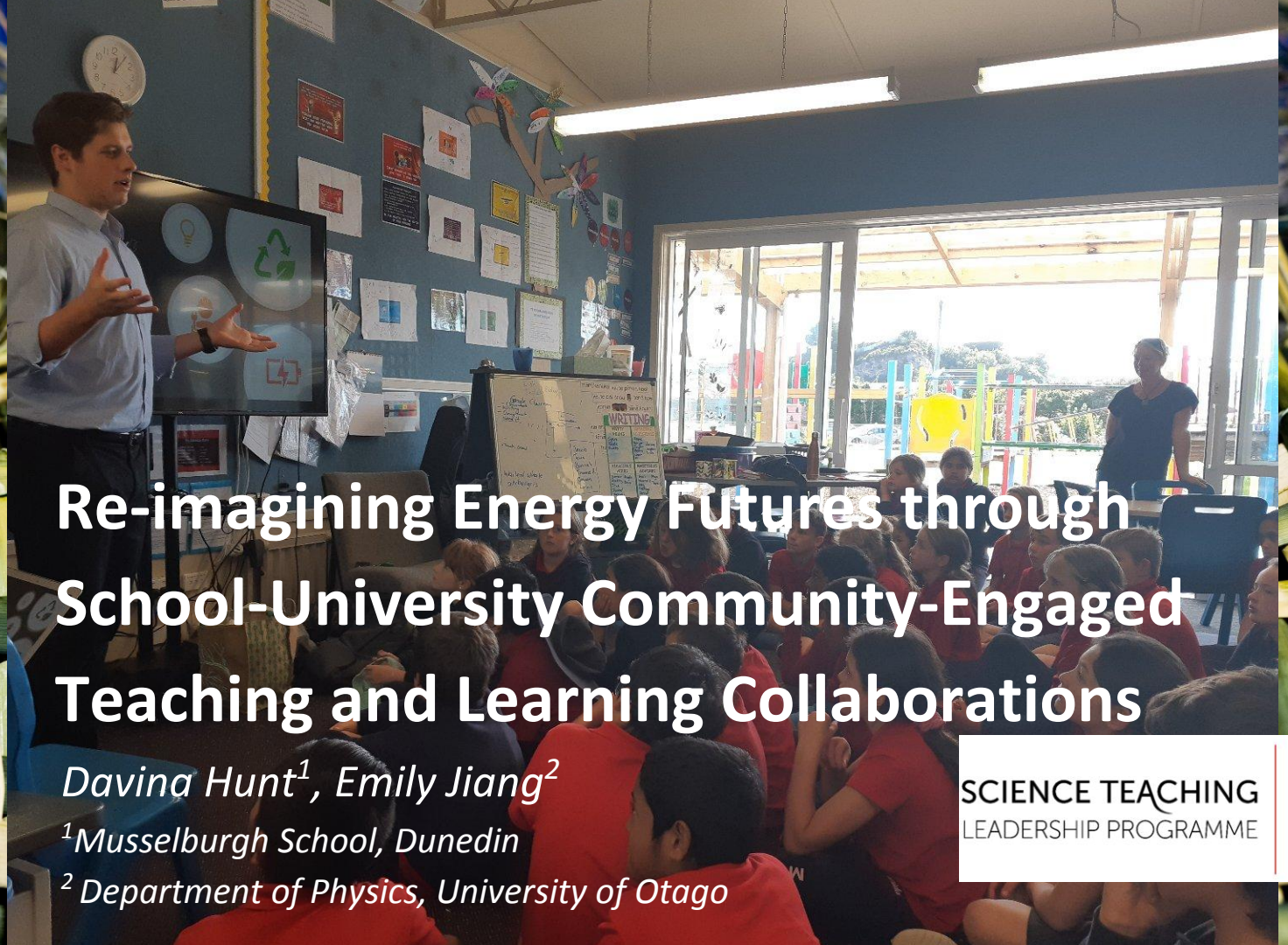

# Re-imagining Energy Futures through School-University Community-Engaged Teaching and Learning Collaborations

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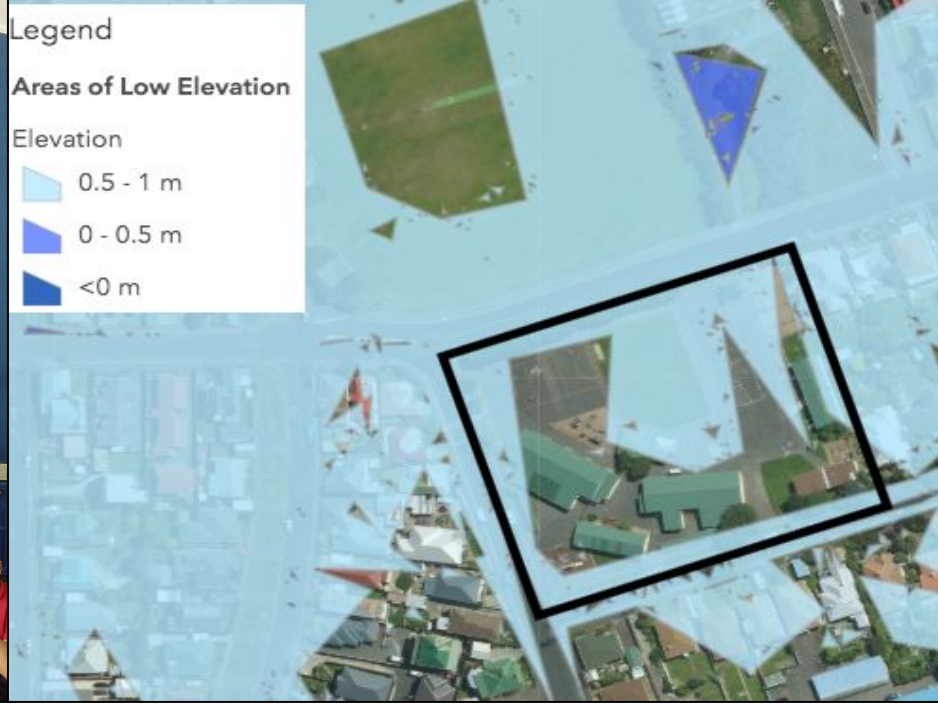
*[2] Department of Physics, University of Otago*

SCIENCE TEACHING LEADERSHIP PROGRAMME

ROYAL SOCIETY TE APĀRANGI

Enviroschools


# EMAN405 Energy Practice & Musselburgh School

*He Kaupapa Hononga: Otago's Climate Change Research Network*

*Royal Society Te Apārangi Science Teaching Leadership Programme*

# Audit for Musselburgh School

- In compliance with AS/NZS 3598.1:2014
- Initial site visit
  - Meeting principal, administrator, teachers, students
  - Presentation to 60 students (9 - 11 years) and four staff to enhance their understanding of the audit's purpose and increase buy-in
  - Developed both a quantitative and qualitative understanding of energy usage patterns through informal interviews and object auditing
- Conducted analyses for Type I and Type II audit reports that were presented to school



## Challenges

- Completing audit after 1 site visit
- Accessing school & staff for data
- Sensitivity around changing priorities
- Need to complete assignment

## Opportunities

- Building on *kanohi ki te kanohi* visit
- Brokering the partnership
- Enhancing Principal involvement
- Building student communication skills

# Audit Findings

*Daily electricity consumption profiles*

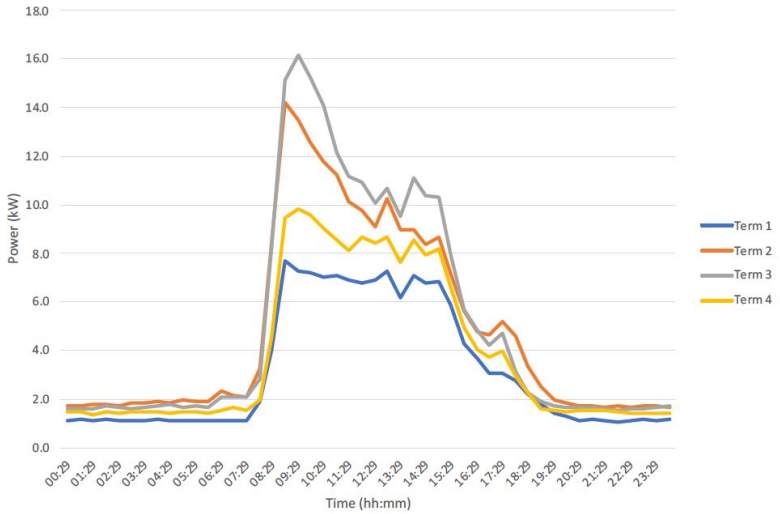



*Figure 4 Daily profile of average electricity usage in 2019 during term time. Averages have been calculated excluding weekend days.*

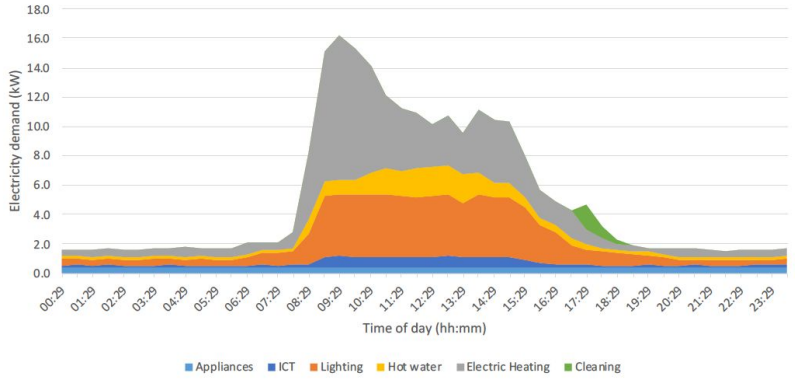



*Figure 9 Term 3 time of use energy end-use breakdown*

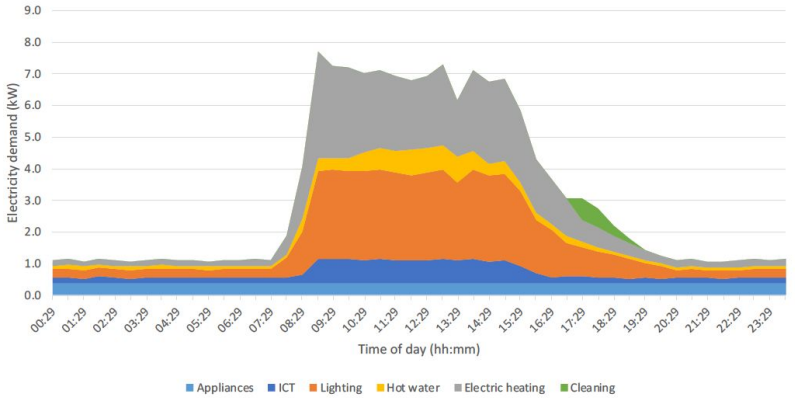



*Figure 10 Term 1 time of use energy end-use breakdown.*

# Audit Findings

*Monthly electricity and gas consumption profiles*

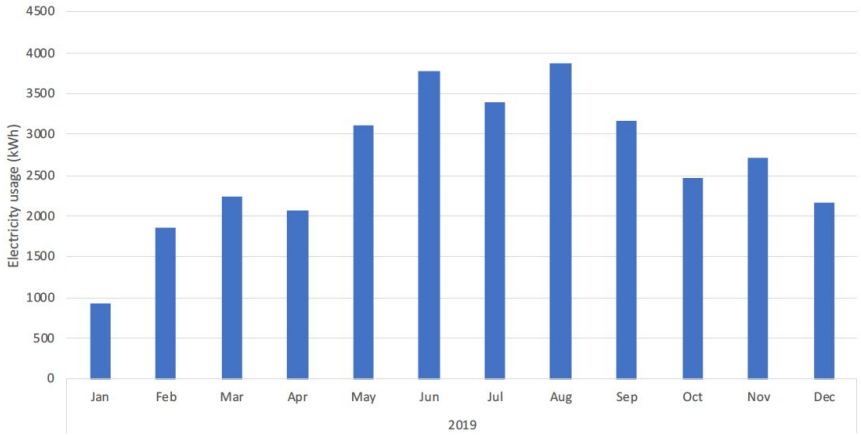



*Figure 5 Monthly electricity consumption in 2019*

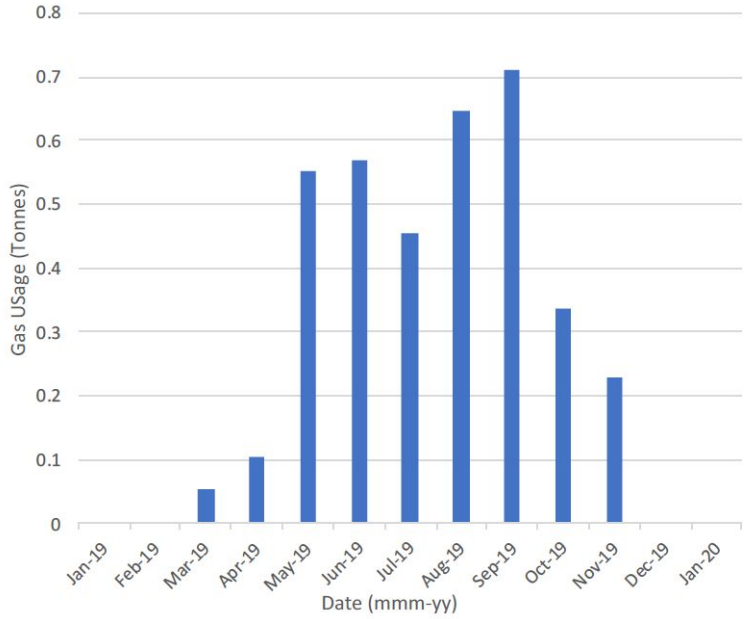



*Figure 12 Monthly gas use between for the 2019 calendar year*

# Audit Findings

*Overview*

- Total site electricity consumption (2019) was 31709 kWh at a cost of $7600
- Total gas consumption for the property (2019) was 168,680 MJ at a cost of $6778.
- Local comparative indicators of performance show that the electricity consumption is smaller (200 kWh per student) relative to larger local schools.

# Recommendations

*Type I*

*Table 1 Annual energy saving measures summary*

| Measure | Energy Savings | Financial Savings $ | Cost $ | Payback years |
|---|---|---|---|---|
| **Shorter Payback Measures (< 2 years)** | | | | |
| **Thermostat control of radiators** | 33,700 MJ (gas) | 1360 | 1600 | 1.2 |
| **Lighting control in classrooms** | 1820 kWh | 550 | 660 | 1.2 |
| **Longer Payback Measures (> 2 years)** | | | | |
| **LED lighting retrofit** | 4270 kWh | 1280 | 2940 | 2.3 |
| **Individual heat pump units to replace boiler**† | 168,680 MJ (gas), -11,060 kWh (elec)ǀ | 3450 | 24500 | 7.1 |
| **Energy Management Measures** | | | | |
| **Energy Savings Measures** | NA | NA | NA | NA |
| **Subtotals** | | | | |
| With thermostat control measure‡ | **33,700 MJ (gas), 6090 kWh (elec)** | **3190** | **5200** | **1.6** |
| With heat pump installation measure§ | **168,680 MJ (gas), - 4970 kWh (elec)**ǀ | **6090** | **29040** | **4.8** |

**Recommendation independent of heat pump replacement of boiler. These recommendations cannot be implemented concurrently.*

*† Recommendation independent of thermostat control of boiler. These recommendations cannot be implemented concurrently.*

*ǀ Negative value represents an increase in electricity consumption.*

*‡ Subtotal including thermostat control measure. Does not include savings accrued from heat pump installation measure.*

*§ Subtotal including heat pump installation measure. Does not include savings accrued from thermostat control measure.*

# Recommendations

*Type II*

Alternative heating systems:

- continued use of natural gas boiler
- wood pellet boiler
- air-source heat pumps

*Table 1 Life cycle cost analysis of alternative heating systems*

| | Current Boiler | Wood pellet boiler | Heat pumps |
|---|---|---|---|
| **Lifecycle cost at N = 10 Years ($)** | 71,392 | 176,680 | 93,647 |
| **Lifecyle cost at N = 20 Years ($)** | | 191,325 | 175,003 |
| **Lifecyle cost at N = 30 Years ($)** | | 199,880 | 250,140 |

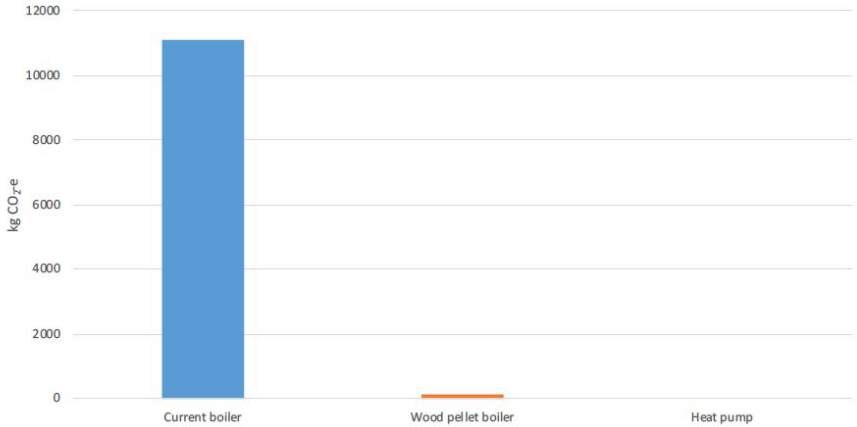



*Figure 2 Comparison of expected annual $CO_2$-e emissions of alternative heating system**

*The CO2-e values for LPG and wood obtained from the Ministry for Environment, 2019. Mercury Energy's electricity is assumed to be 100% renewable.

# School Board of Trustees Response

## Immediate Action on Recommendations

- Repair thermostat controls on radiators
- Reduce use of automatic heating in May-Oct
- Reconsider energy efficiency of new building

## Intentions for 2021

- Consider energy efficiency in policy reviews
- Study energy and eco-building through science curriculum
- Assess own impacts of behaviour change on energy use


# Key learnings in Energy Practice partnership

- Authentic service learning can benefit all partners individual needs while establishing a common goal towards a low energy future
- Community problem solving enhances *Understanding, Investigating, Communicating, Participating and Contributing* in the Nature of Science (NZ Curriculum)
- Relationships initiated kanohi ki te kanohi develop the mutual trust necessary to continue an effective collaborative partnership remotely in COVID-19 times

# Where to from here?

- Practical experience in a controlled environment. Allowed to make mistakes!

- Informal point of contact assisted in the establishment of a good working relationship with client (school). This is particularly important in a COVID sensitive situation.

- Gained the confidence to go into the workforce and conduct energy audits (this time getting paid to do it!)

# Just the beginning …

**2020**

- Energy Audit at 1 school
- Professional development for teachers in science capabilities
- Science Curriculum Development

**2021**

- Return to He Kaupapa Hononga
- Ongoing UO service learning
  e.g. Carbon footprint analysis
- Explore action research possibilities
- Share experiences with other schools
  - Ōtākou STEAM Cluster – 9 schools
  - Otago Enviroschools - 64 schools

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