SUSQI PROJECT REPORT

Improving Theatre Sustainability by rationalising the use of Anaesthetic Gas Scavenging Systems (AGSS) and Ventilation Systems

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Team Members:

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- Mr Marcus Summers, Head of Operational Estates, Wrightington, Wigan and Leigh Teaching Hospitals NHS FT.
- Mr Josh Balmer, Environmental and Sustainability Manager, Wrightington, Wigan and Leigh Teaching Hospitals NHS FT.

Background:

Delivering a Net Zero Health Service' report, published in July 2022, sets out evidence based targets for reducing carbon emissions and ultimately achieving net zero. For the emissions we control directly (the NHS Carbon Footprint), we are required to achieve net zero by 2040, with an ambition to reach an 80% reduction by 2028 to 2032.

Operating theatres are one of the biggest energy consuming areas of any hospital due to multiple active systems maintaining Anaesthetic Gas Scavenging System (AGSS) and Theatre Ventilation, including Laminar Flow ventilation.

Operating theatres use 3-6 times more energy than other hospital areas (NHS Scotland 2023) and are often left on whilst the theatre is not operational. This represents an opportunity in terms of energy expenditure, carbon emissions and financial saving, if the two systems were switched off whilst the theatre is not in use.

AGSS is a vital part of anaesthetic practice as it removes excess volatile anaesthetic gas away from the theatre environment to protect staff within the theatre environment. Theatre ventilation and laminar flow systems regulate environmental temperature and humidity, provide a level of infection control as well as a comfortable ambient temperature to operate in.

Developing a strategy to switch off both AGSS and ventilation systems whilst the theatre is non operational (usually overnight) will provide significant benefit in energy expenditure, carbon emissions and cost savings. This process is termed theatre setback mode.

The plan to put the theatre into setback mode has to ensure that both systems are switched on automatically when the theatre becomes operational on the following day. This has been successfully completed in other organisations without any harm to patients or staff (see References). The significance of this project is to reduce energy use, carbon emissions and associated costs when the theatre is non- operational. The energy consumption of a single AGSS unit is 2-5kW/hour, which is comparable to a domestic oven. Leaving theatre equipment running during non-operational hours is not justified as a safety measure and is irresponsible from a sustainability and financial perspective.

Wrightington, Wigan and Leigh (WWL) is a major acute Trust with theatres across three sites.

- Royal Albert Edward Infirmary (Wigan): 7 theatres including emergency, maternity, trauma and elective care
- Leigh Infirmary Hospital: 4 theatres as a dedicated day case unit
- Wrightington hospital: 12 Theatres as a tertiary orthopaedic centre, with no overnight theatre activity

The project will initially be embedded at Leigh Infirmary as this is a Day Case Unit with defined operational hours during the week and therefore the setback timings can be programmed according to this. Following successful implementation of this project, the aim would be to extend theatre setback positions to relevant theatres across all three sites. This would exclude any theatres used for emergency cases that need to be operational at all times.

Specific Aims:

- Current state: 100% of theatres have AGSS and ventilation active at all times
- Planned future state: Theatres to implement setback of AGSS and ventilation when non operational. This excludes any Emergency theatres.

Methods:

The changes will be undertaken initially at Leigh Infirmary as this is a Day Case unit with defined operational hours and therefore a defined setback programme can be developed. We reviewed current usage at Leigh Infirmary and confirmed both AGSS and Ventilation systems are operational 24/7, which is 168 hours a week. If both the systems are rationalised, then they only need to be operational for 60 hours per week (Mon-Fri 7am-7pm). This would result in a 64% saving in energy consumed and consequently reduced carbon emissions and energy costs.

The Operational Estates team at Leigh Infirmary have provided recommendations for the scope of works required to enable the theatre shutdown between 7pm and 7am Mon-Fri and throughout the weekend. The remedial works would involve replacing aged indicator lights and additional wiring of the AGSS to allow the shutdown process to be automated. Currently neither system can be manually switched off by the staff in a safe manner that would ensure patient safety is not compromised.

Once the works are completed, the system would be automated to shutdown at 7pm, with a manual override in the event of theatre overruns.

Theatre staff would be trained to check the shutdown process has been completed, how to undertake the manual override as well as checking that the systems are operational at the start of the day.

We are currently awaiting approval for the works, and therefore have not been able to move forward in the duration of the competition. The approval process requires several levels of review from the Theatre Manager, Surgical Directorate Operational Manager, Estates manager and possibly from the Executive team as the estimated cost of works is above £5,000. As part of the approval process, it would be determined if the cost for the works would need to be covered by the Surgical budget or Estates budget.

We have modelled potential impact below.

Measurement:

Patient outcomes:

There will be no change in patient outcomes as theatre shutdown will only be operational when there are no patients in theatre. Within any automated shutdown process we will ensure that there is a manual override, in the event of a theatre overrun.

Any incidents will be monitored via Trust Incident Reporting System (Datix)

Environmental sustainability:

All the figures below relate to Leigh Infirmary (4 theatres). Energy usage (kW/h) was provided by the Trust Sustainability Manager. The emission factor for energy (0.2454) was taken from the UK Government Greenhouse gas reporting: conversion factors 2025. This factor includes emissions from electricity generated, transmission and distribution and well-to-tank.

The emissions savings were translated into equivalent miles driven in an average car with unknown fuel using a factor of 0.3399 kgCO2e per mile, as published in the above Government database. This factor is inclusive of fuel and well-to-tank emissions.

Economic sustainability:

The Operational Estates team at Leigh Infirmary have provided recommendations for the scope of works required to enable the theatre shutdown between 7pm and 7am Mon-Fri and throughout the weekend. There is an additional active system operational in Theatre 4 at Leigh which removes air from the theatre and is known as the Extract system. This will also be included in the figures below.

Social sustainability:

Informal discussions with theatre staff indicate that they are supportive of the change and are keen to engage with any learning needed once the systems are upgraded.

Once agreement has been reached on sign off for the remedial works, further discussions with the staff will be undertaken to demonstrate how the automated process functions, manual override and what safety checks are required.

Results:

Patient outcomes:

There will be no direct change in patient outcomes, although potential benefits from any money saved being invested back into theatre activity could result in other positive patient outcomes.

Environmental sustainability:

The calculations of current state and future state are based on the difference between running both systems for 168 hours per week down to 60 hours per week (Mon-Fri 7am-7pm). Examining current activity at Leigh shows that the number of overruns is minimal (only 1 in the last 6 months). Therefore the figures would not be subject to large changes relating to overruns.

	Current state	Setback mode	Setback mode
	kWh expenditure/annum	kWh expenditure/annum	kg CO2e saved/annum
AHU(Ventilation)	129,991.68	46,425.60	20,507.12
AGSS	25,159.68	8985.60	3,969.12
Extract	20,966.4	7,488	3,307.60

The total saved per annum is 27,783.8 kgCO2e, which is equivalent to driving 81,741 miles in an average car.

Economic sustainability:

The cost of remedial works to enable shutdown to be activated is £6,580.80 (Ventilation £2,863; AGSS £2,621 + 20% VAT). The work can be completed over the weekend with no impact on clinical activity. Based upon a 64% reduction in energy usage per week the table below outlines the overall cost savings for each system.

	Savings per annum £
AHU(Ventilation)	19,378.98
AGSS	3,750.77
Extract	3,125.64
Total	26,255.39

In year one, with cost of remedial works deducted, there will be a financial saving of £19,674.58. The total financial benefit from year 2 onwards would be £26,255.39 per year.

If this cost saving is extrapolated to Wrightington (which operates on a similar model to Leigh) then this could be increased threefold.

Social sustainability:
Following the initial training on operating the setback mode, there would be no need for any ongoing competencies to be maintained on an annual basis.

The project team would receive feedback from staff on their experience of the shutdown process to ensure that it becomes an embedded daily practice.

Discussion:

Due to approval processes for remedial works, we were not able to complete the project in the competition timeframe however, we are optimistic that we will be able to move forward given the potential financial and environmental savings demonstrated.

While there would be an initial outlay to complete remedial works, this would be recouped in approximately 4 months and from Year 2 onwards the full financial savings of over £26,000 would be realised. The change would result in a 64% reduction in carbon emissions relating to theatre plant and associated energy costs. The annual carbon emissions reduction is 27,783.8 kgCO2e, which is equivalent to an average car driving 81,741 miles.

There is a small risk that the theatre overruns and setback mode could not be commenced at 7pm and this would impact the savings. However current data demonstrates that this only occurred once in the past six months and would therefore not have a significant negative impact on the carbon or financial savings.

There is a potentially much wider benefit to the organisation if the setback mode could be extended across all sites. The figures above are for 4 theatres but there are another 17 theatres across the other sites that could be put into setback mode. This would realise much bigger carbon and financial savings, even if there was a cost for remedial works.

The work could be spread to other areas (e.g. Endoscopy, Cardiac Catheter Lab) that also use active ventilation systems and operate only during normal working times.

Conclusions:

In conclusion, undertaking this project has the potential to save 27,783.8 kgCO2e per year, equivalent to driving 81,741 miles. Associated financial savings of nearly £20,000 in year 1 and more than £26,000 from year 2 onwards. Further expansion of the project to other similar areas could result in at least a fourfold benefit across Wrightington, Wigan and Leigh Teaching Hospitals NHS FT.

References and Resources

- B1728-delivering-a-net-zero-nhs-july-2022.pdf
- Turning off the anaesthetic gas scavenging equipment in the Royal United Hospital Bath (RUH), day surgery theatre suite when not in use. | Sustainable Healthcare Networks Hub
- Improving ventilation & laminar flow efficiency in theatres | Sustainable Healthcare Networks Hub
- Leigh Theatre Setback Calculations

Critical success factors

Please select one or two of the below factors that you believe were most essential to ensure the success of your project changes.

People	Process	Resources	Context
☐ Patient involvement and/or appropriate information for patients - to raise awareness and understanding of intervention X Staff engagement ☐ MDT / Cross-department communication ☐ Skills and capability of staff X Team/service agreement that there is a problem and changes are suitable to trial (Knowledge and understanding of the issue) X Support from senior organisational or system leaders	☐ clear guidance / evidence / policy to support the intervention. X Incentivisation of the strategy – e.g., QOF in general practice X systematic and coordinated approach ☐ clear, measurable targets ☐ long-term strategy for sustaining and embedding change developed in planning phase X integrating the intervention into the natural workflow, team functions, technology systems, and incentive structures of the team/service/organisation	☐ Dedicated time ☐ QI training / information resources and organisation process / support ☐ Infrastructure capable of providing teams with information, data and equipment needed ☐ Research / evidence of change successfully implemented elsewhere X Financial investment	X aims aligned with wider service, organisational or system goals. ☐ Links to patient benefits / clinical outcomes ☐ Links to staff benefits X 'Permission' given through the organisational context, capacity and positive change culture.