

Healing the Climate Crisis

Jon Utech

Senior Director Sustainability



Today's Agenda:

Measuring Your Carbon Footprint (Scope 1+2)

- Carbon Clinic Overview
- Why Do We Track Carbon Footprint?
 - Cleveland Clinic, UC Health, Kaiser Permanente
- Baselines and Boundaries
- Scope 1 Carbon Footprint
- Scope 2 Carbon Footprint
- Questions & Answers



TACKLING CLIMATE CHANGE COULD BE THE GREATEST GLOBAL HEALTH OPPORTUNITY OF THE 21ST CENTURY

The Lancet, June 2015

SUSTAINABILITY

Cleveland Clinic makes carbon-neutrality its newest sustainability goal

Health system plans to reach goal through renewable energy purchases, continued energy efficiency

November 30, 2017 | Jeff Ferenc



Cleveland Clinic is expanding successful energy-saving strategies it has implemented and purchasing renewable energy to reach its goal of being carbon-neutral in 10 years.

Corporate Carbon Footprint

- GHG Protocol Corporate Standard is the most widely used standard in the world
- 92% of reporters to the Carbon Disclosure Project used this standard to report their 2021 emissions
- Standard has been adopted by ISO and constitutes ISO 14064-1, which is the corporate greenhouse gas accounting standard
 - ISO Standard is based on GHG protocol, so they are mutually compatible

Organizational Boundaries

- Determine which operations are included in carbon footprint and how they are classified
- This is very important with companies that have complex business structures
 - Subsidiaries, JV's, franchises...
- Need clear choice points so companies cannot simply choose to ignore significant emissions

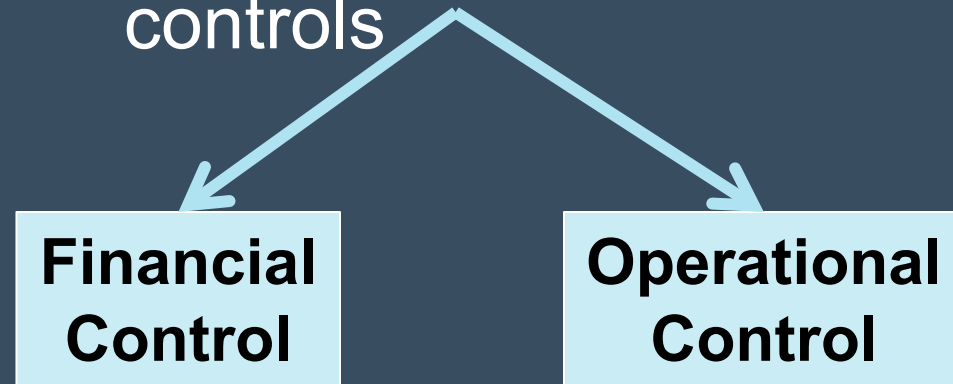
Organizational Boundaries

Equity Share Approach

- Emissions are accounted for by the equity share that a the parent company holds in any subsidiary company (Oil & Gas)

Control Approach

- Entity reports 100% of emissions from an operations that it controls



Which approach to pick?

- What's mainly used in healthcare is operational control
 - Ability to manage – desire for control and ability to influence direction of emissions
 - Regulatory requirements
 - Completeness
- *Used by Cleveland Clinic, UC Health and Kaiser Permanente*

Defining Organizational Boundaries and Baseline Year

Considerations for Organizational Boundaries:

- Hospitals
- Administrative facilities
- Leased facilities
- Leased fleet vehicles

Considerations for Baseline Year:

- Parameters of a Challenge the Hospital is Joining
- Earliest time period with verifiable data for Scopes 1 and 2

Baselines and Boundaries

Carbon Footprint Design Element	Cleveland Clinic	UC Health	Kaiser Permanente
Baseline Year	2010		
Boundary	Operational Control		

What are Carbon Footprint Scopes and Why do They Exist?

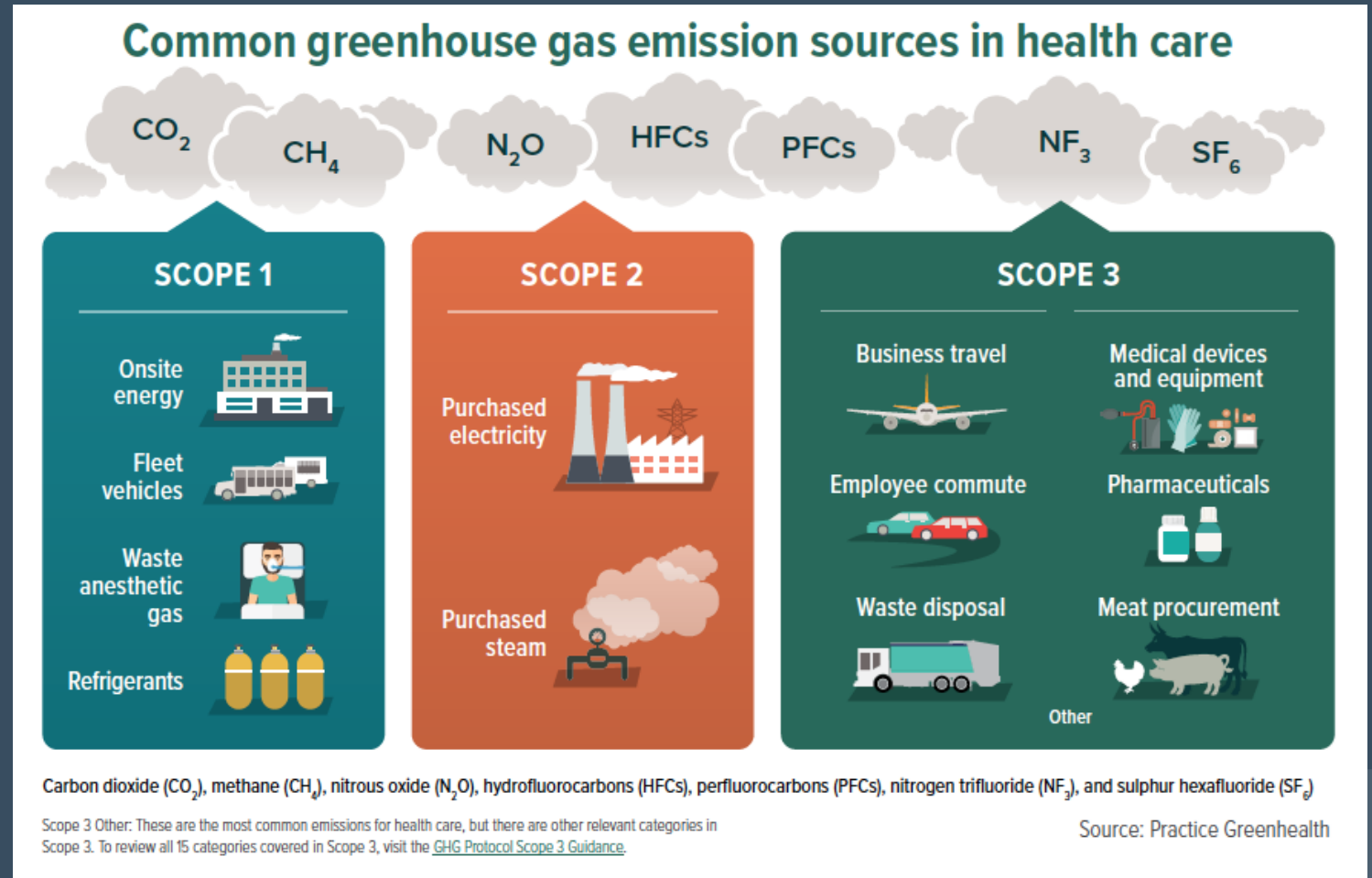
- Organizational carbon footprint split into three scope
 - Scope 1: Own an asset that emits carbon
 - Scope 2: Purchased electricity and steam
 - Scope 3: Supply Chain
- Makes it clear what to include
- Avoid double counting
- Makes information easier for stakeholders to understand
- Makes comparisons possible



What's Contained in Scope 1?

Scope 1:

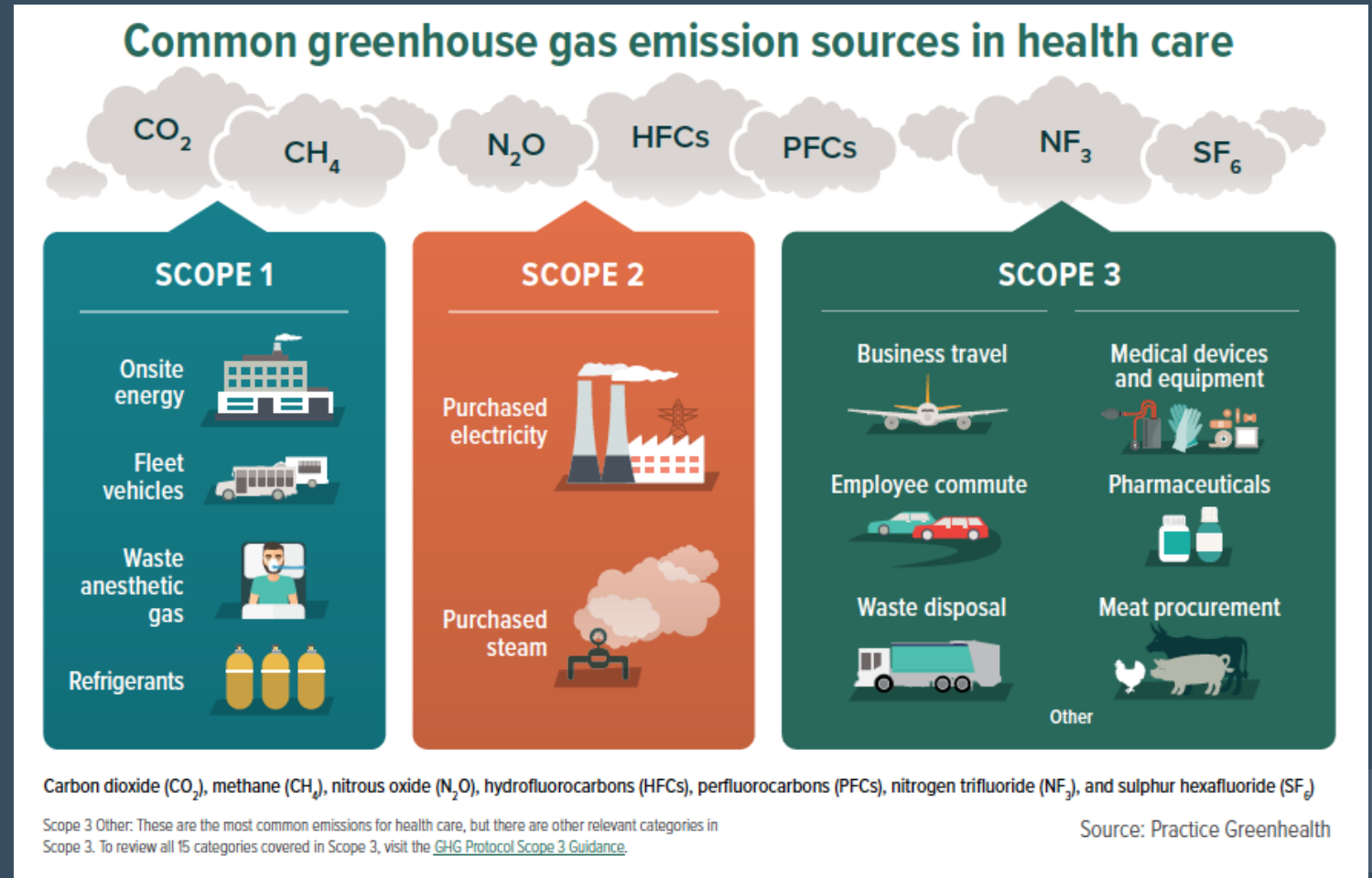
- Stationary combustion of fuels (e.g. boilers, generators, onsite incinerators)
- Mobile fuel combustion by fleet vehicles
- Refrigerants
- Waste anesthetic gas



What's Contained in Scope 1?

Scope 2:

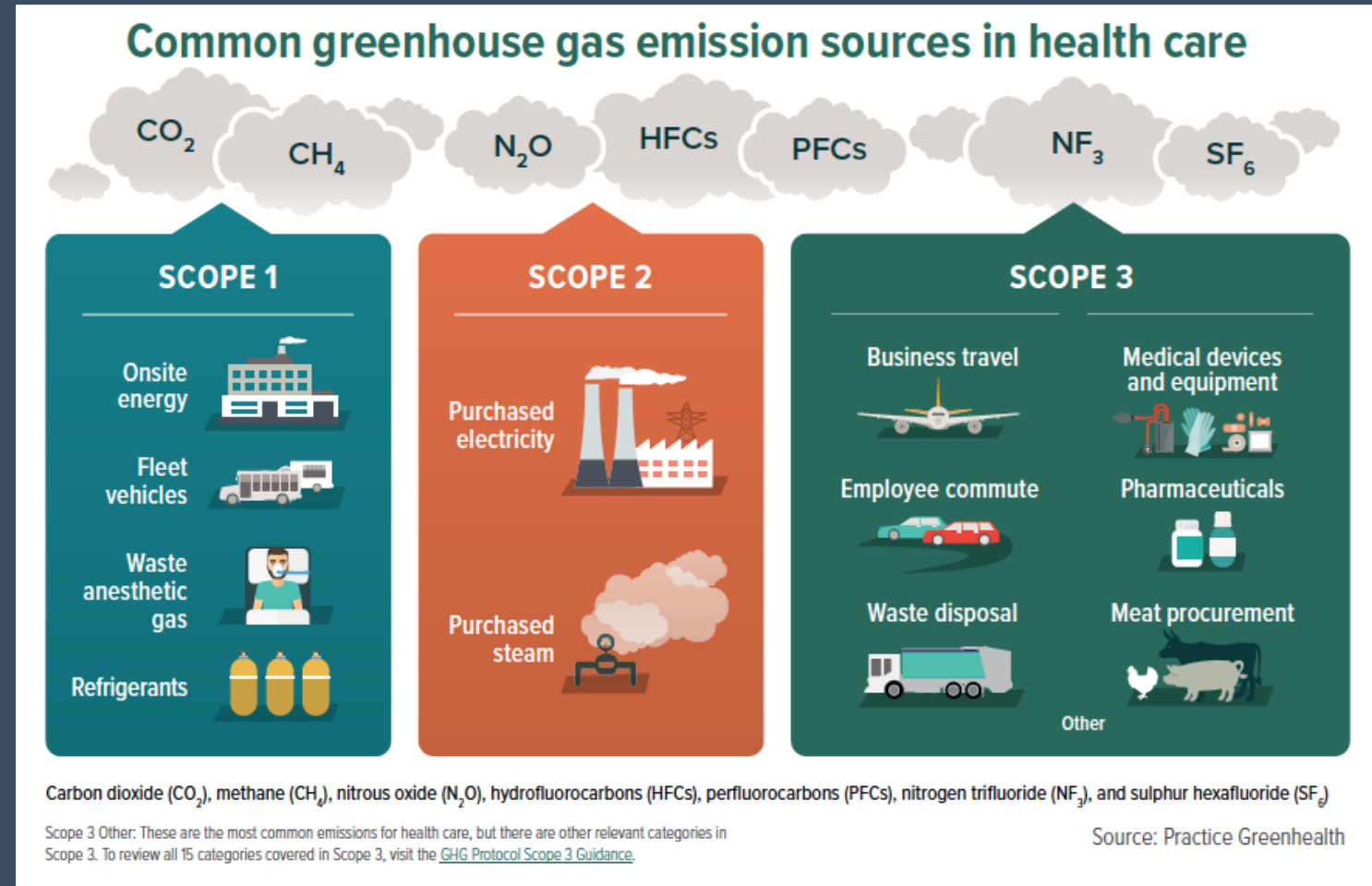
- Purchased electricity
- District steam or hot water
- District chilled water



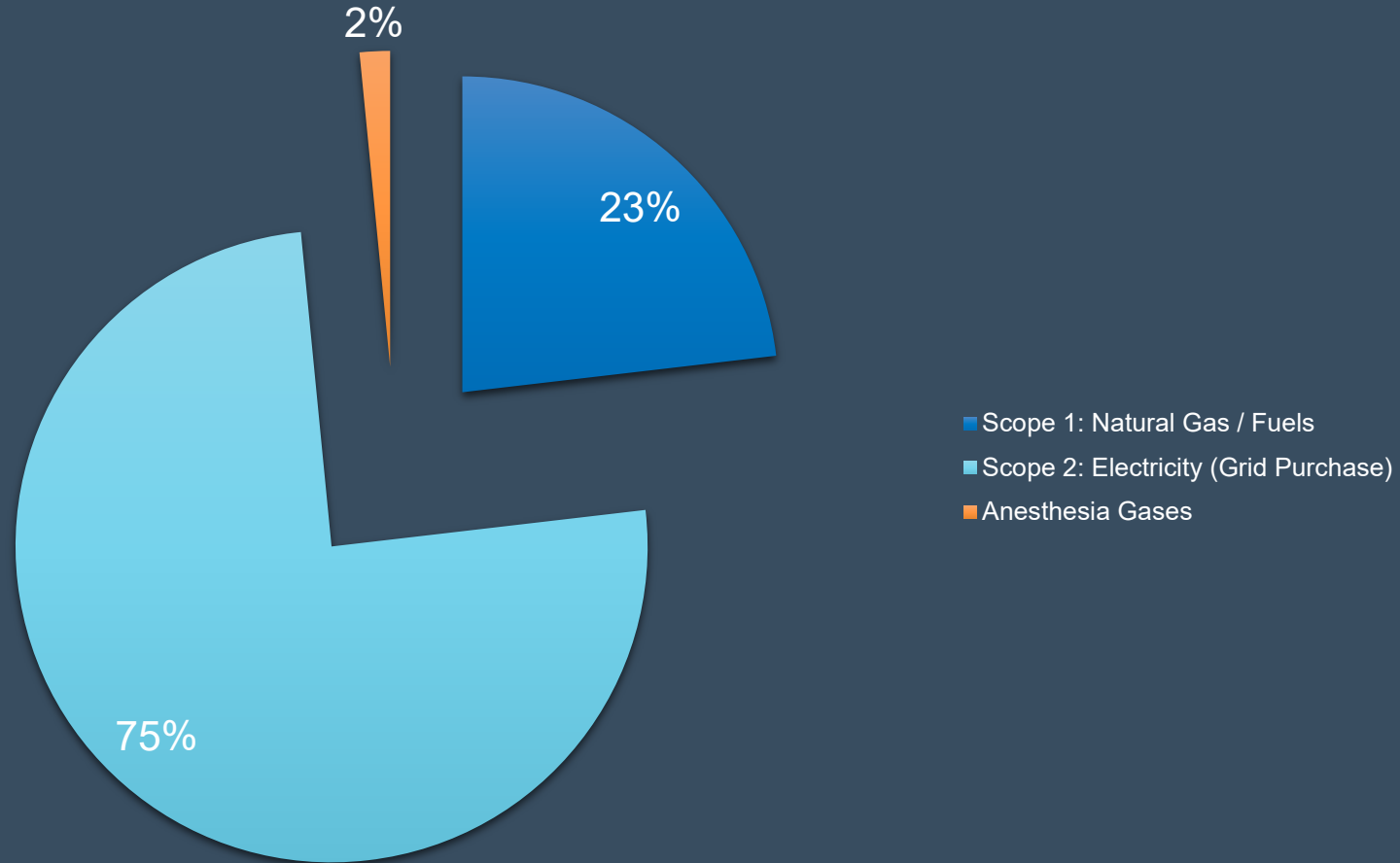
What's in Scope 3?

Scope 3:

- Purchased goods or services
- Investments
- Capital goods
- Fuel and energy-related activities (not in 1 or 2)
- Transportation and distribution of products
- Disposal of waste generated in operations
- Employee business travel
- Employee commute
- Processing of sold products
- End of life treatment of sold products
- Leased Assets



Cleveland Clinic Carbon Footprint



Identifying data sources

- Map out **sources** of emissions in organization based on operational boundaries
- Knowing WHERE TO FIND THE DATA
- For each identified source:
Activity data * emissions factor = emissions
- Carbon Footprint Mathematics for Electricity:
1,000 kWh * 1 ton/kWh = 1,000 tons CO₂e

Cleveland Clinic Data Collection – Natural Gas and Electricity

Evolution of Methods for Collection Data

2013-2014: Manual

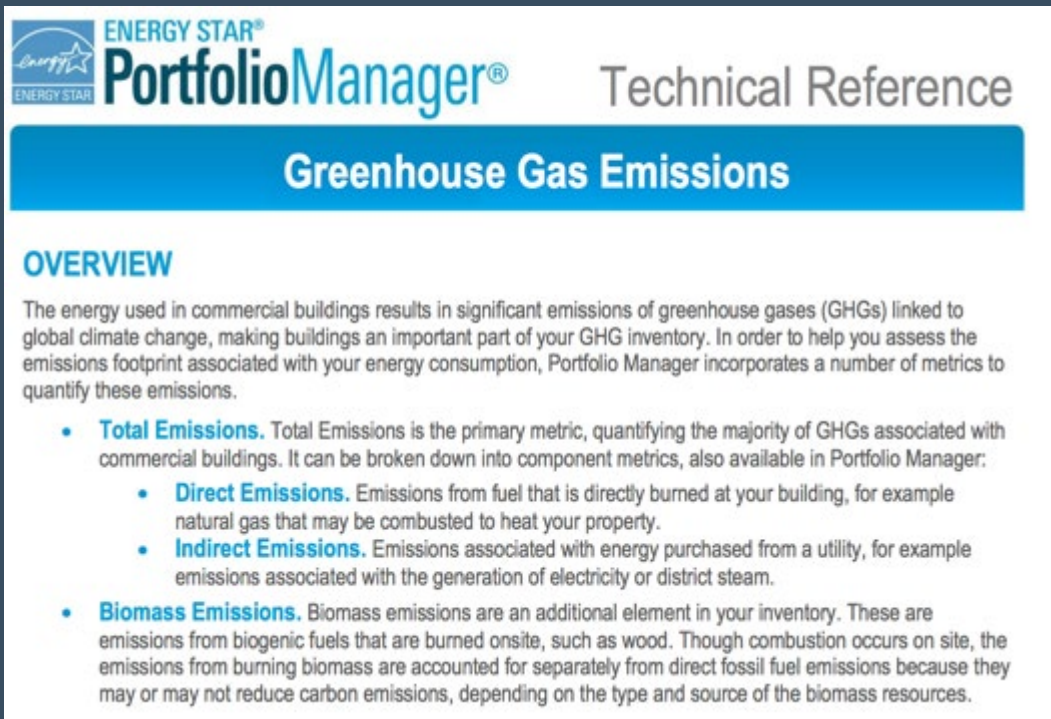
- Obtain and enter each facility meter's bill

2015-Present Automated

- Bill pay system reads bills, manages data quality and uploads usage

Where Cleveland Clinic Aggregates its Natural Gas and Electricity

- ENERGY STAR Portfolio Manager
- Practice Greenhealth GHG Tracking Spreadsheet
- Practice Greenhealth awards application

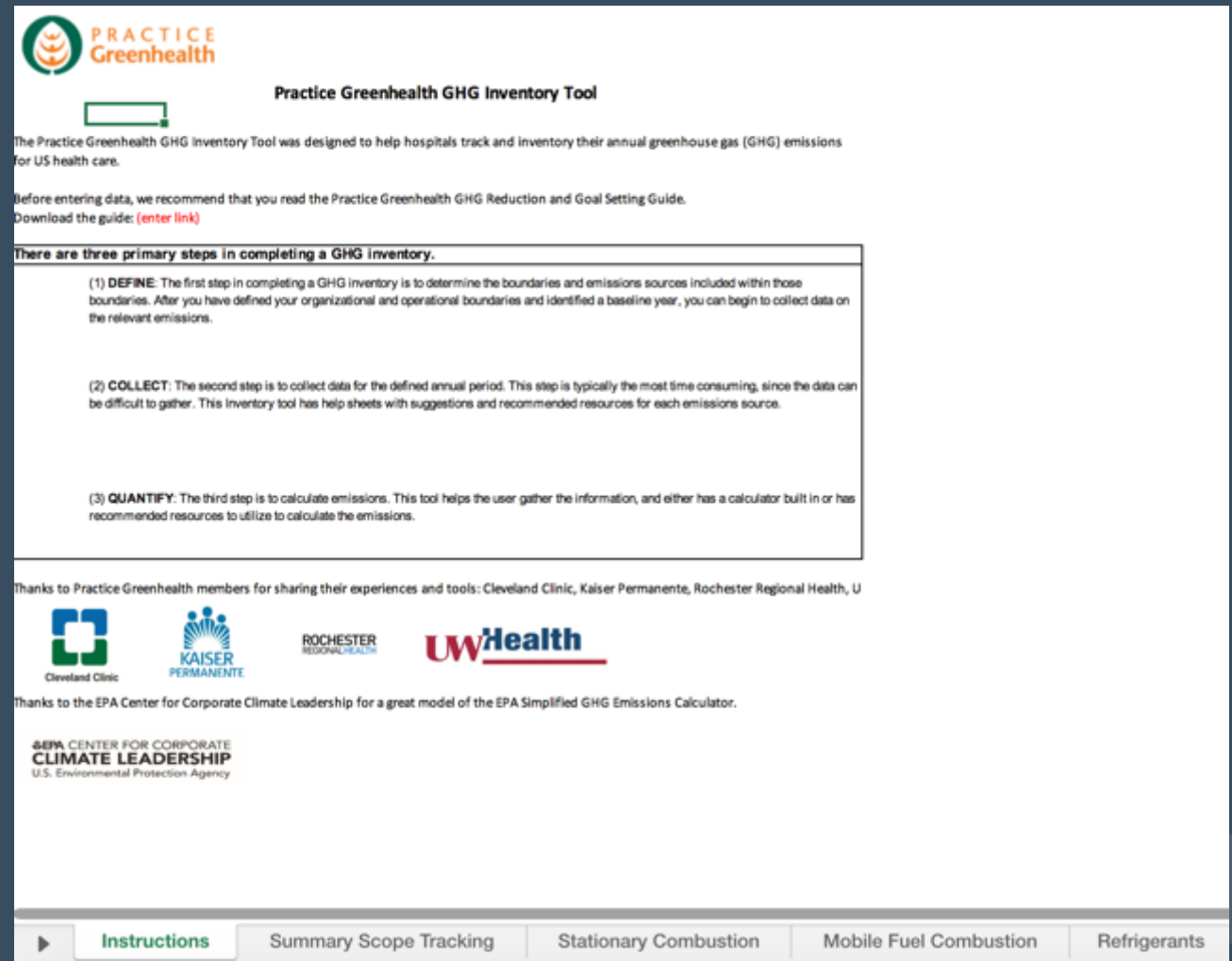


ENERGY STAR Portfolio Manager® Technical Reference
Greenhouse Gas Emissions

OVERVIEW

The energy used in commercial buildings results in significant emissions of greenhouse gases (GHGs) linked to global climate change, making buildings an important part of your GHG inventory. In order to help you assess the emissions footprint associated with your energy consumption, Portfolio Manager incorporates a number of metrics to quantify these emissions.

- **Total Emissions.** Total Emissions is the primary metric, quantifying the majority of GHGs associated with commercial buildings. It can be broken down into component metrics, also available in Portfolio Manager:
 - **Direct Emissions.** Emissions from fuel that is directly burned at your building, for example natural gas that may be combusted to heat your property.
 - **Indirect Emissions.** Emissions associated with energy purchased from a utility, for example emissions associated with the generation of electricity or district steam.
- **Biomass Emissions.** Biomass emissions are an additional element in your inventory. These are emissions from biogenic fuels that are burned onsite, such as wood. Though combustion occurs on site, the emissions from burning biomass are accounted for separately from direct fossil fuel emissions because they may or may not reduce carbon emissions, depending on the type and source of the biomass resources.



PRACTICE Greenhealth
Practice Greenhealth GHG Inventory Tool


The Practice Greenhealth GHG Inventory Tool was designed to help hospitals track and inventory their annual greenhouse gas (GHG) emissions for US health care.

Before entering data, we recommend that you read the Practice Greenhealth GHG Reduction and Goal Setting Guide.
Download the guide: [\(enter link\)](#)


There are three primary steps in completing a GHG inventory.

- (1) **DEFINE:** The first step in completing a GHG inventory is to determine the boundaries and emissions sources included within those boundaries. After you have defined your organizational and operational boundaries and identified a baseline year, you can begin to collect data on the relevant emissions.
- (2) **COLLECT:** The second step is to collect data for the defined annual period. This step is typically the most time consuming, since the data can be difficult to gather. This inventory tool has help sheets with suggestions and recommended resources for each emissions source.
- (3) **QUANTIFY:** The third step is to calculate emissions. This tool helps the user gather the information, and either has a calculator built in or has recommended resources to utilize to calculate the emissions.

Thanks to Practice Greenhealth members for sharing their experiences and tools: Cleveland Clinic, Kaiser Permanente, Rochester Regional Health, U



Thanks to the EPA Center for Corporate Climate Leadership for a great model of the EPA Simplified GHG Emissions Calculator.



EPA CENTER FOR CORPORATE CLIMATE LEADERSHIP
U.S. Environmental Protection Agency

▶ **Instructions** | Summary Scope Tracking | Stationary Combustion | Mobile Fuel Combustion | Refrigerants

Scope 1: Natural Gas Carbon Math

(Cleveland Clinic Baseline Year 2010)

Activity data * emissions factor = emissions

Activity data:	22,354,114 therms of natural gas	*	
Emissions factor:	0.00532 metric tons of CO ₂ e/therm	=	
Emissions:	124,967 Metric Tons CO₂e		

Scope 1: Carbon Footprint Categories

Scope 1

- Natural Gas
- Anesthesia
- Fuel Oil
- Owned Vehicles

Data Source

Utility Bills

Supply Chain &
Suppliers

Facilities Compliance

Transportation



Cleveland Clinic Data Collection – Natural Gas and Electricity

Evolution of Methods for Collection Data

2013-2014: Manual

- Obtain and enter each facility meter's bill

2015-Present Automated

- Bill pay system reads bills, manages data quality and uploads usage

Scope 1: Anesthesia Carbon Math

(Cleveland Clinic Baseline Year 2010)

Activity data * emissions factor = emissions

Activity data:	2,121 liters of sevoflurane	*
Emissions factor:	0.2 metric tons of CO ₂ e/liter	=
Emissions:	424 Metric Tons CO₂e	

Scope 1: Anesthesia Carbon Math

(Cleveland Clinic Baseline Year 2010)

Activity data * emissions factor = emissions

Activity data:	1,188 liters of isoflurane	*
Emissions factor:	0.76 metric tons of CO ₂ e/liter	=
Emissions:	903 Metric Tons CO₂e	

Scope 1: Anesthesia Carbon Math

(Cleveland Clinic Baseline Year 2010)

Activity data * emissions factor = emissions

Activity data:	59,154 pounds of nitrous oxide	*
Emissions factor:	0.00532 metric tons of CO ₂ e/liter	=
Emissions:	8,318 Metric Tons CO₂e	

Scope 1: Fuel Oil Carbon Math

(Cleveland Clinic Baseline Year 2010)

Activity data * emissions factor = emissions

Activity data:	50,500 gallons of oil	*
Emissions factor:	0.01023 metric tons of CO ₂ e/gallon	=
Emissions:	517 Metric Tons CO₂e	

Scope 1: Gasoline Carbon Math

(Cleveland Clinic Baseline Year 2010)

Activity data * emissions factor = emissions

Activity data:	225,032 gallons of gasoline	*	
Emissions factor:	0.0088 metric tons of CO ₂ e/gallon	=	
Emissions:	1,976 Metric Tons CO₂e		

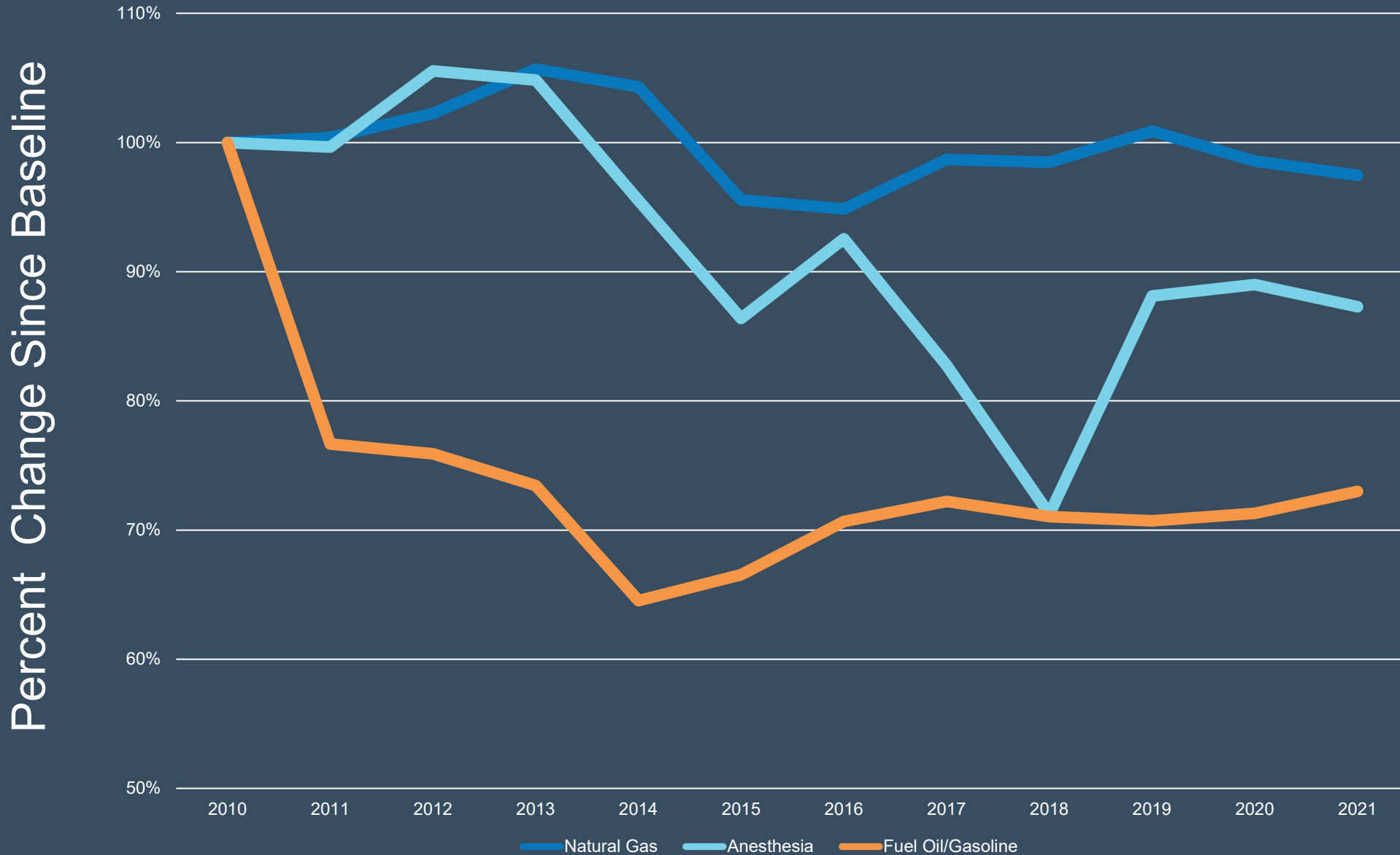
Scope 1: Diesel Carbon Math

(Cleveland Clinic Baseline Year 2010)

Activity data * emissions factor = emissions

Activity data:	55,366 gallons of diesel	*	
Emissions factor:	0.01021 metric tons of CO ₂ e/gallon	=	
Emissions:	565 Metric Tons CO₂e		

Cleveland Clinic Scope 1 Carbon Trends



Trend Driver:

**Sq Ft Increased,
Usage Flat**

**Reduced Use of
Nitrous**

**Fleet MPG
Improvement**



Fleet Vehicle Inventory and GHG Calculator

Table D. Fleet Vehicle GHG Emissions

Vehicle Type	Fuel Type	Number of Vehicles	Criteria	Annual Gallons of Fuel Used	Annual Fuel Cost (in \$)	GHG Emissions from Mobile Fuel Combustion (in MTCO2e)
163. Passenger ▼	164. Gasoline ▼	165. 4	166. Select all that apply: <input checked="" type="checkbox"/> Conventional <input type="checkbox"/> Low-emitting <input type="checkbox"/> Fuel-efficient <input type="checkbox"/> Alternative Fuel Vehicle	167. 1200	168. 3000	169. 10.57
180. Light duty tr. ▼	181. Biodiesel (B) ▼	182. 1	183. Select all that apply: <input type="checkbox"/> Conventional <input checked="" type="checkbox"/> Low-emitting <input type="checkbox"/> Fuel-efficient <input checked="" type="checkbox"/> Alternative Fuel Vehicle	184. 115	185. 287.50	186. 0.93
187. Ambulance ▼	188. Diesel ▼	189. 1	170. Select all that apply: <input type="checkbox"/> Conventional <input type="checkbox"/> Low-emitting <input type="checkbox"/> Fuel-efficient <input type="checkbox"/> Alternative Fuel Vehicle	171. 10,000 ⚠	172. 10000	173. 101.5
174. Bus ▼	175. Natural Gas ▼	176. 2	177. Select all that apply: <input type="checkbox"/> Conventional <input type="checkbox"/> Low-emitting <input type="checkbox"/> Fuel-efficient <input checked="" type="checkbox"/> Alternative Fuel Vehicle	178. 20,000 ⚠	179. 11,428 ⚠	180. 1.08
181. Passenger ▼	182. Electricity ▼	183. 4	184. Select all that apply: <input type="checkbox"/> Conventional <input checked="" type="checkbox"/> Low-emitting <input checked="" type="checkbox"/> Fuel-efficient <input checked="" type="checkbox"/> Alternative Fuel Vehicle	185. 1200	186. 260	187. 0
		188. 12			189. 24976	190. 114.08

Table H1. Volatile Anesthetic Agent Use

Volatile Anesthetic Agent	Number of Bottles purchased baseline year	Number of Bottles purchased previous year	Number of Bottles purchased current year	MTCO2E baseline	MTCO2E previous	MTCO2E Current
Sevoflurane						
100 mL	21. <input type="text" value=""/>	22. <input type="text" value=""/>	23. <input type="text" value=""/>	24. 0.00	25. 0.00	26. 0.00
250 mL	27. <input type="text" value=""/>	28. <input type="text" value=""/>	29. <input type="text" value=""/>	30. 0.00	31. 0.00	32. 0.00
33. Other size (in mL) <input type="text" value=""/>	34. <input type="text" value=""/>	35. <input type="text" value=""/>	36. <input type="text" value=""/>	37. 0	38. 0	39. 0
Total Sevoflurane:				40. 0.00	41. 0.00	42. 0.00
Isoflurane						
100 mL	43. <input type="text" value=""/>	44. <input type="text" value=""/>	45. <input type="text" value=""/>	46. 0	47. 0	48. 0
250 mL	49. <input type="text" value=""/>	50. <input type="text" value=""/>	51. <input type="text" value=""/>	52. 0.00	53. 0.00	54. 0.00
55. Other size (in mL) <input type="text" value=""/>	56. <input type="text" value=""/>	57. <input type="text" value=""/>	58. <input type="text" value=""/>	59. 0	60. 0	61. 0
Total Isoflurane:				62. 0.00	63. 0.00	64. 0.00
Desflurane						
240 mL	65. <input type="text" value=""/>	66. <input type="text" value=""/>	67. <input type="text" value=""/>	68. 0.00	69. 0.00	70. 0.00
71. Other size (in mL) <input type="text" value=""/>	72. <input type="text" value=""/>	73. <input type="text" value=""/>	74. <input type="text" value=""/>	75. 0	76. 0	77. 0
Total Desflurane:				78. 0.00	79. 0.00	80. 0.00

Scope 2 Carbon Footprint Categories

Scope 2

- Electricity
- Purchased RECs

Data Source

Utility Bills

Renwables Statements



Cleveland Clinic Data Collection – Natural Gas and Electricity

Evolution of Methods for Collection Data

2013-2014: Manual

- Obtain and enter each facility meter's bill

2015-Present Automated

- Bill pay system reads bills, manages data quality and uploads usage

Scope 2: Electricity Carbon Math

(Cleveland Clinic Baseline Year 2010)

Activity data * emissions factor = emissions

Activity data:	642,852 MWh of electricity	*
Emissions factor:	1,511.52 US pounds of CO ₂ e/MWh	=
Emissions:	428,611 Metric Tons CO₂e	

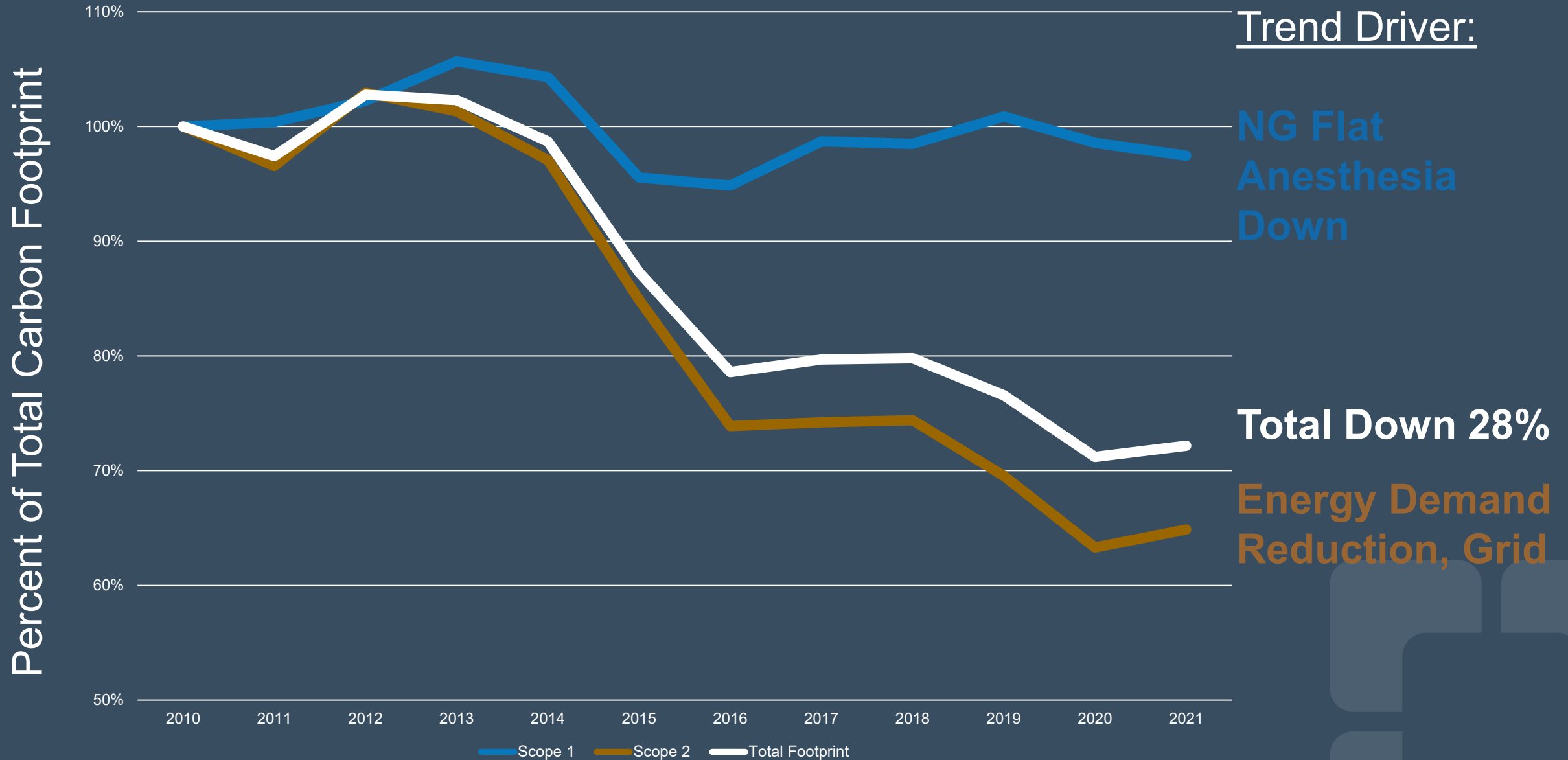
Scope 2: Purchased Steam Math

(Cleveland Clinic Baseline Year 2010)

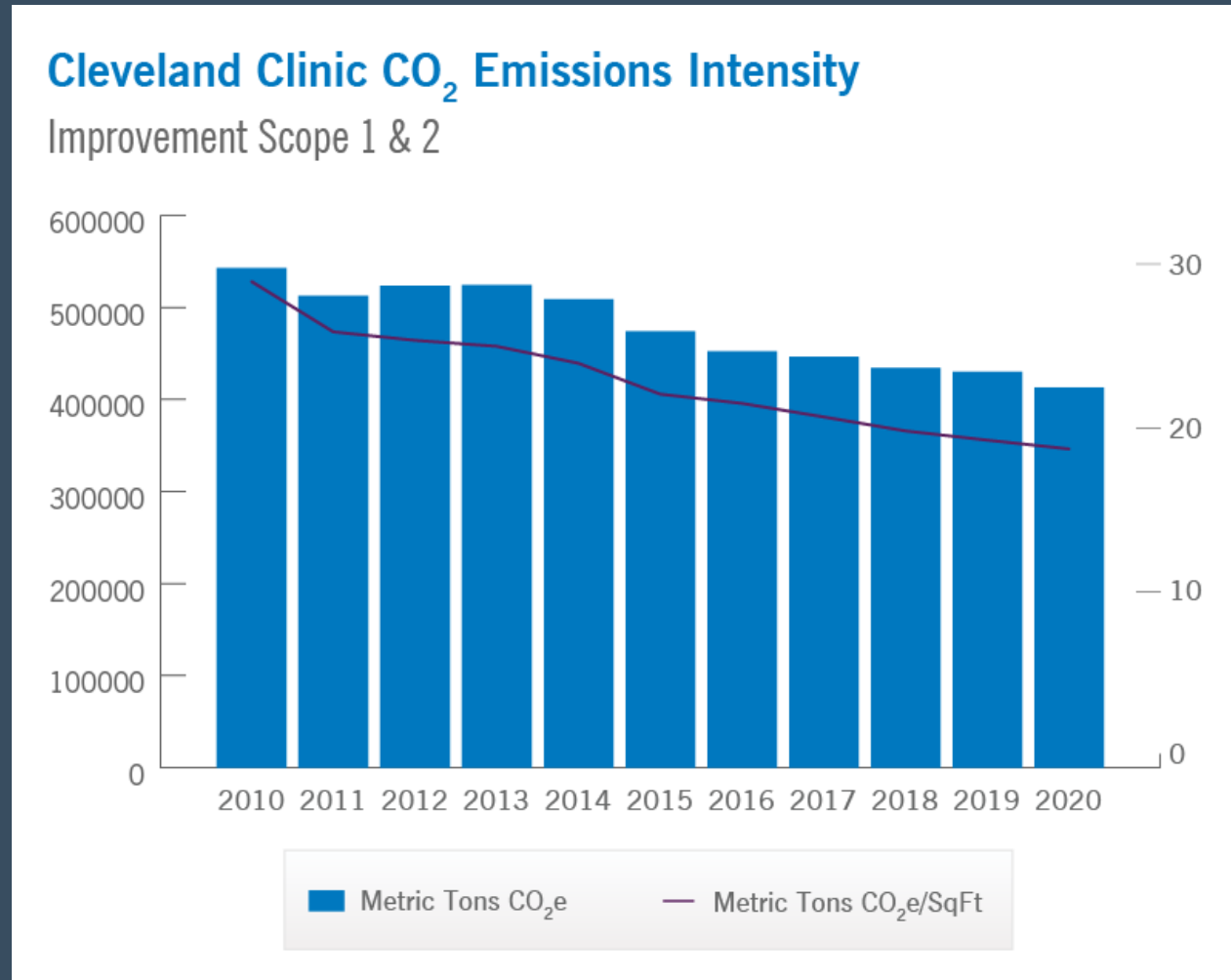
Activity data * emissions factor = emissions

Activity data:	139,873,844 kBtu of steam	*
Emissions factor:	0.0053 Metric Tons CO ₂ e/kBtu	=
Emissions:	7,413 Metric Tons CO₂e	

Cleveland Clinic Carbon Footprint Trends



Cleveland Clinic Publically Publishes Footprint Annually



GHG Inventory Tracking Tool

	A	B	C
1			
2	Scope	Type	
3	Scope 1	Stationary combustion of fuels (or ENERGY STAR direct emissions)	0
4		Mobile fuel combustion by fleet vehicles	0
5		Refrigerants (fluorinated gases)	0
6		Waste anesthetic gases (process emissions)	0
7		<i>Total Scope 1 emissions</i>	0
8	Location-based Scope 2 emissions	Purchased electricity	0
9		Steam, hot water, chilled water	0
10		ENERGY STAR combined indirect emissions	0
11	Market-based Scope 2 emissions	Purchased electricity	0
12		Steam, hot water, chilled water	0
13		<i>Total organization Scope 1 & 2 emissions</i>	
14	Gross and net emissions for Scopes 1 & 2	Total Scope 1 & location-based Scope 2	0
15		Total Scope 1 & market-based Scope 2	0
16		<i>Reductions</i>	
17		Offsets	0
18		Net Scope 1 and 2 location-based emissions	0
19	Net Scope 1 and 2 market-based emissions	0	
20	Scope 3	Purchased goods or services	
21		Capital goods	
22		Fuel and energy-related activities (not in Scope 1 or 2)	
23		Transportation and distribution	
24		Waste generated in operations	
25		Business travel	
26		Employee commuting	
27		End of life treatment of sold goods	
28		Leased assets	
29		Other Scope 3 emissions (please describe):	
30		<i>Total Scope 3 emissions</i>	0
31			
32		<i>Required supplemental information for reporting</i>	
33		Biomass CO2 emissions from stationary sources	0
34		Biomass CO2 emissions from mobile sources	0
35			

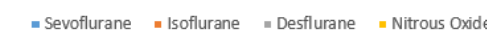


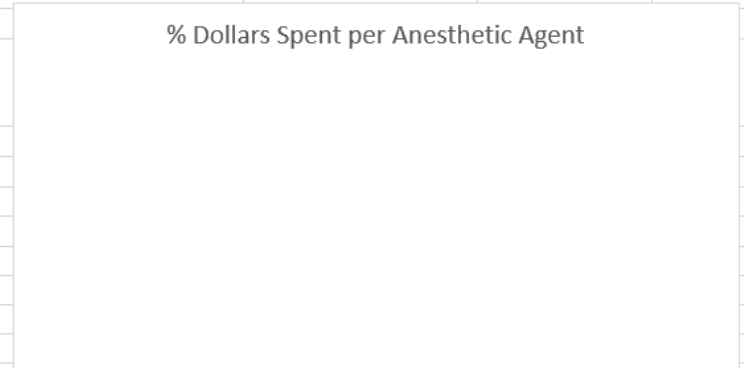
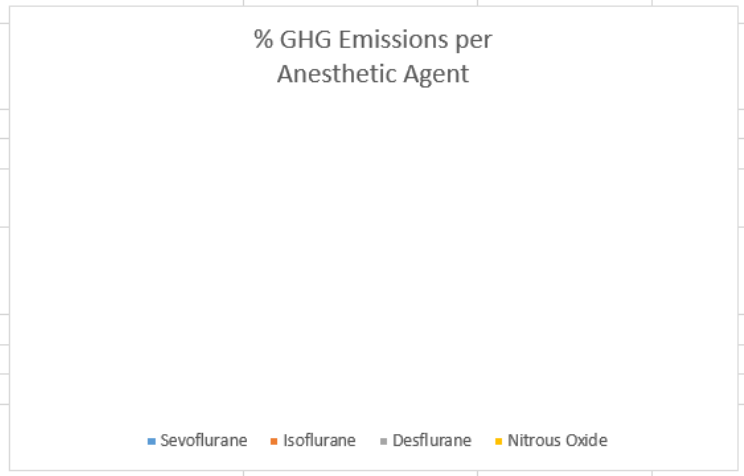
Instructions

Summary Scope Tracking

Stationary

Anesthetic Gas Tracking Tool

	A	B	C	D	E	F	G	H	I	J	K	L	M
13													
14	Anesthetic Agent	Number of bottles purchased (12 month/annual)	Size (mL)	MTCO2E	Total Dollars Spent (\$) Annually		MTCO2E per			<div style="text-align: center;"> <p>% GHG Emissions per Anesthetic Agent</p>  </div>			
15	Sevoflurane		100	0		OR	#VALUE!						
16	Sevoflurane		250	#VALUE!		OR procedure	#VALUE!						
17	Sevoflurane Total			#VALUE!		Number of general anesthesia cases	#VALUE!						
18	Anesthetic Agent	Number of bottles purchased (12 month/annual)	Size (mL)	MTCO2E	Total Dollars Spent (\$) Annually		Total number of general anesthesia hours	#VALUE!					
19	Isoflurane		100	0									
20	Isoflurane		250	#VALUE!		Anesthetic Agent	% Footprint	% Spend					
21	Isoflurane Total			#VALUE!		Sevoflurane	#VALUE!	#VALUE!					
22	Anesthetic Agent	Number of bottles purchased (12 month/annual)	Size (mL)	MTCO2E	Total Dollars Spent (\$) Annually		Isoflurane	#VALUE!	#VALUE!				
23	Desflurane		240	#VALUE!		Desflurane	#VALUE!	#VALUE!					
24	Anesthetic Agent	Total lbs purchased (12 month/ annual)		MTCO2e	Total Dollars Spent (\$) Annually		Nitrous Oxide	#VALUE!	#VALUE!				
25	Nitrous Oxide			#VALUE!									
26													
27	Total MTCO2E from Anesthetic Gases				#VALUE!								
28	Total Dollars Spent on Anesthetic Gases				#VALUE!								
29													
30													
31													
32													



Instructions

Baseline Year

Year 2

Year 3

Long-hand formulas

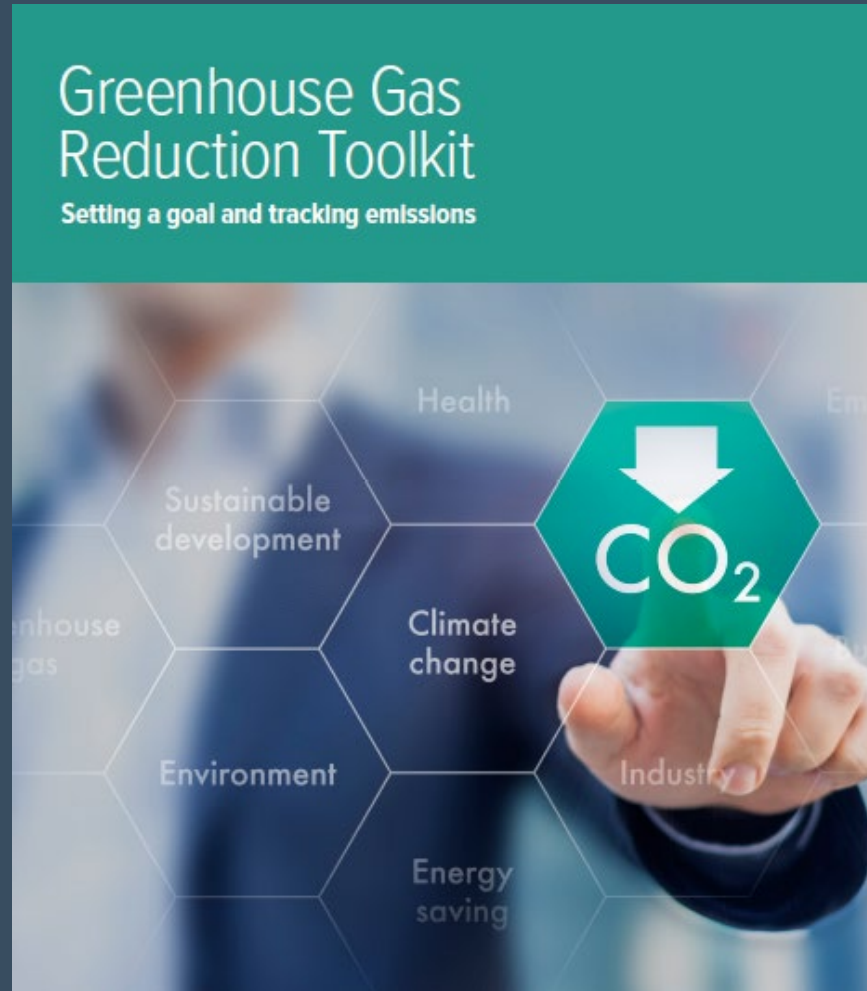
Year over Year Trend

Anesthesia Checklist



Greenhouse Gas Reduction

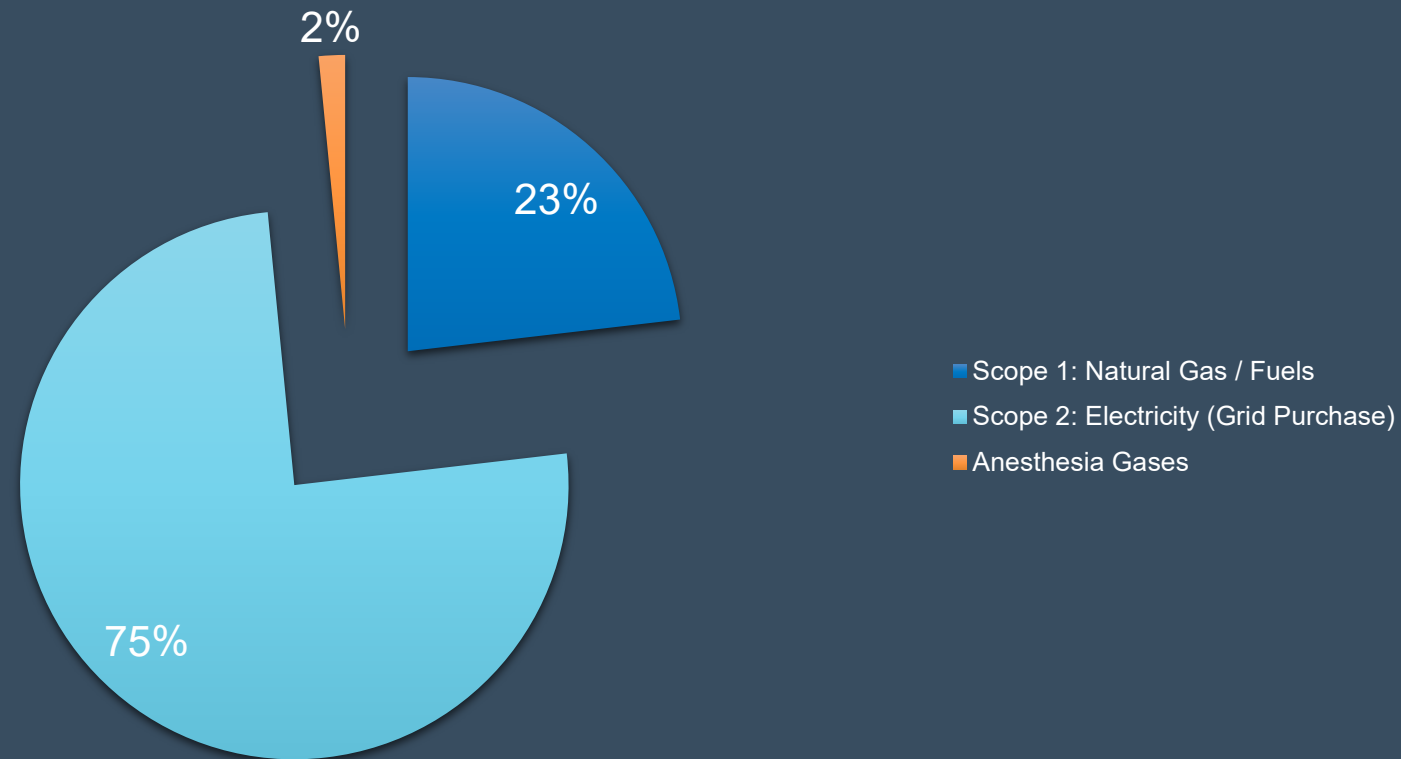
Examples of Practice Greenhealth member GHG reduction goals



- Boston Medical Center: 25% by 2020 and 100% by 2050
- Cleveland Clinic: Carbon neutral by 2027
- Dartmouth Hitchcock: 25% reduction by 2020
- Dignity Health: 40% reduction by 2020
- Gundersen Health: Energy independence achieved in 2014
- Kaiser Permanente: Carbon net positive by 2025
- Memorial Sloan Kettering: 50% reduction by 2025
- Montefiore Health System: 50% reduction by 2025
- NYU Langone: 50% reduction by 2025
- Ohio State Wexner Medical Center: Carbon neutral by 2050
- Partners Healthcare: 25% by 2020 and 100% by 2050
- Providence St. Joseph Health: 30% reduction by 2025 and 100% by 2040
- Rochester Regional Health: 100% renewable electricity by 2025
- Sutter Health: 50% by 2025 and 80% by 2030 with a 2014 baseline
- University of California Health: Carbon neutral by 2025
- Virginia Mason Memorial Yakima: Carbon neutral by 2025

At Cleveland Clinic, scope 2 is three times larger than Scope 1

Cleveland Clinic Carbon Footprint



University of California Health Carbon Accounting

NAM Carbon Clinic

Seema Gandhi, MD
Clinical Professor, Anesthesia and Perioperative Care
Medical Director of Sustainability
University of California, San Francisco

Matt St. Clair
Chief Sustainability Officer
UC Office of the President

UNIVERSITY
OF
CALIFORNIA **Carbon Neutrality**
Initiative

UC Leading on Climate Initiative

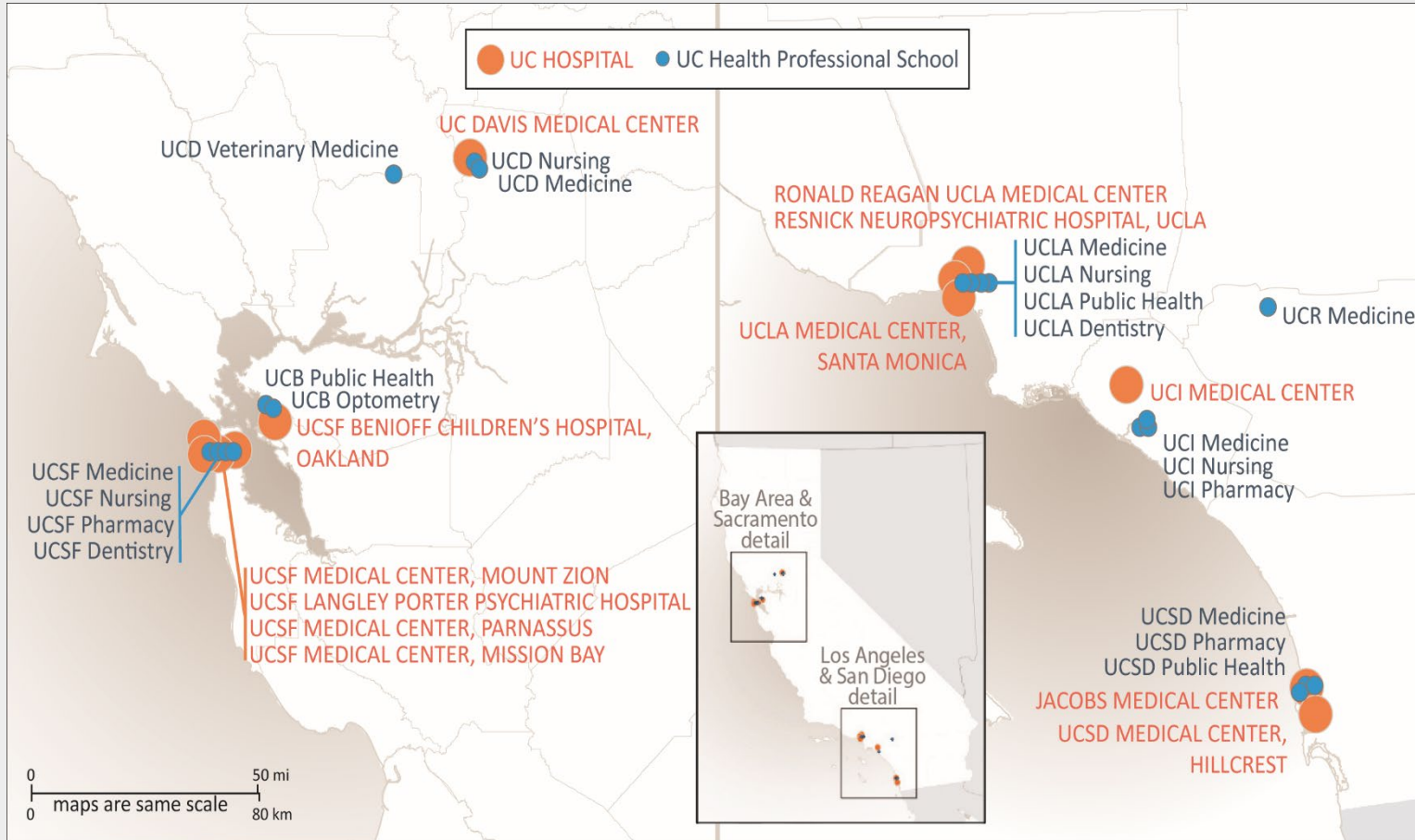
Mission

The University of California's operations will become fossil free by 2045 as part of our larger goal to help create a more equitable, sustainable, resilient and healthy world.

Vision

Our climate research, teaching and actions will prioritize solutions for everyone.

University of California Health



- 6 Academic Health Centers
- 12 Hospitals
- 20 Health Professional Schools

UC Health Building and Carbon Footprint

16,000,000

—
Gross Sq. Ft.

22,000

Electr. MTCO₂

145,000

—
NG MTCO₂

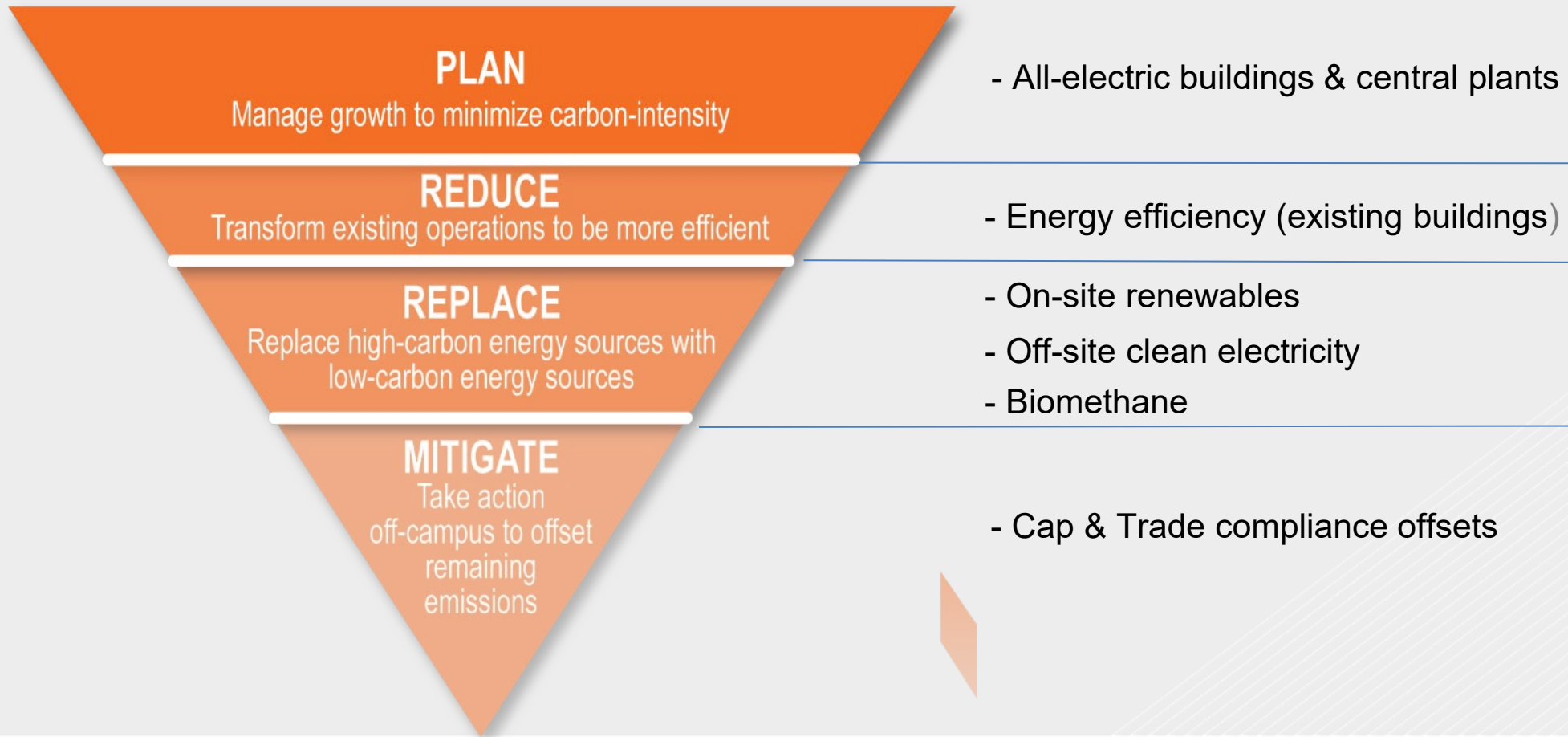
170,000

—
MTCO₂

How and Where Does UC Health Report GHGs

- Sustainability Office collects data
 - From facilities/energy managers, fleet managers, etc.
- 3rd-party verification through The Climate Registry
- Annual Sustainability Report to UC Board of Regents

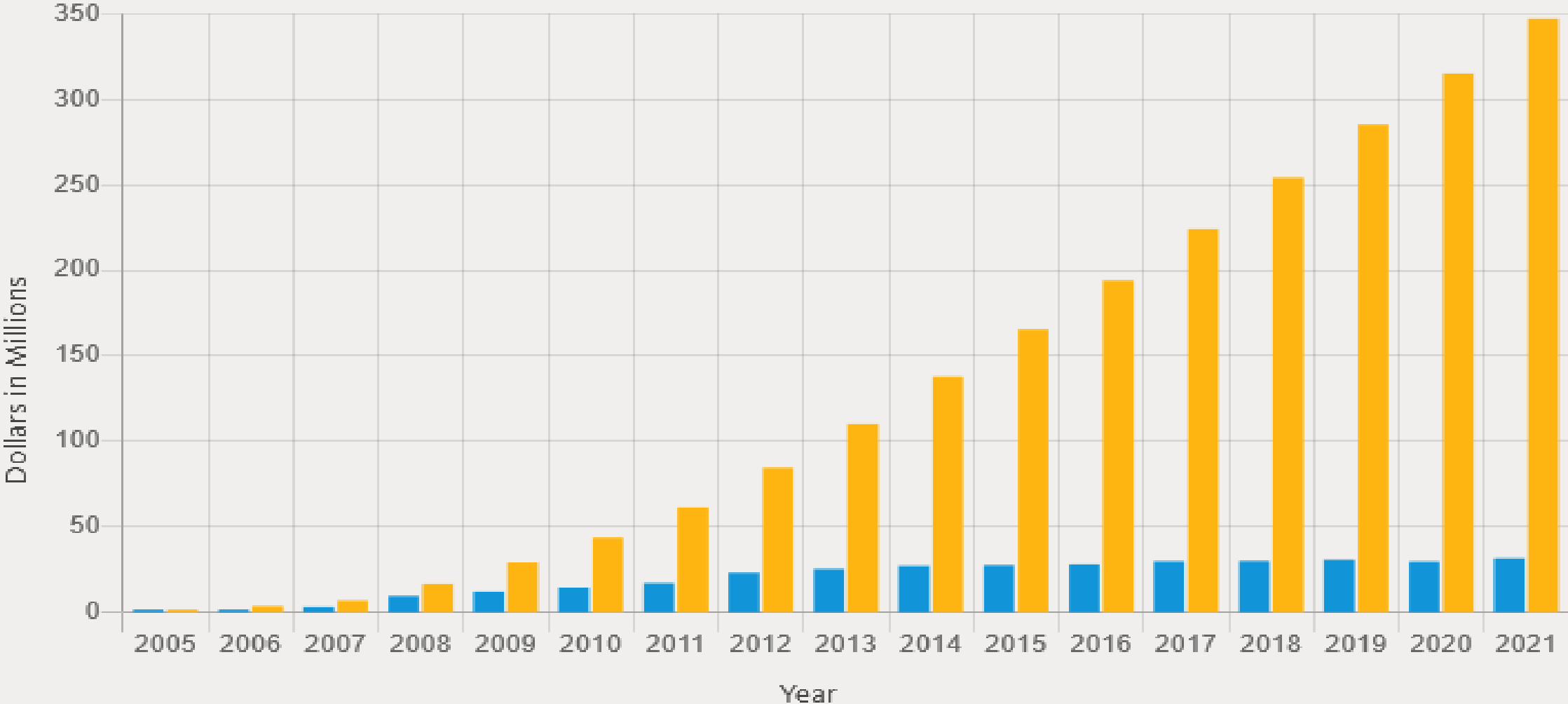
UC's Climate Action Strategies



All-Electric Hospitals and Central Plants

- UC Irvine Health Medical Campus Complex
- UC San Francisco Health Parnassus Hospital
- UC Davis Health Aggie Square
- UC San Diego Health Hillcrest Campus
- All UC health systems completing decarbonization studies in 2024

EFFICIENCY COST SAVINGS



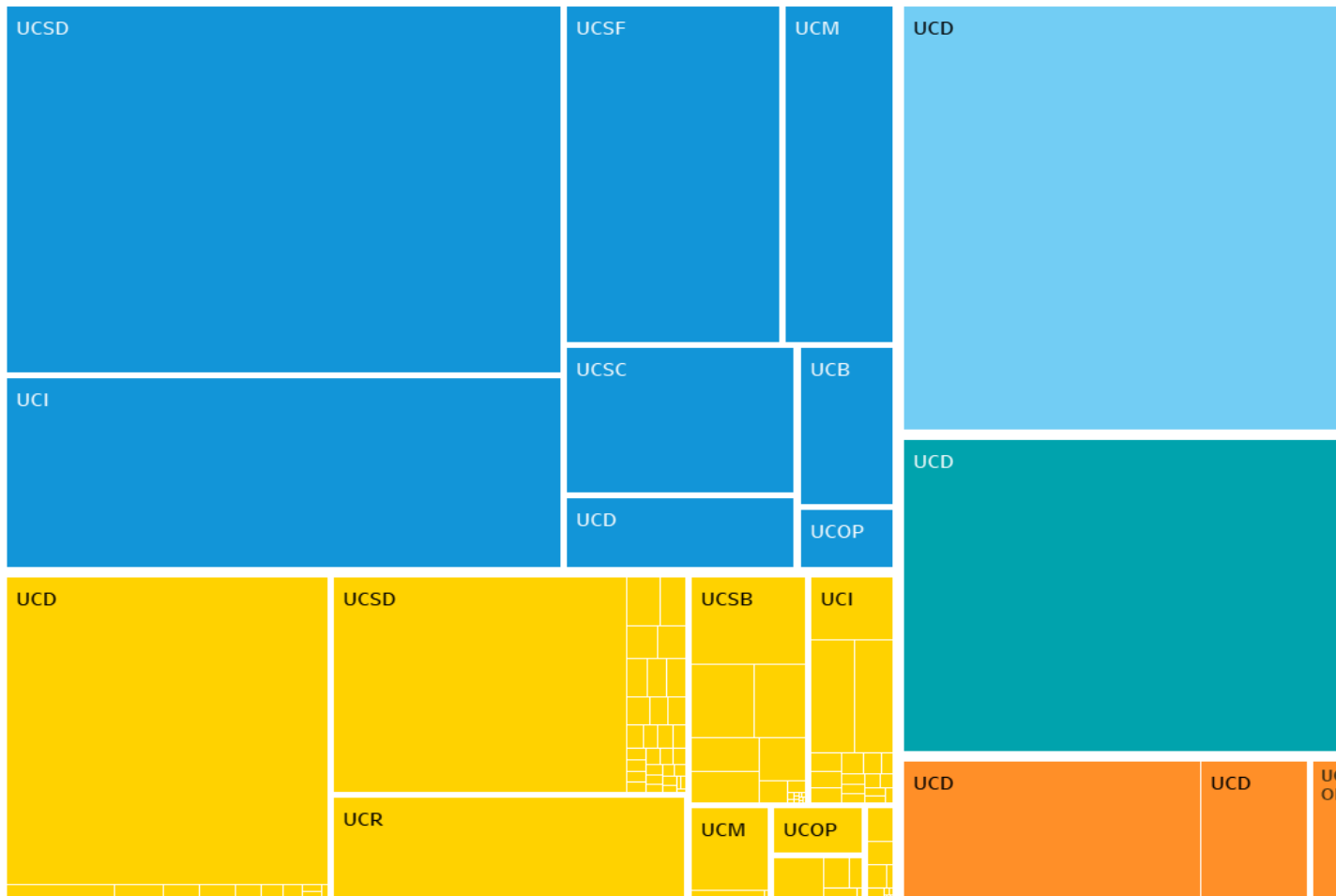
■ Net Avoided Cost (cumulative annual)

■ Net Avoided Cost (cumulative total)

Energy Efficiency in Healthcare Facilities

- Retrocommissioning & Controls Optimization
- HVAC
 - Variable air volume supply using indoor air quality performance targets
- Lighting Retrofits
 - Lighting audits at all 5 UC Health Systems
 - Installed experimental circadian/amber lighting for patient rooms/hallways
 - Installed high CRI lighting in dermatology clinic
- MRI Energy Efficiency
 - Measured energy consumption of each manufacturer's MRI machine

UC has over 100 renewable energy supplies on-line



Energy Supply Type

- Off-campus UC Wholesale Power Program
- Off-campus Long-term Contracts
- Off-campus Short-term Contracts
- Off-campus Opt-in Utility Programs
- On-campus Systems

Each box reflects a separate UC renewable energy supply source. These are organized by energy supply type and then sorted by campus. The size of each box reflects how much energy was generated by that project last year. In total, UC's projects generated 358 million kilowatt-hours.

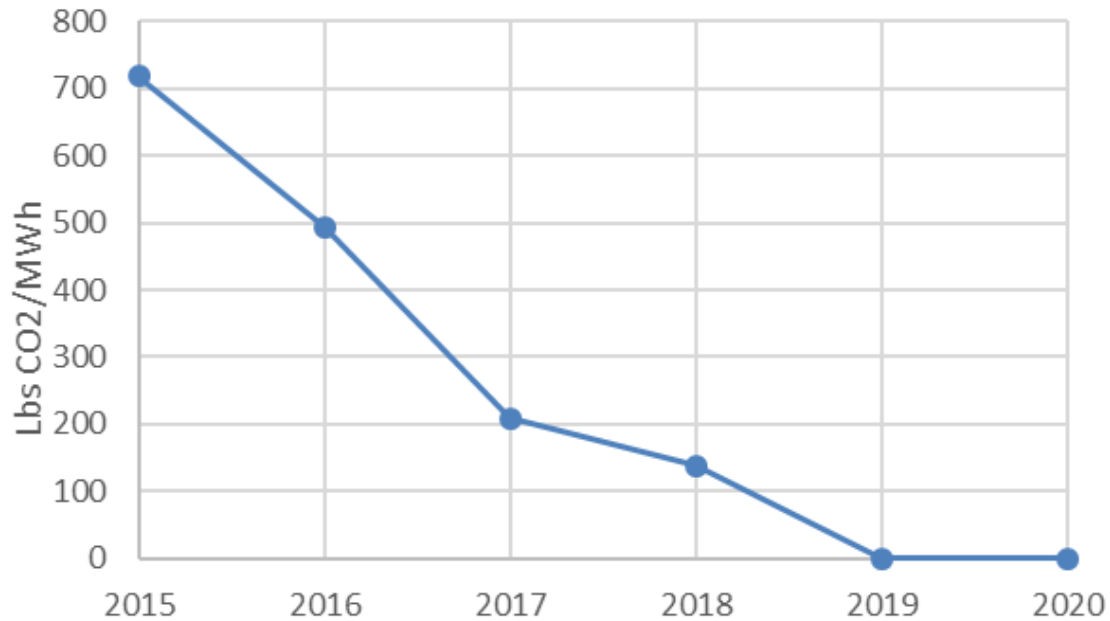


Green Power Partnership Top 30 College & University

Partner Name	Annual Green Power Use (kWh)
1. University of California	328,380,213

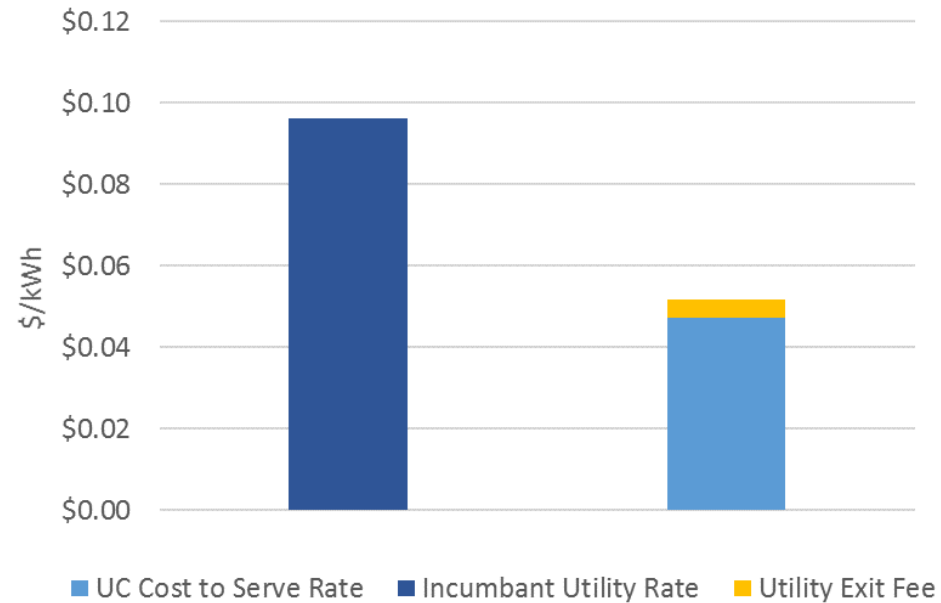
UC Clean Power Program Results

Carbon Intensity of Supplied Electricity



UC's electricity supplies were carbon neutral in 2019...

Price Relative to Business as Usual



...and costs were less-expensive than traditional utility services

Resources

- www.ucop.edu/sustainability
- [*Annual Sustainability Report*](#)
- [*Sustainable Practices Policy*](#)
- [*Climate Lab*](#)



Reduction in Emissions from Waste Anesthesia Gases (WAG)

Seema Gandhi, MD

Clinical Professor, Department of Anesthesia and Perioperative Care

Medical Director of Sustainability, UCSF Health

Seema.Gandhi@ucsf.edu



Agenda

Share

Our institutions journey from the invention to elimination of desflurane

Share

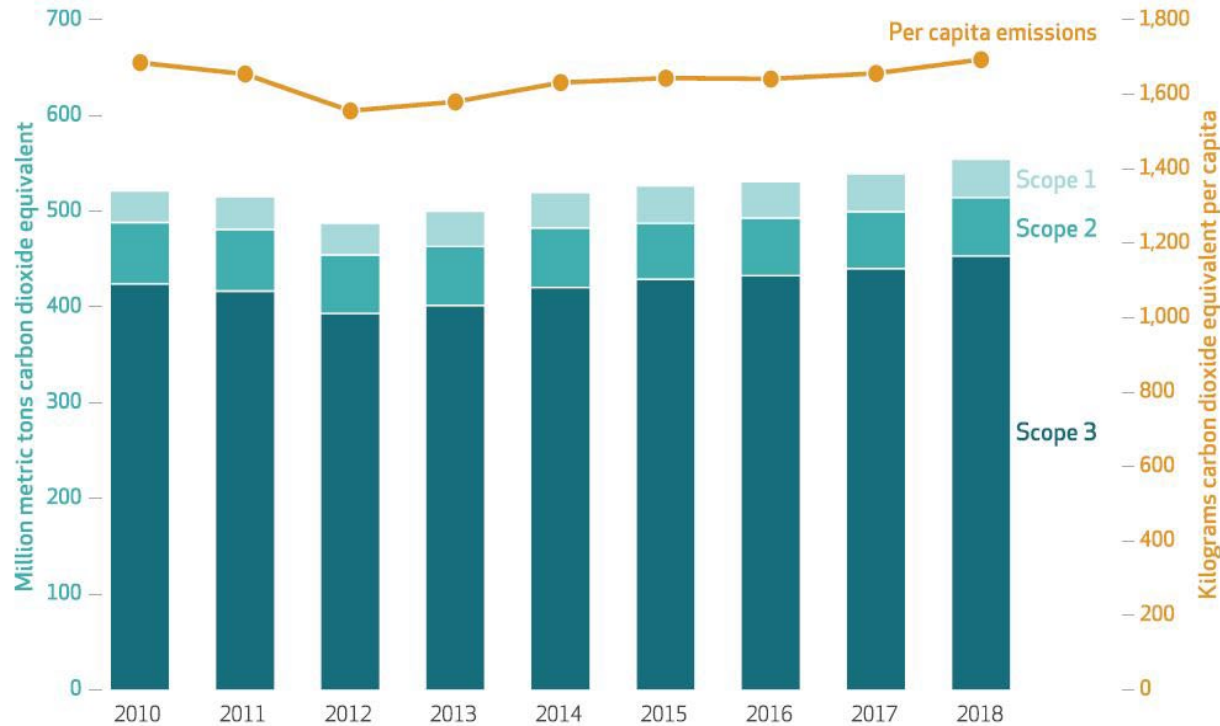
Tools to practice low flow anesthesia

Share

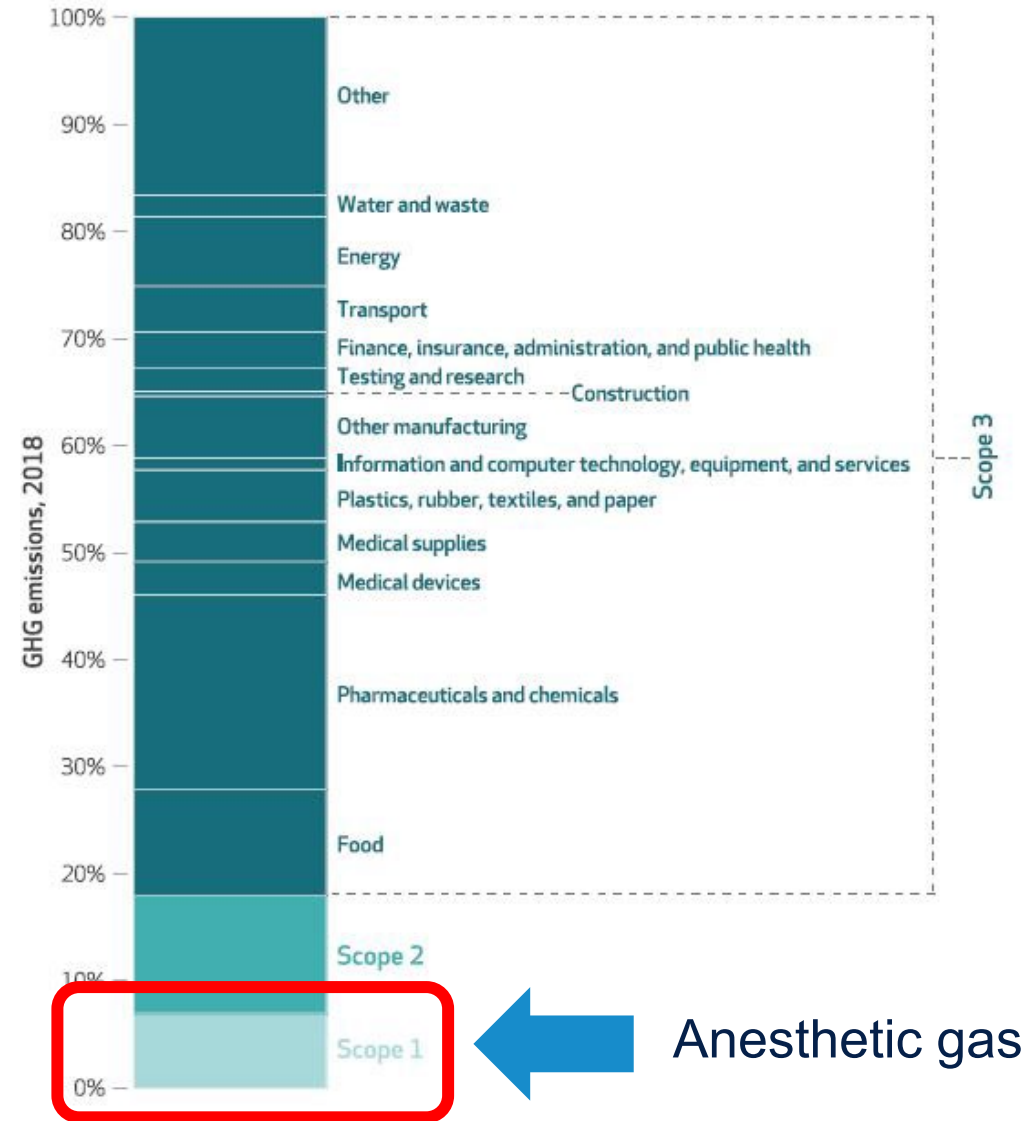
UCSF's case study to eliminate piped nitrous oxide

US Healthcare Emissions

US national health care greenhouse gas (GHG) emissions, 2010-18



US national health care greenhouse gas (GHG) emissions by GHG Protocol Scope, 2018



← Anesthetic gases

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

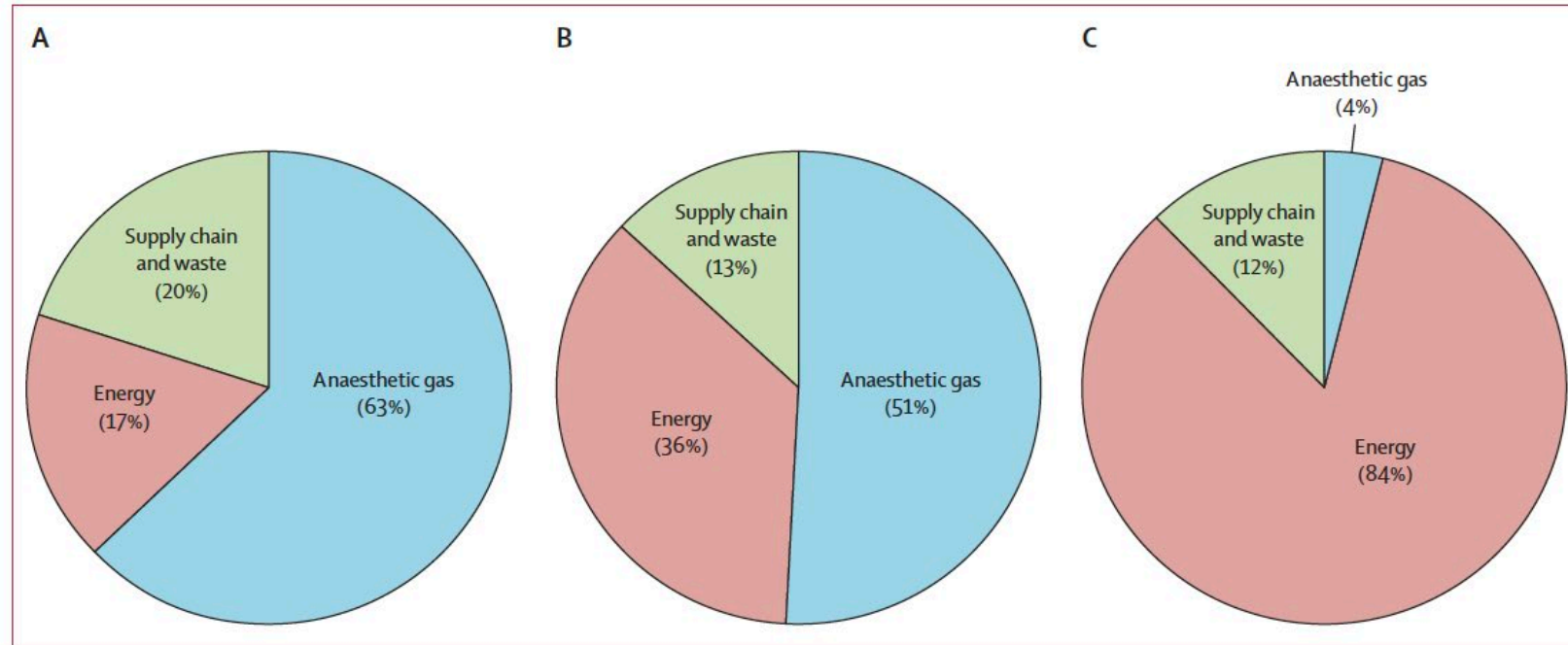


Figure 2: Relative contribution of scopes 1, 2, and 3 to the carbon footprint of operating theatres at (A) Vancouver General Hospital, (B) University of Minnesota Medical Center, and (C) John Radcliffe Hospital
Anaesthetic gas=scope 1. Energy=scope 2. Supply chain and waste=scope 3.

Inhaled Anesthetics: Global Warming Potential



	Lifetime ¹⁶ (year)	GWP100	Driving equivalent (miles/hr.) ^{11,22}			
			Fresh Gas Flow			
			0.5 L/min*	1 L/min*	2 L/min*	5 L/min*
Nitrous Oxide	114	265 ¹⁸	29	57	112	282
Sevoflurane	1.1	130 ²³	-	4	8	19
Desflurane	14	2540 ²³	93	190	378	939
Isoflurane	3.2	510 ²³	4	8	15	38

UCSF's Journey

- Education
 - Grand rounds
 - Resident didactics
 - Sustainability newsletter
- Personalized feedback reports
- Desflurane vaporizer only available in the workroom
- Clinical Decision Support (CDS) tool

UCSF Anesthesia Department Sustainability Newsletter

TAKING CARS OFF THE STREETS OF SF

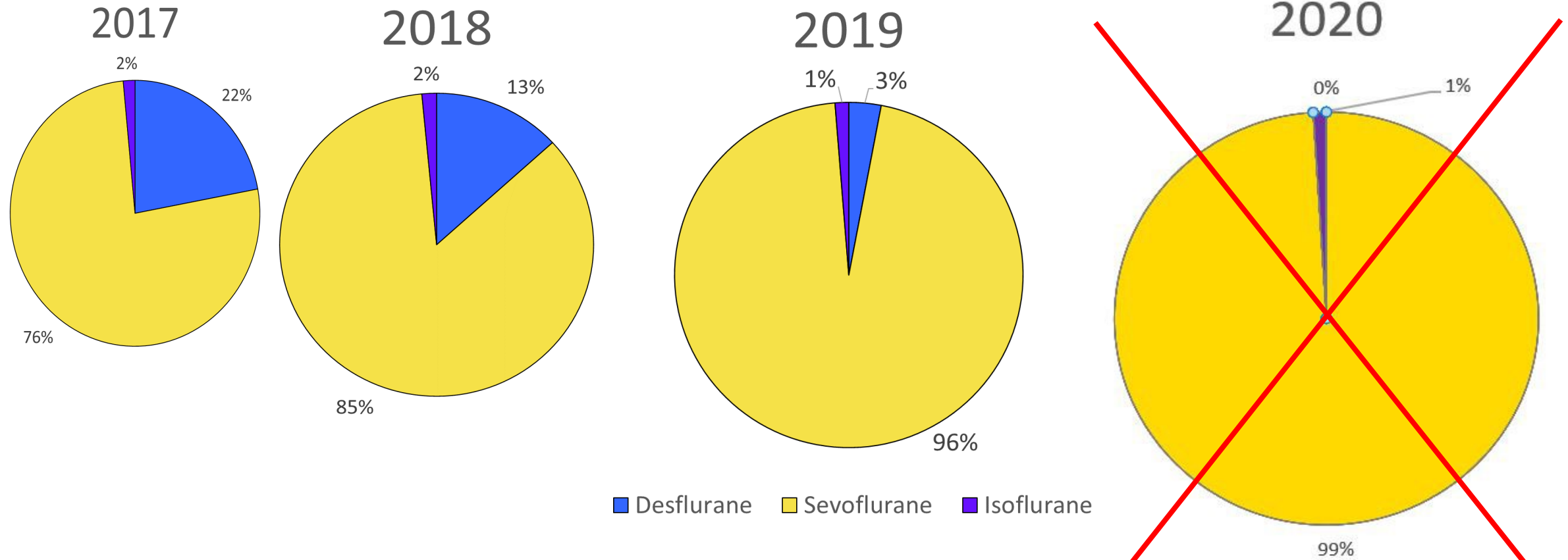
Updates on the Low Gas Flow BPA

with contributions from Dr. Priya Ramaswamy and Dr. Rishi Kothari



Desflurane: From Invention to Elimination

Percentage of Cases For Maintenance



Responsible Provider: (none)

No mean blood pressure.

Sevoflurane in use, and fresh gas flow is > 0.7 L/min. Please consider reducing your FGF.

Column Interval	2021 015	07:35	07:36	07:37	07:38	07:39	07:40	07:41	07:42	07:43	07:44	07:45	07:46	07:47	07:48	07:49	07:50	07:51	07:52	07:53	07:54	07:55	07:56	07:57	Totals	Est Vol
ETCO2 mmHg																										
Ane Vent Mode	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TV mL																										
TV/PIV mL																										
In O2 %	21	21	21	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
Temp 1 °C (°F)				0.56	4	7.1	19	10	3.1	15	2.2															
Sevo Cum Cons mL	13	13	13																							
ETCO2 %	21	21	21	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
PEEP cmH2O	0.1	0.1	0.1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
PIP cmH2O	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean AWP cmH2O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Set PEEP cmH2O	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Set RR bpm	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Set I:E Ratio I:Com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Set I:E Ratio E:Com	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Set Agent	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo	Sevo
Set Agent Concn. %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
In O2 %	21	21	21	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97

Sevoflurane in use, and fresh gas flow is > 0.7 L/min. Please consider reducing your FGF.

- Patient Equipment 0643
- Document Position 0643
- Document Airway 0643
- Document Staff 0643
- Pre Evaluation Attestation 0643
- Apparent Conversion to GA 0643
- Machine Check 0643
- PACU Orders 0644

Column Interval:	3/2	0730	0735	0740	0745	0750	0755	0800	0805	0810	0815	0820	
ET N2O %											0.2	0.2	
ET Sevoflurane %											1.3	1.3	
Ins													
Urine mL													

BestPractice Advisory - DoNotUse, Carly

Important (1)

Sevoflurane in use, and fresh gas flow is > 0.7 L/min. Please consider reducing your FGF.

Last five agent values

	03/02/21 0817	03/02/21 0818	03/02/21 0819	03/02/21 0820
Set Agent:	Sevoflurane	Sevoflurane	Sevoflurane	Sevoflurane
Set Total Gas Flow:	0.95 L/min	0.95 L/min	0.95 L/min	0.95 L/min

03/02/21 0821

Set Agent: Sevoflurane
Set Total Gas Flow: 0.95 L/min

Document a reason this BPA should be turned off for this case

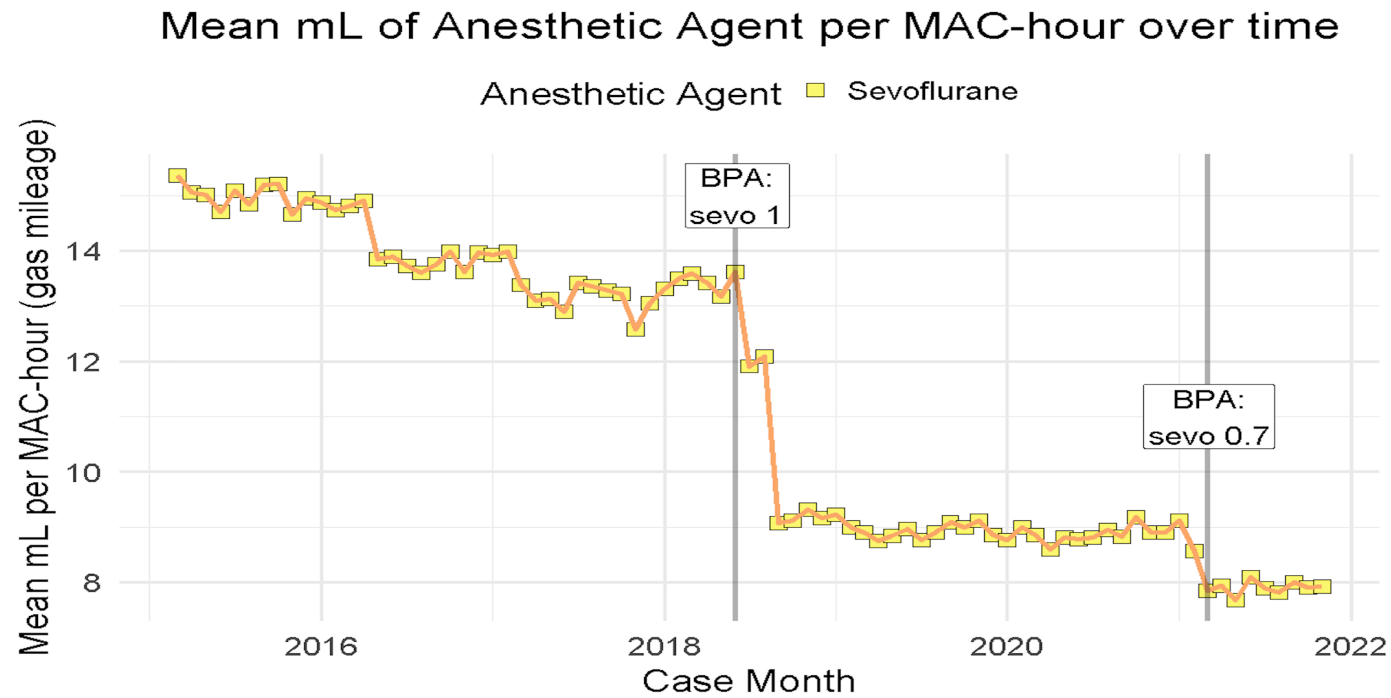
Acknowledge Reason _____

Acknowledge for 10 Mins

Accept Dismiss

Column Interval:	3/2	0730	0735	0740	0745	0750	0755	0800	0805	0810	0815	0820	
ETCO2 mmHg											43	42	
Ane Vent Mode											PCV-VG	FCV-VG	

The Impacts of Low Flow Anesthesia



	Baseline	Intervention	Difference (95% CI)	P Value
Sevoflurane				
MAC	0.9 ± 0.3	0.9 ± 0.3	0.0 (-0.1, 0.0)	< 0.0001
Total mL/hour	13.8 ± 6.8	8.2 ± 4.8	-5.5 (-5.6, -5.4)	< 0.0001
mL/MAC-hour	14.5 ± 5.3	9.3 ± 6.9	-5.2 (-5.3, -5.1)	< 0.0001
\$/MAC-hour	\$5.82 ± \$2.11	\$3.72 ± \$2.77	-\$2.10 (-\$2.13, -\$2.06)	< 0.0001



Low-Flow Sevoflurane is Safe, Economical, and Better for the Environment

Seema Gandhi, MD Jeffrey Feldman, MD, MSE Lauren C. Berkow, MD, FASA Jodi D. Sherman, MD

JMIR PERIOPERATIVE MEDICINE

Ramaswamy et al

[Original Paper](#)

An Accessible Clinical Decision Support System to Curtail Anesthetic Greenhouse Gases in a Large Health Network: Implementation Study

Priya Ramaswamy¹, MEng, MD; Aalap Shah², MD; Rishi Kothari¹, MD; Nina Schloemerkerper³, MD; Emily Methangkool⁴, MPH, MD; Amalia Aleck⁵, MD; Anne Shapiro⁵, MAS, DO; Rakhi Dayal², MD; Charlotte Young⁶, BA; Jon Spinner¹, BA; Carly Deibler⁷, BS; Kaiyi Wang⁷, MS; David Robinowitz¹, MHS, MD, MS; Seema Gandhi¹, MD

¹Department of Anesthesia and Perioperative Care, University of California, San Francisco, San Francisco, CA, United States

²Department of Anesthesiology and Perioperative Care, University of California, Irvine, Irvine, CA, United States

³Department of Anesthesiology and Pain Medicine, University of California, Davis, Sacramento, CA, United States

⁴Department of Anesthesiology and Perioperative Medicine, University of California, Los Angeles, Los Angeles, CA, United States

⁵Department of Anesthesiology, University of California, San Diego, San Diego, CA, United States

⁶School of Medicine, University of California, San Francisco, San Francisco, CA, United States

⁷San Francisco Medical Center, University of California, San Francisco, CA, United States

Clinical Enterprise Management Recognition Plan (CEMRP)

Goals: UC Health Operating Room Sustainability for FY 2023

- Objective 1: Reduce emissions from inhaled anesthetics
- Objective 2: Reduce nitrous oxide usage
- Objective 3: Reduce energy consumption from operating rooms



Milestone	Description	Point Value
1	Implement the Epic “Anesthesia Information Management System” (AIMS) to alert providers when Fresh Gas Flow (FGF) is high	1 point each medical center, 5 points max
2	Reduce nitrous oxide usage from FY21-22 procured level (baseline) by 5%, migrate from piped gas to canister where infrastructure will allow (future years could see bigger reduction)	1 point each medical center, 5 points max
3	Perform energy assessment of each operating room, identifying opportunities for energy reduction in compliance with regulatory and Joint Commission requirements, develop multi-year plan for energy savings	1 point each medical center, 5 points max

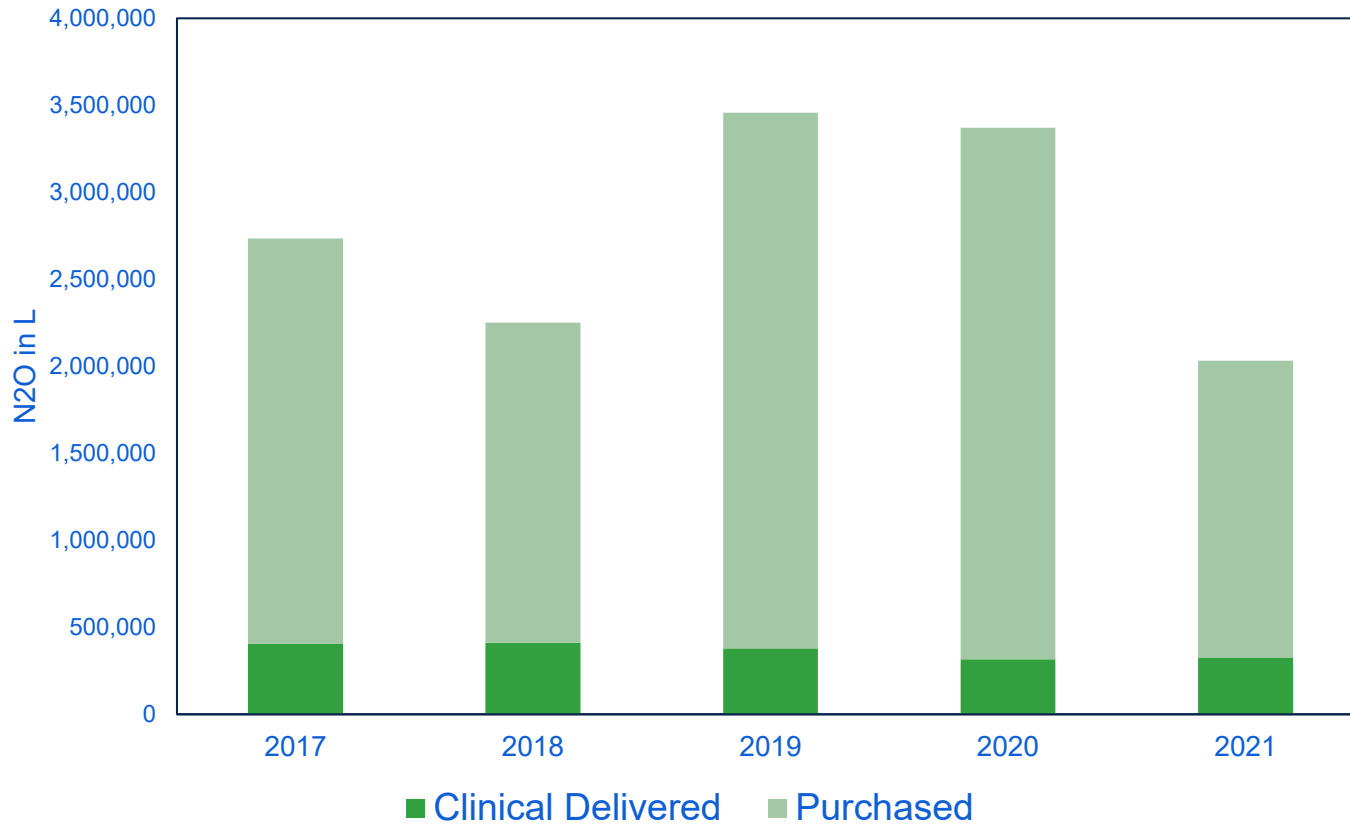
Decommissioning Piped Nitrous Oxide : Low Hanging Fruit

Importantly, we observe that there is typically minimal interaction between engineers responsible for hospital N₂O systems and clinicians who use them, such that procurement and use may be profoundly separated.”

“We have shown that the volume of **leaked N₂O can be much larger than the volume used clinically**, which can remain undetected until hospital staff show interest in discrepancies between N₂O procurement and use. By investigating N₂O use, anaesthetists can be at the forefront of reducing financial and environmental waste, whilst adhering to best practice use of a restricted drug.”

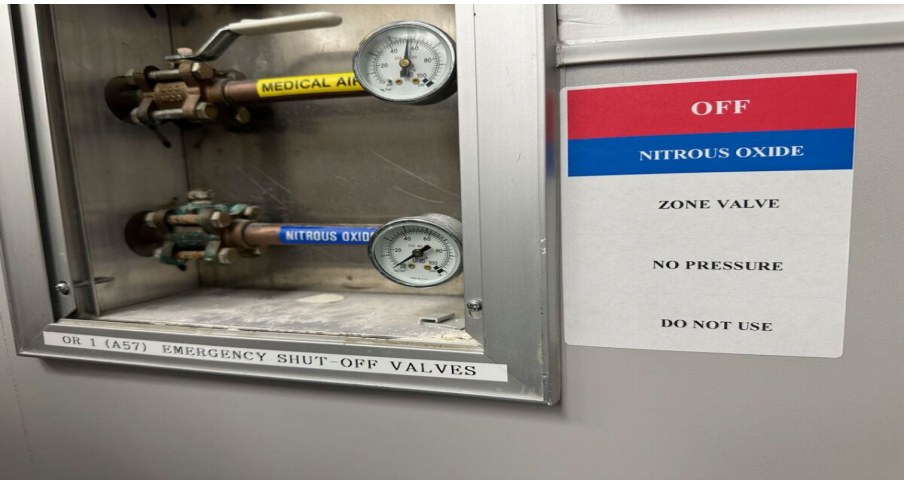


Discrepancy between Clinical Use and Procurement



	2017	2018	2019	2020	2021
UCSF Nitrous % Utilization	17.4%	22.4%	12.3%	10.3%	19.0%

Transitioning to E-cylinders

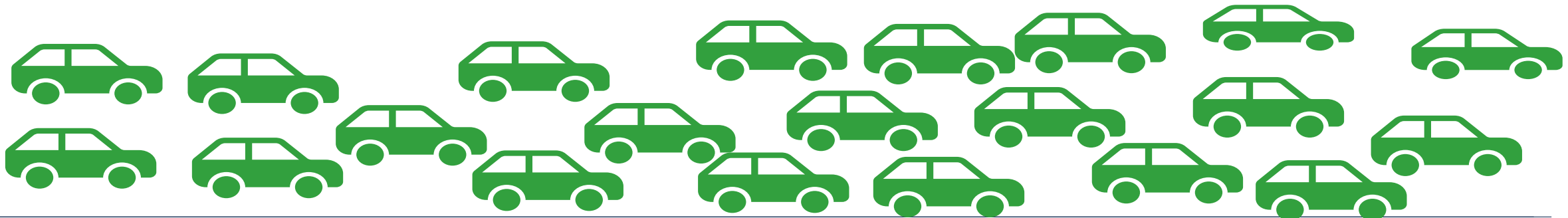


Impacts

- ❑ No piped nitrous supply at the new hospital and the outpatient surgical centers → 1.2M savings in total
- ❑ Savings on pipe infrastructure maintenance and nitrous oxide purchase (\$15k/yr)
- ❑ >80% emission reduction from current nitrous emissions
- ❑ Cost savings in carbon offsets



**2.69 million less miles
driven each year**



- Eliminate desflurane
- Low flow anesthesia with sevoflurane is safe, economical and environmentally friendly
- Convert from a piped system to cylinders for nitrous oxide delivery
- Education and stake holder engagement is the key to success
- Green is gold!!!!

