*Submission on behalf of Mount Pleasant Primary School*

# Inquiry Into the Response of Western Australian Schools to Climate Change – Education and Health Standing Committee

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## Background

Mount Pleasant Primary School (MPPS) plans to embark on a program that encourages Sustainability and Renewables in the school. The planning document that outlines this proposal in included in Appendix A.

The main body of this document briefly details some ideas regarding the terms of reference and ways in which the MPPS program is relevant. More detailed elaboration on several aspects can be found in Appendix A.

## a. The Co-Benefits of Climate Action in Schools

**Student Learning**

MPPS plans to join the ClimateClever program (https://www.climateclever.org/schools) in 2022. The ClimateClever program provides educational materials for multiple age groups that introduce concepts of Sustainability. Within this broad subject, STEM topics are the foundation along with economics, social and community involvement.

The installation of an energy monitor will also introduce students to the concepts of net-energy usage and solar-energy generation. By making the consumption and generation of energy visible to the students, they are then able to make decisions on how they might act to reduce the School's carbon footprint in a sustainable way.

**Direct Health Impacts**

It is proposed that one method of reducing the School's carbon footprint would be to replace all gas heaters with reverse cycle air-conditioners (heat pumps). Not only are heat pumps both carbon neutral and more efficient, but the substitution of gas heaters would also remove the production of Carbon Monoxide on the school grounds. This would prevent any casual or accidental exposure to this poisonous gas. Please refer to this link (https://www.health.vic.gov.au/health-advisories/carbon-monoxide-and-gas-heater-safety-update) for more information regarding the potential risks surrounding gas heaters.

**Mental Health Impacts**

Recent surveys of our youth have revealed that Climate Anxiety is a significant issue[1]. It is also postulated here that the best antidote to Climate Anxiety is Climate Action. Giving students the tools to tackle climate change at home and at school is seen to be a way of addressing these concerns. If we make our overall plan and progress visible to students, this will go a long way to turning their fear into hope.

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[1] https://www.nature.com/articles/d41586-021-02582-8

### Financial Savings

Utility bills make up a significant proportion of a school's operating budget. For example, at MPPS the spending on water, electricity, gas, and waste collection account for ~16% of the operating budget (once fixed salaries are taken out). Any money saved on these bills can then be spent on other worthwhile programs and activities within the School.

### Community

There are many benefits to the community when their local school is engaged in action on climate change. Students can take home information and real-world actions that can be applied in their own home. They can initiate discussions with their parents and siblings on ways to tackle the climate crisis.

Our personal experience at MPPS has also shown that there is a lot of interest in our community in utilising more renewable-energy solutions. One idea that has gained a lot of traction is a community battery or a Virtual Power Plant operating at the School. Local community members could participate by storing and trading energy with the School to save money. Community members without solar panels at their residence can also participate and save money. This concept is fully aligned with the outcomes of the WA Government's Distributed Energy Resources (DER) Roadmap.

### Recognised and Promoted

The School's executive recognises the potential benefits of the proposed Sustainability & Renewables program. Involvement with ClimateClever gives the School a platform to promote their sustainability efforts to the students, their families, and the wider community. The ClimateClever and Solar Schools programs both have public-facing web interfaces to inform stakeholders on what is being achieved.

### Cross Promotion of Existing Activities

Strong action in addressing climate change does not need to be narrow in view or scope. However, we all should be aiming to do more to tackle the problem and set ambitious targets on emissions reductions. Repackaging existing initiatives risks being a distraction from finding ways to make more meaningful progress.

## b. Climate Change Actions at MPPS

### ClimateClever Program

The actions proposed in the MPPS Sustainability and Renewables Program (refer Appendix A) provide meaningful ways to tackle Climate Change. The ClimateClever program provides detailed actions that can be carried out. It has many low- and zero-cost actions, as well as actions that will provide a net-positive financial outcome for the School. Additionally, ClimateClever is a business that has its origins in Western Australia, particularly through Dr Vanessa Rauland and Curtin University.

### Solar Schools Program

The Solar Schools program provides tools for the School to monitor and analyse its energy usage. The company is based in Queensland and provides hardware supplied by another Australian company, Wattwatchers. The costs to join the Solar Schools program are subsidised by the Australian Renewable Energy Agency (ARENA).

## c. Barriers

**Department of Education Policies**

To date, the main barrier encountered by MPPS has been gaining approval from the Department of Education for the School to take part in the Solar Schools program. Technicalities in the contract and installation of devices have held the project up. MPPS will be the first public school in WA to implement this program, so hopefully our efforts will make this process easier for other schools to follow. Alternatively, a state-wide program to install power monitors in schools would be a solution to overcoming internal policies and regulations that might otherwise be a barrier.

**Costs**

Upfront costs are a major barrier to implementing solar and batteries. The long-term financial benefits can readily be demonstrated using standard analysis tools. However, access to capital funding and permission to install these assets at a public school are non-trivial. As always, this issue can be addressed by allocating more public funds.

**Regulatory Issues**

One of the major ambitions for MPPS is the deployment of a large battery storage unit on the school grounds. Leveraging this asset to take part in a Virtual Power Plant (VPP) is also highly desirable. As the WA electricity market is highly regulated, VPPs are quite rare in the state. However, the Government's DER Roadmap gives all stakeholders an impetus to move towards this solution. Additionally, the deployment of a 1MWh battery at Rossmoyne Senior High School (RSHS) demonstrates this is something that Synergy and Western Power deem to be worthwhile.

Our understanding is that the DER Roadmap will mean that eventually these regulatory barriers will be dropped. However, at this point in time there is both great opportunity and great uncertainty. It would be highly beneficial for more clarity to be provided regarding the plans of the Department of Education and other Government Departments in this area.

## d. What More Can Be Done?

A key tenet for embarking on strong climate action is making a net-zero commitment. This a commitment whereby an organisation aims to reduce the sum of its greenhouse gas emissions to being zero when negative offsets are included. It is proposed here that the EHSC should recommend **a goal for all WA public schools to be net-zero emissions by 2030**. This would be feasible using existing technology and by taking the following actions:

1. Increase the use solar and battery storage systems at schools.
2. Setup Power Purchase agreements to buy electricity with Renewable Energy Certificates.
3. Remove all gas heating from classrooms and replace with reverse cycle AC.
4. Audit water usage in schools to identify leaks and areas to reduce consumption.
5. Offset any other emissions via a carbon offset scheme. This could be a tree-planting program that directly involves students.

# Appendix 1

# Mount Pleasant Primary School – Sustainability & Renewables Program

A proposal written by Michael Andrewartha, PhD

> *Young people aren't the leaders of tomorrow. They are the leaders of today and tomorrow.*
>
> Kathy Calvin, Former CEO of the United Nations Foundation

## Summary

Sustainability has been identified as one of the cross-curriculum priorities for the Australian curriculum[2]. Renewable energy plays a key role in achieving sustainability through emerging technology. Engaging students in this subject matter can be achieved via both direct involvement and visible actions. The following actions are proposed:

1. Make the school's carbon footprint visible to all stakeholders and discover ways it can be reduced.
2. Install more renewable energy capacity at the school.
3. Include STEM activities related to renewables in the classroom or via extra-curricular opportunities.

This program is shown to offer potential benefits to three major stakeholders: the students, the school, and the local community. Funding for this program is targeted at the McGowan Government's $40 million Schools Clean Energy Technology Fund [3]. The major actions are discussed in more detail below.

## Action 1 – Visibility of Carbon Footprint

The first step to engaging the students and community with reducing the school's carbon footprint is by making it visible. This is possible by implementing the following ideas:

1. Join the ClimateClever program.
2. Install a publicly accessible power monitor.

### Action 1a – ClimateClever Program (https://www.climateclever.org/schools)

The ClimateClever program is a multifaceted approach to engaging students in sustainability. The program provides the school with the following:

1. An interactive data-driven application that allows the students to directly Measure, Audit, Track and Action items relating to sustainability in the school. The online tools accumulate data and report on how the school is improving its overall sustainability. The program also provides a tailored action plan for systematically reducing the carbon footprint of the school.
2. Teaching resources that can be used in the classroom or as extra-curricular activities. The lesson plans are targeted as STEM activities to educate the students in various area of sustainability.

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[2] https://www.australiancurriculum.edu.au/f-10-curriculum/cross-curriculum-priorities/

[3] https://www.ourstatebudget.wa.gov.au/2021-22/fact-sheets/education.pdf

3. Access to the ClimateClever community which includes expert advisors, community forums and meetups with other schools.

It is expected that the ClimateClever program will be a student-led activity. Students will have the opportunity to engage in practical STEM activities and make decisions that will have a tangible impact on the school's finances and carbon footprint. It is anticipated that even a small improvement in the school's resource usage will provide significant financial benefits.

Money that is saved from the program (plus savings from power bills if more solar/batteries are installed) could then be used to fund the installation of more energy-efficient appliances throughout the school. Alternatively, the school could opt to pay an amount towards a "GreenPower" option with Synergy which purchases Renewable Energy Certificates to match imported electricity. These kinds of decisions could be student led based on the yearly progress reports that are automatically generated by the ClimateClever software.

### Action 1b – Power Monitoring

To complement the ClimateClever program, it is proposed that the school install some form of energy monitoring system. An energy monitor continuously measures and logs the electricity used by the school as well as any energy generated by the school's solar panels. The reasons for recommending this are as follows:

1. The school's live energy usage is visible to students. This will inform students about how energy is consumed and enable them to make decisions about how to make the school more energy efficient.
2. Data is recorded to show how and when the school uses energy. This will be a critical component in reducing the school's carbon footprint and examining how the school can save money on its utility bills.
3. The data logged by a power monitor will inform the design of future installations of solar panels and batteries. This will allow more optimised solutions to meet the school's patterns of energy usage.

Currently, the school pays the electricity bill directly from its own operating budget, and there is no targeted way to find how this can be reduced. An energy monitor would provide information on aspects that can be investigated. There are many relevant STEM activities for students that would involve an energy monitoring system.

Following an analysis of the available options, the Solar Schools program (https://www.solarschools.net/) has been selected as the most suitable option to provide power monitoring at MPPS. It can measure bi-directional power, is connected to the cloud via 4G LTE (bypassing any WiFi and firewall issues) and has a user interface that is accessible for the students.

## Action 2 – Install More Renewable Energy Capacity

The school currently has 73 x 300W solar panels installed on the classroom rooftops and a three-phase inverter with an AC capacity of 17kW. To complement this, the following options are discussed:

a. Install more solar panels on the roof space.
b. Install a small battery behind the meter.
c. Install a community battery on the school grounds.
d. Initiate a VPP with other households in the local area.

### Option 2a – Install More Solar Panels

Solar panels offer the highest rate of return on initial investment for any option when they reduce the electricity (kWh) consumed from the grid. MPPS has a "time-of-use" (TOU) tariff where they pay a higher rate (c/kWh) during peak periods[4] and receive no feed-in tariff for solar power exported to the grid. Solar power is highly effective in reducing the peak period usage, but once the school's power needs are met, any power that is exported provides no financial return for the school. Thus, there is a point where adding more solar capacity provides a diminishing benefit to the school.

It should be noted that the power usage of a school is quite unique. The school terms mean that a school is only fully occupied for ~40 weeks or 200 days a year. When combined with an 8am-5pm working day, this means that the school is fully utilised for just over 20% of the total hours that make up a whole year. There are long periods of low energy consumption on weekends and school holidays. This is particularly evident during January where the solar input is peaking, but the school is empty. Any net export of solar power in this time is an opportunity cost to the school.

### MPPS Analysis

Detailed analysis of the electricity usage at MPPS has revealed the following financial returns from adding more solar panels to the existing system. The results are listed in the table below.

| Additional Solar Size | Total Cost | Payback Period | Annual Savings |
|---|---|---|---|
| 20 kW | $20,000 | 4.8 years | $4,290 |
| 30 kW | $30,000 | 5.1 years | $6,050 |
| 40 kW | $40,000 | 5.4 years | $7,520 |
| 50 kW | $50,000 | 5.9 years | $8,690 |
| 60 kW | $60,000 | 6.4 years | $9,620 |
| 70 kW | $70,000 | 6.9 years | $10,340 |

*Size is based DC power rating of panels (kWp) with an DC:AC inverter power ratio of 1.33:1. Installed cost is assumed at $1,000 per kWp.*

As shown in the summary chart below, the 50kW system provides the highest Net Present Value (NPV) over a 15-year term, with a system larger than 50kW system deemed to be oversized due to declining NPV.

[4] Peak period is 8am-10pm


## Option 2b – Small Battery

The uptake of rooftop solar panels in Australia is the highest in the world in terms of both total installs per capita and the current installation rate. Western Australia has more "solar hours" than anywhere else in the world, and domestic rooftop solar regularly supplies up to 50% of the daytime demand in the SWIS[5] grid. However, the peak demand period is offset from this supply and occurs from 3pm to 9pm.

The figure below shows the grid demand on electricity generators once supply from domestic solar is deducted. During the middle of the day the effective demand is low as solar generation is high. As the sun sets and the evening peak occurs, other generators are required to ramp up quickly to satisfy demand. This has the potential to cause huge problems in terms of grid stability.

[5] The South West Interconnected System (SWIS) spans from Geraldton to Kalgoorlie to Albany.

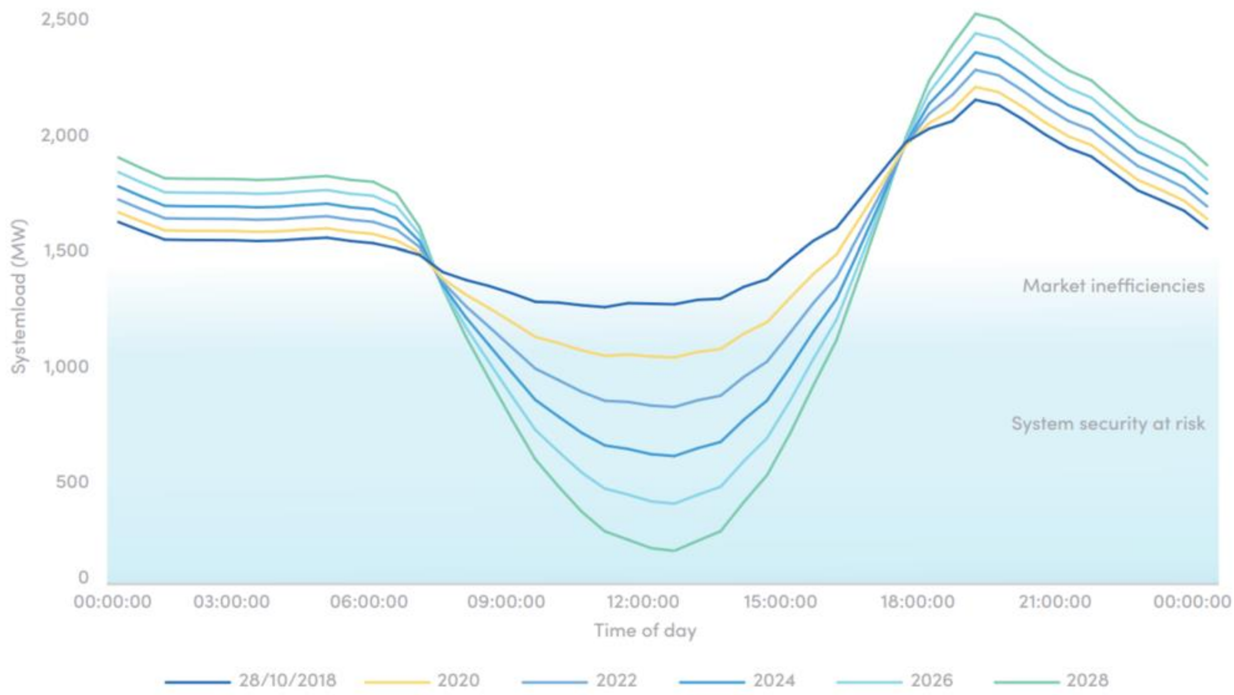
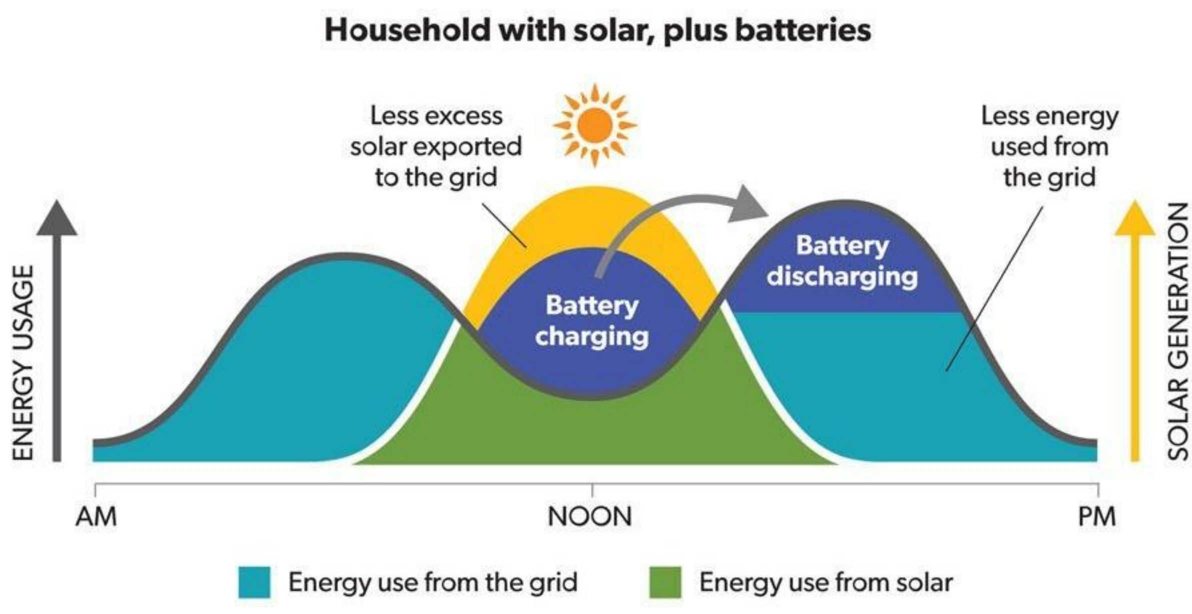



Figure 9 – AEMO analysis on the shape of the load curve on the minimum demand day[26]

Batteries provide a "firming" capability where they absorb the peaks and fill in the dips – see figure below. This smooths out demand on the local grid to give a stabilising effect. Installing batteries thus allows more solar to be installed in a local grid, and many electricity network service providers are cognisant of this – some jurisdictions are not allowing solar installs without an accompanying battery.




Currently, the major issue with small batteries is that they are relatively expensive and only provide a small positive rate of return over a 15-20 year time period. This means the residential uptake is slow. However, if the capital funds for a battery are provided publicly without a requirement on fast payback, then they do provide an immediate financial benefit to the school. At the recent state election, the McGowan government made a promise to provide up to $40 million for a Schools Clean Energy Technology Fund to install clean energy systems in WA schools.

Batteries that support grid stability also provide less visible benefits to the surrounding community who are connected via the local grid. More battery installs mean that Synergy/Western Power is less likely to curtail solar installs and generation. For these reasons, a small battery is seen to be a prudent addition to complement any further installation of solar panels at MPPS as the financial benefits are supported by infrastructure benefits provided to the local community.

There are three other potential usage scenarios where a BESS can be used to aid in reducing a school's electricity bill:

1) Daily Tariff Arbitrage - A BESS can charge up overnight (during off-peak tariffs) and supply during peak, saving the price differential between the two rates.
2) Two-Day Delayed Self Consumption - Excess solar energy that is generated over a weekend can be used by the school from 8am on Monday (peak period) to supplement the existing solar.
3) Holidays - During school holidays, when solar generation is high and school loads are low, the battery can be charged during the day, then exported to the local grid in the evening peak (3pm-9pm). The currently active tariff structure does not compensate for exports, so a new tariff arrangement would be required to encourage this behaviour.

## MPPS Analysis

A battery energy storage system (BESS) that is installed behind the meter can absorb any excess solar power that is produced by the school's PV array. This energy can then be used later in the day instead of importing power from the grid during peak periods. This is commonly known as PV self-consumption.

When included with an additional 30kWp solar system, the following financial returns are predicted for MPPS for various battery sizes.

| Battery Size | Total Cost | Payback Period | Annual Savings |
|---|---|---|---|
| No battery | $30,000 | 5.1 years | $6,050 |
| 17 kWh | $50,200 | 7.7 years | $6,730 |
| 25 kWh | $53,300 | 7.8 years | $7,020 |
| 35 kWh | $58,000 | 8.1 years | $7,370 |
| 50 kWh | $76,500 | 10.1 years | $7,860 |

*Battery charge/discharge is based on maximising solar self-consumption only.*

The following data is provided based on an additional 60kWp solar system.

| Battery Size | Total Cost | Payback Period | Annual Savings |
|---|---|---|---|
| No battery | $60,000 | 6.4 years | $9,620 |
| 25 kWh | $83,300 | 7.4 years | $10,900 |

| | | | |
|---|---|---|---|
| 35 kWh | $88,000 | 7.5 years | $11,370 |
| 50 kWh | $106,500 | 8.7 years | $12,040 |
| 70 kWh | $116,100 | 8.9 years | $12,820 |

Peak NPV occurs for a combination of a 60kWp solar addition coupled with a 35kWh battery.


### Option 2c – Community Battery

A community battery is a larger battery (~500kWh) that is connected to the local grid and services multiple customers. In one type of application known as a PowerBank[6], local members can store their own excess solar generation in the community battery and then use it in the evening. This provides a financial benefit for members and allows more solar to be installed in the local grid due to the ability of the battery to smooth out the generation and demand spikes.

A community battery is a much larger capital outlay, but it does have a lower cost per kWh when compared to residential batteries (~10-20kWh each). Physically, a community

[6] https://www.westernpower.com.au/our-energy-evolution/projects-and-trials/powerbank-community-battery-storage/

battery is not a particularly large piece of equipment and can be fitted into a 10ft shipping container.

The reasons for proposing a community battery are because it makes a lot of sense from an infrastructure point of view. There is available space on the school property to locate the equipment, and there are several medium-voltage distribution lines terminating at transformers and switchgear nodes within the school boundary. Schools also have a lot of roof space with potential for high solar-energy generation. It is proposed that if a community battery were installed at the school, then the school could negotiate favourable trading tariffs with the other battery users. The families of school students are highly likely to live in the immediate area surrounding the school, which means that this arrangement would present an alignment of interests of stakeholders.

### MPPS Analysis

It is not possible to thoroughly model the financial return from this concept without a much more detailed proposal. Instead, we can consider a tariff arbitrage system whereby community users might pay to store and retrieve their solar exports from a community battery. Examples for different arbitrage values (difference between buy and sell price to the battery) are shown below for a 250kWh battery.

| Arbitrage Value | Payments |
|---|---|
| 5 c/kWh | $3,750 pa |
| 10 c/kWh | $7,500 pa |
| 15 c/kWh | $11,250 pa |

*Assume 100% depth of discharge (250kWh useable capacity), 300 discharges per year.*

### Option 2d – Virtual Power Plant

A Virtual Power Plant (VPP) would integrate the solar and large battery systems proposed above with other storage and solar assets in the local community. Participants would work together to serve the community's energy needs. Higher financial returns are possible by putting the system "on-market" where it is exposed to wholesale electricity prices. VPP's also have the potential to participate in the ancillary FCAS markets that assist in maintain grid stability. When a battery participates in a VPP, it is able to access more lucrative value stacks that further reduces its payback period.

The State Government's Virtual Power Plant pilot[7] is one way to achieve this aim. It is proposed that MPPS should aim to position itself as being a highly attractive candidate for this program. It is hoped that the implementation of the Actions outlined in this document would assist in making the case for MPPS to participate in any future Government-initiated VPPs.

## Action 3 – STEM Activities

It is proposed that the above ideas and actions have potential for a direct integration with the curriculum in all STEM areas. Concepts within the community-battery concept could also integrate with Social Science learning areas. Both the Solar Schools and

[7] https://www.wa.gov.au/government/announcements/schools-transform-virtual-power-plants-part-of-recovery

ClimateClever programs provide teaching resources and activities to engage the students at all year levels.

The CSIRO STEM Professionals in Schools program provides a framework for the development of partnerships between STEM professionals and teachers. The author has joined this program as a partnership with Mount Pleasant Primary School. The aim is for the author to support the school in STEM activities related to sustainability and renewables. There are also opportunities for extra-curricular activities in this space, in particular, the Synergy Schools Solar Car Challenge.

## About the Author

Michael Andrewartha is a PhD-qualified Mechanical Engineer. He currently works as a Fluid Dynamicist and SmartHangar Project Manager for Electro.Aero, an Australian technology company that is working on electrifying aviation and marine transport. Michael has two young sons attending Mount Pleasant Primary School and is a former board member. Michael has partnered with the School under the CSIRO STEM Professionals in Schools program.