

Carbon Researchers - How to reduce energy usage at our school

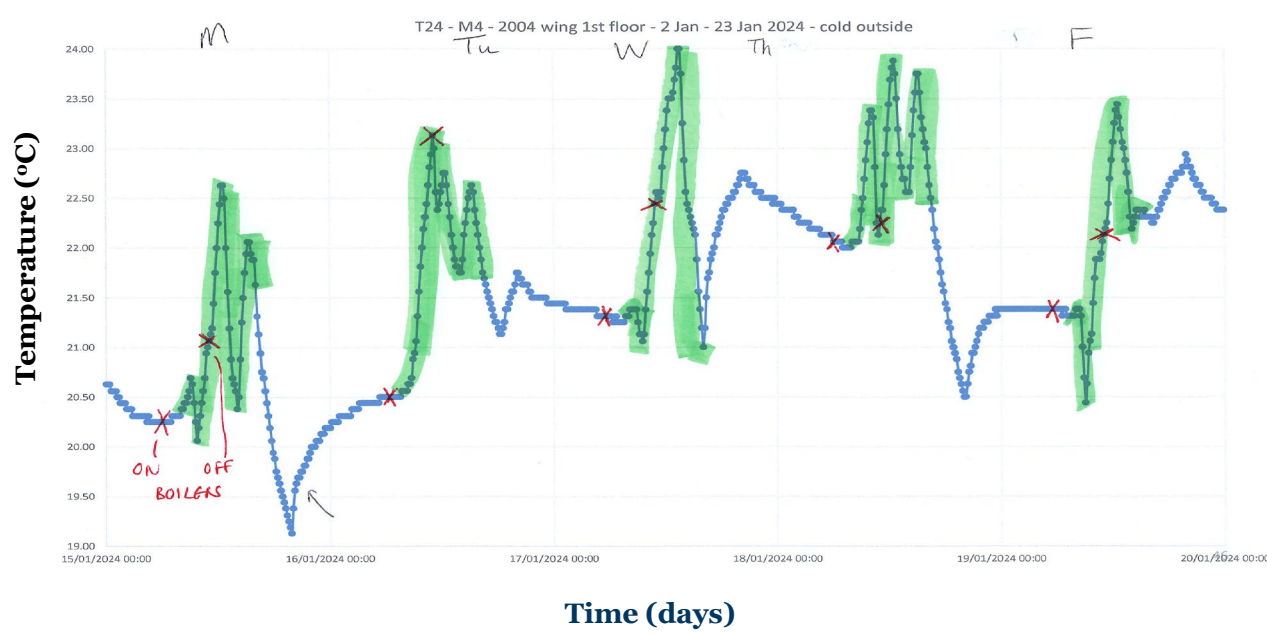


Lily
Dylan
Ethan

Aaron
Angus

Background information

Our school gas consumption is 953,000 kWh p.a. An external engineering assessment suggested that we could save £7,000 p.a. through simple energy-saving measures. We set out to investigate if this was possible. We also investigated how a BMS (Building Management System) and ASHP (Air Source Heat Pump) might help.



Why is the boiler coming on in the evening? Probably frost protection

Summary

We have tried to reduce energy use by looking at graphs using data we have collected around our school. We used data logging thermometers to record the temperature the boilers were heating classrooms in our schools. We have cut our energy usage using two main criteria, the first is the time we turn the boilers on and off; if a boiler is on when no one is in the school (such as holidays) the energy being used is wasted, so we found if we turn the boilers off sooner, we can save a lot of wasted energy. The second is that we have found that some classrooms were at a hotter temperature than they needed to be, and by reducing the set target temperatures, we reduced the amount of energy the school was using.

Research aim

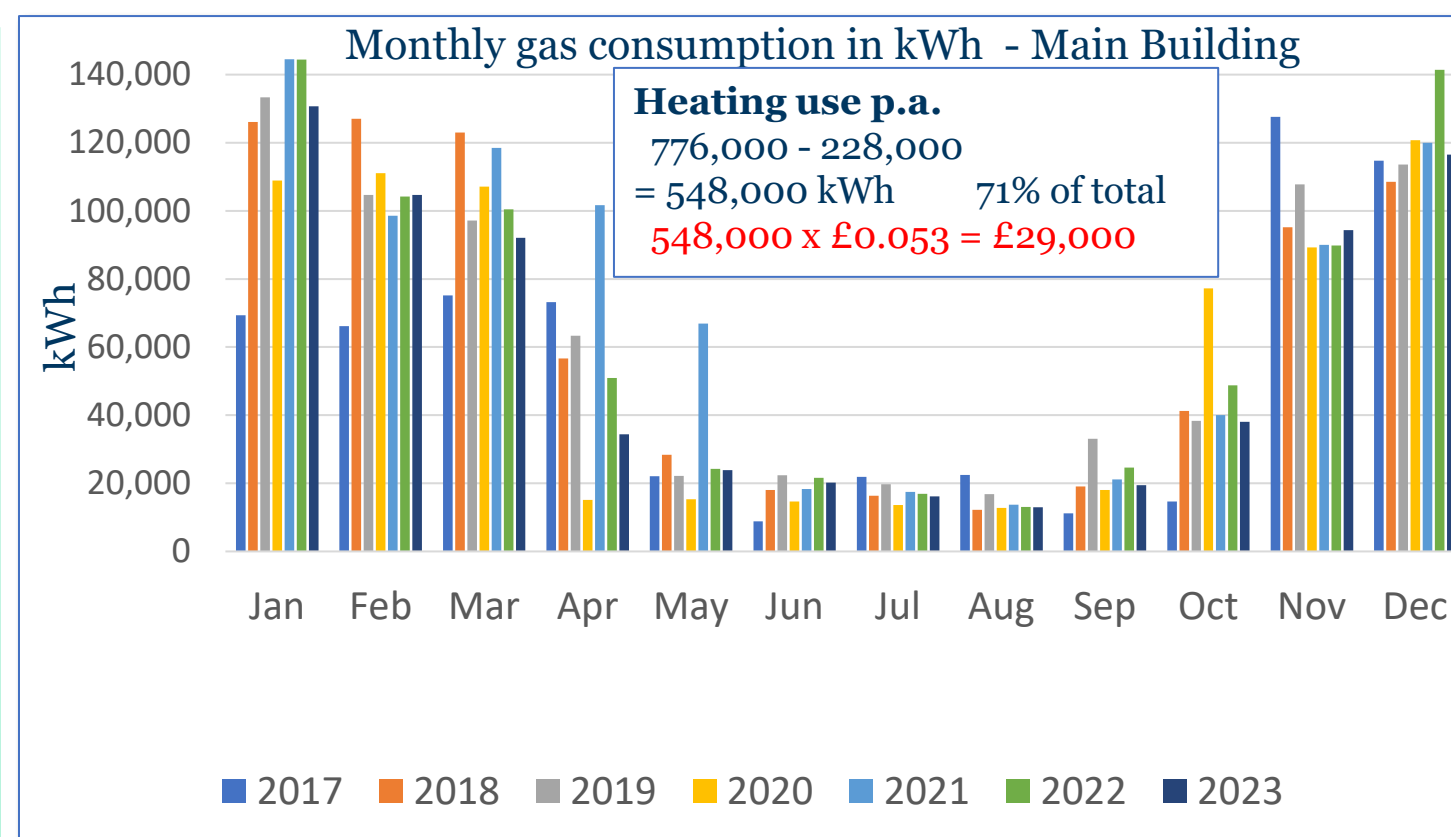
Our aim in this research project is to save energy, carbon, and money on our school's energy usage by taking in data about how much the boilers were heating the school and analysing whether it was necessary to turn the boilers on at certain times.



Energy saving goals:
We aim to save as much energy as possible whilst still keeping the school at a comfortable temperature for everyone. We estimate we could save 21,000 kWh p.a.



Heating goals:
We aim not only to reduce our carbon footprint but to make our school's temperature more comfortable.



Our hypothesis on the impact we think this would make:

- Dylan Jenkins**- "I think this will leave a massive impact on our school if we manage to save as much money as we think we can."
- Lily Owens**- "I think we can make a large impact by reducing the energy consumption. I think it would also make a greater impact if we started using renewable energy, such as getting more solar panels for our school."
- Ethan Campbell**- "I think that if we successfully improve our schools heating systems, we will be able to not only decrease the money we spend on heating and make the temperature more comfortable but massively cut carbon emissions."
- Aaron Benny**- "This will have a big impact and reduce our carbon footprint."
- Angus Brown** - "I think that we will leave a big impact on the school by saving money, helping them make decisions and improving the system."

Variables

Independent variable – time on when we checked
Dependant variable - the temperature

Method

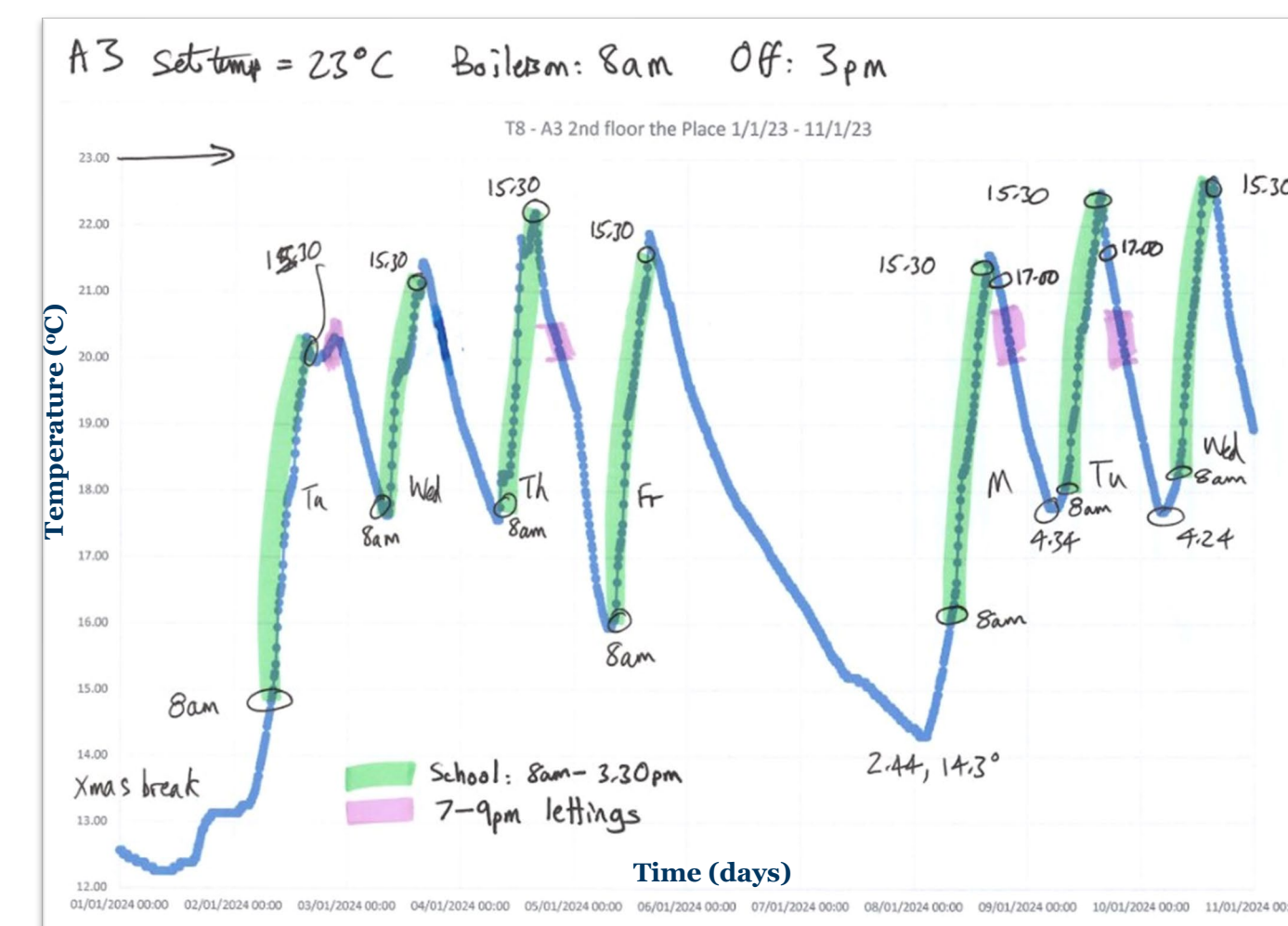
- We deployed data logging thermometers to monitor temperatures in classrooms
- We created graphs of temperatures vs time and analysed them
- We discussed solutions and agreed on plans for changes with our Head of Estates
- The caretakers made changes
- We measured the temperatures again to monitor the benefits

We had 26 thermometers; they were placed in a variety of rooms throughout the school. The rooms were chosen carefully to show a wide area around the school, including classrooms and offices. The thermometers were placed between the waist and head height on a shelf or desk, hidden from pupils, and away from windows or electronics. This was to ensure that we got an average and accurate room temperature.

Method continued

Once deployed, each thermometer was linked to an app on our phones which monitored temperature levels throughout the day, logging a reading every 10 minutes. Readings were collected over a month. Figures were put into an Excel spreadsheet and analysed with line graphs.

We analysed the results and discussed the reasons for what we found and the potential outcomes. We then planned realistic solutions in a way that would cause little problems or cost too much. We have changed the set point temperatures and boiler times and plan to make big changes over summer break.



Temperature graph: Classroom - A3
There is a general climb in temperature before every school day. 20°C is a comfortable temperature; some days the temperatures reach 22°C at the end of the school day. Peaks rise during the week and decrease over the weekend to help maximise energy usage and be as efficient as possible.



Analysis and Conclusion

In conclusion, we discovered that much of our heating was being used at a high temperature and on at inappropriate times. That was one of the reasons we investigated a building management system because it would give us complete control of our boiler and could reduce our energy usage. We discovered that sometimes our school was 3°C hotter than it should have been. To solve this problem, we lowered the set temperature of the thermostats and changed the time when the boiler came on and off, so it was the right temperature at the right times. By measuring the temperatures over time before and after the changes, we were able to optimize the settings for comfort and energy efficiency.

New heating system for the main building

Current situation	Planned installation Summer 2024	Planned installation Summer 2026	Later plans
2 gas boilers 18 years old	Turn down temperature of boilers from 70 to 55 deg.C	Replace boilers with Air Source Heat Pumps (ASHP) (water at 55 deg.C)	ASHP for 2004 Wing; ASHP for the Place
Old pipes, radiators, thermostats	Replace all pipes, radiators, thermostats		
No zone control	Zone control will allow different wings to be managed separately		
EXPECTED SAVINGS:	<ul style="list-style-type: none"> 21,200 kWh pa energy saving £1,100 pa gas saving 5 tonnes pa of carbon reduction 	<ul style="list-style-type: none"> 121,000 kWh pa energy saving Cost neutral 30 tonnes pa of carbon reduction 	<ul style="list-style-type: none"> 158,000 kWh pa energy saving Cost neutral 41 tonnes pa of carbon reduction

Plans for the future

Our school has won £1.2 million of funding to upgrade the pipes and radiators, this is expected to save 4 tonnes of carbon and 21,000 kWh of energy per year according to engineers. This system would be composed of five zones that can be controlled independently. The school also has plans to replace the main gas boilers with air-source heat pumps which should reduce our carbon footprint by 30 tonnes and save 120,000 kWh of energy per year. We have proposed that this includes a building management system. It could be useful to our school because it can give us direct control over our energy usage. We also wish to upgrade our school's roof and add solar panels which would greatly decrease our carbon footprint (by 18 tonnes of carbon p.a.) and our bills (by £68k).

