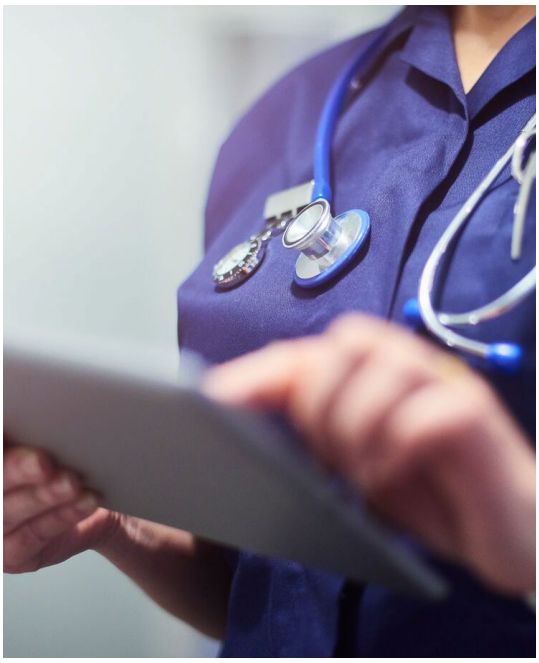
Sustainable Healthcare Toolkit

Reducing Anaesthetic Gases



Purpose

Bupa's sustainability ambitions include reducing greenhouse gas (GHG) emissions produced as a direct result of care delivered at our facilities to Net Zero by 2030. This includes emissions from anaesthetic gases. The purpose of this toolkit is to provide practical guidance and support to healthcare colleagues and partners seeking to;

a) reduce the emissions associated with anaesthetic gases in their organisation's facilities, and/or
b) work with third party providers to help reduce their emissions associated with anaesthetic gases.

Background

Anaesthesia, while typically associated with inpatient and ambulatory surgical settings, can also be used in cardiac catheterisation, endoscopy and diagnostic imaging procedures, as well as dental, labour and delivery, paediatric and emergency departments[i] [ii]. There are a range of anaesthesia types (e.g. general, local, regional) and delivery methods (e.g. nerve block, total intravenous anaesthesia (TIVA), inhaled anaesthesia) each with specific clinical indications [iii].

Anaesthetics is a particularly important area for improving the sustainability of healthcare because of the impact of inhaled anaesthetic gases on climate change. Anaesthetic gases including desflurane, sevoflurane and isoflurane (F-gases) and Nitrous Oxide (N_2O) are powerful greenhouse gases (GHGs). Table 1 below compares their impact versus CO_2.

Table 1 - Global Warming Potential (GWP) of Inhaled Anaesthetic Agents[iv]

Inhaled anaesthetic agent	100-year global warming potential (per kg versus CO2)	
Fluranes (F-Gases)	Desflurane	2,540 x greater
	Isoflurane	510 x greater
	Sevoflurane	130 x greater
Nitrous Oxide		298 x greater

There are a number of initiatives and activities aimed at reducing GHG emissions associated with anaesthetics, including the development of new technologies aimed at capturing and recycling waste anaesthetic gases, an increased focus on facility infrastructure and establishment of a global consensus statement[v].

Many of the leading anaesthetic bodies have endorsed comprehensive strategies aimed at minimising the environmental impacts, with the highest emitting anaesthetic gas – desflurane – due to be banned by the European Commission from 1 January 2026 [vi], and decommissioned by the NHS in 2024[vii].

The Impact of Exhaled Anaesthetic Gases

During a procedure using inhaled anaesthetics, only about 5% of administered anaesthesia is metabolised by the patient. The remaining 95% is exhaled as waste anaesthetic gas (WAG) by the patient during respiration[ii] Scavenging systems draw waste anaesthetic gases out of the surgical area to minimise staff exposure, but this results in venting these agents into the atmosphere and outside air of local communities.

Since waste anaesthetic gases are vented directly from the hospital, they are considered direct emissions.

The availability of alternative anaesthetic gases and anaesthetic delivery methods provides an opportunity to dramatically reduce the environmental impact of the specialty, summarised by the following principles:

1. Limit use of anaesthetic gases altogether where there are safe, clinically appropriate alternatives
2. Where anaesthetic gases are clinically necessary, use the most environmentally favourable medications, equipment and techniques where safe to do so
3. Optimise infrastructure and management of waste exhaled gases

The following section builds on these principles, providing context, insights and recommendations that can be taken forward – where relevant to a specific healthcare organisation – to support a reduction in the environmental impact of anaesthetic gases. Table 2 below summarises which recommendations are relevant based on the type of emissions generated.

Table 2 – Applicability of insights and guidance based on anaesthetic type

Emission Types	Guidance
N_2O Only	Review and consider opportunities to implement recommendations **A1 – A5**
F-Gas Only	Review and consider opportunities to implement recommendations **B1 – B5**
N_2O and F-Gas	Review and consider opportunities to implement **ALL** recommendations

	Reducing N_2O Emissions		Reducing F-Gas Emissions	
	Background	**Recommendation**	**Background**	**Recommendation**
Limit use of anaesthetic gases where there are safe alternatives	Educating clinical staff on the harmful impacts of N_2O and encouraging them to reduce use / consider alternatives has been shown to be effective at reducing emissions[viii]	A1. Review clinical staff awareness / training materials around N_2O and update where necessary	Alternatives to inhaled anaesthesia such as **Total Intravenous Anaesthesia (TIVA)**, regional or local anaesthetic can been used with no adverse clinical outcomes[ix]	B1. Encourage use of alternative non-inhaled anaesthesia options (e.g., TIVA)
Where anaesthetic gases are clinically necessary, use the most environmentally favourable medications, equipment and techniques where safe to do so	N_2O reductions can be achieved by using Low-Flow Anaesthesia where the anaesthetic gas is re-circulated and re-used during the clinical procedure.	A2. Consider use of Low-Flow Circuits and breathing systems / equipment which are closed and leak-free	Replacing desflurane with an alternative anaesthetic gas such as sevoflurane can deliver CO_2e reductions without affecting clinical outcomes[x]	B2. Educate and engage around removal of desflurane from theatres / formularies and use of alternative inhaled anaesthesia
	Using double masks (with a hard outer mask and soft inner mask) can reduce N_2O leakage into the surrounding environment when inhaled or exhaled by the patient.	A3. Consider use of double masks to reduce leakage and upskill staff in patient education	Anaesthesia machines differ in energy efficiency and features such as fresh gas flow rate alerts or sequestration devices[ii] which have implications for their environmental impact	B3. Review energy ratings and features of existing/future anaesthesia machines
			Newer CO_2 absorbers are available that not only reduce the amount of exhaled CO_2, but also allow for lower fresh gas flow rates.	B4. Explore newer CO_2 absorption technologies
			Faulty equipment or devices can result in anaesthetic gas leakage. This can be mitigated if a rigorous process for checking is in place, adhered to and any leaks stopped[ii]	B5. Ensure process in place and adhered to for checking existing machines, infrastructure and medical gas vacuum for leaks
			Many new anaesthesia machines help monitor **fresh gas** flow rates and support providers in using less anaesthesia [ii]	B6. Lower fresh gas flow rates where clinically appropriate
Optimise infrastructure and management of waste exhaled gases	A number of companies including Medclair and Medicvent have developed products that collect exhaled N_2O, break it down into Oxygen (O_2) and Nitrogen (N_2)	A4. Consider procurement and installation of N_2O 'Destruction Units'	Companies such as Baxter and SageTech have developed products that capture (+/- reconstitute) desflurane, sevoflurane and isoflurane.	B7. Consider procurement and installation of F-gas capture / destruction / reuse technologies
	It is estimated that between 77 and 95% of hospital N_2O is lost through leaking pipes or storage systems before it reaches the patient[xi] in addition to expiry/theft losses[xii]	A5. Measure the amount of N_2O used for clinical purposes vs. total usage to help identify leakage and other losses	Scavenger systems that are only active when the pressure switch is on reduce energy use and increase equipment lifespan vs. traditional scavenger systems[ii]	B8. Consider attaching medical gas vacuum valves to reduce energy consumption

Getting Started

The activities and approach to reducing anaesthetic gas emissions will depend on a number of variables including healthcare organisation, emission type, setting and infrastructure. Whether you are looking to reduce emissions related to N_2O, F-gases or both, the following five areas are important first steps to take;

Establish a project team	Anaesthetic gas reduction strategies will invariably involve different departments and cross-function working, so build a project team that reflects these departments to contribute to a successful outcome.
Establish baseline data	Establishing baseline GHG emissions from anaesthetic gases will help to identify key next steps, prioritise action areas, set realistic targets and monitor progress.
Review existing literature	The supporting literature, resources and guides at the end of this toolkit provide further insight re: other organisations who have already started to reduce anaesthetic gas use or change practice.
Establish a target	Work across the project team to define a specific target. This may be influenced by the type of anaesthetic gas in use, future planned activity, budget, resource and other clinical factors.
Identify key stakeholders	Engagement of key stakeholders will be a critical success factor and should as a minimum include clinical staff involved in anaesthetic delivery, estates and facilities and procurement.

Further Reading and Information

1. **Practice Greenhealth** have produced an extensive Anaesthetic Gas how-to guide which includes;
   - a detailed overview of the climate impacts of anaesthetic gases,
   - a 10-step guide to setting up, running and implementing a local project
   - 9 'strategies for success' in your facility / organisation

This reliable source document has been created in association with a number of professional bodies across the US and UK.

2. The Nordic Centre for Sustainable Healthcare has produced a useful guide on reducing Nitrous Oxide emissions.

3. The Centre for Sustainable Healthcare in the UK has a wide range of resources and case studies linked to Sustainable Anaesthesia, and also run a training course on the subject. Their resources can be found across their website.

4. The Greener NHS team has put together a number of Sustainable Healthcare case studies, including one where a team of anaesthetists reduced anaesthetic emissions through colleague engagement alone.

5. The World Federation of Societies of Anaesthesia has developed a consensus statement on environmentally-sustainable anaesthesia which provides a broad framework for changes that need to be made by healthcare organisations.

6. Health Care Without Harm has a significant amount of content on anaesthetic gas emissions, including an article about desflurane reduction and the EUKI Anaesthetic Gas Project.

7. GASP (Greener Anaesthesia and Sustainability Project) has a number of useful links and case studies on their website including a great example of how to find baseline data.

8. The UK and Ireland Surgical Colleges have developed a compendium of peer-reviewed evidence, guidelines and policies that inform the interventions included in the Intercollegiate Green Theatre Checklist which supports theatre teams to introduce changes in their area.

Glossary

Carbon Dioxide Equivalent (CO_2e)	A metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.
Greenhouse Gases (GHGs)	Gases that absorb and trap heat from the Sun in the Earth's atmosphere, including carbon dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O)
Total Intravenous Anaesthesia (TIVA)	The administration of anaesthesia intravenously to induce a temporary loss of sensation or awareness
Fresh Gas	The mixture of medical gases and anaesthetic agents produce by an anaesthetic machine

References

[i] https://www.england.nhs.uk/greenernhs/whats-already-happening/putting-anaesthetic-generated-emissions-to-bed/
[ii] https://practicegreenhealth.org/sites/default/files/2019-04/anesthetic_gas_how-to.pdf
[iii] https://www.asahq.org/madeforthismoment/anesthesia-101/types-of-anesthesia/
[iv] https://journals.lww.com/anesthesia-analgesia/fulltext/2012/05000/Assessing_the_Impact_on_Global_Climate_from.24.aspx
[v] https://associationofanaesthetists-publications.onlinelibrary.wiley.com/doi/10.1111/anae.15598
[vi] https://healthmanagement.org/c/icu/news/ea22-reducing-the-carbon-footprint-of-anaesthetics
[vii] https://www.england.nhs.uk/blog/putting-anaesthetic-emissions-to-bed/
[viii] https://nordicshc.org/images/Nordic_know-how_2020_Nitrous_Oxide_2.pdf
[ix] https://www.england.nhs.uk/greenernhs/whats-already-happening/nhs-organisations-cut-desflurane-in-drive-for-greener-surgery/
[x] https://doi.org/10.1111/anae.15203
[xi] https://www.bmj.com/company/newsroom/set-targets-to-cut-inhaled-anaesthesia-greenhouse-gas-emissions-urge-doctors/
[xii] https://sustainablehealthcare.org.uk/what-we-do/sustainable-specialties/anaesthetics/nitrous-oxide-project