ASX RELEASE | CLEARVUE TECHNOLOGIES LIMITED
(ASX:CPV | OTC:CVUEF)

Solar Greenhouses shining at Murdoch University and now in Japan

HIGHLIGHTS

- **Stage 1 plant science trials at Murdoch University Greenhouse have been completed revealing some exciting power generation, thermal efficiency and plant science data and insights**
- **ClearVue has made significant upgrades to the greenhouse systems in advance of its Stage 2 plant science trial, stemming from learnings of the Stage 1 plant science trial, confirming the readiness of ClearVue PV for commercial applications**
- **Stage 2 plant science trial has now commenced with aim of finding the optimum balance between power generation, thermal efficiency, water savings and maximising plant growth across a wide range of species through adjustment to photosynthetically active radiation (or PAR) light**
- **ClearVue continues to make positive progress installing its PV IGU glazing at the commercial greenhouse at Aqua Ignis resort in Japan**

19 April 2022: Smart building materials company ClearVue Technologies Limited (ASX:CPV OTC:CVUEF) (***ClearVue*** or the ***Company***) is pleased to provide an update on the progress of its solar greenhouse trial at Murdoch University and the progress on the installation of a commercial solar greenhouse in Japan.

Greenhouse Energy Production & Thermal Performance – first 12 months

Energy production performance and energy efficiency of ClearVue's PV glazing at Murdoch University Greenhouse has been measured continuously since the greenhouse officially opened on 19 April 2021.

The greenhouse comprises four glazed rooms and an enclosed, unglazed preparation room at the rear (south). The four rooms include one with normal glazing to create a scientific 'control' as a baseline from which to measure the performance of the ClearVue glazing against a traditional glazed greenhouse.

The remaining three rooms of the greenhouse comprise three different versions of the ClearVue PV solar glazing technology. The second room uses the current commercially available ClearVue glazing product while the third and fourth rooms are variants of that product using different amounts of nano- and micro-particles to look at optimisation of power generation and impact on plant growth dynamics.

This stage of the experiment which is being concluded at the greenhouse comprised three main elements:

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(i) To measure the power generation performance, as an offset to the energy demands of the greenhouse itself;
(ii) To assess the expected reduced energy load due to the thermal performance of the ClearVue product; and
(iii) To consider the impact that the proprietary ClearVue interlayer technology has on plant growth within the greenhouse.

To conduct the energy efficiency and power performance trials, ClearVue's own in-house technical team managed the data collection.

To conduct the plant science research, ClearVue engaged with Murdoch University's Professor Chengdao Li, a world leading molecular geneticist, and his team including Dr Hao Luo under a collaborative research agreement.

Prof Li's team looked at agronomic and physiological characteristics that were recorded from germination to harvest, to understand the plant response to the filtered light through ClearVue's solar glazing panels.

In this context, certain plants need at least some ultraviolet (UV), whilst others perform better with little to none. Other plants need different levels of visible light transmission. The aim of the Stage 1 winter plant science trial (see below) was to commence investigation into finding the right balance for an optimum growing environment whilst maximising power generation and energy savings.

As expected, different plants had different responses to the light passing through the solar glazing panels at different growth stages, where a significant amount of UV and infrared (IR) were removed by virtue of the operation of the solar glazing using those wavelengths for power generation.

For the purposes of the three elements of the experiment, the ClearVue greenhouse incorporates a range of sensors that record and present an array of data in real time providing the scientists with accurate information relating to conditions like temperature, humidity and the actual amount of light in all wavelengths that the plants were receiving.

This information was analysed to make automatic adjustments to lighting, heating, cooling, louvres, fans, blinds and reticulation systems, which in turn allowed scientists to maintain a constant microclimate to provide optimum growing conditions – a proportion of which is being powered by the energy generated by the ClearVue glass deployed on the greenhouse itself.

Trial Limitations

The four rooms of the greenhouse have been divided up with the use of insulated expanded polystyrene (or EPS) refrigeration type panelling and the two East and West ends of the greenhouse were blocked off with EPS to achieve (as close as possible) four consistent rooms for experimentation.

The impact of this on the overall experiment for all rooms is a loss of some light (in all wavelengths) entering the greenhouse – a normal commercial growing greenhouse (for example, the solar greenhouse under construction in Japan – see below) would have no such internal barriers to light entry and solar traversal across the greenhouse.

This important limitation was understood at the outset of the trial and could only have been overcome by the construction of four separate adjacent greenhouses or by using clear room dividers made of polycarbonate or plain glass which would have been less reliable for data collection purposes and also allowed more natural light in that's capable of reaching the plants, thereby generating less accurate measurement of the energy efficiency savings offered by the ClearVue product.

Additionally, it should be noted that the greenhouse is a research greenhouse and the rear (Southern side) of the greenhouse has an unglazed scientific preparation room running behind all four growing rooms, meaning there is no light is coming from that side – whereas in a regular commercial greenhouse this would not normally be the case and all sides of the structure would be glazed permitting maximum daylighting.

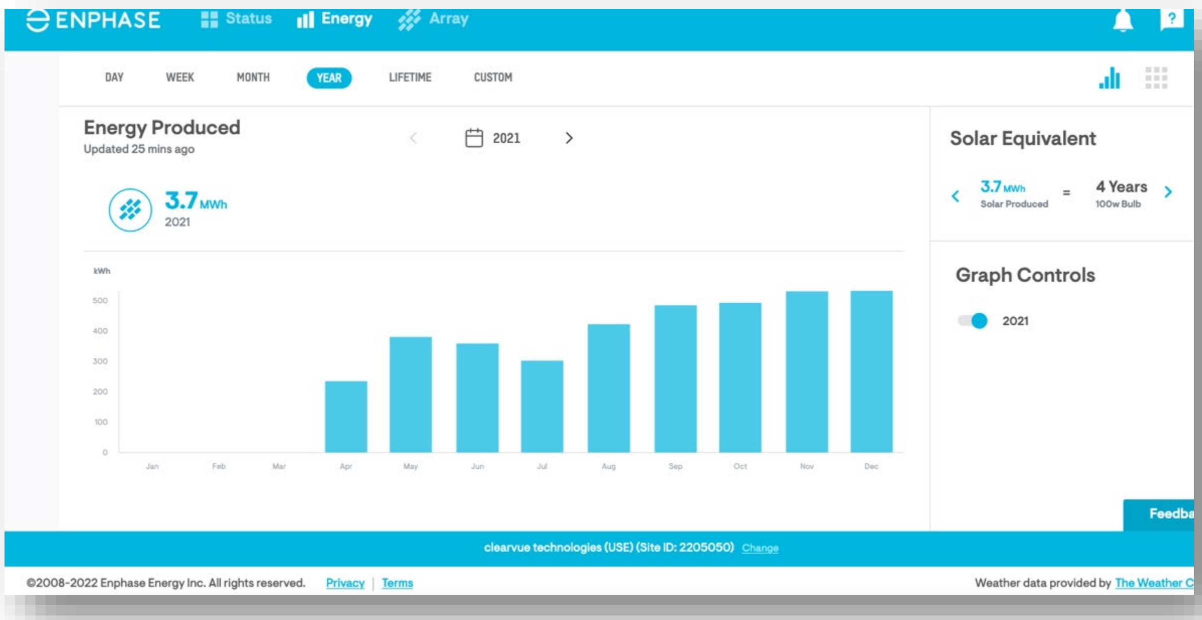
Another influence on accurate data collection was that louvre operation was impaired in all rooms during the course of the trial with three rooms staying closed and one room staying open. Repairs and maintenance have been completed on these in advance of the Stage 2 trials.

A focus of the trials is to measure the energy efficiency and power savings offered by the ClearVue glazing and the power generated from the glazing. This focus has led to careful monitoring and control of the air-conditioning and fans in each of the greenhouse rooms leading to automated shut off of those systems where cooling or heating is not needed to maximise overall energy savings. This approach, although logical, ignores the importance of internal air circulation within a closed greenhouse environment. Air circulation is critical in a greenhouse for plant pollination where there are no natural insect pollinators.

Power Generation Results

Figures 1a and 1b (below) shows energy generation results of the greenhouse being 5.3MWh over a year of operation (mid-April 2021 to present).

The greenhouse is comprised of 153 total panels, almost all are 1115mm x 1228mm in size. There are 120 panels on the roof (North-facing, 20-degree tilt), 55 on the North vertical wall, and 25 panels in the West. There are 90 panels on the roof (North-facing, 20-degree tilt), 42 on the North vertical wall, and 21 panels on the West vertical wall. Energy production performance at the greenhouse was collected through Enphase microinverters' connected to the Internet accessible through an online user interface.



Figures 1a (above) and 1b (below): Energy Production as of 14/04/2022, with 3.7MWh produced from April 2021 until the end of 2021, and 1.6MWh produced so far in 2022.

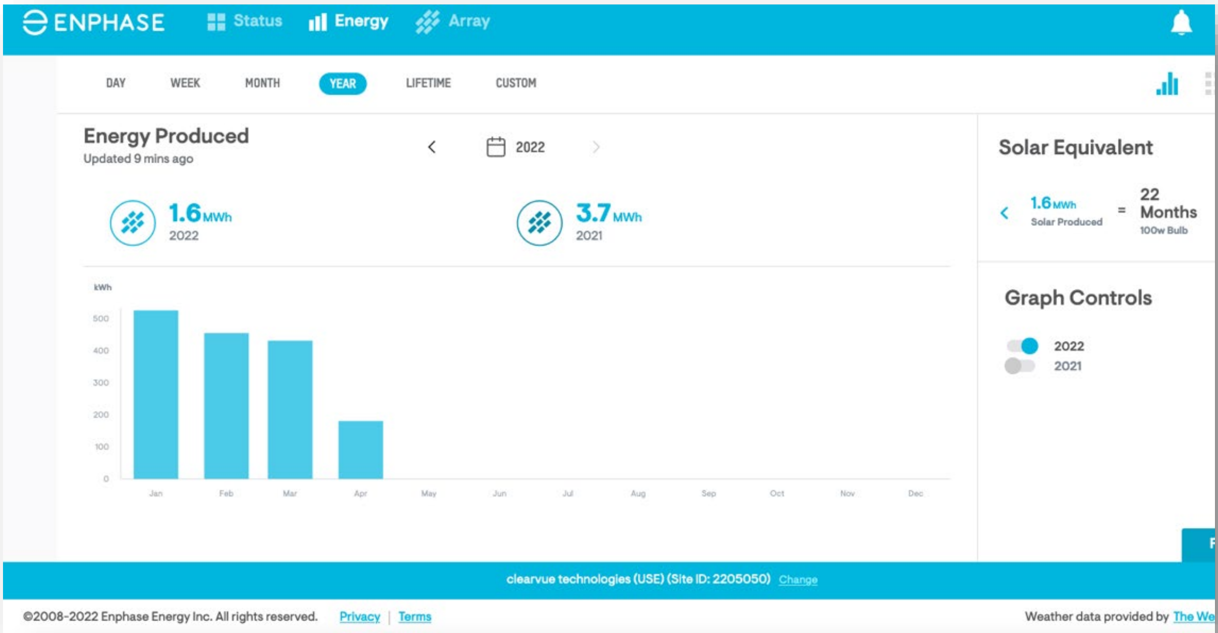


Figure 2 (below) shows a comparison of energy generation at varying orientations. Each line on the chart represents the generation from an array of 12 windows (out of a total installation of 153) over a 5-day period. The observation is that the unique layout of internal PV cells within the ClearVue IGU gives an above-average performance at a vertical orientation compared to a regular PV panel.

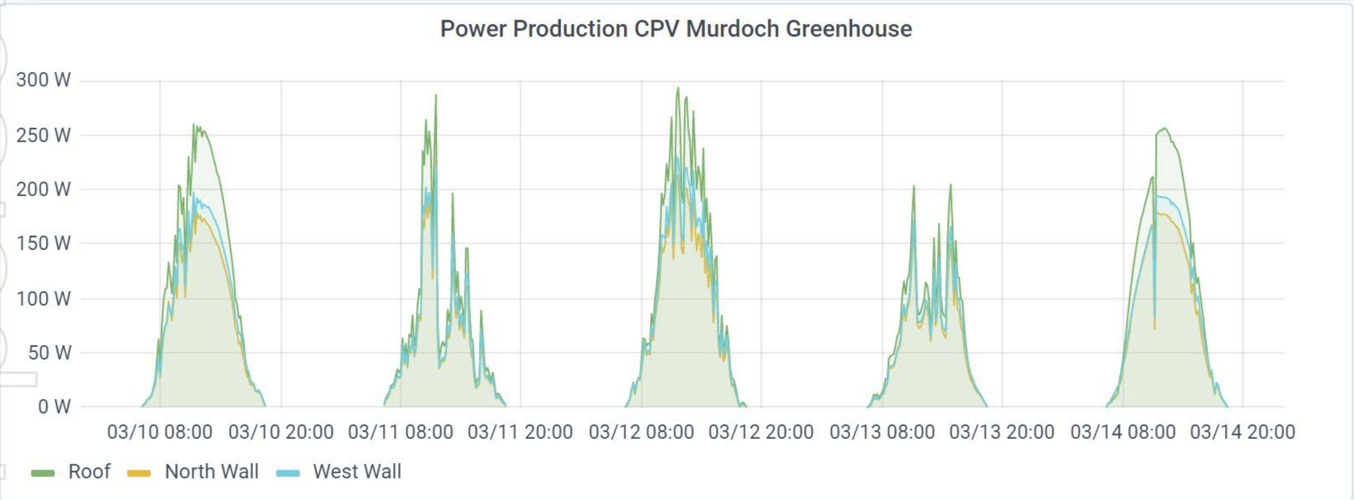


Figure 2: Comparison of energy generation at varying orientations

Table 1 (below) shows a 21% decrease in performance at a vertical orientation. Normal roof-type solar panels typically display a decrease in the order of 30-35% generation[1] when placed vertically. This observation is commercially significant for high-rise construction applications as well as greenhousing.

Array	Generation (kWh)	Percentage reduction from optimal
Roof Array G (12 panels out of 153)	501	-
North Wall Array F (12 panels)	392	21.76%
West Wall Array B (12 panels)	406	18.96%

Table 1: Comparison of lifetime energy production of 12 panels (out of 153) at varying orientations.

Thermal Performance / Energy Efficiency

The ClearVue PV IGUs installed in the greenhouse also demonstrate a significant thermal advantage over the standard single-glazed panels in the control room. The specifications of the installed windows are as follows: U-Value: 1.4W/(m^2.K), SHGC: 0.67, VT: 70%.

This specification is using a baseline configuration. The ClearVue IGU end-product for commercial construction applications is typically a customised product comprising different glazing types and the thermal performance is adjusted using additional coatings and fillings (such as argon or other noble gases) which can dramatically further increase the thermal performance. This exercise is conducted at the time of specification working with architects, façade engineers and sustainability engineers etc. These additional coatings and fillings have minimal impact on the ClearVue electricity generation performance.

Figure 3 (below) shows mean temperatures across each room during initial testing before the HVAC system was switched on in early April 2021. The chart shows temperatures within the ClearVue rooms were 2˚C warmer overnight, heating more slowly in the morning and cooling more slowly in the evening and overnight. This thermal advantage can lead to significant energy savings.

[1] "real-world" (other factors) lead to further drops in the production from vertical placement by as much as a further 10-20%.

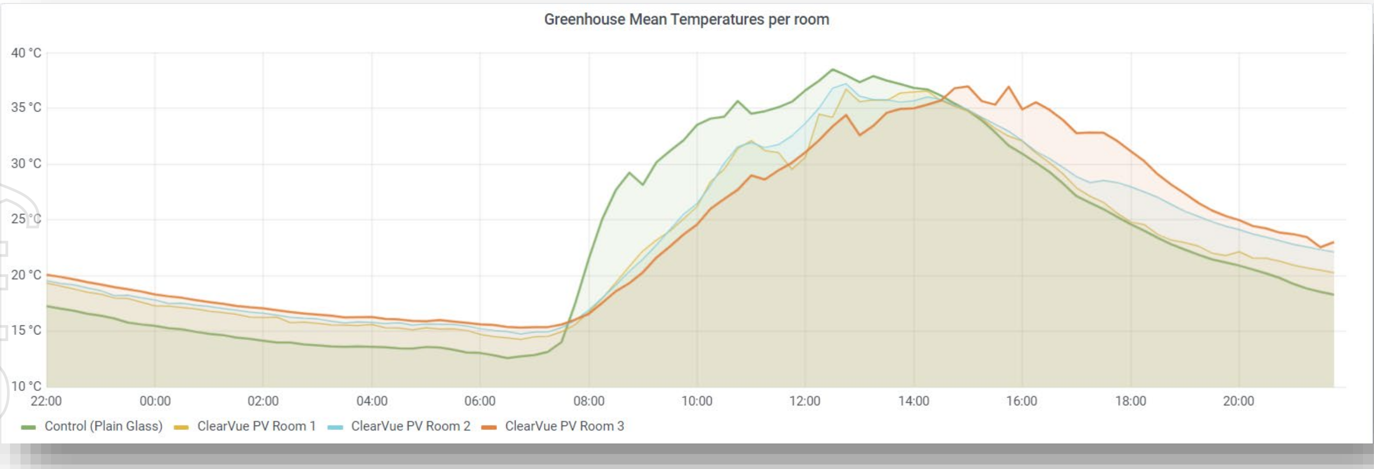


Figure 3: Room temperatures with HVAC system disengaged, 19/04/2021

Figure 4 (below) shows the cumulative energy consumption in each room over the lifetime of the greenhouse. The increased insulation of the ClearVue panels has led to a direct decrease in electricity use within the greenhouse grow rooms. This chart does not include generation, which is subtracted from electricity use on a building level. It should be noted that the control room has an additional HVAC unit to help with the thermal load, however this is only switched on when necessary, according to the control algorithm to avoid damaging the plants.

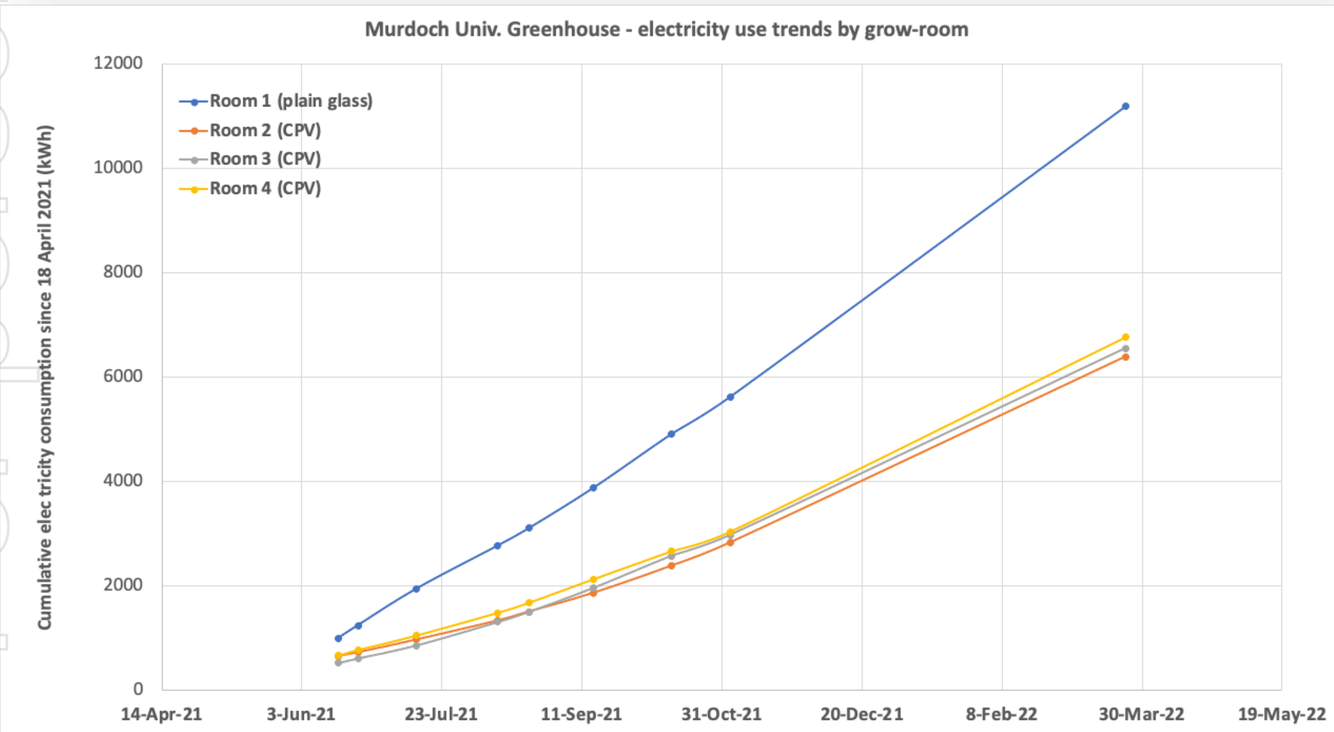


Figure 4: Cumulative electricity consumption since 18 April 2021 (kWh)

Conclusion on Power Performance and Energy/Thermal Efficiency

In summary, power generation data from each of the three rooms of the greenhouse using the ClearVue PV glazing performed better than was predicted for various periods of the year, and overall.

As previously reported:

- advanced temperature control in the range of +/-2˚C was also achieved over multiple days (not all days) within greenhouse growing rooms where the ClearVue PV glazing was used. Data collected demonstrated that those growing rooms used approximately half the HVAC energy compared to the scientific control room, using ordinary glazing.

- the microclimate control algorithms used in operation of the greenhouse are continually being refined and improved, so that a combination of significant energy savings and tight temperature/humidity control can be maintained over different seasons. This aspect of the greenhouse operation has been further developed for the Stage 2 plant science trials and has been an important aspect in the greenhouse upgrades (detailed below).

The Murdoch University solar greenhouse demonstrates the readiness of ClearVue PV for commercial applications. The ClearVue PV product installed within the structure of the building has provided both electricity generation and thermal benefits, demonstrating direct savings for the customer. The product functions well when coupled with conventional PV inverter systems and wiring and demonstrates good electricity generation when installed at angles typically expected of window units.

Plant Science Trials - Stage 1 (Winter season)

Plant science trials were conducted by Murdoch University's Professor Chengdao Li and Dr Hao Luo during the period June 2021 through November 2021 with collation of data being conducted during December 2021 to February 2022. Final report preparation was completed during January through April 2022.

The plant science trials looked at, amongst other things, whether ClearVue's solar PV glazing is suitable for use in protected cropping agriculture or greenhousing by evaluating the development, growth and yield of 10 crops, including leaf vegetables, fruit vegetables, grain crops, oil crops and legumes including wheat, barley, strawberry, lettuce, tomato, dwarf bean, chickpea, lupin, spinach and canola.

Light quantity and quality

Photosynthetically active radiation (or ***PAR***) (mW/cm^2) and photosynthetic photon flux density (***PPFD***) ($\mu mol/m^2/_s$) were compared among different glasshouse rooms (see Figure 5). The light intensity in conventional glasshouse room (glasshouse 898 – being a polycarbonate covered greenhouse adjacent to the ClearVue greenhouse at Murdoch) was reduced to 80% and the normal glasshouse room (control room) was reduced to 77% for PAR and 82% for PPFD compared with the outdoors, whilst the ClearVue PV glazed solar rooms received around 55% sunlight. The light intensity in solar rooms was approximately 70% of the normal rooms. A proportion of this reduction can be attributed to the trial limitations (referred to above).

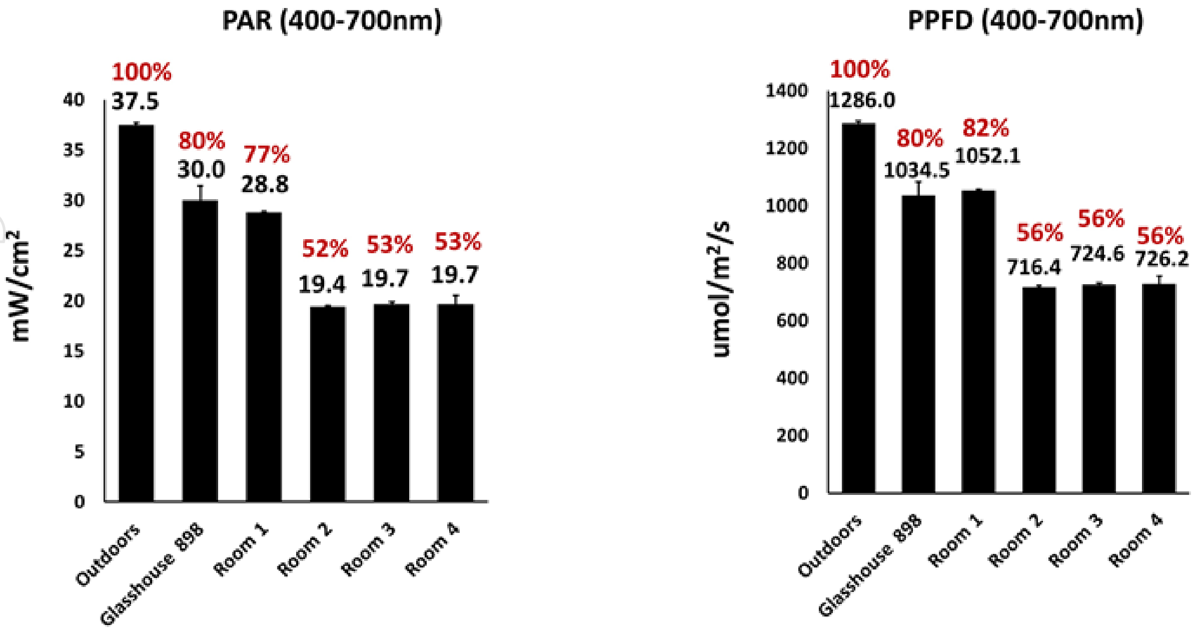


Figure 5. The light quantity (intensity) in outdoors, conventional glasshouse room (glasshouse 898 adjacent the ClearVue greenhouse), normal glass room (room 1 - control) and solar glass rooms (room 2 to 4). PAR: photosynthetically active radiation. PPFD: Photosynthetic Photon Flux Density.

The comparison of light quality between the different rooms is shown in Figure 6 (below). The light quantity and quality were both identical in the three solar PV glazed rooms. The spectra patterns were similar between the normal control room and solar rooms from 400 to 800nm, but the overall intensity was reduced. In the solar PV glazed rooms, the blue light intensity was 64% of the normal room, green light 72% of the normal room, red light 70% of the normal room, and far-red light 70% of the normal room.

The major light spectra difference was identified in UV light from 350 to 400nm. Compared with outdoors, the conventional polycarbonate glasshouse room received 82% of UV light, while in glass control room 14% of the UV light was present and in the solar rooms only 3% of UV remained, which was expected[2].

[2] As previously reported leafy plants require protection from harmful UV rays in the same way humans need to protect their skin. Plants do this naturally by producing a waxy substance that shields them from harmful UV rays. The ClearVue IGU glazing blocks these UV rays, so the energy required by plants to create the protective layer can be preserved for growth.

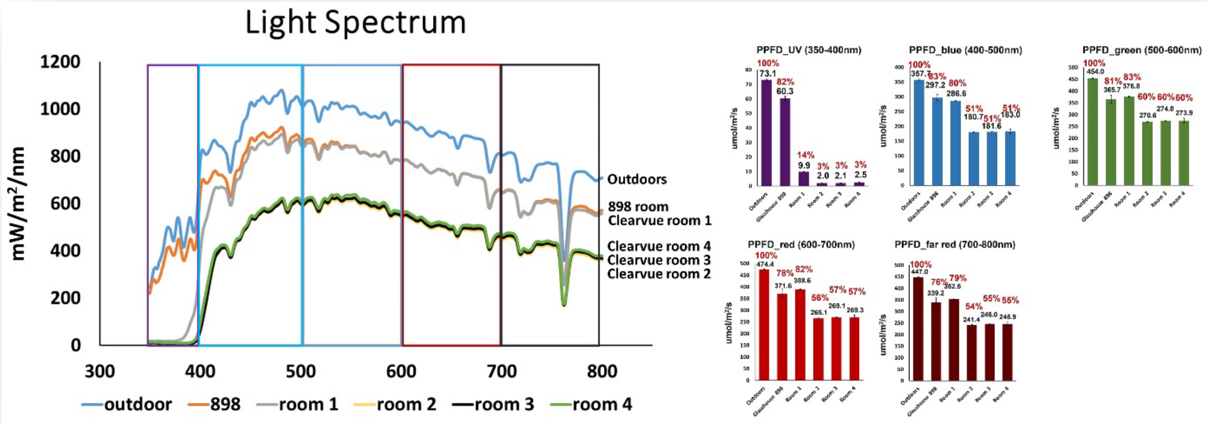


Figure 6. The light quality (spectrum) (300-800 nm) in outdoors, conventional polycarbonate glasshouse room (glasshouse 898), normal glass room (room 1) and solar glass rooms (room 2 to 4). PPFD: Photosynthetic Photon Flux Density.

The main observation from the trial is that the overall PAR, especially in the visible spectrum, needs to be increased for certain plants.

Different plant species responded differently to the filtered light they were receiving through the greenhouse's solar PV glazing panels in the solar glazed rooms but also the reduced PAR light overall due to the limitations of the greenhouse design and trial as outlined above.

In summary, for certain plants, the filtered light in the solar glasshouse rooms delayed development and decreased the biomass and yield. However, other plants were not affected by the filtered light delivering the same biomass and yield as the control plants. Overall, the filtered light had different effects on the vegetative growth of different crops at different developmental stages across the different rooms. Higher growth rates were typical for a number of the plants at the early developmental stages with excessive elongation producing taller and thinner plants.

An overall observation is that the crops in the solar PV glazed rooms demonstrated higher light use efficiency indicating adaptation to shading. Also, the actual photosynthesis rate was lower under the filtered light of the solar PV glazing and in the context of the trial limitations of the greenhouse itself.

Further investigation on this aspect of PAR light will be conducted during Stage 2 of the plant science trials (see below). Unfortunately, the limitations of the trial are not easily overcome in the context of the design of the research greenhouse itself – the solid EPS walls dividing the greenhouse rooms cannot be easily removed and replaced.

The installation of the Tomita Technologies' greenhouse at Sendai in Japan (see below) has none of the limitations of the ClearVue research greenhouse at Murdoch and is a full-scale commercial format greenhouse. It is intended that growth data for commercial crops grown in this greenhouse will be collected during the commercial operation of the greenhouse to add to the learnings of the trials being conducted at Murdoch University.

As previously reported, PAR and PPFD was measured in the three ClearVue PV growing rooms during winter midday conditions – PPFD was found to be between 600-700 micromoles/(m^2*s), which (based on research literature) is in the optimum range for a wide variety of plants eg. tomatoes.

However, due to a reduction in overall light reaching the plants, including due to the limitations of the trial (see page 2), this level of PAR is not optimum for *all* plant species that were grown inside the greenhouse - so the addition of PAR in different light wavelengths will in some cases need to be added back into the greenhouse both for Stage 2 of the trial, and possibly for some commercial growing applications.

This can be done through the inclusion of wavelength-controlled LEDs or by replacing a certain number of ClearVue panels with plain glass or polycarbonate to adjust the PAR light to find the balance between optimum light conditions, maximum plant growth, maximum power generation and minimal water use. In a normal commercial growing greenhouse, the trial limitations will also not be present. Testing of this aspect, including experimentation with added artificial PAR lighting, will become part of the research program being undertaken in the Stage 2 plant science trials which recently commenced (see below for information).

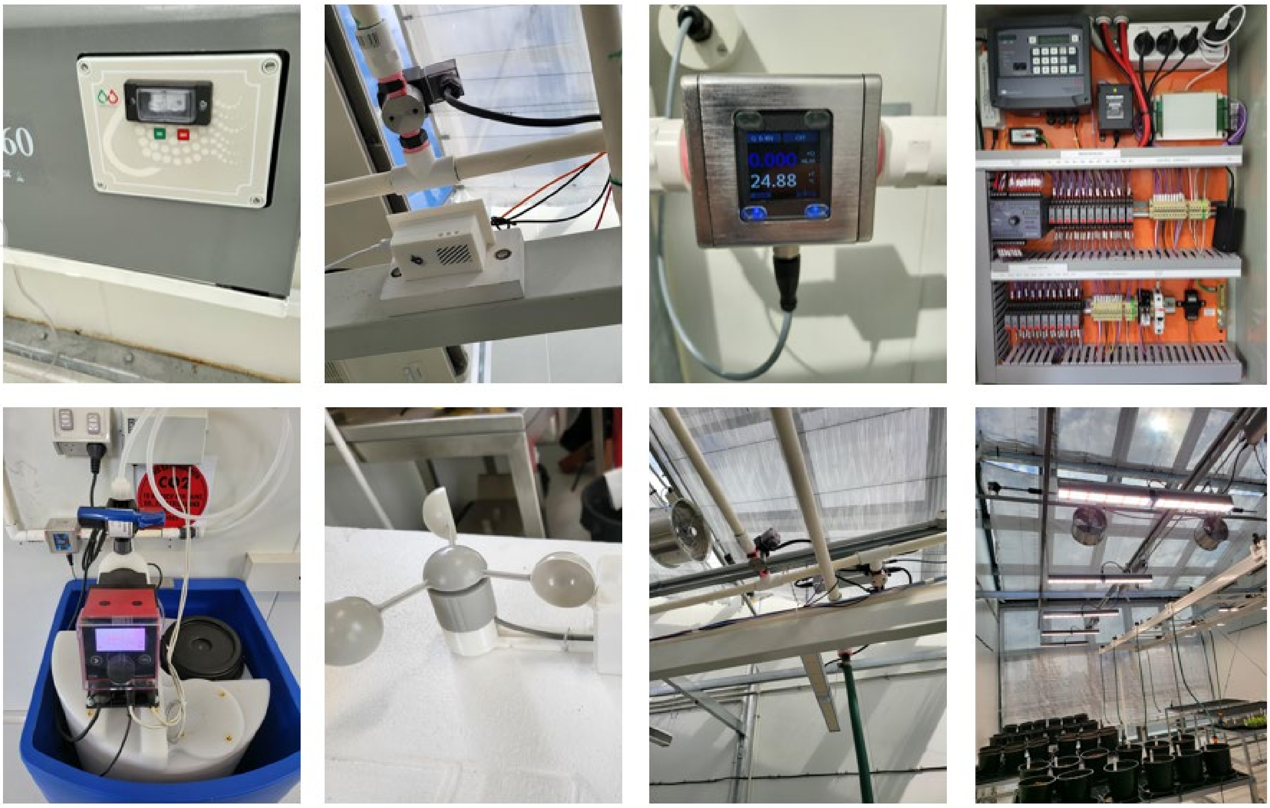
Greenhouse Upgrades

In anticipation of the Stage 2 plant science (Summer) trials and in the context of the learnings from the Stage 1 (Winter) plant science trial, improvements in the trial design have been made and consequential improvements have been made to the ClearVue greenhouse's control and operational systems over the last two months following conclusion of the first trial. The improvements seek to dramatically improve the research capability, accuracy and number of metrics for measurement to better understand plant dynamics within a ClearVue solar glazed greenhouse.

Specifically, ClearVue has further invested into ClearVue's Solar Greenhouse at Murdoch to improve measurement of several key data points being:

- Water Use;
- Photonic transmission;
- Light spectra analysis;
- Internal air movement within the greenhouse rooms;
- Plant growth tracking; and the
- Impact of irrigation and fertiliser application.

The Company has installed automated reticulation and fertigation to all grow rooms in the greenhouse as well as water meters on the misting system. These additions will enable the Company to measure precise water use and precise applications of fertiliser.



Photos of upgraded equipment and systems at the ClearVue greenhouse at Murdoch.

These parameters are now individually selectable for each growing table in each greenhouse room with up to 12 variations per growing room and 48 variations possible across the four rooms of the whole building.

The Company has also installed Fluence LED growth Lighting in the third grow room of the structure which reproduces the spectra of natural light used by plants to promote photosynthesis. It is expected that this lighting will offset the limitations of the trial referred to earlier.

In addition, ClearVue has installed new bespoke sensor arrays in each grow room which measure the following data points:

- Relative humidity at 5 points in each grow room;
- Photons transmitted by the glass and spectra of those photons at each rooms centre;
- Air movement in each Grow room;
- 6 temperature sensors per grow room; and an
- Innovative solar powered camera system on each table to measure growth rate, plant mass and plant dimensions. This was all previously measured by hand, taking the researchers a great deal of time on a daily basis but was also lacking in accuracy due to the risk of human error.

The growth camera system will be sensitive enough to detect growth rate differentials with a high degree of precision and speed.

All of these systems are controlled via Internet of Things and bespoke controllers designed and manufactured by ClearVue engineers.

In combination, all these changes have now made the ClearVue solar greenhouse at Murdoch one of the premier plant research facilities in Australia.

Plant Science Trials – Stage 2 (Summer season)

The Stage 2 (Summer) plant science trials commenced following conclusion of the upgrades in March 2022. The new trial is looking at a varied range of crops suited to the growing season including snow pea, basil, lettuce, spring onion, sunflower, chilli, maize, capsicum, ginger and tomato and is expected to run for 8 months. The research being conducted is partially funded by an Innovation Connections grant of AUD $50,000 from AusIndustry which is paid to the researchers at Murdoch University.

As mentioned, the significant upgrades to the control and operational systems of the greenhouse are expected to deliver much more accurate results which are expected can be used in discussions with growers and greenhouse suppliers. Several specific data points not looked at in detail in the Stage 1 trial will be now conducted including:

- a much more thorough analysis and understanding of water use and savings in the ClearVue greenhouse;
- a closer analysis of PAR light levels and requirements – this will be tested (i) in Room 3 by the using of commercial growing LEDs at various growth stages as well as (ii) a direct comparison with a polycarbonate type greenhouse room of the same dimension in the adjacent greenhouse to the ClearVue greenhouse; and
- a look at the role of air circulation – as mentioned, this is critical in a closed greenhouse for plant pollination where there are no natural insect pollinators. The Stage 2 plant science trials will specifically monitor internal air movement within the greenhouse rooms to ensure there is sufficient air circulation to permit pollination.

Images showing upgraded plant tables with initial plantings for commencement of Stage 2 plant science trials.

Aqua Ignis Greenhouse – Sendai City, Japan

ClearVue's PV IGU products are currently being installed by ClearVue's Japanese licensed distributor, Tomita Technologies', onto a greenhouse at the Aqua Ignis Hot Springs tourism resort project in the Fujitsuka area of Wakabayashi-ku at Sendai City, Japan. The greenhouse is a commercial greenhouse that will be used to supply produce for the resort. Completion of the glazing is expected over the coming weeks with overall completion of the greenhouse and its opening within the next month or two. For more information see the Company's ASX release of 25 August 2021.

Partially glazed greenhouse at Aqua Ignis Sendai showing installed ClearVue PV IGU panels of custom dimension - 1.908m high x 0.95m wide.

Completely glazed greenhouse at Aqua Ignis Sendai showing installed ClearVue PV IGU panels of custom dimension - 1.908m high x 0.95m wide around all sides of the greenhouse.

Victor Rosenberg, Executive Chairman of ClearVue, commented:

> *"The results from the ClearVue Greenhouse at Murdoch have demonstrated the power performance of the ClearVue's PV glazing both as a power source for the project but also as a significant contributor to energy reduction within the operation of commercial greenhousing where growers are willing to invest into a long-term capital asset that can pay itself back – both financially and from a carbon perspective – something no other greenhouse covering product on the market can offer today.*
>
> *The recent upgrades made to the greenhouse will offer an even greater insight into the role the ClearVue glazing can play in commercial greenhousing. Whilst the results show that we still have a little work to do in finding the optimum balance between power generation, minimal water use, and optimised light conditions for maximum plant growth – we are confident that we are close to finding this equilibrium point and are looking forward to working with the Murdoch team on the*

Stage 2 plant science trials but also with Tomita on the commercial greenhouse at Sendai in Japan to round out this work.

The Tomita Technologies greenhouse installation is itself progressing very well and will in addition to offering a commercial greenhouse as a reference point it will also serve as a good demonstration of larger sized ClearVue PV glazing performing in a cold-climate real-world setting. We very much look forward to the finalisation of this exemplar project and its opening in the coming months."

ClearVue looks forward to updating the market on the Stage 2 plant science trials as they continue and on the progress with the Tomita commercial greenhouse at Sendai in Japan.

Authorised by the Board of ClearVue Technologies Limited.

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ABOUT CLEARVUE TECHNOLOGIES LIMITED

ClearVue Technologies Limited (ASX: CPV) is an Australian technology company that operates in the Building Integrated Photovoltaic (BPIV) sector which involves the integration of solar technology into building surfaces, specifically glass and building façades, to provide renewable energy. ClearVue has developed advanced glass technology that aims to preserve glass transparency to maintain building aesthetics whilst generating electricity.

ClearVue's electricity generating glazing technology is strategically positioned to compliment, and make more compelling, the increased use of energy-efficient windows now being regulated in response to global climate change and energy efficiency goals.

Solar PV cells are incorporated around the edges of an Insulated Glass Unit (IGU) used in windows and the lamination interlayer between the glass in the IGU incorporates ClearVue's patented proprietary nano and micro particles, as well as its spectrally selective coating on the rear external surface of the IGU.

ClearVue's window technology has application for use in the building and construction and agricultural industries (amongst others).

ClearVue has worked closely with leading experts from the Electron Science Research Institute, Edith Cowan University (ECU) in Perth, Western Australia to develop the technology.

To learn more please visit: www.clearvuepv.com

FORWARD LOOKING STATEMENTS

Statements contained in this release, particularly those regarding possible or assumed future performance, revenue, costs, dividends, production levels or rates, prices or potential growth of ClearVue Technologies Limited, are, or may be, forward looking statements. Such statements relate to future events and expectations and, as such, involve known and unknown risks and uncertainties. Actual results and developments may differ materially from those expressed or implied by these forward-looking statements depending on a variety of factors.