Energy-wise installations for greenhouses
Featuring Heko Ltd and Southern Paprika

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In the series about energy saving in greenhouses, this article is a bit unusual, because it is anecdotal. It features Heko Ltd., a company specialising in heating equipment and energy saving techniques, and shows photos of energy saving equipment installed at Southern Paprika, a large greenhouse property in Auckland.

Energy, water and computers
Heko Ltd owned by Frank Hectors is known to many greenhouse growers for installing heating systems such as boilers, pipe heating and other equipment to do with energy. In the nineties Frank operated the business single-handedly, but in 2001 Frank's son Richard Hectors came on board and brought his expertise in electronics and computers into the firm. The two Hectors combined forces with Ton Luiten Horticultural Techniques in the Netherlands and formed RTF Climate Ltd. They also engaged in a business relationship with Priva (horticultural technology from the Netherlands) and Netafim (irrigation and automation specialist from Israel). Hence the range of products expanded. Heko has completed projects in the wider Auckland region and other centres, as well as in Australia. Heko comprises of just two people and they hire local contractors, mainly welders, to accomplish the projects.

Products and services
Heko installs systems for heating, irrigation, water treatment and climate control. In the field of heating and energy, Heko install boilers, modulating burners, flue gas condensers, frequency controlled pumps, pipe heating systems, pipe-rail systems, CO2 units and buffer tanks. IN the field of irrigation, plant nutrition, water treatment and control computers Heko installs both the Priva and Netafim brand. For example in the last few years they have installed about ten large High-Pressure UV systems for disinfection of water or nutrient solution. The UV unit can be fully integrated with the climate computer, although normally they are stand-alone. Heko can supply both new and second hand materials, all imported from the Netherlands. A few times the Hectors have had the opportunity to install 'everything' in a new greenhouse property. Not only were these projects delivered on time, but they also proved to be very successful. Heko services a number of boilers, computer and irrigation systems, ranging from small to the very big ones. They also help out servicing and maintaining installations installed by others.

Southern Paprika
Southern Paprika in Warkworth is one of the many places where Heko installed the boiler, condenser, pipe heating, control computer and irrigation systems. Southern Paprika produces capsicums (various types) mainly for export to Japan and Australia, while about 20% remains on the local market. This operation consists of 7.5 ha modern Venlo-type greenhouses, and will expand next year to 10 ha (25 acres). The current 7.5 ha greenhouse was erected in 3 parts of 2.5 ha each. The energy facilities are already built to serve 10 ha.

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Greenhouse
The newest greenhouse of 2.5 ha at Southern Paprika was completed in 2002, and is now planted with the first crop. This greenhouse is of the brand Greentex and was imported completely: all materials including glass, and even the crew and their tools came from the Netherlands. Some characteristics of the structure are: 8 m wide trusses; gutter height 5.5 m; width of the glass panes 1.12 m; powder-coated gutters; condensation gutter on the inside; vents opening 30% of the greenhouse roof, and a row of extra vents in the roof near the side walls.

Energy saving
Hamish Alexander, Stuart Ettwood and Paul Stevenson of Southern Paprika discussed energy issues with us. The biggest concern for the grower is what will happen if the existing gas sources such as Maui Field run out, as is predicted to happen within the next five years. Apart from that, energy saving is important simply from the viewpoint of reducing the production costs. Energy is the second biggest cost factor after labour.
Like other large greenhouse operations in the Auckland region, also this one uses natural gas. The gas consumption is well over 100,000 GigaJoule per annum, which covers heating and CO2 enrichment. The most obvious energy saving practices on this property are the flue gas condenser, heat buffer, energy screen and insulation of the heater, buffer and all the transport ducts. Secondly energy can be saved by choosing smart settings in the computer.

Heating system
The newest greenhouse block is equipped with a Crone boiler with a capacity of 6000 kiloWatt (5.1 million kilocalorie per hour). At present it heats 2.5 ha but it will also heat the future 2.5 ha expansion. The burner is fully modulating, which means that it can run at variable speed. A Danfoss controller gets a reading of the water temperature and then adjusts the fan for air inlet as well as the gas inlet.
The flue gas condenser is a lamella condenser of Crone. It is situated on the back of the boiler, behind the third path, and in fact acts as the fourth path where heat is transferred to water. The lamellas in the condenser are cooled down by contact with a stream of cold water. The lamellas cool down the flue gases and make the water vapour condensate to form water. This releases energy which is transferred to the cold water, which is either the cold water coming from the greenhouse (the return in the transport loop), or the cold stream coming from the heat buffer (and going back in). This boiler and this condenser combined have an efficiency of over 90%.
The heat is transported via insulated transport ducts, and then distributed throughout the greenhouse by a net of heating pipes (51 mm diameter) that serve as pipe-rail for trolleys. There are 6 tracks (or 12 pipes) in every 8 m double bay. The modern tracks are 550 mm apart, to give the trolleys a wider wheel base to make them more stable. The pipe-rails tracks are the only heating pipes. It is possible to have another pipe higher in the crop, e.g. a pipe that uses the heat from the condenser.

Heat buffer
The heat buffer was originally invented in the Netherlands for CO2 enrichment. It allows burning gas during the day while using the flue gas for CO2 enrichment, and storing the heat for use at night. This is still the major purpose of most heat storage tanks. A bonus of a buffer is that some spare heat is available when the heater is temporarily out of order. There is an additional function too. At some properties, the heat buffer is used to create an even intake of natural gas during the course of a day and over a year. This is important for growers who have a gas contract based on a constant gas intake. If the grower decides to use more than his contracted supply rate (e.g. to use more gas in a cold night) he will have to pay a much higher price (or draw hat from the buffer).

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Southern Paprika has two huge heat storage tanks of 650 and 750 m3 volume. The tank is made of steel, insulated with pink bats, covered with corrugated iron, and painted to match the finish of the buildings. They are 10 m in diameter and about 10 m high. One of the buffers serves the present 2.5 ha and is also meant to be used on the future expansion of 2.5 ha. The ratio of water volume to greenhouse area will then be 15 litres per m2 (750,000 / 50,000). This is at the top of the range, as the guidelines are to have 10 to 15 litres of heat storage volume per m2 greenhouse area.

CO2 unit

Southern Paprika has three CO2 units on site (of the Van Dijk brand). A CO2 unit is basically a large fan that sucks the flue gases from the chimney and puts it into a transport duct to pump it to the greenhouse. One CO2 unit consists of a fan of 11 kiloWatt which can pump 9000 m3 of gas mixture per hour to the greenhouse. This CO2 unit is meant for 5 ha, so it will dose 180 litre/m2/h. If the CO2 content is 10%, the CO2 supply is about 18 l/m2/h, which is a generous amount. The variable-speed fan can run at any lower speed, for instance when the demand for CO2 is lower (e.g. if windows are closed) and/or when the boiler produces less flue gas.

A carbonmonoxide detector (CO detector, of the brand Fercom) continuously checks the flue gas if there is any carbon monoxide gas. This CO gas is fatal for humans. Also, CO is an indicator that ethylene gas is produced, which is fatal for plants. If any CO gas is detected in the flue gas, the CO2 unit is switched off automatically, and the flue gases go out through the stack.

The CO2 unit is controlled by a controller (brand Van Dijk) that takes the relevant factors into account. If there is not enough flue gas produced for a particular CO2 fan speed, the CO2 unit automatically sucks air in either from the surroundings or from the stack. The flue gases contain usually around 12% CO2, but it can be less when more air is mixed in. It is distributed in the greenhouse through polyethylene lay-flat ducts. They are 1.3 m apart, or one duct in each row.

Thermal screens

The newest 2.5 ha greenhouse of Southern Paprika is equipped with a dual purpose screen. There is a huge choice of screen materials available. Some materials are solely for insulation: they keep the warmth in the greenhouse and don't transmit any light. Other materials do not keep the warmth in, but they block a certain percentage of sunlight. Dual-purpose materials do a bit of both. The screen at Southern Paprika is made of Vepritec material. Apparently when the screen is closed, it transmits 85% of the light (in other words it blocks 15% of the light), and it achieves 43% energy saving. The screen has not been used long enough to conclude anything with any certainty about the benefits either in summer or winter.

Irrigation system

The irrigation and nutrition system in the newest section of Southern Paprika is a Priva Nutriflex, installed by Richard Hectors. It is based on the standard A & B system with automatic mixing in a mixing tank. The drain water is re-used, so it is a closed system. Southern Paprika has separate irrigation systems, one for the first 5 ha, and one for the second section. They are set up in such a way that, if one fails, the other one can take over on the whole property. If both irrigation systems would fail at the same time, the plants can be supplied with fresh water.

The drain water is collected in a large drain water collection tank. In one section of the greenhouse, the return water (drain or run-off) is treated with a high pressure UV installation, and then mixed with fresh water. Subsequently fertilisers and acid are added to achieve the required EC and pH.

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Control computer
For climate control and irrigation control, Southern Paprika uses a Priva Intégro Computer. There are 2 such systems on the property. The large blocks are divided in smaller units that can be controlled independently. The computer has a vast range of settings, many of which have an effect on the energy consumption.

These and other details of particular energy saving techniques will be discussed in future articles.