Case Study:

Mac Burge

Citrus Grower
Riverina District, NSW

The Challenge

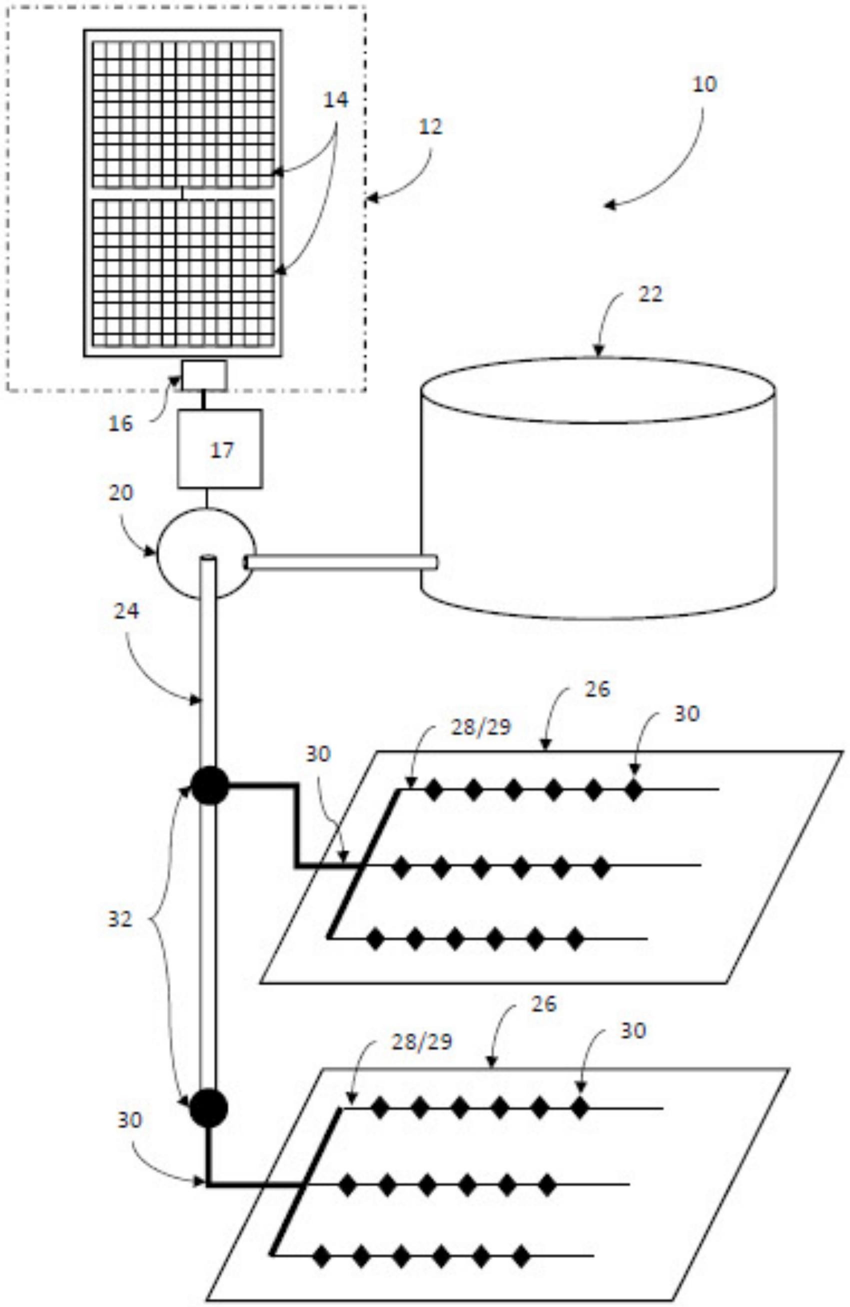
- 18.6ha established citrus orchard requires a drip irrigation system
- … with a few specific features and an industry first configuration!

Existing Scenario

- Inefficiently flood irrigated using gravity pipelines and risers
- No electrical power available & electrical infrastructure upgrade unviable
- Client wants to be carbon neutral without generator back-up
- Solar power is the most viable power source
- However existing drip irrigation systems require constant pressure which is difficult to achieve with solar due to continuously varying solar radiation levels

Planning

- Calculate the maximum application rate for the crop, using historical evapotranspiration(ET_0) data x maximum variable crop factor for citrus = in this case, 8.6mm/hectare/day
- Required maximum daily water volume = 18.6 ha x 8.6 mm/day = 1.6 Mg/L per day
- Typically maximum daily plant water usage occurs in Australian summers - generally for up to 30% of a month (approx. 10 days)
- To ensure the system can exceed the maximum monthly requirements, it is configured to provide average daily output of 1.6 Mg/L per day
- Careful planning and sizing of the solar panel configuration is required to maximise lowest radiation levels at the start and end of the day



Introducing...

SolarDrip

An industry first

The Solution

- Design and deploy an autonomous, solar powered, drip irrigation system utilising non-pressure compensating emitters. **In this situation, Metzer LIN driptube**.

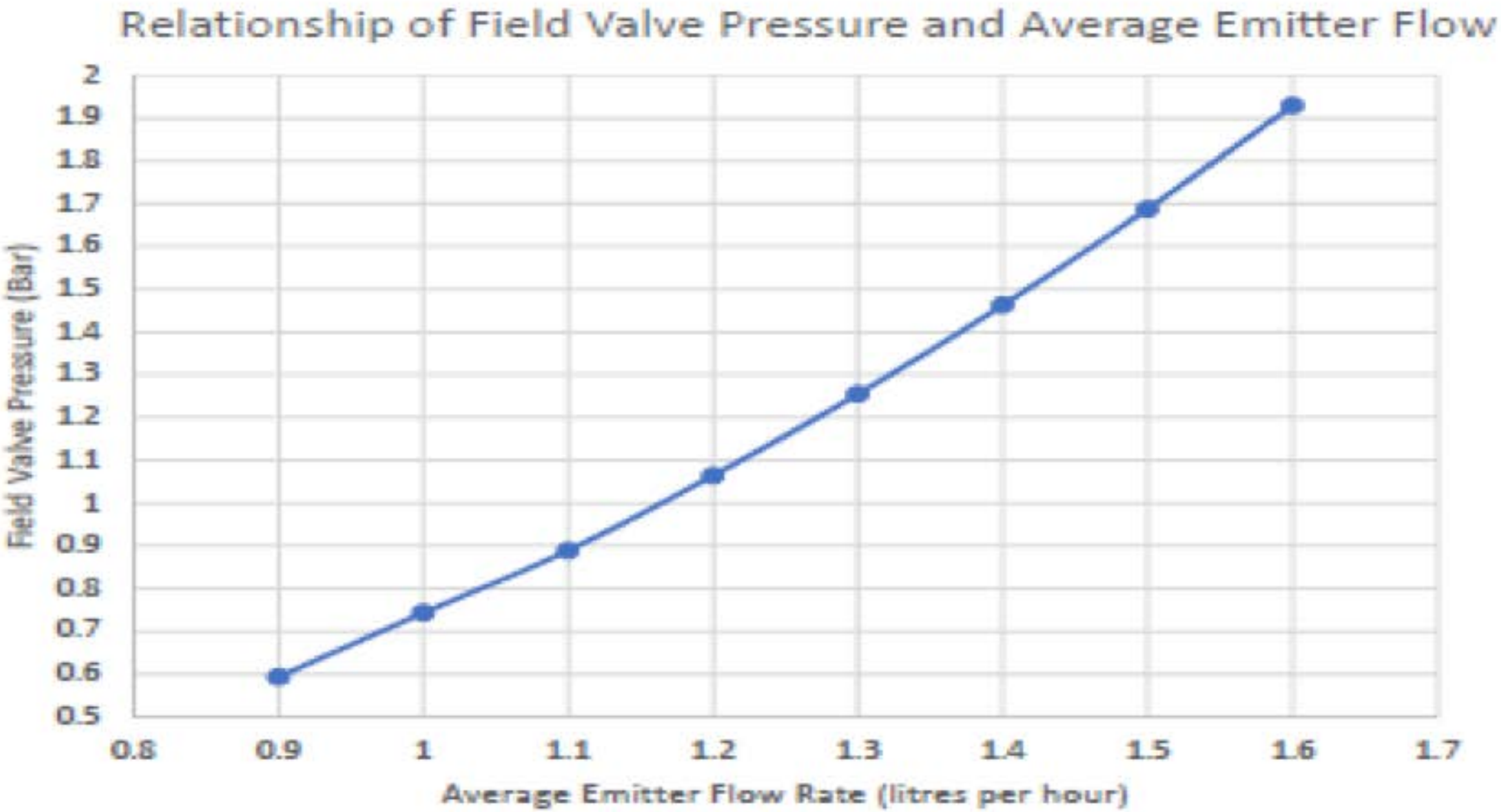
- Technically, as a component of ET_0, solar radiation contributes around 88% of its value. Other components influencing ET_0 including wind, temperature and humidity make up for the remaining 12% ± 4.6%.

- It is therefore reasonable to conclude that a drip irrigation system application rate driven purely by solar radiation is a valid way to estimate plant water usage over the year.

Irrigation System Design Target

- A flow rate variation of less than ± 5% across a variable range of pressure inputs was used as the benchmark design target over the entire 18.6 Ha.

- As such, mainline, submain and lateral pipework are designed to minimise friction losses so as to in turn minimise variation in non-compensated emitter uniformity (Metzer LIN emitter).


Relationship of Field Valve Pressure and Average Emitter Flow
Field Valve Pressure (Bar)
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
Average Emitter Flow Rate (litres per hour)

Design Specifications

- Lateral emitter flow & spacing set to meet & exceed application rate during highest ET_0 demands
- Lateral diameter must achieve velocity that generates turbulent flow to scour intermittent build-up of debris (velocity required = .50m/s)
- Nominal flow/spacing of emitters must achieve appropriate application rate for the crop. Tube diameter must minimise friction losses along each lateral.
- Nominal flow rate is 1.6L per hour. Actual flow rate dependent on pressure.

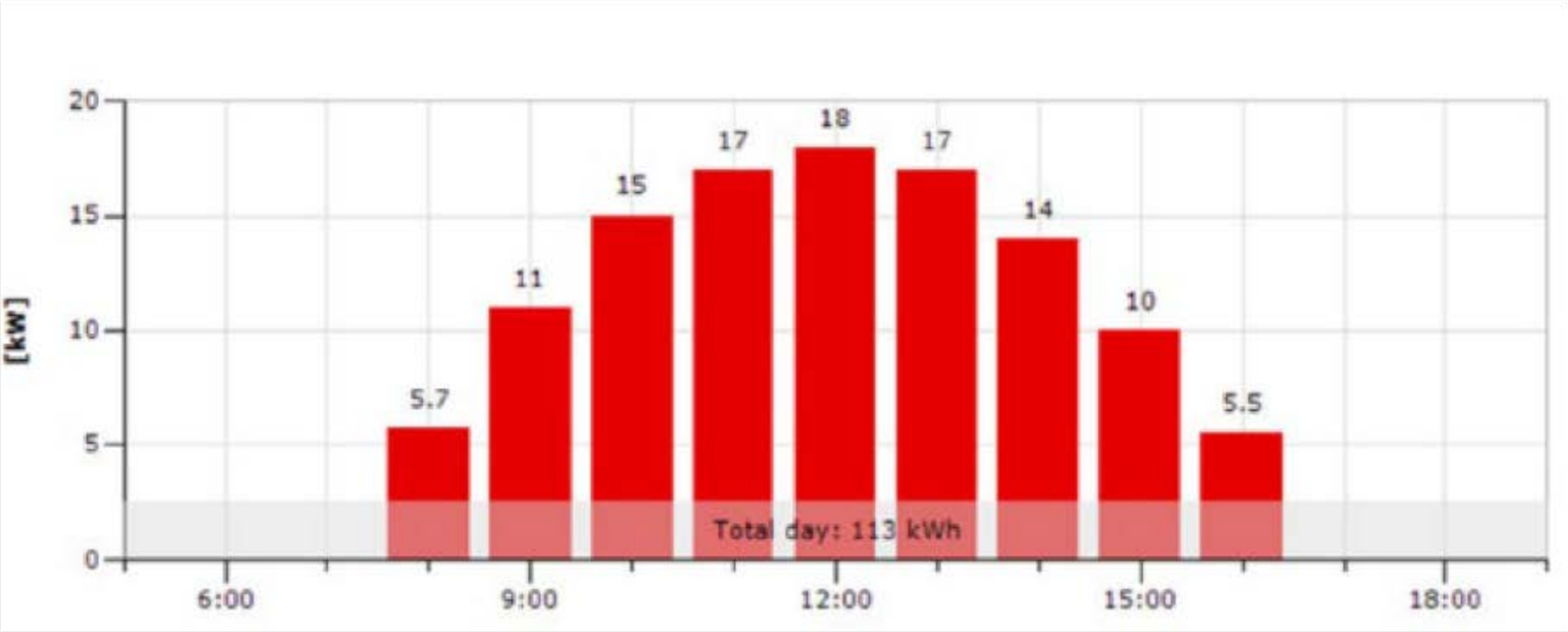
Design Specifications

- 25mm internal diameter PN4 polyethylene tube with integral non-compensating emitters every 60cm.
- Mainline is selected to ensure that all blocks can be supplied with the necessary flow & pressure at the same time.
- All blocks irrigate together if required at maximum flow rate, whilst minimising friction losses throughout the mainline piping network. Emitter uniformity is maintained.
- Once pressure/flow are determined, a suitable pump and filtration system, and solar power requirements are selected.


METZERPLAS
IRRIGATION SYSTEMS

Solar Power Considerations

- A 26kW solar system is required to power the 22kW pump.
- The system is designed to exceed maximum ET_0 requirements for the citrus crop throughout the entire year and may be manually or automatically controlled to avoid potential over irrigation.



[kW]
20
15
10
5
0
5.7
11
15
17
18
17
14
10
5.5
Total day: 113 kWh
6:00
9:00
12:00
15:00
18:00

Pumping System Considerations

- Pump selection is determined by local solar data and the variable flow and pressure for the drip system. It must also maintain application uniformity across the farm.

- Must ensure maximum flow required during the highest usage months is exceeded, whilst keeping a relative flow throughout each day based on solar radiation levels.

- The pump controller must be configured to start the pump when a minimum of 15m of pressure can be produced by the pump. This enables the system to overcome frequent stop/starts by setting a minimum power of 6kW.


AZUD

Pumping System Considerations

- Additionally the pump can be set up to turn on and off at a certain minimum solar radiation level. This level is detected by a simple sensor and the minimum setting can be adjusted to fine tune the actual application rate being delivered each day.

- A **higher** pump output pressure **increases** emitter flow and uniformity, but also **increases** submain and mainline friction losses.

- A **lower** pump output pressure **decreases** emitter flow and uniformity, but also **decreases** submain and mainline friction losses.

- The key is the iterative calculation to find the **balance point of pipe sizing** vs **cost efficiency** vs **flushing velocities** vs **uniformity.**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Advantages

- System automatically adjusts water application to plant water usage
- Capital investment is equivalent or slightly greater than existing drip systems
- No ongoing running costs (energy costs) – solar is extremely cost effective!
- Simplified operation & scheduling of irrigation compared to existing system
- Reduces or eliminates the need for additional reactive control inputs/sensors

SolarDrip

Has enormous potential throughout Australia …
and across the world!

Truly, an industry first!


Thank you for listening.
Any questions?