems, probabilities and risk assessment, and the impacts of high penetration of PV systems on the distribution grid.

This workshop, sponsored by Novem and KEMA, is intended to inform utilities, manufacturers, PV system installers, users and other authorities of the conclusions of the group's research. Both days include a forum to provide an opportunity for interactive discussions to ensure a better understanding of the technical requirements that allow a reasonable penetration of PV systems into a distribution network.

The workshop will be held in KEMA's ELEKTRUM conference facilities in Arnhem. Registration costs EUR 150. The workshop programme and registration forms can be downloaded from the PVPS website. Alternatively contact Bas Verhoeven at KEMA for further information:

Fax: +31 (0) 26 44 33 843

INTERNET RESOURCES

CREST

Another site that has recently undergone a major overhaul is that of the Centre for Renewable Energy & Sustainable Technology (probably better known as Solstice). At first glance the new site looks pretty, but somewhat lacking in content. Do not be misled! The majority of the site is database-driven, dynamically generated content that can be summoned up using the search engine. The CREST discussion groups on a variety of renewables topics are easy to locate (and join), and the 'Global Energy Marketplace' is a useful portal database for locating renewables organisations around the world, though it does rely on external submissions for websites to be included in the database.

www.crest.org

SOLARBUZZ

Solarbuzz aims to become 'a premier source of independent and comprehensive solar energy information on the internet.'

The website provides a good introduction to solar technologies and has a good news section, as well as many links to companies and other useful websites worldwide. If anything, there may be too much to choose from, but the information on latest systems and components prices, a lot of which is free, is valuable. For those looking for more detailed market analysis the 'information centre' charged subscription service could be worth a visit.

www.solarbuzz.com

SOLARHOST

If you have been searching for an environmentally friendly web hosting solution, this could be the site for you. SolarHost maintains one of the largest privately owned renewable energy systems in Virginia. All of the company's websites, databases, and Internet applications run on servers powered 100 % from the sun.

www.solarhost.com

IN BRIEF

VENTURE FUND FOR PV IN DEVELOPING COUNTRIES

GEF and IFC have created a USD 30 million fund for PV business development

The Global Environment Facility (GEF) and the International Finance Corporation (IFC), the private sector arm of the Word Bank, launched a new 'Solar Development Capital' (SDC) initiative in April. The ten year, USD 30 million private equity fund will focus on providing capital to companies that distribute PV products or services in unelectrified rural areas in developing nations. GEF support will enable most of these companies to provide customer leasing or credit to overcome the high initial expense of PV systems. One of the project's main objectives, however, is to highlight how the renewables sector can be a profitable investment for private sector firms, and that future investments do not need public sector subsidies. Contact: Hutton Archer at the World Bank. Fax: +1 202 458 7117

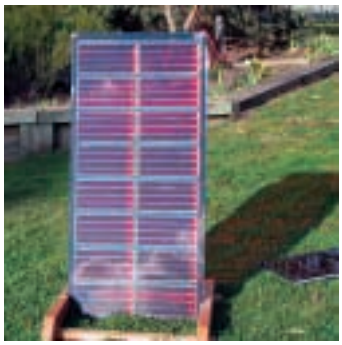
EU DIRECTIVE FOR ELECTRICITY FROM RES

22 % of electricity from renewables by 2010?

The Parliament of the European Union has passed a directive calling for 22,1 % of the Union's electricity to come from renewable energy sources by 2010. Initially the directive relies upon the voluntary efforts of Member States. However, should these prove inadequate, the Commission could push for legally binding commitments to achieve the target. The agreement falls short of the parliament's original plans for binding targets to achieve 23,5 % by 2010. There was also some dissatisfaction that the target will allow energy from waste incineration to be counted in the total. The directive, which has yet to be ratified by the Council of Ministers, does however provide for EU-wide harmonisation of support measures for renewables, based on an assessment of the various national schemes over the next four years.

FIRST COMMERCIAL PLANT FOR ORGANIC DYE CELLS

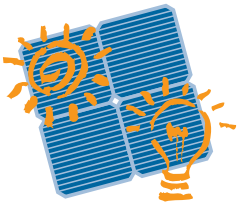
Graetzel Solar Cells soon to be on sale?



The world's first large-scale manufacturing facility for titanium dioxide based solar cells was inaugurated in New South Wales in May. The plant established by STA – Sustainable Technologies Australia – has an initial production capacity of 150 kW. Orders are now being taken for the first products, with delivery scheduled for November this year.

The product, a 22 W 'Solar Wall Panel' measuring 0,6 x 0,9 m, is focused directly at the building industry, being marketed as a building product first and foremost as opposed to a pure power module.

The STA cell efficiency is currently 5 % and reportedly shows only marginal degradation. The company hopes to improve this by 40 % within two years. Contact: STA, Fax: +61 (0)2 6299 1698



DIARY DATES...

17th EPSEC, European PV Conf.
Munich, Germany
22-26 October 2001
☛ Bettina Kaisa, WIP-Munich
Fax: +49 (0)89 720 1291
www.wip-munich.de

ISES 2001 Congress – Bringing Solar Down to Earth Adelaide, Australia
25 November - 2 December 2001
☛ Hartley Management Group
Fax: +61 (0)8 8363 4577
www.unisa.edu.au/ises2001congress

Technology Advances for Sustainable Development Cairo, Egypt
5-8 November 2001
☛ Dr Fuad Abulfoturh
Fax: +880 2 861 3046
www.aast.edu/mceet

Renewable Energy for Rural Development
Dhaka, Bangladesh
19-21 January 2002
☛ Dr A.M. Sadrul Islam
Fax: +880 2 861 3046

Impacts of PV Penetration in Distribution Networks
Arnhem, The Netherlands
24-25 January 2002
☛ Bas Verhoeven, KEMA
Fax: +31 (0)26 44 33 843
www.iea-pvps.org

29th IEEE PV Specialist Conf.
New Orleans, USA
19-24 May 2002
☛ John Benner, NREL
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IEA-PVPS NEWSLETTER

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PV POWER

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PAUL LÖBE HAUS

CASE STUDY

PROJECT SUMMARY

- Location: Berlin, Germany
- Installed: February 2000
- Semi-transparent (10 % trans) moveable louvre blinds
- Total area: 5 500 m^2
- Total array generation capacity: 123 kWp
- 6 048 louvres, each comprising 3 x ASE raw a-Si modules (fabrication by Solon AG)
- Annual electricity production: 61 500 kWh

Contact: Sven Lehmann, Solon AG
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The Paul Löbe Haus is one of the myriad of new buildings that have been erected in Berlin since German reunification. It houses the offices of Germany's members of parliament and parliamentary committee meeting rooms.

In terms of area, the Paul Löbe Haus is the largest semi-transparent PV installation in the world and, for the time being at least, it is also the largest building integrated amorphous silicon system in the world.

The original architectural concept for the building featuring the enormous rooflight (171 m x 32 m) was devised in 1994, but it was not until the end of 1997 that the PV system consisting of over 6 000 semi-transparent a-Si PV louvre blinds was introduced to the plans. The architectural constraints posed some 'interesting' problems for the PV system designer, Solon AG; notably how to minimise the effects of shading from the mounting frame which would drastically reduce the electrical output of the system. The solution is a unique a-Si module configuration whereby three banks of six cells are effectively treated as sub-modules. Each bank has its own bypass diode so that if part of the louvre is shaded, the unshaded banks can continue output at full power.

PVPS IN MUNICH

The IEA-PVPS Programme will have a strong representation at the 17th European PV SEC in Munich in October 2001.

Two PVPS Workshops have been scheduled alongside the main conference programme to give delegates to what has become the world's largest regular PV event an opportunity to learn more about the Implementing Agreement and the emerging results of PVPS research activities.

At 14:00 hours on Wednesday 24 October in the public ICM Exhibition Hall there will be a workshop specifically to present and discuss the latest results of the PVPS activity on Operational Performance, Reliability and Sizing of PV Systems (Task 2). This will draw on the performance data of 260 systems installed worldwide as contained in the Task 2 Database (see page 4).

At 14:00 on Thursday 25th October, a special 'PVPS Outlook Workshop' will be held in the ICM Conference Centre to highlight recent activities and results of this important international cooperative initiative and put this into the perspective of the broader framework of the IEA. The emphasis will be very much on information exchange and providing an opportunity for networking with and between PVPS national representatives and other EPVSEC delegates and exhibitors from industry, utilities and national authorities.

Entrance to both events is free of charge.

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