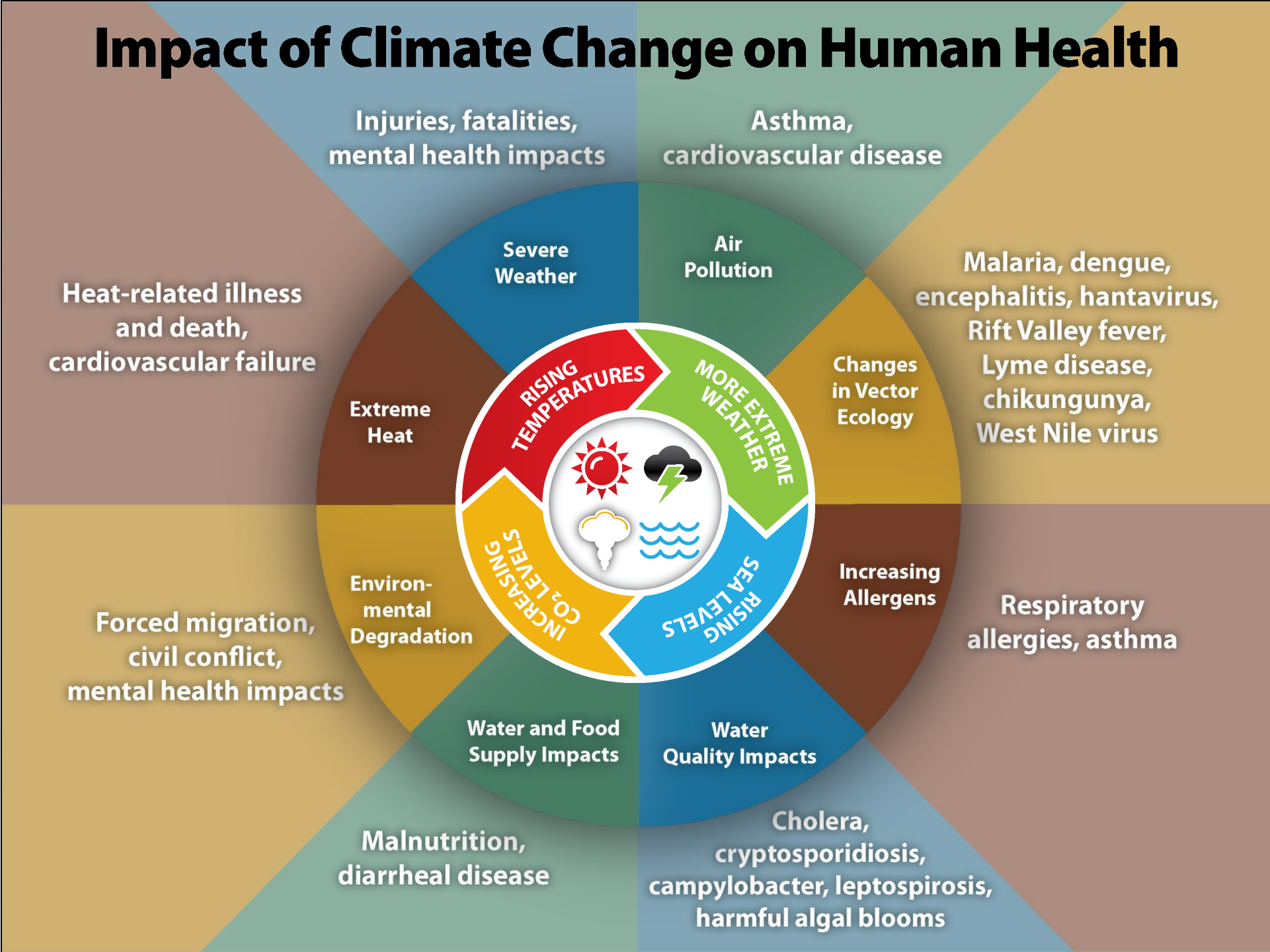




Intersection of Anesthesia and Climate Crisis

Elizabeth Hansen MD PhD
Seattle Children's Hospital
University of Washington

Impact of Climate Change on Human Health





2

gigatons
CO₂ equivalents

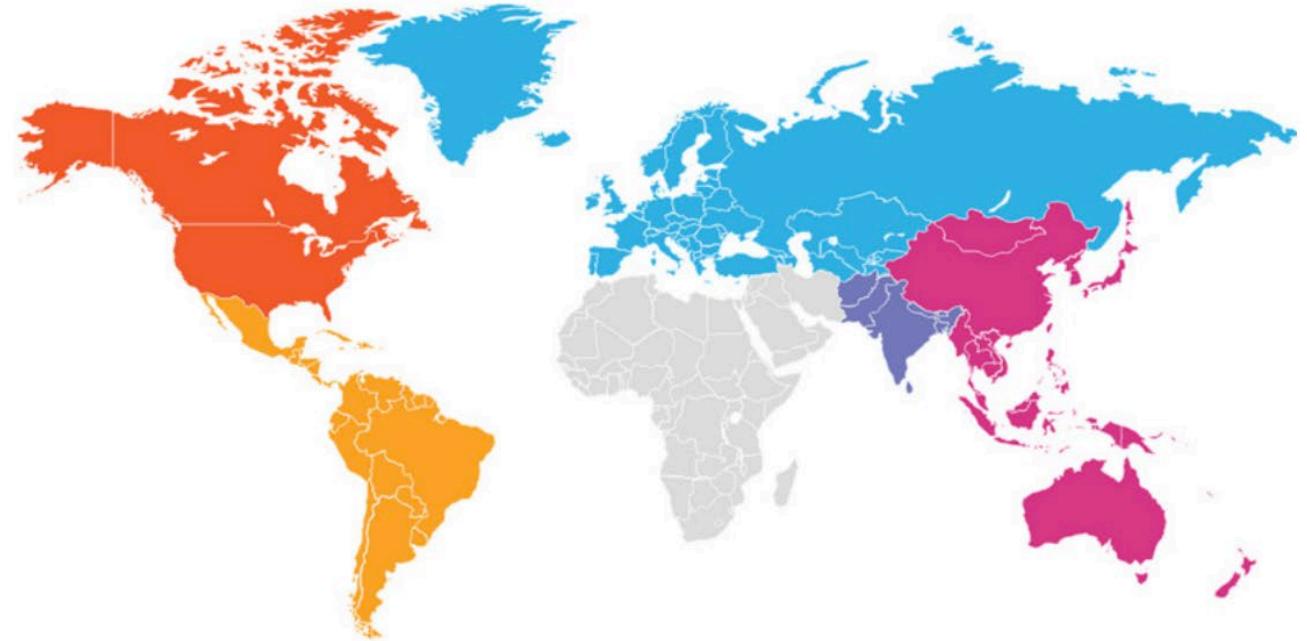
4.4% of global emissions

Global healthcare sector's carbon footprint in 2014

emissions by region

Healthcare sector

GHG emissions by region



United States ◎

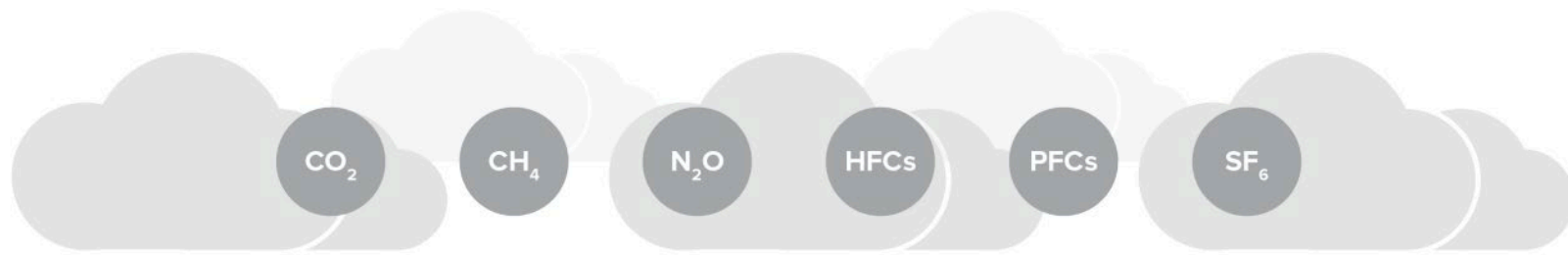
8% of national emissions

Canada ↗

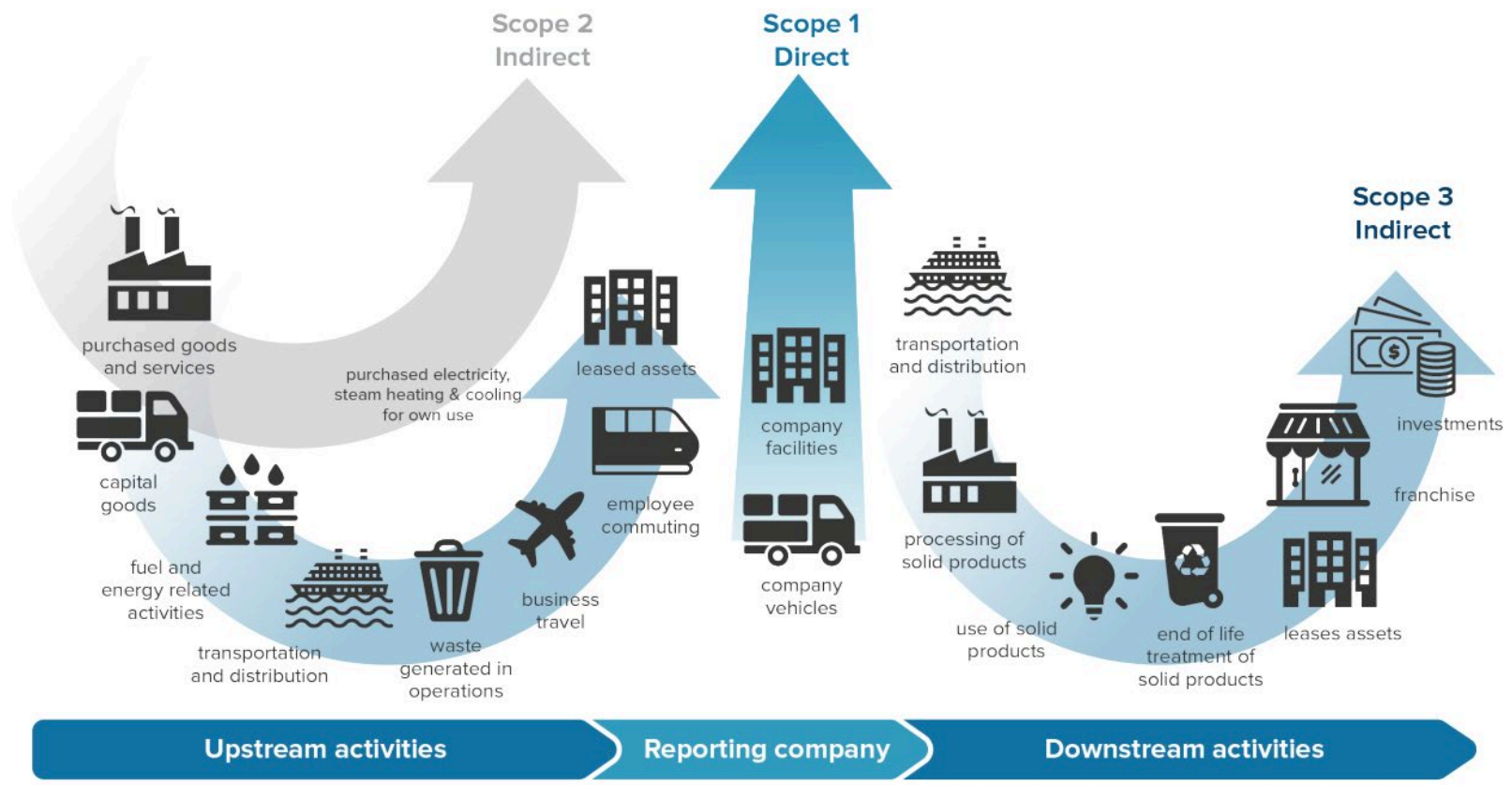
4-6% of national emissions

North America	Latin America & Caribbean	East Asia Pacific	South Asia	Europe & Central Asia	
1.65	0.20	0.26	0.03	0.43	tCO ₂ e/capita
0.58	0.13	0.60	0.05	0.39	GtCO ₂ e total
29	6	30	2	19	% global

Figure 9: Estimated health care emissions for World Bank regions other than Sub-Saharan Africa and Middle East and North Africa

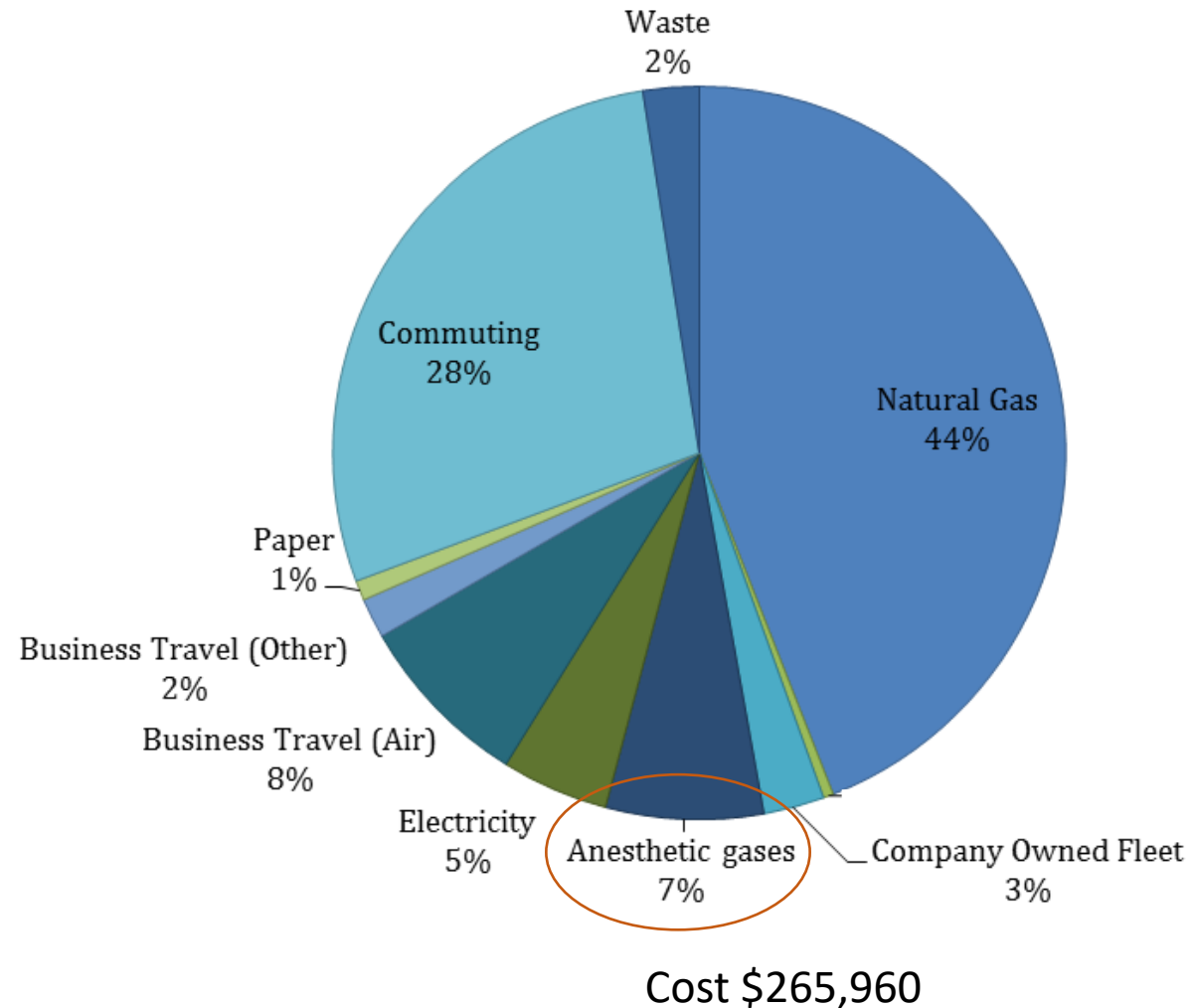


Types of emissions

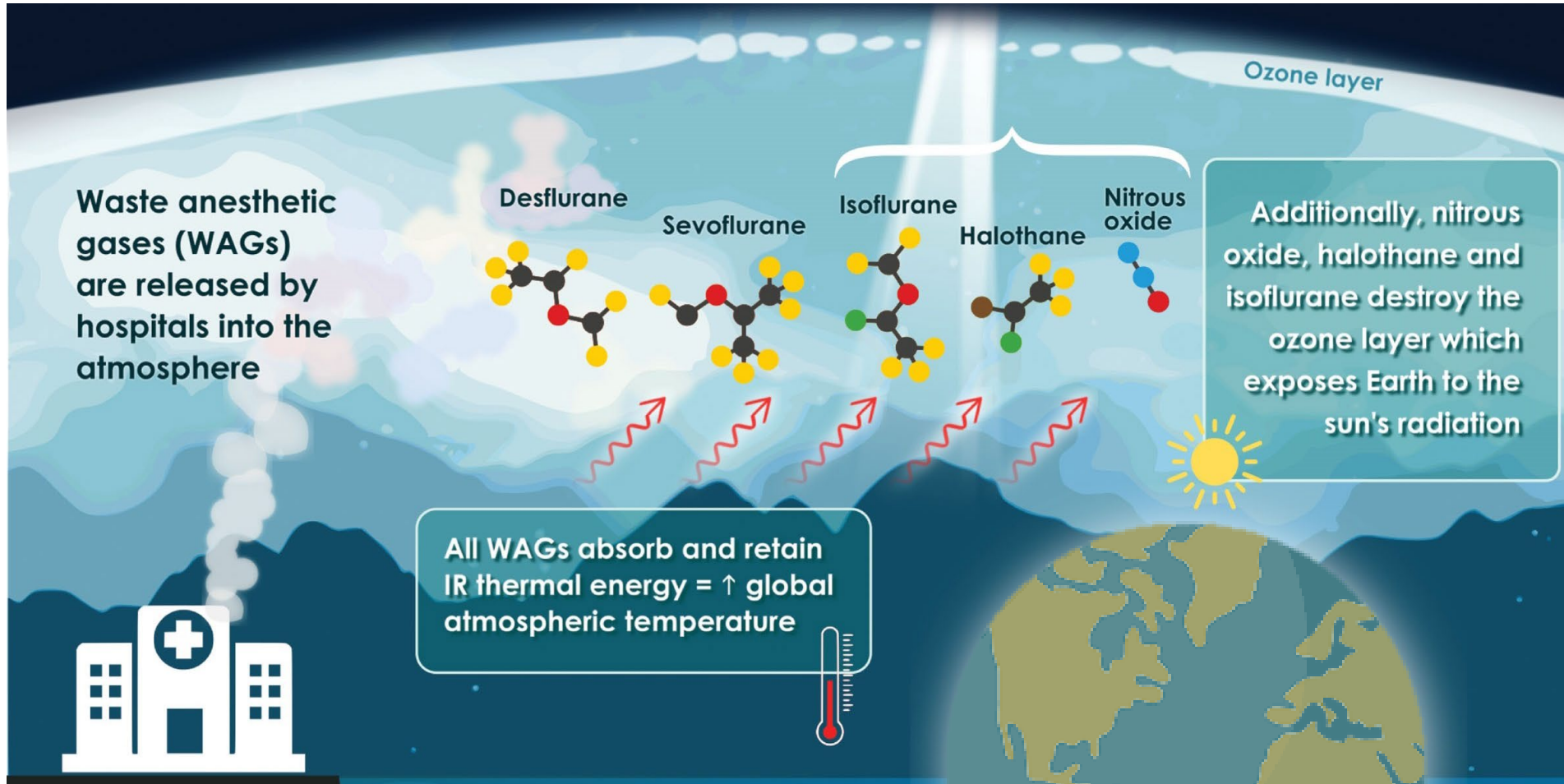


Seattle Children's Main Hospital 2018 emissions

FY 2018 GHG Inventory 22,069 mt CO₂e



Anesthetic Agents



Approximately 5% of delivered anesthetic metabolized by patient

- Rest is vented to atmosphere
- Not scavenged (technology in development)

Global Impact: The Environmental Effects of Anesthetic Drugs

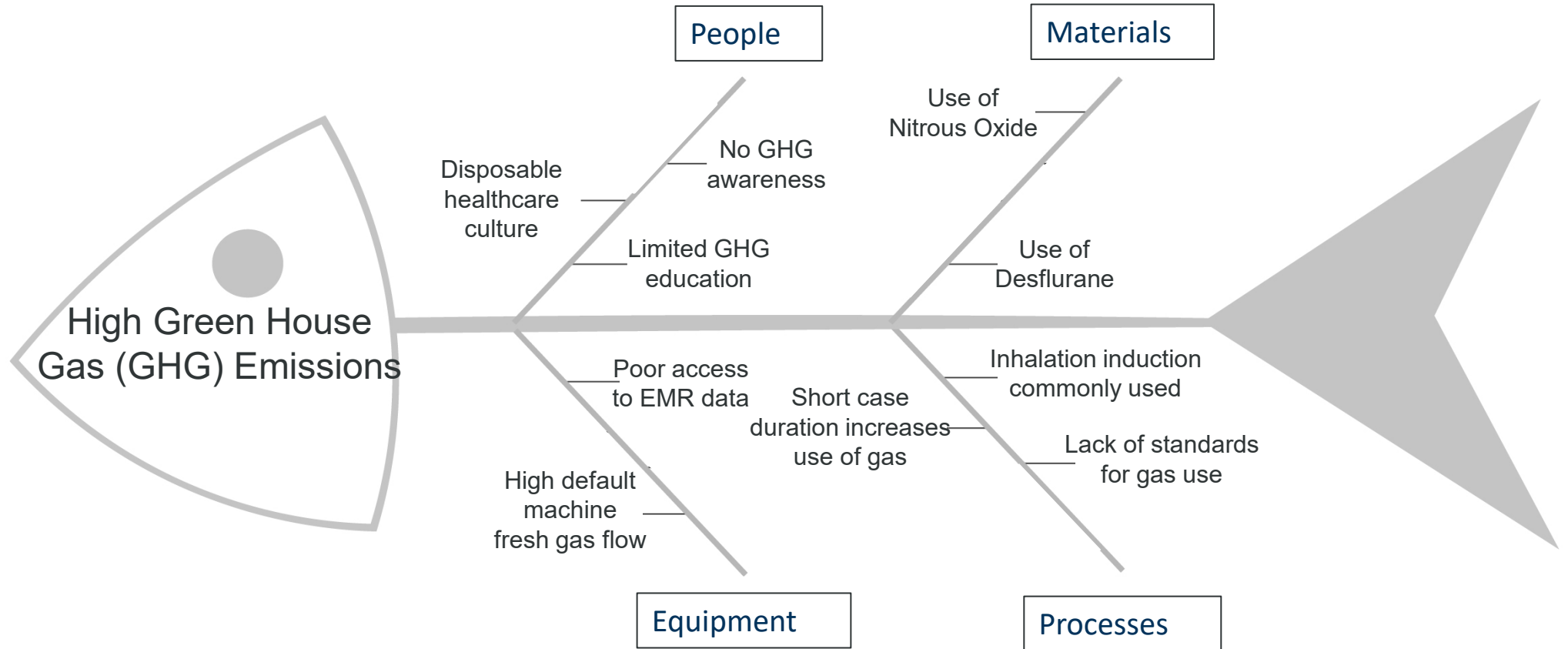
Nathan, Naveen
Anesthesia & Analgesia 133(4):825, October 2021.
doi: 10.1213/ANE.00000000000005729

1 bottle of desflurane - equivalent to 988 pounds of coal burned



PROBLEM

CAUSES

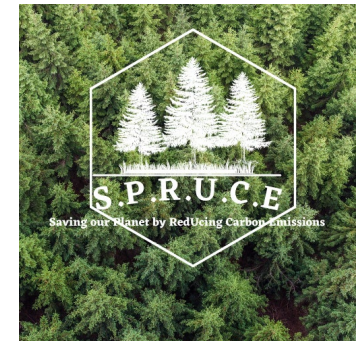
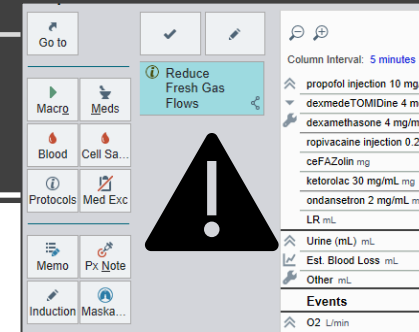


What's Known: We Can Reduce Impact

- Eliminate Desflurane
- Eliminate or drastically reduce use of nitrous oxide
- Reduce fresh gas flows during induction and maintenance (decision support alerts)
- Utilize total IV anesthesia - TIVA
- IV inductions when clinically feasible
- Provide near real-time feedback on emissions

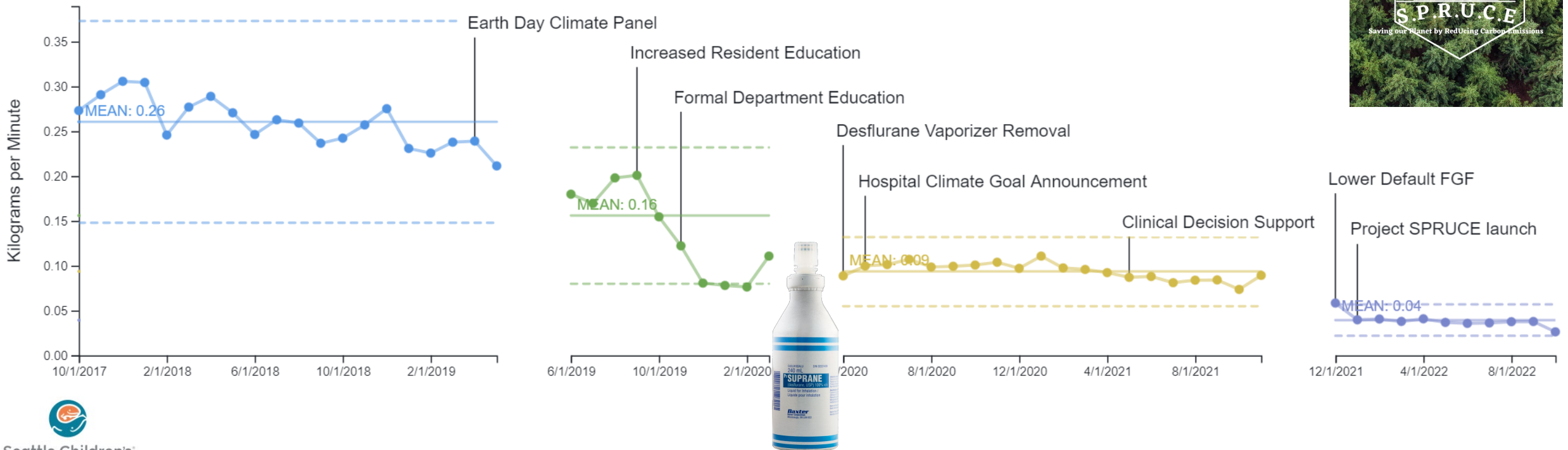


Main hospital Emissions



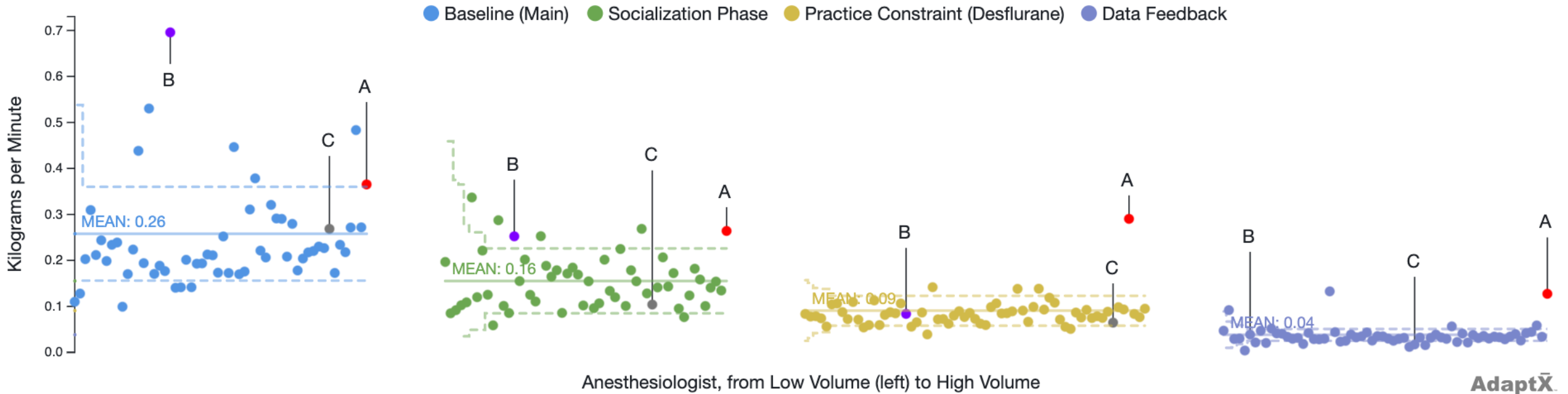
Average CO2 (Equivalent) kg/Min

● Baseline (Main) ● Socialization Phase ● Practice Constraint (Desflurane) ● Data Feedback



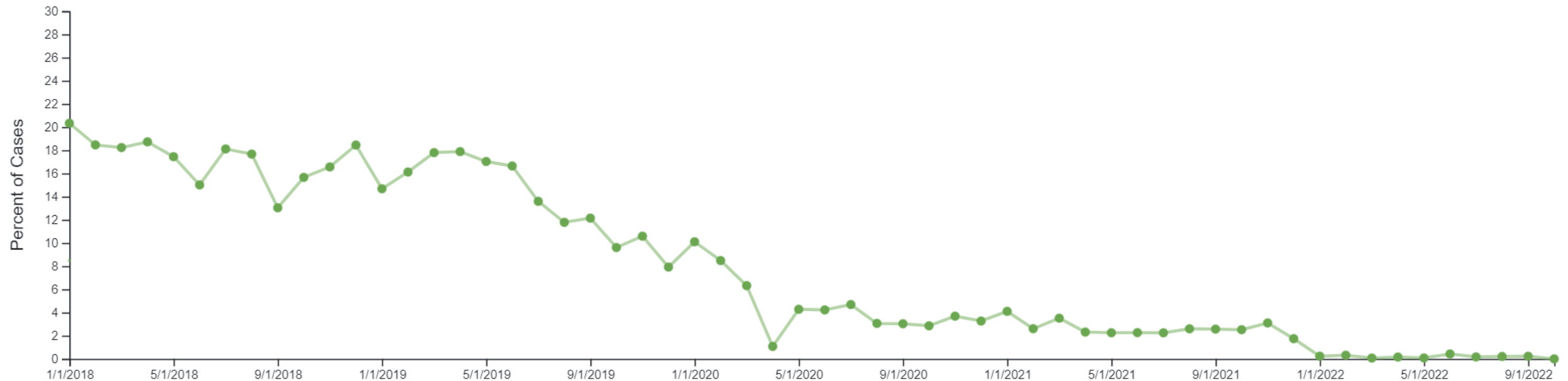
Emissions decreasing over time, by anesthesiologist

CO2 (Equivalent) kg/Min by Anesthesiologist
10/1/2017 to Present



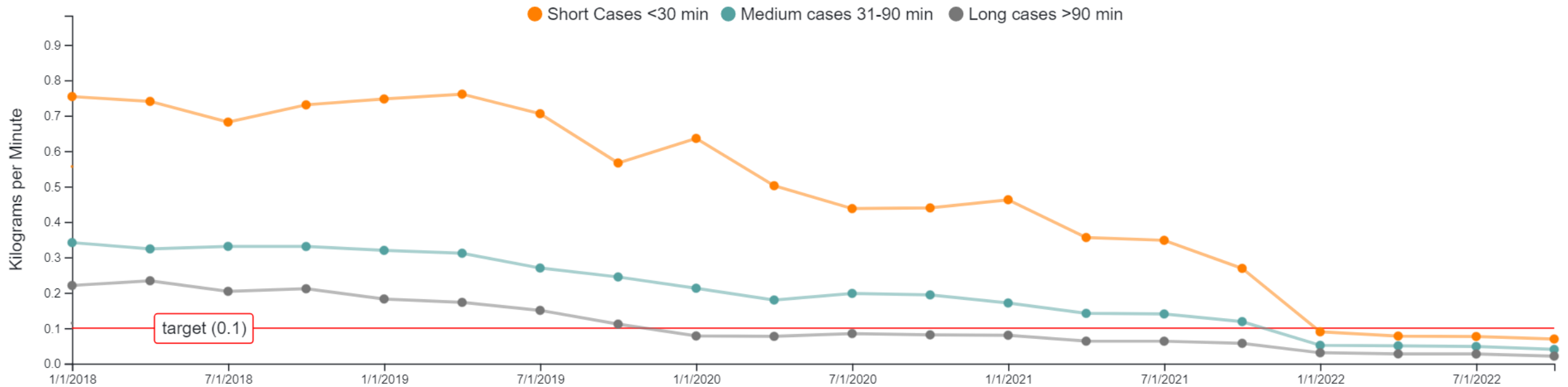
High emissions cases trending down

Percentage of Cases averaging >0.5 kg CO₂e/min



Reduction of emissions for all case lengths

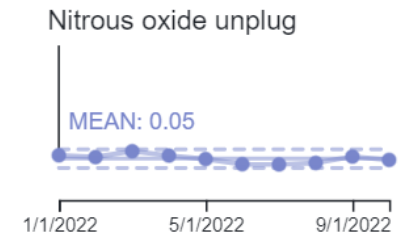
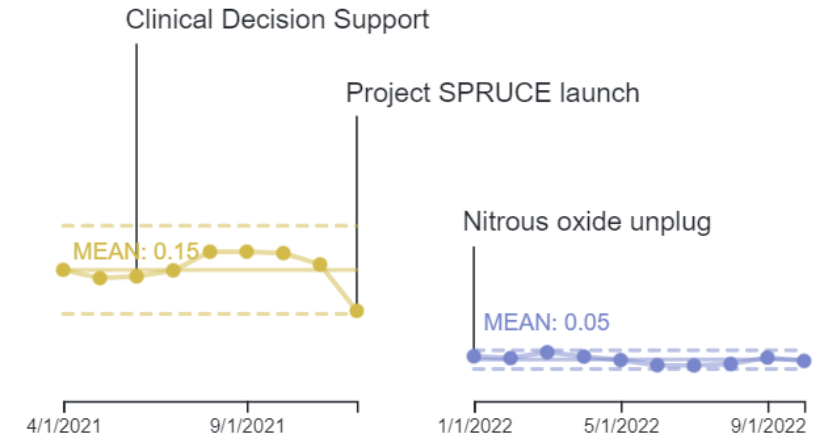
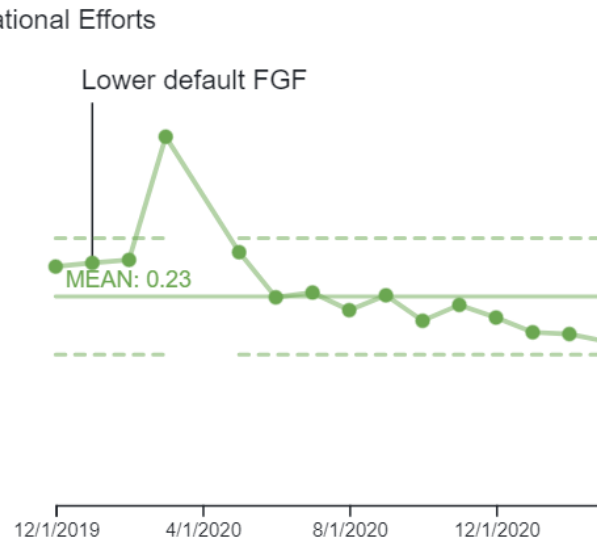
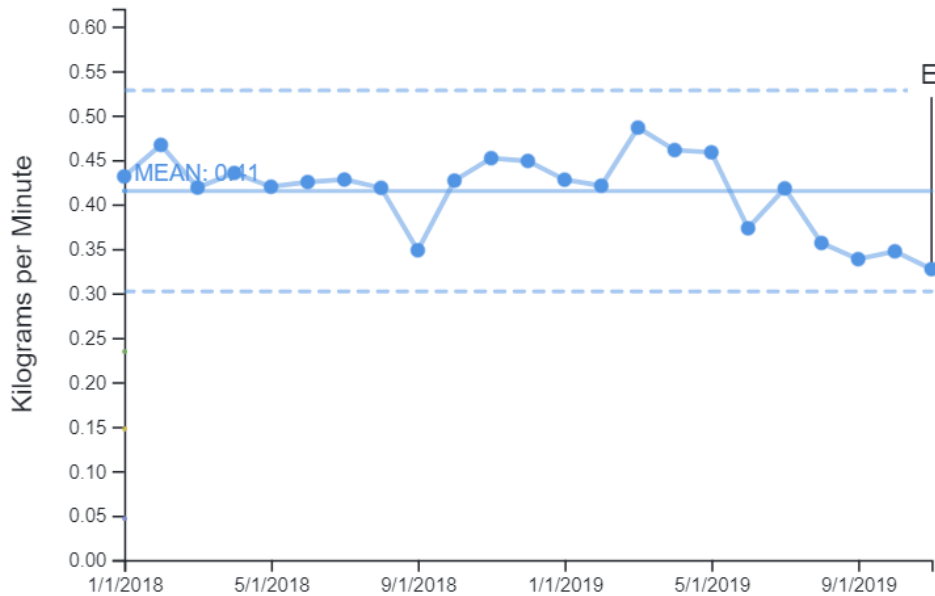
All Sites Average CO2 (Equivalent) kg/Min by Case Length



Emissions at the ASC

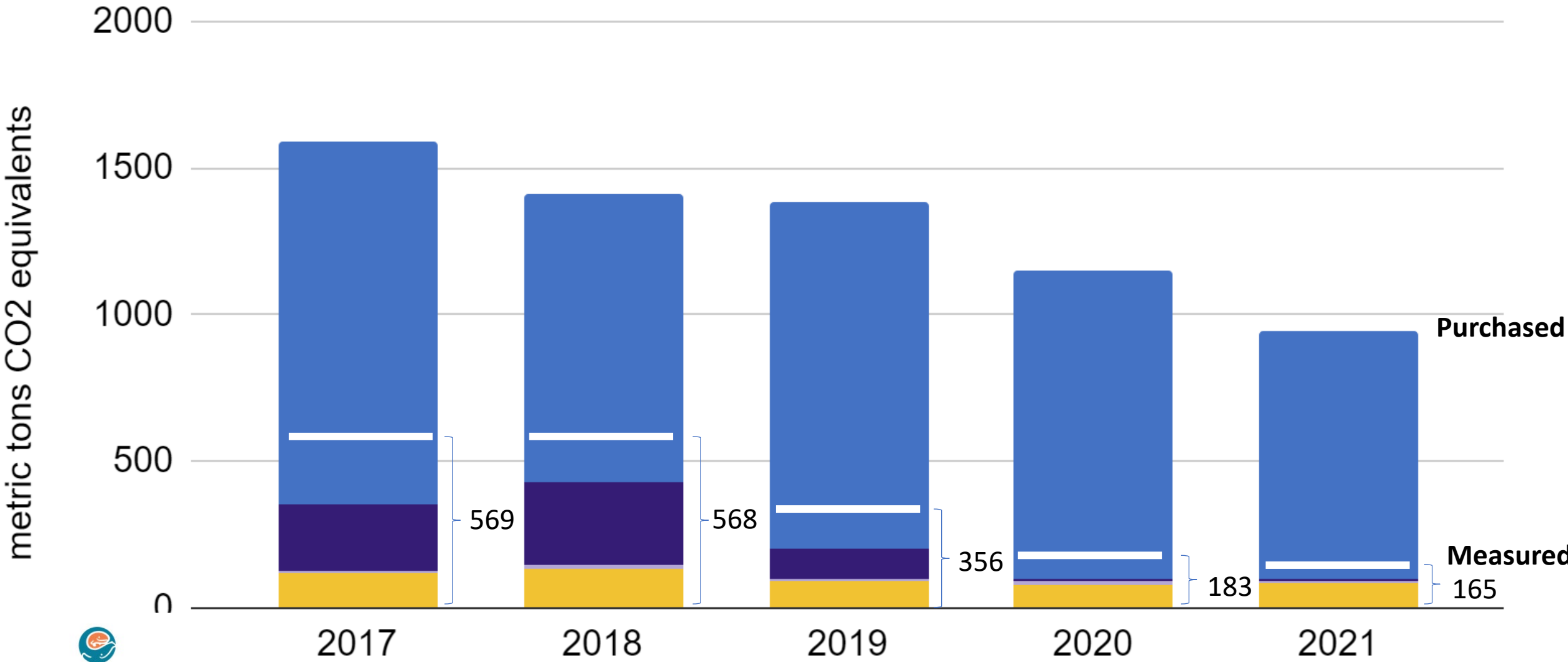
ASC Average CO2 (Equivalent) kg/Min

● Baseline (ASC) ● Phase 1 ● Phase 2 ● Phase 3

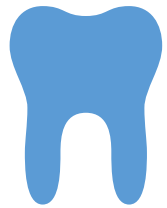


Greenhouse Gas Emissions by Anesthetic Agent (purchasing data)

Nitrous Oxide Desflurane Isoflurane Sevoflurane



Where is the nitrous oxide going?



Non-OR uses

Dental clinic
Mobile Sedation team
Emergency Department
Cardiac ablations/Cath lab



Leaks

At central supply
Connections at pipes



British Journal of Anaesthesia
Volume 128, Issue 1, January 2022, Pages e32-e34



Correspondence
Discrepancy between procurement and clinical use of nitrous oxide: waste not, want not
Richard Seglenieks^{1, 2} ✉, Angela Wong¹, Fiona Pearson³, Forbes McGain^{1, 2, 4}



Thank you!

Anesthesia group

- Ting Zha
- Kimberly Righter-Foss
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- Dan Low
- Lynn Martin

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- Amber Yun
- AdaptX team

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- Colleen Groll

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- Hannah Cockrell



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