SOMETHING FROM NOTHING

On the salty barren plains of the Spencer Gulf in South Australia, a state-of-the-art greenhouse is growing blemish-free tomatoes. Sean McGowan reports on the unusual combination of high-efficiency horticulture and a location many had given up for dead.

Sundrop Farms uses sun, seawater and wind to grow high-quality produce.

When a group of international scientists and engineers selected an area of farmed-out land on the eastern shores of the Spencer Gulf in South Australia to begin trialling their unorthodox horticultural practices, the locals must have thought them mad.

Add the fact that they intended to grow tomatoes, and surely more than a few eyebrows were raised at the local watering holes in nearby Port Augusta.

"Have you heard the one about the German, the Dutchman and the Canadian?" you can imagine the locals joking, rolling about in fits of laughter at the thought that this land could produce anything other than saltbush.

And little wonder. It rains here just 68 days of the year, with nearly as many days reaching temperatures above 35°C. That makes water here a very precious commodity, and irrigation for farming extremely challenging.

But, as the town of 14,000 went back to its business of generating a third of the state's electricity, the London-based consortium known as Sundrop Farms did the unthinkable.

They created something from nothing.

Ina trial period lasting three seasons, Sundrop Farms' 2000 sq m pilot greenhouse produced blemish-free, hydroponically grown tomatoes in a controlled environment. And it did so using only the natural resources of the area – seawater, sun and wind – and a combination of the latest greenhouse and renewable-energy technologies.

In fact, such is the success of the venture that plans are now afoot to expand the operation by a staggering 100 times.

Funding is being sought for a massive 20 hectare (200,000 sq m) greenhouse, which will employ the same technologies and techniques already trialled. The business case that claims tomatoes (as well as other crops including capsicums) can be grown much more cheaply this way is set to be tested.

Although the system involves a much higher fixed cost, the lower operating costs compare favourably to traditional farming methods, where electricity and water account for a large portion of a farm's expenses.

And then there's also the belief that if it can be done in Port Augusta, it can be done in any other barren location in the world.

With the technology said to work best in flat, arid areas close to the sea that have low humidity, regions in the Middle East, Africa and South America seem likely candidates.

COMBINING TECHNOLOGIES

It is not only the location of this greenhouse complex that sets it apart. Closer examination reveals important differences from the standard set-up.

For a start, an 80m long parabolic mirror dominates the site, running in a north-south direction to benefit best from the sunrise and sunset.

This is the heart of the operation, ultimately providing the heat required to power the greenhouse, as well as to a desalination unit that turns seawater into 10,000 litres of freshwater each day.

The parabolic trough tracks the sun all day, focusing this solar energy onto a receiver tube that runs along the length of the mirrors. Through the tube runs thermal oil that is heated up to 165°C. This super-heated oil then runs through a looped piping system to provide heat to a series of thermal energy storage (TES) tanks.

These tanks, made of 6mm steel, have been further insulated.

Each contains a freshwater media used to store the heat produced by the parabolic mirror, before it is supplied to a desalination unit and turbine. These units produce freshwater and electricity, respectively, for the greenhouse.

This is the first example of something from nothing. The second is the desalination of seawater into the freshwater used to irrigate the crop.

The thermal desalination unit is custom-built to suit Port Augusta's high number of sun hours and high salinity levels. The site is able to produce the 10,000 litres of fresh, demineralised water per day that the 2,000 sq m greenhouse irrigation system demands.

The unit is a so-called multiple-effect distillation machine with thermal vapour compressor (MED-TVC).

According to Sundrop Farms, this means there are multiple chambers where seawater is evaporated (the effect). A TVC pipe supplies super-heated steam (generated by the heat from the TES tanks) to evaporate seawater and maintain low pressures in the effect.

All of this seawater vapour is then pushed to a vertical cylinder where it condenses with fresh water droplets. This method is said to be considerably more efficient than other methods, such as plastic condensers.

Even the by-product of this process – salt – has value, used sparingly as a nutrient on the plants, or sold to third parties.

Although 10,000 litres a day might seem like a lot, it is a pittance compared to what would be required if the same crop was grown in the field.


An 80m parabolic mirror provides the heat that powers the greenhouse.

And the fact that up to 40 per cent of this water can be recycled again for irrigation, depending on the season, makes it a very efficient system.

Yet there is a third and final example of something for nothing.

Made up of CELDek pads, the wet-wall system at Sundrop Farms provides free cooling and humidity to the greenhouse. Eight fans at the opposite end of the greenhouse draw dry, hot air from outside through the damp wall to create cool, moist air inside.

In this, a rare case where seawater is irrigated over the corrugated cardboard pads to saturate them, the issues of corrosion are avoided by using plastic components in the wet-wall system.

During periods where greenhouse heating is required, waste heat from the desalination process is used to maintain optimum temperatures. A gas-fired boiler provides supplementary heating for cold nights.

Although Sundrop Farms remains tight-lipped about the exact climate control parameters used in their pilot greenhouse, it is assumed that the temperature range is somewhere around 20–24°C, which is typical for greenhouse-grown tomatoes.

Air changes are likely to be in the region of 30 to 40 per hour, with the air velocity dependent on the type of crop being grown.

PERFECT PRODUCE

The result of this combination of technologies – and this something-for-nothing approach – is that tomatoes and capsicums are being grown blemish-free and without many of the herbicides and pesticides required in traditional field farming.

This latter point is a natural benefit of the isolation of Sundrop Farms' operation, far removed from the traditional tomato-growing regions of Victoria's Riverina.

The controlled environment of the greenhouse also allows for fertiliser to be better targeted than it would in the field, resulting, according to Sundrop Farms, in a more consistent crop.

South Australia – home of the super glasshouse

Like the operation found at Port Augusta, d'VineRipe's tomato glasshouse complex in Two Wells, South Australia, has also found an energy-efficient, environmentally responsible method for growing commercial volumes of tomatoes.

Located 20km north of Adelaide, the 27 hectare complex has achieved a massive increase in tomato output. At the same time, it has solved the issues of water usage and energy efficiency in a climate where temperatures fluctuate from – 2°C in winter to 47°C in summer.

D'VineRipe combines the free-cooling effects of a wet-wall system with a co-generation plant that creates electricity, heat and carbon dioxide (CO_2), and a reverse-osmosis plant to reuse Adelaide's waste water.

Developed over a number of stages, the glasshouse complex was designed by a world leader in glasshouse construction, Dutch builders Van der Hoeven.

Featuring a roof-span designed to minimise shade, the glasshouse maximises daylight through 130,000 panes of strengthened glass on the roof and 45,000 panes on the walls – each measuring 1.8m by 1.2m. This makes them the largest panes used in Australian glasshouse construction to date.

Special glass panes that filter UV rays have also been used, allowing more useful light to reach the plants. Internal steel structures have been painted white to reflect light and help boost crop yield.

Some 300km of drip-house piping is used to irrigate the plants; a further 510km of heating pipe is used to heat the glasshouse.

The wet-wall evaporative cooling system designed and supplied by Munters helps to maintain an optimum temperature that averages 21°C over any 24-hour period. It also maintains humidity of between 65 and 75 per cent inside the glasshouse.

Munters national sales engineer Sudhee Satyan says the company's state-of-the-art pad and fan technology was already at the heart of the d'VineRipe first-phase 8Ha glasshouse complex.

This involvement meant it wasn't difficult to adopt the same technology for the second and third stages.

A total of around 10,000 pads, each measuring 1.53m high, 0.6m wide and 0.15m thick were used to create the wet-wall system for the three stages of the d'VineRipe complex.

These are held securely by a Munters wet-wall system manufactured from corrosion-resistant stainless steel for a long, trouble-free service life. This modular system also allows for simple routine inspection, and periodic maintenance and pad replacement.

About 15 per cent of the water produced by the site's reverse-osmosis water treatment plant is used on the pads. This source augmented by rainwater collection from the complex's vast roof.

Water is also recycled from the wet-wall system for re-use.

Additionally, a total of 1140 extraction fans have been precisely located to optimise air flow, temperature and humidity control in the glasshouses. They eliminate hot spots, drafts and chills that can damage plants.

Satyan says the combination of these systems has delivered d'VineRipe consistent temperature and humidity control and reduced water and power consumption.

It also contributes to the growth of a higher-than-average percentage of first-grade tomatoes, with reduced risk of disease and reduced use of herbicides and pesticides.

This has ultimately delivered d'VineRipe a predictable, higher return on investment (ROI) compared to field-grown tomatoes.

A receiver tube full of superheated oil runs the length of the mirrors.

Although exact figures weren't forthcoming, the yield produced by Sundrop Farms is reportedly 15 to 30 times greater per hectare than conventional field production.

That Australian consumers have been conditioned by the big supermarket chains to accept nothing less than consistently sized, blemish-free fresh fruit and vegetables also plays into Sundrop Farms' hands.

Some would even call these tomatoes organically grown – but as they are grown in water rather than soil, this claim cannot be made.

The planned expansion of Sundrop Farms' operation to 20 hectares could produce up to 10 million kilograms of blemish-free tomatoes and capsicum annually. Already the big supermarket chains have been calling.

Yet the end game appears to extend well beyond Australian shores.

"Our goal as a company is to grow in this sustainable manner ourselves and operate the greenhouses," Sundrop Farms CEO Phillip Saumweber told ABC's Landline program last year. "So, we're very much looking forward to building a base here in Australia, but also expanding the knowledge and the experience that we've gained here to other parts of the world.

"We've had very positive responses so far, and most of them are coming from places like the Middle East where the issues of food security and water security are very topical at the moment." ▲

PROJECT AT A GLANCE

The equipment

Co-generation: Power and Drive Solutions

Extraction fans: Munters Euroemme fans

Pads: Munters CELdek

Reverse-osmosis plant:
Veolia Water Solutions & Technologies

Water treatment plant:
Veolia Water Solutions & Technologies

Wet-wall system:
Munters WDP stainless steel wet-wall system

At least 10 million kilograms of tomatoes and capsicums could be produced each year if Sundrop's latest expansion goes ahead.