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■ Reader Reply No 90 ■



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■ Reader Reply No 2 ■

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Up Front

Give and you shall receive

Jesus may have said it as advice on how we should conduct our daily lives. In business there is a similar phrase – even if the philosophy is different – give in order to receive. We call it negotiation.

Two of the world's great negotiators – France and Italy – have been locked in talks for months now over the future direction of their electricity giants Electricité de France (EDF) and Enel. The recent discussions are in fact the culmination of a dispute that has been simmering for the last four years.

In 2001 EDF purchased a stake in Italian power producer Edison in an effort to enter the Italian power market. In return, Enel hoped to gain a position in the French market. As part of the deal, however, the Italian government passed a decree limiting EDF's voting rights in Edison to two per cent. The first rule of negotiation: give, but not too much too soon. The cap was put in place on the grounds that France was essentially still a closed market while other markets were open.

Certainly it was a slick move by the Italians; a move which now puts EDF in a delicate position. When EDF purchased its stake in Edison, to secure the backing of its partners EDF said it would buy them out of Italenergia (the holding company of Edison) in 2005. It was reported that within the coming weeks, Fiat and three Italian banks – EDF's Italian partners – would force EDF to buy their shares. This would push EDF into a costly takeover of a company in which it had limited voting rights. But perhaps more important is the financial burden. The cost of assuming Edison's debt and buying out all minority shareholders would be €12-€14 billion (\$15.7-18.3 billion) according to EDF's estimates. With privatization planned for later this year, a weak balance sheet and looming pension payouts, it is a takeover that EDF can ill-afford.

Yet if the Italians can be described as slick, the French are known to be resolute. EDF has said that if the cap is not lifted it will withdraw from Italy. The second law of negotiation: be prepared to walk away. Certainly EDF could withdraw, even if it has much to lose. Italy is important to its European strategy. It is one of Europe's most attractive markets. Generating capacity is tight with demand growing at about two per cent per annum – higher than the European average of about 1.5 per cent. Also, electricity prices are significantly higher than in other countries. The average price of electricity in Italy is €54/MWh compared to €34/MWh in France and €45 in the UK. If EDF is forced to pull out of Italy, some fear it may be forced to withdraw from other markets such as Germany.

Nevertheless, EDF may follow through with its threat. Already it has invited bid offers for all or part of its interests in Italenergia. In the last two months there has been high interest in Edison. According to reports, some ten bidders have put in indicative offers and Spanish utility Endesa confirmed it had indicated an interest in buying all of EDF's Edison stake. Of the bidders, a consortium led by Milan utility, AEM, is the favourite.

Further, EDF has more to offer than just idle threats. At the beginning of May, both sides thought the dispute was finally resolved when the Italian government agreed to remove the limit on voting rights. Industry minister Claudio Scarjola was reported as saying: "This accord will permit reciprocity and interesting investments for Italians in France."

The deal was expected to be "completed" by an industrial partnership between EDF and Enel aimed at helping Enel gain access to EDF's nuclear technology. This is expected to include Enel investing in a new generation of nuclear reactors being prepared by EDF. Enel is eager to buy nuclear capacity, which was banned in Italy following Chernobyl. It is also believed that EDF would agree to allow Enel to build two combined cycle power stations on its nuclear sites and to supply the Italian company with 1000-5000 MW of peak power at market prices.

In the latest development (as of May 18) both sides have agreed to delay the agreement. The third law of negotiation: when the deal is 'agreed', there may be a time of reflection to determine if you are satisfied with the outcome or whether you need to come back to the table with any minor issues. EDF said that the finalization of the accord required a number of checks, notably the consequences of a progressive creation of an Italian electricity market, and developments in the French market over the coming months.

With negotiations well on the way to reaching a conclusion, the Italians must be pleased with the way things are turning out. It's a shame (for the Italians) that AC Milan could not negotiate its way past that great bastion of English football, Liverpool.

Junior Isles

Junior Isles, Publisher & Editorial Director

***"With privatization planned for later this year,
a weak balance sheet and looming pension
payouts, it is a takeover that EDF can ill-afford"***



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■ Reader Reply No 3 ■

Analysis



The EU's emissions trading scheme is up and running, but are companies taking on board the full implications? *Janet Wood* reports.

Time to spread the word on ETS

Market activity in trading in greenhouse gas emissions has been steadily growing for a number of years. According to research from Natsource LLC, worldwide trades increased by 38 per cent from around 78 million tonnes in 2003 to 107 million tonnes in 2004 (see diagram). Those worldwide trades, however, will be outweighed by trading in the EU's emissions trading scheme (ETS), which will see allocations for half of Europe's emissions of carbon dioxide change hands.

The ETS imposes prescribed targets for reducing CO₂ emissions on companies from a variety of industries, from power generation to building materials production. It will allow the trading of emissions allowances on an open market. Companies can choose whether to reduce emissions or purchase spare allowances, but if they are not fully prepared for this legislation they face costs and even fines that could run into millions of Euros, thanks to penalties for non-compliance at €40 per tonne of unauthorised CO₂ emissions.

The EU's emissions trading scheme has already gone into operation and trading has begun. The first spot trade was back in March when a bilateral trade was carried out by Shell Trading and Barclays Capital. But now that the European Commission has approved almost all the countries' allocation plans, and several allocation registries have gone live, trading is beginning in earnest. London-based ICAP Energy claimed the first on-screen spot transaction at the end of April. Now new trading platforms are being set up to handle the expected volume of trades. Among them are the International Petroleum Exchange's platform, which hosted a trade between E.ON UK and BP. Meanwhile, the London Energy Brokers Association has launched a new benchmark index for trades in emissions allowances, known as the LEBA Carbon Index.

With all the financial instruments in place and trading underway, have companies come to grips with the scheme and its effect on their business? Far from it.

New research from LogicaCMG suggests that in the UK at least, companies have a long way to go before they have fully grasped all the implications of ETS. The

company used an independent research firm Coleman Parkes to conduct research on the power generation, refinery, cement, iron/steel, heavy engineering and automotive sectors. Some 100 senior executives were surveyed to gauge companies' perception of, and compliance with, the ETS regulation.

Five months into the scheme, half of UK companies told Logica they were fully compliant with the trading scheme and a further 23 per cent said they would be ready by December 2005. However, the remaining 28 per cent of companies did not know when they would be ready to comply. "This suggests an element of complacency towards the scheme and indeed the issues behind it," said Logica, and that lack of support from companies was borne out by the fact that one in four companies said they view the scheme as an unnecessary piece of Government regulation.

The survey found that the majority of UK companies have grasped the importance of verification. Three quarters have invested in it, and 61 per cent had appointed an accredited verifier – a stipulation of the scheme. However, one fifth of companies told the survey they would not appoint a verifier by the end of this year. LogicaCMG said, "This means that an alarmingly large group of companies do not seem to realise the repercussions of their complacency – the fines for not being able to report on emissions could run into thousands of pounds."

Nearly half of UK companies said they saw a correlation between emissions management and share value. Yet an overwhelming number – 83 per cent – had not discussed the financial impact of the ETS with either their insurer or institutional investor.

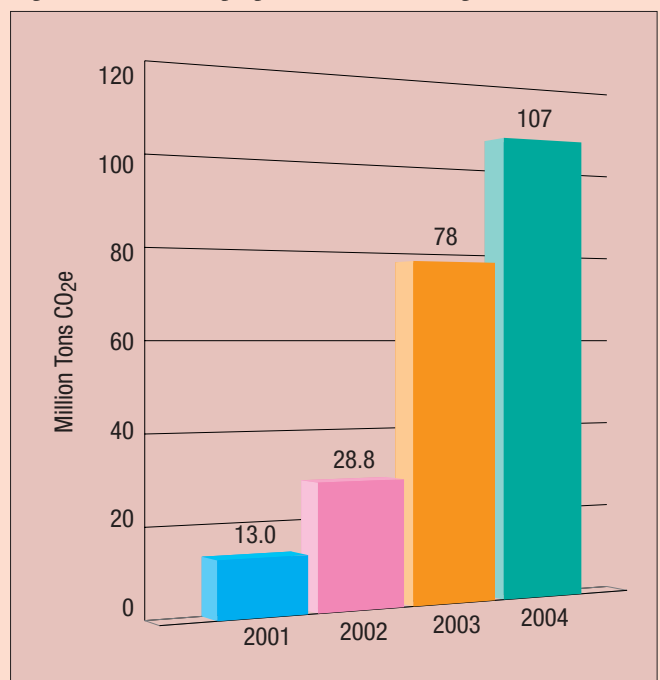
In addition, companies strongly felt that

emissions management affects customer-buying preferences. Nearly half felt that customers would prefer to purchase from a company that was environmentally friendly, with just six per cent believing customers would rather buy from a non-compliant company.

Just one in ten companies in the UK feel they will be in a position to sell allowances. More will buy, but they have financial concerns regarding trading. Thirty nine per cent fear the market will be volatile, making it hard to plan and budget for trading and a further 37 per cent worry that emissions prices will be high due to high demand (caused by a general shortfall across the UK).

However, despite the concerns clearly shown by companies regarding the number of allocations they have received and the links to share value and customer opinion, a surprising 83 per cent of companies had made no financial provision for fines or trading.

It seems that in the UK, although the idea of emissions trading has been taken on board by companies, many are still ill prepared for the full implications.



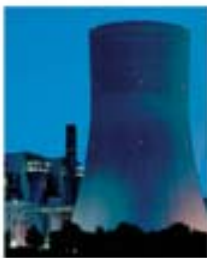
Total traded volume of project-based emissions reductions
Source: Natsource LLC

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international

World News

Regulators warned lack of certainty threatens supply

Utility companies have warned that regulatory uncertainty is holding back the investment needed to secure power supply worldwide.

According to the seventh annual PricewaterhouseCoopers global utility survey, titled *Under Pressure*, regulatory worries top the list of concerns

expressed by investors about funding the industry. While a majority of investors believe deregulation is helping the investor climate, 39 per cent say market reforms are damaging confidence.

The International Energy Agency believes that an investment of \$12.7 trillion will be

needed by 2030 in the global power generation, transmission and distribution and gas supply infrastructures. However, the report found that the utility sector faces stiff competition in attracting investors from the financial services, consumer and retail and pharmaceuticals industries.

South East European grid would reduce costs, says Argonne report

If the South East Europe region were to operate as a regionally integrated system dispatching on a least cost basis, operating costs could be reduced by 11-15 per cent, according to preliminary reports from a study by Argonne National Laboratories.

Power supply in South East Europe (SEE) is projected to

tighten significantly during the next few years, threatening to constrain the region's economic development and quality of life if not addressed.

Apart from Turkey, investment in the region over the last ten years has been limited, with the average age of capacity now in excess of 30 years. If

severe power shortages are to be avoided, over the next decade 12 000-15 000 MW of new capacity will be required and 8000-9000 MW of plants will have to be rehabilitated, along with matching investments in the region's transmission and distribution system investments.

Major interest in South African independent power projects

More than 90 companies worldwide have registered their interest in the South African government's R6bn (\$912m) tender to build two new power stations planned to alleviate the threat of a power crisis.

The winner will build two gas fired power stations, in KwaZuluNatal and Eastern Cape, which will deliver the first 1000 MW of the 5000 MW the government has predicted will be needed within the next five years if

it is to avert blackouts.

To attract investment after uncertainty surrounding its potential liberalization, Eskom, the state owned utility, has agreed that the successful tender will have a 15 year power purchase agreement.

Eskom will provide 70 per cent of the investment needed over the next five years to address South Africa's power demand problems, with the remaining 30 per cent to come from the private sector.

Estlink underwater cable project launched

The first interconnection between the Baltics and Nordic electricity markets has been launched after the European Commission approved an exemption which will charge Nordic Energy Link for the cable's construction rather than adding the costs to the domestic tariffs of the main grids.

Part of the European Union's plan is to expand interconnec-

tions in Europe – the link is seen as a vital step towards increasing energy efficiency. It will use ABB's high voltage direct current light technology, in a contract worth \$110m to the company.

Estlink will be approximately 100 km long, 75 km of which will be underwater, and will stretch from the Harku 330 kV substation in Estonia to Espoo 400 kV substation in Finland.

REEEP to spend €1m on global energy projects

The Renewable Energy and Energy Efficiency Partnership (REEEP) is to invest just over €1m (\$1.3m) in clean energy projects in Africa, Asia, North America, Latin America and Europe.

The €1m will be spent on 18 new projects that will strive to accelerate the market development of clean renewable energy projects. The projects range from blueprints for national renewable energy policies, to support for clean energy funds.

Half of the announced developments will establish policy and regulatory models, and half will focus on establishing new financing techniques.

Two thirds of the projects are in the renewable energy sector and the final six are focused on energy efficiency.

The REEEP project is an international response to clean energy that aims to propagate best practice internationally. It went into operation in 2003.

News digest

Azerbaijan: Japan Bank for International Co-operation is to loan the government \$273.4m for the construction of a 400 MW gas fired combined cycle power plant that will be located near Baku, the country's capital.

Egypt: East Delta Company for Electricity Production and France's Alstom are to modernize the 750 MW Talkkha, Delta power plant as part of the Ministry of Electricity's plan to secure power supply by 2007.

Finland: The Karelian regional government may resume construction of the Beloporozhskaya hydroelectric station, which has stood idle since 1980.

Iran: Domestic electricity production is expected to have increased 3000 MW by March 2006. Iran currently imports from its neighbours 1.2 million kWh, 500 000 kWh more than it exports.

Iraq: Japan is researching the possibility of constructing a \$100m 60 MW thermal power plant in the southern Iraqi city of Samawah. If it is established that Japanese engineers can work safely the power plant could be in operation by mid 2007.

Middle East: Zurich based, Asea Brown Boveri is to bid for the \$1.25bn Gulf Power Grid that will initially connect Bahrain, Kuwait, Qatar and Saudi Arabia by 2008. The first contracts are expected to be awarded by mid September 2005.

Romania: VA Tech has secured the €135m (\$170m) contract for the construction of a gas combined cycle heat and power plant in Bucharest, Romania.

Russia: Power Machine's Group is to supply three 660 MW units for the construction of the Barh thermal power plant in Bihar, India.

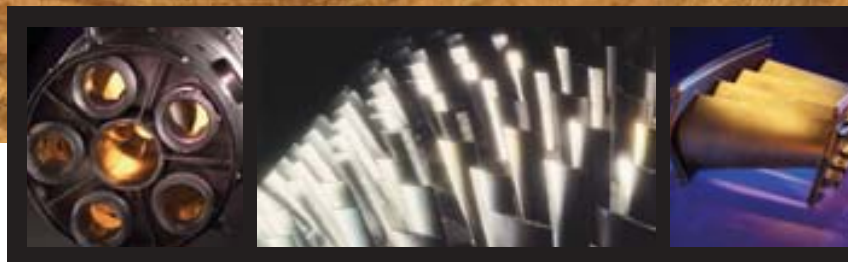
Swaziland: The Swaziland government is planning to expand domestic power production after it became clear that South Africa's national utility, Eskom, would not be able to export more power into Swaziland than it already does. It currently supplies 80 per cent of Swaziland's electricity.

Tanzania: Following in Uganda's footsteps, Tanzania is to start an electrification project to make electricity and information technology more accessible in rural and semi urban communities.

UAE: Abu Dhabi has finalized a \$2.7bn financing package to build its fifth water and power project in the Emirate. The Taweelah B project will supply 2000 MW of power and 728 million litres/day (160 MIGD) of water by 2008.

Uganda: A newly installed thermal power plant will provide the national grid with an extra 50 MW to halt the country's regular power cuts. Uganda has demand for 340 MW while it currently produces just 220 MW.

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■ Reader Reply No 5 ■

Greater European energy community considered

The European Community is to investigate the possibility of creating an extended pan-European energy community that would include Russia and Ukraine.

Energy director general, Francois Lamoureux, has told a parliamentary energy committee that Russia would not ratify

the existing Energy Charter Treaty, making it an impractical venture.

Lamoureux said that the successful dialogue between Russia and the EU should be used as a model for the development of a pan-European energy community. Over the past few years, discussions between Russia and

the EU have led to the Russian gas firm Gazprom dropping destination clauses in its long term supply contracts with EU member states.

While still supporting the Energy Charter Treaty, the EU is to strive for a mechanism that would create an acceptable energy link with Russia.

Enersis create world's first wave energy farm

The world's first commercial wave energy farm is to be built off the northern coast of Portugal after a consortium led by Enersis ordered three Pelamis P-750 machines from Ocean Power Delivery (OPD). The total cost of the project is €8m (\$10m).

Generating 2.25 MW of renewable electricity from ocean waves, the Pelamis devices are expected to displace

6000 tonnes per year of carbon dioxide emissions. If the three machines perform as expected an order for a further 30 is anticipated, adding a further 20 MW to the farm's capacity.

Richard Yemm, managing director of OPD, said: "We see this order as just the first step in developing the Portuguese market, which has the potential to be worth up to a billion Euro over the next ten years."

Vattenfall pilot for carbon dioxide free power announced

A pilot plant, championed as the world's first carbon dioxide-free coal fired power station, is to be built by Vattenfall south of Berlin in Germany, at a cost of €40m (\$50m).

Ready for operation in 2008, the 30 MW plant will use carbon dioxide separation with oxyfuel technology. The

lignite will be fired using pure oxygen and recycled carbon dioxide. Vattenfall then plan to separate the carbon dioxide that is formed in the combustion process in such a pure form that it can then be retrieved and stored permanently in underground rock formations.

Blair called to action over CO₂ target

Recently re-elected prime minister Tony Blair has been called upon to put his promises over climate change into action after it was announced that the UK will miss its domestic target of cutting CO₂ emissions by 20 per cent by 2010.

Callum Stewart from international energy consultancy McKinnon & Clarke, said: "The government needs to take drastic steps to curb emissions

in order to get back on target."

A Sustainable Development Commission report suggests that the wind energy industry could produce 20 per cent of the UK's electricity by 2020 taking up just 0.0001 per cent of British land. However, economics consultancy Oxera, has suggested that a new nuclear programme may be a much cheaper option for the taxpayer.

EU rejects TSO regulator proposal

The European Parliament has rejected major elements of the European Commission's draft security of electricity supply and infrastructure directive, on the way to voting for its adoption.

One of the main elements the Parliament's energy committee found unacceptable was the proposed creation of a regulator to oversee transmission system operators' plans for investment.

Also thrown out by the committee was the proposal to give national power regulators extra authority over new projects. The plans rejected, included the ability to fine projects that fall behind schedule and the power to set project start dates.

Plans approved to expand Italian grid

Italy's Ministry of Productive Activities has approved the grid operator, GRTN's plans to develop the country's power transmission grid.

In addition to connecting new power plants to the national grid, over 160 projects are now planned from now until 2014 at a cost estimated around €2.1bn (\$2.6bn).

By the end of 2006 GRTN plans to complete three 380 kV interconnections in Calabria, Lombardy and Puglia as well as an undersea link between the islands of Sardinia and Corsica. The remaining priority projects, to be undertaken before the end of 2009, include further 380 kV interconnections and an undersea link between Sardinia and the Italian mainland.

News digest

Austria: Verbund is to "strongly push" the Styrian provincial government for their support in an energy package, which would see a total investment of €674m (\$846m) in the regions power plants and grids.

Czech Republic: The government has agreed a three year plan with the European Commission to reduce its carbon dioxide emissions from 107.6 million tonnes to 97.6 million tonnes. Emissions trading vouchers will now be issued to 436 companies.

Europe: Regulation is growing in importance as a key rating issue across Northern Europe, according to a report issued by Standard and Poor's, which highlights regulatory problems in the Netherlands, Austria, Sweden and Germany.

Europe: Six renewable energy groups have forecast that Europe will have 4500 MW of solar PV installed by 2010 after last year saw an installation increase of more than 69 per cent over 2003 levels.

Europe: The 33 members of the Union for the Co-ordination of Transmission of Electricity (UCTE) have formally agreed to a first set of security and reliability standards.

Finland: The Finnish government has pledged to create a stable and favourable business environment to encourage the necessary investments in domestic energy production, transmission and distribution.

France: EDF is reportedly searching for partners to collaborate over the European Reactor Project on a risk sharing basis. Enel is expected to take a ten per cent stake but EDF want to avoid giving a privileged role.

France: GE is to install 57 MW of wind capacity at six sites in the Massif Central region. The projects will increase France's current installed wind capacity by nearly 15 per cent.

Germany: A document from the electricity industry association that argues for the replacement of the current promotion and financial support of renewables with a quota system, has led to a clash with the Environment Ministry.

Ireland: The 100 MW peat burning Lough Ree power station at Lanesboro, County Longford has been officially opened. Ireland's Electricity Supply Board invested over €200m (\$251m) in the project.

Italy: Italy's market operator GME may create a electricity futures market. Such an exchange would be split in two, the trading period and the delivering period and would allow trading of power up to a month before the current limit.

Spain: Iberdrola has surpassed FPL Energy as the world's largest wind farm owner after record expansion in 2004 saw its wind plant portfolio grow to almost 2950 MW in 2004, according to the latest rankings from Emerging Energy Research.

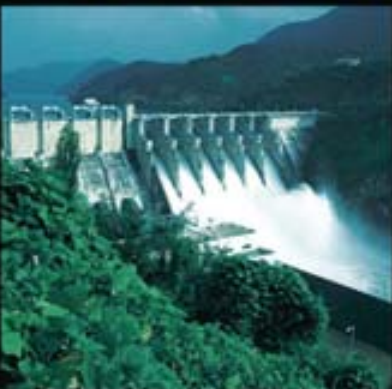


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World News

State blocked Dabhol rights

An independent arbitration panel under the auspices of the ICC International Court of Arbitration in Paris has ruled that the Indian State of Maharashtra must pay \$125m to Bechtel Corporation and GE as compensation for 'appropriating the assets' of Dabhol Power Corporation (DPC). The \$2.9bn stalled 2184 MW power project has been the

subject of a series of protracted disputes since electric power generation ceased in 2001.

The panel found that the State of Maharashtra, which has a 14 per cent share in DPC, had breached provisions of DPC project agreements and effectively disabled DPC itself from pursuing its remedies.

India's National Thermal Power Corporation is seeking

to revive the project once a deal can be reached to settle the claims of GE and Bechtel.

Indian gas exploration, petrochemicals and energy company, Gail, is investigating new sources of LNG fuel from Qatar or Indonesia, although the original supply contract negotiated by Enron with Oman and Abu Dhabi remains legally valid.

Coal could make Thai comeback

The next round of independent power projects (IPP) in Thailand due at the end of this year may include coal fired plants after the government gave its consent for their inclusion in bids for plants due to come on line after 2010.

"Although, previously coal fired power generating projects had faced strong opposition from residents in the

areas where they were to be located due to environmental concerns, they still are seen as potential power sources when taking into account energy security and pricing stability," said Viraphol Jirapraditkul, deputy director-general of the Energy Policy and Planning Office.

Natural gas now accounts for 75 per cent of Thailand's power

generation, raising concerns over energy security. The country's gas reserves are forecast to be depleted within the next 30 years but fears are that this could be sooner if new power projects continue to use gas. From now until 2015, a total of 18 power plants with a combined installed capacity of 18 000 MW are planned to come on stream.

East Asian economies booming

East Asia's emerging economies are projected to grow by six per cent this year, according to the latest regional update from the World Bank. The report highlights as key drivers the reduced pace of global trade expansion, slowing growth in China, higher oil prices, and the large dollar inflows to the region.

Despite the horrendous loss of life, the update notes that the December 26 tsunami is expected to have a minor impact on overall economic growth in Indonesia and Thailand. The six per cent forecast growth for

emerging east Asia is slightly down from last year's cyclical peak of 7.2 per cent. Much of the region's expansion has been bolstered by robust global and regional demand growth, supported by low interest rates, although growth is uneven across countries.

"It is important for governments to take advantage of this period of high growth to strengthen the financial sector and the capital markets since these are the institutions that channel foreign capital into the domestic economy," the report's author noted.

Nuclear contract competition heats up

The final winner of an \$8bn contract to build four nuclear reactors at two power plants in Zhejiang and Guangdong provinces in China is likely to be known in October. The bidders are France's Areva, US-based Westinghouse, and Russia's AtomstroyExport.

Final bids were submitted in late February and construction is set to commence a year after signing of contracts. "It's hard to predict which one will be the

final winner" said Fu Manchang, secretary general of the Chinese Nuclear Society.

Recently, Areva signed a €400m (\$500m) contract to supply control and instrumentation systems for the third and fourth units of the Ling Ao nuclear power plant extension project in Guangdong Province. Alstom has also won a contract worth €80m at Ling Ao to supply two Arabelle 1000 MW steam turbines and related alternators for phase II.

Power Grid IPO

India's state run electricity transmission giant Power Grid Corporation is planning an initial public offering (IPO) in September or October of this year in an effort to raise Rs15bn (\$345m).

The IPO will take place subject to regulatory approval and would add 5-10 per cent to the corporation's equity base of Rs32bn. The price band is to be decided later in consultations with the government and merchant bankers, but is expected to be in the region of Rs 45-46 per share. It is unclear whether the IPO would be accompanied by the government divesting itself of a proportion of the company, as was the case with the IPO from NTPC.

Besides the national power grid, the company is planning to focus intently on improving rural power infrastructure. The company currently has 50 transmission projects under implementation with an investment of about Rs140bn.

Power Grid reported a 3 per cent drop in net profit during 2004-2005.

News digest

Australia: Australia's environmental minister Ian Campbell has predicted a huge expansion of solar energy as a mainstream electricity supplier as a result of the government's forthcoming Solar Cities project, which provides funding of A\$75.5m (\$58.3m) over nine years.

China: Aveva has become the biggest provider of engineering IT solutions to the \$1.8bn Chinese industrial boiler market. The Dongfang, Shanghai Boiler Works and Harbin Boiler Companies have all purchased Aveva's flagship Vantage PDMS product in deals worth more than \$300 000.

China: China Yangtze River Three Gorges Project Development Corporation has been granted permission to restart a new underground power workshop after construction was halted earlier this year over environmental concerns.

China: Construction of China's largest thermal power plant in Zouxian County in East China's Shandong Province has begun. The \$1bn Huadian Power International Corporation plant will be equipped with two extra super critical units rated at 1000 MW each.

India: Government officials are planning to expedite the financing of nine private power projects in order to address power shortages across the country. These include Reliance Energy's 3500 MW Dadri project and a 1000 MW Tata power project in Maharashtra.

Indonesia: Indonesia is to revive plans to build two large coal fired power plants that were shelved following the Asian financial crisis. The Tanjung Jati A and Tanjung Jati C plants, each with capacity of 1320 MW, will be built in Jepara, Central Java.

Philippines: Aboitiz Equity Ventures plans to spend between \$300-400m to build three power plants in the next three to four years in anticipation of a power shortage in the Visayas and Mindanao. The company plans to construct both coal and hydroelectric plants.

South Korea: Macquarie Bank Group has taken a stake in the South Korean energy and utilities sector after purchasing a share in electricity generator Korean Independent Energy Corporation.

South Korea: South Korea has started work on two nuclear reactors in Gori with a combined capacity of 2000 MW. A total of Won4900 bn (\$4.89bn) will be spent on the project which is due for completion between late 2010 and the end of 2011.

Thailand: Mitsubishi Heavy Industries has received an order for the construction of a 1400 MW gas fired combined cycle power plant from Ratchaburi Power Company to be built 140 km west of Bangkok. Power generated will be sold to EGAT under a 25 year PPA.

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■ Reader Reply No 7 ■

Light relief at debt agreement

Twelve banks and investment funds have agreed in principle to extend debt facilities of over \$760m owed by the Brazilian power distributor, Light. It is hoped that the restructuring package will reverse the company's fortunes.

If Light signs the agreement by the end of June 2005, the maturity of debt repayments on \$600m will be delayed from mid-2006, the date originally

agreed with lenders. Light will also be able to defer repayments of a further \$160m from 2007 until 2012.

Before the agreement is signed, EDF will turn the \$400m it is owed by Light into a three per cent stake.

The debt relief will enable the company to invest \$417m in the 2005-2007 period to expand its operations and fight against power theft.

Duke and Cinergy merge to create giant

Duke Energy and Cinergy's boards have unanimously agreed to a merger that would create a combined company with an approximate market capitalization of \$36bn.

The new energy company, which would trade under the name of Duke Energy, would have approximately 5.4 million retail customers and assets totalling more than \$70bn

generating 54 000 MW.

If the deal is approved by the shareholders and various regulatory bodies, Paul Anderson, currently chairman and chief executive officer of Duke, would become the new company's chairman of the board while James Rogers, currently Cinergy's president and chief executive officer, would maintain his job titles.

Banks prepare to finance upcoming tenders in Brazil

Brazil's national development bank BNDES and the Inter American Development Bank are forming a finance package for generation projects the Brazilian government is expected to tender later this year.

It is understood that the banks will finance 70 per cent of each project with the remainder coming from shareholder equity. Future power sales rev-

enues from long term power purchase agreements would be used as a guarantee.

The government is expected to tender for 17 projects that will have a combined capacity of nearly 3000 MW.

In 2006, Brazil will tender for the 8000 MW Madeira hydroelectric complex and the first stage of the 11 000 MW Belo Monte hydroelectric complex.

World FGD orders to hit \$11bn in 2006

Orders of flue gas desulphurization (FGD) systems are expected to hit a record high of \$11bn in 2006, according to a report published by the McIlvaine Company.

During the 1990s annual sales of power plant FGD systems were less than \$1bn a year globally, while last year the orders recorded were only just over \$7bn.

The report predicts that after the expected \$11bn peak in 2006, sales in 2007 will drop to \$7.5bn before rising again to \$9bn in 2008. McIlvaine cites the present market being driven by regulations to retrofit at existing plants, whereas the long-term market will be bolstered by substantial construction of new coal fired plants.

Bush proposes new nuclear plant incentive scheme

President Bush has proposed a new nuclear power plant incentive, designed to give investors confidence that licensing will not be impeded by regulatory delays.

Speaking at the US Small Business Administration's conference in Washington, Bush called for a form of risk insurance in the licensing process to provide stimulus and protection for those seeking to apply for a nuclear power plant licence.

Many companies are already participating on a cost share basis with the Department of Energy to test the new process for issuing early site permits and combined construction and operating licences.

Grid companies to co-ordinate on connections in US

The Midwest Independent Transmission Operator, PJM Interconnection and the Tennessee Valley Authority have signed a Joint Reliability Co-ordination Agreement that will see unprecedented co-operation in the management and operation of the transmission grid over many of the eastern United States.

The companies will share operating information, system models and planning data and will also conduct joint planning sessions to ensure that all improvements are cost effective.

Edison tempt with ten year PPA

Power contracts lasting up to ten years have been offered by Southern California Edison as part of its bid to attract new generation plants to the south of the power hungry state.

The company issued a competitive Request for Offers for facilities that could be online between June 2006 and August 2008.

Assessments by state agencies have indicated that the power supply may be vulnerable this summer if extreme conditions develop in the SP-15 grid.

News digest

Brazil: Areva is to supply a new 345 kV transformer bank and switchyard equipment to boost the electricity transmission network in the state of Espirito Santo. It will also build five new air insulated 138 kV substations in Mato Grosso.

Brazil: Local power distributor Celpe will invest Reals127m (\$53m) over the next 12 months after it took a Reals150m loan from Brazil's national development bank, BNDES.

Central America: Bids have been called for the contracts to build the 1800 km Siepac transmission line that will connect six countries in Central America.

Chile: Generation company Colbún could pursue alternative gas supplies and may build new hydro or coal fired generation facilities after it was revealed Argentina's gas export restrictions would be worse than predicted.

Panama: AES Panama has awarded a contract to GE Energy for the repowering of two hydroelectric plants that will add a total of 12 MW to its national grid. The projects will be completed in April 2006 and April 2007.

Uruguay: The government has halved the tender that state power company UTE issued for the construction of a new thermoelectric plant. Instead of 400 MW, the company will now request 200 MW to be operational by August.

USA: A Colorado firm will conduct scale up and advanced research on metal, alloy and ceramic metal membranes to separate hydrogen from carbon dioxide in a stream of synthetic gas produced in coal gasification.

USA: An appliance that gives homeowners the ability to create electricity from the energy they use to heat their homes has been developed by Climate Energy and the US Honda motor company.

USA: BESS, a battery that consists of 13 760 rechargeable nickel cadmium cells in four parallel strings, has smashed a Guinness world record after it delivered 46 MW for five minutes.

USA: Of the 359 largest power plants in the US, the dirtiest 50, which generate just 14 per cent of the electric power, account for up to 42 per cent of mercury, 40 per cent of nitrogen oxides and 35 per cent of carbon dioxide pollution, according to a report from the non partisan Environmental Integrity Project.

USA: Texas Genco has purchased an additional 13.2 per cent stake in the South Texas Project nuclear generating plant. The \$174m acquisition has raised its total interest to 44 per cent.

USA: Wind, solar and cogeneration units under 2 MW should find it easier to connect to the electric system after the Federal Energy Regulatory Commission accepted a proposal from PJM Interconnection.



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World News

Calpine considers disposal of natural gas assets

Heavily indebted US power producer Calpine is considering selling some or all of its natural gas assets.

Calpine's assets are primarily located in the Sacramento basin of California, south Texas and the Gulf of Mexico. It also has

a sizeable presence in Colorado, New Mexico and Utah. It has 11 billion cubic metres of proven natural gas reserves, currently producing two million cubic metres per day from 607 wells - seven per cent of Calpine's gas needs.

The company did not release specific details of how it would use any income from potential sales, but it is thought that it would be used to pay off debts built up after implementing expansion plans before the decline in US power sales.

Dynegy returns heavy first quarter loss

Two after-tax charges are the cause of a \$267m 2005 first quarter loss, according to the US utility Dynegy, which returned a \$65m profit in the first quarter of 2004.

The two charges, which totalled \$265m, included \$156m spent on settling an environmental litigation action

and \$109m incurred in restructuring a power tolling deal.

Dynegy said it had acted responsibly to ensure the long term viability of its Midwest coal fired fleet. The first quarter was also marked by the company's first growth-inspired acquisition since the start of its restructuring programme three years ago.

Chinese coal casts black cloud

The high cost of coal in China has hit US energy company Alliant, where first quarter earnings have taken a tumble due to its ownership of eleven Chinese power plants.

Alliant's net income for the first quarter of 2005 was \$2.4m, compared to \$34.1m in

the same period a year earlier.

It is now unclear as to whether Alliant will keep its foothold in China and serious doubts have been cast over the company's future investment plans in the country. The board will review Alliant's operations and aspirations in China in July.

Enel acquires majority Romanian stake

Romania's state electricity company, Electrica SA, has sold Enel a 24.62 per cent stake in the distribution companies Electrica Banat and Electrica Dobrogea for €112m (\$140m), raising Enel's stake in each to 51 per cent.

The selling of controlling interests marks the first privatisation in Romania since the

opening of its electricity market in 2003. The process is expected to accelerate in the coming years with the privatization of the other six regional distribution companies and generation facilities before the 2007 deadline set by the EU.

Enel has also recently purchased generating assets in Slovakia, Bulgaria and Russia.

Italy lifts EDF voting cap in Edison

The Italian government has withdrawn the decree barring EDF from having more than two per cent voting rights in Italy's Edison, a move expected to put an end to a four year dispute over competition in their respective power markets.

EDF had made it clear that it

could withdraw from the Italian electricity market completely if the limit remained while Italy argued that EDF was gaining an unfair advantage as France has yet to fully liberalize its energy industry.

A bid for Edison by EDF and Italian utility Aem is expected.

European utility consolidation helping rating stability

Ratings stability among the top 20 European utilities over the first quarter of 2005 reflects the positive impact of a period of business consolidation and debt reduction, according to a report from Standard and Poor's (S&P).

The Report Card also cited strong cash flow on the back of high power prices and moderate capital investment plans as reasons behind the stability, stating that sufficient cash flow had been generated for necessary investment.

S&P believe that most utilities can easily sustain their credit profiles and any fluctuations would result from acquisitions, share buybacks and dividend distribution.

GE 2005 wind turbine revenues to exceed \$2bn

GE Energy has received orders and commitments totalling 2400 MW of new wind power capacity for 2005, representing a projected increase in revenue from its wind business of 300 per cent compared to the year it entered the commercial wind turbine market.

The company achieved \$500m revenue from wind energy projects in 2002 and it expects that figure to grow to more than \$2bn in 2005. Orders in the US, where GE hopes to install 66 per cent of all turbines this year, have so far totalled 1650 MW, while it expects to install 1600 turbines world wide.

News digest

VA Tech orders up: Austria's VA Technologie reported record order intake at €1.6bn (\$2bn) for the first quarter of 2005 and sale up 11 per cent at €984bn. Subject to anti-trust approvals, VA Tech is due to be taken over by Germany's Siemens AG.

Double diesel plans: Mitsubishi Heavy Industries intends to increase production capacity in medium and large industrial diesel engines from the current 2300 to 4200 per year by financial year 2006 in order to meet demand in China, south east Asia and North America.

Reliant sells hydro: Reliant Energy has completed its sale of two hydroelectric power plants for \$42m to Brascan Power. The two stations near Clarion, Pennsylvania and Deep Creek in western Maryland, have combined capacity of 48 MW.

Konarka expands: US light to energy technologies company Konarka Technologies has opened a new centre of operation and R & D facility in Nuremberg, Germany.

Exelon sets green goal: Exelon Corporation has established a voluntary goal to reduce its greenhouse gas emissions (GHG) by eight per cent from 2001 levels by the end of 2008 and has pledged to work with its suppliers to reduce their GHG emissions.

Edenor for sale: EDF has begun the process of selling off its Argentinian electricity distribution company Edenor as part of its strategy to refocus on Europe. Bankers JP Morgan have been engaged to handle the sale.

VRB gets Reliable: VRB Power Systems plans to acquire one of its technology suppliers, Reliable Power. VRB Power will then have exclusive manufacturing and supplier rights to Sumitomo Electric Industries' VRB technology and lower costs for 42 kW VRB cell stacks.

Intergen sold: Shell and Bechtel have agreed to sell Intergen and ten of its power plants with combined capacity of 5500 MW to a partnership between AIG Highstar Capital and Ontario Teachers' Pension Plan for \$1.75bn.

Alliant divests: Alliant Energy has sold its energy services business to Constellation Energy Projects & Services Group, a subsidiary of Constellation Energy, for \$35m. Proceeds will go towards debt reduction.

Globelec tops up: Emerging markets power company Globelec has increased its ownership of 683 MW Egyptian gas fired power plant Sidr Krir to 100 per cent by buying the outstanding stake from Edison.



Power briefing: Italy

Italy's electricity sector is responding to a new freedom: faster permitting of new generation, new entrants into the market, and increased customer choice.

Italy imports 90 per cent of its energy needs, either as fuel or electricity. Increasing unreliability in its system – particularly the blackouts of 2003 – and a volatile fuel market have magnified the need for Italy to increase its generation capacity. In response the government has introduced new legislation to reduce the time taken to get permits for new plants: now it should take no longer than six months to obtain the necessary permission.

In the year of the blackouts, demand reached 320.7 billion kWh, a rise of 3.2 per cent from 2002 and bucking the trend of demand mirroring the stagnant economy. This increase was caused by an exceptionally cold winter followed by an equally exceptionally warm summer. Without the extreme climactic conditions, demand was predicted to have grown by two per cent.

Although Italy has the fourth largest proven natural gas reserves in the EU, measured at 222.5 billion m³ in 2002, production is falling. It currently imports 56.6 billion m³ of the 70.8 billion m³ it annually consumes. Helping to quell security of supply fears, the December 2004 completion of the Bordano-Flaibano gas pipeline is one of the last links in the expansion of the gas pipeline network that imports gas from Russia.

Domestic coal production came to an end in 2001, leaving the country's coal fired facilities entirely dependent on imported coal to generate 6 per cent of Italy's energy demand.

Italy imported 11 per cent of all the electricity it consumed in 2002, rising from 8 per cent in 1997. In 2003, Italy purchased 50.5 per cent of total electricity imports from Switzerland, 35.2 per cent from France, 8.9 per cent from Slovenia, 3.2 per cent from Austria and 2.2 per cent from Greece, according to Italy's network operator, Gestore Rete Trasmissione Nazionale (GRTN).

Although not operated directly by the state, shares in GRTN are held by the Ministry of Economy and Finance, who make decisions as shareholders in conjunction with the Ministry of Production Activities, which also issues strategic and operational guidelines for the transmission company.

Security of supply fears

After 2003 security became Italy's greatest energy concern and GRTN unveiled plans to invest \$544 million in expanding the country's electricity network in 2004-2006. A further €1.25bn (\$1.6 billion) has been promised for medium to long-term investment, including plans to add 1900 km of new lines and 51 new substations. All of this extra investment is to take place while the government tries to lower the price of energy.

The independent Regulatory Authority for Electricity and Gas, (Autorita per l'Energia Elettrica e il Gas – AEEG) has stated that Italy's energy prices are among the highest in Europe, due in part to inadequate competition. In order to encourage competition the government created the Power Exchange market. It went live in 2004 and the general consensus is that it has enjoyed a smooth start, although the AEEG launched an investigation into the unex-



plained price hikes at the beginning of January 2005.

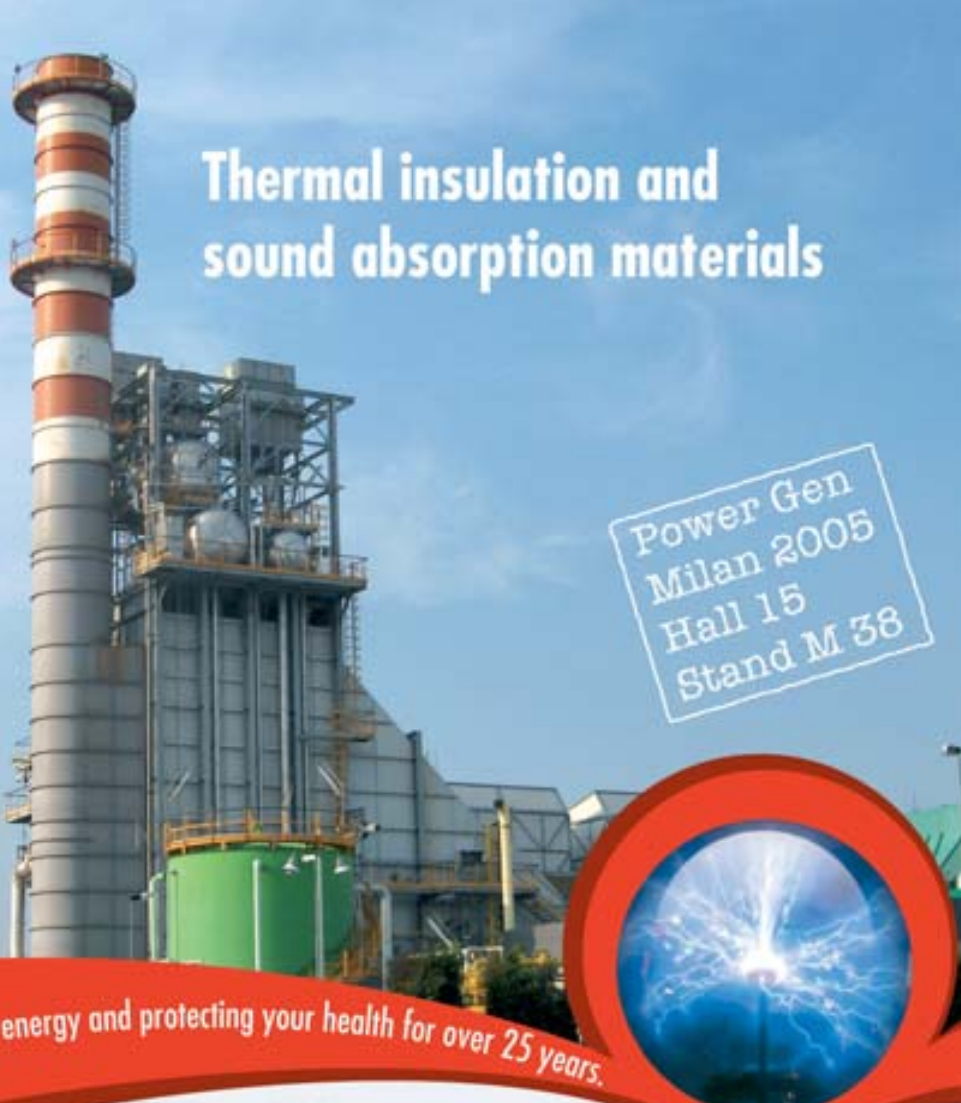
In order to further open the Italian electricity market to competition the Bersani Decree introduced competition to the supply sector, giving consumers the freedom to select their electricity supplier. Consumers with an annual consumption of more than 100 MW were allowed to choose their supplier from April 2003, representing 66 per cent of the market. By 1 July 2007 all households will be able to choose their electricity supplier, in order to comply with the European directives.

The Bersani Decree also required state-owned utility Enel to divest 15 GW of its 56 GW capacity by 2003. This led to the creation of three new generation companies: Elettrogen (5438 MW), Eurogen (7009 MW) and Interpower (2611 MW), which were soon bought by an Endesa-led consortium, an Edison-led consortium and a consortium of Energia Italia-Electrabel-Acea, respectively. The government is set to undertake a further sale of Enel and reduce its share from 50.6 per cent to 30 per cent.

While Italy lacks traditional fuel resources it has an abundance of renewable potential in the form of solar, biomass and geothermal. The government is encouraging renewable growth with national funding schemes such as Green Certificates in order to help it achieve its target of doubling the country's renewable energy production by 2012.

Italy is one of the most important markets for wind energy development, and the Italian government has set a target of 2400 MW to be achieved by the end of 2008. Installed wind capacity at the end of 2003 stood at 922 MW.

The blackouts of 2003 have given the Italian government and energy industry a wake up call as to the frailty of its infrastructure and the vulnerability of being reliant on others for its energy needs. Generation expansion is set to continue, while proposals have been put forward for near, mid and long term investment in the transmission network as the state aims to ensure it never loses mass power again.



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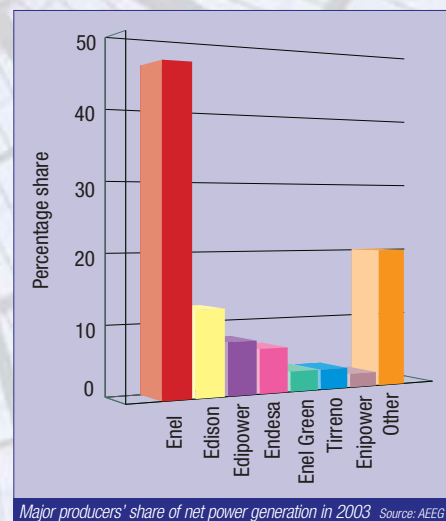
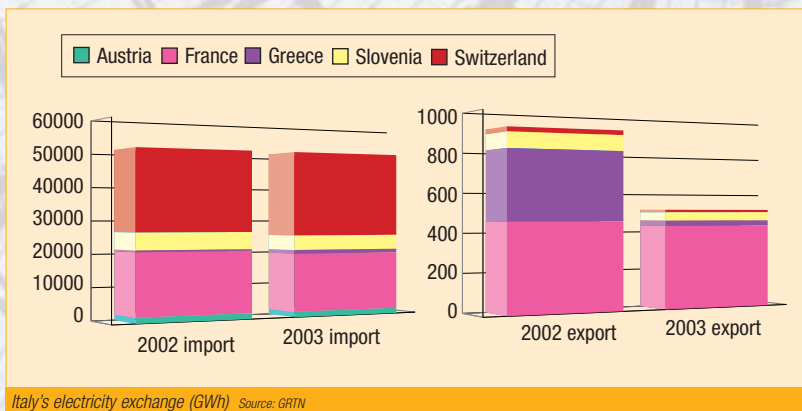


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■ Reader Reply No 8 ■



Italian energy: Statistics



Electricity balance 2002 (TWh) Source: GRTN

	Europe	Italy
Net production consumed	4516.2	260.1
Demand	4512.3	310.7
Net imports (+) export (-)	-3.9	50.6

Availability of import capacity in 2004 (MW) Source: GRTN

	France	Switzerland	Austria	Slovenia	Total
Winter day	2650	2800	220	380	6050
Winter night	2450	1600	180	320	4550
Summer day	2400	1950	200	300	4850
Summer night	2250	1550	180	270	4250

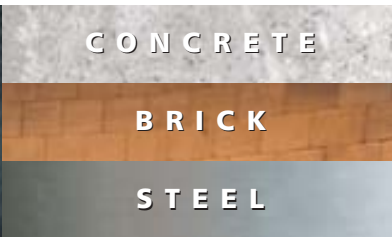
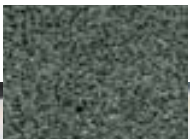
Gross Italian electricity production by source (GWh) Source: AEEG calculations on GRTN data

	1997	1998	1999	2000	2001	2002	2003
Solids	20518	23311	23812	26272	31730	35446	39671
Natural gas	60649	70213	86217	97607	95906	99413	114500
Petroleum products	113282	107237	91286	85878	75009	76997	66579
Other	5600	5900	5900	8800	14147	15789	16700
Total thermoelectric	200049	206661	207215	218557	216792	227645	237450
Total pumping	4965	6232	6451	6688	7117	7744	7511
Hydroelectric	41599	41213	45358	44204	46810	39519	36702
Wind	118	232	402	563	1178	1404	1419
Solar	6	6	6	6	5	4.1	4.1
Geothermal	3905	4214	4403	4705	4506	4662	5340
Biomass and waste	820	1228	1822	1906	2587	3422	4400
Total renewable	46448	46893	51991	51384	55086	49012	47865
Total	251462	259786	265657	276629	278995	284401	292826

Cutting SO₂ emissions can be hazardous to your chimney

One step forward and two steps back. That's how plant managers are now describing the structural damages that result after their facilities undergo FGD (flue gas desulphurization) retrofitting to reduce SO₂ emissions.

The hidden side effect of the procedure is that highly acidic flue gas condensates are produced that can prove devastating to the internal flues of power plant chimneys. Since FGD reduces SO₂ emissions in coal-fired stations by as much as 90 percent, governments around the world are now pushing ahead legislation to require widespread implementation. Unfortunately for plant operators, the cost of structural damage to chimneys and other components may soon run into the millions of dollars. That is...



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30 May - 1 June 2006
Koelnmesse, Cologne, Germany

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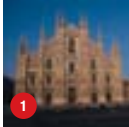


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CULTURE

As the second largest city in Italy and capital of the Lombardy region, Milan is also the most cosmopolitan and wealthy. This obviously has a lot to do with its status as one of the fashion capitals of Europe, a fact reinforced by the city's chic inhabitants. Situated in the Po valley, Milan is a thriving business and commercial centre with a historical heart boasting the spectacular Il Duomo and world famous Opera House, balanced by a contemporary, buzzing nightclub scene.

PLACES OF INTEREST

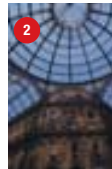


Il Duomo

No trip to Milan is complete without a visit to the magnificent Gothic cathedral, Il Duomo, set in the heart of the city. The third largest in Italy, the cathedral was started in 1386 and wasn't completed for several centuries. The interior, with its intricate stained glass windows and magnificent columns, is impressive enough, but once outside again use the entrance at the back of the cathedral to take you to the roof. It costs up to €5, and is worth every cent – the view from the roof is breathtaking and you can take a closer look at the famous gilt statue of the Madonnina, the highest point on the roof. On a clear day the French Alps are clearly visible.

Galleria Vittorio Emanuele

Leading directly from Duomo Square is the glass roofed plaza of the Galleria Vittorio Emanuele. Here you'll find a handful of designer shops and cafes, but it's the amazing roof, beautiful mosaic floor and relaxed atmosphere that makes this a must-do experience. It's also a great place to sit and people-watch at one of the excellent, though often pricey, cafes.



Teatro alla Scala and Museo Teatrale alla Scala

Milan is home to Italy's famous Opera House – Teatro alla Scala – and its adjoining museum. Guided tours take you through the museum's large collection of costumes, scenery and instruments and you can also see the Opera House's spectacular auditorium that is well-known for its amazing acoustics. Entry to the museum is €5.

Museo Civico di Storia Naturale

The Natural History Museum, situated in one of Milan's central parks – Giardini Pubblici – houses an excellent and well-preserved collection of butterflies, moths and other insect specimens in addition to many rocks, minerals, fossils and other fascinating exhibits. Entry is free, but it's worth going along with a native speaker as all information sheets about the exhibits are in Italian only.

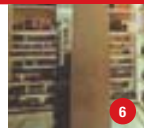
Planetario Ulrico Hoepli

Next door to the Natural history museum is Milan's Planetarium. It's worth going to one of the shows here that follow the trajectory of the planets in the solar system, but there are only four per week on Tuesdays, Thursdays and Sundays.

SHOPPING

Golden Square

A stone's throw from Il Duomo is Milan's fashion district (take Metro line 3 to Monte Napoleone). The golden square is so named because of the four roads that border the area (namely via Monte Napoleone, via della Spiga, via Sant'Andrea and via Borgospesso). All the big Italian designers keep shops here – everything from Gucci, Giorgio Armani, Versace, Valentino and Dior to name but a few. It's chic and pricey, a fact that's reflected by the shoppers who spend their money here, but if you love designerwear you'll feel right at home.



Corso Buenos Aires

For more middle-of-the-road, high street prices your best bet is to head for Corso Buenos Aires, a long main road lined with shops selling clothes, shoes, electrical goods, toys, jewelry and much more. A number of metro stations (on Metro line 1)

MILAN

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place you at different points along the road – namely Palestro, Lima or Loreto – and shops stay open until 7pm on most days.

Open air market

Take metro line 2 to San Augustino to find the cheap and cheerful open air market that runs along Viale Papiniano. Here you'll find a wide selection of goods ranging from denimwear, shoes and handbags to fruit, vegetables and Italian foods such as cheeses, capers and the largest selection of olives you're likely to see anywhere! Open on Saturdays.



PLACES TO EAT



Milan is full to bursting with restaurants, bars and eateries that reflect a wide range of international cuisines. It's certainly not hard to find somewhere to eat, but here are a few restaurants worth trying.

The Kitchen

Via Scarlatti, 7, Tel: 02 3881 0287

Good food, and cheap, in a venue that's perfect for lunch. It's small but the green, white and brick décor gives the restaurant a fresh feel. Very tasty Italian food – pizza, pasta, salads – with amazingly quick service.

Milch

Via Petrella, 19, Tel: 02 2940 5870

Modern and intimate setting that's lit predominantly by candlelight. Tucked away on a backstreet, but a stylish restaurant serving traditional Italian dishes made entirely with organic ingredients at very reasonable prices. Book in advance.



Joia

Via Panfilo Castaldi, 18, Tel: 02 2952 2124

A vegetarian restaurant serving inventive and tasty food that's been described as the best in Italy. Its soft lighting and modern wood surround sets off the restaurant's intimate feel. Very large selection of wines, but although food is delicious portions are small and quite pricey. Booking is recommended.

Hong Kong

Via Schiaparelli, 5, Tel: 02 6707 1790

If you fancy a change and like Chinese then this is the place to try. It's just a short walk from Stazione Centrale – Milan's central train station – and boasts a décor more Victorian than Chinese. However, the Canton and Sichuan dishes are superb and at prices that won't break the bank.

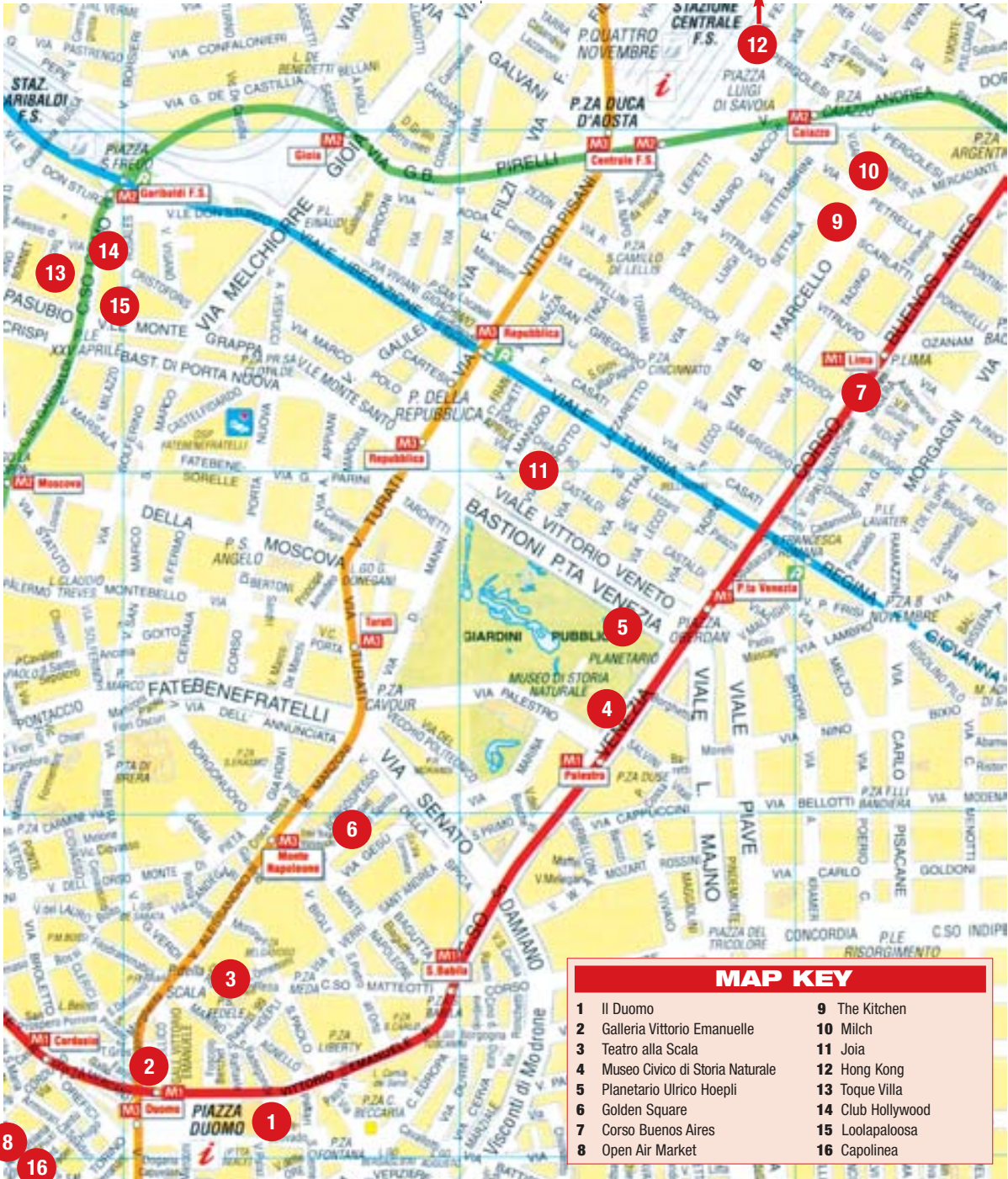


NIGHTLIFE



After dark Milan buzzes with a vast array of bars and clubs. The world-famous Opera House draws visitors

from around the globe and thus tickets need to be bought in advance. But for those keen to try out the club scene, Milan doesn't fail to deliver.



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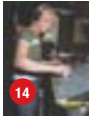
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Toque Villa
Via Tocqueville, 13: Open 11.30pm-5.30am
Nightclub with modern décor geared towards a predominantly 20-something crowd. It's a lively and popular haunt for young Milanese.



Club Hollywood
Corso Como, 15: Open 10.30pm-4am
Not as atmospheric as Toque Villa, Hollywood is the club where many of the city's fashion models hang out. It's trendy – with its modern, metal décor – and more than a little too chic. Drinks are pricey, though.

Loolapaloosa
Corso Como, 15: Open: 10pm-4am
This is a very small, but very lively nightclub playing a good selection of RnB, right next door to Club Hollywood. The dancefloor is small – hence the patrons tend to dance on the tables instead! – but the atmosphere is lively. Get there early to ensure entry.



Capolinea
Via Lodovico il Moro, 119
One of Milan's premiere jazz clubs. Set opposite the canal – the Naviglio Grande – some

of the jazz world's greatest have played here. Worth a visit if only to witness one of the spontaneous jazz sessions and enjoy some of the very good homemade food.

TRANSPORT

The easiest and quickest way to get around is on public transport. The Metro – underground railway – has three lines (Line 1 is red, Line 2 is green and Line 3 is yellow) and all major attractions are within easy reach of a metro station. The metro runs from 6am to midnight. Trams, buses and trolleybuses are run by the Milan Transport Authority and run from between 4 and 6am until between midnight and 1am. For unlimited travel on all public transport you can buy a one day travelcard from newsagents, which is valid for 24hrs from the first time you use it.

INFORMATION

Important telephone numbers:
Ambulance: 118 **Doctor:** 02 34567
Fire Brigade: 115 **Police:** 112
Pharmacist (Stazione Centrale): 02 6690 735
Radiotaxi: 02 6767 or 02 8585 or 02 8388

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- Gas Turbine Technologies SpA
- Turbo Services Torino SpA
- Power Developments International
- Wibrem Turbomachinery Service
- Jet Turbine Service

■ Reader Reply No 28 ■



Diary dates

July

Nuclear Power Asia Pacific 2005
12th – 15th July
Hong Kong
www.terrapinn.com

International Hydrogen Energy Congress & Exhibition
13th – 15th July
Istanbul, Turkey
www.ihc2005.com

Vibrosystem Workshop on Machine Condition Monitoring
18th July
Austin, Texas, USA
www.vibrosystem.com

Waterpower XIV
18th July – 22nd July
Austin, TX, USA
www.hcipub.com

RPA Biogas Conference & Renewables East Biofuels Conference
19th – 20th July
Cambridge, UK
www.r-p-a.org.uk

CMMS – 2005
26th – 29th July
Indianapolis, Indiana, USA
www.maintenanceconference.com

Power Africa
26th – 29th July
Johannesburg, South Africa
www.powerafrica.co.za

August

APC Round Table & Expo
1st – 3rd August
Tampa, Florida, USA
www.reinholdenvironmental.com

Nigerian International Oil, Gas, Petrochemical & Power Exhibition
4th – 6th August
Lagos, Nigeria
www.wellspringng.org

Utility Working Conference
7th – 10th August
Amelia Island, Florida, USA
www.ans.org

China Power
10th – 11th August
Beijing, China
www.powerinchina.com

7th Annual Australian Wind Energy Conference
16th – 19th August
Sydney, Australia
www.auswea.com.au

COAL-GEN
17th – 19th August
San Antonio, Texas, USA
www.coal-gen.com

Power Trends Asia
22nd – 24th August
Karachi, Pakistan
Email: info@ecgateway.net

ISH2005 – The 14th International Symposium on High Voltage Engineering
25th – 29th August
Beijing, China
<http://ish2005.tsinghua.edu.cn/ish/>

6th European Wave and Tidal Energy Conference
29th August – 2nd September
Glasgow, Scotland
www.evttec.net/1st-page.htm

H2 Expo 2005
31st August – 1st September
Hamburg, Germany
www.h2expo.de

September

IPG 05 Conference
6th – 7th September
Berlin, Germany
www.hhc.co.uk

Ineltec
6th – 9th September
Basel, Switzerland
www.ineltec.ch

Electric Power Generation Association Conference 2005
7th – 8th September
Hershey, PA, USA
www.epga.org

Balkan Power Conference
7th – 9th September
Sofia, Bulgaria
www.balkanpower.org

POWER-GEN Asia
13th – 15th September
SUNTEC, Singapore
www.powergenasia.com

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Diary dates

Resource 05

13th – 15th September
Watford, UK
www.pv-uk.org.uk

Power Generation Summit

19th – 21st September
Noordwijk aan zee, Netherlands
www.powergenerationsummit.com

PDM-2005: Predictive Maintenance Conference & Expo

19th - 22nd September
Atlanta, GA, USA
www.maintenanceconference.com

Metering, Billing & CRM/CIS Europe 2005

20th – 22nd September
Barcelona, Spain
www.metering.com

Electric Indonesia 2005

21st – 24th September
Jakarta, Indonesia
www.pamerindo.com

Marine & Power Emissions Conference 2005

22nd September
London, UK
www.hhc.co.uk

Renexpo 2005

22nd – 25th September
Reutlingen, Germany
www.renexpo.de

Green Power Central & Eastern Europe

26th – 27th September
Prague, Czech Republic
www.greenpowerconferences.com

QWETEX

27th-29th September
Doha, Qatar
www.qwetex.com

Financing & Management of Energy resources for Sustainable Quality of Life

28th - 30th September
New Delhi, India
www.indebo.com

October

Power 2005

4th - 5th October
Abuja, Nigeria
www.inditiative.com

Ninth Grove Fuel Cell Symposium

4th - 6th October
London, UK
www.grovetfuelcell.com

Solar Power 2005

6th - 9th October
Washington, DC, USA
www.solarpower2005.com

The 2005 IEEE PES Transmission & Distribution Conference

9th – 14th October
New Orleans, USA
www.ieee-t-d.org

ISEIT 2005

11th – 12th October
Frankfurt, Germany
www.aveva.com

PVSEC-15

13th – 15th October
Shanghai, Peoples Republic of China
Email: srexpo@sh-wes.com

The Future of Nuclear Energy in Europe

17th – 18th October
Brussels, Belgium
www.euconferences.com

14th European Biomass Conference and Exhibition Biomass for Energy, Industry and Climate Protection

17th – 21st October
Paris, France
www.conference-biomass.com/

The 5th International Conference on Power Transmission & Distribution Technology 2005

18th – 20th October
Beijing, People's Republic of China
Email: xx_qz@sgcc.com.cn

BWEA27

18th – 20th October
Cardiff, Wales
www.bwea.com/27/index.html

Power Africa 2005

24th – 26th October
Johannesburg, South Africa
www.powerafrica.co.za

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Diary dates

Bioenergy 2005

25th – 27th October
Trondheim, Norway
www.bioenergy2005.no

Copenhagen Offshore Wind 2005

26th – 28th October
Copenhagen, Denmark
www.offshore.windpower.org

China International Energy and Power Exhibition

27th – 29th October
Beijing, China
www.cepex2005.com

November

4th World Wind Energy Conference & Exhibition

2nd – 5th November
Melbourne, Australia
www.wwindea.org

Power 2005: Scale up Strategy & Renewables

3rd – 4th November
Abuja, Nigeria
www.inditiative.com

Emerging Europe Energy Summit

3rd – 4th November
Vienna, Austria
www.doingbusiness.ro

Jeddah Forum for Water & Power

12th – 14th November
Jeddah, Kingdom of Saudi Arabia
www.thecwcgroup.com

International Conference on Future Power Systems

16th – 18th November
Amsterdam, The Netherlands
www.fps2005.org

Domestic & Commercial CHP Conference 2005

16th November
London, UK
www.hhc.co.uk

Australasian Power & Electricity Congress

21st – 22nd November
Sydney, Australia
www.terrapinn.com

Independent Power & Energy Europe 2005

23rd – 24th November
London, UK
www.gmp.uk.com

GCC Power 05

28th – 30th November
Doha Sheraton, Qatar
www.gcc-cigre-power.com

December

POWER-GEN International

6th – 8th December
Las Vegas, NV, USA
www.power-gen.com

Vietnam Electricity Expo 2005

7th – 9th December
Hanoi, Vietnam
www.cpexhibition.com

2006

January

POWER-GEN Middle East

30th January – 1st February
Abu Dhabi, UAE
www.power-gen-middleeast.com

February

Middle East Electricity

5th – 8th February
Dubai, UAE
www.middleeastelectricity.com

2006 Wind Energy Conference & Exhibition

27th February – 2nd March
Athens, Greece
www.ewec.info

March

Russia Power 2006

14th – 16th March
Moscow, Russia
www.russia-power.com

MAREC 2006

6th – 10th March
London, UK
www.wmtc2006.com

Electric Power 2006

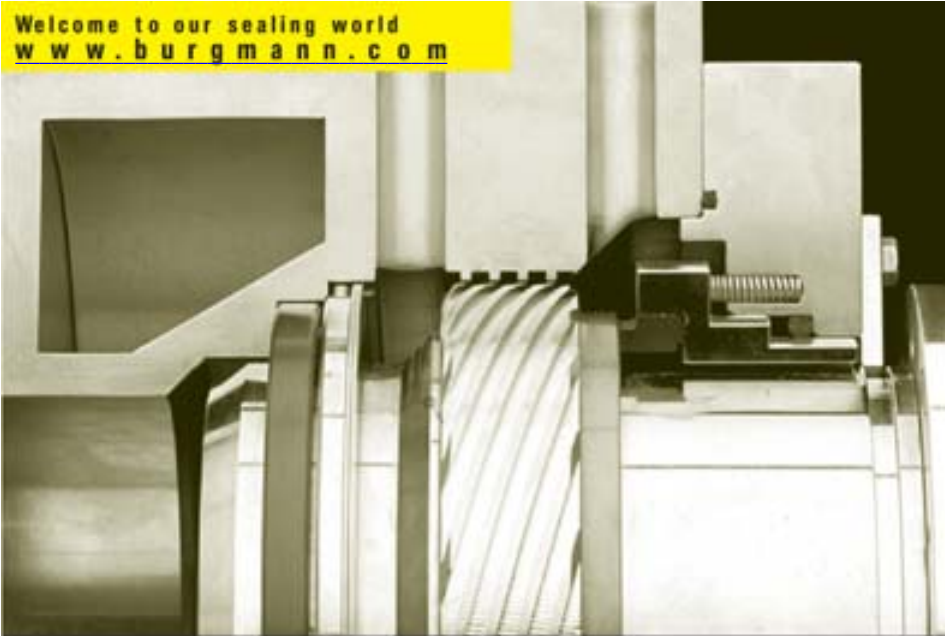
28th – 30th March
New Orleans, Louisiana, USA
www.electricpowerexpo.com

April

POWER-GEN Renewable Energy

4th–6th April
Las Vegas, NV, USA
www.power-gengreen.com

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|--|--|

New plants - modernization - upgrades

For sales forces

Don't just sell plants: Sell benefits

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|--|---|
| <ul style="list-style-type: none"> • Active Pricing • Target your market • New contract models • New technologies • Value proposition | <ul style="list-style-type: none"> Based on benefits Select potential projects Profit Sharing Analyse market volume Instead of rough estimates |
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SOUTH EASTERN EUROPE

REPORT

Balkan community spirit

In the south east corner of Europe the energy industry is stirring. Plans to establish an energy community are well advanced but the sector has much to do if the goal of EU integration is ever to be met.

The European Union and countries from the South East Europe (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, FYR of Macedonia, Romania, Serbia and Montenegro and Turkey as well as the United Nations Interim Administration Mission in Kosovo) are on the way to establishing an Energy Community for South East Europe (EC SEE). The proposed multilateral treaty stipulates establishment of the regional markets for electricity and natural gas and may involve other energy markets at the later stage.

The SEE region potentially covers a market with over 120 million people and a power market that uses almost 250 TWh annually.

While the growth potential of the Turkish power market is well known, it is envisaged that other countries need to invest about \$15bn over next 15 years in rehabilitation of 11 500 MW of existing power plants and the construction of about 11 000 MW of new centralized generation. This recent estimate, contained in the SEE Stability Pact report and based on work of the World Bank consultants, does not include associated investment in transmission and distribution, which is probably of the same magnitude.

The regulatory and legal framework envisaged by the EC SEE

Treaty is explicitly intended to facilitate massive investment that is likely to be accompanied by considerable financial support from international financial institutions (IFIs).

Most of the SEE region has very low energy efficiency, although two countries with strong energy policies – Turkey and Croatia – demonstrate better energy efficiency in relation to GDP growth. These two countries have exceptionally high import dependency that goes above 50 per cent of their primary energy supply, while the rest of the region remains more import dependent than the OECD average, despite considerable exploitation of scarce and expensive domestic resources.

Energy resources

In South East Europe energy resources are far below the world average and even the European average. The region is not endowed with any significant energy resource such as coal deposits or natural gas fields. Available lignite deposits are shallow and distributed across a wide land area.

Hydro resources are also below the European average. These resources are available in either small volume high-head projects in mountainous areas or the River Danube catchment. The Danube enters the region at over 70 meters above sea level. Most of its energy capacity is already used in two dams between Serbia and Romania, known as the Iron Gates. Furthermore, the limited availability of surface water affects the cooling capacities of existing and potential thermal power plants. For example, two lignite fired power plants near Obrenovac in Serbia with 2800 MW installed capacity use more water than the rest of the national industry and agriculture combined.

After decades of neglected forestry and land governance most of the region is exposed to erosion and floods that affect the use of available water resources and hydropower. Deforestation contributes to the

cold winters, limited water conservation over the territory and extended summer dry periods that lead to exceptionally large volatility in energy demand.

Most of the region's power industries are still vertically integrated state-owned utilities at various stages of restructuring with the remainder of the energy sector (gas utilities and district heating providers) fragmented between them.

The current reform agenda does not encompass internal cross-service energy markets, lower transaction costs or removing barriers to entry. However, distribution companies in Romania, Bulgaria, Montenegro and Bosnia are emerging as potential sources of innovation.

Physical integration of the energy industry within the region and – even more importantly – with the rest of Europe is an obvious necessity for this region. “A non-integrated power industry would be a luxury which this part of Europe (SEE) could hardly afford,” Stjepan Han told the Eighth World Power Conference in Vienna in 1956, and it is still true today.

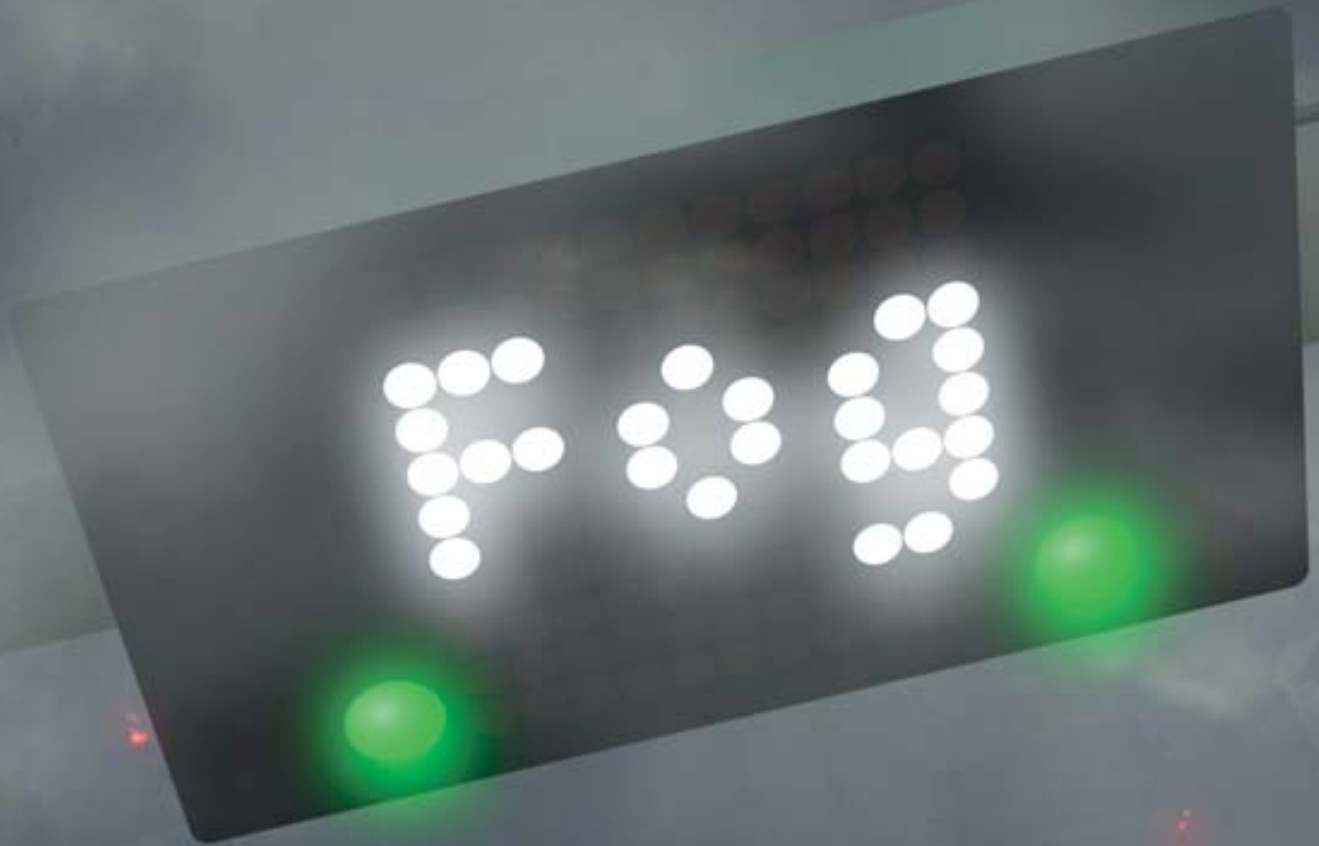
Russian connection

As SEE load characteristics differ from load shapes across Western Europe, and while availability of energy resources are complementary with those of the Russian Federation and the Ukraine, integration is the real buzz word for the SEE power industry. Although the proposed Treaty provides a robust framework for integration with the EU area it does not provide a basis either for participation of these countries in the EU, Russia energy dialogue, or guidelines for eventually agreeing a similar arrangement with the Russian Federation. Understandably, most SEE countries have considerable energy arrangements with the Russian Federation: most natural gas is delivered to the region from Russia via Ukraine and based on longer term institutional arrangements. Russian equipment vendors

Table 1. Power demand and peak load throughout SEE countries

	Power demand	Peak load
	TWh	GW
Albania	5.5	1.1
Bosnia and Herzegovina	9.8	1.8
Bulgaria	36.5	6.9
Croatia	14.4	2.7
FYR Macedonia	6.2	1.3
Romania	54.0	9.2
Serbia	33.8	6.8
Montenegro	4.1	0.7
Turkey	130.0	20.0

Source: ETSO, Rome, 2003; data refers to year 2001



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■ Reader Reply No 18 ■

REPORT

SOUTH EASTERN EUROPE

are still leading technology providers to the region, accounting for over 13000 MW of installed capacity.

High voltage power networks are very well integrated throughout SEE. International donors are completing some important 400 kV connections such as an Albania to Montenegro link that will further integrate the region. Gas networks remain fragmented in terms of geographical coverage, supply directions and technical standards. There are plans to restart hard coal imports along the Danube, while coastal located plants (around the Balkan peninsula from Plomin in Croatia to Varna in Bulgaria and on to Romanian plants in Black Sea area) are actively exploring various coal import options.



▲ Southeast Europe: building an energy community

Wood fuel

Most of the national statistical systems fail to accurately measure wood fuel consumption for space heating and cooking. For example, official statistics in Serbia reveal the use of about two million cubic meters of wood fuel per year, while recent surveys conducted by the UNDP and FAO suggests that 11 – 12 million cubic meters a year is being used.

This extensive use of wood fuel for space heating affects electricity demand in an unexpected way: during very cold days the marginal price of wood fuel (both the value of stocks and open market prices) increase while electricity prices fixed by Government tariff policies remain unchanged. Consequently, households shift to electricity for supplemental space heating. The consequence of such a shift is a very high sensitivity of winter peak electricity demand in relation to the outside temperature. Such peaks are typically

met by very expensive means: pumped storage plants, idled lignite fired power plants, lignite stocks and natural gas underground storage systems. Taking into account average winter temperatures, which are relatively high in comparison with the rest of continental Europe, and peak demand periods that are relatively short, the generation fleet is, as a result, very poorly utilized.

Turkey has about 65 per cent of its power generation from gas fired units and is somewhat more capital efficient in this respect.

Untapped potential

Countries with a larger proportion of district heating in energy supply (Bulgaria, Romania and Serbia) have lower energy efficiency in terms of total primary energy supply against GDP. Common district heating systems are based on hot water boilers or steam subtraction from power turbines. The low quality of district heating services, financial problems and poor housing standards mean electricity is required for supplemental heating during very cold days. This practice adds to the cold day peaks and the utilization problems detailed above. In Romania about 450 000 flat owners have disconnected themselves from centralized heating systems in the last five years, according to the World Energy Council.

The existence of large district heating networks provides an opportunity for true cogeneration (CHP), use of indigenous opportunity fuels, heat pumps, geothermal energy and waste heat. In Serbia alone, about 6600 MW of district heating sources are to be replaced by various innovative solutions.

New players

Inadequacies in the energy infrastructure are surfacing due to the gradual removal of government intervention and subsidies, a number of energy consumers are looking for alternative solutions. Regional sales of heat pumps for space heating and air conditioning are booming. Industrial consumers are exploring various options to generate electricity, including providing reactive power and various associated services. For example, the largest power consumer in Montenegro – the Podgorica Aluminium Smelter has become an active power trader in the region, while exploring internal technical capabilities to provide network services and increase energy efficiency.

Investors are focusing on emerging opportunities throughout the region. The most active are: CEZ of Czech Republic, Gazprom and RAO UES of the Russian Federation, OMV of Austria, Enel, RWE, AES, Entergy, EON and some newcomers such as Rusal. Although large scale privatization of existing facilities is still some way off, investors are considering various market entry points. These include privatization of distribution companies in Bulgaria or Romania, partnering with municipal administrations in offering some distributed CHP, pursuing management contracts and electricity trading.

The proposed framework for the SEE Energy Community offers a variety of opportunities to energy sector actors. It is to be expected that international financial institutions will play their part in supporting restructuring and innovation. The SEE energy sector with its distinctive and

“Most of the region’s power industries are still vertically integrated state owned utilities at various stages of restructuring”

District heating networks are likely to be supplied by distributed generation of various types, accounting for considerable savings in electricity transmission and distribution investment costs as well as in network losses. Distributed generation throughout the region offers an untapped potential for development and better efficiency. Taking into account this opportunity to address seasonal demand fluctuations in a most economical way and given current district heating service prices, distributed generation will be on the development agenda.

difficult problems – poverty, environmental damage and the winter mortality it causes – requires variation and innovation. All governments in the region are now installing institutional structures in line with the EU. It remains to be seen how newly established regulators, transmission operators, distributors and administrators will handle consumers and new energy market entrants. Those who still see unbundling and liberalization as a kind of intra-family game of hide and seek could be surprised by new faces hiding around and seeking their market share.

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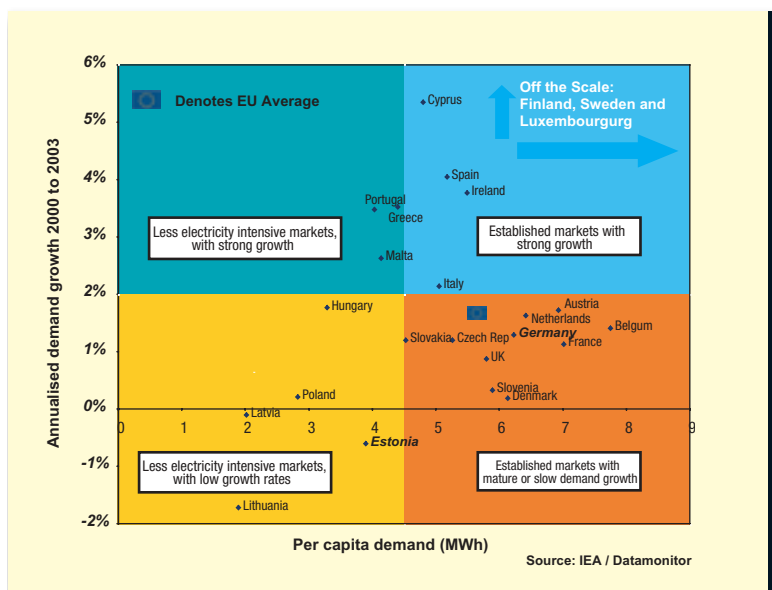
EUROPEAN LIBERALIZATION

REPORT

Diversity prevails

As the first anniversary of the initial phase of electricity market opening in the EU approaches, Europe's power markets remain as diverse as ever in almost every respect, despite the aims of the EU Directive.

► Figure 1. There remains a high level of diversity among the EU's electricity markets



pressure from the EU. Germany still does not officially have an energy regulator in place, although one is due to become operational in July 2005.

The EU has made various attempts to ensure full compliance with the terms of both the gas and power directives, the most recent being in March when infringement proceedings were escalated against ten member states who had not fully transposed the terms of the directives into national law.

Differing attitudes

Supply and demand conditions vary widely between markets, and as a consequence, so does security of supply.

Absolute levels of demand and demand growth rates vary widely. While a wide degree of diversity could reasonably be expected to exist given the obvious differences in population size between markets, there are still wide variations in per capita demand. These differences reflect a number of economic factors, though one of the issues is the availability of other fuel sources.

By far the largest per capita electricity consumption in Europe takes place in Sweden and Finland, where levels are around two and a half times the EU average. Although the extreme winter climate seen in these markets account for part of this, there are also other factors driving these high demand levels. In the case of Sweden, a key issue is the widespread availability of hydro power, the use of which has long been extensively harnessed given its cost and environmental advantages.

As of July 1, 2004 the majority of non-residential power and gas consumers in the EU became eligible to choose their supplier. However almost a year later, the competitive nature and market structure of the EU 25 markets remains highly diverse, as does the appetite for and progress towards market liberalization.

The fact that the energy markets are at widely differing stages of development and maturity is one of the main barriers to bringing about a truly liberalized and competitive single European energy market.

The progress made so far towards adopting and complying with EU market opening legislation has been highly diverse across the EU. This varied progress in implementing the EU directives reflects a broad spectrum of willingness, at both a political and corporate level, towards the concept of market opening. At the pro-liberalization end of the spectrum are markets such as Denmark (full market opening took place in January 2003, four and a half years ahead of the EU timetable). Similarly Germany (at least theoretically) fully opened its power market as far back

as 1998, while Austria, Ireland and Spain fully liberalized their markets well ahead of the EU's July 2007 deadline.

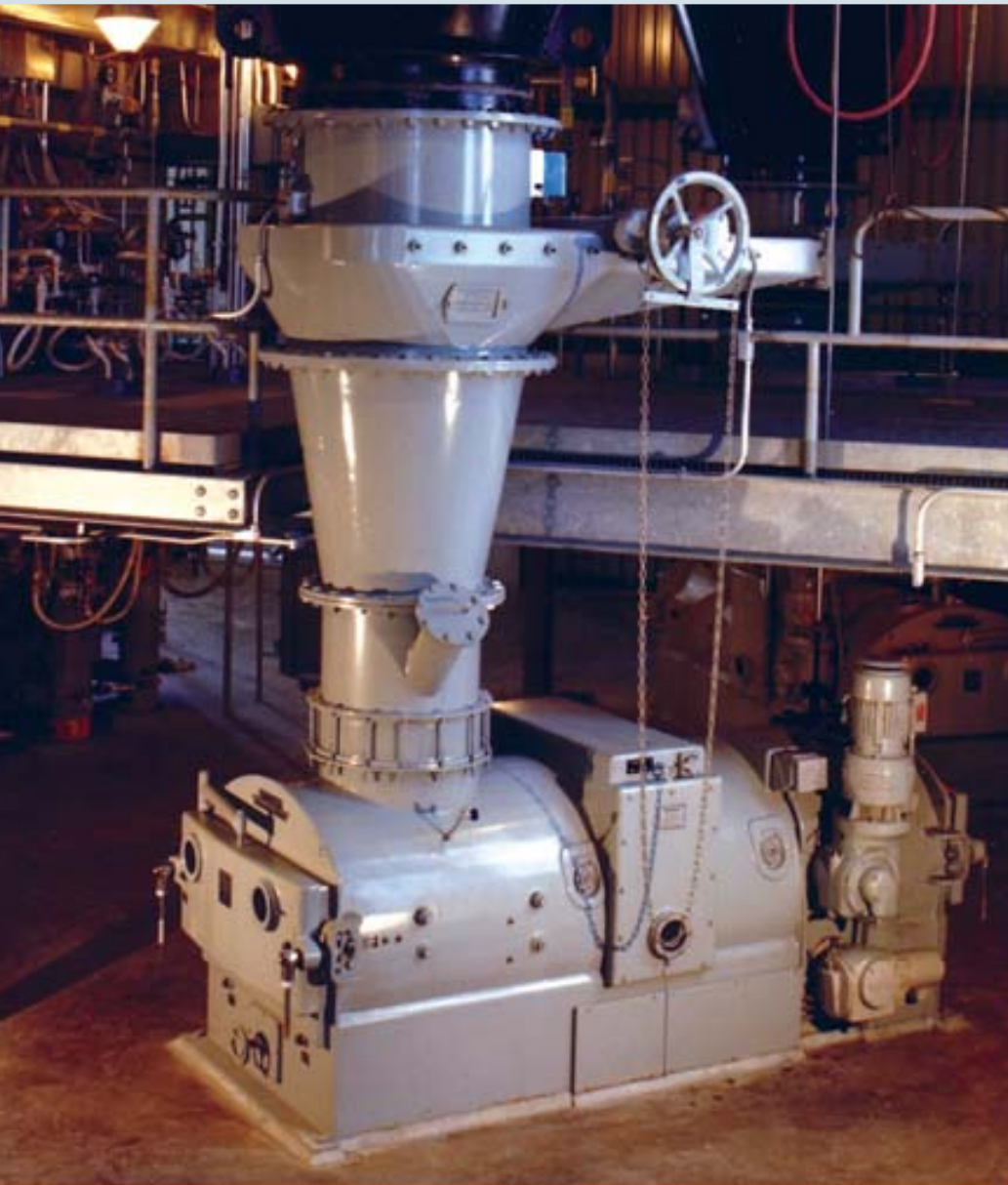
Slow progress

Conversely, France has lagged behind the requirements of the EU regarding the opening of both its power and gas markets. The ongoing monopoly status previously enjoyed by EDF was criticized in many quarters because the company was aggressively pursuing an internationalization strategy aimed at capitalizing on market opening elsewhere in the EU (and to a lesser extent in South America), while at the same time seeking to prevent new entrants entering its home market.

“Despite the on-going process of liberalization and unbundling, the former national monopolies still exert considerable influence in some markets”

Similarly, Belgium's official rubber stamping of the appointment of Elia as Transmission System Operator took place three years behind the EU deadline, only occurring following

This, combined with a lack of indigenous gas resources has led to electricity becoming the main element of end use energy consumption. The demand levels in Finland and Sweden are also



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REPORT

EUROPEAN LIBERALIZATION

driven by the fact that these economies are heavily dependent on energy intensive industries.

Conversely the markets with lower levels of per capita consumption are either where demand is growing rapidly such as Greece and Portugal or in the more mature markets of Central Eastern and Eastern Europe. There, demand growth has stagnated in recent years but has grown over the past decade, largely as a result of economic growth.

The ability of the EU 25 markets to meet their demand levels through indigenous production, and hence the level of import dependency, is another key area of difference and varies widely.

Self sufficiency

With the ability to produce over 160 per cent of demand, and hence make significant exports, Lithuania is the most self sufficient power market (at least in percentage terms) within the EU. The vast majority of Lithuanian power production comes from just one facility, the Ignalina nuclear plant. Until the end of 2004, Ignalina had a rated capacity of 3000 MW, though one of the plant's reactors had to be shut down as one of the conditions imposed by the EU for Lithuania's accession to the EU in May 2004. The significant impact of effectively eliminating 40 per cent of the country's rated capacity quickly became clear. Recent figures indicated that Lithuanian electricity exports fell nearly 60 per cent year on year in the first quarter of 2005. Another condition of EU entry was that Ignalina be completely closed down by 2009. As such, a race against time is now underway to replace this capacity and to prevent a radical shift in import dependency

and supply security. Efforts have been made to develop an interconnection with Poland, though at the time of writing, development of the project has shown minimal progress. At the other end of the self sufficiency scale is Luxembourg which, in 2003, produced just over half of its power requirements. This lack of production capacity created a significant import dependency which was filled by Belgium and Germany.

extreme example of this is in Germany where the retail market is in the hands of around 800 municipal utilities, known as Stadtwerke. The net result of this is a very diluted retail market structure where market shares are generally in single figures and often fractions of a percentage point. Less well developed markets such as Cyprus, Malta, Latvia and Greece still have near monopoly influences in both the retail and wholesale markets.

"The competitive nature and market structure of the EU 25 markets remains highly diverse, as does the appetite for and progress towards market liberalization"

The types of plant the EU 25 markets use to produce power is heavily dependent on resource endowments and the historical development of individual markets. These range from high users of gas such as the UK, Denmark and the Netherlands to the coal based energy economies of Germany and Central and Eastern Europe. Oil remains dominant in Malta, Cyprus and Estonia while France, Sweden and Lithuania are all significant users of nuclear power.

Market structures

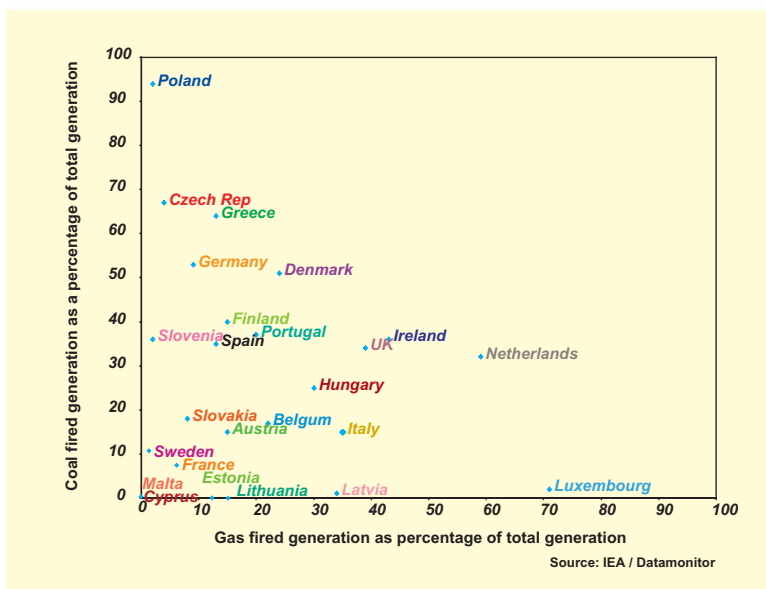
The level of wholesale and retail concentration in the EU 25 markets also varies widely. Despite the ongoing process of liberalization and unbundling, the former national monopolies still exert considerable influence in some markets.

Both the generation and retail markets across the EU have varying levels of market concentration. One

With such widely divergent market characteristics and sometimes reluctant and conflicting political attitudes towards market liberalization across the EU, it is not surprising that progress towards a single European energy market has been somewhat sporadic and disjointed. Even as political willingness at a national level becomes more attuned to the concept of market opening and new market entrants continue to emerge throughout the EU, it is still likely to be some considerable time before a truly single European market can hope to be achieved.

The theoretical 100 per cent market opening that will arise from the second phase of the electricity directive in July 2007 will in itself not be a guarantee of full market liberalization on an EU-wide basis. Considerable progress still needs to be made, possibly catalysed by further legislation and action from the European Commission against those still not yet in full compliance with the terms of the directive, to bring about its aim of a harmonised single European energy market. Whilst there is little the EU can do in the short term about the differences in market characteristics across EU member states with regard to factors such as generation mix, import dependency and consumption patterns, there is a considerable amount that can be done with regard to structural and regulatory factors. The onus must now be on the EU to ensure that the remaining aspects of the electricity directive not yet implemented at a national and corporate level are put in place to ensure that the liberalization process continues to progress as agreed by the member states. PEi

► Figure 3. Markets such as France, Cyprus, Malta, Sweden, Lithuania and Estonia have very low levels of both gas and coal fired electricity production





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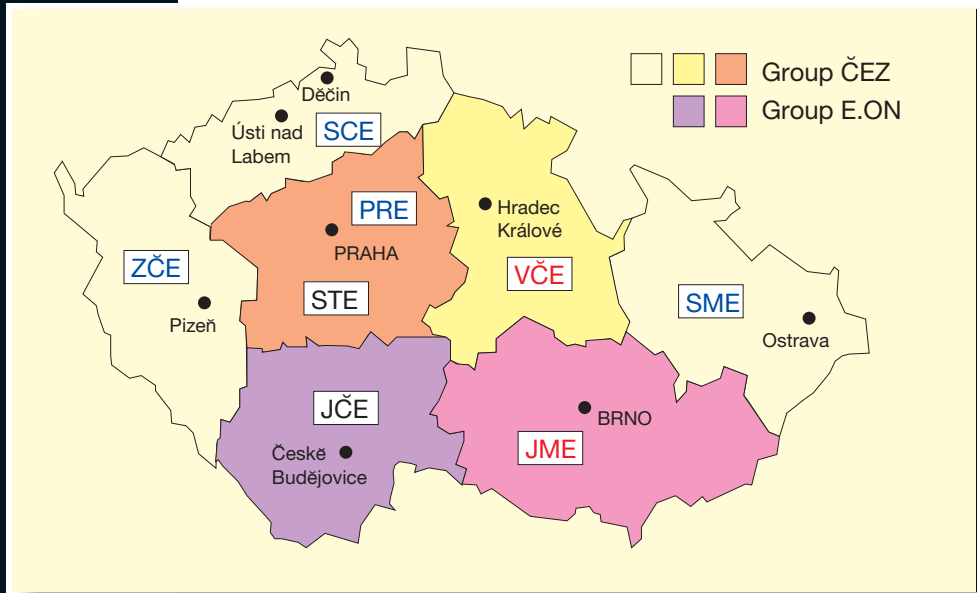
Jan Baltus
Czech Republic

CZECH REPUBLIC

REPORT

Annual Czech up

The Czech Republic had to restructure its energy markets in the run-up to its EU accession one year ago. What has liberalization achieved and what further changes are in store?



▲ The Czech power market is divided between CEZ and E.ON with the one exception of Prague Energy

Countries across Europe have had to accept a new legal basis for operating their energy industries. A variety of laws and directives including an Energy Act in 2001 and directives on power generation from alternative energy sources have affected all countries.

In the Czech Republic, the prospect of these fundamental changes prompted the establishment of a market regulator (ERU) in 2000 and a market operator (OTE). These facilitated the creation of a power market on 1 January 2002 available to eligible customers with the provision of back-up services and energy trading.

Since 2004 all metered industrial and commercial consumers have had the option of choosing their energy supplier, which has resulted in a market that is around 60 per cent open. Full liberalization (extended to the residential sector), is scheduled for 1 July 2007. Alongside this market opening has been the introduction of some privatization in the Czech energy system, including the gas and water industries.

A new and significant element of this change has been the spin-off of the country's power transmission system from the state controlled behemoth CEZ. The Czech Energy Transmission System (CEPS) was

established and assets transferred to this entity. Another notable development was the remerger of five (out of the eight) independent power distribution companies (REAS) and their incorporation into CEZ. Two other distribution companies, South

transmission company Transgas and six out of the eight gas distribution companies. State support for the gas market has led to market distortions and current high gas prices are prompting communities to look to other fuel sources for heat generation. The gas price also affects the possible development of combined cycle power generation in the Czech Republic.

Inside the Czech Republic there are concerns over the relatively high price for electricity charged by CEZ and followed by the other privately owned power companies. The market regulator (ERU) plays a role in setting the regulated components of the power price, which are updated in the annual Price Decision process. These elements include the transmission price, locally determined distribution price, market operator, price for system services, and support for distributed generation, cogeneration and renewables.

Although power prices have risen 11 per cent over the last year, electricity in the Czech Republic is still 21 per cent cheaper than in Germany.

"The dominant position of CEZ on the Czech power market remains, particularly after its acquisition of the distribution companies"

Moravia and South Bohemia Energy were also merged and bought by Germany's E.ON group. The remaining distribution company, Prague Energy, is owned jointly by the city of Prague and RWE. The five merged distribution companies, controlled by CEZ, have formed a new vertically integrated power energy unit that dominates the Czech market.

In its assessment of the Czech Republic's electricity market in 2004 the European Commission (EC) stated that the progress represented only an initial phase of the liberalization process. However, the EC saved most of its criticism for the gas sector, which it said did not have a functioning market at all as the monopoly owner RWE controls both the

Capacity make-up

The Czech Republic has an installed capacity of 17.3 GW, of which CEZ is responsible for 12.1 GW, independent generators 3.4 GW and industrial power plants 1.8 GW. Power production amounted to 84.3 GWh in 2004, with CEZ responsible for 60.4 per cent. The country produces 30 per cent more electricity than it needs and CEZ exported 15 GWh in 2004 to neighbouring countries.

Coal fired power plants account for 56 per cent of generation in the country. Of this, CEZ accounts for 6.5 GW, with independent operators having 2.4 GW and industrial generators 1.8 GW of coal capacity.

CEZ owns nuclear power capacity of 3.8 GW which accounts for 31.1 per



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REPORT

CZECH REPUBLIC

cent of its total capacity. Temelín, close to the Austrian border, is the largest at 2000 MW and CEZ has indicated its intention to extend the operating life of its nuclear fleet out to 2025.

Cogeneration plants account for 18 per cent of power generation capacity and power is purchased from these facilities with the support of the ERU's Price Decision. The country has a number of local and regional heat distribution networks.

"There is a debate in Europe on Russia joining UCTE and we must be prepared for this alternative"

The natural environment of the Czech Republic does not offer many possibilities for alternative energy sources with the exception of biomass. A large expansion of wind power is planned with a target of 500 MW in 2007. Such a dramatic growth would undoubtedly create challenges in terms of reserve capacity and balancing in the transmission network. Czech experts follow wind power generation development in the neighbouring Germany and Austria, if only for the reason that the output regulation and its transmission are already seriously affecting the Czech transmission system in the cross border profiles and making power trades more difficult.

market, particularly after its acquisition of the distribution companies. Attempts to sell the government's interest in CEZ have failed, principally due to the difficulties presented by the company's nuclear assets.

As a result CEZ has switched to a different strategy – to become a dominant energy company in Central Europe, concentrating on markets in Eastern and Southeastern Europe. It was successful in acquiring

the three most lucrative distributing companies in Bulgaria as well as winning the tender for the Romanian distributing company Electrica Oltenia. CEZ has also expressed an interest in power stations in Bulgaria, Poland, Macedonia and Montenegro. It bid unsuccessfully for a Slovakian power plant privatization. Thanks to its new acquisitions in Bulgaria and Romania, CEZ sells electricity to 6.6 million customers. It is also a supplier of supporting services and is a major exporter of power.

CEZ has said that power prices will continue to rise as a result of investment in reconstruction of its coal fired power stations, most of which date back to the 1960s and 1970s. The main investment period for CEZ will fall in 2013 – 2015 when a 4500 MW reduction in installed capacity is expected because of technological obsolescence. This, combined with the anticipated increase in power consumption in the Czech Republic, is expected to eliminate the current power surplus.

Future energy production by CEZ as well as most of the

Republic will have to solve compelling questions of its power energy future including the future of its nuclear power programme; this energy forecast also explains the importance of the privatization of still unsold coal mines.

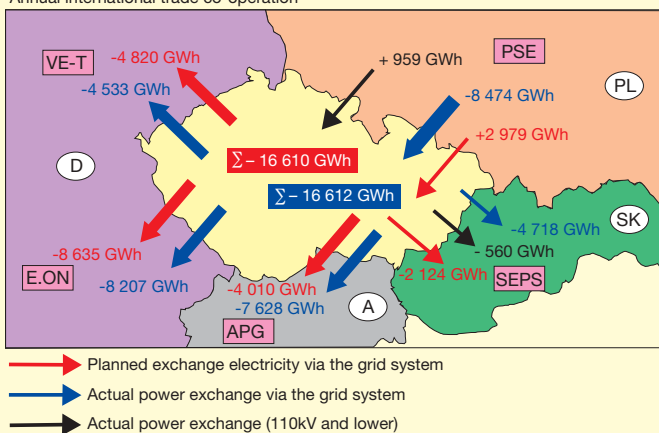
The CEPS spin-off from the CEZ assets appears very positive. CEZ engaged in the EU structures through its membership in UCPTE (currently UCTE) in 1995 and at present it participates in the work of many other European energy bodies, e.g. ETSO or CIGRE. CEPS not only serves the Czech power market but also plays a role in the power transmission between countries. The geographical position of the country in the middle of Europe means this is a key function.

EU regulations require that every country should free up a minimum of ten per cent of its overall transmission capacity for international trade. The capacity available from the Czech Republic system is 20 per cent and it is fully utilized. CEPS accepted the auction system where bid prices are arranged in a descending order and the last price that still applies is used as a reference one. This price for capacity allocation is paid by all satisfied customers.

Despite this, there are certain problems with the cross border profiles due to large volumes of international trade of electric power. Nowadays, huge overpower in the Czech transmission system can be found at the Polish border, reaching as much as 1800 MW. A UCTE study confirms that if power trade between Russia and Germany could be realized, then 48 per cent of such supplied power would cross the Czech Republic. That would endanger the internal stability of the network. For this reason CEPS decided, with the agreement of ERU, to strengthen the internal networks as well. "There is a debate in Europe on Russia joining UCTE and we must be prepared for this alternative," commented L. Petranova, managing director of CEPS.

With this prospect in mind, CEPS has to pay permanent attention to safety and reliability of the energy power system, where for systems services alone, about CZK 8 billion/year (\$333 million) is spent. In the current system the market regulator defines the permissible amount of these funds that are recoverable from customers. Due to its capacity surplus both in output and in its transmission network the Czech Republic is considered to be a country with a well managed and high quality energy system.

Annual international trade co-operation



▲ Power flows between the Czech Republic and neighbouring countries

The Czech government currently subsidizes both power and heat generation from alternative sources, particularly from biomass, but the former high subsidies offered by means of power redemption prices are gradually diminishing. Even so, smaller communities remain interested in using biomass for heat supply thanks to new available technologies and Austrian supplied equipment.

Foreign ambitions

CEZ still dominates the Czech power

independent generators will depend on the use of lignite. About 48 million tonnes of brown coal and 13.3 million tonnes of hard coal is extracted in the Czech Republic every year. However, to secure sufficient amounts of coal for the power stations over the next 30 years will require an increase in the so called ecological extraction limits. These are the limits on the use of coal reserves set by the government in the 1990s as a result of public pressure to preserve the landscape of North Bohemia. It is apparent that the Czech

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■ With approximately 60 % of the power generated, ČEZ dominates the Czech power engineering market. Given the limited growth of the Czech economy (approx. 2 to 3 %), it cannot rely on any dynamic manufacturing and profit jumps in the domestic conditions. What are the territories or what are the projects of the ČEZ Group in which your business will concentrate in the next 3 to 5 years?



There are opportunities for growth, but only gradual growth. Our shareholders expect us to grow more dynamically. If we look at it realistically, we can see that the Czech market is almost fully open to competitors, and we hardly anticipate our market share to experience a significant rise. However, what we definitely wish is to reach the maximum possible profit based on year-to-year increments. The most essential thing we can do for such growth is to place emphasis on growth through foreign acquisitions.

We have taken a strategic decision: we are going to focus on an area we understand and where we have had success. This is the power engineering industry or better the "power generation industry". We want to become the leader in the electrical energy market in Central and Southeast Europe. In the Balkans, we have already succeeded in developing some opportunities after the acquisition of three distribution companies in Bulgaria. We have succeeded in the tender for the Romanian distribution company, Oltenia. In addition to the distribution companies mentioned in this area, we would like to acquire

some generation capacities. That would allow us to make use of some other synergy effects. We have participated in the tender for the sale of three coal-fired power plants in Bulgaria. Moreover, privatisation processes and sales of Romanian power plants could start, as well as the privatisation of the entire industry in Macedonia, Montenegro,

push it through in the framework of the EU structures.

■ ČEZ has grown strongly on the exports of electrical energy to foreign markets. Nevertheless, Europe is considering the purchase and supply of electrical energy from Russia and Ukraine to Germany and Au-



etc. In short, we would like to develop another ČEZ in the Balkans.

The competition in Central Europe will be even stronger. The privatisation process has already been completed in a number of countries. The largest market in this region is Poland. Privatisation has just started in Poland, and it will determine what our position will be like.

If we look at the map, both areas where we are look like two footprints. And if there is something standing on two legs in a straddling position, it is a very stable and firm position. We want ČEZ to be exactly like this.

■ ČEZ has to withdraw from a part of the market due to the decision of the Government of the Czech Republic on the merger of the manufacturing division of ČEZ, a. s. with distribution companies and the opening of the market to competitors (including, but not limited to E.ON). How do you feel about this competitive environment and the fact that the Czech market is entirely open for the major consumers of electrical energy?

The electrical energy market in the Czech Republic is one of the most open ones in Europe. Unlike other countries, there are not any administration or technical barriers at our borders. We would like to see the liberalisation of international trade throughout Europe, as does the European Commission. We will try to

stria. This would be strong competition for ČEZ, a. s., both in terms of the volumes of the offered electrical energy and in terms of prices as well. How do you want, as the ČEZ management, to fight the flood of cheap energy from Eastern Europe?

Firstly, only a part of the electrical power energy may be imported for the control of the system. The share of the sources for the provision of a reliable supply of electrical energy to customers through the development of auxiliary services in the framework of the EU keeps growing hand-in-hand with the growth of the renewable resources and their support. Rendering such services is an interesting business, too.

Secondly, Europe will face a lack of resources in the years to come. The reason is simple: the electrical energy market has emerged just recently and new sources have been developed with the support of the governments in most countries. This changed after 1990. Private investors and companies with a state participation also partly neglected their long-term investments in the existing infrastructure. The power plants throughout the EU need vast renovations. According to Euroelectric, 200 000 MW installed in current facilities are close to the end of their service life and should be replaced by 2020. Moreover, there will be an additional demand for 100 000 MW. By 2030, European countries are believed to need new generation



capacities of up to 520 000 MW (both as a replacement for those still working and new plants). The worries are on the opposite side. Specifically, the worry is that there could be a lack of sources.

■ The foreign expansion of the ČEZ group will not be possible without the mobilisation of the capital and consolidation of state-of-art know-how. Do you think ČEZ can manage it in terms of material capacities and human resources? Do you plan to employ in your foreign projects Czech science, research, design, construction and manufacturing or do you intend, rather, to rely on cooperation with your foreign partners?

All you have asked in your question applies. As to foreign acquisitions, we want local experts and managers to take over a substantial part of the management. We have personal experience with the lack of managerial sensitivity when bringing foreign managers and experts into all levels of the management. Even if the upper management must be foreign for some time, it is best to recruit lower and middle management from the indigenous population. At the same time and as soon as possible, we would like to transfer our technical and managerial know-how to the local market economy. This will require the employment of a number of foreign Czech managers and experts, at least in the initial phase. It is a great opportunity for our people. We have plenty of specialists.

■ Before it had joined the EU, the Czech Republic undertook to implement an environmental tax reform. Any rise in prices of raw materials, such as in coal, would also affect ČEZ. What are you doing to get prepared for it? How do you plan to replace the existing domestic power facilities and when do you want to do it? How do you want to come to terms with the more and more limited domestic resources of coal? Will the mining limits have to be lifted, or will it be necessary to revise these limits in order to increase the generation of electrical energy in the Czech Republic?

There is no doubt about the fact that such a tax reform would have some impacts upon us. However, it will identically impact our competitors. Of course, we will behave in an economical way, depending on how many resources we will require. Dependency on the import of power resources is a nightmare for Europe, a fact that will drive natural gas prices upwards. An advantage we will have in future is a balanced share of resources, that is both old and new coal, nuclear, hydro and gas facilities.

The problem of coal resides in the fact that, given the current mining limits, the resources will be exhausted by 2030. In my opinion, our priority should be the renovation of the coal-fired power plants and addressing the related question of the mining of the remaining coal deposits in North Bohemia. Unlike black coal,

our coal deposits cannot be used for anything else except the generation of power, and they cannot be used to any significant degree in the



chemical industry. We will not hurt future generations this way, anyhow.

■ The adopted power-engineering concept of the Czech Republic envisages, among others, the development and commissioning of additional nuclear units after 2020. Have you already started your preparations for this demanding phase of the Czech power engineering and heat generation industry in terms of research, design and cooperation?

At this moment, we are fully concentrating on the renewal of the coal-fired facilities. However, it is almost too late to meet the conditions for the timely renewal of the Czech thermal power plants. As the investor and opera-

As to nuclear facilities, these are not a current topic. Nevertheless, we have charged our scientists with the preparation of an analysis that should at least outline the basic contours. As far as I am concerned, we cannot manage without nuclear resources in future.

■ The Czech Republic, too, as a new member of the EU, has to identify and exploit in an efficient way the renewable resources of energy. What are the design, development and manufacturing concepts adopted by the ČEZ management for a better and more efficient exploitation of such resources in the country?

I do not have anything against renewable resources. However, their potential in the Czech Republic is not sufficient, and a massive implementation would result into a number of risks that are not known to the public. For instance, wind-powered plants pose an enormous issue in Germany. Not only is the power generated by them more expensive, but their operation is irregular, dependent upon unpredictable fluctuations of the weather conditions. Wind-power represents a risk for the entire system, and our German partners have to work really hard to prevent the collapse of the network by investing enormous amounts to back up capacities in order to cover the outages from the wind-powered plants. Fluctuating outages of 5,000 to 6,000 MW are not so unusual. In such an instance, the German power engineering system works like a giant vacuum cleaner that sucks energy from the surrounding countries, including the Czech Republic. This is very costly, and it exposes Germany and the surrounding countries to hardly-to-believe risks.



tor, we have got into a time trap. What we have to know before we take a specific decision on investments is the decision concerning the future of coal mining. The investment horizon in the power engineering industry, involving all necessary authorisation and approval procedures, needed for the development is very long. After 2010, we have to anticipate a gradual decommissioning of power plants provided with the desulphurisation systems. If we have a surplus of facilities and we can export energy, by 2015, the lack of capacities may amount to 15 %.

Even if we set aside the giant additional extra costs related to the operation of a wind-powered plant, the price of the eolian electrical energy is three times as much and, according to Czech legislation, it is paid by the customers in the price of every consumed kWh. Should we follow the German example, customers would have to pay extra for the development of spare power capacities. The pressure created by German utilities on the increasing prices of electrical energy that we have recently seen is partly due to the dramatic development of their wind-powered plants and their real costs.

Eric Saat & Lennard de Klerk
Global Carbon, The Netherlands

RUSSIA

REPORT

Opportunity NO_x

Russia's decision to ratify the Kyoto Protocol on Climate Change ensured that the treaty would come into effect but what does it mean to Russia itself and will the opportunities to achieve emissions reductions in the country be taken?

With the ratification of the Kyoto Protocol, Russia has ensured accession to the World Trade Organization next year. Now everybody is looking to see whether Russia will become an important player in the emerging Kyoto market and can benefit from the Kyoto Protocol. The potential for the reduction of greenhouse gases, the most important of which are carbon dioxide (CO₂) and methane (CH₄) in Russia is enormous.

will not be any problem. On the contrary, the trading mechanisms of the Kyoto Protocol create opportunities to modernize its industrial infrastructure and further reduce the emission of greenhouse gases.

Under the rules of Kyoto, the Russian state is entitled to sell the headroom to Western governments that are in deficit. However, currently there is a political ban on buying this 'hot air' as the reductions of emissions since 1991 were not caused by any energy saving

but also CH₄, Nitrous Oxide (N₂O) and three other rare gases are considered to contribute to the greenhouse effect. These emissions can be reduced directly at an existing installation, for example using alternative fuels in a cement factory, or can be reduced indirectly e.g. through the construction of a wind farm. In an indirect JI project, electricity is produced for the grid, thereby reducing power generation from fossil fuel fired power plants.

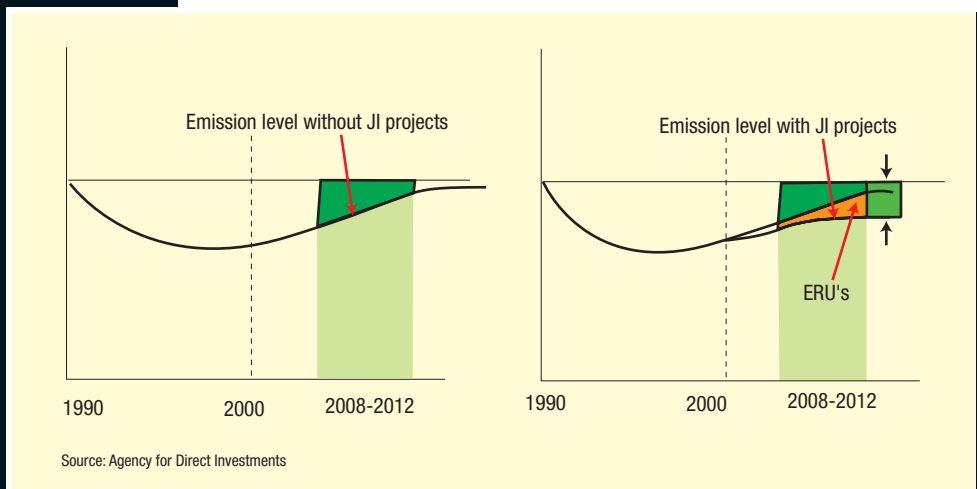
Several categories of project qualify under JI including:

- Fuel switching (e.g. coal to natural gas);
- Energy efficiency measures;
- Biomass;
- Capturing methane at landfills or waste water treatment facilities;
- Wind power;
- Hydro power;
- Afforestation and reforestation

The first three project types in particular have the biggest potential in the Russian Federation. The Russian Ministry of Economy expects that in the period 2008-2012 approximately 200-300 million tonnes of CO₂e will be traded through JI and other project based mechanisms.

Additionality demanded

The Kyoto Protocol sets several requirements for a JI project. First of all the project should be additional. This means in effect that the investment should not be business-as-usual and is not commonly implemented in the market it is operating in. Countries of the former Soviet Union (FSU) often find it difficult to obtain the financial means to undertake projects and the additional revenue arising from a JI project makes it easier to attract financing. Hence proving additionality is in most cases not a problem unless the



Source: Agency for Direct Investments

▲ **Figure 1.**
Reduction of
GHG emissions in
2008-2012 due to
JI project imple-
mentation creates
ground for
stabilization of
GHG emission in
further periods

The Kyoto Protocol sets a cap on greenhouse gas (GHG) emissions that each industrialized country is allowed to emit in the period 2008-2012. The base year of the Kyoto Protocol is 1990 and Russia negotiated a reduction target of zero per cent. After the collapse of the Soviet Union in 1991, the emissions of GHGs went down considerably and as a consequence Russia is expected to be below the Kyoto cap of 500 – 700 million tonnes of CO₂e per annum in the period 2008-2012.

For Russia, like many other Central and Eastern European countries, meeting the Kyoto obligations

policy. Furthermore, were the EU, Canada or Japan to purchase all the 'hot air', there would be hardly any incentive to reduce emissions at home, undermining the environmental integrity of the Kyoto Protocol.

Joint implementation

Most of the attention is now focussed on project-based emissions trading, better known as the joint implementation (JI) mechanism. Under a JI project a concrete investment should be made that leads to additional reductions of the emissions of greenhouse gases. CO₂ is the most common greenhouse gas,





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■ Reader Reply No 99 ■

REPORT

RUSSIA

project has already been constructed. Other ways of proving additionality is the application of new or innovative technology in the project.

Secondly, a baseline should be constructed that indicates the emissions levels arising in a particular case, were the project not to have been implemented. This so-called baseline study should describe the hypothetical 'no-project' situation from the start of the project until 2012. An independent Validator that has been accredited by the United Nations Framework Convention on Climate Change (UNFCCC) should approve this baseline study. After project implementation, the actual emissions should be monitored on an annual basis so that the reductions can be determined. Based on this report, a project owner can claim the emission reductions and transfer them to the buyer.

In recent years, some very good JI projects have been developed in the energy and industry sector in Russia. One of the most prominent projects is a fuel switch at the Amursk cogeneration plant in the far east of Russia, owned and operated by the state monopoly RAO UES. By switching from coal to natural gas, considerable emission reductions will be achieved – up to 1.5 million tonnes CO₂e for the first commitment period. Against current market prices for future delivery contracts for JI credits, the carbon revenue of this project is almost equivalent to the investment costs. The prospective buyer is Denmark through the Danish Environmental agency.

Another good JI example is a 55 MW thermal biomass boiler plant at a particle board and fibre board factory in Kostroma owned by the Swiss Kronoholding. The project will reduce an estimated 1.7 million tonnes for the period 2008-2012. The prospective buyer is the Dutch government through its purchasing programme ERUPT.

On the seller side, more and more

funds are being created to invest in JI projects or purchase the resulting emissions reduction credits. Governments and international institutions have been the most active buyers to date. The World Bank is the dominating market player with several multi-country and national funds. The Prototype Carbon Fund is the best known. The Netherlands has established funds at the European Bank for Reconstruction and Development, while the International Finance Corporation has been one of the biggest buyers through its tender-based ERUPT programme which has contracted for the delivery of more than 15 million tonnes of CO₂e since 2001.

sellers. The biggest challenge for Russia at the moment is setting up an institutional framework necessary to endorse and approve JI projects that want to export JI carbon credits to buyers. According to the Kyoto Protocol, each JI project should be approved by the 'Focal Point' of the selling country. This Focal Point would maintain a national JI log, submit data to the UNFCCC, guarantee offsets transactions and issue and transfer Emissions Reductions Units (ERU). In Russia, this Focal Point does not yet exist although the government is working on establishing such an institution. Even more important will be an established approval procedure and the applica-

“Many private funds are now considering investing directly in (JI) projects, instead of just purchasing the resultant emission reductions”

Market growing

With the start of the European Emissions Trading Scheme (ETS) in January 2005, more and more private buyers such as energy and industrial companies and intermediaries are expected to enter this market. These companies will have liabilities under the ETS in the coming years. When they compare prices of EU allowances and their own marginal reduction costs, against prices for JI credits, the latter will offer an interesting hedge product. The JI credits can be imported into the EU system thanks to the EU linking directive. The price difference between JI credits, currently around €5-6 (\$6-7) and EU allowances (€10-17) will also attract private intermediaries such as banks and hedge funds.

Different structures of JI deals can be observed. Most buyers have up until now only bought the future emission reduction based on future delivery contracts directly from the owner of the project. The price and the volume of emission reductions to be generated and transferred were fixed during the negotiations phase. Lately, hardware suppliers have also stepped in, offering emission reductions from equipment they have installed with their clients. Many private funds are now considering investing directly in the projects themselves, instead of just purchasing the resultant emission reductions.

Missing framework

The emerging carbon market is growing quickly and becomes more and more creative in finding ways to close the gap between buyers and

tion of transparent criteria. This is the big challenge for Russia if it is to open up its potential to buyers becoming more and more eager for JI credits. In other countries such as Bulgaria several JI projects have been approved since 2002. Currently the Bulgarian government applies a very transparent and quick procedure to award projects with JI credits. As the approval comes at the 'end of the pipe' developing a JI project in Bulgaria has low risks.

A number of benefits could flow to Russia through the implementation of JI projects, not least of which would be a reduction of GHG emissions under conditions of economic growth and a macroeconomical cost saving. Extra ecological, social and economical benefits can come from JI projects implemented with public financial support, such as the promotion of environmental activity and innovation. Russia could also meet its obligations on stabilization of GHG emission beyond the bound of the first commitment period.

Russia is potentially a large supplier of emission reductions, but not the only one. Large developing countries like China, India and Brazil are also able to supply emission reductions in a similar way and could present competition to Russia. The ministry responsible, Russia's Ministry of Economy, insists that the JI approval procedure will be up and running in September 2005. If it achieves this, Russia opens up a huge opportunity for both itself and foreign investors to benefit from the Kyoto Protocol.

Table 1: Example Russian JI projects

- Combined cycle cogeneration in Mednogorsk, owner: RAO UES, reductions 37 000 tonne CO₂e per annum;
- Switch from coal to gas in Amursk, owner RAO UES, reductions , reduction of 270 000 tonne CO₂e per annum;
- A 55 MW biomass boiler in Kostroma region, owned by KronoStar, reducing 350 000 tonne CO₂e per year;
- Switch to natural gas at communal heating facilities in the region of Omask, reducing 60 000 tonne CO₂e per year;
- Energy efficiency at Kotlas Pulp-and-Paper mill, reducing 100 000 tonne CO₂e per year.



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■ Reader Reply No 97 ■

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■ Reader Reply No 27 ■

renewable energy review **Offshore Energy**

Simon Rees, Frazer Nash Consultancy, Bristol, UK

The force of the sea

Moving turbines offshore requires a top-to-toe reassessment of the equipment and its response to maritime conditions

North Hoyle was the UK's first offshore wind farm. 'Second round' sites will be farther from the shore. Photo: Anthony Upton

Throughout history, the engineering challenges of the marine environment have been consistently underestimated. The ancients characterized the power of the sea in the myths of Poseiden and the fall of Atlantis, but the oceans have retained the power to surprise us into the present day, and sacrificing chickens has never been truly effective. There are plenty of more recent examples that illustrate the dangers that face us, ranging from the destruction of the Mulberry harbour off the Normandy coast in 1944 to the recent loss of the ferry Estonia.

However, the sea has many more subtle and pervasive ways to destroy than by the force of waves alone. Although there is an ongoing academic debate about the prevalence of extreme wave conditions, this problem is usually recognized by the engineer and dealt with by increasing the strength of the design. Less well appreciated are the problems brought by prolonged exposure to a cold, damp, corrosive atmosphere, with limited opportunities for maintenance. High salinity and poor weather are unfortunately more common in those areas of greatest interest to the potential harvester of marine power.

Marinization

Marinization is not merely modifying a design with materials and redundancies that increase the robustness of the system. Although this improves the quality of the device, it is invariably accompanied by an increase in cost that may not be supportable by the project as a whole. A more thorough approach to marinization is to consider all those factors that would normally be taken into account – cost to manufacture, maintain, replace – and to define an optimum system specification tuned to the actual environment.

For example, consider a ship's hull. A simple material replacement option for a large commercial steel hull, which is prone to corrosion, is to replace it with aluminium. However, in practice it is much cheaper to use sacrificial zinc anodes to protect the hull electrochemically, and accept that they will need to be replaced occasionally. That solution involves two lower specification materials and a maintenance strategy that costs less through the life of the vessel than material replacement.

This may seem an absurdly simple example, and in reality the evaluation of costs and benefits may prove to be considerably more marginal. There will also be constraints to consider when taking existing terrestrial equipment offshore, but these can also

be expressed in the language of life-cycle costing. With a clear and coherent assessment strategy, a balance can still be found.

The probable situation

The probable situation is that there is a proposal to use a device developed for terrestrial use in a marine application. The device will have been proven over a suitable time by testing or service deployment, and the attraction of offshore conditions leads to a financial case for moving out to sea. Such a device may be a wind turbine, for example, whose foundations, tower, nacelle and turbines are all well understood in onshore conditions. Alternatively it may be a wave or tide device.

"In practice it is much cheaper to use sacrificial zinc anodes to protect the hull electrochemically, and accept that they will need replacing occasionally."

In order to maintain reliable performance some degree of marinization is required, but the changes must take account of the costs of modifying the existing design and tooling, and the available capital budget.

Aggressive corrosion problems must be identified and resolved immediately. However, after this essential point the implications of design changes become more complex.

Degrees of freedom

The options open to the developer depend on the degrees of freedom available in the existing design.

Given these freedoms, the options include:

- Changing the fundamental design to make it right for the environment
- Improving the design to allow maintenance with a minimum of effort and cost
- Testing to identify weaknesses, and to define an appropriate management and maintenance regime.

The balance is clear – the more fundamental changes that can be made, the lower the cost of operation and maintenance, but the greater the initial investment. A choice between design routes can only be made on the basis of a properly informed and constructed cost model of the development, and that model requires an understanding of what the design options involve.

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■ Reader Reply No 16 ■

Offshore Energy



Denmark's Horns Rev wind farm. Replacement, with as much work as possible completed on shore, was the answer to generator problems at these units. Photo: Elsam

Getting the design right

Marinizing an existing design does provide the benefit that weak components in the system should be apparent from terrestrial operations. It is reasonable to assume that exposure to the marine environment will only increase the failure rate of those components. It is also reasonable to assume that there will be some components that are perfectly adequate onshore but fail more frequently offshore. Identifying these items and predicting their performance demands a combination of different technologies.

Firstly, there must be confidence in the structural integrity of the design. The designer must know the loads to which the device will be exposed, and the strength and fatigue properties of the materials. Particularly problematic components can be subjected to structural reliability assessments, which utilize statistical assessments of load and material property variations to predict likelihood of failure. This technique is also useful for forensic studies into failed components.

Secondly, the designer must have confidence in the mechanical integrity of the components used. Again understanding physical loads and spectra are essential, but it is at this stage that a thorough assessment of the potential failure modes for each component should be undertaken. Returning to the wind turbine example, there is a move towards direct drive generators and even a return to two bladed designs to reduce the number and complexity of components. Where such radical changes are impractical, de-rating of bearings and other fundamental components can provide significant benefits for reasonably low cost.

"In the damp marine atmosphere apparently reasonable metal combinations become batteries and suffer incredibly rapid reactions"

Seals are another weak point – designs that let surplus lubricant out can also let water in. Condition monitoring is important, with surveys showing that up to 50 per cent of shutdowns of onshore turbines are caused by electrical and electronic systems failures, so the system should include a degree of self-diagnosis and remote override.

Aggressive corrosion has been mentioned above but more subtle and long term problems are inevitable in a marine environment. A factor to take into account in material selection is electrochemical corrosion. This can be used to your advantage, but in the damp marine atmosphere apparently reasonable metal combinations become batteries and suffer incredibly rapid reactions. Even if this problem has been dealt with, marine grade coatings, sealants, lubricants and paints should be liberally applied.

Finally, it is important to think about the configuration of the system. Redundancy should be introduced where design and cost allows, but beware spurious Mean Time Between Failure (MTBF) targets – a redundant system may have twice as many components, halving its MTBF, but its availability will be greater. If an item is either known to be a reliability problem, or is in some way consumable, modularization should be used to allow for easy replacement.

Maintenance at sea

The cost of maintenance at sea is between five and ten times more than on land. That means that a fundamental of the design is that it can be maintained with a minimum of effort and cost. It is absolutely necessary to review the design to ensure that any maintenance work can be done as easily and quickly as possible.

The CEC-Joule funded Opti-OWECS study (see panel) into offshore wind-turbine operations assessed four different maintenance strategies:

- No maintenance. Neither preventative nor corrective maintenance are executed, and major overhauls are performed every

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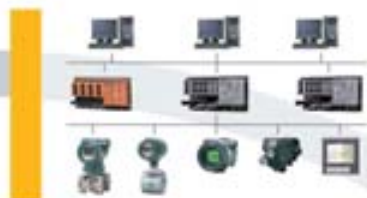
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■ Reader Reply No 21 ■

YOKOGAWA

Offshore Energy

five years or so. One of the few alternatives is exchanging a whole turbine if availability drops below a predefined minimum or after a certain amount of operational hours. Given the current level of turbine failure rates, this option is not presently viable.

- **Corrective maintenance.** Repair is carried out soon after a turbine is down, or, alternatively, when a certain number of turbines are down. No permanent maintenance crew is needed;
- **Opportunity maintenance.** Corrective maintenance is executed on demand and the opportunity is used to perform preventive maintenance at the same time. No permanent maintenance crew is needed;
- **Periodic maintenance.** There are scheduled visits performing preventative maintenance, and corrective actions are performed as necessary by a permanent dedicated maintenance crew.

The study concluded that the designs at that time could not be economically operated with reduced corrective or preventative maintenance regimes because they had originally been designed for a terrestrial environment. However, if the other maintenance

“one of the luxuries that the offshore generating industry does not have is the ability to flood maintenance tasks with labour”

strategies can be implemented there are potentially very great cost benefits. It also concluded that O&M strategy should be optimised with respect to localised energy production costs rather than pure capital or O&M costs.

Looking more widely than the power industry, there are many examples of what can be done to achieve a reduced maintenance load. The commercial aircraft industries are a particularly good example where power companies may be able to take advantage of this experience. There are also many other examples in the process and generating industries, but one of the luxuries that the offshore generating industry does not have is the ability to flood maintenance tasks with labour. Some suggestions of what should be considered are given below.

Modularization, mentioned above in the context of reliable design, will also be a boon to the maintenance technician. The size and weight of modules is a restraint as there are health and safety limits on what a single person can handle, especially as they have to position the item where accessibility is poor. Modules can be made larger as well as smaller if this reduces the amount of maintenance necessary at sea. It is much cheaper to bring something back on land for repair, even if it means towing it, than to engage in prolonged activity on-site, and this strategy is employed by Ocean Power Delivery for their Pelamis device.

Permanent handling gear, integrated with the device, simplifies known maintenance tasks and helps with the manoeuvring of heavy parts. Special multi-functional transportable tooling should be designed where the capital cost can be justified by a reduction in expensive offshore maintenance time. Another time saving feature is an on-board diagnostic system that quickly identifies where problems have occurred. Finally, the designer should ensure that the number of steps in any task is minimized, for example by removing the need to make changes to settings after installation.

All potential maintenance tasks, planned and unplanned, should be subject to a risk assessment (preferably involving someone who routinely undertakes maintenance), and any identified safety hazards designed out. Safety assessment for offshore operations is a major topic in its own right and is not discussed here, but good safety practice stems from good design and must be taken into account from the start.

Test the design

There is no way to get away without testing. It is the nature of marine engineering that something will have been underestimated, or missed entirely, such is the number of different processes of destruction the device must face. The tests that will have been done to prove the performance of existing equipment will, in all probability, be representative of land based conditions. There is a set that is required to prove acceptability for the marine environment, which includes:

- Survival in the marine extremes
- Operation in the marine extremes
- Salt spray.

These expose the device to representative levels of force, moisture, salt and temperature, and are governed by a number of national and international standards (depending on type and level of equipment). However, there is no substitute for the real thing and genuine confidence in the technologies can only be obtained from a prolonged trial at sea.

Even when a design is proven for the marine environment, installed and running, the job is not over. A marine application will require appreciably more effort to manage and maintain throughout its life than an equivalent land based item, the problems it experiences will be more acute and the frequency with which these problems arise will be greater.

Operational costs will never be as low as on land, as even routine tasks will be harder to execute. However, the environment that poses these problems is far richer in energy resource than the land, and providing the cost implications of marine design, operation, maintenance and disposal are understood there is no reason why the rewards should not be reaped. **PEi**

Europe's sea view

In 2001 an EC funded project, Concerted Action on Offshore Wind Energy in Europe, acknowledged that “Operation and maintenance of offshore wind farms is more difficult and expensive than equivalent onshore wind farms”. Onshore wind turbine availability levels are generally very high – in excess of 97 per cent with appropriate servicing and maintenance. In practice, this typically equates to visiting a wind turbine four times a year, either for regular service or for repair tasks.

However, offshore conditions cause more onerous erection and commissioning operations and accessibility for routine servicing and maintenance is a major concern. During harsh winter conditions, a complete wind farm may be inaccessible for a number of days due to sea, wind and visibility conditions.

Among the other points made in the report:

- Onshore equipment can be sourced and mobilized within a short period of time, usually within hours, and is available on site within a day. Offshore lifting cranes are uncommon, and will generally have to travel a considerable distance to site;
- Access to the turbine may be difficult or impossible in harsh

weather conditions due to wave heights, wind speeds and poor visibility. There are a number of projects addressing the issue of improved access;

- Electrical and control system failures account for the highest percent age of failures. Typically, failures of this nature occur due to the number of components, poor electrical connections, corrosion, lightning strikes, etc.;
- Wind farm sites being considered in the North and Baltic Seas present harsh maritime. Cathodic protection technology of subsea structures is integral to the front end engineering design, with due consideration of modern paint systems and metal spray coatings, particularly for application within the splash zone;
- More work is needed in developing support structures which can withstand stresses caused by wind and wave loading, together with reductions in material fatigue strength caused by corrosion;
- Power for the turbine controller, electrical actuators, monitoring and communications systems are drawn from the turbines gross output, or imported from the grid system. In the event of loss of power generation or lost electrical grid connection, backup power is required.

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■ Reader Reply No 15 ■

renewableenergy review

Solar Power

Paula Mints, Senior Photovoltaic Analyst, Strategies Unlimited, California, USA

Achieving the potential



Sales of solar photovoltaic modules grew 54 per cent in 2004 – achieving an industry goal of 1 GW in sales. Indeed, sales growth in the solar PV industry has been enviably strong for the past eight years, driven primarily by the extraordinary escalation of its grid connected rooftop application. Along with strong growth in 2004 have come rumours of profits in a historically unprofitable industry, and even the investment community is experiencing an up tick in interest in solar investments. Does this mean that the solar electric industry has arrived at a point where it can overcome barriers of cost, marketing naiveté, and reliance on government subsidies to achieve its potential? There is, unfortunately, a long history of the industry failing to do just that, but industry history does not necessarily have to foretell the future.

Supply constraints and demand spurts continue to take the PV industry by surprise, despite historical context for both. The industry has typically not done a good job of supply chain management. For one thing, there are still too few dedicated suppliers of solar grade silicon. For another, even silicon suppliers who promise the PV industry a dedicated supply generally only commit to a fraction of the industry's requirement.

Meanwhile, PV's demand for silicon continues to grow. In 2004, semiconductor industry and PV industry demand for silicon was on the order of 32 000 tonnes, of which approximately 41 per cent came from the PV industry. Assuming current

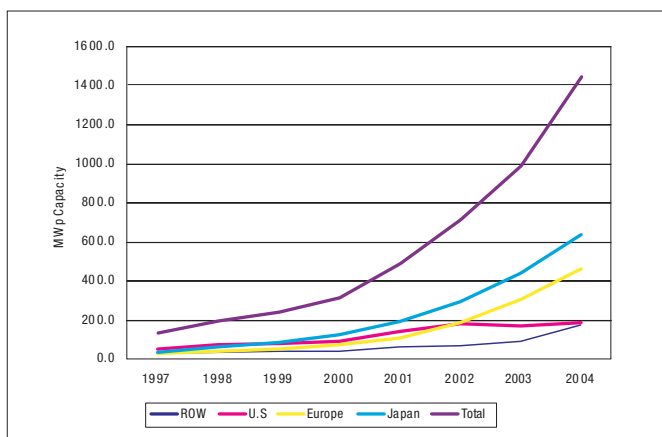


Figure 1. Industry capacity increases by region and in total (1997-2004)

In the midst of another period of a rapid expansion, there are major issues which must be addressed this time round if the PV market is to overcome its growing pains and reach maturity.

industry growth, by 2006, PV industry demand for silicon should be equal to that of the semiconductor industry. Though an argument can be made for the maturing of the semiconductor industry (and thus the slowing in demand), when push comes to shove, silicon suppliers will continue to sell to the highest bidder putting a financial and supply strain on PV wafer and cell manufacturers. Case in point, in 2004, the PV industry was forced to pay close to \$50/kg for its silicon feedstock, double the price paid in previous years. Historically, the semiconductor industry has understood and proved willing to pay a higher price for its starting material, while the PV industry has dragged its feet in this regard. Given the high probability of future price wars, the PV industry may need to consider competing with the semiconductor industry on its own terms – in other words, pay a higher price for higher grade silicon. Of course, the PV industry can also better control its silicon future by using half as much silicon (thinner wafers, higher efficiency cells).

The market direction

A problem that is not easy to solve for cell and module manufacturers as well as providers of silicon material is how to strategically manage manufacturing capacity increases based on government programmes. These programmes, both performance and capacity based, still drive PV industry demand, especially for the grid connected market. The market for remote PV applications, traditionally the backbone of the PV industry and still experiencing healthy growth (around 15 per cent per year), gets short shrift these days, even though it is generally independent of subsidies.

PV manufacturers face uneasy choices in terms of rapidly increasing manufacturing capacity to serve periods of high demand, or slowing building capacity to avoid an idle factory in case of slower demand and feedstock shortages. Take a conservative road and you miss out on high demand and the ability to price at a profitable margin. Take an aggressive road and you may be stuck with excess capacity and product, and face the choice of selling it at negative prices. Cell and module manufacturers must bet on continued government support, high demand, and a consistent supply of silicon in order to make the leap of faith (not to mention the capital investment) required to ramp up capacity.

In 2004 as demand soared, driven primarily by Germany's hyper successful feed in tariff law, industry wide optimism coexisted with feedstock supply anxieties. Sales to the difficult US market took a back seat to Europe and even the US selling channel was guilty of avoiding domestic sales to take advantage of quick and easy sales to Germany – that is when module product could be found at all. Many in the sales channel, particularly in the US, found themselves waiting months to receive their supply from manufacturers. Profitable short term tactics proved more compelling than tackling traditional industry practices such as poor product development, naïve marketing strategy, inefficient supply chain planning, and overcoming dependence on government subsidies, practices typical to the industry.

Historically, the sales channel (dealers, distributors, system integrators and installers) has wielded a great deal of control in the PV industry. In terms of sales channel strategy, it continues to be time consuming and expensive for manufacturers to support. In the long term, this support remains necessary, even as the

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■ Reader Reply No 31 ■

Solar Power

industry undergoes the necessary growing pains. In the short term, particularly in a high demand year, it becomes tempting to give short shrift to these relationships and focus on ready profits. This tactical view forgets that market development depends on maintaining relationships and perhaps passing up part of the value gained by serving the current high demand.

Global markets

This is not to state that all industry players think only tactically and for the short term. Some manufacturers continue to nurture their relationships with mid-size selling channel participants while also developing projects with, and designing products to serve, end-use customers. At the same time, some sales channel participants are focusing on partnerships with the building industry for the residential rooftop market, and on developing projects for the grid connected commercial application that make good business sense even without subsidies. A period of high demand, such as the one in which the industry now finds itself, offers an opportunity to begin responding to the market instead of reacting in knee jerk fashion to its every signal. This is a good time to remember what happens when demand subsides and to plan for the time when government support again becomes questionable.

Once the world-wide leader in regional manufacturing and shipment, the US position began to slip in 1999. Lower manufacturing costs and higher demand in other regions began to influence the location of manufacturing capacity. In terms of sales, the US lost the number one market share position as Japan's rooftop programme enabled its regional manufacturers to build enough capacity and sales to become the market leader. Meanwhile, shipments from cell and module manufacturers in Europe began to increase with sales rising 93 per cent during 2000, surpassing that of the US in 2002. From 1997 through 2004, the compound growth rate for shipments from US manufacturers was the lowest of the four main regions, at 17 per cent.

As with those in Europe, Japan and US manufacturers began announcing capacity increases in 2004. But these increases are not necessarily to serve the US market. Instead a weakening US dollar along with the lure of easy sales to Germany, have led to most manufacturers devoting less attention to the difficulties of the US market. This is not just because Germany is clamouring for product. It simply is not easy to sell to the US market with its sometimes irrational interconnection schemes, varied incentive programmes, not always friendly renewable portfolio standards, and generally low electricity rates.

"A period of high demand offers an opportunity to begin responding to the market instead of reacting in knee jerk fashion to its every signal."

The US market should continue experiencing steady growth going forward, though nothing like the extraordinary growth experienced in Germany and Japan, and that predicted for China. Although it currently has little grid connected market, China's incredible economic growth and the coinciding hunger for a stable electricity supply may soon change that situation. The country has at least one large, 8 MW, grid connected project in the works for 2005. Moreover, China's need for rural electrification must be met in order for its economic growth to continue.

Europe and Japan have higher energy prices, a real commitment to the environment, and a realization that solar is good business (meaning jobs and personal, corporate, and tax revenue). In these two areas, for many reasons, solar makes economic sense. When surveyed, US customers who bought solar electric systems listed 'the environment' as part of their buying decision, but importantly, it was not a key reason. In the US, if the economics work for the buyer, then any benefit to the environ-

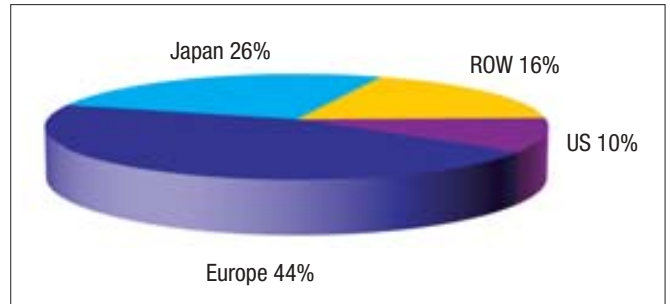


Figure 2. Global demand by region (2004). Germany alone was responsible for 36 per cent of total global demand.

ment is a perk, not a factor in purchase. Rational buying behaviour tends to err on the side of practicality. The successful German programme is an example of how well a profit motive can marry with environmentalist instincts. With the German system, a photovoltaic system owner can make money by selling electricity to the utility. This system has been likened to a twenty year annuity. In the US, in general, net metering rules also encourage system purchase by enabling system owners to watch their meters 'spin backwards,' thus offering the potential of zeroing out the owner's electricity bill. The US system is fine, but Germany has proven that motivation to install can be taken to a higher level.

To sell into the vast, sleeping bear that is the US market a manufacturer needs courage, fortitude, and a very good long term strategic plan. It is little wonder then that a lot of cell and module manufacturers have been left pondering if it is all worthwhile. This does not mean that the US market is being ignored. BP Solar has announced a \$25 million expansion of its Maryland facility; Sharp Solar remains committed to its MODCO in Tennessee, and system integrator PowerLight continues to pioneer the grid connected commercial market.

A bright future for solar PV?

In 2004, even given the limits of silicon feedstock supply availability, photovoltaic cell and module manufacturing capacity expanded and new companies prospered. As the battle for product grew intense, hard feelings began to surface in the sales channel. PV distributors (in this case referring to the supply chain in general) did not control price – an atypical situation for the PV industry. This situation, while good for cell and module manufacturers, and also for large distributors and system integrators, put a strain on the ability of smaller members of the selling channel to compete.

In the end, despite the accompanying pain, the industry needs a reassessment of the way it does business in order to continue towards a sustainable model and consistent profitability. It should succeed if manufacturers can use this period to develop strategies that serve the long term, including addressing industry goals of a lower cost structure, while also encouraging market demand that is independent of government subsidies. Doing so may require forgoing some easy profit, or, ploughing some of it back into marketing programmes. In the past, the industry has complained about the lack of funds available for an industry wide marketing programme. This excuse will not exist in 2005.

Despite industry optimism, yearly demands at levels of 40 per cent and up do not appear to be sustainable given the constraints of silicon material supply and the uncertainty of grid connected subsidies. Optimism should be encouraged, but as a necessary component of risk. Overlooking substitute products, customer objections, the world-wide economic situation, and a lack of control over the supply chain will not take the industry in the direction of steady demand. It should be a market that has been crafted, instead of one that reacts wildly to situations of excess demand and insufficient supply. **PEI**

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■ Reader Reply No 22 ■

Exploiting hidden depths

The ERBD-backed Mutnovsky geothermal power station in Russia's Kamchatka region has reduced local dependence on imported fuel and improved power supplies. Although it has lost its status as a true independent power project, Mutnovsky may serve as a model for future developments.

Russia's renewable energy resources are vast and as yet little exploited. The country's substantial fossil fuel stocks have served to overshadow the potential that renewable energy offers. Of these resources, geothermal energy represents a substantial proportion with usual economic estimates of geothermal resources at 115 million tonnes of coal equivalent (mtce) out of total renewable sources in Russia of an estimated 275 mtce.

The Kamchatka Peninsula and the Kurils Islands, on the far eastern edge of the Russian Federation, hold the richest geothermal resources in the country. In Kamchatka, there are 150 thermal springs groups and 11 high temperature hydrothermal systems. Exploration of geothermal fields in Kamchatka started in the 1950s, since when about 400 boreholes have been drilled. Studies have shown that the geothermal reservoir is adequate to ensure the operation of a geothermal power plant with more than 300 MW total capacity. The first geothermal power station in the region, Pauzhetskaya, with an installed capacity of 5 MW, was built in 1967, and it is still in operation with current capacity of 11 MW. A 12 MW geothermal station, Verkhne (Upper) Mutnovskaya, was also built in the Mutnovsky geothermal field, and this is also still operating.

Geothermal projects

The Mutnovsky geothermal field is located south of the city of Petropavlovsk-Kamchatsky, the administrative centre of the

Kamchatka region. In 2001 the first stage of the 50 MW Mutnovsky geothermal power project, located about 120 km from Petropavlovsk-Kamchatsky, was constructed. The plant consists of two 25 MW units and when the second unit was built in 2002 it became the largest geothermal installation in Russia.

The project is owned and operated by the Russian joint stock company Geotherm SC (Geotherm) as an independent power project (IPP) and cost a total of \$150.2 million. It was among the first IPPs in Eastern Europe and operates in accordance with a power purchase agreement (PPA) selling electricity to a single client, the power distribution company Kamchatkaenergo. Geotherm's only fixed assets are the concession to exploit the Mutnovsky geothermal field and the 12 MW Verkhne-Mutnovskaya power plant.

"Today, the total electricity generation capacity based on geothermal energy in Kamchatka is 73 MW, accounting for a quarter of the region's power supply"

Power generated from the Mutnovsky resource is transported along a purpose built 220 kV transmission line to the Avacha substation, a distance of 90 km, where it connects to the Kamchatka electricity grid. Given its remote location, the Kamchatka grid is not connected to the rest of the Russian power network and so the region relies on electricity generated locally, mostly by oil fired CHP plants, using imported fuel.

Project Finance

The majority of the finance for the project resulted from a loan from the European Bank for Reconstruction and Development (EBRD), the single largest investor in Central and Eastern Europe. The project fitted the EBRD's remit to develop the private sector in emerging democracies with an eye to sustainable energy initiatives. The EBRD provided a \$99.9 million sovereign loan to the Russian Federation, which was then lent to Geotherm, with a fifteen year maturity (including a five-year grace period). Other finance came from RAO Unified Energy Systems of Russia, the Kamchatka Regional Administration (Kamchatka Oblast) and Kamchatskenergo SC. Loans represented 65 per cent of the project budget with shareholders providing 35 per cent.

The project originally involved the construction of a geothermal power plant of 44 MW total capacity at the Mutnovsky geothermal field. Through the efforts of engineers on the project, this was expanded to 50 MW. The EBRD employed a team of international consultants from WestJEC in Japan and New Zealand's GENZL, along with Russian company Nauka, to carry out a feasibility study of the project, prior to agreeing the investment. The



Figure 1. The site of the Mutnovsky geothermal power station

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■ Reader Reply No 33 ■

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Geothermal Energy



Figure 2. Due to the conditions, all plant and equipment are located inside.

environmental benefits included the option to close an old oil fired combined heat and power plant in Petropavlovsk. Since road and transmission infrastructure was largely already in place, there would be limited environmental impact outside the site as a result of the construction.

Procurement of all goods, works and services for the project was undertaken using international competitive tender procedures in accordance with EBRD rules. A total of 14 tenders were issued including three main engineering, procurement and construction (EPC) contracts. These were awarded to GUP VO Technopromexport for the power plant, OCS Kamchatskagropromstroi for the fluid collection and disposal system and the Vostokgeologia GP Mutnovka consortium for the well drilling. Although Russian companies handled the construction of the power plant, steam field facilities and drilling works, foreign subcontractors participated in the project. Siemens supplied a teleperm ME distributed control system (DCS) and 220 kV gas insulated switchgear as well as providing training to Russian staff, while Alstom were responsible for relay protection equipment. The US firms Psychrometric Systems and Cameron supplied mechanical draft cooling towers and well head equipment, respectively.

Site conditions

The geothermal field is located 800m above sea level. A 130 km long road was built to connect Petropavlovsk-Kamchatski and the site. The nearest village is 50 km from the power plant.

Climate was a key factor in the design of the power plant and continues to be a challenge for plant operators. Winters are long with frequent snowstorms and average snow cover height is 4m, reaching 17 m in valley areas. Due to the severe climatic conditions all plant and equipment are located indoors, including steam field equipment such as wellheads, separators, control valves and silences. Buildings on the site are all fully heated using geothermal fluids and are connected with elevated bridges to avoid operating personnel having to venture outdoors in winter. The power plant and steam field facilities are designed to allow for unmanned and remotely controlled operation with the DCS linked by satellite to Petropavlovsk-Kamchatski and Moscow.

Today, the total electricity generation capacity based on geo-

thermal energy in Kamchatka is 73 MW, accounting for a quarter of the region's power supply. The use of geothermal has reduced the region's dependence on expensive imported fuel. In late 2002, AO Kamchatsenergo paid 5750 roubles (\$182) per tonne of black oil, which is the highest price among the plants within RAO UES. By using geothermal energy, Kamchatskenergo's imports of fuel oil have fallen by 90 000 tonnes, down from 480 000 tonnes previously demanded for power generation.

In addition to the economic benefits, geothermal based electricity generation has improved the ecological situation in the region. Emissions of greenhouse gases (GHG) and local pollutants are estimated to have fallen: CO₂ by 1.6 million tonnes per year, nitric dioxide by 8 thousand tonnes per year, sulphurous anhydride by 11 thousand tonnes per year and ash by 650 thousand tonnes per year. The additional installed capacity in the region will enable environmentally damaging old fossil fuel fired plants to be decommissioned including the oldest combined heat and power plant in the city of Petropavlovsk.

Independence compromised

The Mutnovsky geothermal project established the first independent power producer in the region, very much in line with the objectives of Russia's reform programme for its electricity sector. Subsequent events have however caused the ownership to vary from its original model, with RAO UES now the majority shareholder. The local shareholder, Kamchatka Oblast faced mounting debts from oil imports and Kamchatskenergo have suffered a loss of revenues as a result of a change in VAT rules. In both cases they were unable to meet their obligation to the project and RAO UES stepped in to provide finance and take over the shareholdings.

"The project has been a success. We have a state-of-the-art power plant producing clean energy that has prevented the blackouts previously commonplace in the region"

The EBRD was not unhappy about the involvement of RAO UES at that stage and remain positive about the project. This was despite Geotherm having to accept a lower tariff for the plant's output after the local regulator and Kamchatskenergo sought revisions to the agreed tariff calculation methodology just before construction was completed. Grzegorz Zielinski, associate banker with the EBRD's Power & Energy Utilities Division, who has been closely involved with the project said, "The Mutnovsky Geothermal power project has been a success. We have a state-of-the-art power plant producing clean energy that has prevented the blackouts previously commonplace in the region." Mutnovsky was the first major renewable energy project for the EBRD and so far is the only geothermal electricity investment the bank has made.

Future expansion

Geotherm has plans to further increase geothermal capacity in Kamchatka over the next few years. The potential capacity of the Mutnovsky field alone is estimated at 300 MW. A business plan has been prepared for the next phase of the development; most likely an additional 100 MW located on two adjacent sites and connected by short transmission line to the existing 50 MW plant. In parallel, Geotherm is expanding the 3 x 4 MW Upper Mutnovsky plant by adding a fourth unit.

The EBRD has reviewed the proposals for the next phase of expansion at Mutnovsky but has declined to participate at this stage. "We looked at the business plan and although we liked the proposals, the financial condition of Kamchatskenergo meant that we could not go ahead privately without a sovereign or RAO UES guarantee," said Zielinski.

PEI

Table 1. Turbine Main Technical Characteristics

Turbine type	K-25-06-Geo
Output at generator terminals	25.0 MW
Steam flow rate	154.5 T/hr
Rated steam pressure	6.2 bara
Steam dryness at turbine inlet	0.9998
NCG content (by weight)	0.4%
Condenser pressure	0.05 bara

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■ Reader Reply No 62 ■

Wind of change for India

India has muscled itself toward the top of an industry dominated by developed nations. The question now is how it will adapt to tap the rest of its vast resource.

New technologies and emerging nations do not often marry well. There is often not the confidence, the will, or the incentive to take the necessary risks in order to make a new industry a success. India has broken this mould to establish itself in among the big players in the wind energy industry, but this somewhat surprising emergence has left those involved pondering what shape the market will take in the future.

In March 2005, the World Wind Energy Association declared India as the fifth largest country in terms of installed wind capacity and third in terms of capacity installed over the last 12 months (behind Spain and Germany). As well as having the greatest wind capacity in Asia, by the end of 2005 the country is also expected to overtake Denmark, home of one of the longest established wind industries in the world, to occupy fourth position, one place behind the USA.

With 45 000 MW of untapped potential, according to the Indian Wind Energy Association (INWEA), India has been blessed with a great natural platform from which to encourage wind energy development. A strong south west summer monsoon from May to June brings cool humid air, while a winter monsoon ensures a supply of cool dry air. In addition, from March to August, strong winds prevail over the majority of the subcontinent.

While some of the reasons behind India's emergence are down to the natural resources and a maturing of the more established industries, to put its growth purely down to these factors would be unjust, especially when considering the scale of the projects involved.

"In the early 1990s, about 90 per cent of the wind turbines in India were in the 200-300 kW category" says Glen Reccani, county manager, GE Energy. It is only now that the country is

beginning to see global companies bringing their megawatt class wind turbines into the market. For example, GE has installed over 3000 of its 1.5 MW wind turbines worldwide and yet they were installed in India for the first time just last year. The Indian market is one which has recently grown from 200-300 MW per year of new installations, to an 1100 MW market annually, and yet the average size of a wind farm remains at 5 MW.

Ansand Bansal, sales leader of GE Energy's wind business, believes the practicalities of wind and the incentives offered by the federal and individual state governments have been key factors in the growth: "In this expanding economy where the demand for power outpaces the supply, wind is a major source of power due to its short cycle characteristics and its attractiveness due to depreciation benefits."

"If and when the utilities become involved in wind energy, some speculate that 100, 200 or 500 MW projects could be developed"

National and state incentives

Six states currently provide around 98 per cent of the total wind capacity, of which Tamil Nadu makes up nearly 50 per cent. This is down to the favourable wind conditions in these states and the renewable incentives they offer. While the government has set the basic levels of depreciation and import duties, the state governments compete with each other for development. These incentives range from wheeling to buy back rates, but most are focussed on the commercialization of the technology and not the long term development and performance of wind energy. Jami Hossain, from INWEA, comments: "Different states have different policies. Generally the state government allows the developer to set up a wind farm at any location in the state and then to wheel the electricity generated to a developers unit. Most of the projects are captive power projects and there are very few independent power projects."

Herein lies India's next challenge. There is often speculation over mega scale wind projects, which would see the Indian market conform to a more familiar pattern, but so far this has remained mainly speculation. If India is to sustain growth levels of 40 per cent and make sizeable progress toward using more than seven per cent of its wind resource, it will have to turn this speculation into reality.

In February of this year, INWEA publicly called on the Indian government to introduce a performance based incentive scheme to help attract new investment to the industry. A scheme such as this would replace the existing practice of accelerated depreciation, which is often at the rate of 80-90 per cent. Arguments for the change come from many sources and range from ideas that many IPPs and foreign investors have been shut out of the market as they are unable to benefit from the depreciation, to the sug-



Figure 1. In 2004 GE installed its first 1.5 MW wind turbines in India, for Nuziveedu Seeds Limited based in Karnataka Province.

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■ Reader Reply No 35 ■

Wind Energy

Table 1. The World Wind Energy Association's installation figures as at 31 December 2004.

World ranking*	Country	Total capacity installed	Capacity installed in 2004	Rate of growth in 2004 (%)
1	Germany	16 628 MW	2019 MW	14
2	Spain	8263 MW	2061 MW	33
3	USA	6740 MW	370 MW	6
4	Denmark	3117 MW	7 MW	0.2
5	India	2985 MW	875 MW	42
6	Italy	1125 MW	221 MW	24
7	The Netherlands	1078 MW	170 MW	19
8	Japan	896 MW	390 MW	77
9	UK	888 MW	240 MW	37
10	China	764 MW	197 MW	35
14	Canada	444 MW	122 MW	38
17	Australia	379 MW	181 MW	92

* = in terms of total wind energy capacity

gestion that some wind farms are poor performers because they have mainly been set up as tax shields.

Jake Burnyeat, of Ernst and Young's (E&Y) Renewable Energy Group, says: "Performance based support by way of tariff or renewable portfolio standard has worked in all major markets so far and it is important, for investor confidence, that India adopts a support system that is transparent and that has been proven elsewhere." According to Burnyeat and his colleague, Nikita Addams, India's economy is currently evolving from a corporate tax based system toward a VAT based system, reducing the significance of tax based investment as an incentive driver and leaving it in the hands of more traditional industry drivers such as high energy prices and long term power purchase agreements.

Appetite for wind

India's Electricity Act 2003 mandates that all State Electricity Boards unbundle their assets by 9 June 2005 and so far only two states have applied for extensions. Although this Act does not enforce privatization, it is seen by many industry spectators as the start of a process that will bring India further into the realms of the traditional wind markets, with utilities playing a larger role responding to demand, enforcing efficiency and reacting to the environmental pressures placed on large companies. GE's Bansal agrees that it would take the involvement of utilities to take growth to the next level.

With regard to the cost effective practices of project management, he says: "It is difficult to convince customers who are not familiar with the power business to take on these responsibilities." He continues: "If and when the utilities become involved in wind energy, some speculate that 100, 200 or 500 MW projects could be developed."

There is no point in developing projects of this scale if there is nowhere to transmit the electricity. Much of the wind energy in India has been developed as captive generation, as the grid infrastructure is not able to handle larger loads efficiently.

However, as highlighted in the largest wind resource assessment programme, carried out by the Ministry of Non Conventional Sources of Energy, India has the same problem as many other countries pursuing wind generation: potential wind farm sites are generally located in remote areas. These sites carry the fear that if a large wind farm was to be developed without the necessary infrastructure, the electricity generated could not

be exported – a fatal deterrent to investors. As well as the ongoing process of improving grid infrastructure, the federal government is currently considering a proposal that would make bulk trading of electricity from wind farms between states much easier.

There is belief within the industry that India can overcome market uncertainty, capital intensive practices and a grid infrastructure that is not as well developed as those above it at the top of the world league table (Germany, Spain, USA and Denmark). GE's wind business has established a head office in Bangalore and three site offices as well as assembly facilities in Chennai. The Danish firm Vestas has also set up a practice in India.

If India is to build upon its current installed capacity it will find itself in competition for investment with countries who are also emerging in the wind industry. First among them are Australia and Canada where, unlike in India, utilities are readily supporting wind growth.

Addams believes that although India has comparable exploitable wind resources and a fast growing economy to drive prices up, there are some market weaknesses in comparison: "Australia and Canada are considerably smaller markets than India yet offer more investment certainty, with the national renewable energy certificates and tariff support mechanisms, respectively; grid access rules are transparent and the planning environment is generally very benign in these countries."

Triggered by a market orientated strategy adopted in 1983 to encourage commercialization, India's wind energy growth has been achieved without large scale projects and without mass foreign private investment.

Whether it will hold its current position at number three in the world in terms of newly installed wind capacity remains to be seen. Much more pressing is the question of whether the new model India has created, which enabled this growth, will sustain this level in the future or even take the country on to the next level. Around 20 per cent of the population is still without access to power and the small captive projects could keep momentum in the industry ticking over. But if the country is to surge forward, take advantage of its natural resources and those prepared to invest, it will have to adapt its policies at a state and national level.

The first call is to create a mechanism that will enable grid access, supported by long term bankable power purchase agreements for the power generated by the new wind farms. **PEI**

Table 2. Comparison of incentives, capacity and potential between Indian states

State	Total installed capacity* (MW)	Gross potential (MW)	Captive Use	Wheeling of energy (%)
Andhra Pradesh	101	8275	Not allowed	n/a
Gujarat	218	9675	Allowed	4
Karnataka	274	6620	Allowed	20
Kerala	2	875	Allowed	5
Madhya Pradesh	26	5500	Undecided	Undecided
Maharashtra	411	3650	Allowed	2
Rajasthan	212	5400	Allowed	10
Tamil Nadu	1684	3050	Allowed	5
West Bengal	1	450	Allowed	2
Others	3	2990	n/a	n/a
Total	2932	46 485	n/a	n/a

* up to 31/09/04



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Emissions Trading

Dr. Theo Fens and Berend Olde Rikkert, Capgemini Energy & Utilities Consulting Practice, The Netherlands

As dust begins to settle after the birth of the EU's emissions trading scheme, the effects on the market are becoming clearer. One Dutch utility has taken steps to ensure it is ready to reap rewards from the unfolding potential.

Learning the trade

A few months into Europe's emissions trading scheme (ETS) and the 15 EU countries committed have already managed to reduce emissions of the key six greenhouse gases to 2.9 per cent below the 1990 level.

On the surface this appears to be a good start but the latest projections suggest that measures so far implemented at a national and European level are unlikely to cut emissions levels by 2010 to more than one per cent below the 1990 ceiling – far short of the targeted eight per cent below 1990 levels by 2012.

While it is arguably too early to say whether the European ETS has been a success, it has certainly highlighted a number of weaknesses within the European energy market and is acting as a powerful force for change whose impact seems likely to go far wider than emissions management.

One of the most obvious impacts of the ETS was the rapid increase in the cost of carbon certificates. In April 2005, prices per certificate reached around €15, compared to around €7 in January and February.

These price increases have been largely fuelled by the recent spell of cold weather across Europe which led to an increased demand for power. At the same time, an associated increase in demand for gas pushed up prices and prompted power generators across Europe to switch to spare capacity coal fired plants in a bid to meet the increased demand, while also controlling costs. This increased demand for the finite supply of carbon certificates pushed up their prices, a classic case of demand-induced inflation.

–“Kyoto and the European emissions trading scheme are accelerating the need for security of supply issues to be addressed”

This spike in power usage caused by the cold spell would have happened with or without the European carbon trading scheme. What made this period particularly noticeable was the increased costs power generators had to bear. Through buying more carbon certificates at an inflated price in order to enable them to

switch power generation to spare capacity in the form of coal fired production, the market encountered a new form of price pressure. It also exposed the lack of available peak level capacity across some European countries and highlighted the importance of security of energy supply.

Kyoto and the European emissions trading scheme are accelerating the need for security of supply issues to be addressed and new low emissions power generation plants to be developed in response. Failure to do so will see the sort of pricing and supply instability that was experienced across the EU during the recent cold spell becoming more the norm.

Stable prices

Given that the European Commission forecasts a 44 per cent increase in power consumption across Europe by 2020, if power prices are to remain stable, then a significant investment in low emissions power generation, such as nuclear and renewable energy, seems the most likely outcome if across the board increases in energy prices are to be avoided. If this capacity issue is not addressed, and we continue to rely on coal fired power generation, then the 50 per cent increase in the price of carbon certificates we have seen recently, will merely be the tip of the iceberg.

Coal fired generation will not meet existing energy requirements, let alone secure future power needs at a price

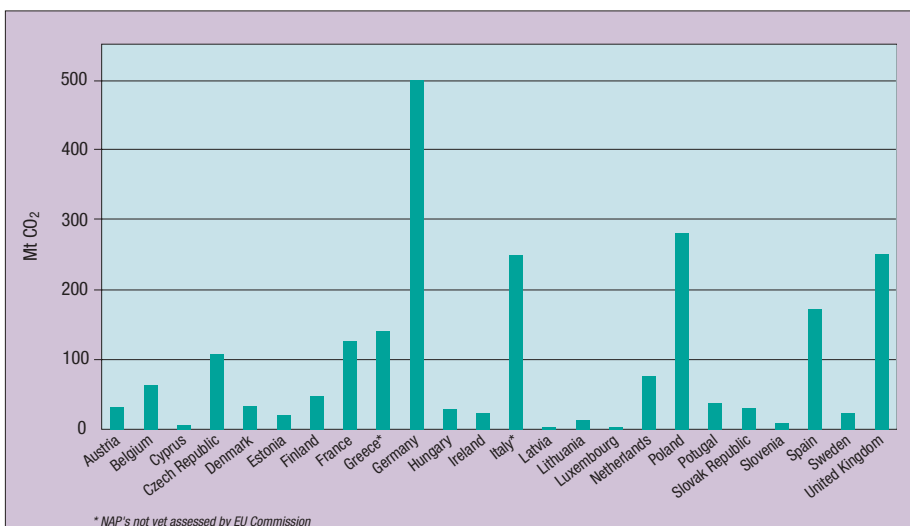


Figure 1: Allocation of carbon dioxide emissions in the EU ETS area by country



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■ Reader Reply No 39 ■

Emissions Trading

acceptable to consumers, industry and politicians.

Countries that rely predominantly on coal fired power stations are finding the targets particularly tough and nuclear power is increasingly looking like the most viable long term solution to meet both the EU's demand for power and its obligations under the Kyoto protocol. This has been exemplified not only by the installation of new nuclear capacity in Finland, but also by reopened societal discussion on the imminent decommissioning of nuclear capacity in France, Belgium and the UK. In The Netherlands a full political debate is ongoing to postpone the closure of the only Dutch nuclear power plant from 2013 to much further in the future.

So far, attempts to move to a more carbon friendly generation portfolio has resulted in notable growth in renewable generation, particularly of wind power in Spain and Denmark. The growth in other countries is more modest, but if planning applications are an indication, we should see a very substantial growth in countries such as the UK.

The introduction of the ETS and the recent increase in the cost of carbon certificates has also intensified the strain that both industry and governments are feeling in meeting the new emissions targets.

Immovable targets

The UK Government, as one notable example, has been trying to negotiate with Brussels to increase the amount of CO₂ that British industry can produce from 736 million to 756 million tonnes of carbon dioxide over the next three years. The EU has so far refused to increase the UK's limit but it illustrates the impact that emissions trading is having at a political level. The Polish government is now considering mounting its own challenge and more governments could be poised to follow. Similar discussions have been observed in The Netherlands where generators objected to their allocated emissions rights but, again, the EU refused to reduce the ceiling for emissions that it had already fixed.

"It is fair to conclude that internationalization of Kyoto costs into the electricity price will have a profound impact on making it more expensive"

Just months into the life of the ETS, the long term impact is still uncertain but analysis to date suggests that it will significantly change the way power is generated

across the EU. It is fair to conclude that internalization of Kyoto costs into the electricity price will have a profound impact in making it more expensive. Given the impact of fast growing economies such as India and China, followed by Russia, and the onset of a GPEC (Gaspec, next to the Opec) energy will become a sellers market with its own price dynamics. This may cause a shift in the fuel mix as we know it today. It also makes the issue of security of supply and the importance of introducing price stability (which relies to a large extent on low emission spare power generation capacity) an urgent consideration.

Discussions surrounding the next phase of the emissions trading scheme, due to run from 2008 to 2012, start this summer and we are likely to see governments and industry across the EU lobbying hard for more generous carbon emissions quotas. But while industry and national governments may be keen to ease the pressure on power prices and provide greater flexibility for generators and industry to deal with fluctuating supplies of gas and coal, the EU is unlikely to capitulate on its commitment to the Kyoto Protocol. The second round will almost certainly involve tougher cuts on carbon dioxide output and bring even more sectors under the umbrella of the mandatory scheme, including high CO₂ producers such as the aluminium, chemicals and aviation industries and perhaps even marine transport.

In addition, the advent of NO_x trading

in The Netherlands may even instigate NO_x trading in the EU, as air pollution awareness is gaining ground rapidly.

The numerous changes that we have seen

in the first months of the European ETS are only the beginning of a process that could profoundly change the way the European power industry operates. Kyoto's impact looks certain to extend far beyond the reduction of greenhouse gases.

The Dutch utility Essent is a prime example of how operational emissions management can counter the effects previously discussed.

With over 4.7 GW of mainly coal and gas fired generation capacity, Essent adopted an integrated approach to emission management that resulted in a company-wide implementation programme (EMIT) which has been in operation since 2003. A key element of this programme involved the design and implementation of operational processes, supported by Capgemini consultants.

Essent is a vertically integrated energy company, active in production, distribution, trade and sale and is the largest producer of renewable energy in the Netherlands. Its generation capacity includes wind farms, biomass plants, waste incineration, hydro and solar energy.

Essent decided to introduce a programme as it saw the potential of emissions trading to act as the best instrument to achieve cost effective emissions reductions. One of the utility's key objectives was to manage and optimize compliance with the EU ETS with minimal costs and against acceptable risks.

The main objectives of this programme were:

- To assess the financial, legal and operational consequences of the EU ETS
- To be well prepared for and provide input to the discussions regarding national allocations
- To comply with monitoring and reporting requirements
- To establish an internal structure ensuring emissions and allowances are balanced.

Responsibility for the EMIT programme was placed with the Business Development unit and programme managers reported

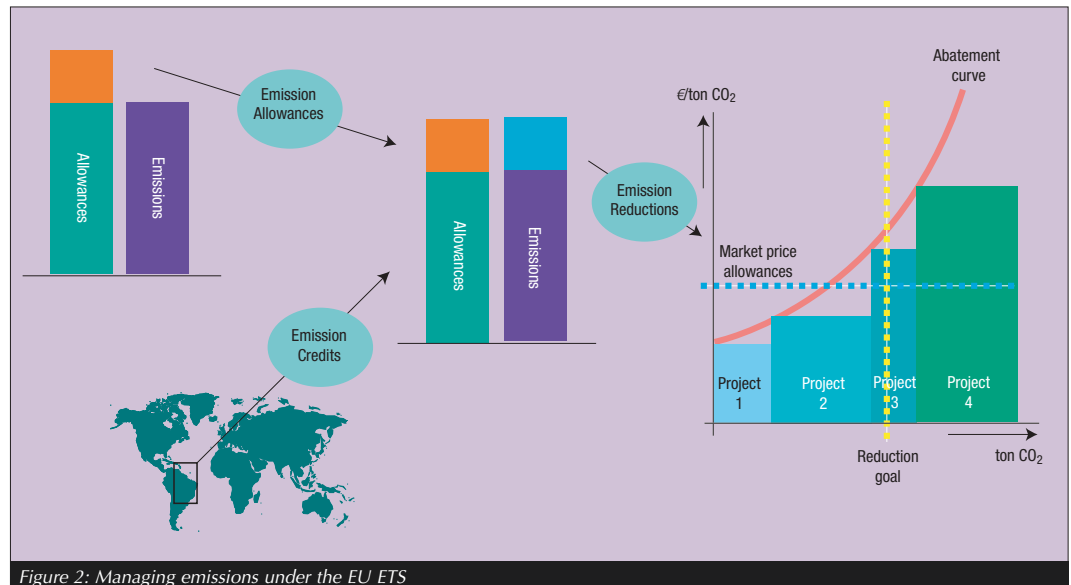


Figure 2: Managing emissions under the EU ETS

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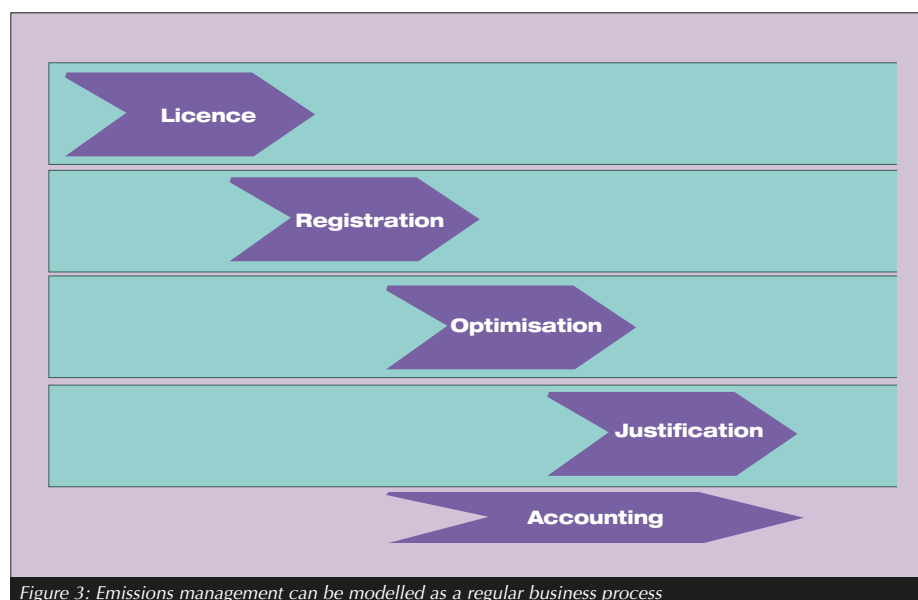


Figure 3: Emissions management can be modelled as a regular business process

directly to division management. Staff throughout the company were involved in the programme from the start.

Trading targets

The EMIT programme focused on four major areas. Finance and risk, assessing the impact of emissions trading on financial processes / structures and risk management; registration and monitoring, complying with requirements regarding monitoring, reporting and verification of emissions; public affairs, providing input to the establishment of the National Allocation Plan, and assessing the consequences of the new regulations; and trading and business development, integrating emissions in the existing trading activities.

The approach of the EMIT programme proved effective for Essent in handling the challenges resulting from the introduction of the EU ETS. Firstly, providing input to discussion about the NAP in The Netherlands resulted in a national allocation plan which takes into account the key issues of early action and security of energy supply.

Secondly, the requirements for a monitoring protocol led to a thorough consideration of emissions data management in Essent's generation units. As a result of this analysis, the need for a dedicated ICT solution emerged, and the EMIT programme was closely involved in the selection and implementation of integrated emission registration, monitoring and reporting software.

Thirdly, trading and risk management activities were established to trade the new asset and emissions rights. As such Essent took a central role in the preliminary emissions trading initiatives and pilot projects organized by the Dutch government.

Finally, great uncertainty about accounting principles for emission rights emerged. The allocation of knowledgeable staff during and after these discussions reduced

the risk of late or wrong information.

By applying a structured and managed approach, Essent was able to manage the risks and opportunities of the EU ETS at an early stage and gain an informed insight into the impact on its operations.

As the EMIT programme highlighted the impacts of the EU ETS, Essent found that it above all, had to be flexible. Foremost, the company found that as environmental data has been monetarized and thus has to be treated accordingly, a change in mindset was essential.

Also, enhanced interdependencies between organizational units was necessary through new cross-organizational flows of goods, money and information. With regard to personnel, new roles and responsibilities were allocated in several organizational units

"By applying a structured and managed approach, Essent was able to manage the risks and opportunities of the EU ETS at an early stage"

In order to manage and optimize emissions within the organization, an overall blueprint was necessary to describe the operational strategy of emissions management.

This blueprint aimed to develop transparent processes for emissions management and clarify who is responsible for each aspect. It was also created to provide a platform and reference for improving the quality and efficiency of emission management, while facilitating internal and external audits to ensure reliable and transparent ways of working.

In order to achieve the blueprint's objectives and secure commitment within the organization within a limited timeframe, Capgemini worked with Essent to help design the EMIT programme.

Through interviews and workshops the main processes, such as emissions registration, trading and compliance, were identi-

fied and structured into one overall business process. Emissions management is now a core value and output, with legal compliance and financial results as the main deliverables of the emission management process.

Every sub process was defined in terms of the activities involved, the desired goal and the overall result. These processes were discussed and reviewed extensively to close any gaps and settle discrepancies that resulted from different interpretations by the staff involved.

Spreading clarity

The EMIT protocol was completed at the end of 2004. Maintenance and co-ordination tasks regarding the protocol and the main processes were assigned to individual managers and internal implementation and auditing activities have been set up, ensuring the compliance of the organization with the protocol. In parallel to the establishment of the EMIT protocol, the implementation and go-live of dedicated software took place for emissions registration, monitoring and reporting.

Awareness and understanding of the operational execution of emissions management has grown at management and operational levels and this has been enhanced by the availability of the process models on the company intranet.

The comprehensive process model is an excellent tool for performance tracking and improvement management. The model also forms the basis for further emissions management processes once stricter regulations based on ICCP or Kyoto come into force. Finally, the process

model and the management principles of the protocol form the reference for internal and external audits.

After the project had been implemented it was concluded that while emissions management processes were often clear on a high level, the actual detailing and implementation formed a considerable challenge, especially in terms of managing data flows, flows of emission rights and flows of money between organizational entities. A structured and well managed approach for developing and communicating the process model has proven to be a key success factor in achieving the successful implementation of the Essent EMIT scheme.

Essent will now be able to focus more towards optimizing its position in the emission market in order to meet the challenge of delivering operational excellence in the daily practice of the EU ETS. **PEi**



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■ Reader Reply No 41 ■

Refurbishment & Repowering

Jason Makansi, Pearl Street Inc, Missouri, USA

Combine engineering ingenuity, the EU CO₂ trading market, strategically located power plants and a burgeoning electricity market with the potential to close the fuel cycle ecologically - and the will to survive becomes a recipe to thrive.

Growing the market

The conversion of 1950s-vintage boilers from lignite-firing to biomass at two venerable Hungarian power stations, Borsod and Tiszapalkonya, represents a classic power industry version of “think global, act local.” Faced with the imminent closure of these two plants in 2002, the people of AES Borsod, (part of the global power company AES Corp Arlington, VA, USA), which acquired these facilities in 1996, successfully executed a unique turn-around.

The project included the following elements:

- Sale of CO₂ credits to the Dutch government through the Joint Implementation mechanism of Kyoto in the European market to finance part of the project at Borsod.
- Home-grown bubbling fluidized-bed boiler technology applied at both plants.
- Addition of an expansive fuel management and fuel preparation strategy that is evolving to include growth and harvesting of energy crops in the area.
- Programmes and demonstrations to recycle the fly ash from the plants into a compost that exceeds the performance of chemical fertilizers.
- Contract sales of electricity to meet Hungary's quota for renewable energy as stipulated by the European Union, as well as sales into the emerging Hungarian electricity market.
- At around 120 MW total electric output, the two plants now represent one of the

largest biomass-to-electricity operations in the world.

Both plants are now reaping the rewards of some calculated technical risks taken to survive. The go-ahead for the Borsod turn-around plan was given in 2002, during the depths of the crisis in merchant and global power generation. Visits to AES biomass plants in the US and sharing of technical knowledge among AES business units lent confidence that the turn-around could be achieved.

Old boilers, new technology

Converting 50-year old boilers designed for lignite was the hallmark of the retrofit project. Each plant pursued different strategies to handle a biomass fuel that

typically has 33-35 per cent moisture content and 0.5 per cent ash content.

At Borsod, explains plant manager George Vesci, two of the ten boilers, each producing 100 t/h of 75 bar/495°C steam, can now be fired by 100 per cent biomass (Figure 1) and achieve 90 per cent boiler efficiency at 2-3 per cent O₂ content. The patented “turbulent-bed” technology was originally developed for coal and adapted for biomass by a consortium of the Hungarian firms Veiki and TransElektro. A small amount of sand, relative to other bubbling bed techniques, is used, along with ash, as bed material. Generally, these units run baseload but operators indicate that they are flexible and can run at 50 per cent capacity with no problems.

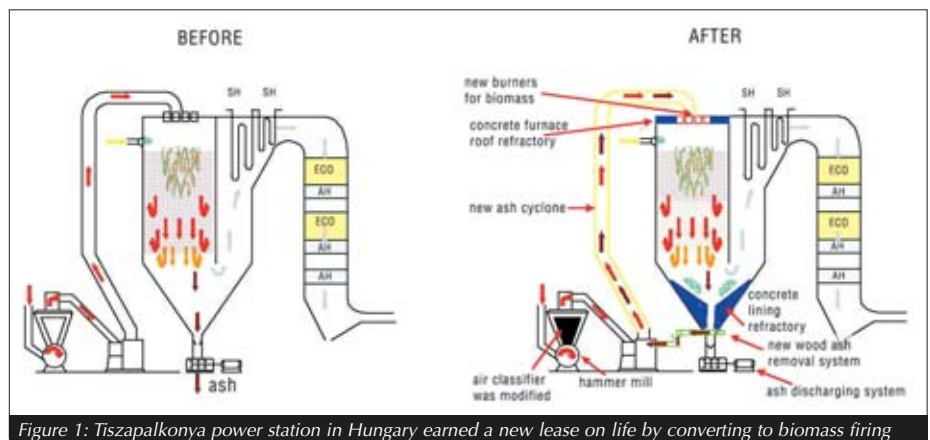


Figure 1: Tiszapalkonya power station in Hungary earned a new lease on life by converting to biomass firing

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Figure 2: Biomass storage, management and feed systems were installed at both plants

Fuel is fed from the top of the boilers from a long bi-directional conveyor system, reconstructed to handle wood chips typically sized to 2.5 cm by 2.5 cm. The conveyor stops over each boiler's storage bin and discharges woodchips. These chips flow from hold-up storage bins either directly to the furnace or to hammermills which further reduce the size of the fuel to a few millimeters. The hammermills were added after it was determined that the elimination of high bed temperatures would require smaller sized fuel.

Material ultimately entering the furnace is a mixture of approximately 50 per cent woodchips and 50 per cent sized material from the hammermills. This mixture is fed to the furnace from eight fuel injector ports, approximately 9-10 m above the furnace floor, from two levels, separated by 2 m, on opposing furnace walls.

New forced-draft fans were added to assist the existing induced-draft fans in moving air through the furnace at higher pressure. The bottom of the boiler now includes hundreds of air distribution ports to keep the bed material fluidized. The bed operates at approximately 1000°C.

A third boiler was also converted to burn sawdust. Only minor boiler or furnace modifications were required here as the plant progressively moved from an 80 per cent coal/20 per cent sawdust blend to 100 per cent sawdust firing. This boiler only operates about one week out of the month. The woodchip-fired boilers can also burn sawdust.

The ash is high in potassium, which aggravates deposition on boiler, convective pass, and air heater surfaces. Water washing and air blast systems were added to remove deposits during maintenance outages; some deposits must even be removed by hand. Each boiler generally must come down 1-2 days per month for scheduled maintenance and cleaning. This does not cause any problem since there is much spare capacity and flexibility at the plant.

Big chipper, little chipper

Feeding these boilers 800-1000 tonnes/day of woodchips requires wood receiving and preparation on both sides of the plant, hence the bi-directional conveyor. On one end, a large 160 cm diameter, 980 rpm, 120 tonne/hr chipper, driven

by a 1 MW motor, is fed logs from the storage area by two 12 m long, 6 m wide chain conveyors. Chips are subsequently sized through a mesh screen, and large material is recycled. The smaller back-up chipper is used to maintain an inventory, typically 5000-10 000 tonnes, of chipped wood fuel.

Generally, six to eight hours worth of fuel is kept in the powerhouse storage bins, although plant operators indicate

that more hold-up is necessary. This could be achieved by activating storage bins at adjacent boiler units. On one side of the plant 30 days-worth of wood chips is stored, and 30 days of raw wood is held on site. The plant maintains long-term fuel contracts with four privately owned foresting companies for 280 000 tonnes/year, delivered by rail and truck, over ten years.

Other aspects of the project include: refurbishment of the electrostatic precipitators and cooling tower, steam turbine and generator overhaul, and addition of a distributed control system (DCS). While the DCS has helped to automate much of the plant's operation, except for the fuel handling and prep which is very labour intensive, it could use additional built-in diagnostics, report plant officials, to prevent forced outages caused by the instrumentation and electrical systems.

At Tiszapalkonya, two of the eight 125 t/h, three-pass, balanced-draft type boilers were converted for 100 per cent biomass and two others were converted for 80 per cent coal and 20 per cent biomass.

The 100 per cent boiler conversions proceeded differently from Borsod, because the plant was informed that the units were not suitable for the turbulent bed technology. With the Hungarian firm Matuz as advisors, the burners of the original roof-fired boiler were replaced with biomass injection ports and the roof waterwalls were replaced with refractory lining to retain heat and help dry the wood. Refractory lining was also added to the furnace floor to improve carbon burnout. Flue-gas recirculation (FGR) was added to reduce NO_x emissions and maintain appropriate steam temperatures.

The original coal mills and classifiers were modified to achieve a 100-micron sized biomass fuel. A new chain conveyor belt with heat-resistant steel was added to remove ash from the bottom of the furnace. Finally, a furnace ash recirculation system was installed to ensure high carbon burnout. No gas firing support is needed at typical operating loads.

"There is surplus land available to devote to energy crops, at least 20 per cent of the agricultural land, or one million hectares"

Certainly one source of pride for the plant is the 100 t/hr wood chipper purchased for \$50,000 from a Slovak paper mill, deconstructed at the mill site, hauled to Tisza, and rebuilt inside a new housing unit. A new chipper would have cost \$2-3 million. Every four shifts, the chipper is taken out of service, the knife is replaced by one with a sharpened blade, and the previous knife is taken in for sharpening.

Plant manager Kiss Csaba explains that

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Refurbishment & Repowering

Tiszapalkonya is now the largest power plant without long-term power purchase agreements selling into the Hungarian liberalized electricity market. The conversion was achieved while the plant continued to supply power to the grid. The entire retrofit work and equipment cost under \$2.5 million, with the electrostatic precipitators accounting for 40 per cent.

CO₂ emissions from 2003 levels have been cut by a third and are projected to be cut in half by 2007. Fly ash emissions are below the 50 mg/m³ limit, and SO₂ emissions are almost negligible. Csaba expects the plant to sell more than 150 GWh of renewable energy into the Hungarian market in 2005.

Maintain fuel supply lines

Presently, both plants can consume more biomass than is available in the region. Plus, other units at the facilities could be converted for biomass firing. Both plants, for example, burn sunflower hulls (a good fuel because they are relatively low in moisture and have an oil residue, according to plant officials).



Figure 3: The Hungarian power plants of Borsod (left) and Tiszapalkonya (right) were both built in the 1950s

barley straw contracts which could amount to 10 000 to 50 000 tonnes/year. "In 2008 energy crops could represent 40 per cent of Borsod's fuel requirements," notes Istvan.

One of these energy crops is energy grass, a form of straw. It grows to a height of about 2 m and has been found to be relatively insensitive to weather, rainfall, and soil conditions. The grass would have to be baled to appropriate sizes to fit the

investigating refuse-derived fuel (RDF) made from a process developed in Italy. If pilot tests with RDF that AES will soon conduct are successful, then the Italian firm will consider building an RDF processing plant in Hungary. The RDF would be delivered to the plant as compact bales.

No resting on laurels

Technology in the service of social responsibility is a hallmark of AES's facilities around the world. But you can't let your guard down in this industry. As Peter Lithgow, AES Hungary country manager, remarked, "These conversions are great projects, but still the long-term fate of these plants must be considered." Should subsidies for renewable-generated electricity retreat, or the CO₂ credits market falter, AES is already considering options such as biomass gasification or a high-temperature high-pressure circulating fluidized bed coupled to a highly efficient gas turbine combined cycle. The larger point, concludes Peter, is that "these facilities are strategically located in terms of rail lines, the European grid, fuel sources, etc."

The evidence is that the new leases on life at Borsod and Tiszapalkonya should ensure their successful operation extending far into the future.



"The go-ahead for the Borsod turn-around plan was given in 2002, during the depths of the crisis in merchant and global power generation"

To plan for the future, according to Istvan Aved, AES project director, the company has cultivated relationships with area universities and others to develop a regional energy-crop industry. Says Istvan: "There is surplus land available to devote to energy crops, at least 20 per cent of the agricultural land, or one million hectares." Within a radius of 50 km, 40 000-50 000 hectares are available for energy plantations.

Already, AES has contracted with third parties for 160 000 tonnes of energy crops annually, and is negotiating for wheat and

lorries that transport fuel to the plants.

Another option under investigation is poplar plantations. Poplars can grow to 6-7 m high with 4-5 cm stump sizes on a one-year rotation. This material would likely be chipped, stored, and dried at the growing sites. The poplars would be around 50 per cent moisture and, ideally, they should be around 35 per cent moisture when fired in the boilers.

Long term, AES may require more than just forest residues, agricultural wastes, and energy crops. Therefore, it is also

Social responsibility

Social responsibility can manifest itself in many ways. One indicator is called E-Equity, the holistic value a power station possesses when all its outputs—economic and community development, emissions and discharges, electricity, and even national security—are optimized and considered within a framework of industrial ecology and sustainability.

From this perspective, AES Borsod and Tiszapalkonya present an interesting case study over the long-term. First, both plants still cogenerate steam (Borsod produces 60 t/hr) and produce demineralized water for neighbouring industrial facilities, maximizing the productive use of biomass fuel.

Second, low-grade lignite and coal firing has been greatly reduced, with obvious but substantial reductions in SO₂, NO_x, and flyash emissions.

Importantly, the plants now generate net CO₂ credits. In fact, this is how more than 20 per cent of the total conversion costs were financed at Borsod. The Dutch government contracted with AES Hungary to buy 740 000 tonnes/year of CO₂ for the period 2008-2012. Half of the contract value came as a prepayment, based on achieving milestones in the conversion project and first-month's operation.

At the same time, the Hungarian government must meet an EU mandate of 3.6 per cent electricity generation from renewable sources by 2010. Therefore, a compulsory off-take was instituted at a price that is typically double that of the current market prices.

Growth, harvesting, and preparation of wood and energy crops could eventually make up for coal mining losses to the local economy.

Biomass growth (which sequesters CO₂) and biomass combustion (which releases CO₂) net out as reduced CO₂ emissions overall. AES, along with local academic institutions, is even demonstrating that a material consisting of 25 per cent wood combustion ash, bark, and dewatered sewage sludge makes a compost that is superior in quality and lower cost than ammonium-based fertilizers. AES Borsod expects to receive a licence for this beneficial use of flyash soon.

Such examples of industrial ecology—in which discharges are beneficially recycled into another industry—have a net positive impact on the environment. In this case, the impacts caused by drilling, transporting, and processing natural gas into fertilizer are avoided, as are the potential impacts of agricultural run-off when too much fertilizer is applied to the land.

Thus, such power stations come tantalizingly close to a true "zero impact" facility. Combine this with the role the power station plays in the community, which even includes partnerships with schools to provide IT and computer education and training in area high schools, and perhaps the ultimate goals of social responsibility are not only met, but surpassed.



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■ Reader Reply No 44 ■

Refurbishment & Repowering

Helmut König, Siemens Power Generation, Germany

In 2004 the owners of the Farge power plant saw work begin to increase its generated output without the consumption of more fuel. Along with other measures, improvements to the turbines contributed massively to the efficiency drive.

More for less

The development of the steam turbine has been in progress for over 100 years and while it has reached a high level in terms of efficiency and reliability the challenge to beat previous results is forever ongoing. New requirements pertaining to engineering, economic and environmental aspects again and again provide impetus for further refinements. For example, numeric methods were created using high performance computers that now permit calculation and depiction of complex three dimensional flow conditions. This, coupled with new fabrication methods, has made it possible to manufacture not only turbine blading but also inlet and exhaust casings with innovative geometry that have yielded substantial advances in efficiency. This has not only given turbine engineering new momentum, it has also opened new possibilities for upgrading existing turbine plants.

Even after several decades of continuous service involving more than 170 000 operating hours, steam turbines are not necessarily ready for the scrap heap. For this reason it is definitely worth considering, before the end of the design service life has been reached, whether such robust work-horses justify upgrading coupled with uprating. In addition, operational flexibility usually increases. These factors are of great significance in liberalized power markets, where cost-effectiveness is the dominant parameter. Measures of this type, which Siemens Power Generation (PG) has implemented in numerous power plants, pay off for the power plant operator in only a few years because the fuel required to generate one kilowatt of power can be clearly reduced. Furthermore, the environmental balance is improved, as specific emissions are also reduced.

and reliability. The key elements of this approach are new blade design, improved blading clearance seals and increased flow cross sections. Modern twisted blades with integral shrouds which allow for three-dimensional flow characteristics are much more capable of meeting the requirements imposed by the flow of steam than previous simple designs. The geometry of these blades varies from stage to stage as deemed necessary by flow analysis. Three-dimensional flow analysis design techniques also significantly reduce secondary losses at the blade tips and roots. Additionally the degree of reaction of the individual stages can be optimally selected for each stage, increasing overall turbine efficiency further still.

Fit for future

The Farge power plant, situated on the lower Weser River in the northern part of Bremen, is owned by E.ON Kraftwerke GmbH. The first coal fired unit was built at the Farge site back in 1921 and was continually expanded and improved over the years that followed. The unit that is still in service was built in 1969 and originally had an output of 300 MW. All earlier turbine and power plant equipment at this site has been removed. Despite its age of more than 35 years, Farge is definitely comparable to modern power plants, because this plant was optimized again and again by implementing technical measures, increasing output to 325 MW prior

“it is definitely worth considering, before the end of the design service life has been reached, whether such robust work-horses justify upgrading coupled with uprating”

The Siemens upgrading concept does not merely focus on restoring the original output capability of steam turbines, instead it is geared to increase efficiency

to performing the upgrading work described in this article.

In October 2002 Siemens was contracted during performance of a major inspection



Figure 1. Turbine efficiency was increased through new blade design, improved blading clearance seals and increased flow cross sections

of the turbine plant to make Farge fit for the future. The comprehensive turbine upgrading measures were selected so as to increase efficiency and output without changing fuel consumption. Furthermore, reliability was to be improved and the service life of the turbines considerably extended.

The primary focus of the upgrading performed there last year was the renewal of the intermediate-pressure (IP) and the two low-pressure turbines (LP) as well as the condensers. Specifically, Siemens replaced the turbine rotor, blading, and inner casing including the blade sealing configuration and upgraded the bearing shell linings. The exhaust flow conditions for the LP turbines and the efficiency of condensers were improved by installing new, optimized flow condenser internals with a new tube pattern.

The configuration of turbines built today diverges sharply in certain aspects from previous designs. As an example, the previous mechanical design of the low pressure rotor had nine rows of blades; by contrast the new design has only six rows. The new rotors for the IP and LP turbines are major components with impressive physical dimensions. The LP rotors have a diameter of 3.5 metres; they are some seven metres long and weigh 63 tonnes each. These parts are manufactured by Siemens in Mülheim, Germany.

After completion of upgrading, the Farge plant will chiefly be used between base load and intermediate load, logging over 6500 operating hours per year and generating more than two billion kWh of electricity per year. “Furthermore, one partic-



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■ Reader Reply No 45 ■

Refurbishment & Repowering



Figure 2. The location of the Farge plant allows for the co-combustion of sludge from the adjacent sewage works with the supply of coal brought in to the plant's own dock

ularly advantageous aspect for the E.ON power plant fleet is the fact that our unit will be able to make rapid load changes over a broad range and offers considerable grid control capability. Internal ranking performed by E.ON indicates that we lead the pack in this regard," reports Fritz Henken-Mellies, plant manager of Farge.

Output increase

The new turbine parts alone improve output by 16 MW and thus account for the largest share of the overall optimization in terms of the total 27 MW increase. Condensers were fitted with new modules featuring a modified tube pattern, and this measure increased output by a further 4 MW. Shortly after shutting down the plant, a decision was made to ship the high-pressure turbine to Mülheim, where Siemens operates a turbine manufacturing plant, for a major performance inspection; this brought about another 1 MW increase. Thus all three turbines at the Farge plant were overhauled.

Numerous other minor measures performed in various parts of the power plant contributed to the final 6 MW output increase. Major measures included optimization of flow in the scrubber of the flue gas cleaning plant and in the final superheater stage. Siemens had from mid-July 2004 until the end of September that same year to complete their work and perform the ten-day programme of restart tests and inspections. The result of these modifications is a power plant with a net efficiency of approximately 42.3 per cent. "This figure is definitely comparable to more recently built and larger power plant units," highlighted Henken-Mellies.

Ruhr district coal, used previously at the Farge plant, has been replaced by imported coal. On average, 2000 tonnes of coal is combusted per day in the steam generator;

depending on the market this coal is delivered from coal fields located around the world by waterway to the Nordenham port. The fuel, totalling over 700 000 tonnes per annum, is delivered to the plant's own ship unloading station and from there is forwarded to a large coal stockpile that has a capacity of up to 50 000 tonnes, thereby ensuring an uninterrupted supply of coal to the power plant.

Co-combustion specialty

A special feature of the Farge plant is the co-combustion of sewage sludge. The Farge power plant first demonstrated over ten years ago that such sewage treatment plant residues can be co-combusted with coal. This process involves pumping sludge from the adjacent sewage treatment plant via underground lines, dewatering and co-combusting in the coal-fired boiler. Compared

"The Farge power plant first demonstrated over ten years ago that such sewage treatment plant residues can be co-combusted with coal."

with utilization in agriculture or disposal in a landfill, this solution is considerably more environmentally friendly. Pollutants contained in the sludge are either entirely combusted or firmly bound in the vitreous ash matrix. Co-combustion annual throughput currently entails some 15 000 tonnes of sewage sludge (90 per cent solids).

Highly effective flue gas cleaning equipment – electrostatic precipitators for dust removal, NO_x abatement plant for reduction of NO_x emissions and flue gas scrubber for desulphurization – ensure top performance in terms of emissions as well. Comparing the present generation performance with the past, a reduction in CO₂ emissions of 100 000 tonnes per year is

achieved. Without implementation of the output enhancing measures, generating the same amount of electricity would have required combusting 40 000 tonnes more coal each year. The requisite total investment was about €30 million. "This is a sound investment, because Farge is now equipped for at least ten more years of power production," said Henken-Mellies.

E.ON Kraftwerke holds a similar view for its entire power plant fleet. The power producer worked with Siemens on projects similar to that at Farge in 2002 and 2003. In 2002 the Unit F HP turbine at the Scholven coal fired power plant was modernized, significantly increasing its efficiency. In 2003, modernizing of the HP, IP, and LP turbines at the Mehrum power plant resulted in an efficiency improvement of 3.8 per cent and an output increase of 30 MW. The manager of the Mehrum plant said: "The results of turbine modernizing exceeded our expectations, extended plant service life, reduced CO₂ emissions by approximately 200 000 tonnes per year and made a substantial contribution to our competitiveness." Implications for the Scholven plant were summed up by plant manager Rainer Telöken: "Previously we ran the plant at a constant output, now we have gained considerable operating flexibility."

For Siemens PG, extending the life of steam turbines that are more than 20 years old has become a significant field of business. Modernizing a turbine by fitting advanced blade-design makes it possible to achieve efficiency comparable to that of new plants.

For this reason it is generally cost effective and very favourable in terms of interfaces of the turbine outer casing to only replace the rotor and inner casing together with new blading design as demonstrated by the projects described earlier.

The German company has pursued upgrading of steam turbines since the mid-1980s and in the last five years alone has completely modernized 40 conventional design HP turbines and 45 conventional design LP turbines using the approach detailed above. In the same time frame, 45 turbine modernizing projects have been completed in nuclear power plants and numerous minor modifications performed such as replacement of individual rows of blades or vanes and refurbishment of control and valve equipment installed on turbine island.

The turbine modernization process increases a power plant's ability to produce electricity cost-effectively and reliably for years to come.

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■ Reader Reply No 46 ■

Tomas Rönn & Johan Pellas, Wärtsilä, Finland

Delegating operation and maintenance to your supplier can deliver savings on multi-unit or single sites. Wärtsilä is applying a condition based monitoring and maintenance approach to achieve this for its customers.

Making the most of what you've got

The overall measure of a power plant's operational success and commercial viability is its life cycle effectiveness. This incorporates several goals such as lowest life cycle cost, highest possible efficiency and the ability to meet environmental targets. The concept comprises two key categories of measurement: the performance of the equipment and the personnel operating it, and the factors that make up the equipment's operational availability.

Asset management is an effective business solution to control a plant's operational efficiency performance. An all-inclusive operations and maintenance (O&M) agreement for the running of a power plant is a comprehensive form of asset management. The O&M contractor is not only maintaining the asset but is ensuring the plant is operated at optimum levels of performance to produce energy at the lowest possible cost for the owner.

When a system is new, the equipment performance is usually at its highest. After this point the task of ensuring optimum performance becomes the task of the plant's owners and the team they employ to oversee the running of operations.

Operational availability is the key to the asset's business success as outage costs can

be extremely damaging and have a negative effect on the bottom line. The operational availability is the percentage of time that a system performs, or is ready to perform, satisfactorily in an operating environment.

Asset profitability

The running cost of a power plant depends heavily on its technology, size and location. The costs are typically: O&M 12 per cent, fuel 50 per cent, repayment and interest of loans 30 per cent and other costs eight per cent. For the owner many of these costs are difficult, if not impossible, to predict, making asset costing forecasts a hazardous task.

The process is made more accurate if the O&M contractor can provide guarantees that provide hard facts and figures for some of the running costs. The power plant's day-to-day operations and maintenance represent key factors in the asset's operational costs. The original equipment manufacturer (OEM) should be able to give a fixed contract price for a comprehensive O&M agreement.

Compared to the plant's total costs, the O&M contract cost is rather small, but the day-to-day performance of the O&M contractor will play an important role on the

long-term profitability of the asset. For instance, while the O&M contractor cannot guarantee fuel prices, it can guarantee the plant's efficiency. Also, the contractor cannot alter the existence of loan repayments but it can have a positive effect on the loan's interest rates. Additionally, the O&M contractor cannot guarantee the stability of the insurance market rates but the O&M agreement can positively impact on preferential low premiums for the power asset.

When the OEM is contracted to carry out a power plant's O&M functions, the plant owner or manager has a long term fixed price for the operations and maintenance of the asset and its energy production.

The O&M contractor also provides performance guarantees for availability, heat rate, output, etc. and will pay liquidated damages to the owner if the performance is not met.

Operational predictability

Efficiency improvements are implemented more swiftly and access to the correct spares and parts is made simpler. In this manner the O&M contractor is ensuring that the asset maintains its value and operational effectiveness.

Lenders and insurers often grant reduced premiums as a direct result of an O&M contract with an experienced OEM contractor. These reductions are due to the fact that these O&M contracts represent risk hedging by both the lenders and insurers. The fact that a company's power plant asset is covered by an O&M contract, from the OEM, means that the financial markets will have more confidence in the asset's long-term efficiency and its future financial performance as well.

An O&M contract also offers effective solutions to one of today's major problems for asset managers – staff. It is essential that operating staff possess the right levels of technical competence to provide the efficiencies required, plus the numbers of staff employed must be economically viable.

The staffing problems caused by operational fluctuations can be affected by many factors such as new technologies being introduced by equipment suppliers,



Figure 1. Reports CBM centres analyze and evaluate operational data daily, or more frequently if required

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or by the company restructuring because of market conditions, or even a new generating plant being installed.

An O&M contractor often provides all staff required to operate a power plant asset. This provides better flexibility because a contractor is typically operating many plants with broad range of differing technologies and can quickly add staff competencies or reduce and relocate staff.

The Finnish based company Wärtsilä has developed specialized functions that can assist the managers of a power plant in operating their asset. Firstly, there are the service projects that specialize in the plant modernization, which brings older plants up to today's technical standards. Then, there are the O&M projects, which specialize in all of the tasks needed to operate and maintain power plants world-spanning.

As new technologies are introduced for power plant operations, it is essential for the plant's management to optimize these technical solutions to ensure their asset continues to perform at the highest efficiencies that can be achieved.

Since the relative life cycle effectiveness changes over the years due to the new technological developments and the introduction of more efficient solutions, a plant may need several 're-vitalising' packages to perform optimally throughout its long lifetime. These upgrades would be recommended and implemented by the O&M contractor, thus ensuring the plant continues to be a valuable asset.

efficiency of a power asset. Measurement systems should preferably employ the latest technology in order to keep up with today's requirements and tomorrow's challenges in monitoring and data collection.

Environmental aspects are another important consideration, especially the need to obtain accurate information on vital energy production parameters to keep the plant within environmental limits.

An electrical and automation service package helps to safeguard the plant against interruptions in power distribution. The package offered by Wärtsilä contains complete engine function tests with running sequences including safety systems and controls. All sensors, transducers and meters are calibrated.

An automation modernization package, also offered, brings an older installation up to the latest technical standards. In many cases this means adopting digital in place of analogue systems. If not already present, remote connections with data acquisition systems can also be installed. Wärtsilä can provide specialized systems covering data acquisition, fault analysis, planned maintenance and technical information for the asset management team.

Other effective asset management solutions for power plants and marine installations, which can also be linked to O&M operations, are known as condition monitoring and condition based maintenance (CBM), both are aimed at getting the most out of an installation at the lowest possible

addition to being labour intensive.

Traditional maintenance programmes usually involve visual inspections of certain components, thus requiring the equipment to be shut down and dismantled. When operational availability is critical, for example when any downtime will result in substantial revenue losses, any equipment outage must be avoided or minimized. In contrast, a maintenance programme that can predict incipient failures and continuously address a real maintenance need is therefore a more effective approach to cutting costs and increasing the safety and operational availability of equipment.

The CBM programme

Each installation has its own unique operating environment. This includes an operation profile, fuel type, load pattern, ambient conditions and many other factors, all of which influence the operation as well as the maintenance programme.

CBM optimizes operational availability according to the customer's business needs by grouping maintenance tasks in an optimal way. CBM incorporates, rather than replaces, scheduled maintenance knowledge; when determining the equipment condition engineers, as well as computer programmes, still need to draw comparisons with real life reference cases or experience.

Nor is CBM about extending maintenance schedules. Instead, it places maintenance where it is most beneficial – in some cases earlier than stipulated in the preventive maintenance schedule, in some cases later, adapting to the customers' operational availability scheme.

A CBM programme can include purely technical solutions, such as computing power that facilitates an instant awareness of equipment conditions, as well as remote monitoring and also advisory services. The programme affects more than just direct costs. It can also reduce the negative consequences of maintenance practices that may not be so easily quantified.

CBM would not be possible without monitoring the operation parameters. Determining current equipment operating status is possible today by utilizing modern control and monitoring systems such as the Wärtsilä Operator's Interface System (WOIS) and the Wärtsilä Information System Environment (WISE) solutions in combination with modern communication technology and advanced CBM analyzing solutions.

Wärtsilä's range of services is aided by a condition monitoring process with remote CBM centres capable of analyzing and evaluating operational data daily, or more frequently if required. Various alternatives are available for data capture and data transfer.

These include the Internet with Virtual Private Networking (VPN), which also offers the possibility of online monitoring,

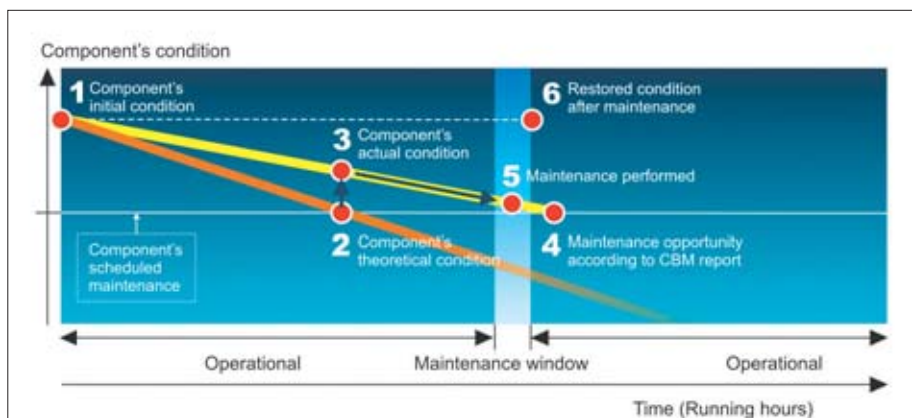


Figure 2. A condition based approach can result in longer maintenance intervals and resultant cost savings

As is usually the case with older plants, the asset's own automation systems often need modernization alongside the new technologies being implemented. Wärtsilä has recognised this need and has the capability to perform electrical and automation modernization. Upgrading of the various systems is based upon proven solutions using standard Wärtsilä modules and system components designed to meet client needs and demands.

Asset analysis

A regular power system analysis is becoming an increasingly important management tool for optimizing the performance and

life cycle cost. Productivity and profitability demands, new environmental regulations, and increasingly sophisticated equipment have all combined to push power companies to invest in efficient and cost-effective maintenance programmes to maximize the technical and economic performance of their installations.

Although preventative maintenance, typically scheduled maintenance, is a safe approach for keeping installations and equipment in shape and avoiding unplanned stops, it will not always ensure optimized equipment availability because of its generic nature, in



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■ Reader Reply No 48 ■

automatic, or manual e-mail transfer, or satellite communication. By connecting to the Wärtsilä website, users can access CBM information (the web service is only available for installations connected to the CBM centre), service bulletins, technical manuals and spare parts online.

Optimized operation and correctly tuned equipment keep operating costs at a healthy level. Remote monitoring, including the proper CBM solution, supports operators in their day-to-day operation of the installation by applying the company's vast experience and operational knowledge. This helps to keep the plant's thermal and mechanical load at the design level for the actual operation conditions. It also enables savings in fuel consumption while simultaneously reducing NO_x, CO_x and SO_x emissions, providing a more environmentally friendly operation.

CBM and remote monitoring are important service support functions for land and marine engine installations as well as Wärtsilä's O&M activities. Minimal arrangements are possible when the latest in remote monitoring supports a plant's operations. With fewer site personnel, experts can concentrate on one location and track several plants, providing advice as needed. Feedback and recommendations are supplied regularly (in urgent cases, immediately) to the owner/operator, the installations and the local Wärtsilä service office.

Monitoring data

The analyzing programmes used by the CBM centres take into consideration the technical design data of the specific engine and installation, the ambient conditions and the engine load. The measured operation data is automatically compared with the calculated ideal operating data. If the measured operating data are outside the calculated (pre-set) ideal operation data window, the system will give an early warning, and an indication of possible reasons.

At the same time, trend prognostics can identify the corrective action to be taken and when this is required. The early warning or alert indication is sent out well before the real alarm set value is reached, thus giving more time to plan maintenance actions.

The operational concept of CBM is well established within the power and marine industries and is expected to be further developed which will make it an integral part of daily operation for many power plants and marine applications around the world. Wärtsilä's offerings range from normal engine technical follow-up and reporting, to automatic data analysis (e.g. CBM) via remote plant service and prognostics.

In February 2001, the first power plant (a Wärtsilä 18 cylinder 32LN engine located in Portugal) was connected to the CBM service system, and the first marine

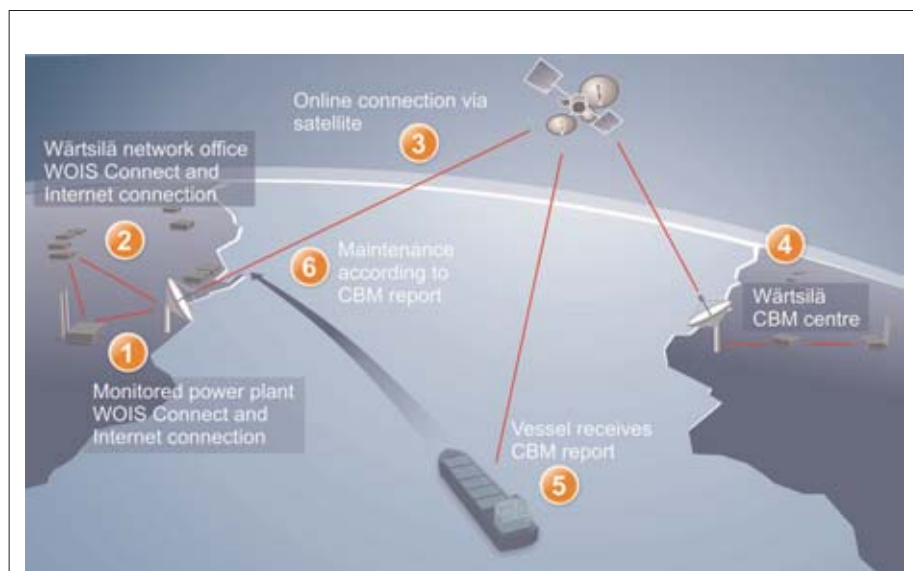


Figure 3. CBM combines with remote monitoring to maximise plant operation

installation was connected in November of the same year. By the end of 2004, 54 installations with 250 engines were connected to the Wärtsilä CBM system. Currently there are agreements with some 100 installations and more than 300 engines connected or to be connected to the system during 2005.

In the set up for CBM, all operation related data (covering pressures, temperatures, load, speeds, and ambient conditions) are measured by the WOIS system and transferred via the WISE system, or by partly utilizing existing control monitoring systems, to the remote monitoring CBM centre in Vaasa, Finland. Most monitoring and supervision systems delivered today can be upgraded with automatic data transfer to supply the necessary information to the CBM centre.

The data quantities captured from the site depend on the communication set up chosen. They include:

- Automatic data capture and on-line monitoring over the internet
- Automatic data capture and collection via ISDN
- Automatic data capture and e-mail despatch from the plant
- Automatic data capture and semi-automatic e-mail despatch from the plant
- Manual data collection and sending via e-mail.

Logically, the chosen communication set up will have an impact on the frequency with which the data processing, analysis and prognostics occur. With many installations, sending or retrieving a batch of operating data once a day is sufficient to address the real maintenance need, thereby cutting costs and increasing the safety and operational availability of the equipment. In these cases, the reports are then produced according to a bi-weekly or monthly schedule.

Of course, if the daily data processing and analysis reveal that something requires

immediate attention the installation is notified immediately. Typically, monthly reports are sent to the customer by e-mail as well as being available via Wärtsilä Online services on the Internet.

Tomorrow's world

The energy market of today has moved from the traditional, big centralized solutions of yesterday towards a more decentralized energy production, often resulting in low manned or even unmanned plant operations. Taking this into consideration, Wärtsilä enables its remote monitoring system to alert standby maintenance personnel to any major problems at the plant.

From portable workstations, they can connect with the power plant, investigate the situation and recommend or take the necessary action. In turn, Wärtsilä can also make use of the service, which helps it maintain parts of the control systems and also remotely assist customers with fault tracing and problem solving. When problems can be diagnosed and corrected in minutes instead of days, it becomes apparent how substantial savings can be made.

The future of power generation is and will be more about the business of power. An asset's costs and returns will be more and more in the management's thinking and decisions. Investments will be considered in both the short term and the long term. The power industry is already seeing a heavy swing towards the life extension and modernization of an asset rather than the energy companies entering into expensive and long-term investments for new greenfield projects.

Plant services, such as outsourced O&M contracts, that save time, effort and money for the plant will become even more important factors in asset management thinking, planning and investment. The effective running of their power asset, which provides them with the best life cycle costs, will be their primary goal.



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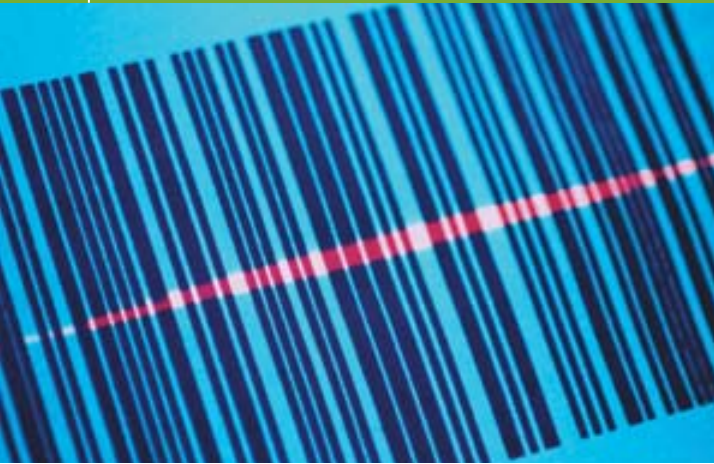
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■ Reader Reply No 73 ■



Asset Management

Michael Trenchard, Component Obsolescence Group, UK



The growing trend of disposable technology has left the power generation industry needing to be on guard for failures prior to normal life expectancy, or else face the massive costs.

Missing parts

Many people see technological change as a sign of progress, but as the pace of development increases, major problems could arise in the power generation industry, as well as other industry sectors which rely on an ability to maintain in service vital long lifespan equipment.

Power stations and the devices within them, such as control equipment, are required to last for several decades and as they are so capital intensive to develop, it is crucial that they actually last for their full life expectancy. However, when electronic or mechanical spare parts are required, it is not always possible to find identical components to repair equipment that has been in service for many years, because during that time, they may have become obsolete. Failure to get replacement parts quickly or at all could incur considerable costs if it means that the whole piece of equipment is put out of service or parts of it need to be redesigned to accommodate modern devices.

Once a component is obsolete, the cost of the replacement parts can be many times the original amount depending on whether a replacement is available or not. Research conducted last year indicates for the first time the likely costs that could be avoided through effective obsolescence management. This ranges from more than £300 000 (\$550 000) for a major component redesign to £13 500 for finding a substitute component and £100 for a solution involving using existing stockpiled parts.

These are non-recurring engineering costs and do not include any other associated costs, such as: down-time of equipment, any additional engineering necessary to integrate the part, new training procedures and manuals which may be required, or storage costs.

In extreme cases, the damage to an organization's reputation and customer relationships could also be enormous, for example if a lack of serviceable equipment causes shortages or failure of power. With public scrutiny of how infrastructure is maintained becoming increasingly intense, it is vital for all round prosperity that the power generation industry avoids this.

A growing problem

In recent years, components have had a high reliability and long life expectancy: for electronic components the average annual failure rate has been just two per cent. This has misled many who will ignore the issue until there is a failure and then they may find that there are no components available to manufacture replacement parts.

Another dimension is likely to exacerbate the problem. Industry was the main market for electronic components, and until the 1970s, the vast majority of components were designed for long lifespan equipment for the industrial market. Today this only accounts for about 15 per cent of electronic component demand, as

consumer demand is now the driving force. As consumer goods such as PCs and mobile phones become more and more cutting edge they also become more disposable, so increasingly components are actually being designed to wear out and become obsolete very quickly. According to QinetiQ, Europe's largest science and technology organization, on average 2000 components become obsolete each month.

"Once a component is obsolete, the cost of the replacement parts can be many times the original amount"

Since industry may rely on many of the same components, this could make its ability to maintain and repair existing equipment all the more difficult. For the energy and power generation sector, in which equipment costs are high and the focus is on maximizing product life

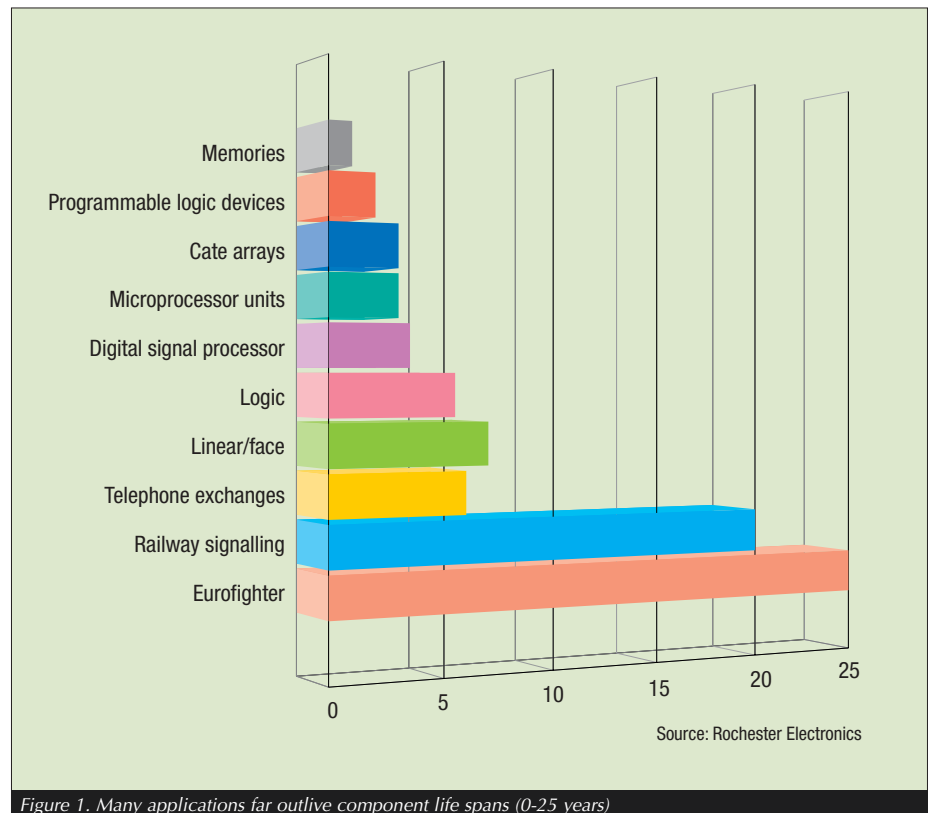


Figure 1. Many applications far outlive component life spans (0-25 years)

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Figure 2. Mobile phones are becoming more disposable and include parts designed to wear out.

expectancy, as well as maintaining safety standards, this is likely to be a critical issue.

EU proposals to ban the use of lead in electronic equipment are also likely to aggravate the problem. Lead, which is used in soldering on the vast majority of electronic circuit boards, is due to be banned in July 2006 under the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive. In addition, the simultaneous implementation of the Waste from Electrical and Electronic Equipment (WEEE) Directive could also raise obsolescence issues. This is because, if rules on the separation and collection of waste products are too onerous or costly, WEEE may act as a disincentive to use certain materials.

Pro-active strategy

Component obsolescence is moving up the management agenda, but there is still a long way to go.

Organizations may be unwilling to admit that obsolescence affects them at all, but taking a proactive approach should reflect well, rather than badly. Too often companies are taking a reactive approach, when in the majority of cases prevention is far more effective than cure.

By identifying a problem early, the more expensive solutions can be avoided. Steps should be taken to forecast where potential problems might occur and to monitor the availability of components that have a high risk of becoming obsolete, so that organizations can plan whether and when to increase their stocks and/or update equipment.

Extreme care should be used when looking at substituting commercial off-the-

shelf electronic devices as alternative replacements for obsolete industrial components. Commercial components are far more readily available, are often much cheaper and they can serve a useful purpose in replacing obsolete parts in certain industrial applications. However, in many others they may not be fit for the purpose, as well as often having quite a short lifespan.

For example, possible substitutes may not have comparable performance electri-

"The number of counterfeit or substandard products coming onto the market is likely to increase in line with the scale of the obsolescence problem"

cally, in terms of reliability, thermal performance or safety control, to the original components designed specifically for the industrial market.

If a commercial memory product meets the necessary electrical requirements, and is to be used in a benign environment where the temperature will stay moderate (such as office equipment), it should be suitable for use. However, if it is going into a piece of equipment which has to withstand high vibration levels, very high or low temperatures, it is likely to be far harder to find an appropriate commercial alternative.

Adding to the problems, the number of counterfeit or substandard products coming onto the market is likely to increase in line with the scale of the obsolescence problem. If demand outstrips supply, there could well be a temptation among some operators in the supply chain

to fill the gap in the market by selling on second hand, reclaimed or reject products as something they are not.

For organizations that are desperate to source hard to find parts to keep vital equipment up and running, this is likely to compound their problems rather than solve them. In many cases, accompanying paperwork can also be falsified and those purchasing such products are often unaware that they are not what they should be until they fail or find that they do not offer the required performance. In extreme cases the product may not even work, or it may work in a very similar way to the specified component, but with a vastly reduced reliability or life span. In other cases, parts may not meet all the necessary criteria for a particular application.

Organizations should ensure that they have the full performance and technical data about a potential replacement product and assess it carefully.

Buyer consciousness

Buyers of components should always be conscious of the potentially varying aspects of the product. It is recommended that only known and trusted suppliers are used, as this will give more security over the quality and origin of products.

The acceptability of the parts should always be assessed, particularly for components that have been obsolete for some time, as it may be harder to trace their origin. For example, organizations could request datasheets or a sample batch of components for testing prior to a bulk order. However, even these measures may not necessarily give absolute assurance of

a component's long term, in-service performance as the design of components even with the same part number may be changed to achieve cost savings.

Although lack of traceability does not mean that the product is in some way inferior, it does mean that there is no guarantee from the supply chain as to its quality and origin, so the onus is on the end user to check, as far as possible, that it is fit for its purpose.

In order to quell any fears over a component's sustainability, those purchasing should always establish what warranties the supply chain provides and whether they are negotiable.

Although a quick fix may seem like the answer, unless the time and trouble is taken to ensure a component is truly fit for the required purpose, organizations may well only be storing up problems further down the line.

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Distributed Generation

Staffan Asplund and Karl Hyland, WSP Environmental, Finland and UK

Waste to energy has evolved far from early waste incinerators. Now it is seen as a useful route to reclaim the energy from materials that would otherwise be forgotten in a landfill.

Why waste energy?

Burning waste is an old custom for getting rid of space demanding and smelly garbage. Unfortunately, if not cleaned efficiently, the flue gas from burning waste is both a hazard to your health as well as to the environment. The technologies used for waste incineration have gone forward from being just a way to get rid of waste to become a way to utilize the energy in the waste. Public opinion is slowly becoming more positive towards waste combustion, especially in the form of waste to energy

projects instead of increased landfill disposal.

April 2005 saw the publication in the UK of a report commissioned by two organizations, the Institution of Civil Engineers and the Renewable Power Association, on the potential energy yield from waste residuals in the UK through the use of energy from waste technologies. This report proposed the potential production of energy from waste could produce around 17 per cent of

total demand in the UK for electricity by 2020, and act as a significant replacement for fossil fuels.

To put this in context, such production would provide enough electricity to power the combined populations of both Wales and Northern Ireland.

At present, energy from waste only provides approximately one per cent of all energy needs within the UK. This is among the lowest proportions in Europe and is something that undoubtedly needs to change to make best use of resources, and to meet global warming targets.

In the Nordic countries the co-combustion of municipal solid waste and biomass residues from sources such as forests and sawmills residues in combustion plants is commonplace.

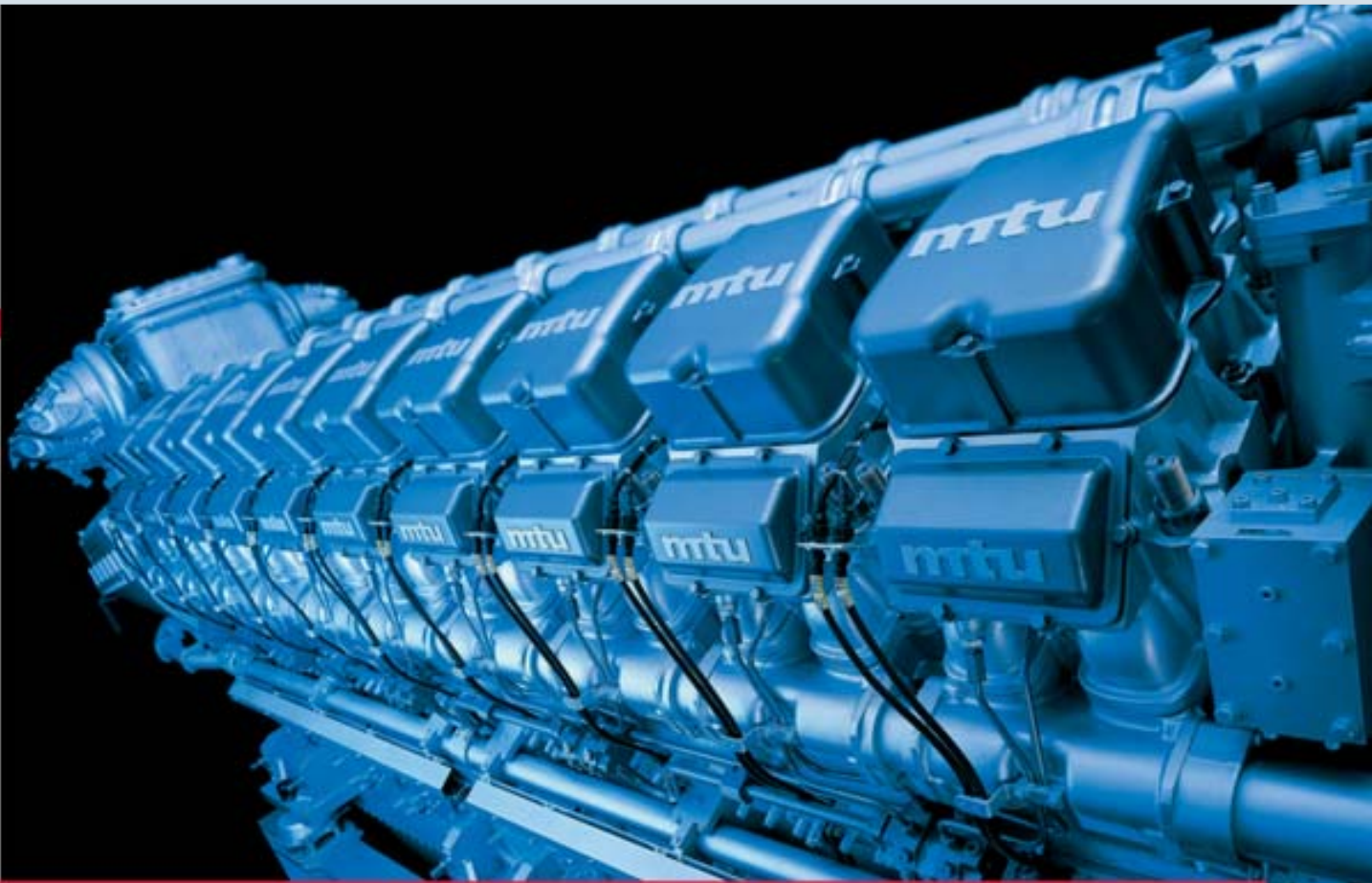
This is considered a legacy of the generally high levels of public education in waste management issues, and the long history of source separation that has occurred within these countries. The need to reduce and recycle waste is also taken into consideration. The recovery of energy from waste is integrated into governmental plans, while general waste education initiatives also encourage recycling and reduction of waste.

The main objective with the Finnish national waste management strategy is to reduce waste and to improve recycling. Burning waste should only be an option to landfill disposal and the waste must always be carefully separated before combustion.

Despite many preventive actions towards diminishing waste, very little has changed during the last ten years. The goal for the Finnish national waste management strategy is a 15 per cent reduction of the total amount of waste by 2010. However, since



Figure 1. Up to date flue gas cleaning techniques can cope with the differing levels of particles emitted from the wide range of waste materials used to generate energy



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■ Reader Reply No 25 ■



Figure 2. If combustion conditions are optimised pollutants can be minimized as early in the process as possible

1990 most waste sources have increased. The recycling of paper and glass is at a high level but at the same time the amount of cardboard and plastic wrapping being carelessly disregarded has increased. For these waste sources recycling is working poorly and incineration would therefore be a strong alternative to landfill disposal. This is being held back in part due to the fact that burning plastic materials is still controversial, despite its high energy content.

Nordic understanding

With high participation rates in both, many onlookers are left with the conundrum of how Nordic countries manage to recycle so effectively while reducing the amount of waste available by using it as fuel to create energy. The key word is efficiency.

Acceptance varies widely

While, the above factors have encouraged the development of waste energy it should be noted that there were no easy wins here either, and the goodwill towards energy from waste is based almost entirely upon communication with all interested stakeholders. Lessons which have been learned include:

- The necessity of community involvement and education in the issues surrounding the management of waste, including realistic understanding of the limitations of all waste management options
- Recognition that the majority of stakeholder concerns are legitimate and require consideration
- Utilization of debate and provision of staff who are available to respond to local concerns

eration needs to be given to the factors considered most important to countries with a low proportion of waste energy in their generation portfolio.

These include:

- Lack of political will at the local, regional and national level
- Opposition from environmental groups and local communities, some of which is based upon political agenda and poor science
- Lack of widespread understanding of the technologies available, and of actual proven technologies
- Concerns over emissions and potential health and environmental effects
- Concerns over impacts on local landscapes or house prices
- Concerns over where such plants are located, particularly where a previous industrial use of the site has not occurred
- Lack of trust in the waste management sector
- Lack of confidence in environmental regulation
- Poor communication by strategy developers and waste operators with all stakeholders.

A comparison of the above points would suggest that a great deal of work is needed to assist these countries with a low proportion of waste energy to aid the development of a realistic waste management infrastructure, particularly with respect to gaining widespread public support. In

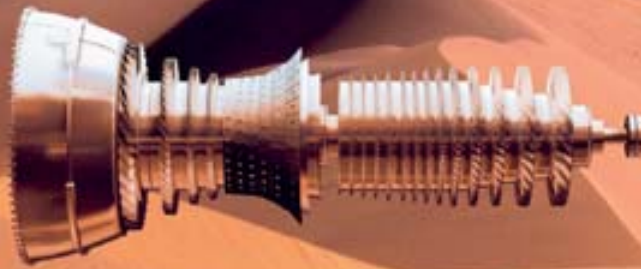
“there were no easy wins here either, and the goodwill towards energy from waste is based almost entirely upon communication with all interested stakeholders”

In order to encourage the development of energy from waste a number of these countries have introduced high levels of tax on landfill sites, banned biodegradable materials from landfills and invested in educating the public through well developed communications strategies.

- Development of high emission standards and strong regulatory regimes, in some cases with publication of emissions data to name and shame
- National level policy to provide a framework for local decision making.

In contrast to the above lessons, consid-

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many cases such issues are being taken into account in the development of the waste management infrastructure for the next 25 to 30 years.

In others, an ostrich mentality exists which does not take into account the potential opportunities related to the utilization of energy recovery techniques.

Integrated strategy

The benefits of generating energy from waste are wide ranging. It can be utilized as a complement to recycling and material recovery rather than as a competitor as targets can be met and exceeded with respect to landfill obligations whilst still providing sufficient feedstock for smaller scale energy for waste plants.

Also, waste to energy plants have the ability to effectively deal with waste residues after recyclable materials have been recovered. The current favouring of Mechanical biological treatment (MBT) options within municipal waste strategies provides an ideal base for the introduction of energy from waste later in the strategy period; many have viewed MBT as a final waste management solution rather than as an ultimate producer of refuse derived fuel.

A further benefit is that energy production is a rational and positive diversion of waste from landfill, and as technology advances occur and improve in terms of economic viability, it should be considered as an effective enhancement of the overall waste strategy. Current concerns over energy production from traditional fuels in the future may provide a further driver for development.

Finally, energy from waste is an effective stabilization of the waste, reducing overall environmental burden and reducing the volume of waste for final disposal to landfill.

Incineration technology

The two most commonly used techniques for incinerating waste are fluidized bed boilers and grate boilers. The advantage of the fluidized bed boiler is that the fuel (i.e. the waste) has to be very well prepared before incineration. When using a grate boiler a real mix of waste can be burnt, which from an environmental point of view is a waste of resources. The fluidized bed boiler works hand in hand with the common strategy for source separation and recycling, as only waste that is left after these processes have been finalized will be used for incineration.

Finland has a local excess supply of district heating, and this is mainly the result of the fact that when waste is burned heat is the primary product, with some electricity as the by-product. By carefully choosing the incineration technique you can raise the level of electricity produced. When using fluidized bed boilers you can raise the efficiency by several per cent in comparison to other techniques due to

higher steam parameters.

On the other hand it can be debated whether grate boilers can utilize a bigger fraction of the waste and thus reach higher total utilization.

Due to enter into force at the start of 2006, a new EU directive for flue gas cleaning from waste incineration plants will set limits for dust particles, nitrogen oxides, sulphur oxides, heavy metals and dioxides. A large proportion of waste incineration will therefore have to include extensive flue gas cleaning.

The different levels of particles and other contraries required can easily be met by up to date flue gas cleaning techniques. When using contemporary flue gas cleaning equipment a waste to energy plant emits less pollutant than an ordinary power plant burning heavy fuel oil.

Flue gas recovery

Waste incineration in all Swedish plants is combined with energy production. The resulting energy is used for district heating in most cases. The systems for flue gas condensation, which are in use in several locations, aim to increase energy recovery without increasing fuel consumption.

More than 99.5 per cent of the original amount of burnt waste oxidizes into carbon dioxide and water. The quantity of non-oxidized gases which leaves the furnace along with the flue gas mainly consist of carbon monoxide and the same type of light hydrocarbons that occur with all incineration.

"Both governments and supervision authorities need to have a clear framework in place, and this must be connected to an efficient permitting procedure".

The incineration conditions have a greater influence on many of the other organic micro-compounds, such as, polycyclic aromatic hydrocarbons (PAH). The chlorinated hydrocarbons are an important pollutant group that need to be specially considered when constructing waste combustion plants.

The three factors to be considered when limiting the production of chlorinated aromatics during waste incineration are the chlorine content during incineration, the combustion efficiency and the energy density in the furnace.

Measures to reduce the production of chlorinated aromatics are the same for incineration in grate fired and fluidized bed combustion. The homogenous composition of the fuel, the particle size and

Municipal waste management in the European Union

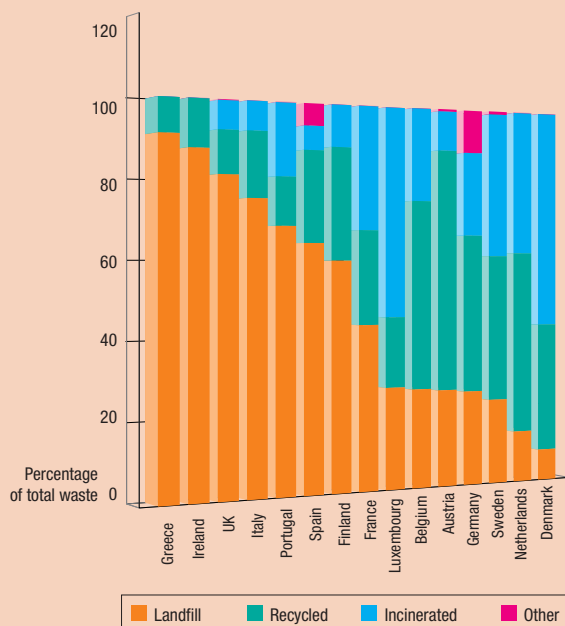


Figure 3. The use of landfill varies considerably among the EU 15

heating value are recognized factors, which are of great importance to the possibilities of carrying out good combustion in FCB boilers.

By optimizing combustion conditions, pollutants are minimized as early in the process as possible. The ideal and best is of course to minimize the pollutants in the waste to start with.

Flue gas cleaning is playing an important part of the cost in a waste combustion plant. By combining the flue gas cleaning with condensation of the flue gases, considerably increased energy recovery can be achieved.

In Sweden, for example, releases with the flue gas during the incineration of municipi-

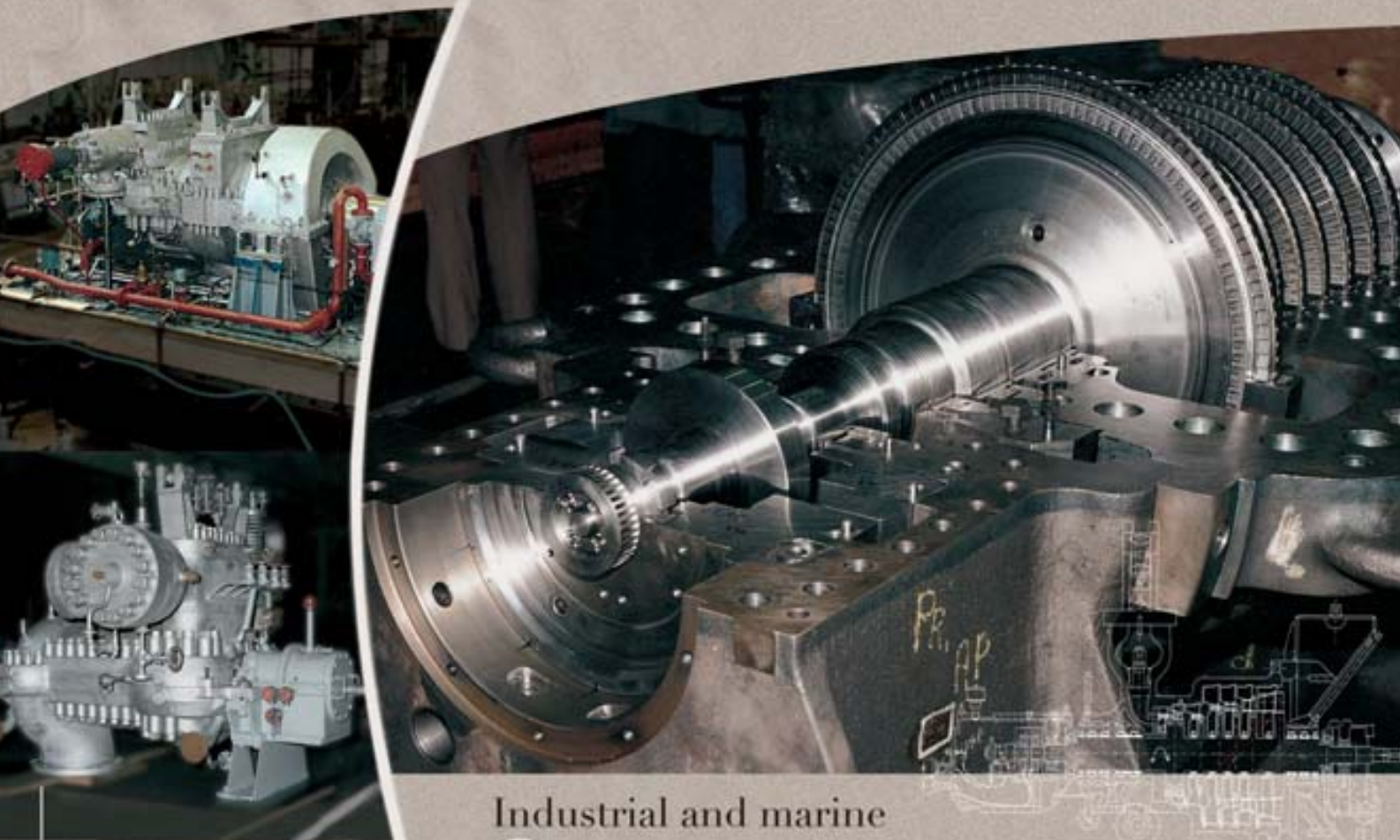
pal waste with both dry and wet cleaning systems can be limited, so that the limits specified in EU directives are fulfilled.

It can be concluded that several well proven technical solutions exist for efficient and environmentally feasible waste combustion. But the key to successfully implementing waste to energy projects is clearly on the political level.

Both governments and supervision authorities need to have a clear framework in place, and this must be connected to an efficient permitting procedure. Careful planning and communication from developers regarding waste to energy projects and continuous information to all interest groups at the early stages of a project will diminish the risk of possible misunderstandings from the public.

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■ Reader Reply No 54 ■

Distributed Generation

Steve Armitage, SmartestEnergy, UK



The UK power and gas sector is blazing a trail in terms of deregulation and increased market competition. No feed-in tariffs here – it's a market-driven arena with prices going up and down throughout every trading day. It's a unique model within the EU, and offers opportunity for a new breed of power market player – the consolidator.

Consolidating power

The overall landscape of the power sector in the UK is quite different from that of many of its European neighbours. Back in 1990, the British government broke up the centralized system symbolised by the 12 local electricity supply and distribution companies and the national generation and transmission company (the Central Electricity Generating Board). It introduced the twin concepts of deregulation and increased competition to the wholesale electricity market.

As part of this ongoing policy of liberalization, the New Electricity Trading Arrangements (NETA) came into effect in March 2001. NETA is the main instrument through which increased competition and transparency was delivered.

NETA replaced the electricity Pool Purchase Price system under which market prices were determined centrally and replaced it with a system where prices in the wholesale electricity market were set through bilateral contracts, supported by a central system to adjust and balance the positions of the industry players.

Under NETA, generators could enter into a bilateral contract for their exported power with any counter-party, at any time, for a specific duration of their own choosing at a price agreed between the two parties and fixed delivery at any point. This is in marked contrast to the typical pre-NETA situation where all generators sold their power to the central trading body, with the exception of the embedded generators, in particular the renewable generators who would sell power to suppliers at the centrally set price.

But with this new-found freedom came new-found responsibilities. Generators were now exposed to fluctuations in market prices and, in addition, faced having to purchase costly spot price electricity for under-delivery of power versus contract terms or, alternatively, receive just the spill price for any over-delivery of

power versus contract terms – both downsides from which they had previously been protected.

While the larger, better-resourced generators could adapt to the 'Brave New World' of a market-driven power sector in the UK, smaller electricity producers, for whom power generation was not necessarily their core activity could not easily do so. Knowing with whom to trade, when to trade and at what price, had become a greater challenge and one which brought with it real financial risks.

Risk management

It was the government's and Ofgem's (the UK's gas and electricity market regulator) thinking that a new breed of player, namely consolidators, would establish themselves in the marketplace to represent these smaller and renewable generators, provide them with a range of off-take and risk management services and help them maximize the value of their power and the associated benefits.

SmartestEnergy is one of these consolidators which was set up to meet the needs of this new segment of the market and is today the UK's leading independent provider of consolidation services with close to 1 GW of power within its consolidation portfolio.

At the heart of SmartestEnergy is its Energy Management Centre (EMC), which operates on a round-the-clock basis.

Through sophisticated IT and telemetry systems, it receives half-hourly meter readings from each customer site and monitors these outputs in real time to ensure that SmartestEnergy's agglomerated customer portfolio remains in balance at all times. The EMC works hand in hand with SmartestEnergy's own electricity and gas trading desks which buy and sell power and gas contracts, on both a spot and forward basis as required, to meet its customers' trading obligations.

A typical SmartestEnergy customer is a renewable generator with a number of different sites. Not only will SmartestEnergy contract to take all the power and any embedded benefits (i.e. those resulting from being 'embedded' in the local distribution network and thus receiving a benefit for reduced transmission losses), but will also contract to take the LECs (climate change Levy Exemption Certificates) and the ROCs (Renewables Obligation Certificates), the latter two being mechanisms to help ensure the UK meets its CO₂ and other greenhouse gas emissions targets and stimulate the growth of renewable power generation.

The principles behind each SmartestEnergy contract are the same, namely ensuring each individual customer's precise requirements are met through the provision of particular contract terms. For example, some of the larger generators require closer access to the markets, buying and selling throughout the trading day to take advantage of the marked price fluctuations which have been a constant feature of the power and gas sector since NETA came in.

Other generators, often companies for whom power generation is not their core activity are keen to lock out all risk and secure a power selling price which is fixed, with any input fuel purchased forward simultaneously on a back-to-back contract with the power deal.

One interesting development on its standard off-take and

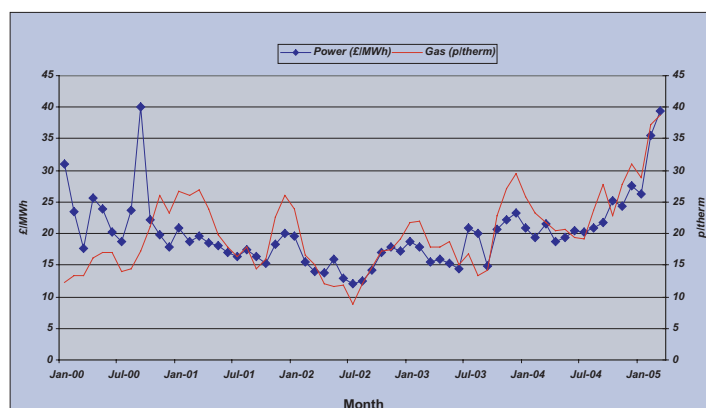


Figure 1. This graph shows the clear relationship between power and gas prices in the UK. Price fluctuations have been more marked since the introduction of NETA

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■ Reader Reply No 55 ■

Distributed Generation

consolidation offer is SmartestEnergy's innovative risk management contract with Good Energy, one of the leading green electricity supply companies in the UK.

Under the terms of the contract, known as a Supply-Side Electricity Trading Service Agreement (Supply-Side ETSA), SmartestEnergy will manage Good Energy's imbalance exposure. Alongside the Supply-Side ETSA, Good Energy and SmartestEnergy have also executed a 'ROC Repo' agreement. This adopts the principles of Global Master Repurchase Agreements, commonly used in the City for securities lending and allows Good Energy to use its inventory of ROCs more efficiently.

Good Energy purchases wind, small hydro and solar power from a number of renewable producers which it supplies to retail and business customers throughout the UK. It also has a sister company which owns wind assets, but it is not a generator in its own right. As a purchaser of power, it has less control over generation output projections and with the added uncertainties due to its power deriving from wind: 75 per cent, small hydro: 25 per cent, and solar under one per cent, Good Energy needed to ensure that any risks it might be exposed to under NETA were fully hedged and that any spikes in customer demand for power could be met instantaneously.

In this way, Good Energy can ensure that it can deliver green power to its customers on a round-the-clock basis, whatever the demand profile, while simultaneously ensuring that any potential risk exposure is professionally managed as cost-effectively as possible.

Different strokes

In contrast to the route adopted by the UK to achieve deregulation and increased competition in the UK power market, many of its European neighbours have adopted different procedures to create more liberalized power markets, while some are still near monopolies, virtually dominated by a single, vertically-integrated supply company.

For example, in France, although power contracts are negotiated bilaterally, there is



Figure 2. Monkton Generation owns Delabole Wind Farm near Camelford in Cornwall, UK, and supplies the power to sister company, Good Energy. The power is consolidated by SmartestEnergy

bilateral contracts, while capacity payments to generators are regulated. The Spanish power sector comprises the following categories of players:

- Producers produce electricity as well as build, operate and maintain production stations.
- Special regime producers benefit from particular incentives because they improve energy efficiency and reduce environmental impact thanks to the use of renewable energy sources, residues and co-production.
- Carriers take the power from the generation sites to the distribution grid and build, maintain and manage grid installations.
- Distributors and resellers are companies which have access to the transportation or distribution grids and whose responsibility is to sell electricity to qualified consumers or other members of the system.

All of the above are overseen by the National Government Office which is responsible for electricity planning, regulation and operation of the production market. It defines the basic governing rules of production, transportation, distribution and sale of electricity and specifies the minimum quality and safety levels for supplying electricity.

Scandinavian exchange

Denmark's power market needs to be considered simultaneously with that of Norway, Sweden and Finland, as it is part of Nord Pool, the Scandinavian power exchange which was established in 1993 and is the world's only multi-national exchange for trading power.

With Nord Pool, Danish market participants trade residual volumes on a day ahead spot market basis (bid and offer stacks creating the marginal price) with counterparties in Norway, Sweden and Finland, with prices varying if there are constraints on the interconnectors between those countries. Imbalances in Nord Pool are settled with the National Grid Operator, which has its own balancing mechanism.

Generally speaking the market is bilateral with over the counter (OTC) trades, but there are some national anomalies in Denmark such as specific environmental taxes which do not apply in other Scandinavian markets.

In 1988, Germany opened up its power market to competition without passing through any transition phase and allowed network operators to develop the access rules, the pricing rules and data exchange standards with the network users. The outcome was an OTC, exchange-based market place with regulated third party access to transmission and balancing/reserve handled via an auction process.

It is clear from these examples that power trading in the EU is far from being a single market. However, the common theme of deregulation becoming more of a key driver, supported by the EU's competition agenda, it is likely that over time, the various national power trading regimes will begin to converge.

This process is likely to accelerate as the dominant generation and supply companies continue to expand their business activities internationally and make significant acquisitions in other European territories.

"With the common theme of deregulation becoming more of a key driver, it is likely that over time, the various national trading regimes will begin to converge"

a national balancing mechanism managed by RTE (Réseau de Transport d'Electricité), the transmission system operator. In addition, although there are 50 power companies operating in France, EDF (Electricité de France) still supplies around 90 per cent of the country's power.

Unlike France, Spain has a much more deregulated power market, with a non-mandatory pool and optional physical

In addition, there is a National Energy Commission which ensures competitiveness, objectivity and transparency in the electricity sector, a system operator which is responsible for guaranteeing continuity of supply and a market operator, responsible for financial management, and final settlement of the energy buy and sell offering system used by the various players in the power market.

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■ Reader Reply No 74 ■

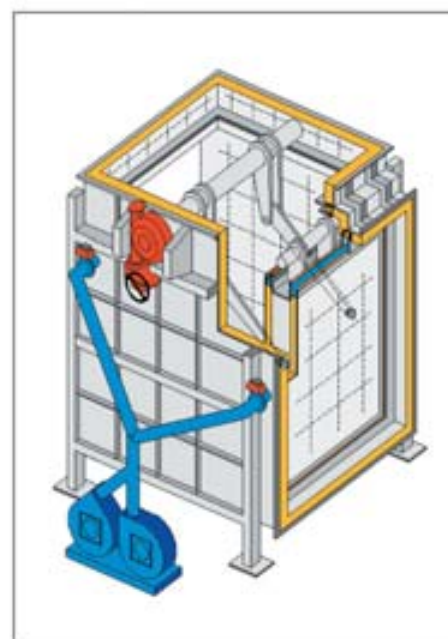
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■ Reader Reply No 56 ■

Transmission and Distribution

Wang Jinglin, Wang Shuyu, East China Grid Co. Ltd., Wu Jianhong, Jiangsu Provincial Electrical Power Company, Wu Jiansheng, Yang Yuanchun, East China Electric Power Design Institute, Xiong Zhiming, Niu Yonghua, Jiangsu Power Transmission & Transformation Corporation, Andreas Fuchs and David Hughes, Fichtner/PB Power

Critical path

The East China/Jiangsu 500 kV power transmission project is being implemented against the background of the rapidly rising demand for electric power in Jiangsu province, China. The overall project objective is to alleviate critical bottlenecks in power transmission in east China and to promote electricity trading on a commercial basis, so providing a prerequisite for economic growth by making available sufficient power to consumers. This goal is considered to be attainable most economically through expansion of the existing 500 kV power system.

New high capacity power plants are to be built along the seashore of north Jiangsu province, but this electricity has to be supplied to the load center of south Jiangsu, which is separated by the Yangtze River. So, an important component of system expansion is a crossing of this river by the 500 kV double circuit overhead line of 2000 MVA capacity per circuit, running from Yangdong to Doushan. Project planning started in 1998 and foundation construction commenced in 2001. The overhead line was first energized on 18 November 2004.

The crossing is located between the cities of Nanjing and Shanghai, 200 km upstream of the Yangtze River estuary. Both sides of the river are embanked and the terrain is totally flat. At this point, the river is more than 2 km wide and heavily populated on both sides, with the land used intensively for agriculture and industry. To optimize the right of way, some dwelling houses had to be pulled down and families resettled. New modern houses were erected for them near their original location.

The Yangtze River is a major transportation waterway, and is used by ocean-going vessels at this section. The highest water

level has been established as 5 m above sea level, and then clearance of 50 m for the highest ships plus 6 m electrical safety clearance to the lowest conductor must be assured.

Suspension towers

The tower is equipped with two 500 kV circuits in a 'Danube' configuration, plus one groundwire and one optical ground wire (OPGW). The span between the two suspension towers is 2303 m. Considering a ground level of 4 m below highest water level, total clearance to the lowest conductors of 56 m, a conductor sag of 227 m, an insulator string length of 10 m and a tolerance of 5 m, a height of 302 m is obtained for the bottom suspension string attachment point. The total tower height is

The recently energized East China/Jiangsu 500 kV transmission project employs the world's tallest transmission towers, reaching 346.5m at the Yangtze River crossing. The \$50.7m project was completed under challenging conditions, and has relieved a major bottleneck in the East China grid.

calculated by adding the vertical distance to the upper conductor crossarm of 27 m and the distance to the groundwire crossarm of 17.5 m, for a height of 346.5 m. The maximum crossarm length is 38.5 m from the tower axis; the tower width at the top totals 8 m but at ground level it is 68 m. One tower weighs 4192 t.

The towers are lattice steel structures of welded and rolled angle profiles. During the preliminary design stage, a comparison was made between angle steel towers, tubular steel towers and reinforced concrete towers. Although all options can boast successful experience in design, fabrication and operation, the angle steel tower possesses some advantages: a high degree of production automation; machining quality is easier to guarantee; no inner concealed surfaces; galvanization quality is easier to check; no vibration problems under gentle breezes; and better fatigue resistance and lower costs than reinforced concrete towers.

The Jiangyin Yangtze river crossing now has the highest transmission line towers in the world. Previous towers with a height of above 200 m are mostly located in China and Japan.

The tower top geometry is determined by the electrical safety clearances at the tower and at midspan under normal (no wind) and exceptional (maximum wind or galloping conductor) conditions. Under Chinese regulations, the horizontal distance between conductors in long spans has to be 22.5 m. This value corresponds with the Norwegian rule for fjord crossings of one per cent of maximum span. The distance to the tower is fixed by the swing-out behaviour of the insulator string and the allowable air gap. Determination of the vertical distance between conductors takes account of conductor



Figure 1. Constructors step carefully as they work on building the world's tallest transmission tower

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■ Reader Reply No 57 ■

Transmission and Distribution

Table 1. Highest transmission line towers of the world

Project Name	Country	Volt (kV)	Span (m)	Circuits	Conductors (per bundle)	Tower height (m)	Tower type	Year of completion
Jiangyin Yangtze River Crossing	China	500	2303	2	4	346.5	Lattice box angle steel	2004
Nanjing Yangtze River Crossing	China	500	2053	2	4	257	Reinforced concrete	1992
Orinoco River Crossing	Venezuela	230	2537 + 2161	2	1	240	Lattice box angle steel	
Zhujiang Crossing	China	500	1547 + 931	2	2	235.75	Lattice box angle steel	1990
Wuhu Yangtze River Crossing	China	±500	1910	2	4	229	Tubular tower	2003
Elbe River Crossing	Germany	380	1200	4	4	227	Lattice box angle steel	1978
Chusi Crossing	Japan	220	2357	2	1	226	Tubular tower	
Daqi Channel Crossing	Japan	220	2145	2	1	223	Tubular tower	1997
Suez Canal Crossing	Egypt	500	600	2	4	221	Lattice box angle steel	1998
LingBei Channel Crossing	Japan	500	1463	2	4	214.5	Tubular tower	1993
Luohe Crossing	China	500	1478	2	4	202.5	Reinforced concrete	1989

galloping (ellipse axes of 8 m horizontally and 16 m vertically), recoil when ice falls off and electrical clearances. This was calculated to 27 m. The vertical distance between groundwire and conductor is selected as 15 m, and depends on the lightning protection angle at midspan, ice drop-off recoil distance and galloping.

Anchor towers

For each circuit, two anchor towers take up the conductor tension forces left and right of the river crossing. The span in each case between suspension and anchor towers is 700 m. These towers are of rectangular cross-section of dimensions 16 m x 24 m at ground level. Each of the four anchor towers has a height of 55 m and weighs 110 t. A cruciform component composed of two heavy angle steel sections welded back-to-back is the main member of the tower body below the crossarms. A maximum leg pressure of 4058 kN and a maximum leg uplift of 3848 kN have to be transferred to the foundations. The crossarm axis is perpendicular to the crossing span, and the distance between the two towers on each side is 40 m.

Conductors and groundwires

The crossing ensures power transmission at 2 x 2000 MVA, or 3200 MVA if just one circuit is in operation. The conductor

has to transmit the corresponding current under conditions of 40°C ambient temperature and 0.6 m/s wind speed. But the conductor's mechanical strength is decisive for the design and cost of the crossing. Only aluminium alloy conductors with high tensile steel reinforcement are able to combine high conductivity with an adequate tension-weight ratio for economic sags. The design process included a review of the conductors used in existing crossings, investigations of new types with closed surfaces, electric field calculations, and comparisons between different bundle configurations. Finally, a quadruple bundle of conductor type AACSR 500 (42/3.9 aluminium alloy, 19/3.9 high tensile steel) was chosen.

The operating stress in the conductor affects not only sag and tower height but also conductor safety and susceptibility to vibration. Conductors of existing crossings are designed for everyday stresses (EDS) in a range of between 17 per cent and 25 per cent of the conductor's ultimate strength. The relationship between EDS and sag can be illustrated for the conditions of the Yangtze Crossing: a reduction in

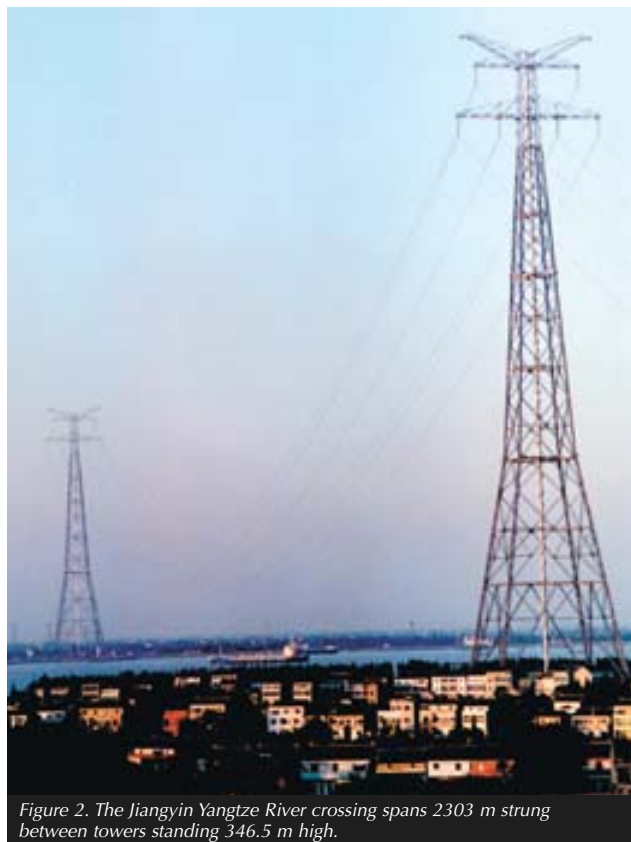


Figure 2. The Jiangyin Yangtze River crossing spans 2303 m strung between towers standing 346.5 m high.

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EDS of one per cent results in a sag increase of approximately 11 m. After consideration of all economic and technical factors, an EDS of 20.2 per cent was selected. The maximum conductor stress is restricted to 40 per cent under the conditions of combined ice and wind loading. The actual value calculated amounts to 36.2 per cent and corresponds to 724 kN per phase bundle. Additionally, a combination of ice and wind loading that occurs very rarely is considered, and the conductor stress limited to 60 per cent of the ultimate strength.

Normally the thermal limit during short-circuit currents decides groundwire

Table 2. Meteorological conditions

	Air temperature [°C]	Wind speed [m/s]	Ice thickness [mm]
Minimum	-15	-	-
Maximum	40	-	-
Every day	15	-	-
Highest wind	15	32	-
Ice covering	-5	10	10
Erection / maintenance	0	10	-

tension set. The suspension string consists of four sub-strings, each of 33 cap-and-pin type porcelain insulators. The tension set has six sub-strings, each of 26 cap-and-pin type porcelain insulators. Total creepage paths are calculated as 19 800 mm and 13 650 mm for the suspension and tension strings, respectively.

Suspension design

Twenty different loading cases are considered for the structural analysis of the tower, including normal and rare extreme wind conditions, normal ice covering combined with wind, rare extreme ice covering, broken conductors, conditions during stringing of conductors and groundwires, and tower erection loads. All loads are calculated according to the limit process based on probability statistics. During normal wind conditions, the reference wind speed (v_0) is assumed as 32 m/s at a height of 10 m, and the ground roughness is fixed as B class in accordance with China's official specification for architectural structural loading. The wind speed coefficient depends on height and is calculated from $1.0 \times (z/10)^{0.16}$, where z is the height above ground. The wind acts at angles of 90°, 60°, 45° and 0° to the line axis. For the rare wind condition, the reference wind speed is assumed as 35 m/s acting at an angle of 90°. The Eiffel effect as a function of tower slope variation according to BS 8100, wind loading on the towers without conductors before stringing as well as all loads regarding conductor galloping are considered.

Normal ice covering conditions comprise an ice thickness on the conductors of 10 mm and a wind speed of 10 m/s. The rare ice condition assumes an ice thickness on conductors and groundwires of 20 mm and 25 mm, respectively, while wind speed is 15 m/s.

The contract for crossing tower manufacture was awarded to a joint venture of Balfour Beatty and Cleveland in December 2001, following international competitive tendering in line with the procurement guidelines of the World Bank.

Due to the unique tower structure, the manufacturer was faced with major challenges: welding of cruciform profiles of 40-65 mm thickness, welding and galvanization of high strength steel components of 12 m length and 2 m width, and design of special structure junction points with compact plate configurations of 60-100 mm thickness and 18 t weight. To check that quality requirements could be met, a cruciform prototype was manufactured and tested before series production. The experience gained from this showed that it would be better to define prototypes for special member junction points, too.



Figure 3. The towers were constructed in 135 work days spread over 17 months

design but for long span crossings only the mechanical strength is decisive. The mechanical behaviour has to match that of the phase conductor to ensure lightning protection under all conditions. If the tension-weight ratio of the groundwire is higher than that of the conductor, the top part of the tower can be reduced in height. Good corrosion resistance is also required. The investigations resulted in a groundwire of aluminium-clad steel, ACS 360 (37/3.5), with a tension-weight ratio of 17.9 > 15.2 (AACSR 500) and a maximum short circuit current capacity of 400 kA²s.

Components of strings

Considering the long span length, the weight of the quadruple conductor, wind, and ice loading conditions with a safety factor of 3.0 for all loads including the maximum conductor tension, the minimum failing load of the insulator sets is 2120 kN for the suspension set and 2400 kN for the

In view of the crossing's unusually extreme conditions, special accessories and fittings were developed and passed all tests to confirm the theoretical calculations. Suspension type clamps are adapted to cater for special deflection and outlet angles, so that no non-allowable conductor stresses will arise. The clamps can also withstand unbalanced longitudinal conductor forces. The saddle clamp is 1.55 m long, weighs 116 kg and has 2.54 m long armour rods that are fitted on the conductors before installation. For conductor anchoring, compression-type tension clamps are used, which have been tested to withstand 95 per cent of the ultimate conductor strength (475 kN).

Table 3. Clearances at tower

	Wind speed [m/s]	Swing-out angle [°]	Minimum clearance [m]
Operating conditions	32	31	1.2
Switching conditions	16	11	2.5
Lightning conditions	10	6	5.6

Member forces

The loading conditions decisive for member rating are normal wind conditions, rare ice covering and broken wire conditions. The maximum leg compression force amounts to

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Transmission and Distribution

71 057 kN and the maximum leg uplift force 52 642 kN.

A square-section, bolted lattice box member with a side length of between 800-1200 mm is used as the main member in the middle and bottom sections of the crossing tower. This is built up of four welded cruciform components with a maximum thickness of 65 mm and angle bracing bars. A lattice component composed of four pieces of heavy angle steel is used as the main bracing of the tower body. A double baseplate is used at the tower bottom to prevent laminated tearing due to the extremely high internal forces.

At a height of 120 m, the structure is quite complicated because the tower body changes its slope angle at the junction point. The thickness and section dimensions of the lattice box members above and below this junction are different. To ensure the necessary stress transmission at the junction, a welded block component built up of a central cross part with a thickness of 100 mm is inserted between the four cruciform members in the corners. Each node weighs approximately 18 t.

As the internal forces between the structural members are unusually high, normal stress analysis software could not be used.

"The Yangtze River is the most important waterway in China. Therefore, stringing without closing the navigation channel was adopted for this project"

The East-China Electric Power Design Institute has developed two special programmes, Box and MSF, which may be linked to the 'Tower' programme – a finite element programme developed in Canada and adapted for calculating the static forces of the crossing tower – via an automatic interface. The Box programme is used mainly to design components with a lattice box-type section, while the MSF programme calculates components made up of single angle, double angle, butterfly and quadruple angle profile sections.

Foundation

A technical and economic comparison between the options of pre-tensioned spun high-strength concrete (PHC) piles, steel pipe piles, H-type steel piles and filling piles was carried out in the initial stage of foundation design. The investigations resulted in the choice of PHC piles, and tests of mechanical strength under field conditions showed a 7200 kN compression bearing capacity and 2300 kN uplift capacity.

The design of the foundation comprises 56 PHC piles under every leg of the crossing tower with a pile length of 38 m and a pile spacing of 2.5 m. The foundation cap is positioned

Table 4. Soil conditions

Depth (m)	Soil type
0-11	Silty sand
11-20	Fine sand
20-27	Embedded layers of silty clay and silty sand
27-37	Silty clay
37-44	Silty sand
44-56	Fine sand

diagonally with a length of 19.5 m and a width of 17 m. Tie beams are laid out between every two caps of the foundation and designed with a cross section of 2 m x 1.6 m. Two bearing piles of 25 m length support the tie beam.

A recess equipped with anchor bolts was provided at the foundation top to install the double base plate of the tower and to prevent its movement under the action of the design loads. The base plate was inserted into the recess. After adjustment of the leg, the bolts were tightened and the recess filled with grout. The depth of embedment of the base plate into the foundation is 1350 mm. The anchor bolts are of 42CrMo high-tensile alloy structural steel, ensuring strength and elasticity.

Foundation settlement has been continuously monitored since starting concrete pouring and installation of conductors and groundwires. Up to now, settlement of the four foundations of the tower is absolutely consistent, totalling 6 mm.

Welding of cruciform profiles

The lattice box member structure of the suspension tower consists of four welded cruciform sections made of 25 mm to 65 mm thick high-strength steel plates.

Welding was done to the international standard ANSI/AWS D1.1, and procedures and tests were adapted to suit. During fabrication, non-destructive examination was effective in locating hidden faults in weld seams. Steel plates exceeding 40 mm were tested 100 per cent by ultrasonic inspection and 20 per cent by magnetic particle inspection. To clear up any remaining doubts concerning the test results, radiographic inspection was applied to clarify the nature of any faults.

Table 5. Maximum foundation loads

	Compression (kN)	Uplift (kN)
Axial load	-71 890	+53 780
Horizontal load x-direction	12 010	9 065
Horizontal load y-direction	11 930	8 982

If cracks were detected in the weld surface, additional dye penetration inspections were conducted.

During a routine pre-assembly test of 286 m junction points and the mid-tower sections (206-286 m), penetration cracks were detected in the welding seams and adjacent steel plates. The overall inspection revealed some shortcomings in the fabrication process. Finally, the supplier agreed to re-manufacture these structural components. In order to simplify the manufacture and to minimize the project delay, it was agreed to revise the design and apply the welded cruciform sections made with steel plates instead of the large rolled angle sections.

Size induced problems

Technical and quality problems arose during fabrication of the junction point at 120 m. This is located where the tower body changes its slope and the size of the box member changes from 1200 mm to 800 mm. It is welded from 65/100 mm and 60/100 mm high strength steel plates, and is very complex and difficult due to space constraints with insufficient access between the plates. The fabrication process was improved by changing the preheating and interpass temperatures, closer supervision, and heat treatment of the complete junction point after manufacture. Finally, full penetration welds could be performed and deformations avoided.

Timetable

Erection of the crossing towers took 17 months, starting on 8 November 2002 and finishing on 13 April 2004, with both crossing towers erected in parallel. Work was stopped four times due to delays in delivering main components with the longest interruption from 17 July 2003 to 7 February 2004. Erection was influenced by bad weather for 76 days, mainly in the first half of 2003 and spring of 2004. Due to rainy and foggy weather, erection and stringing work could not proceed continuously, so making it difficult to schedule the jobs on site. Fortunately, this had no serious consequences. Ultimately, the effective construction period was 135 days with a working rate of 14 t every day.

The Yangtze River is the most important waterway in China, with average traffic on the river exceeding 2500 ships per day at the crossing location. Therefore, stringing without closing the navigation channel was adopted for this project.

Stringing started on 14 May 2004 when the helicopter strung the first pilot wire. Eighty days later the process was complete. In total, twenty-four conductors, one groundwire and one OPGW with all fittings were installed.



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■ Reader Reply No 60 ■

Energy Management

Oxana W Yakovleva, System Operator, Russia, Vladimir Calovic and Hans Pille, KEMA Consulting, Russia

As Russia's electricity sector moves forward towards a competitive environment, its System Operator and advisors have evaluated the existing Energy Management System and decided to implement a state-of-the-art upgrade for both the central and regional systems.

All systems go

The Russian System Operator (SO) is by far the largest energy company in the world. Not only is the geographical area it controls the largest country in the world, but one single system operator manages all this territory. Although the existing Energy Management Systems (EMS) are still functioning within operational limits, the organization decided to replace the central and territorial systems with modern state-of-the-art systems.

The main advantages of the new implementation are expected to be increased reliability and quality of operational control, increased efficiency of the SO, a reduction in undelivered energy due to SO mistakes and a reduction in maintenance expenses, technical staff and expenses for additional software.

Sector organization

The Russian electricity sector is undergoing a process of restructuring and liberalization to provide for better economics and competition for current and future services. The principal objectives of this reform are unbundling and division of the power sector into natural monopolies (energy dispatching and transmission) and competitive businesses (generation and distribution).

The joint stock company United Energy System of Russia (RAO UESR) was formed by the Russian government in 1992 to commercialize and partially privatize the national electricity system. In 2002, the operating-dispatch unit of the RAO UESR was transformed into joint stock company 'System Operator Central Dispatch Unit of the Unified Energy System' (SO), RAO UESR's transmission assets were consolidated into the Federal Grid Company (FGC) and the Administrator of Trade System (ATS) was formed as operator of the wholesale electricity market. The FGC owns the transmission network, is responsible for development of the network, and operates the network under control of the SO. The ATS is responsible for commercial operation and settlement of the wholesale market.

With the monopolistic elements, grid companies and

system operator established and operational, the competitive suppliers were established. At the end of 2004 the RAO UESR holding company was configured and it is currently setting up ten wholesale generation companies (with an average installed capacity of 8 GW) and 14 territorial generation companies (with an average installed capacity of 3 GW).

Marketplace

A transitional model of the wholesale electric power market began to operate in the European and Ural territory of RAO UESR in November 2003. The wholesale market includes three interrelated sectors: regulated, free trade (competitive sector), and deviation (balancing sector).

The expansion of the energy market is in full progress. The trading exchange of the ATS has

System Operator

The SO organizes the electricity transport throughout the Russian Federation. The balancing of the energy production and consumption in the energy market is also done by the SO organization. This balancing requires intensive co-ordination with the market operator ATS and the market participants. The final result of this co-ordination is an energy market that not only reflects the market price but also the physical constraints of the network.

The main tasks of the SO organization are the control of energy transport, drawing up energy balances, ensuring electricity supply reliability and supporting the energy market. These tasks are not complicated, but the size of the grid, the energy flows and the constraints make the whole operation rather complex.

"The study showed that the most viable option to proceed with the EMS project was a stepwise replacement of the entire system"

been in operation since November 2003 and has more than 80 corporate members.

Prices set at the exchange are on average five per cent below those of the regulated sector. The 2004 annual sales of ATS are expected at about \$850 million. The volumes of electric power traded in the free trade sector are currently limited to 15 per cent of the total planned generation. The introduction of a fully competitive market is set for summer of 2006.

The SO is organized hierarchically. A single control centre (CDU) in the capital, Moscow, directly communicates with seven territorial centres (ODU), spread geographically all over the Russian Federation. These seven territorial centres communicate with 63 regional centres (RDU). Each of these centres is equipped with automated Energy Management Systems.

Control systems

The System Operator relies heavily on automated systems to register and analyze the status of the electricity transport. Just like the tasks and responsibilities of the organization, the requirements of these systems changed dramatically while introducing a liberalized energy market. The EMS controlling the energy transport required many new functions specifically to interface with the newly developed energy market systems. This was a reason for the SO management to analyze the need to replace most of the automated control systems.

The existing operational Energy Management Systems are

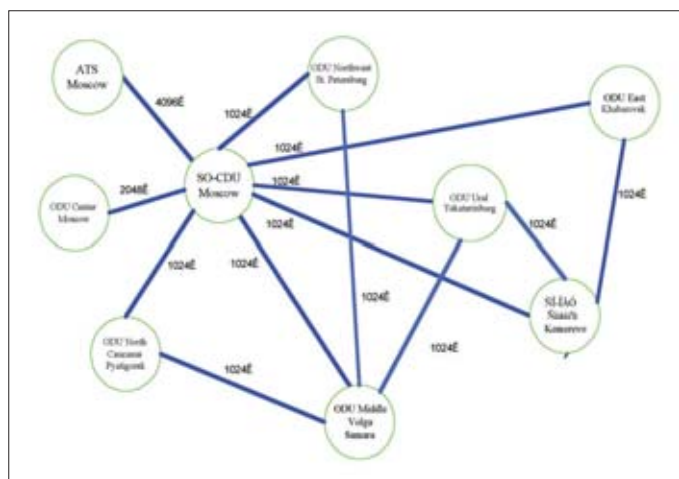


Figure1: Communication infrastructure of Russia's System Operator

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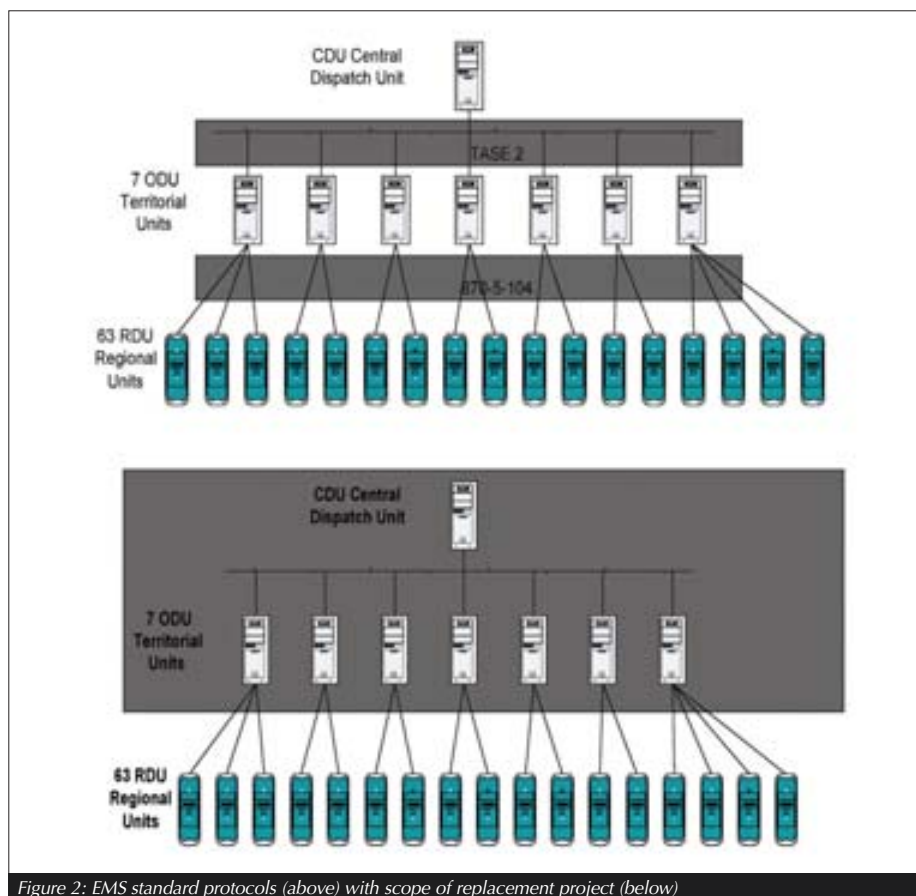
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■ Reader Reply No 61 ■



exchange, efficiency and time-critical operation. Regular requirements are consistent data and reproducible analysis. Important criteria for any system are a consistent and clear definition and structure of data.

In an early stage the SO management decided to implement standards for data exchange. Several IEC standards were evaluated and selected for implementation in future systems. The management of RAO UESR related companies followed up this decision. In September 2004 in Moscow, top managers from RAO UESR and from the major infrastructure energy organizations signed a Memorandum of Understanding acknowledging the importance of using the Common Information Model (CIM) as the principal mechanism for enabling compatibility of information within the Russian electric power system. This decision obviously has consequences for the architecture of the EMS.

The new EMS will, like the existing system, reflect the structure of the System Operator organization. A central system (CDU) in Moscow will directly interface with seven territorial systems (ODU). These seven territorial systems will interface with a total of 63 regional systems (RDU). Replacement of the 63 regional systems is carried out by the System Operator's own staff. An international project team will replace the two upper levels of EMS.

The EMS consists of several component subsystems:

- Energy control system
- Information storage & retrieval system
- Backup control system
- Operator training simulator
- Programme development system.

All data storage and data exchange will be based on CIM. The data exchange with the energy market will be based on CIM compliant data streams.

Project status

In 2004, working groups of SO staff, their consultants and several other Russian and foreign specialists prepared the system's technical specification. This specification was approved by all organizations involved.

SO and its consultants organized a pre-qualification for potential tenderers in Spring 2004. This pre-qualification was open for all specialized companies. Six companies from the initially sixteen interested companies sent in a pre-qualification tender. From the six companies only three remained. These three companies were able to prove to the pre-qualification evaluation team that they had indeed the experience, qualifications and potential to provide the SO organisation with a state-of-the-art Energy Management System. Between the end of 2004 and Summer 2005 the suppliers – ABB, Areva and Siemens – will prepare technical and commercial tenders. One of these companies will be selected to implement the project and have the system operational before 2008.

developed and maintained by in-house staff or related companies. The system and software maintenance efforts have been growing rapidly with each new addition to these systems. The existing systems are now at a stage where new functionality cannot easily be added and have low capacity compared to currently available technology. The systems are close to the end of their life cycle and a lot of manual work is required for daily operations (filling database, forms, reports, requests). In addition, interconnectivity with the future automation systems of the Federal Grid company (grid owner) and ATS (market operator) is not possible or would be very expensive to implement. The same would apply in the case of interconnection with other European energy systems, as the mechanisms for operational control do not support the new commercial market relations.

The new market designs require detailed and accurate mathematical modelling of the energy transport as well as reproducible reporting and calculations. The new systems should have automated facilities for energy market support and many options for sharing and reporting of data.

Feasibility study

To finance procurement of the systems and to enable the SO management to decide on future developments, SO staff and their consultants undertook a study to find the best economic migration track for the evolution of the SO-CDU's EMS. In this study, special attention was given to different models for a deregulated, commercialized

electricity supply market within the Russian Federation, and the expanded role that an EMS has to play in such a new landscape. The result of that study was the basis for an investment programme to replace the current EMS with an advanced system, that will both skirt the risks associated with the operation of the current outdated system and provide a sustainable environment enabling operation for a period of ten years or more, including any future deregulated market functions.

This study showed that the most viable option to proceed with the EMS project was to engage in a stepwise replacement of the entire system: replace both the central CDU and seven territorial ODU systems, then gradually replace the regional systems.

The working group expects the cost of the operations using the current EMS to rise in the short term. This additional cost can be avoided by replacement of the EMS. By adding standard features of modern EMS type systems, several other costs (e.g. transport losses) can be avoided, or at least limited. Also, most important but not quantified in this study, market support is certain during the lifetime of the new system. Benefits from this are not directly for the SO organization. The study was reviewed by the European Bank for Reconstruction and Development (EBRD). The EBRD is to finance key elements in the replacement projects.

Architecture and standards

Key issues in the new system and in the new market oriented organisation are data

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investment into a potentially lucrative market. Hosted by the China Electricity Council and supported by the State Electricity and Regulatory Commission, China Power aims to define the region's needs by presenting a strong technical and strategic user-focused conference as well as an array of key industry exhibitors looking to do business in the Chinese power market. This important platform will enable international power executives with interests in the region to meet under one roof.

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Energy Management

Glen Akselrod, Electric City, Illinois, USA

With the grid in North America firmly under the spotlight, Electric City is working on two projects that aim to manage peak loads best by using smart systems to remotely control demand.

Take a **load off**



Since the California energy crisis and the massive blackout that struck North America in August 2003, regulators and policy makers along with other stakeholders have realized that North America's electric grid has not kept up with the growth in electricity demand.

As a result of this growing demand-supply imbalance, utilities, large consumers, regulators and policy makers concluded that regions must immediately consider ways in which the power grid can be upgraded and are now questioning how alternative energy can be utilized to help solve problems on the grid. However, while transmission constraints have become a major issue, as a result of urban sprawl it has proven to be very difficult to expand existing transmission systems due to 'not in my back yard' concerns.

First and foremost, the basics have to be addressed. Some of the quickest and most cost-effective ways to solve strain on the electric grid include promoting efficiency and demand reduction technologies.

Demand response

In response to these observations and subsequent shift in resource planning and policy making, many regions across North America are launching government-sponsored, utility-owned and market-based demand response programmes. Examples include proactive and innovative approaches at the state level. For instance, Pennsylvania has recently passed legislation that qualifies demand response as a renewable resource within a renewable standards portfolio and Illinois is in the process of passing similar legislation. Additionally, California has led the way with a large number of demand response programmes;

New Mexico has announced plans to adopt an energy efficiency bill, while the government of Ontario, Canada has initiated significant regulatory and policy changes that will treat the economics of demand reduction equal to that of new power supply generation.

“Regulators and policy makers along with other stakeholders have realized that North America's electric grid has not kept up with the growth in electricity demand.”

At the same time, the shift by utilities and regulators to include demand response in overall power grid design has coincided with advancement of demand response technologies and companies that develop and manufacture them. One such company is Illinois based Electric City Corp.

Electric City provides EnergySaver and GlobalCommander energy conservation

technologies, as well as its independent development of scalable demand response systems with the trade name Virtual 'Negawatt' Power Plan (VNPP).

The EnergySaver is a lighting control, power reduction system that provides variable baseload demand side energy manage-

ment by increasing or decreasing the active power supplied to a ballasted lighting system without abrupt voltage changes. Consequently, the product allows end users to curtail power to their lighting systems by as much as 30 per cent. Current results demonstrate that occupants of curtailed locations do not perceive any lighting degradation and experience no adverse impact on their business operation.

Installed in just a few hours, it can be located in the backroom area of a facility and can provide internet connectivity and real time reporting of energy savings. The system is appropriate for both interior and exterior lighting systems, including all ballasted lighting fixtures. To date, the EnergySaver has been used in a variety of applications to provide steady-state energy savings and real time peak demand load control.

Combining programmes

According to Electric City, the GlobalCommander is the only advanced controller capable of providing large scale demand side management savings without turning off the lights. Electric City has packaged the



Figure 1. The equipment can be located in the back room area of any utility and comes complete with security controls

Creation



Evolution



Revolution



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■ Reader Reply No 37 ■

EnergySaver technology with area wide communication to provide a curtailment control system that strives to efficiently reduce base lighting loads. When used in conjunction, the GlobalCommander provides the EnergySaver with multiple communication capabilities and accurate microprocessor based measurement and verification on a real time basis. The package allows Electric City to respond to market information by changing control set points, activating start/stop schedules, and altering other operating parameters to take full advantage of market rates and peak load conditions.

With the capability to accept additional load control points and devices the GlobalCommander reduces the installed cost of additional demand response systems that may be selected or desired in the future.

Major US retailers such as Home Depot, Gillette, Heinz, Toyota, A&P and Linens 'N Things as well as many state and municipal governmental agencies have saved significant sums from their lighting bills utilizing the EnergySaver-GlobalCommander technology. The growing customer successes have been instrumental in advancing the company from a manufacturer of an energy efficiency product to a developer of scalable demand response systems.

The combination of the two also produces 'Negawatts' in lieu of megawatts at a cost that is significantly lower than the wholesale cost of power. The system provides a large level of power curtailment that is completely dispatchable, remotely controllable and verifiable over an internet based system that is completely transparent to end users. The VNPP is a binding together of the Negawatt concept with the EnergySaver-GlobalCommander.

Remote control dispatch

VNPP allows utilities to remotely control commercial, industrial and government lighting systems over a managed and secure IP network. By using the system, a utility is able to reduce electric capacity requirements during periods of peak demand, providing instantaneous control, measurement and verification of load reduction.

Electric City or their utility customers can operate real time dispatch of load curtailment. Dispatch control facilities have geographic control and real time communication in order to measure, verify and shift load from any specific installed EnergySaver-GlobalCommander system, or a select network of EnergySaver-GlobalCommander systems across multiple sites. Dispatch can also be pre-programmed into the system in advance and can automatically respond to price signals

and other market based events.

The VNPP system was first demonstrated in August of 2001. At that time ComEd and the Chicago Mayor's Office requested that city facilities curtail electrical consumption to avert blackouts as demand for electricity reached an all-time record high. Utilizing Electric City's technology, the Chicago Park District was able to respond instantly with a simple click of a mouse, immediately shutting off non-essential lighting at 34 of its locations city-wide. This demonstrated the first real test of the VNPP methodology.

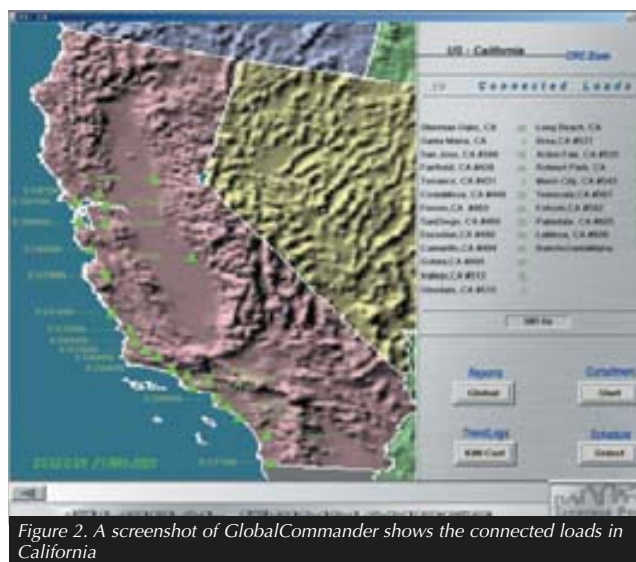


Figure 2. A screenshot of GlobalCommander shows the connected loads in California

Green energy initiatives

The demand response programmes currently being developed for Commonwealth Edison (50 MW) and PacifiCorp (27 MW) represent some of North America's largest cost effective demand response programmes known to date. These projects will be a key part of ComEd's and PacifiCorp's green energy initiatives and a valuable asset to their overall future all source resource plan. Both of these large scale demand response programmes are structured through long term power purchase agreements. Under these agreements, Electric City will deploy its demand

dous customer acceptance of the technology and the ease of the programme, which encourages customer participation. Since the cost of the programme is borne by the utility in the form of a long term power purchase agreement, Electric City is able to provide the system to end use customers at no cost. In exchange for receiving free technology, the customer agrees to operate the system at a steady state reduction level of 3 to 5 per cent and thereby receives an infinite return on their zero dollar investment. For these free savings, the customer then gives Electric City and its utility partners the right

to further reduce the power to their lighting system by another 20 to 25 per cent on certain days when the power grid reflects peak demand conditions. The customers are open to this additional reduction and agree to give up control of their lighting systems to the utility because they know that even at a 30 per cent reduction level, the loss of lighting will be minimal and will never adversely impact their business operations. Customers will be able to run their sales, service or manufacturing operations without interruption and without noticing any difference in their level of lighting. In addition, the installation process only takes a couple of hours.

The simplicity of the programme has resulted in customers who have signed up and are currently participating in the ComEd project, entering into agreements with Electric City to participate in similar VNPP programmes in other electricity jurisdictions in North America. This allows the company to approach utilities and regulators who are studying or discussing programmes in their respective jurisdictions with pre-aggregated load from current customers who have already expressed an interest in becoming a participant. This has helped utilities get over some of their historical concerns about not getting enough customers to participate in previous programmes.

"In exchange for receiving free technology, the customer agrees to operate the system at a steady state reduction level of three to five per cent, receiving an infinite return."

response system, which will allow PacifiCorp and ComEd to remotely control commercial, industrial and government lighting systems over a managed and secure IP network. Using Electric City's system, the utilities will be able to reduce electric capacity requirements during periods of peak demand, providing instantaneous control, measurement and verification of demand reduction.

The deployment of the VNPP demand response system has been aided by tremen-

Utilities and regulators had been slow to recognize the importance of demand response in the electric power markets. That has all changed. The historic power outage of 14 August 2003 has raised critically needed awareness among the same utilities and regulators that were previously wary of this type of load management initiative. Electric City has demonstrated that one of the quickest and most cost-effective ways to solve the strain on the electric grid is to utilize demand reduction technologies.

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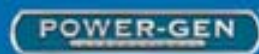
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■ Reader Reply No 65 ■

Battling the cyber menace

Computer system-based attacks on infrastructure organisations, including electric utilities and power stations, are on the increase. Defending against them requires a holistic approach and a commitment from board level down.

There has been a tenfold increase in successful cyber attacks on process control and SCADA (supervisory control and data acquisition) systems since 2000, according to a 2004 report titled "The Myths and Facts behind Cyber Security Risks for Industrial Control Systems". Many of the systems attacked were responsible for the operation of critical services including electricity, petroleum production, nuclear power and communications. The report was produced jointly by security experts at the British Columbia Institute of Technology (BCIT) and PA Consulting Group (PA).

The report noted that industrial control and automation systems have traditionally been seen as immune to external attack, as systems were based on proprietary technologies and isolated from other IT systems. But it said the ten reported cyber attacks in 2003 were likely to be just the tip of the iceberg and industry estimates indicate that between 100 and 500 unreported cyber attacks occur every year.

The situation is being exacerbated by new efforts by the hacker community to specifically target process control and SCADA systems for attack. A recent hacker conference included a demonstration on how to attack a water utility

nuclear power plant in January 2003. The plant and corporate networks were connected to external networks via a firewall, and an SQL slammer worm entered the system because no access control policies were in place. Infected servers on the corporate network left vulnerable ports open and the result was an overloaded network and interrupted server communication.

Analysis shows that the increase in successful industrial cyber attacks is the result of:

- an increasing alignment of process control and corporate IT systems;
- the fact that corporate IT security measures often cannot be applied to process control systems;
- increasingly powerful and malicious cyber threats.

Research was based on data collated in the BCIT Industrial Security Incident Database, dating back to 1981. Results were born out by a separate report from the US General Accounting Office ("Critical Infrastructure Protection," March, 2004) which said, "there has been a growing recognition that control systems are now vulnerable to cyber attacks from numerous sources, including hostile governments, terrorist groups, disgruntled employees, and other malicious intruders."

"Of those organizations that put a figure on the impact of cyber attacks on their process control and automation systems, 50 per cent experienced financial losses of more than \$1 million"

control system. Of those organizations that put a figure on the impact of cyber attacks on their process control and automation systems, 50 per cent experienced financial losses of more than \$1 million. In one example, a so-called slammer worm hit the Davis-Besse

Eric Byres, BCIT researcher, said: "The results were a surprise to us because they indicate that industry has been focusing its security efforts in the wrong direction. The real threat is coming from outside the organization, rather than from within, as most of us originally believed.



Network systems are increasingly under cyber attack

We can't just throw in a firewall and hope all our security problems will be solved."

Gary Sevounts, director of power and energy industry solutions at Symantec, identified several reasons why traditional approaches to managing SCADA cyber security have fallen short. Typically, disparate internal factions have worked independently and security projects have taken a micro view. There has been little coordination of efforts between IT and operations departments and there has been little SCADA cyber security expertise and few cyber security products.

Sevounts also said SCADA systems' vulnerabilities have been made more exposed because of their increased connectivity to the rest of the world. For example, there is an increasing need to share SCADA information with corporate enterprise networks for various administrative functions. Those systems, in turn, are exposed to the Internet. Through this connectivity, a malicious insider or outside hacker could misuse SCADA controls.

An Internet security threat report published by Symantec in March 2004 describes and compares the vulnerabilities and cyber security challenges that industries face. The report identifies power and

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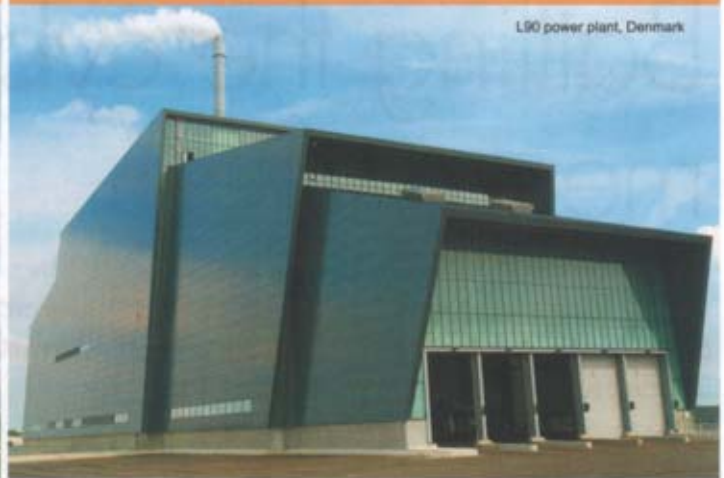
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IT FOCUS

energy organizations as being nearly twice as likely to experience a "severe" Internet attack as other industries.

As part of a report prepared for Symantec in May 2004, Battelle Pacific Northwest evaluated security products in a SCADA environment and developed a list of potential vulnerabilities associated with servers used in communication between two utility control centres (or between a utility control centre and another entity). Those vulnerabilities included:

- Denial of service
- Disgruntled employees
- Virus/worms
- Packet sniffing at ISP/carrier
- Modifying packets
- Unauthorized access to control centre network

Many of these vulnerabilities highlight a reluctance in applying traditional security measures such as patching, authentication, virus scanning, and password management to systems with the precise timing issues required by SCADA systems. Yet, as SCADA systems increasingly connect with other networks and systems, their exposure to threats increases.

According to reports from Symantec, power and energy companies' approaches to protecting their digital assets within corporate networks and SCADA systems are beginning to change. There are unified information security organizations, corporate-wide information security policies (combined with routine vulnerability audits), incident management programmes, and comprehensive deployments of protection technologies. Some information security providers now also offer SCADA and corporate network assessment services to help utilities evaluate their corporate and SCADA networks and connections, identify vulnerabilities, and offer recommendations.



Increasing connections with external IT systems offer points of attack and adds to system vulnerability

Early warning systems, in turn, are available to keep electric utilities alerted to attacks that are occurring elsewhere across the globe and that might affect their corporate or SCADA networks – before those attacks can affect the organization.

But the company said the underlying fact was that a corporation cannot achieve effective information security by tactical deployments. The practice of "cherry picking" individual solutions has proven costly in the context of the business. Instead, the approach must be holistic – and a strategic organizational priority.

Symantec maintains that a comprehensive information security programme should combine the proper mix of people, technology, and processes. For power and energy companies, that programme ideally focuses on these seven priorities:

- Security risk awareness
- Regulatory readiness
- Perimeter security
- Network and host security
- Incident response
- Secure systems management and recovery
- Security strategy and planning

"The practice of 'cherry picking' individual solutions has proven costly in the context of the business. Instead, the approach must be holistic"

How should power companies and utilities address these priorities with real security measures? There are a number of very practical ways. For example, companies should use internal firewalls to throttle traffic between operational and other corporate networks. They should use VPN to secure communications with remote users and networks. Companies should ensure that operations servers and remote user PCs are compliant with security policy. In addition, they should use intrusion detection to detect misuse/anomalies, and use anti-virus on all systems connecting to the operations network.

When anti-virus, firewall, and intrusion detection solutions are implemented at various internal and external points of the cyber infrastructure, power and energy companies can quickly recognize and stop malicious code and hack attempts.

In the past, corporations within the electric power sector used a highly fragmented, divisional organizational approach for protecting their digital assets within corporate networks and SCADA systems. Now, the industry is



SCADA systems can be affected by different cyber attacks

showing signs of change.

In 2002, the United States Department of Energy (DOE) published a list of 21 steps to improve the cyber security of SCADA networks. Of particular importance, according to Symantec, is step 20: "Senior organizational leadership should establish expectations for cyber security performance and hold individuals accountable for their performance."

Suppliers have also responded: Symantec is now working with Areva's

T&D division to provide a comprehensive security solution that includes products, services and best practices for SCADA systems in the electric power industry. The tested solution includes Symantec Manhunt Intrusion Detection System, Symantec Gateway Security, Symantec Client Security, and Symantec AntiVirus.

"Interconnection between SCADA environments and corporate networks introduce specific security needs around protocols and applications used that are not addressed by majority of existing cyber security products," said Brent Broback, security marketing director for AREVA T&D Division. Gary Sevounts added, "The challenge with introducing untested information technology security products into a SCADA environment is that it can cause service interruptions, performance degradations, while still not addressing SCADA specific security needs. We believe this partnership will ease the mounting pressure by providing products, services and best practices for SCADA and corporate environments that have been tested and validated in SCADA environments." **PEi**



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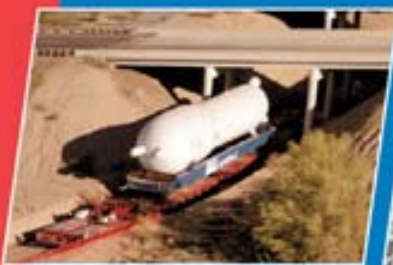


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■ Reader Reply No 67 ■

EquipmentRoundup

Heavy fuel checker launched



Turbiscan Heavy Fuel instrument undertakes oil stability checks in 15 minutes

The French company Formulation, specializing in the development and sales of instruments for analysis of concentrated dispersions, is launching a new instrument, Turbiscan Heavy Fuel. The device was designed in collaboration with The Associated Octel (UK), a company manufacturing additives. The instrument complies with the

ASTM D7061-04 for measuring heavy fuel oil stability. Over recent years several methods have been developed, but these analyses remain time-consuming, subjective and tedious. Turbiscan Heavy Fuel is the first instrument providing an objective, repeatable and accurate measurement of asphaltene stability in heavy fuel oils.

Reduction in the quality of crude oil throughout the world, due to diminishing resources and increasing refinery efficiency, have led to a deterioration in heavy fuel oils quality. Asphaltenes – a mixture of heavy hydrocarbons – tend to precipitate depending on the nature of solvents in which they are contained. The result is blocked pipework, clogged filters or plugged burners. Extraction sites, refineries and heavy fuel oil users (marine companies and electrical power plants) are therefore obligated to systematically test the heavy fuel oils' stability in order to improve efficiency of their processes.

The ASTM compliant Turbiscan Heavy Fuel device enables measurement of heavy fuel oil's stability reserve in 15

minutes. This parameter quantifies the capacity of asphaltenes to precipitate and settle within a fuel oil. It allows the accurate optimization of the concentration of additives to be added to optimize the stability of the fuel.

The technology can also have other applications within the petroleum field, such as de-emulsification of water-in-oil emulsions during extraction processes, stability of drilling fluids or any other applications in which the stability or destabilization of dispersed systems need to be monitored.

The Turbiscan range of devices combine the multiple light scattering measurement to a vertical scanning of the product analyzed. This scanning enables the identification and quantification of localized destabilization phenomena (creaming, sedimentation, clarification, etc.). Furthermore, the measurement is sensitive to variations in size, allowing associated instabilities to be identified e.g. coalescence, aggregation, flocculation.

Reader Reply Number 100

Shark emerges



Electro Industries/GaugeTech has recently launched the new Shark 100 Digital Power Transducer.

This low cost digital transducer measures 3-phase voltage, current and power and provides a hi-speed RS485 digital output using Modbus or DNP 3.0 protocols.

The unit's small footprint and simple installation make it the ideal solution for embedded power telemetry for industrial, OEM and utility applications.

The unit is designed to mount to a DIN rail and offer a 120/220 AC or DC power supply. Low voltage 24-48 VDC power supply is also available.

Reader Reply Number 101



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■ Reader Reply No 68 ■



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■ Reader Reply No 78 ■

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■ Reader Reply No 79 ■

Equipment Roundup

Float level switch makes waves

K-TEK, a manufacturer of state-of-the-art level instrumentation for liquid and bulk solids detection, has announced the launch of the MS50, the latest version of the company's low cost float level switch.

The MS50 is designed to reliably handle a wide range of applications, including sump level control, alarms, and shutdowns.

Each switch features application-specific float designs that optimize performance and reliability in the fluid being measured, whether butane, propane, oil, acid, water, or interfaces between two fluids. A unique magnetic coupling ensures optimal switch performance throughout the life of the unit. The MS50 can be equipped with up to six SPDT switch points per unit. For maximum up-time, a K-TEK latching switch design allows each point to be adjusted and replaced in the field.

The MS50 is FM Approved and CSA Certified for use in hazardous areas. A high temperature option handles process temperatures up to 149°C. For high vibration/shock applications, such as transportation, a multi-float



K-TEK's MS50 float level switch is approved for use in hazardous areas

option uses special non-latching reed switches and stop collars to guarantee reliable switching.

"K-TEK's switches are designed for the needs of today's production operations, maximizing flexibility and minimizing down-time," said Kevin Hambrice, director of marketing, K-TEK. "The MS50 can be adjusted in the field, without removing the vessel from service. And K-TEK's broad range of float designs ensures a match for the specific gravity of virtually any fluid. Competitive float switches are

limited to only a few available float designs, mounting configurations, and measuring lengths. They must be pre-configured in the factory and are designed such that if one contact fails, the entire unit must be replaced."

Each MS50 features an application-specific float design optimized for the specific gravity of the fluid being measured. K-TEK provides the largest selection of float designs, including 14 standard and hundreds of custom options.

External relays are optionally available for the MS50. The IR10 Interposing Relay Output Module is designed for process control equipment that may require a higher operating current than can be provided by most switches.

The PP10 Latching Relay provides control of on/off devices, such as motors, motor starters, solenoids, and alarms. Both units are easily mounted and installed. Each is supplied in an explosion-proof enclosure with terminal blocks for fast access to field wiring. K-TEK says its new product is competitively priced.

Reader Reply Number 102

LOAD finds problems

Digital Inspections has launched a new software module designed to allow utilities to maximize electrical transmission capacity on their lines. The company, which is a pioneer in utility equipment health systems, has introduced Line Optimization and Analysis Database (LOAD) as a new product directed to the transmission and distribution organizations within the utilities industry.

LOAD is a unique programme that factors actual data from line equipment with anticipated variables such as climate and time limits to target which element within a line is the bottleneck for ampacity. By defining a transmission or distribution line and all its associated equipment, creating a thermal ratings standard, and selecting the environmental conditions within LOAD, factors that limit increases in capacity can be identified.

Reader Reply Number 103

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■ Reader Reply No 89 ■

Equipment Roundup

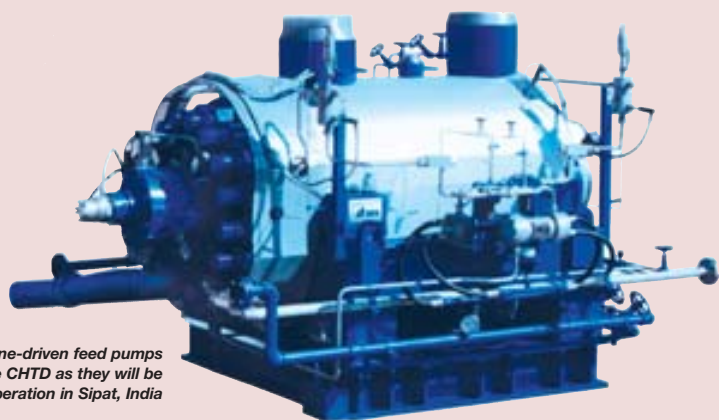
KSB power plant technology for India

KSB Group has announced that in 2006 it will start delivery of 12 large boiler feed pump sets and nine condensate pumps for use in India's most modern coal fired power plant. The contract, awarded by Russia's Power Machines, is valued at several million Euros.

The equipment will be used in three 660 MW coal fired units being

built in Sipat, Bilaspur, in the state of Chattisgarh. The units are owned by India's National Thermal Power Corporation (NTPC). KSB expects this contract to trigger further orders for power plant equipment in both India and Russia.

Reader Reply Number 104



Turbine-driven feed pumps type CHTD as they will be in operation in Sipat, India

Shenhua selects Haldor SCR

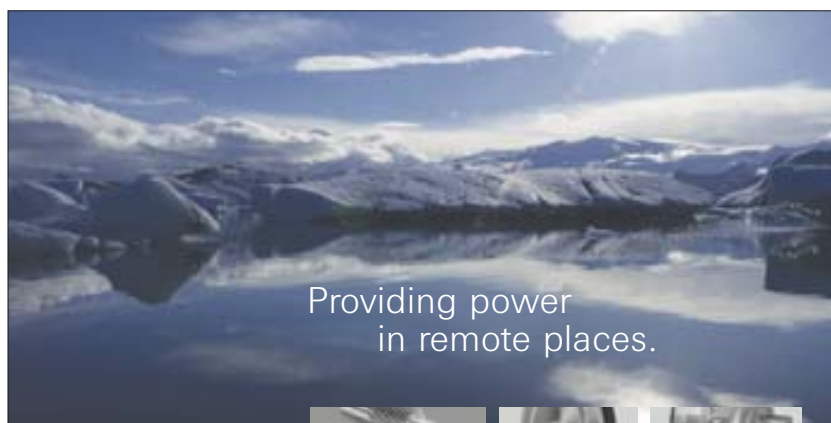
Shenhua International Ltd. has awarded Haldor Topsøe a contract to supply a flue gas SCR deNO_x system for Guohua Taishan's 600 MW unit 5 which is the last unit completing phase 1 of the 300 MW coal fired power plant in Guangdong Province, China.

The deNO_x system will be designed to reduce emissions of NO_x by more than 94 per cent and will not exceed an ammonia slip of 3 ppm in the treated flue gas. Haldor Topsøe has selected a highly efficient catalyst for this state-of-the-art demonstration project, specifically suitable for high-dust applications. The system is due to be commissioned in December 2006.

Reader Reply Number 105



Guohua Taishan coal fired power plant, Guangdong Province, China



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■ Reader Reply No 81 ■

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■ Reader Reply No 83 ■

EquipmentRoundup

First field trial for fuel cell appliance

Ceramic Fuel Cells Limited (CFCL) and Central Gippsland Institute of TAFE (GippsTAFE) have announced their agreement for Australia's first field trial of a fuel cell powered micro-CHP generator appliance.

The prototype trial will be conducted at GippsTAFE's Chadstone campus in Melbourne's south-east, by the company's subsidiary Energy and Telecommunications Training Australia (ETTA). The trial will also utilise the expertise developed by GippsTAFE in its long association with the Latrobe Valley electricity generation industry.

Julian Dinsdale, executive chairman of CFCL said: "We are pleased that the first Australian site for testing and monitoring of our fuel cell powered prototype micro-CHP unit will be with a leading energy industry training institution.

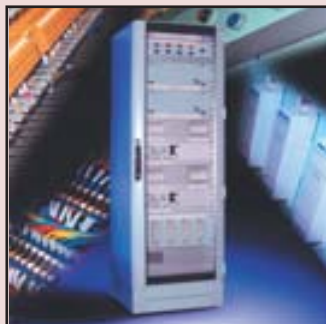
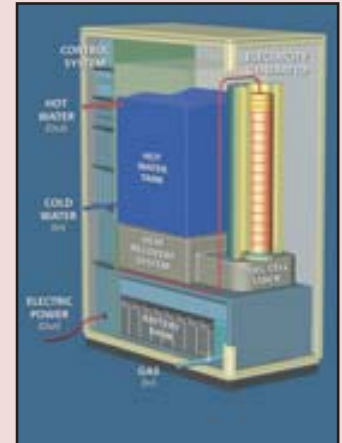
"It is an ideal match for us to work with people in energy utilities, showing them the features of two emerging and sophisticated technologies – fuel cells and micro-CHP."

CFCL's fuel cell units are designed to provide efficient, reliable, constant and environmentally-friendly mini-generators

on site in homes, offices and farms, thereby reducing reliance on large, centralized electricity generators and transmission and distribution networks. The units currently use natural gas, and have the potential to use renewable fuels such as ethanol or biogas, according to Dinsdale.

"Our prototype micro-CHP units are expected to be extremely efficient," says Dinsdale. The field trial is for an initial period of three months and may be extended by agreement.

Reader Reply Number 106



Capable cubicles

Kenda Electronic Systems Ltd. has launched a new turnkey service for the design, manufacture and site commissioning of high-accuracy metering (HAM) cubicles, which are used for tariff metering purposes at 132 kV and 400 kV supergrid substations.

Kenda aims to provide a complete service from initial design to final

commissioning, including all necessary transformer-error compensation calculations and full secondary injection testing on site.

Kenda HAM cubicles are of a standard COP1 design and incorporate class 0.2 s main and check meters, together with dual redundant Kenda Meteor 16- or 32- channel outstations

for maximum data integrity.

Each cubicle includes voltage failure alarm relays, a latching alarm indicator panel, test terminal blocks, and ancillary equipment such as anti-condensation heater and thermostat, interior light and door switch.

Reader Reply Number 107



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GensetRoundup

Wärtsilä tunes in

An Indian glass shell company seeking to double its output and become one of the world's largest in its field has contracted Wärtsilä to supply an 18 MW gas fuelled captive power plant.

Videocon Narmada Glass in Bharuch is already India's largest manufacturer of glass shells for colour television tubes and it is confident that the three 18V34SG generating sets it has purchased will power its growth plans.

Each of the gensets produces 6 MW and has an output at 11 kV. They were selected to provide the factory's new production capacity with electrical power and process heat.

Reader Reply No. 108



The 18V34SG sets can balance between electrical and thermal output

LCH powers charity's Tsunami relief mission

Glasgow based LCH Generators and Scottish Water have combined to donate a 415 V, 60 kVA three phase generator to power a water purification plant together with two water tanks for victims of the Asian tsunami disaster.

Built by Babcock, the reverse osmosis plant is a self contained unit

housed in a standard 20 foot ISO container. Designed to turn brackish water into clean fresh water for drinking, the plant is being shipped to the Indonesian region of Banda Aceh by Blythswood Care, an international aid charity.

Reader Reply No. 109



Members of the relief team test the generator before it is sent to Indonesia

Centinel stands guard

Cummins' advanced engine oil management system, Centinel, is now available as an aftermarket kit for the QSK, QSK19, QSK45 and QSK60 engines rated between 261-2238 kW.

The Centinel enables operators to extend oil change intervals to up to 4000 hours, removing 15-20 oil changes, depending on the platform. Integrating with Cummins electronics, Centinel blends the lube oil with fuel prior to engine combustion and

adjusts the burn rate based on the equipment load factor. The system is available with reserve tanks for continuous oil replenishment.

Further maintenance interval extensions can be achieved with the addition of the Eliminator oil filtration system, a full flow and centrifugal system. By eliminating the need to replace and dispose of used oil filters, lube system maintenance costs are reduced by as much as 90 per cent.



The Centinel was formerly only available as a new engine option

The Centinel aftermarket kit can be purchased and installed at any Cummins distributor location.

Reader Reply No. 110



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■ Reader Reply No 26 ■

GensetRoundup

Quietly efficient

Aggreko has introduced a new line of 1.5 MW diesel electric generators to the US market, designed to handle loads ranging from large events to baseload power generation.

Featuring ISO-size containers the generators also offer synchronizing and load sharing capabilities. Aggreko say the generators are its most advanced attempt at creating environmentally friendly, quiet and efficient contained generators.

The company has

stated that the 1.5 MW range is available for rent to its industrial, commercial and event/entertainment customers.

Reader Reply No. 111



Figure 3. Aggreko's new fleet stand ready for action

Electronic control

Volvo Penta has replaced its 9 litre industrial engine range with a new engine that is fitted with EMS 2, a new electronic control system that aims to optimize performance and fuel efficiency.

The new 9.4 litre engine is available with power outputs ranging between 190 and 280 kW. Compared to its predecessor, the new engine delivers 22 per cent more torque and 20 per cent more power.

One of the factors behind the new engine's improved performance is the



The TAD940VE offers four placement alternatives for the turbo compressor

Engine Monitoring System 2. The system monitors and regulates the engine components, including the fuel needs up to 100 times per second. Volvo Penta state that by controlling injection levels and timing through valves in the unit injectors, the engine always receives the amount of fuel that operating conditions demand.

As the new engine is electronically controlled, it can be connected to VOIDA, the compact service tool tests, troubleshoots and diagnoses.

Reader Reply No. 112

XL lubricates for long life power

Shell Lubricants have developed a new long life gas engine oil for use in high output 4 stroke engines.

Mysella XL, a low ash oil, has been formulated to lubricate modern gas engines used in power generation, co-generation, gas collection and transmis-

sion applications. Shell state that field trials with companies such as Rolls-Royce, Waukesha and MWM Deutz, have proven that Mysella XL resists oxidation and nitration, increase of viscosity and the formation of harmful acids.

The lubricant can help minimize

engine wear, lubricate hot pistons without forming excessive deposits in ring grooves and control ash deposits in valves and spark plugs. All aiding the prevention of problems such as knocking.

Reader Reply No. 113

WEG waters San Diego

The San Diego Water Authority is using WEG's MV motors to power the first part of its \$827m emergency stock project that it hopes will secure the area's water supply.

The \$200m Olivenhain dam and reservoir project is fed by pumps driven by WEG H-line 60Hz motors that generate 1865 kW.

Because the region around San Diego is essentially dry, water needs to be pumped from remote sources both for domestic and industrial use. If there are any shortfalls in this process then the result is huge problems and losses for the whole area. The dam will not block off a stream or river, instead it will box



WEG's 1865 kW motors are employed at the Olivenhain dam

off a canyon and be filled with 7.8 billion gallons of water.

Reader Reply No. 114

GE launches engine for gas compression



Jenbacher gas mechanical drive engine in Louisiana

GE Energy has introduced its first Jenbacher gas mechanical drive engine for use in gas compression. The 12 cylinder J312 GMD engine, rated at 676 brake horsepower and 1800 rpm, is driving a GE A354 three stage compressor.

The J312 comes equipped with the DIA.NE XT monitoring system, which interfaces with compressor controls

and provides air/fuel ratio control to help maintain NOx emissions without using oxygen sensors.

GE's Jenbacher gas engines range in output from 0.25 to 3 MW and run on natural gas as well as gases created from biomass, landfills, coal mines, sewage and industrial wastes.

Reader Reply No. 116

Perkins adds another

Perkins has introduced a new addition to its Sabre engine range. The 415GM extends the lower end of the Sabre line up to seven models with net power outputs spanning from 13.5 kW to 161 kW.



Reader Reply No. 115



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■ Reader Reply No 36 ■

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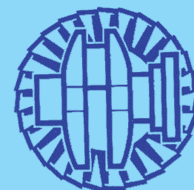
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■ Reader Reply No 93 ■

GensetRoundup

Rypos filters particular about particulate

A diesel particulate filter (DPF) system that traps up to 90 per cent of soot while using less than 1 per cent



Continuous monitoring maintains back pressure

of the engines output has been developed by Rypos.

The DPF is controlled by a micro-processor that monitors operation and periodically, as required, transmits an electric current through a filter, which then acts as a heating element. A dedicated power source then provides the required electrical current to heat the filter element to the temperature required to burn soot.

The sintered metal fibre filter has been designed to be electrically conductive with high soot holding capacity and is capable of capturing the very fine particles in the exhaust system.

The Rypos DPF package includes filter housing, an electrical control circuit and filter cartridges. It is fully automatic, with no downtime and can be adapted for use with 50 kW to 2000 kW diesel generators that need not have had a diesel oxidation catalyst fitted.

Reader Reply No. 117

FEV and NREL develop diesel of the future

FEV is working on a US National Renewable Energy Laboratory programme to develop a new diesel control system that will meet the US emissions requirements that will come into effect in 2007.

To put the emission control system through its paces, FEV used an advanced high pressure common rail fuel injection system, low sulphur diesel fuel, NOx absorber catalysts and diesel particulate filters on an Audi A4. Built primarily from production parts the test engine was also fitted with a special cylinder head and piston design developed to reduce emissions. These measures were designed to test the systems impact on engine performance and durability.

Initial results have indicated that the levels being introduced can be met and the company are confident that their concept can

deliver with a fuel economy penalty of less than five per cent. The next phase of the programme will test the long term aging performance of the system.

Reader Reply No. 118



The layout of the FEV system

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■ Reader Reply No 94 ■

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