Renewable energy: 'Hatching' new ideas

by Peter Middleton

In March 2008, Hatch Africa launched an energy project sector in South Africa to leverage its global capability and skills for power developments in South and sub-Saharan Africa. WATTnow speaks to Dieter Matzner, principle power consultant for Hatch about renewable power options – wind, solar and water power.

Abengoa's CSP facilities near Seville, Spain. The larger addition (foreground) is called PS20 and is currently the largest in the world with a capacity of 20 MW.

Globally, Hatch offers comprehensive engineering consultancy, project and construction management services in three key business areas: mining and metals; infrastructure; and energy. "We manage, for example, the Transnet project portfolios – for the harbour and railway extensions, the Richards Bay coal line and the Sishen-Saldanha line expansions. In our South African Woodmead offices we employ about 1 000 people and 8 000 people worldwide," says Matzner.

Energy expertise developed over the last 30 years includes: nuclear and thermal fossil fired power options, including co-generation plants and substantial involvement with carbon sequestration technology; oil and gas – non-conventional oils, oil sands and shale in particular; LNG terminals; coal gasification technology; and renewable energy projects including wind, solar and hydro-electric developments.

Hatch is involved in co-generation projects in South Africa and is currently engaged with the design and soon to be constructed plant at Richards Bay Minerals to use furnace off-gas, which will eventually generate more than 20 MW of power, this off the back of the experience gained at the Elgen plant with a rated capacity of 54 MW. "We are thermal specialists in co-generation projects, one of the few companies that has actually designed and constructed real co-generation plants," claims Matzner.

Hatch is currently busy putting together and training local staff to form specialist power teams in South Africa in wind, solar and hydro-electric technologies. It is bringing people from Canada and sending local engineers to Canada for training and real project exposure so that, through these exchanges, skilled local teams can be established. "Our team has already secured work for South African power developments in all the disciplines: thermal, oil and gas and renewable power," Matzner says.

The new local energy consultancy will deal with all power projects in South and sub-Saharan Africa. "I am responsible for the renewable power business, which is very topical at the moment; wind, solar-thermal and hydro-electric power across Africa," he adds.

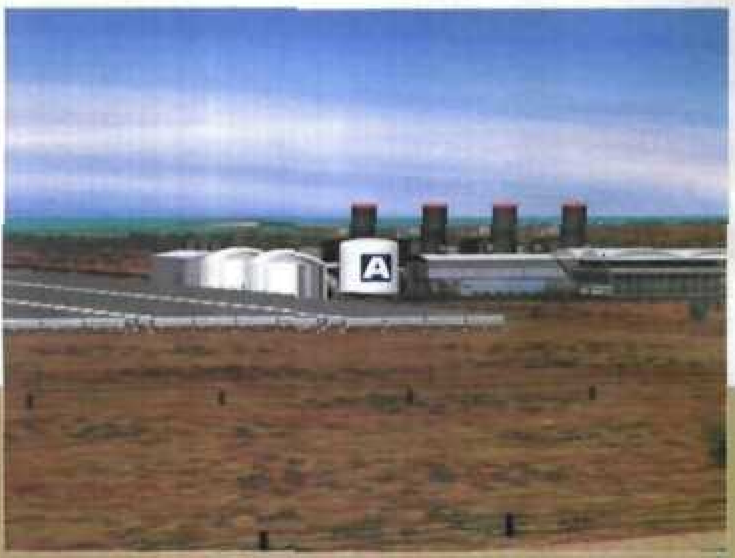
"Africa north of our borders has provided Hatch with numerous opportunities on the hydro side, in East and West Africa – Kenya, Uganda, Tanzania, Ghana and Zambia," says Matzner, "and we will continue to pursue other opportunities as they arise." But, he believes, the two particularly exciting renewable opportunities for South Africa are wind and Concentrated Solar Power (CSP) technologies.

"Globally, Hatch has been instrumental in the development of 12 700 MW of wind power projects – roughly 10 percent of the world's 120 000 MW of 2008 wind capacity," he says, "as owner's engineers to developers offering EPCM services, or as lender's engineers offering EPCM services to the equipment vendors, who sometimes take on a complete project because a wind turbine is by far the largest cost item in a wind farm development."

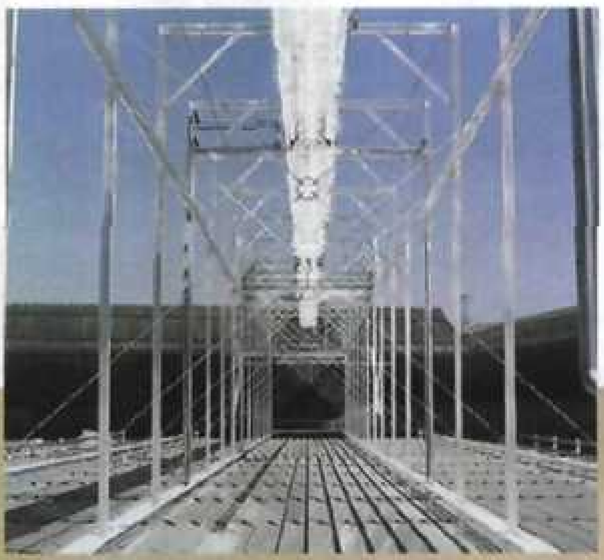
He describes how a wind project usually begins: "A project starts with a wind resource assessment after a developer has identified a site. The first thing we do is put up a wind mast to measure the wind speeds. We are currently engaged in assessments along the coast of the Western Cape.

"Typically, we are looking for an annual capacity factor of better than 26 percent – that is if you run a 1,0 MW wind turbine for a year, 8 760 hours, then you would be looking to average 260 kW of power output for the whole year."

This would enable the operator to sell 2 278 MW hours of energy, which is worth about R2,85-million per year – based on the proposed REFIT tariff for wind of R1,25 per kWh. "Some developers may take on a contract at 22% capacity factor but that would be about the



The Elgen plant with a rated capacity of 54 MW. "We are thermal specialists in co-generation projects, one of the few companies that has actually designed and constructed real co-generation plants," claims Matzner.



A typical CSP plant based on the Fresnel mirror.

minimum," explains Matzner, "because income from CDM carbon credits could be added to the revenue stream."

The next step in a wind resource assessment is to calculate the annual energy production (AEP) estimate for the site: The AEP estimate needs to factor-in a conceptual wind farm site layout, taking into account the site constraints – technical, environmental, servitudes, waterways, distances away from borders, and so forth.

"On the basis of this layout, we would then go through a turbine selection process, to get the appropriate turbine for the specific conditions," he adds. "Our turbine evaluation model evaluates over 100 factors in order to determine which turbine is best suited to the specific terrain – and not only to optimise power output. The ultimate criterion is the power output per unit cost, to maximise the net present value of the complete project taking all costs and revenue streams into account."

We ask about maintenance, a common argument used against the viability of wind projects. "Maintenance is an important issue here because the skills have not yet been developed in South Africa. In countries like Germany, however, maintenance skills and routines are very well established and annual capacity factors are routinely being achieved," he responds.

Once an AEP estimate has been established, wind data is correlated to long-term data trends to identify possible major deviations. "Hatch would then help the developer to put the whole business case together, combining construction schedules, capital cost estimates and annual energy production estimates (AEPs) into a business case.

Projects require the services of environmental impact assessment consultants, financial and legal advisors to secure the necessary legal agreements and regulatory approvals as well as the required financial loans and structures to achieve financial closure. "We would again get involved in project execution – the detailed engineering, the contracting of construction and equipment vendors, overseeing construction up to the hand over and commissioning of the facility," claims Matzner.

Matzner believes that 2 000 to 3 000 MW of power wind capacity will be constructed in southern Africa in the next 10 years on wind farms from 15 MW to 100 MW each. Already more than 6 000 MW are planned by independent power producers (IPPs) and there are more than 3 000 MW in applications for grid connections. "Of the current 400 entities wanting to develop wind projects, perhaps 20 to 30 developers are likely to build something within the next 10 years," he predicts.

Dieter Matzner, principle power consultant for Hatch for the renewable energy options – wind, solar and water.

Capital costs of wind farms are typically in the order of $2 500 per installed kW, putting the cost of a 10 MW farm at around $25-million or R200-million. In return, annual income based on a 26% annual capacity factor and a REFIT tariff of R1,25 per kWh would be in the order of R28,5-million per year, around 14%.

"The big disadvantage of wind," adds Matzner," is that it does not produce dispatchable power, ie you do not necessarily have power when you need it. But in the Western Cape, if you couple 3 000 to 4 000 MW of wind power with the newly installed 2 000 MW from the Open Cycle Gas Turbines (OCGTs), which can be connected to the grid virtually immediately, then any short-term load requirement due to poor wind conditions can easily be filled," he suggests.

"Once the wind capacity is installed, the electricity is virtually free of charge whenever the wind blows, so there is an argument for installing significant amounts of wind power, and filling in the demand gap with OCGT and power from Koeberg. Once the additional transmission capacity from the Highveld has been installed (around 2013) surplus wind power should be transmitted into the interior to relieve the base-load demand or to store the energy in the Eskom-owned pumped storage schemes, which will service peak demand in the country," he says.

CSP technology is the other very exciting renewable opportunity: "The sun is the biggest renewable energy source available in South Africa by far," says Matzner "several orders of magnitude bigger than any other renewable resources.

"In the long term, we can comfortably accommodate 10 000s of MW of power supplied by modular, 50 to 100 MW in size, solar thermal plants. The resource is ample, and so is the space," he claims. Most of these plants will be dry cooled in order to mitigate for the water shortages.

"As a country we should be placing a much bigger emphasis on developing home-grown CSP technologies," he suggests. "The technology is maturing fast, and there is currently a drive to deploy it – in the USA, North Africa, Australia and Spain. In South Africa, we should be developing a national CSP strategy to develop home grown technologies and skills. If we had a big programme, similar to the PBMR programme, for example, then we could create a manufacturing industry around it and an export industry too. All it would take is the political will and a policy decision."

Matzner believes that, starting in 2023, we should replace all end-of-life coal fired stations with CSP technology. "Then private developers, institutions like the IDC, the DST and other government