RENEWABLE ENERGY

Keeping the sprinklers on – Farmers turning to wind, solar to water thirsty crops

As bouts of loadshedding leave South Africans in the dark for hours at a time, the country's irrigation farmers are increasingly turning to renewable energy. But there are still hindrances in the way of rolling out renewable energy technologies at a large scale in the agriculture sector. Article by Matthew Hattingh.

Kakamas table grapes farmer Dr Tokka van den Hever reckons it's been R19.2-million well spent. That's the initial sum he sunk into capturing energy from the sun, with the electricity generated used to pump Orange River water into his vineyards and to keep the harvest cool before it leaves for markets in the Northern Hemisphere.

In the Northern Cape winter, when Van den Hever's farms need little power, he feeds his surplus into the national grid. This earns credits, which are used in summer when he draws on the Eskom grid. Such have been the savings that, with tax breaks, Van den Hever reckons his sun-fuelled system should pay for itself in six years.

Elsewhere in the country, from a lucerne, potatoes and pecan grower in Limpopo with 768 solar panels, to a dairyman in Cookhouse, in the Eastern Cape, who powers his pumps with electricity from his own hydro plants, farmers are looking to renewable energy sources, particularly to water their crops. And it's a growing trend, according to a new report published by the Water Research Commission, entitled ***Technical and financial feasibility of alternative renewable energy sources and technologies in irrigated agriculture*** (**WRC Report No. 2969/1/22**).

Its authors, Sarlet Barnard, Bennie Grové, Isobel van der Stoep, and Richard Moyo, of Isowat Consulting and the University of Fort Hare, explain the shift to renewables. They consider the pros and cons of the different technologies; look at how to properly plan an alternative energy system; and discuss how more

farmers can be encouraged to follow suit. Here we are talking about energy sources that are not depleted when used – such as solar or wind. They represent alternatives to Eskom's coal-fired power stations, which not only generate 77% of South Africa's electricity, but also receive considerable criticism for adding to the world's greenhouse gases, which have been linked to climate change.

More than a quarter of the country's farming depends on irrigation. It helps ensure the security of our food supply, it guarantees an income for farmers and many others and it stimulates rural development. But getting water out of boreholes and dams and onto crops takes energy, especially electricity and diesel. A combination of carrots and sticks is prompting farmers to seek alternatives. Among the biggest sticks is the rising prices Eskom is demanding for its increasingly precarious service. From 2008 the power utility's tariffs have outstripped inflation, even as load-shedding leaves farmers high and dry at the very times they need electricity most – when crops need watering.

The juiciest carrots include the potential savings alternative energy offer. The technology to tap the sun's energy or harness the wind has for a long time been expensive, but in recent years growing demand, particularly for photovoltaic systems, has spurred mass production, driving down prices.

The alternative energy sources considered in the report are all, it concluded, technically up to the task. But depending on site conditions and other factors, some make more sense than others. And it's for photovoltaic energy that the authors generate the greatest enthusiasm, describing it as "the future" for South African agriculture and calling for a follow-up study.

They chart how prices for photovoltaic panels have tumbled by 80% between 2012 and 2015, with further falls predicted. In sunny South Africa, where solar radiation is plentiful and more direct (than in countries at higher latitudes or in cloudier regions), the case for photovoltaic-powered pumps seems self-evident. As the report notes: "When the sun is shining it feeds irrigation systems ensuring that they work hardest in the hot summer months when they are needed most."

Batteries can be used to store any energy not immediately needed. And inverters and other devices are often added to the system to turn the direct current from panels into alternating current and to regulate its frequency. The system can be arranged to feed any surplus electricity into the grid too. The green icing on the solar irrigation cake is that photovoltaic systems can be sited near pumps, doing away with lengthy and expensive power lines.

Yet, despite these and other advantages, photovoltaic energy, the report notes, waters a mere 2 000 hectares of the 1.2 million hectares of land under irrigation in the country. It's a drop in the ocean.

Why is this so? Cost remains a big reason. Panels, despite a fall in prices thanks to Chinese mass production (underpinned, as others with an eye for irony have observed, by cheap, coal-fired electricity) still come with a hefty price tag. But that's only part of the story.

If a photovoltaic system is to run off-grid – without top-ups from Eskom – or if it must supply energy come rain or shine and at night, batteries are needed. These remain pricey and that's before you wire in a controller and other power electronics to prevent overcharging or discharging of batteries. It all adds up, leading the authors to observe that "investment in battery banks to meet a full off-grid capacity required to run a farm is usually not financially feasible".

So, even if a farmer powers his pumps from a photovoltaic system, chances are he will still be buying electricity to meet his other needs. And, as the report explains, a grid connection saddles the farmer with fixed costs that must be borne irrespective of how little Eskom (or municipal) electricity he draws.

Although photovoltaic energy works with a variety of irrigation techniques, including drip, micro sprinklers and rain guns, it does impose some additional costs and complications. Farmers must make hay, as it were, while the sun shines. And to do this, the authors recommend photovoltaic systems be designed with two-and-a-half times the capacity of conventional systems. "Large water tanks can be used to store the extra water pumped during sunny days from where the water can gravitate to the small water tank when needed. Storage for two or five days should be sufficient," the report said, advising that the size of the water storage should be optimised with cost in mind.

The authors stress that irrigation sites differ widely and farmers must understand their needs in detail. This includes getting to grips with soil types, groundwater depth, elevation of storage dams, times of the day when water is required and more.

Next, the irrigation system's energy needs can be determined and thereafter the costs of tapping different energy sources can be calculated and compared. When renewable energy supplements Eskom power, or vice versa, farmers must make the most of seasonal and time-of-use charges that apply at peak, standard, and off-peak periods under the utility's Ruraflex tariff.

As ever, the devil lies in the detail, and the authors work to bring order to a deluge of data. Their report provides a summary of the literature, as well as formulas, maps and other tools to aid planning and arrive at an optimum irrigation and energy setup. A

Some of the 768 solar panels at Becker Farm, which generate energy for a direct pump irrigation system.

Becker Farm in Limpopo has a 250kWp DC system and 200kVA AC.

renewable energy system makes economic sense only if its initial cost, together with installation, operating and disposal cost over its lifespan (typically 25 years) is less than grid power based on current tariffs.

With no end to Eskom tariff hikes in sight, the future looks rosy for alternative energy. Nevertheless, as the report notes, "electricity rates for the agricultural sector are still competitive" – or at least for now.

What about feeding surplus renewable energy to the grid? Farmers who do so earn credits that can be set off against the power they buy from Eskom at other times. It improves the feasibility of some projects, but it does come with its own difficulties and costs. But before any of this can happen, farmers must register and get approvals from the National Energy Regulator of SA, Eskom or the local municipality. This can involve a lengthy and frustrating paper chase.

Other hassles include getting finance (this can be especially hard for smallholders); panel theft; and a general lack of specialist solar power irrigation systems suppliers, servicemen and advisers. Here the report comes to the rescue by including a directory, listing service providers, plus case studies and the contact details of farmers who have made a success of alternative energy installations.

But perhaps don't bet the farm on it just yet. The authors note, quoting other researchers, that, "Solar power is not yet a viable option for large irrigation companies who service between 90% to 95% of the commercial irrigation farms."

So much for the sun, what of wind, water, biomass and other renewables? Biomass is about using fuel from plant-based materials like wood and bagasse (think sugarcane waste) to generate electricity. The report concluded this was more viable in the wetter, eastern parts of the country, but noted this energy source was not being used for irrigation and was considered the most expensive of the renewables. Wind, like sunshine, is plentiful in South Africa, but local conditions can vary widely and this must be considered.

The flamboyant Queen frontman Freddy Mercury once sang, "Any way the wind blows doesn't really matter to/ Me, to me." But down on the farm, consistency is king. Obstacles may get in the way of the wind causing turbulence so you want your turbines reasonably high off the ground and robustly mounted. This comes at a price and is part of the reason for the high capital costs of small-scale wind turbines.

The report quotes prices ranging from R36 500 for a 1kW turbine, to nearly R100 000 for a 3.5kW turbine. It suggested a particular brand of supposedly European-made turbines, with considerably lower price tags might be "worth looking into". But sadly, online customer reviews of the brand's products and pre- and after-sales service are scathing.

Leaving aside prices and the merits of individual suppliers, the real problem with wind is that it's fickle. Sometimes there may be no wind at all, or too little to generate electricity. At other

A storage dam on Becker Farm Limpopo supplies centre pivot irrigation to potatoes, onions, lucerne and pecan nuts.

Becker Farms is tied to Eskom and is considering feeing back into the system. A R120 000-R150 000 monthly electricity bill and unreliable Eskom power prompted the farm to install a photovoltaic powered irrigation system.

times a gale may strike and then turbines typically cut out to save themselves from destruction. To get around this problem the authors suggest hybrid wind-diesel generator power or combining wind and solar energy.

Water power is certainly in the mix. Small, local-level projects to turn the movement of water into electrical energy for irrigation are technically feasible, the report found. It cited a Department of Water and Sanitation study that noted a network of more than 6,500km of canals in 47 schemes in South Africa. "A multitude of structures such as syphons, control gates, weirs, chutes and drops exist in these canals. All of these hold large unexploited hydro-kinetic potential," the report said.

But the authors also explain why exploiting this potential can be hard to do. Ours is a water scarce country, which is also part of the reason the National Water Act requires authorisation of all hydropower plants, regardless of size. Also discouraging small and micro hydro facilities are: the long waits for approval from various government entities; complex water use regulations; and a lack of locally-developed components and maintenance.

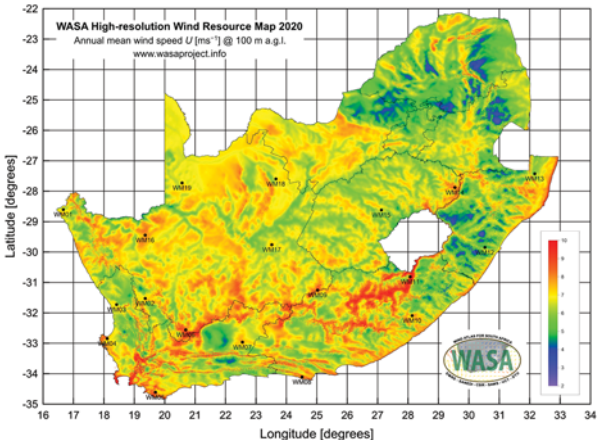
Beyond such financial, technical and planning difficulties – and this applies to all alternative energy sources – there's a sense that farmers are slow to adapt, or perhaps conservative. "Many associations indicated that they will also take time and significant effort to change the conventional agricultural mindset of farmers and their behavioural tendencies to embrace sustainable agriculture," said the report.

It's hard to dispute that South Africa's largely coal-dependent grid leaves a heavy carbon emissions footprint and that reducing this would be good for the environment, but appeals to altruism seldom trump economic concerns. Nor are the tax deductions currently available to farmers who install alternative energy sufficient motivation.

What can be done to encourage a switch to alternative energy? The report identified the banking of surplus electricity; finding other uses for the energy produced; getting farmers to organise themselves to share costs; the trade in carbon credits; and subsidies. "There is a need for the government to play a more active role," said the authors.

More carrots are needed before we can expect a greener harvest.

To download the report, ***Technical and financial feasibility of alternative renewable energy sources and technologies in irrigated agriculture*** (**WRC Report No. 2969/1/22**). https://bit.ly/3PqIP7I



The South African Wind Atlas Guide is a useful tool for those considering wind power. The areas shaded in red and dark orange have the highest average wind speeds. The Eastern Cape is considered particularly well placed to harvest this energy source.