Climate Change and Health

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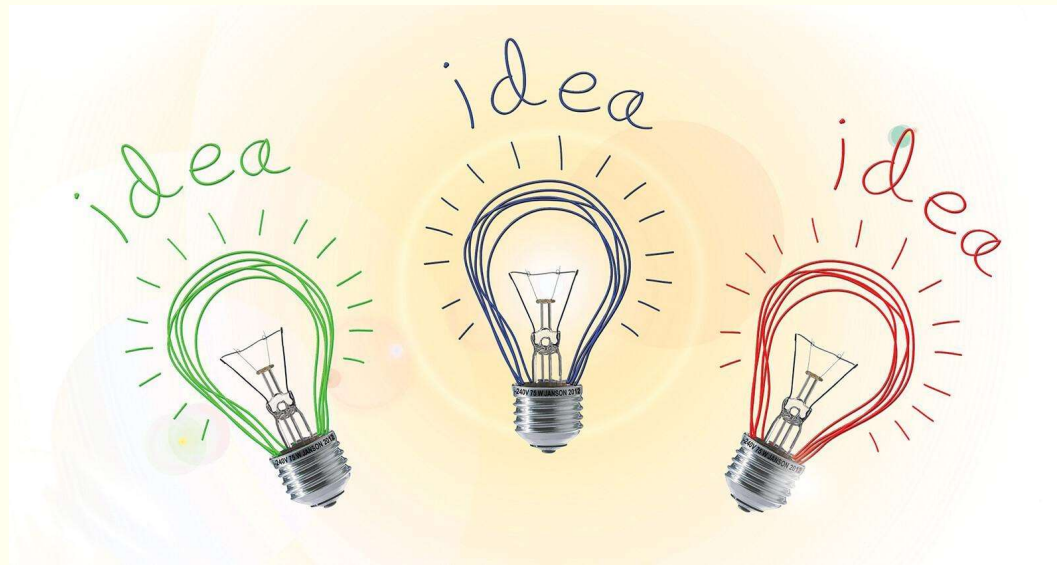Duncan Neuhauser Professor of Community Health Improvement

Case Western Reserve University
The MetroHealth System

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Three ideas

- Health systems will have to deal with health impacts of climate change

- Health systems contribute to climate change

- Better Health Partnership quality improvement approach may help with both
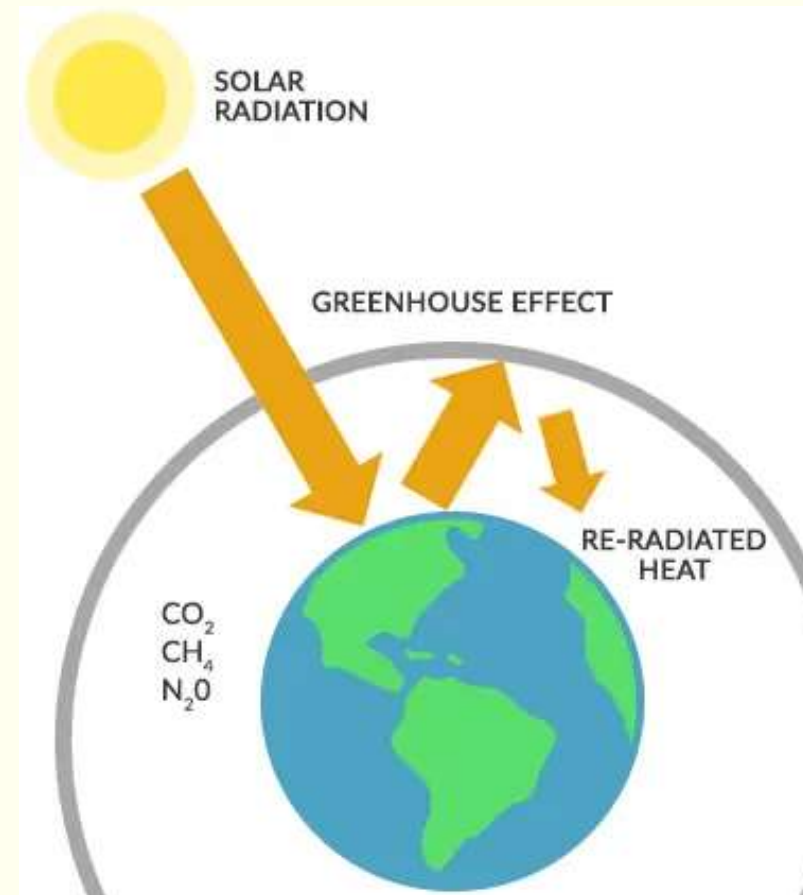
OUTLINE

- ***Mechanisms of climate change***
- Health impacts of climate change
- Northeast Ohio health system collaboration

- Final thoughts

Mechanisms of climate change

- Solar energy absorbed by earth's surface
- Some energy radiated back
- At longer wavelength (infrared) than incoming
- CO_2, other greenhouse gases absorb some of this infrared energy, limit radiation to space

SOLAR RADIATION

GREENHOUSE EFFECT

RE-RADIATED HEAT

CO_2
CH_4
N_2O

Climate change urgency

- Carbon dioxide levels increased from 280 to 413 ppm
- To limit further increase, need to
  - Cut carbon emissions by 50% by 2030
  - Be carbon neutral by 2050

OUTLINE

- Mechanisms of climate change
- ***Health impacts of climate change***
- Northeast Ohio health system collaboration
- Final thoughts

Climate hazards

- 1. Increased temperature
- 2. Wildfires and air pollution
- 3. Storms and floods
- 4. Droughts

1. Increased temperature

- Dehydration, fatigue, heatstroke, kidney disease

Farmers, El Salvador

2. Wildfires and air pollution

- Higher temperature increases wildfires, mold, pollen, other pollutants
- Asthma, allergies, cardiovascular disease, mortality

Wildfire, Australia

3. Storms and floods

- Warming increases evaporation
- Injuries, deaths, mental health

Hurricane Maria, Puerto Rico

4. Water and food supply

- Droughts reduce fresh water supplies and agricultural production
- Malnutrition, diarrheal diseases

Drought, Corn field

Impact on health care systems

- Changes in prevalence, geography of illnesses
- Extreme weather disrupt utilities, transportation, communication systems
- Sizeable carbon footprint (10% US)
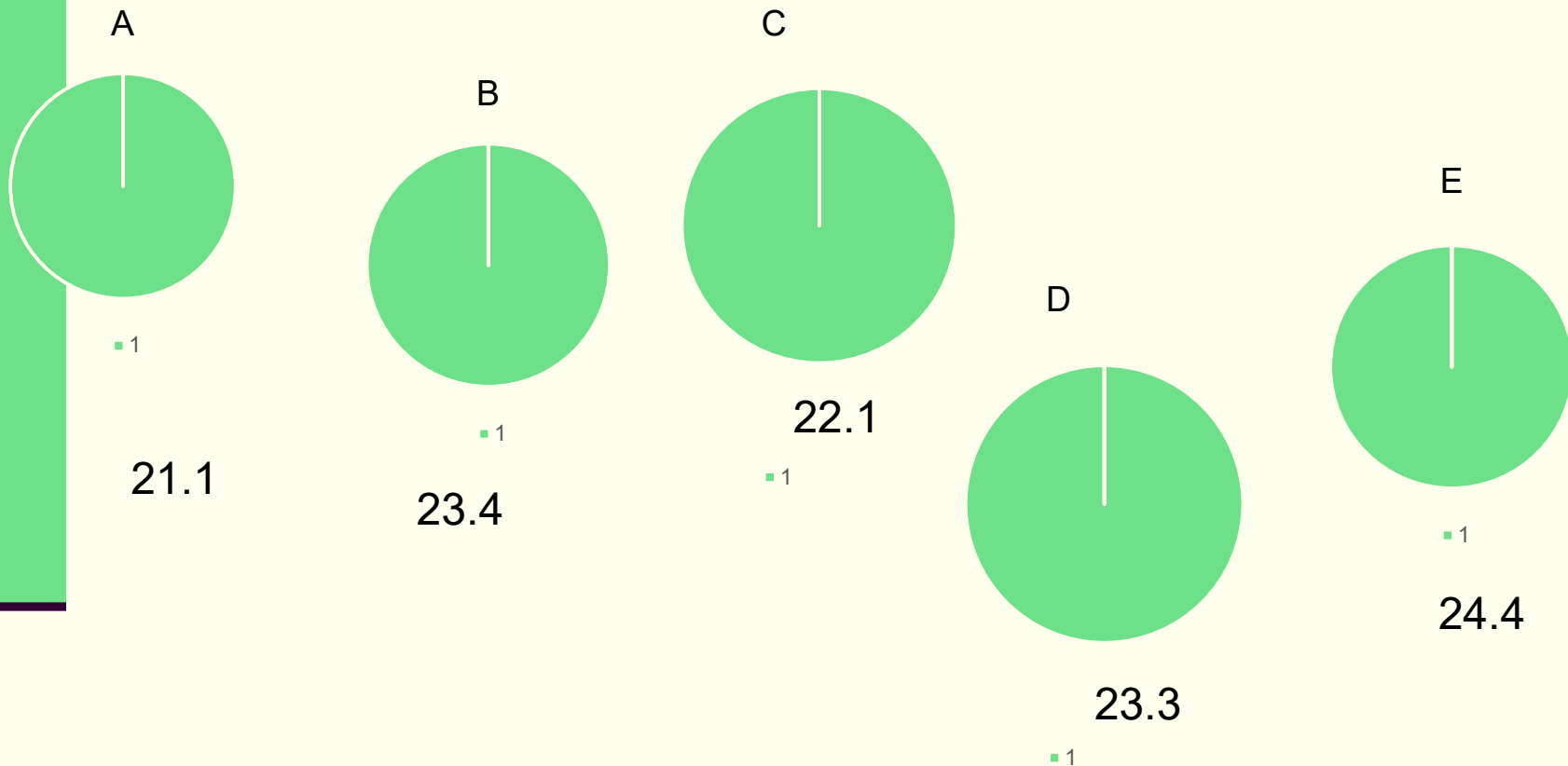

Hospital, Hurricane Katrina

OUTLINE

- Mechanisms of climate change
- Health impacts of climate change
- ***Northeast Ohio health system collaboration***
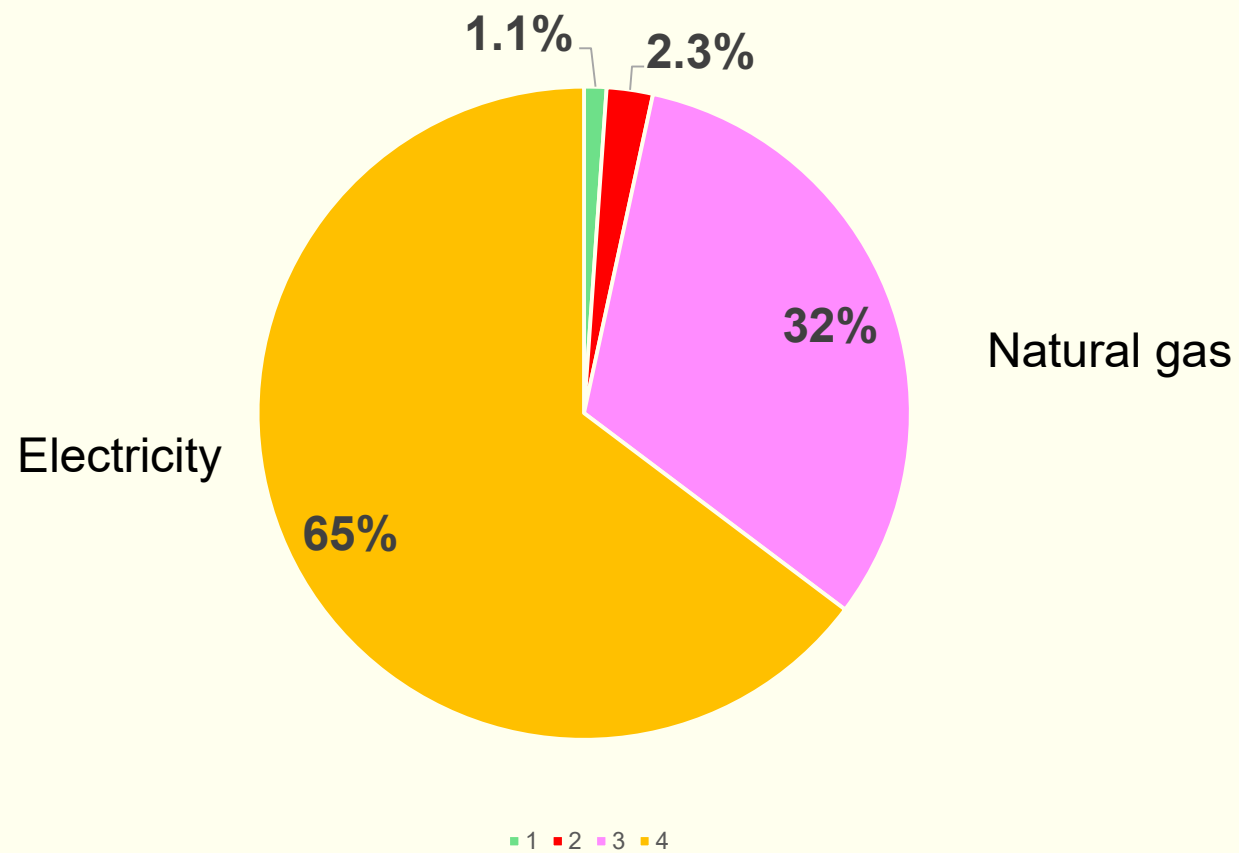- Final thoughts

Health system collaboration

- 5 health systems
- Share energy use data
- Use quality improvement methods to understand and reduce carbon footprint

2020 energy use emissions (metric tons CO$_2$-eq per 1000 sq ft)

A

■ 1

21.1

B

■ 1

23.4

C

22.1

■ 1

D

23.3

■ 1

E

■ 1

24.4

Source of emissions

1.1%   2.3%

32%   Natural gas

Electricity

65%

■ 1 ■ 2 ■ 3 ■ 4

62

Change from 2019 to 2020, (emissions per 1000 sq ft)

- A: not available
- B: 1.7% decrease
- C: 0.6% increase
- D: 0.2% decrease
- E: 1.4% decrease

- To cut emissions 50% by 2030: 7.5% decrease year over year

Collaboration next steps

- Identify best practices to reduce energy use
- Examine emissions related to supplies and services
- Prepare for climate sensitive health conditions, e.g. asthma, COPD, allergies

OUTLINE

- Mechanisms of climate change
- Health impacts of climate change
- Northeast Ohio health system collaboration
- ***Final thoughts***

Climate change cascade

Fossil Fuels → Carbon Dioxide → Climate Change → Climate Hazards -e.g. wildfires → Health Impacts -e.g. asthma
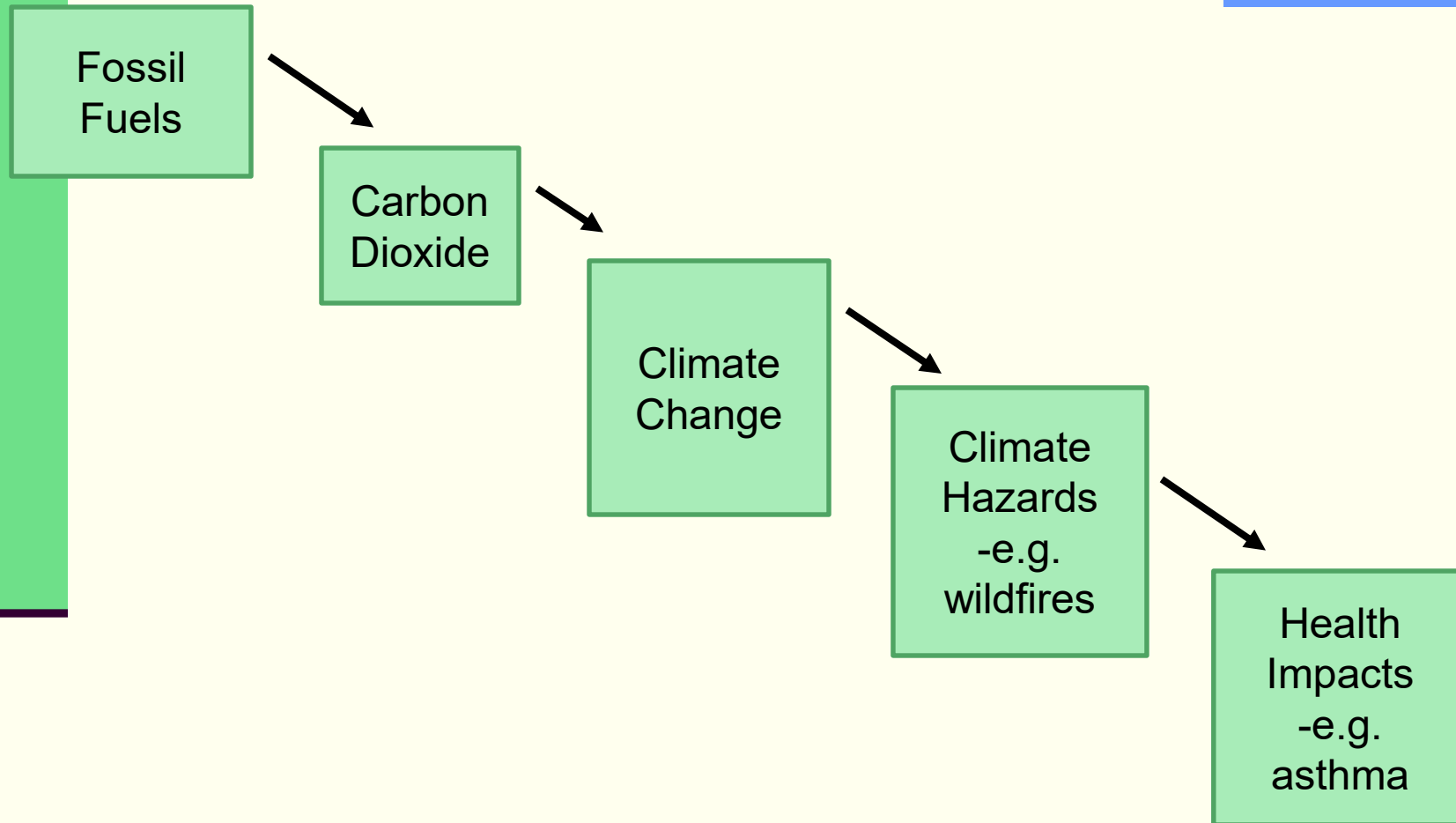
Our future

- Mitigation: reduce carbon dioxide emissions

- Adaptation: try to adjust to effects of climate change

- Suffering: pain, distress, hardship

What you can do

- Pick a climate hazard or health impact
- Review what has already been done
- Decide where you can contribute
  - Educate public, policy makers, providers
  - Implement programs in your practice or health system
  - Conduct research to address gaps
  - **Most important: push government, corporations on carbon footprint**

Some resources

- Ohio Clinicians for Climate Action
- Journal of Climate Change and Health
- Newsletters
  - Bill McKibben, The Crucial Years
  - Emily Atkin, Heated
  - New York Times, Climate Forward
- sehgal@case.edu

Climate Change and Health

Sarah O'Keeffe, MBA, EcoDistricts AP
Director, Sustainability
The MetroHealth System

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Our energy, our health
Talking Points for Healthcare Anchors seeking to take action on climate and health

Energy and our health | Health care itself is a major contributor to decreased air quality, climate change

- The health care sector is responsible for nearly **10% of greenhouse gas emissions in the United States**, with hospitals accounting for over one-third of those emissions.

- The U.S. health care sector **spends over $9.5 billion on energy each year** and **uses 2.5 times more energy** per square foot than an office building of the same size.

Hospitals are major polluters and energy consumers.
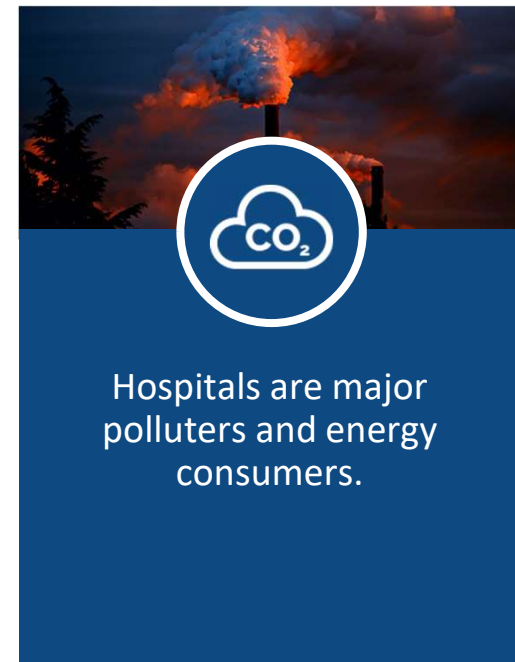
Energy and our health | Energy choices are health decisions

- Hospitals use 2.5 times more energy / sq ft than an office building of the same size

- The cleanest form of energy is energy not used.

- Depending on margin, every $1 a nonprofit health care organization saves on energy is equivalent to generating at least $20 in new patient revenue

- Energy savings divert savings to patient care and reduce health care costs
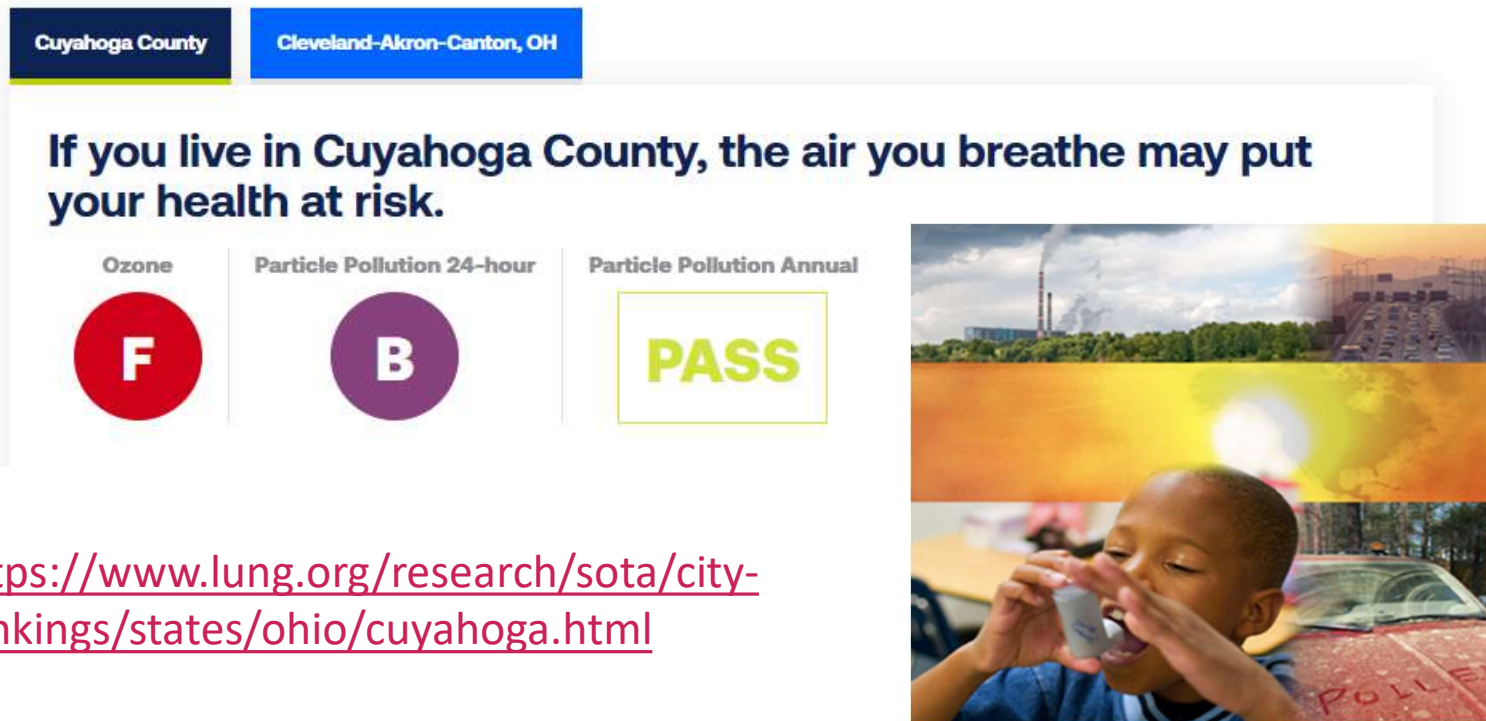

The Health Impacts of Energy Choices

Source: Health Care Without Harm 2016
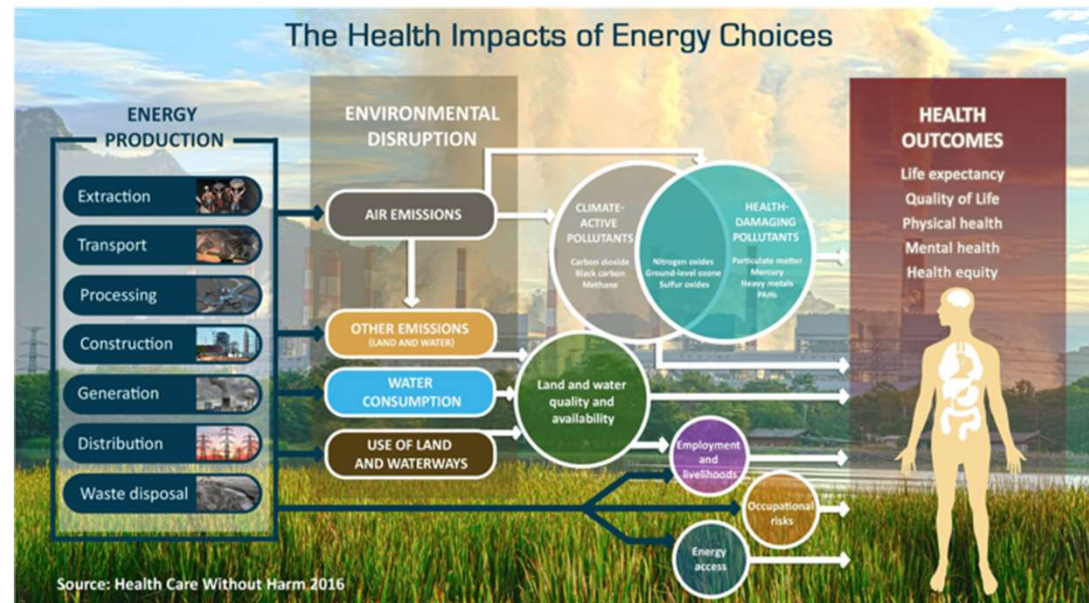
http://www.healthyenergyinitiative.org/wp-content/uploads/2016/07/Health-Impacts-of-Energy-Choices-FACT-SHEET-July-2016_lowres.pdf

Energy and our health | Air pollution = paying with human health:

Cuyahoga County population statistics and disease related to Air Quality – counts of individuals

County	Total Pop	Under 18	65 & Over	Pediatric Asthma	Adult Asthma	COPD	Lung Cancer	Cardio V Disease	Poverty Estimate	People of Color
Cuyahoga	1,235,072	254,117	230,202	19,601	108,987	88,818	799	100,971	195,758	511,426

Cuyahoga County | Cleveland-Akron-Canton, OH

If you live in Cuyahoga County, the air you breathe may put your health at risk.

Ozone — F
Particle Pollution 24-hour — B
Particle Pollution Annual — PASS

https://www.lung.org/research/sota/city-rankings/states/ohio/cuyahoga.html

Cuyahoga County Community Health Needs Assessment – 2019

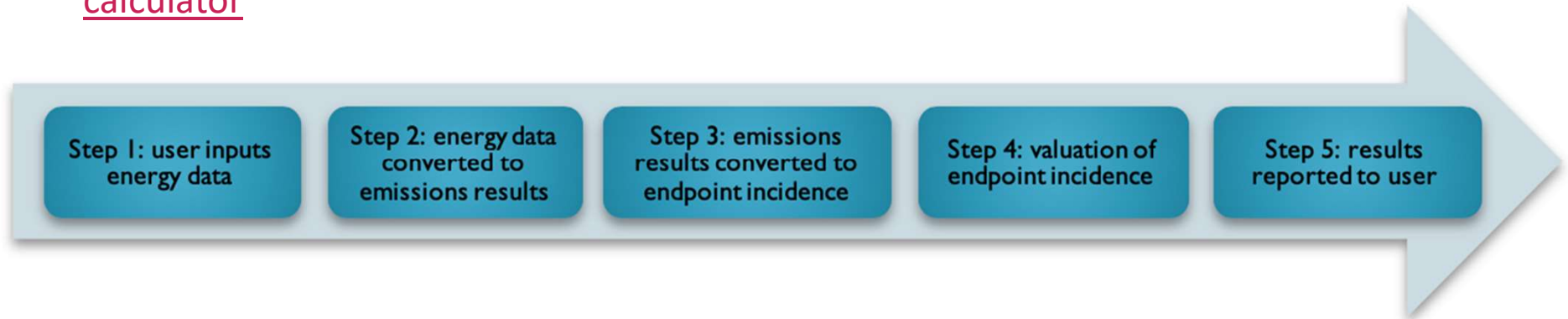**Energy & Health connect to Three of the Five priority areas of focus for 2019-2022:**

- Eliminating structural racism* - BIPOC individuals often more exposed to air pollution

- Enhancing trust and trustworthiness across sectors, people, communities* - Anchor mission resonant: large energy users = large potential impact

- Addressing community conditions, such as reducing poverty and its effects

- Enhancing mental health and reducing substance abuse

- Reducing chronic illness and its effects – Asthma, COPD, Cardiovascular disease

* Long-term, cross-cutting strategies that will be integrated into each of the other priority areas through an intentional plan to address these fundamental contributors to the health of both individuals and populations within Cuyahoga County

CC CHNA Collaborators: Better Health Partnership, Case Western Reserve University School of Medicine, the Cleveland Department of Public Health, the Cuyahoga County Board of Health, the Health Improvement Partnership-Cuyahoga (HIP-Cuyahoga), PolicyBridge, Southwest General Health Center, St. Vincent Charity Medical Center, The Center for Health Affairs, United Way of Greater Cleveland, University Hospitals, The MetroHealth System

Energy and our health | Health Impact Calculator – how it works

https://practicegreenhealth.org/tools-and-resources/energy-and-health-impact-calculator

Step 1: user inputs energy data → Step 2: energy data converted to emissions results → Step 3: emissions results converted to endpoint incidence → Step 4: valuation of endpoint incidence → Step 5: results reported to user

1. Emissions associated with electricity consumption: eGRID and EPA's AVoided Emissions and geneRation Tool (AVERT)
2. Emissions associated with thermal load: EPA's AP-42 Compilation of Air Emissions Factors and EPA's Energy Star program
3. Health and welfare impacts of emissions: EPA's Co-Benefits Risk Assessment Screening Model (COBRA)
4. Value of health and welfare impacts: EPA's Co-Benefits Risk Assessment Screening Model (COBRA)
5. Other data sources: Federal Reserve Bank of St. Louis, Rice and Hammitt "Economic Value of Human Health Benefits of Controlling Mercury Emissions from U.S. Coal-Fired Power Plants", other EPA documentation

Energy and our health | EX Hospital (fossil fuel generated electricity) Total Health Results

Total					
	Incidents Per Year	Total Incident Value	Direct Medical Costs	Pain and Suffering	Lost Wages
Premature death	4.1	$38,898,122	●	●	●
Hospital admissions	1.6	$60,117	●	○	●
Asthma exacerbation	72.7	$4,674	●	●	○
Respiratory symptoms	124.1	$5,858	●	●	○
Non-fatal heart attacks	1.6	$214,594	$172,929	○	$41,665
ER visits (asthma)	1.3	$611	$611	○	○
Work loss and restricted days	2,207.2	$200,514	○	○	$200,514
Mercury related	-	$75,014	●	●	●
Social cost of carbon	-	$3,020,760	●	●	●
Total	2,412.6	$42,480,265	$173,540	-	$242,180

Due to dispersal patterns, social determinants of health and other environmental health factors, health impacts and costs of emissions cannot typically be attributed to a given location and population.

However, the mission to improve human health has no geographical limit.

Electricity

	Incidents Per Year	Total Incident Value	Direct Medical Costs	Pain and Suffering	Lost Wages
Premature death	3.6	$34,010,249	●	●	●
Hospital admissions	1.4	$52,600	●	○	●
Asthma exacerbation	63.4	$4,080	●	●	○
Respiratory symptoms	108.4	$5,113	●	●	○
Non-fatal heart attacks	1.4	$187,822	$151,355	○	$36,467
ER visits (asthma)	1.1	$535	$535	○	○
Work loss and restricted days	1,928.8	$175,223	○	○	$175,223
Mercury related	-	$58,701	●	●	●
Social cost of carbon	-	$1,844,813	●	●	●
Total	2,108.1	$36,339,136	$151,889	-	$211,690

NOTE: Fossil Fuel generated Electricity is the majority impact on health results, accounting for ~85% of total incident value

Delivered Fuels

	Incidents Per Year	Total Incident Value	Direct Medical Costs	Pain and Suffering	Lost Wages
Premature death	0.5	$4,887,873	●	●	●
Hospital admissions	0.2	$7,517	●	○	●
Asthma exacerbation	9.2	$594	●	●	○
Respiratory symptoms	15.8	$745	●	●	○
Non-fatal heart attacks	0.2	$26,772	$21,574	○	$5,198
ER visits (asthma)	0.2	$76	$76	○	○
Work loss and restricted days	278.4	$25,292	○	○	$25,292
Mercury related	-	$16,313	●	●	●
Social cost of carbon	-	$1,175,947	●	●	●
Total	304.5	$6,141,129	$21,651	-	$30,490

Natural Gas, Fuel Oil, other delivered fuels have lower impact for this Hospital

Energy and our health | Energy comparison - where is impact coming from?
THIS EXAMPLE: Purchased Electricity
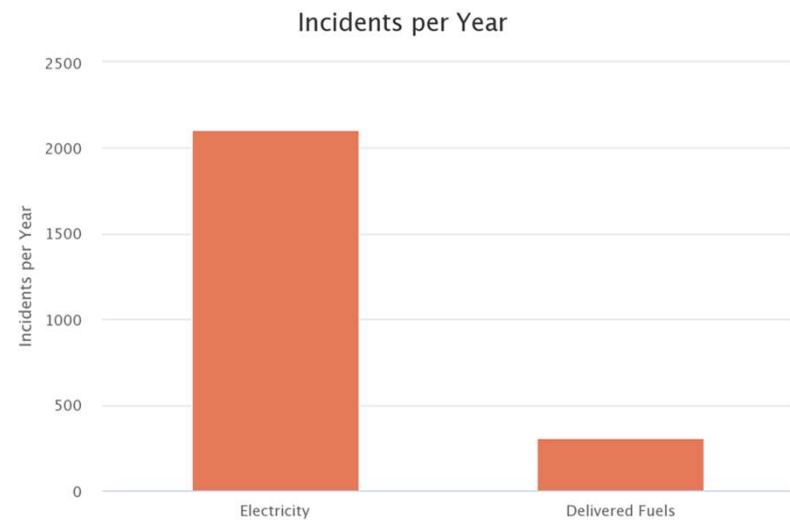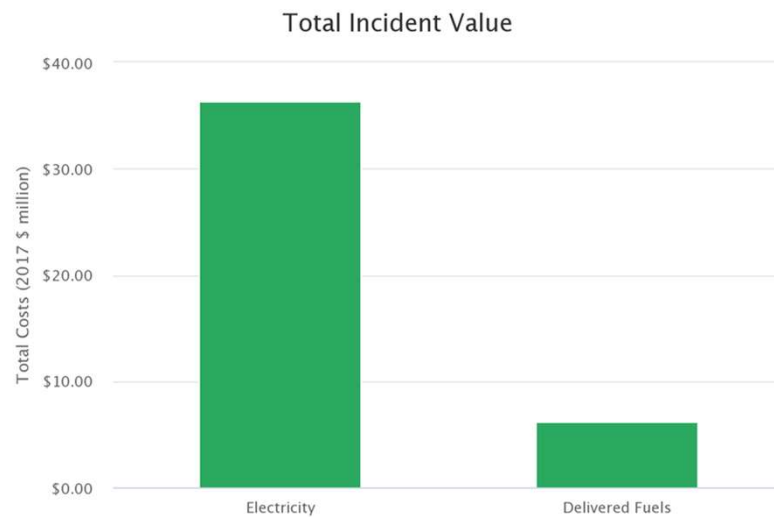
Based on real annual usage from XX Hospital: XX kWh electricity and XX mmBtu natural gas → purchased electricity

Energy and our health | Example Hospital emissions

Emissions

	CO$_2$	SO$_2$	NO$_X$	PM$_{2.5}$	Hg
Electricity	41,172	102,940	82,552	7,799	0.4511
Natural gas	26,245	289	67,502	3,664	0.1254
Fuel oil	0	0	0	0	0.0000
#2 - Distillate	0	0	0	0	0.0000
#4 - Distillate	0	0	0	0	0.0000
#6 - Residual	0	0	0	0	0.0000
Propane	0	0	0	0	0.0000
District steam	0	-	-	-	-
Coal	0	0	0	0	0.0000
Total emissions	67,417	103,229	150,054	11,463	0.5765

CO$_2$ emissions from

1,407,989

gallons of gasoline consumed

2,182

homes' electricity use for one year

Energy Efficiency Planning & Renewable Energy Methods to Decrease Health Burdens

Energy Efficiency – DECREASE energy use FIRST

- Retrofits – higher R values when doing replacements / renovations
- HVAC equipment –
    - Commissioning
    - Enhanced Commissioning
    - Reduced air exchanges
- LEDs
- Energy Efficient Buildings – LEED Enhanced Energy Performance

Renewable Electricity – NE Ohio and beyond

- VPPA Wind – Icebreaker – local
- On-site Solar – solar developers, aggregation
- Bulk renewable electricity purchase

Local /Regional Goals for % Renewable:

- 35% minimum (NE OH Regional Sewer District)
- 100% by 2050 (City of Cleveland**)**

National Goals for % Renewable:

- 25% by 2025 (Healthcare Anchor Network)
- 36% national median (Practice Greenhealth)
- 100% by 2030 (Health Care Without Harm)

Energy Health Impact Calculator:

- **50% Renewable energy = ~40-50% reduction in incident value of health results**

Reducing Carbon Footprint

Jon Utech, Senior Director Sustainability

Office of Sustainability

Buildings + Design

UTECHJ@ccf.org
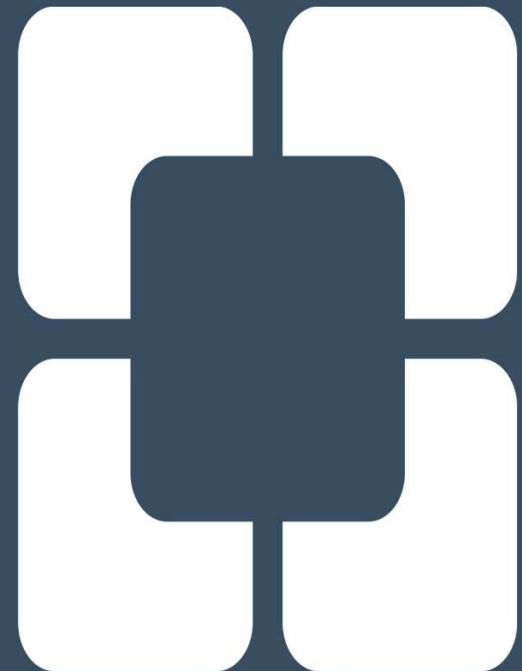
Cleveland Clinic

25% Global Deaths Caused by Environmental Factors

10% US Deaths Caused by Environmental Factors

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

The Lancet, June 2015

HEALTH FACILITIES MANAGEMENT

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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.

Climate Change Strategies

Human Interference → **CLIMATE CHANGE**

MITIGATION Of Climate Change via GHG Sources and Sinks

IMPACTS

Exposure

Initial Impacts or Effects

Autonomous Adaptations

Residual or Net Impacts

VULNERABILITIES

Planned **ADAPTATION** to Vulnerabilities and Impacts

CLINICAL Transformation

ADVOCACY Policy Responses
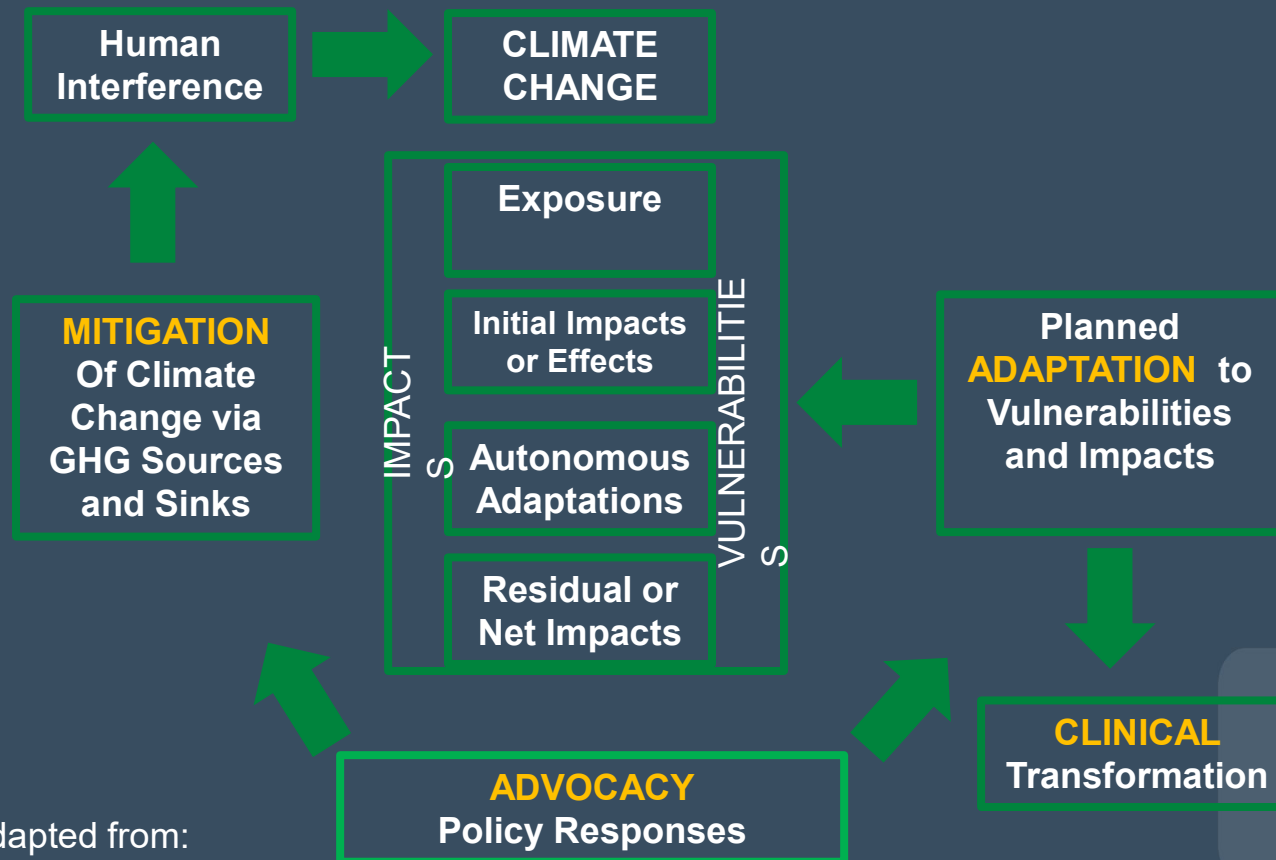
Adapted from: IPCC

Climate Change Partnerships

Scope 1: If you own an asset that emits a greenhouse gas

Scope 1:

- Stationary combustion of fuels (e.g. boilers, generators, onsite incinerators)

- Mobile fuel combustion by fleet vehicles

- Refrigerants

- Waste anesthetic gas

Common greenhouse gas emission sources in health care

CO_2 CH_4 N_2O HFCs PFCs NF_3 SF_6

SCOPE 1 — Onsite energy, Fleet vehicles, Waste anesthetic gas, Refrigerants

SCOPE 2 — Purchased electricity, Purchased steam

SCOPE 3 — Business travel, Medical devices and equipment, Employee commute, Pharmaceuticals, Waste disposal, Meat procurement, Other

Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), nitrogen trifluoride (NF_3), and sulphur hexafluoride (SF_6)

Scope 3 Other: These are the most common emissions for health care, but there are other relevant categories in Scope 3. To review all 15 categories covered in Scope 3, visit the GHG Protocol Scope 3 Guidance.

Source: Practice Greenhealth

Scope 2: Purchased electricity, steam or chilled water

Scope 2:

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

Common greenhouse gas emission sources in health care

Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), nitrogen trifluoride (NF_3), and sulphur hexafluoride (SF_6)

Scope 3 Other: These are the most common emissions for health care, but there are other relevant categories in Scope 3. To review all 15 categories covered in Scope 3, visit the GHG Protocol Scope 3 Guidance.

Source: Practice Greenhealth

Scope 3: Everything else

Scope 3:

- Fuel and energy-related activities (not in 1 or 2)

- Transportation and distribution of products

- **Purchased goods or services**

- Capital goods

- **Disposal of waste generated in operations**

- **Employee business travel**

- **Employee commute**

- Processing of sold products

- End of life treatment of sold products

- Leased Assets

Common greenhouse gas emission sources in health care
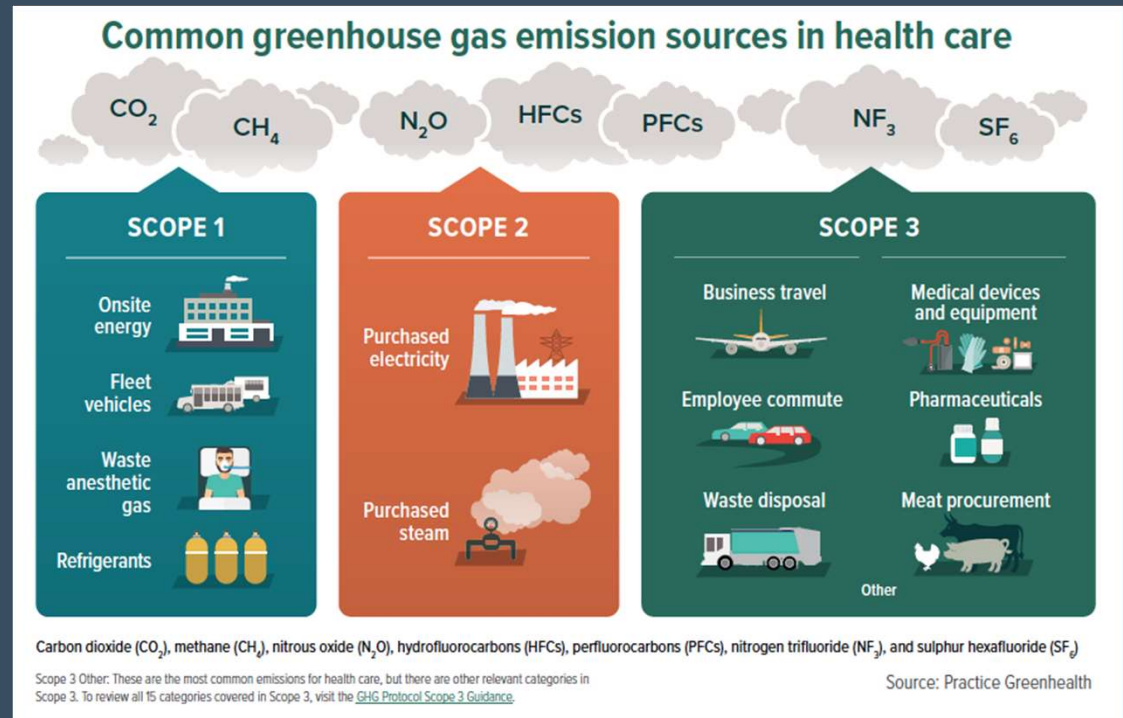
At Cleveland Clinic, scope 2 is three times larger than Scope 1

Cleveland Clinic Carbon Footprint

2%

23%

75%

- Scope 1: Natural Gas / Fuels
- Scope 2: Electricity (Grid Purchase)
- Anesthesia Gases
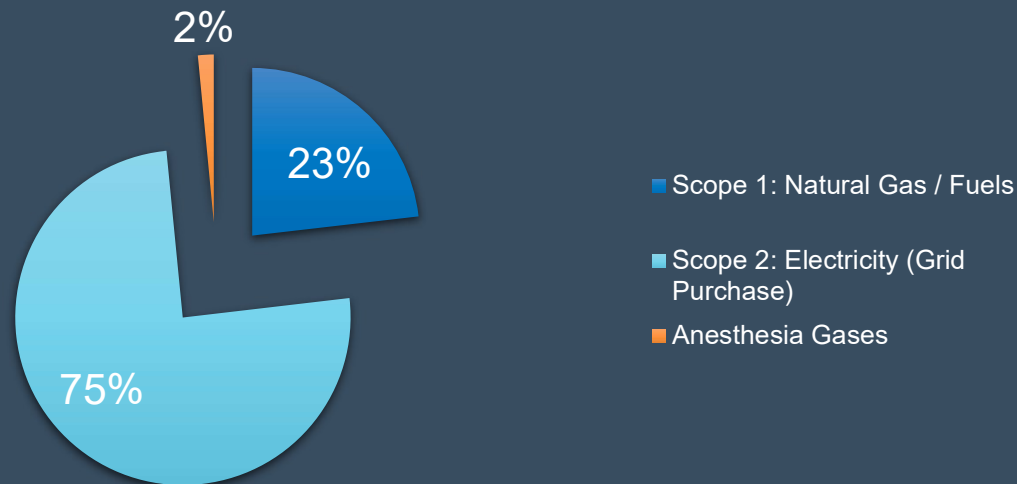
Our Scope 3 screenings revealed similar emissions hotspots across multiple systems, warranting targeted measurement and action

Scope 3 screening results for two health care systems - UPDATED
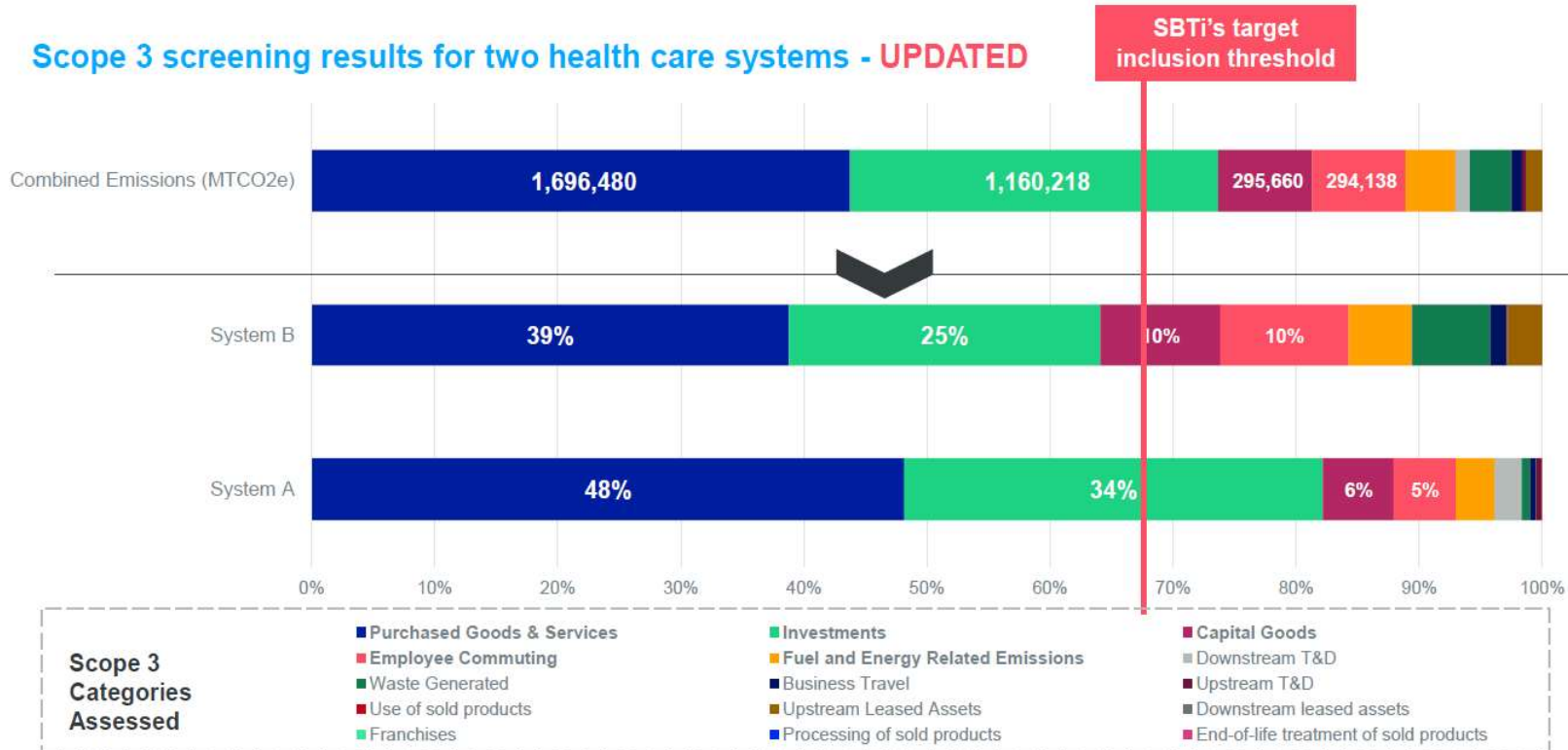
Energy Efficiency: Mitigation = 20% Goal

Enterprise Weather Normalized Source Energy Use Intensity
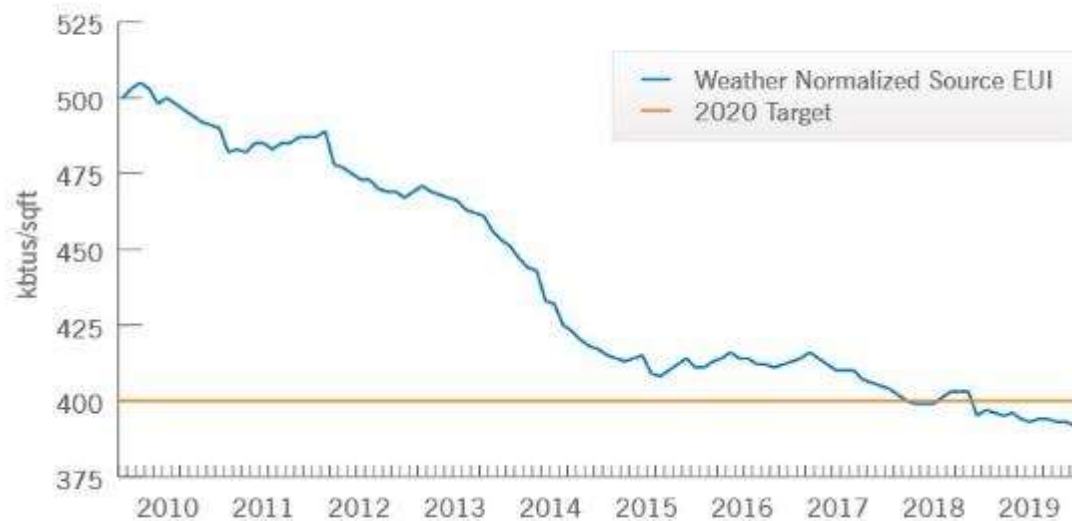
- LED Retrofits
- OR Setbacks
- Chiller Optimizations
- Filter Optimizations
- Retro-Commissioning
- Building Monitoring
- Temperature Control

26%

Percent EUI Reduction from Baseline 2010-2020

Note: other participants include Mayo Clinic, Kaiser Permanente, Legacy Health, North Shore-Long Island Jewish, Univ. S. Alabama Medical Center, University of Utah Healthcare
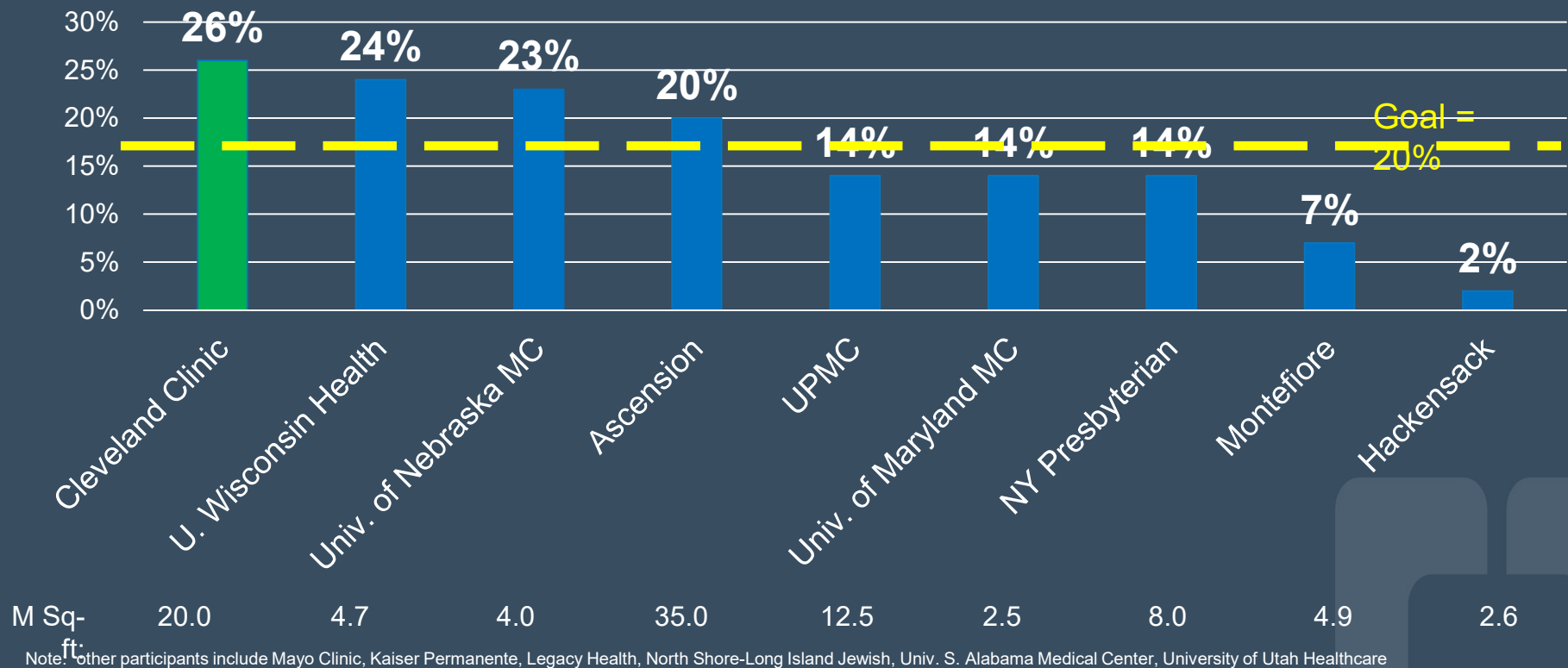
Cleveland Clinic is Reducing Its Carbon Footprint
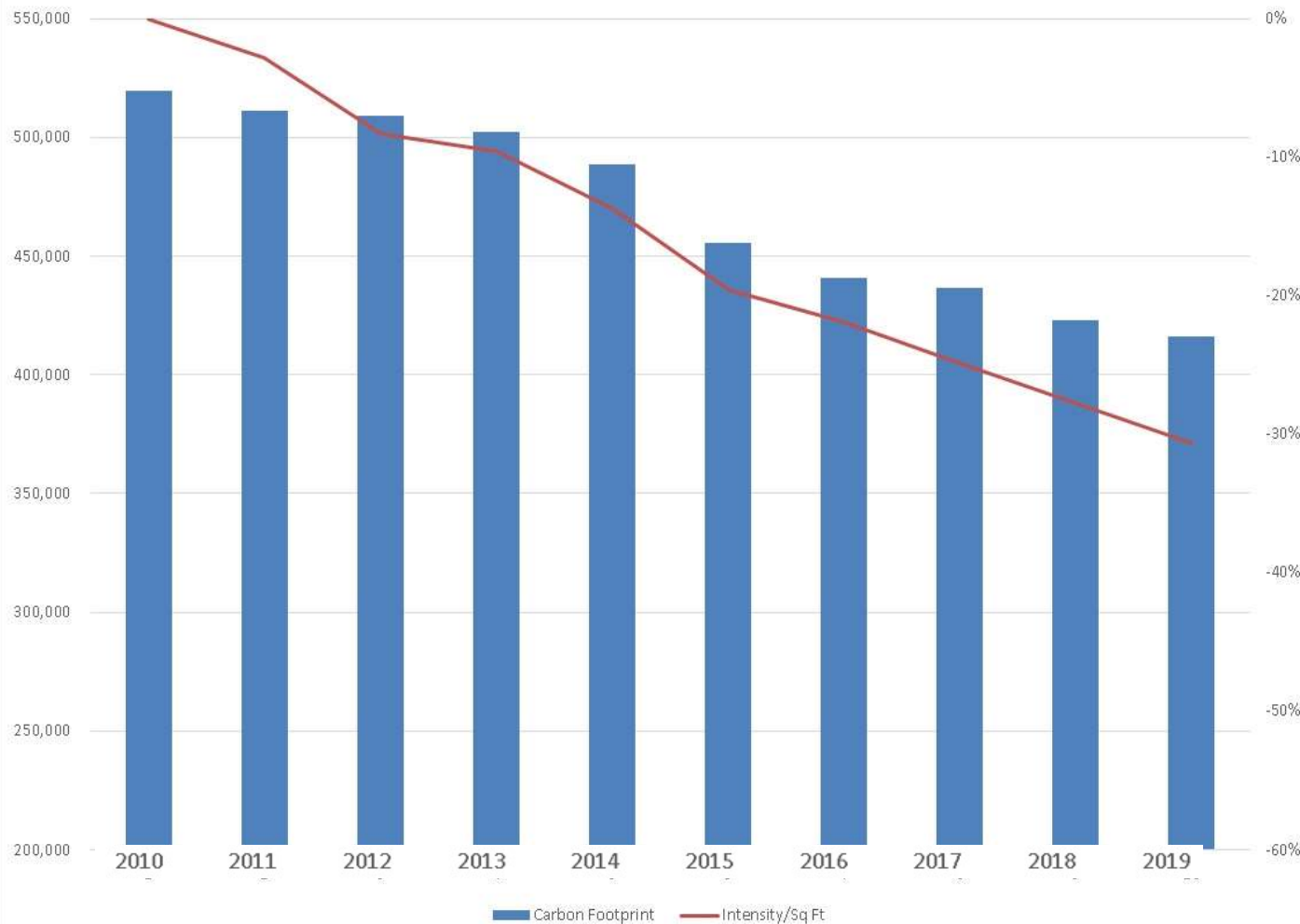
Carbon Reduction
Drivers

2010-2020 (Sq Ft)
- Energy Efficiency (26%)
- Fleet Efficiency (2%)
- Anesthesia (2%)
- Renewables/Grid (3%)

2020-2027
- More Efficiency
- Better Buildings
- Renewable Energy
- Offsets

There were eight main drivers of energy reduction…

26% Energy Reduction

- ☐ LEED/NC
- ☐ OR/Lab Setbacks
- ☐ Behavior
- ☐ Retro-commissioning

- ☐ LED Lighting
- ☐ Equipment Upgrades
- ☐ Setbacks
- ☐ Filter, Traps, Other

Sustainable Buildings:
LEED Certified

- **Global Cardiovascular Innovation Center (Admin)**

- **Twinsburg Family Health Center**

- **Tomsich Pathology Laboratory Building**

- **Marymount Hospital Expansion**

- **Cleveland Clinic Abu Dhabi Hospital**

- **Health Education Campus**

- **E89 St Garage and Service Center**
- **Brecksville Data Center**
- **Richard E Jacobs FHC**
- **Hillcrest Hospital Seidman Tower**
- **Stephanie Tubbs Jones FHC**
- **Weston NICI**
- **Taussig Cancer Center**

Implementing the Largest Healthcare LED Retrofit

- 500,000 tubes/can lights

- Creation of 20-25 manufacturing and installation jobs

- 0.2% failure rate – reduced maintenance cost

- Health impact from less brown power

- Flicker-free light for caregivers

Energy Efficiency:
OR Setbacks = $2 Million

BEFORE:	AFTER:
Exceeding ASHRAE Guidelines	Meeting ASHRAE Guidelines
In Use: 25+ ACH	In Use: 20 ACH
Unoccupied: 25+ ACH	Unoccupied: 6 ACH
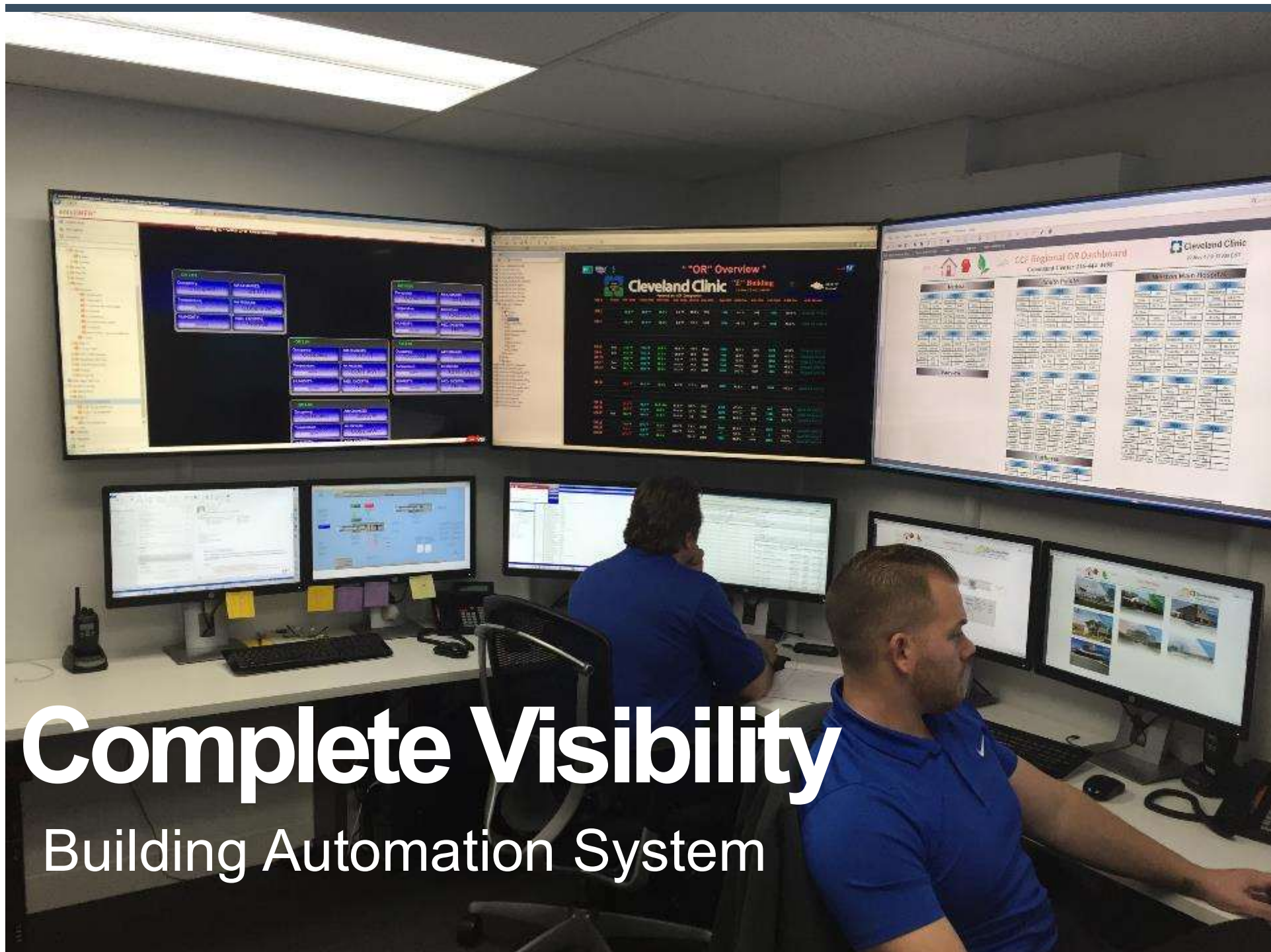
Complete Visibility
Building Automation System

Changing Behavior
Sample Messaging

No Space Heaters!!

Mandatory Energy Training

EcoCaregiver™: Energy Savings & You

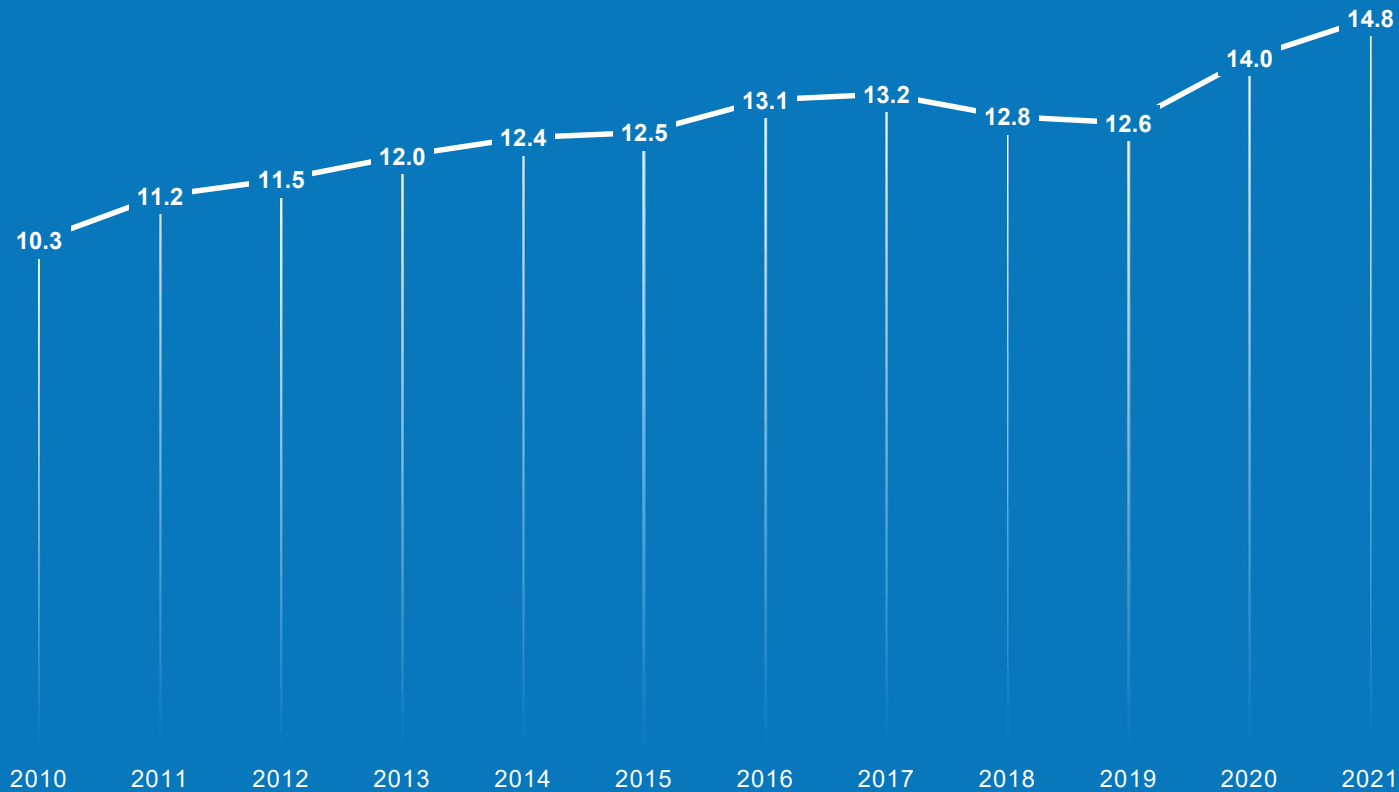100,000+ trained!

Outreach Events

Earth Day

Labapalooza

CLEVELAND CLINIC OWNED VEHICLE FUEL EFFICIENCY IMPROVED BY 44% (MPG 2010-2021)

Anesthetic Gases

- Reduced 31%/Sq Ft 2010-2020

- Desflurane Elimination

- Low Flow

Renewables and Offsets

Beyond Energy Efficiency

- On site renewable energy

- Off site renewable energy

- Renewable Energy Credits

- Carbon Offsets

Main Campus Solar

Akron General Solar