

FAKULTNÍ NEMOCNICE BRNO
A LÉKAŘSKÁ FAKULTA
MASARYKOVY UNIVERZITY



**KLINIKA DĚTSKÉ
ANESTEZIOLOGIE
A RESUSCITACE**

Udržitelnost udržitelně Konference AKUTNĚ 2025

Martina Klincová

**M U N I
M E D**



sekce mladých
anesteziologů
a intenzivistů



**FAKULTNÍ
NEMOCNICE
BRNO**

FIND OUT MORE [OCEAN.PANDA.ORG/#REPORT](https://ocean.panda.org/#report)



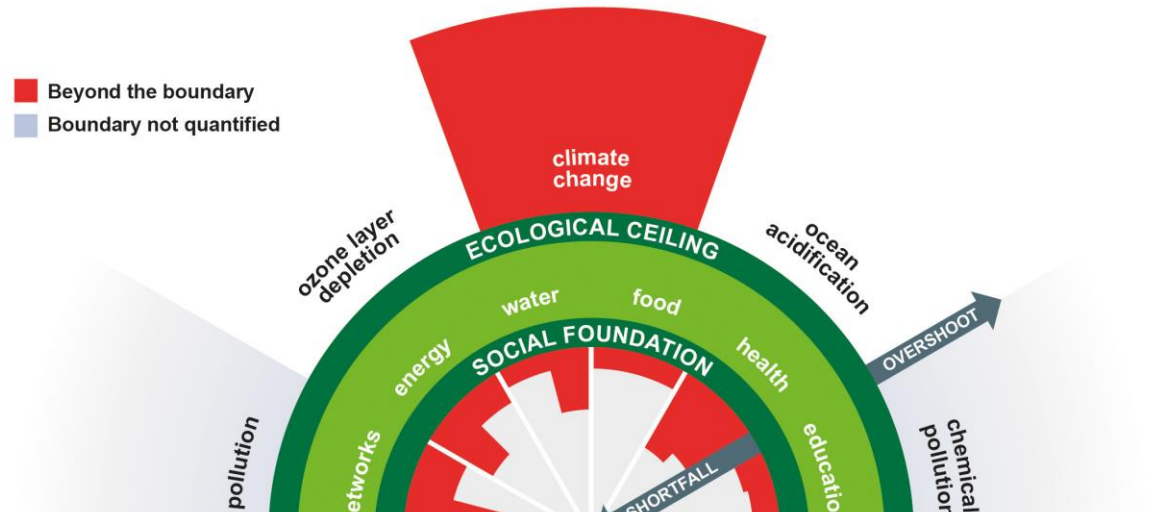
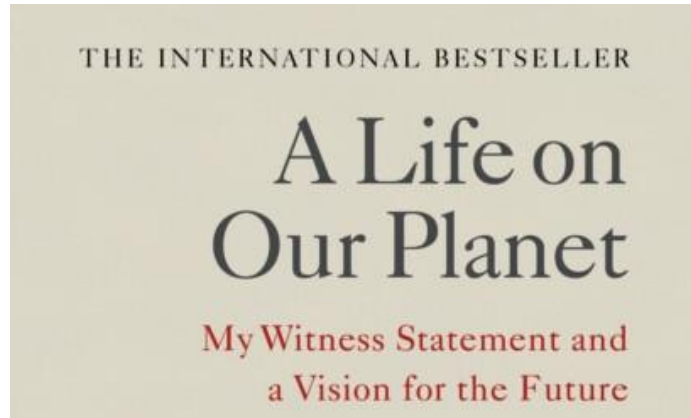
FISH POPULATIONS
ESSENTIAL FOR
FOOD AND
JOBS HAVE
CRASHED BY 50%
IN THE LAST
4 DECADES



The Blue Marble, taken by [Harrison Schmitt](#) of the [Apollo 17 crew](#) in 1972.



Křehká „rovnováha“



2009

2015

2023

2025

We human beings are, above all, the most astonishing problem solvers. We have made difficult journeys before that evolve enormous social change throughout our history, and we can do so again. (David Attenborough, p.139)

7 boundaries assessed,
3 crossed

7 boundaries assessed,
4 crossed

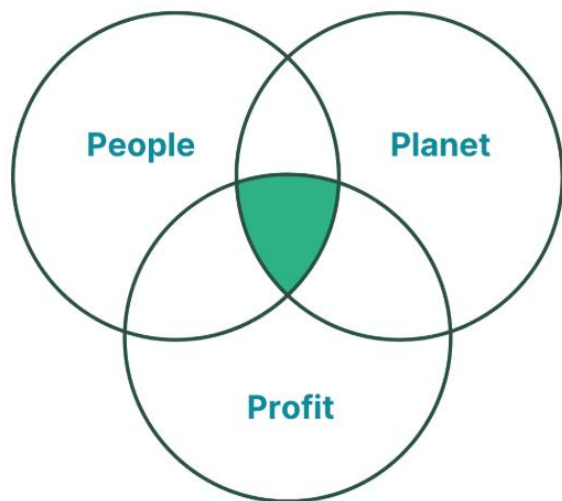
9 boundaries assessed,
6 crossed

9 boundaries assessed,
7 crossed

Udržitelnost



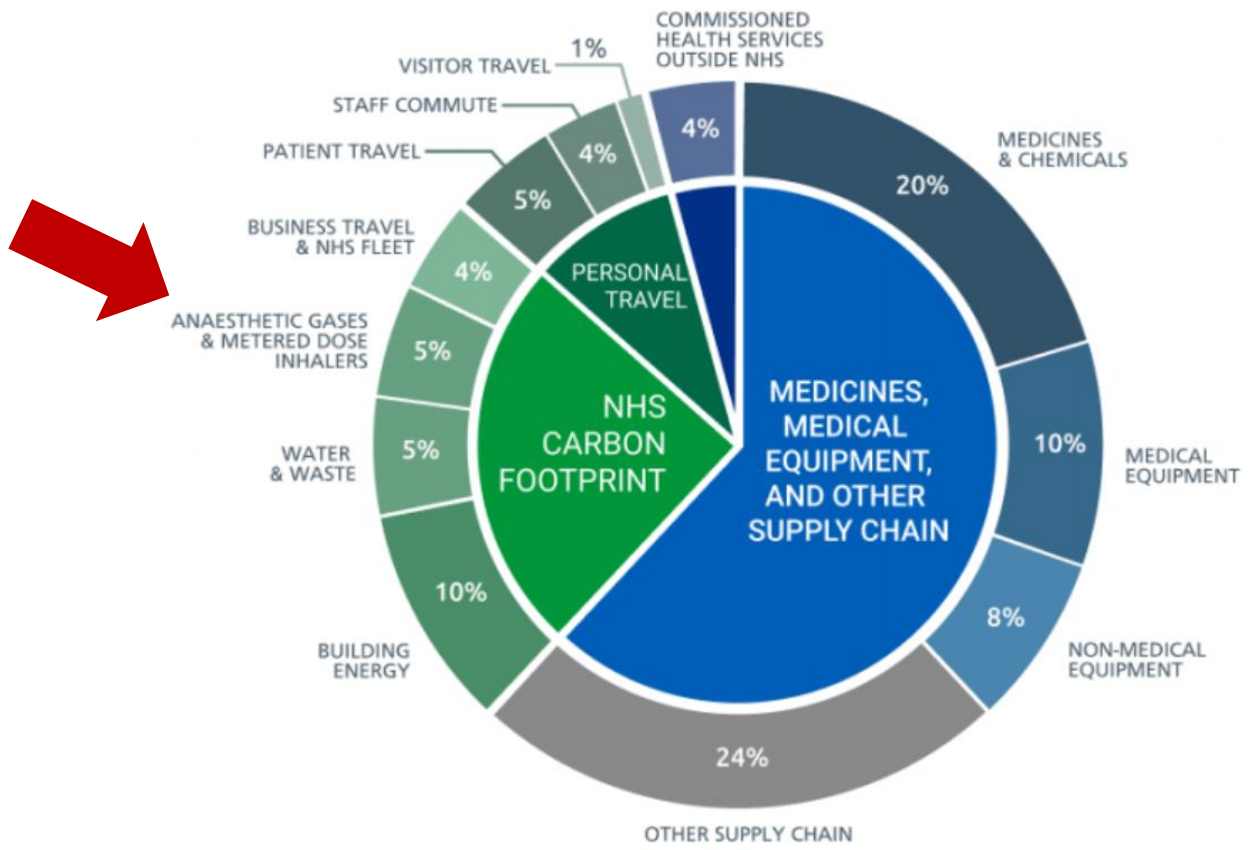
3 Pillars of Sustainability



program OSN rozvoje na období let 2015 až 2030

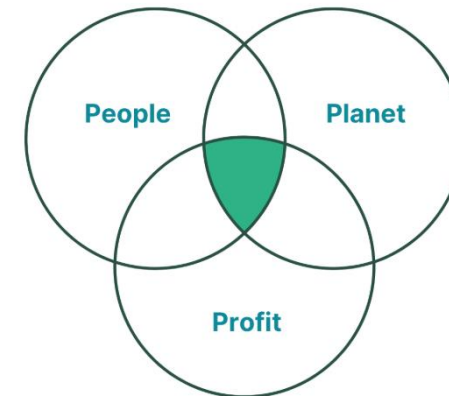
Udržitelně...

Zdravotnictví...



Health sector accounts for 5% of global emissions

3 Pillars of Sustainability



Figures from NHS England's and NHS Improvement's 'Delivering a net-zero NHS', 2020

The impact of surgery on global climate: a carbon footprinting study of operating theatres in three health systems

Andrea J MacNeill, Robert Lillywhite, Carl J Brown

*Lancet Planet Health 2017;
1: e381–88*

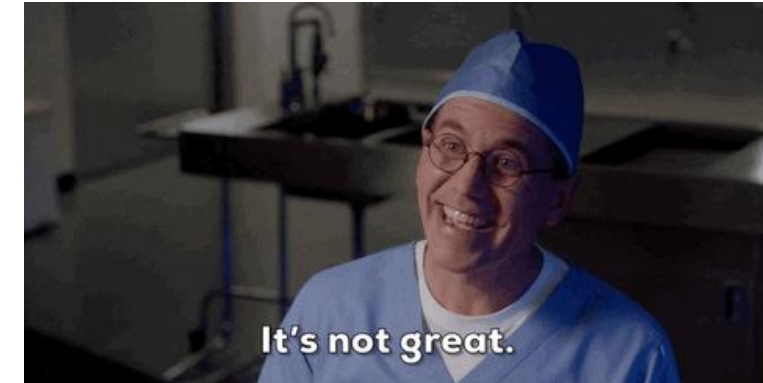
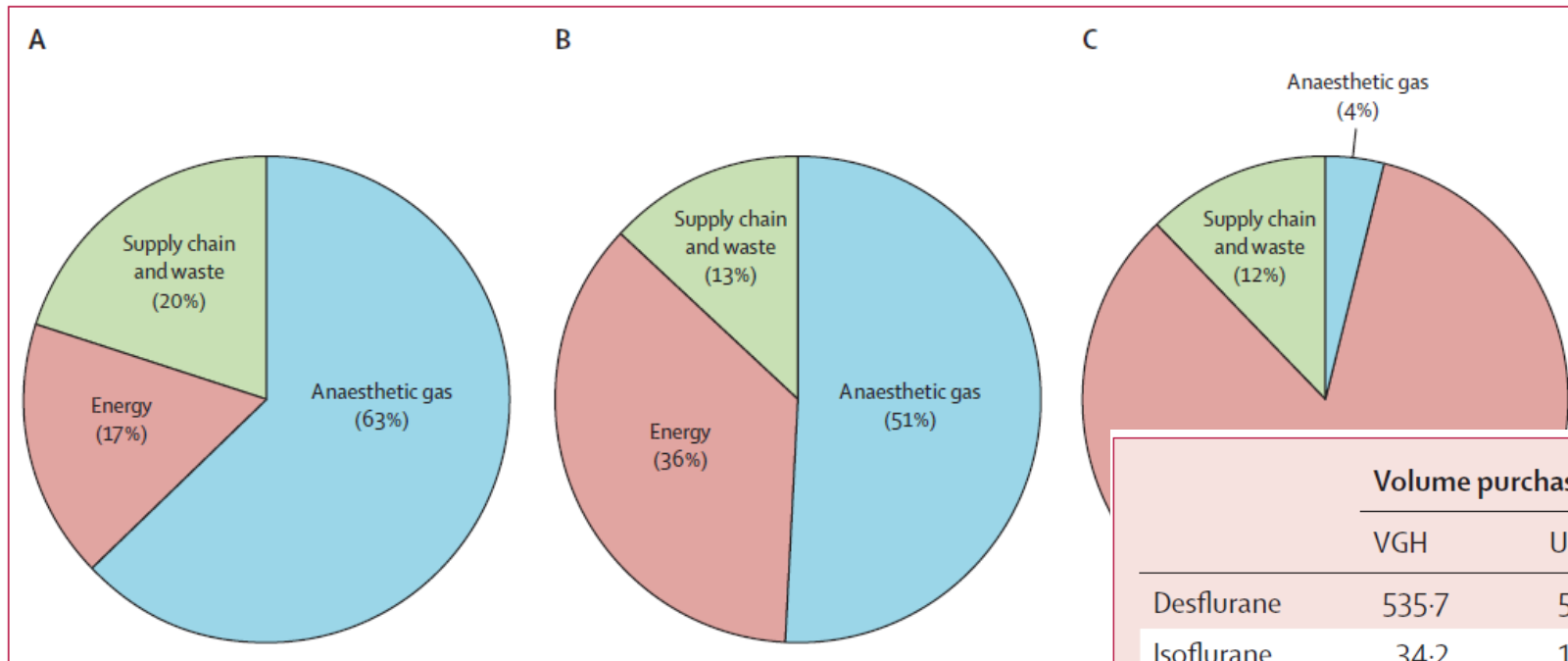


Figure 2: Relative contribution of scopes 1, 2, and 3 to the carbon footprint of operating theatres at (A) Vancouver General Hospital, (B) University of Minnesota Medical Center, and (C) John Radcliffe Hospital
Anaesthetic gas=scope 1. Energy=scope 2. Supply chain and waste=scope 3.

	Volume purchased (L/year)			CO ₂ e (kg/year)		
	VGH	UMMC	JRH	VGH	UMMC	JRH
Desflurane	535.7	532.8	0	1 983 073	1 972 412	0
Isoflurane	34.2	176.4	222	26 297	135 636	170 314
Sevoflurane	132	115.5	217	24 907	21 793	40 898
Total	2 034 277	2 129 841	211 212

CO₂e calculated using 100-year Global Warming Potential (GWP₁₀₀) values of 2540 for desflurane, 510 for isoflurane, and 130 for sevoflurane.⁸ VGH=Vancouver General Hospital. CO₂e=CO₂ equivalents. UMMC=University of Minnesota Medical Center. JRH=John Radcliffe Hospital.

Table 1: Annual greenhouse gas emissions from volatile anaesthetics



environmental impact anaesthesia



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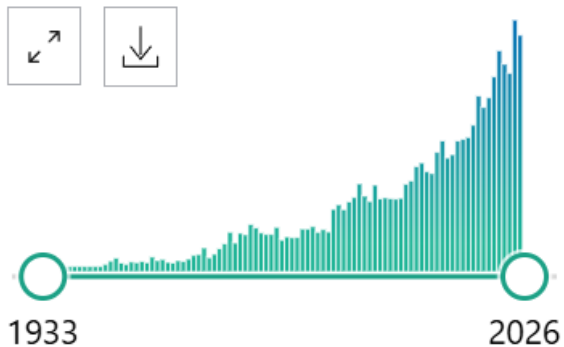
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MY CUSTOM FILTERS

14,515 results

Page 1 of 1,452

RESULTS BY YEAR



Environmental sustainability in anaesthesia and critical care.

1 McGain F, Muret J, Lawson C, Sherman JD.

Cite Br J Anaesth. 2020 Nov;125(5):680-692. doi: 10.1016/j.bja.2020.06.055. Epub 2020 Aug 12.

PMID: 32798068 **Free PMC article.** Review.

Although health systems respond to this disease burden, healthcare itself pollutes the atmosphere, land, and waterways. We surveyed the 'state of the art' **environmental** sustainability research in **anaesthesia** and critical care, addressing why it matters, what is know ...

ESAD1 – Will vapour capture devices allow for free inhaled drugs use? Pro-con debate

Session organised by the ESAIC Sustainability Committee

Pro-Con Debate | 25 May 2025, 10:30



Capture efficiency

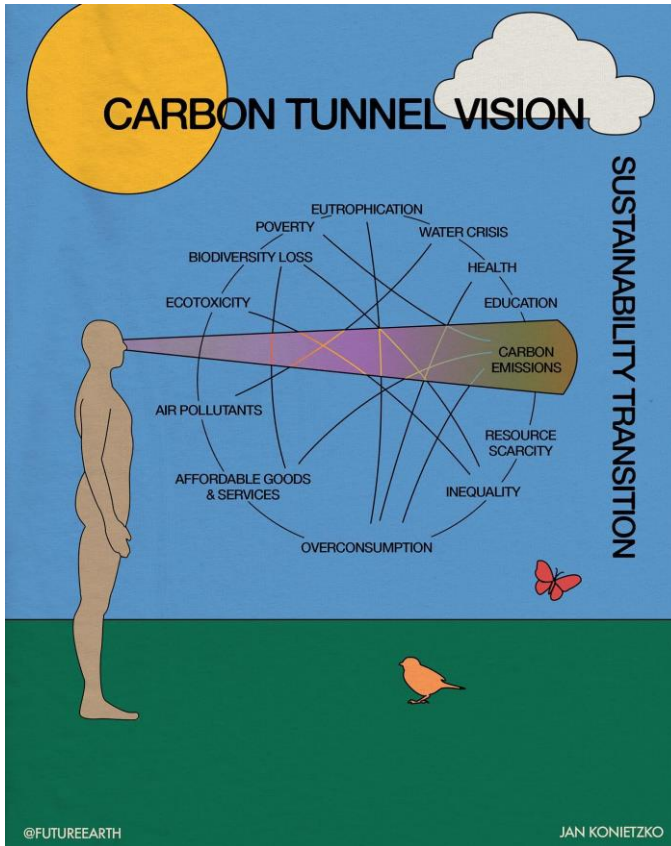
Reference	Setting	Finding
Hinterberg et al. BJA 2022	80 adults, bariatric surgery, desflurane, CONTRAfluran	Mass transfer 37%, capture efficiency 25%
Ghandi et al. BJA 2023	43 adults, sevoflurane, SageTech	Capture efficiency 43%
Mulier et al. Anaesthesia 2024	70 adults, bariatric surgery, sevoflurane, CONTRAfluran	Mass transfer 45%

C/ Only 25-45% of anaesthetic agent is captured (!)

Niek Sperna Weiland | EA25 Lisbon | CON Vapour Capture Technology

41D1 – In 10 years, will we still need volatile anaesthetics? Let's get rid of them now! Pro-con debate

Pro-Con Debate | 26 May 2025, 17:00



ESAS10 – Perioperative sustainability: Can I really make a difference?

Session organised by the ESAIC Sustainability Committee

Symposium | 27 May 2025, 11:00

**ANO,
když budu chtít...**

The optimal mode of anaesthesia: are we ready for an evidence-based recommendation?

Jasper M. Kampman^{1,2} · Nicolaas H. Sperna Weiland^{1,2} ✉

Carbon footprint per hour of different modes of anaesthesia (median, IQR)

Regional / spinal anaesthesia

General anaesthesia

Without sedation

1.6 (1.6–1.6)
kg CO₂e·h⁻¹

Dröog 2024

With sedation

1.6 (1.4–1.8)
kg CO₂e·h⁻¹

McGain 2021, Dröog 2024

Total intravenous anaesthesia

0.7 (0.0–1.6)
kg CO₂e·h⁻¹

Sherman 2012, Thiel 2015, Hu 2021, Dröog 2024, Bernat 2024, Bernat 2025

Sevoflurane
3.5 (3.1–4.8)
kg CO₂e·h⁻¹

Sevo + N₂O
22 (10–46)
kg CO₂e·h⁻¹

Sherman 2012, Thiel 2015, McGain 2021, Hu 2021, Bernat 2025

Isoflurane
3.0 (2.0–4.0)
kg CO₂e·h⁻¹

Iso + N₂O
22 (19–24)
kg CO₂e·h⁻¹

Sherman 2012, Hu 2021

Desflurane
43 (33–139)
kg CO₂e·h⁻¹

Des + N₂O
56 (49–150)
kg CO₂e·h⁻¹

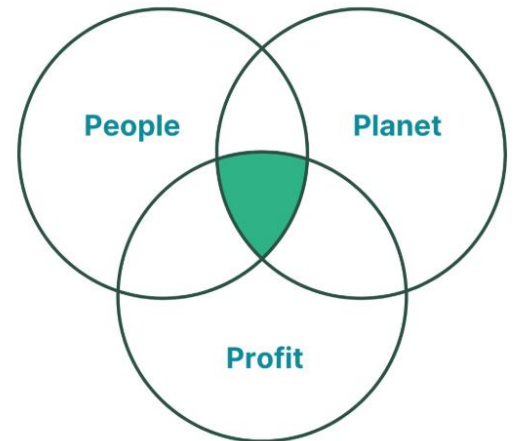
Sherman 2012, Thiel 2015, Hu 2021

80%

Znamená to, že nikdy nesmím použít Desfluran nebo „rajský plyn“?

NE, ale neměl by to být standard

3 Pillars of Sustainability



98%



2024/573

20.2.2024

REGULATION (EU) 2024/573 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 7 February 2024

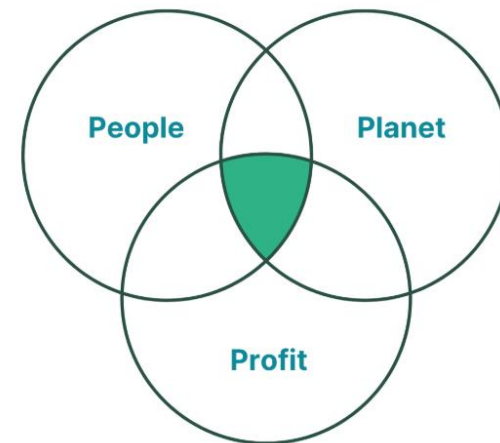
on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation
No 517/2014

(Text with EEA relevance)

Stanovisko výboru ČSARIM: Zachování dostupnosti desfluranu v klinické praxi

Balík M., Beneš J., Bláha J., Černá Pařízková R., Černý V., Duška F., Dostál P., Gabrhelík T.,
Mach D., Michálek P., Stern M., Ševčík P., Štourač P., Truhlář A., Vymazal T.

3 Pillars of Sustainability



such use is
evidence of
ad or to the

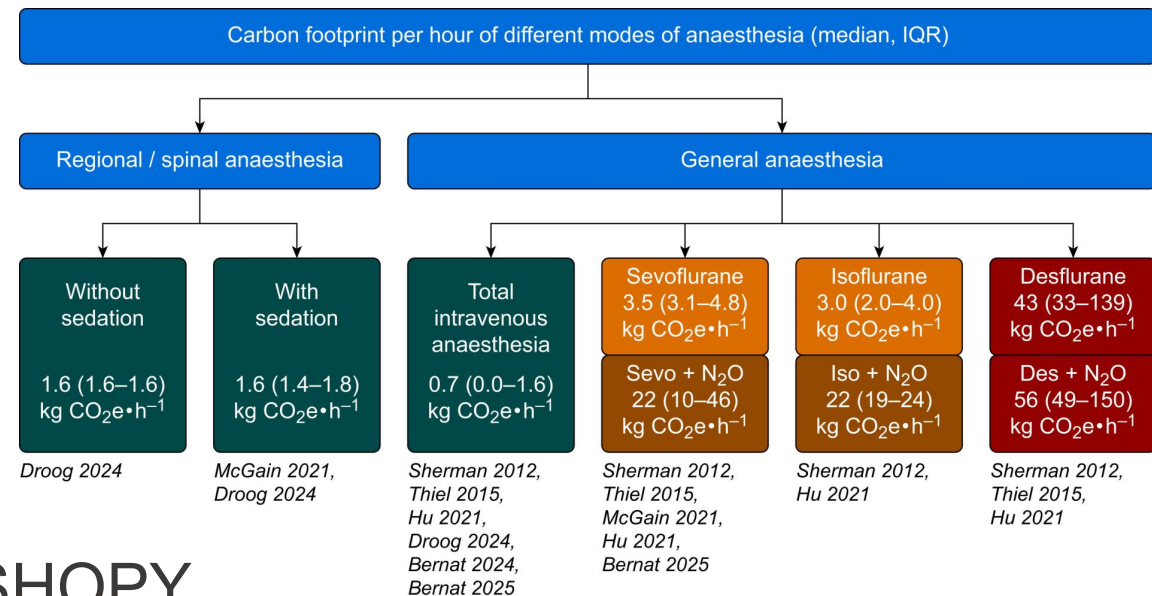
V čem se mohu zlepšit?

1. Regionální anestezie

2. TIVA

- Umím dostatečně bezpečně? - WORKSHOPY
- TCI – model Eleveld
- EEG monitorace
- 2% Propofol?
- Správná likvidace zbytků

3. Inhalační anestezie



Myth: You Gotta Green Everything to Green Anything

Na velikosti průtoku záleží!

Navigating Europe's sustainable anaesthesia pathway

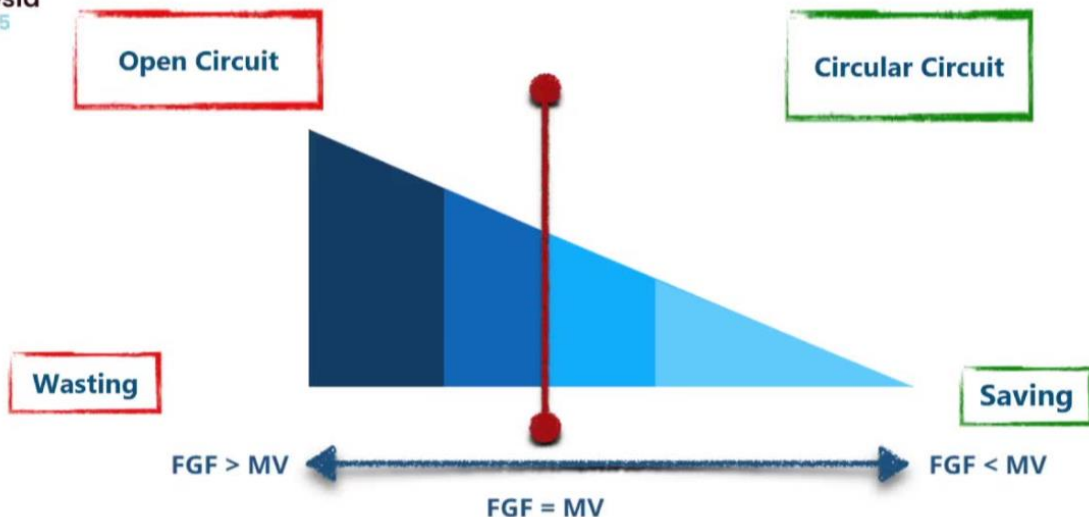
Kalmar, Alain F.; Teunkens, An; Rex, Steffen

Author Information

European Journal of Anaesthesiology 41(7):p 465-467, July 2024. | DOI:

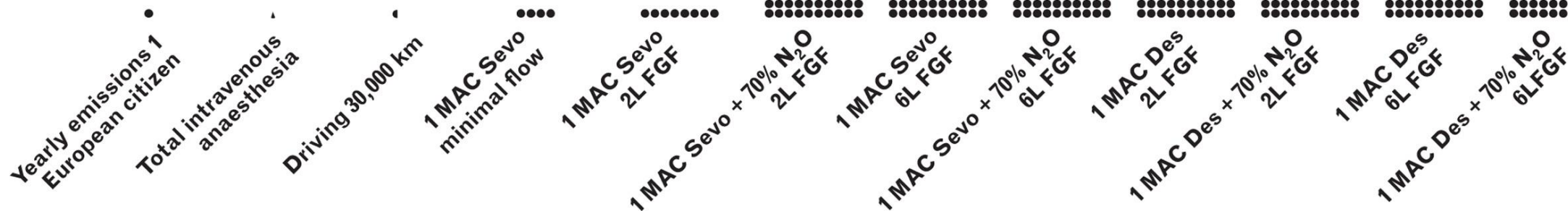
10.1097/EJA.0000000000001993

euro
anaes
thesia
2025



Dr. Patricio González Pizarro 2025

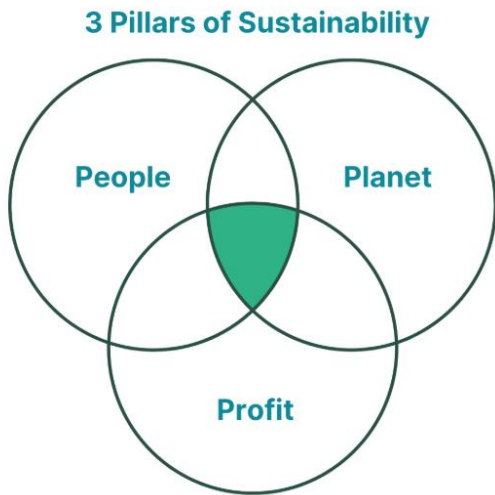
Hospital Universitario
La Paz



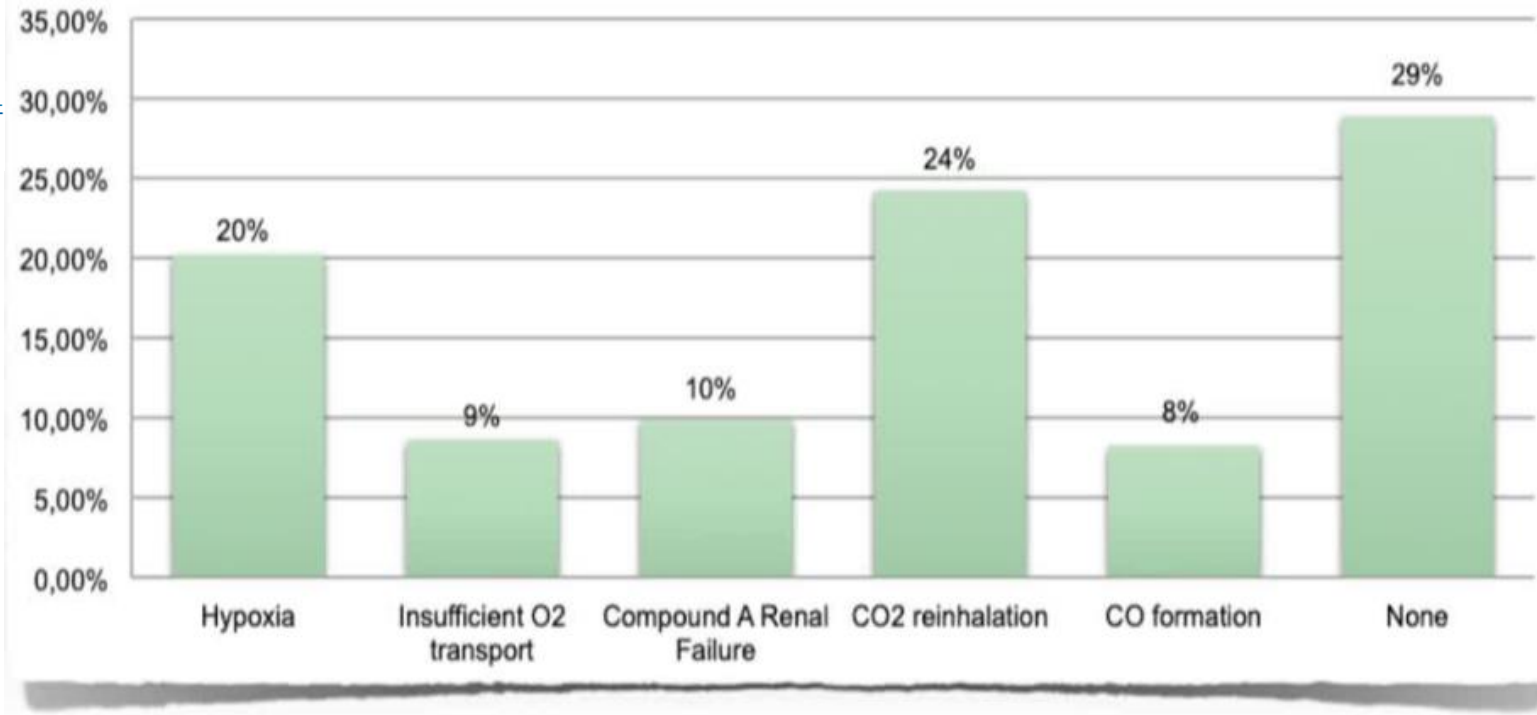
Environmental sustainability in the operating room

A worldwide survey among anaesthesiologists

[Patricio Gonzalez-Pizarro](#)¹, [Susanne Koch](#)¹, [Jane Muret](#)¹, [Alexandra Trinks](#)¹, [Luca Brazzi](#)¹, [Francisco Reinos-Barbero](#)¹, [Jesus Diez Sebastian](#)¹, [Michel MRF Struys](#)¹



Why do you use a FGF > 1.0 L/min?



Rebreathing fraction = $\frac{FGF}{MV}$

13 yo
45 Kg
MV 5.4 lpm

$\frac{2.0 \text{ lpm}}{5.4 \text{ lpm}} = 0.370 \rightarrow 63\%$
 $\frac{1.0 \text{ lpm}}{5.4 \text{ lpm}} = 0.185 \rightarrow 81\%$
 $\frac{0.5 \text{ lpm}}{5.4 \text{ lpm}} = 0.093 \rightarrow 91\%$

↑
≈ 30%

The Dutch Approach to decarbonising
A novel approach to tackle difficult sustain

1) Research



2



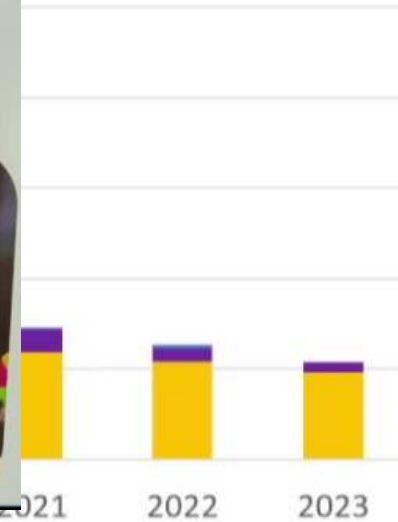
Sino-Dutch Green Hospital Project



35,000 hospitals, 117.000 anaesthesiologists



Footprint of Dutch UMCs



Desflurane: -100%
Isoflurane: -94%

Sevoflurane: -44% +

Total: -76%

Saves >3,400,000 kg CO₂e annually

be collected during all subsequent
quality control audits

■ Sevoflurane ■ Isoflurane ■ Desflurane

EJA

Eur J Anaesthesiol 2024; 41:1 – 18

GUIDELINES

European Society of Anaesthesiology and Intensive Care consensus document on sustainability

4 scopes to achieve a more sustainable practice



SCAN ME



SCAN ME

Take Home Message



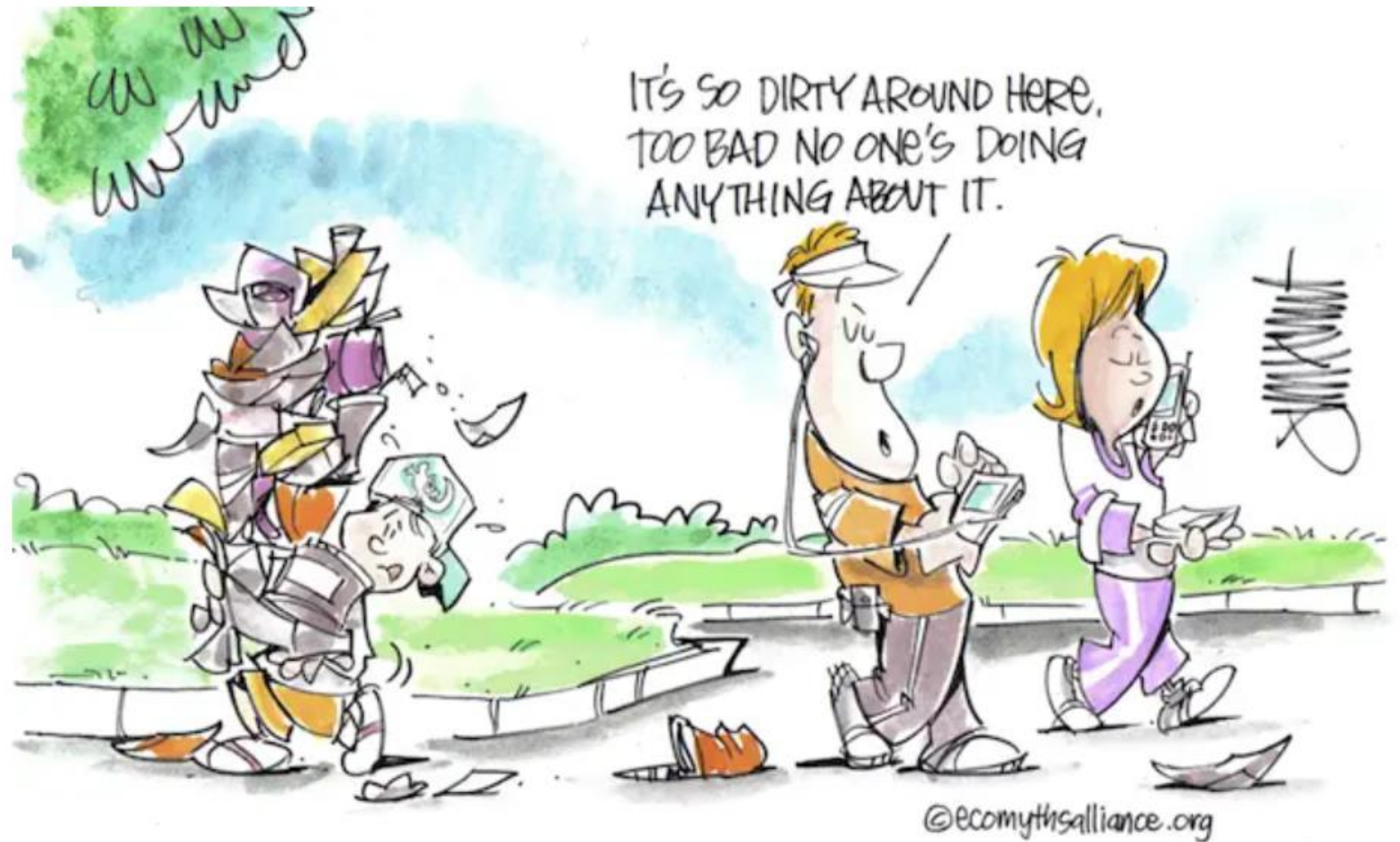
Direct Emission

SCOPE 1

- Choose TIVA or Regional Anaesthesia when possible
- Choose the inhaled agent with the lowest Global Warming Potential available (sevoflurane < isoflurane < desflurane)
- Desflurane should be avoided and only used when strictly clinically indicated, and when there is not a valid alternative available
- Nitrous oxide should only be used when other alternatives are not available
- All halogenated drugs should be used at the lowest possible fresh gas flow (FGF) during induction and steady phase of anaesthesia
- Aim at minimal FGF (< 0.5 lpm), whenever safe and technically feasible during steady phase
- Although still under-studied, the use of Vapor Capture Technology together with minimal FGF in an Air-Oxygen mix might have a significant positive impact in your carbon footprint
- Anaesthetic drug requirements should be tailored according to depth of anaesthesia (pEEG) monitoring to avoid unnecessary gas or propofol consumption

**Udržitelnost
udržitelně...**

**Děkuji, že jste
udrželi
pozornost 😊**



**Myth: One Person Can't Make a
Difference**

November 22, 2020 by [EcoMyths Team](#)