

National Green Theatres Programme

Prògram Nàiseanta Lannsaireachd Uaine

Automated switch off out of hours Heating Ventilation Air Conditioning (HVAC) within operating theatres -Opportunity for Change Revised: October 2024



5,937 Tonnes of CO₂e



£3,587,549 Cost reduction



1. Description of action

1.1 It is the intention of this opportunity for change to highlight the environmental benefits and cost saving opportunity of switching off Heating, Ventilation and Air-conditioning (HVAC) systems within operating theatres during out of hours operation.¹

2. Background

- 2.1 Operating theatres are three to six times more energy intensive than the rest of a hospital as a whole.² This carries a financial as well as environmental cost that is often poorly appreciated. People are increasingly aware of the need to reduce energy consumption at home and it is important that the NHS educates, encourages and enables staff to do the same at work.³ Within the operating suite HVAC systems commonly account for over 90% of operating theatre energy consumption⁴.
- 2.2 Energy manager Allan Lamb from NHS Greater Glasgow and Clyde conducted an evaluation of the plant running regimes within his site. The aim was to identify the carbon and financial savings of switching off HVAC system within operating theatres. In the trial an operating theatre was identified and the HVAC system was switched off between the hours of 7pm and 6am, totalling 11 hours per day. The trial identified that for each 11 hour period the system was switched off saved just under 50kg of Co2e and saved the hospital £30.15. For a full break down of the cost calculations and evidence please see Appendix A. As a result of this evaluation the team in NHS Greater Glasgow and Clyde have now began a trial with 2 operating theatres switching off their HVAC units overnight with plans to expand this across all applicable theatres in NHS GGC, potentially saving the health board around 1,700 tonnes of carbon emissions annually and saving close to a million pounds⁵.
- 2.3 At present, some hospitals have automated controls with local over-ride, but many units have person-specific protocols for management meaning that these systems can remain switched on 24/7. Instituting automated systems, where practicable, with occupancy sensors would potentially reduce energy consumption by 66%.

³ Dr, J. and Puddy, E. (n.d.). *Sustainability: Energy use and water consumption*. [online] Available at: https://www.rcoa.ac.uk/sites/default/files/documents/2021-

¹ Out of hours is defined as the hours when the theatres are not in use.

² MacNeill AJ, Lillywhite R, Brown CJ. The impact of surgery on global climate: a carbon foot printing study of operating theatres in three health systems. Lancet Planetary Health 2017; 1; e381-88

^{12/}Energy%20use%20and%20water%20consumption%20final.pdf.

⁴ MacNeill AJ, Lillywhite R, Brown CJ. The impact of surgery on global climate: a carbon foot printing study of operating theatres in three health systems. Lancet Planetary Health 2017; 1; e381-88

⁵ https://www.nhsggc.scot/nhsggc-takes-major-step-towards-net-zero-simply-by-turning-lights-off-in-operating-theatres/



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- 2.5 NHS England also published their Health Technical Memorandum in 2021 and addressed the issue of sterility. Their report stated that 'a ventilation system should not be run at full output "just in case it will be needed". This is particularly a problem in operating departments where the ventilation is often run out of hours as it is believed that it will "maintain sterility" in the operating suite. This is not true as airborne contamination in operating theatres is caused by the people in them when they are in use. The theatre ventilation is provided to cater for this "in use" biological load. When the theatre is not in use, there is no biological load so the ventilation can be turned off and set to automatically start at "Set back" in order to maintain a minimum background condition, for example room temperature, if needed. The time taken to start the ventilation and achieve full operating conditions in an emergency will be less than the time taken to bring a patient to theatre and prepare the staff and instruments ready for emergency surgery to commence. A similar situation applies to obstetrics theatres and "special" delivery rooms.⁷
- 2.6 The National Green Theatres team is working closely with health boards across the country to validate and report on improvements made in implementing this action. Based on data it has gathered so far from health boards (as of October 2024) it has identified that just over 15% of theatres in Scotland are currently out of scope. This is due to the theatres being used as emergency theatres and as such must be fully operable in case of emergency. This work has helped to identify the in-scope theatres where switch off should be implemented, totalling 326 theatres. Working on the assumption that each of these theatres can be switched off for a minimum of 11 hours per day we are able to calculate carbon savings of 5,937 tonnes and over 3.5 million pounds annually.

3. Who needs to be involved in this change locally?

- 3.1 In order to implement this action it is recommended that the following groups should be consulted and involved:
 - Anaesthetists
 - Surgeons
 - Theatre staff / managers
 - Estates and Facilities

⁶ SHTM 03-01 Part A v3.0 Feb 2022 (nhs.scot)

⁷ Health Technical Memorandum 03-01 Part B (england.nhs.uk)



- Engineering leads
- Infection prevention and control

4. Boundaries

4.1 The table below identifies the boundaries for this action:

In scope						Out of scope						
•	All	surgical	suites	across	NHS	٠	Emergency	theatres	that	must	run	at
Scotland.				optimum cap	acity.							

5. What is the change and how will it be implemented?

5.1 Hospital sites will switch off out-of-hours Heating Ventilation and Air Conditioning (HVAC) systems across appropriate theatres. This will be implemented at all sites with the required equipment on site to make these changes safely.

6. What are the potential co-benefits of this change?

6.1

Outcome	Potential Benefits
Carbon Savings	5,937 tonnes
Cost Savings	£3,587,549
Patient Outcomes	Care needs to be taken to ensure correct infection prevention policies and testing are completed to validate the new policy. If implemented correctly this should not pose any increased risk to the patient and will reduce the patients' carbon footprint when undergoing an elective surgeries.
Staff experience	Input from estates/facilities will be required to set up the correct conditions via the building management system.

7. Risks and Issues

7.1 As part of the development of this action there has been one risk identified to date, outlined below:

Description of risk or issue	Mitigation / Action Plan
Older hospitals will have to retrofit these	Discussions will take place with the
changes through their BMS systems at a	engineering and finance networks to identify
cost and as such the change is not taken	the scale of the issue and determine ways to
forward.	break through the barriers to change.



8. Implementation Guidance

- 8.1 The opportunity for change highlights the importance of implementing this action. This change will help your site and NHS Scotland achieve net-zero emissions by 2040 as stated in NHS Scotland's Climate Emergency & Sustainability Strategy 2022-2026.
- 8.2 Below the National Green Theatres Programme has provided guidance on how you can implement this change within your area. If you require any further information or guidance, please contact the National Green Theatres programme team on: cfsdgreentheatres@gjnh.scot.nhs.uk

Loc	cal Sustainability or Green Theatre Group:
1.	Review opportunity for change and validate what this means locally.
2.	Provides National Green Theatre Programme Team with validated information/local targets.
3.	Convene a discussion with the staff who need to implement it and those who are impacted by the action.
4.	Understand what the opportunity is for implementing the action locally: work already undertaken and challenges.
5.	Agree a local implementation plan.
6.	Implement local plan.
7.	Provide data as per measurement plan.
8.	Monitor implementation of action.



Appendix A - Carbon and Cost calculations - Supporting paper

The purpose of this paper is to provide transparency to health boards surrounding the calculations that have been used to identify the board level opportunities for both carbon and cost savings for the switch off of out of hours Heating Ventilation and Air Conditioning (HVAC) action.

The figures are based on electric metering work conducted at the Queen Elizabeth University Hospital in Glasgow using Schneider metering across a 12 month period (2022).

Utilising data spanning 12 months enables a higher level of precision in reporting as it captures the temperature changes across each season. Figure 1 shows the monthly average mix of power and heat used throughout 2022. An average was then calculated which found that 71% of the energy used from a theatres HVAC unit comes from heat which is generated by gas and 29% comes from power which is generated by electricity and is mainly associated with cooling.

Figure 1

	Heat –	Power –		Heat –	Power -
Month	gas (%)	electricity(%)	Month	gas(%)	electricity(%)
January	87.7	12.3	July	53.4	46.6
February	87.1	12.9	August	38.9	61.1
March	83	17	September	52.3	47.7
April	80.4	19.6	October	71.1	28.9
Мау	72.4	27.6	November	76.4	23.6
June	61.3	38.7	December	87.8	12.2

Average 71% 29%

The QEUH aims to switch off in scope theatres for 11 hours each day, the metering identified that 238 kilowatt hours (kwh) could be saved over the 11 hour off period. Based on the findings from Figure 1 we were able to calculate that 169 kwh of gas consumption (71%) and 69 kwh associated with electricity consumption (29%) could be saved daily. This figure will fluctuate depending on the

outside temperature and size of the motor within the HVAC unit but can be used as an indicative figure.

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Below includes an explanation of where the figures for gas and electricity originated, for both pricing and carbon.

Pricing per kilowatt hour

The price per kilowatt hour has been taken from most recent figures from NHS Greater Glasgow and Clyde (April 24'), prices may vary for other health boards.

Gas	0.06 pence per kwh
Electricity	0.29 pence per kwh

Carbon per kilowatt hour

The associated carbon figures have been taken from the UK government's greenhouse gas conversion factors document, last updated June 2023⁸.

Gas	0.2kg Co2e per kwh			
Electricity	0.21kg Co2e per kwh			

Using the above information we were able to calculate a single theatres financial savings associated with 11 hours of switch off daily. This is outlined in Figure 2, the table also includes an explanation of how each figure has been calculated.

Figure 2

Financial savings breakdown per theatre	Savings	Explanation
Daily gas cost	£10.14	0.06p/pkwh x 169kwh saved
Daily electricity savings	£20.01	0.29p/pkwh x 69kwh saved
Daily combined savings	£30.15	Daily gas savings + daily electricity savings
Monthly savings	£904.50	Daily combined savings x 30 day average month
Yearly total (per theatre)	£11,004.75	Daily combined savings x 365 days of the year
Hourly cost	£2.74	Daily combined savings / 11 (hours of switch off)

Similarly, we were then able to adopt a comparable model to calculate the associated carbon savings. We have established that switch off saves on average 238 kilowatts of energy per day which is 21.6 kwh.

⁸ https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023



If we multiply the average kwh's (21.6kwh) saved by the number of hours the units will be switched off we can calculate the total kilowatt hours saved.

At this point we would take the total number of kWh saved and multiply this by the UK's carbon conversion figures, across gas and electricity it averages at 0.2kg Co2e. This method informs us of the total volume of carbon saved by implementing switch off.

Considerations

- Gas and electricity mix will differ across each site and will vary to reflect external conditions.
- Energy use will vary depending on the size of the motor in the HVAC unit.
- Unit energy pricing may differ regionally.
- Savings will fluctuate depending on the agreed hours of switch off.

This document is to provide a case for reducing unnecessary energy use across the NHS Scotland estate. Stakeholders should take into account the above considerations when reporting.

If there are any further questions or comments on the document or the calculations please do get in touch with a member of the green theatres team via the mailbox:

cfsdgreentheatres@gjnh.scot.nhs.uk