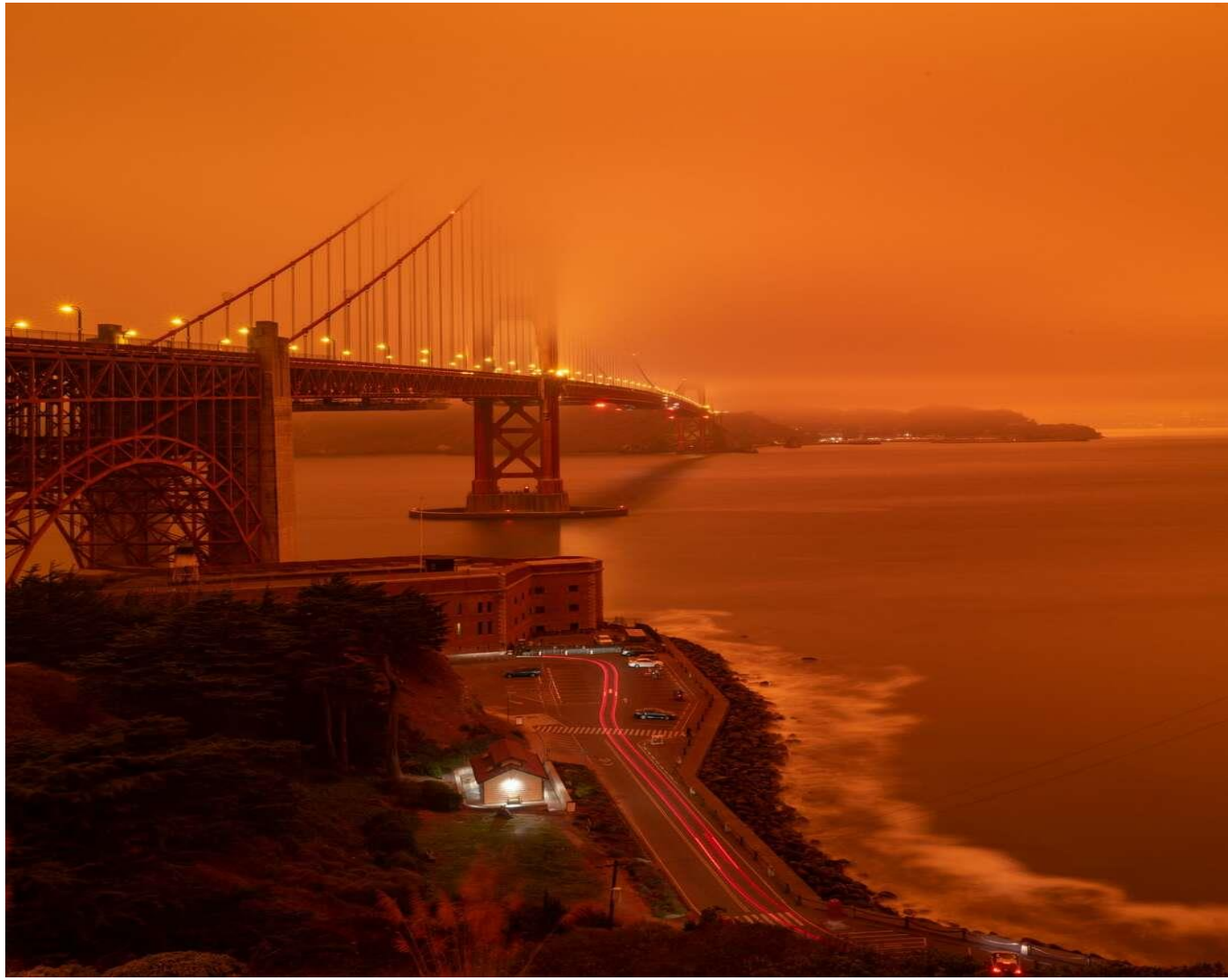
Environmental Impact, Sustainability Metrics, and the Critical Importance of Collaboration

Christopher P. Hess, MD, PhD – Alexander Margulis Professor – UCSF

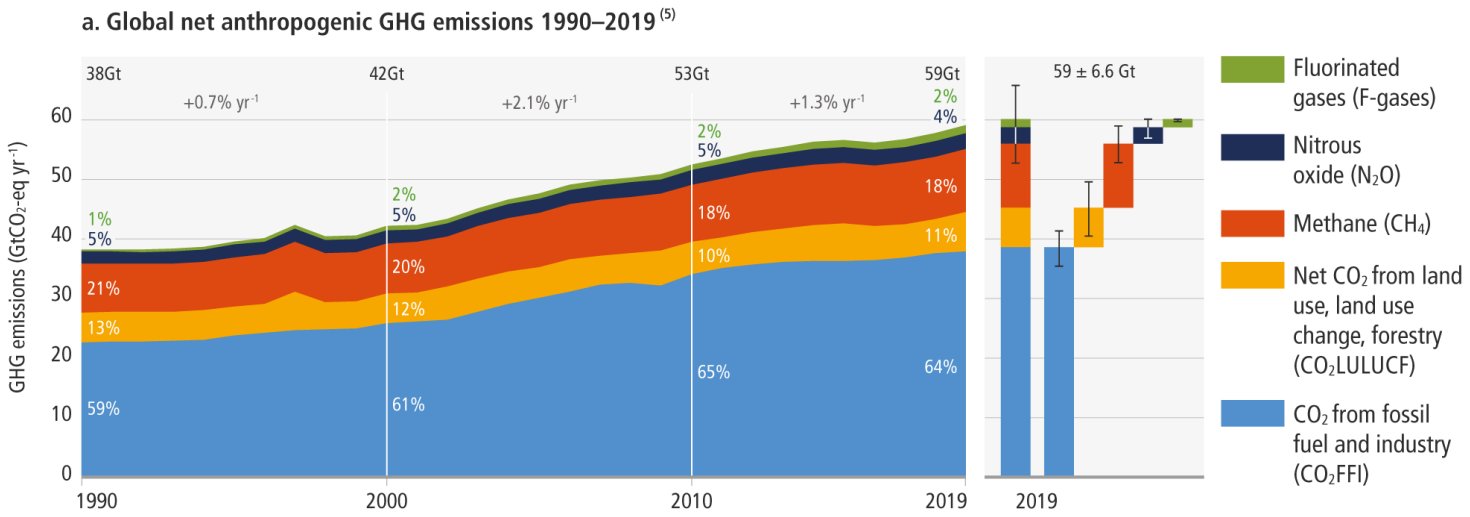
Disclosures

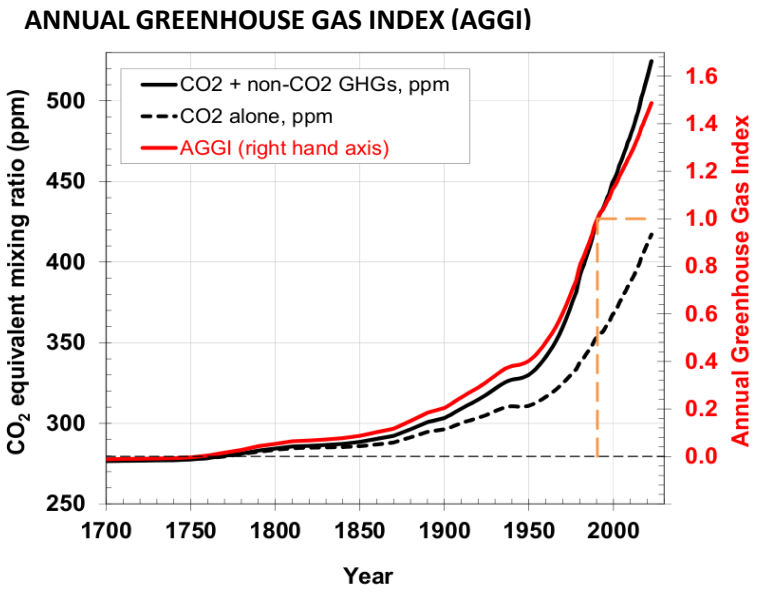
AskBio Biopharma, Focused Ultrasound Foundation, GE Healthcare, Kheiron Medical Technologies, Siemens Healthineers, uniQure Biopharma

San Francisco September 9, 2020



Climate Change and Healthcare Impacts

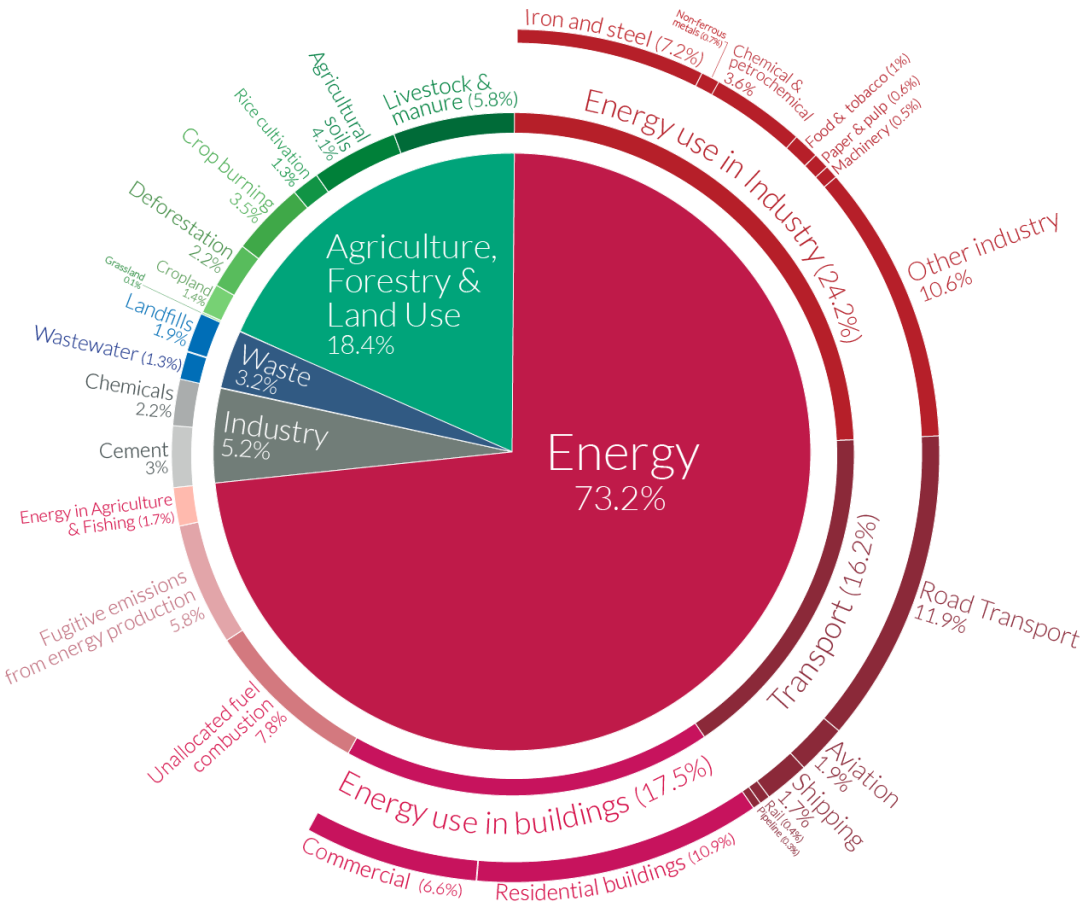


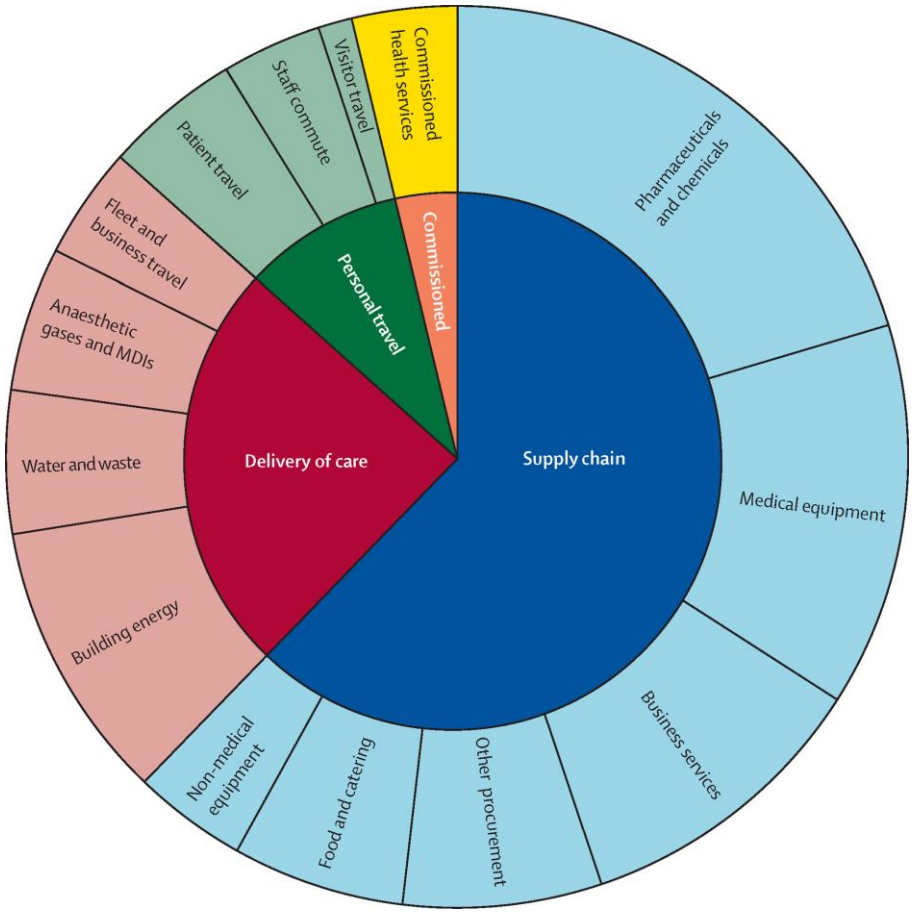


- Disruption of supply chains
- Reduction in healthcare access and quality
- Increased cost of energy and power delivery
- Decline in population health
- Accentuated healthcare disparities

1. IPCC (Intergovernmental Panel on Climate Change)
2. NOAA AGGI - https://gml.noaa.gov/aggi/aggi.html

GHG Emissions ~ 9.8% Healthcare

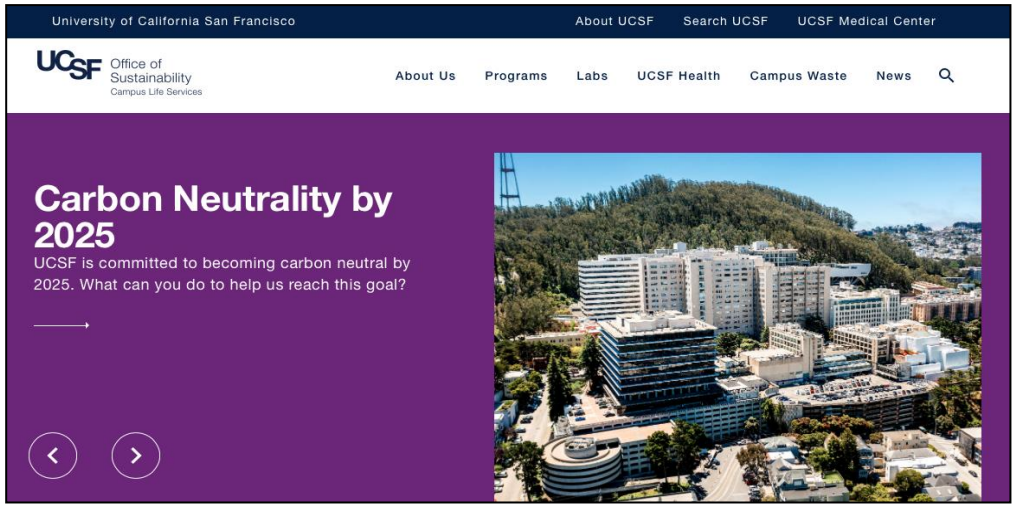


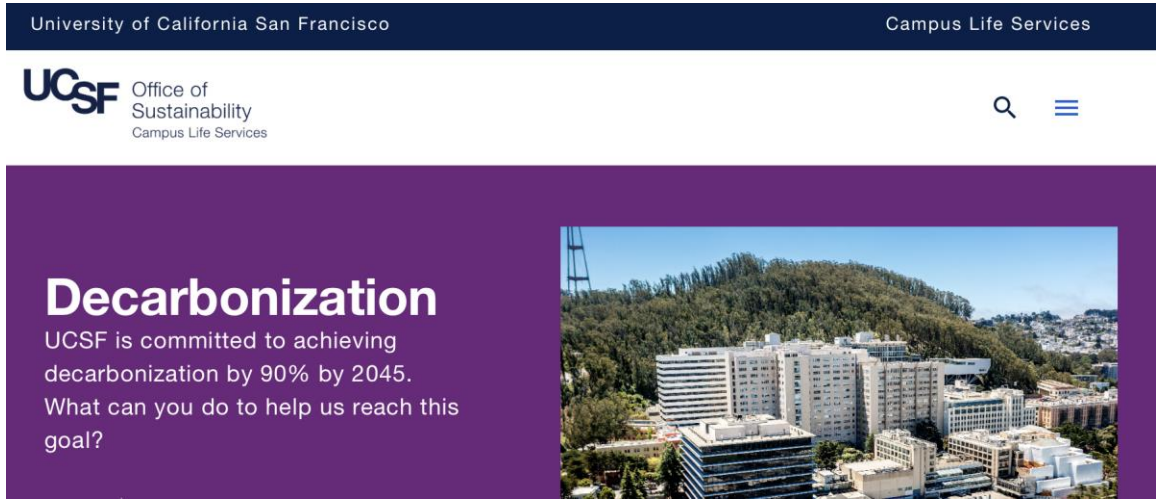


1. Ritchie et al, *Our World in Data* 2020
2. Tennison et al, *Lancet Planetary Health* 2021

System Sustainability Commitments

UCSF	Carbon neutrality by 2025, 90% decarbonization by 2045
NHS	Carbon neutrality by 2050
NYU Langone	Reduce GHG emissions by 50% by 2025
Northwestern	Reduce GHG emissions by 30% from 2012 – 2030
MGB	Reduce energy consumption by 25% from 2008-2020
Mayo	Reduce energy consumption by 20% by 2020



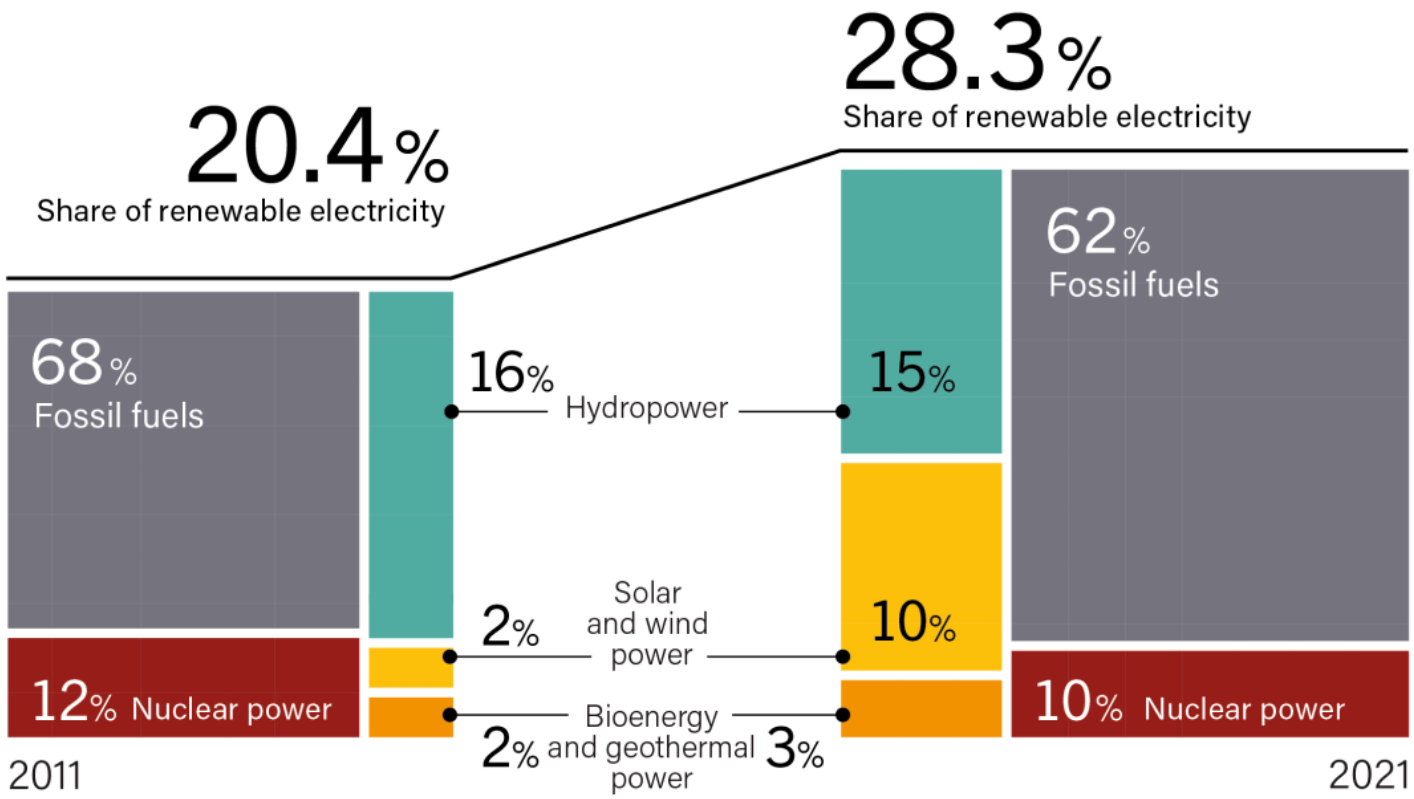


Governance, Regulations and Compliance

- Paris Agreement – limit increase in mean global temperature to “well below” 2°C
- Federal regulations – US EPA
- State regulations – California Climate Crisis Act – zero GHG emissions by 2045, SB1020 – 90% renewable energy by 2035, anticipated ESG procurement restrictions
- COCIR Self Regulatory Industry Initiative – Eco-design principles, GRP, EPD
- ESG reporting – European CSRD, NHS, State of California, under consideration by most funding & approval agencies (CMS, FDA, NIH, DOD in US)
- Certification – LEED (design-based), EPA ENERGY STAR® (performance-based)

Strategies to Reduce GHG Emissions

- Renewable energy
- Circular economies
- Reduce consumption
  - Green supply chain
  - Decrease waste
  - Reduce utilization
  - Operational efficiency
- Carbon offsets and RECs



REN21 RENEWABLES 2022 GLOBAL STATUS REPORT

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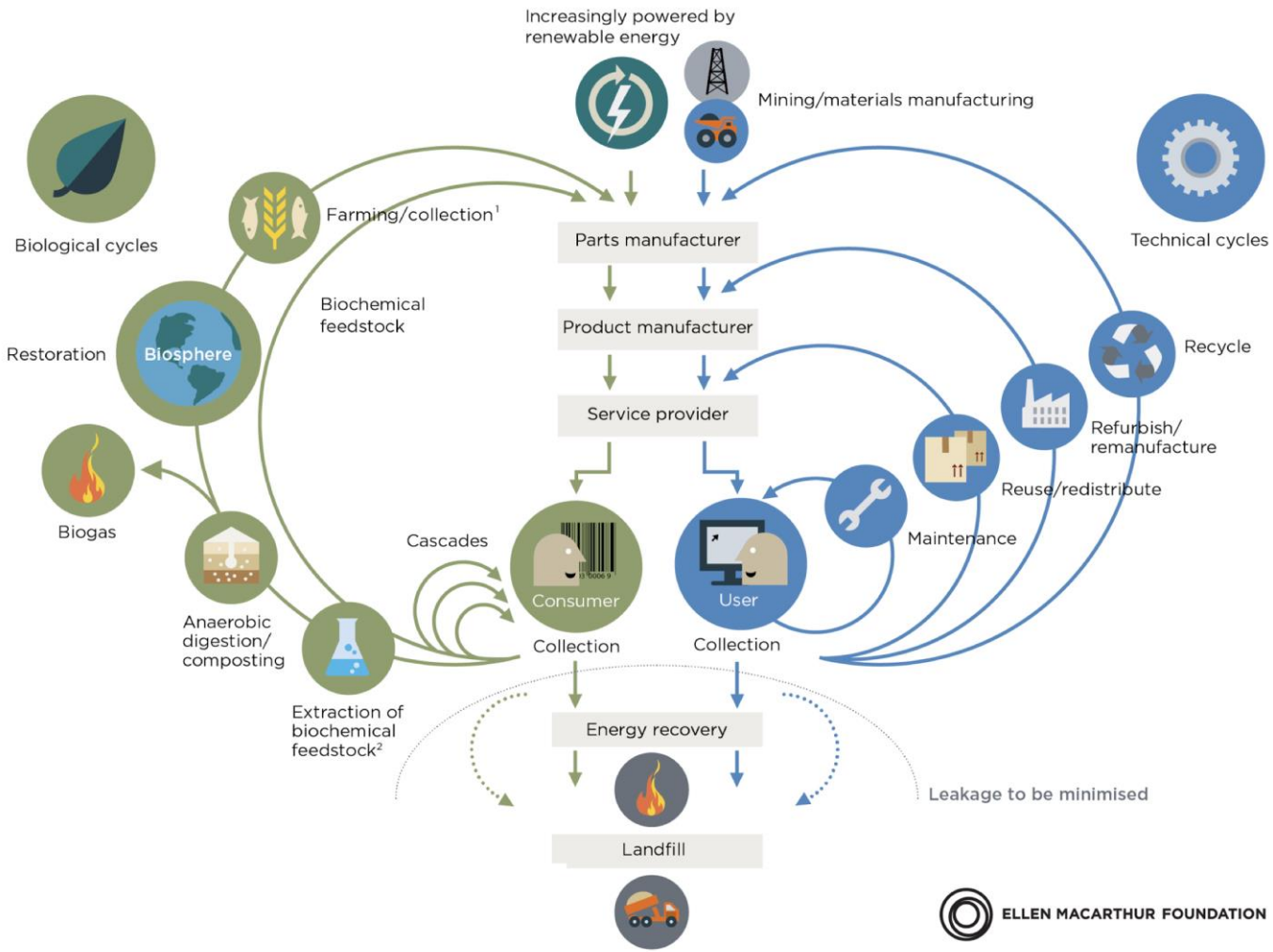

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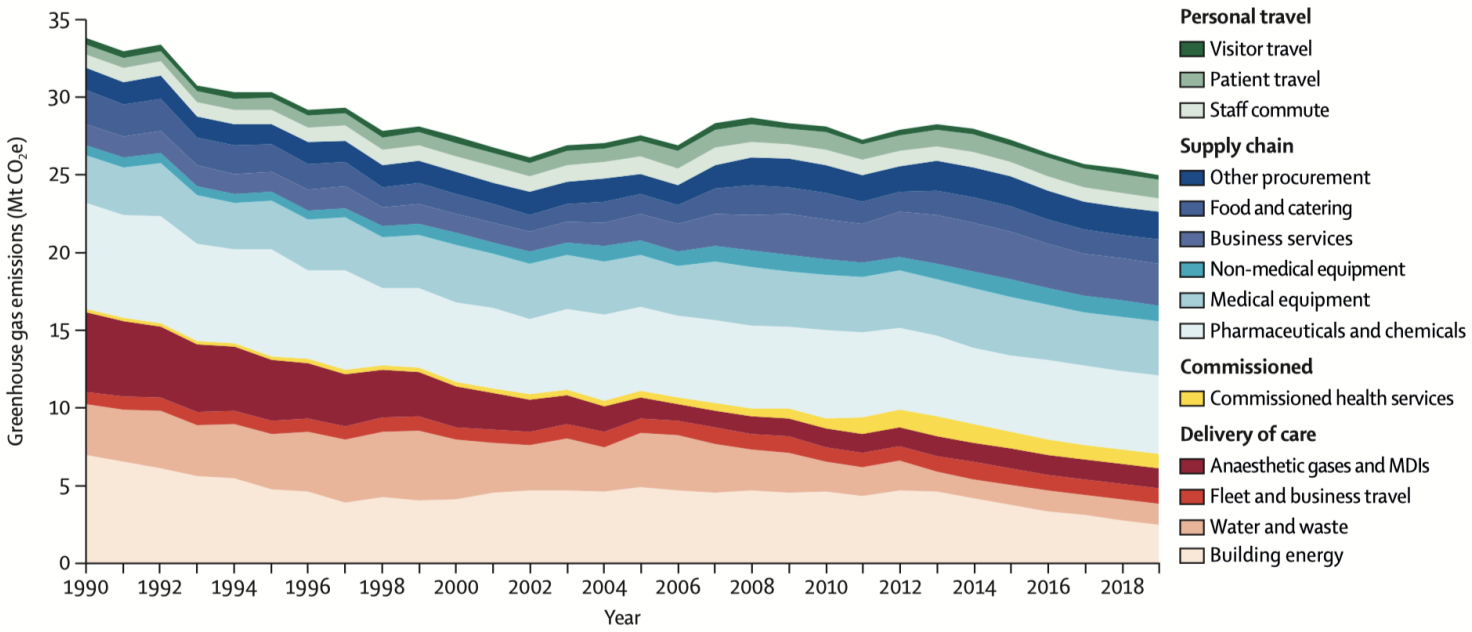

- UK Climate Change Act - carbon neutrality by 2050
- Energy use - 62% supply chain, 24% care delivery 10% travel
- Impact @NHS – 20% in carbon footprint 1990-2019[1]

2. Tennison et al, *Lancet Planetary Health* 2021

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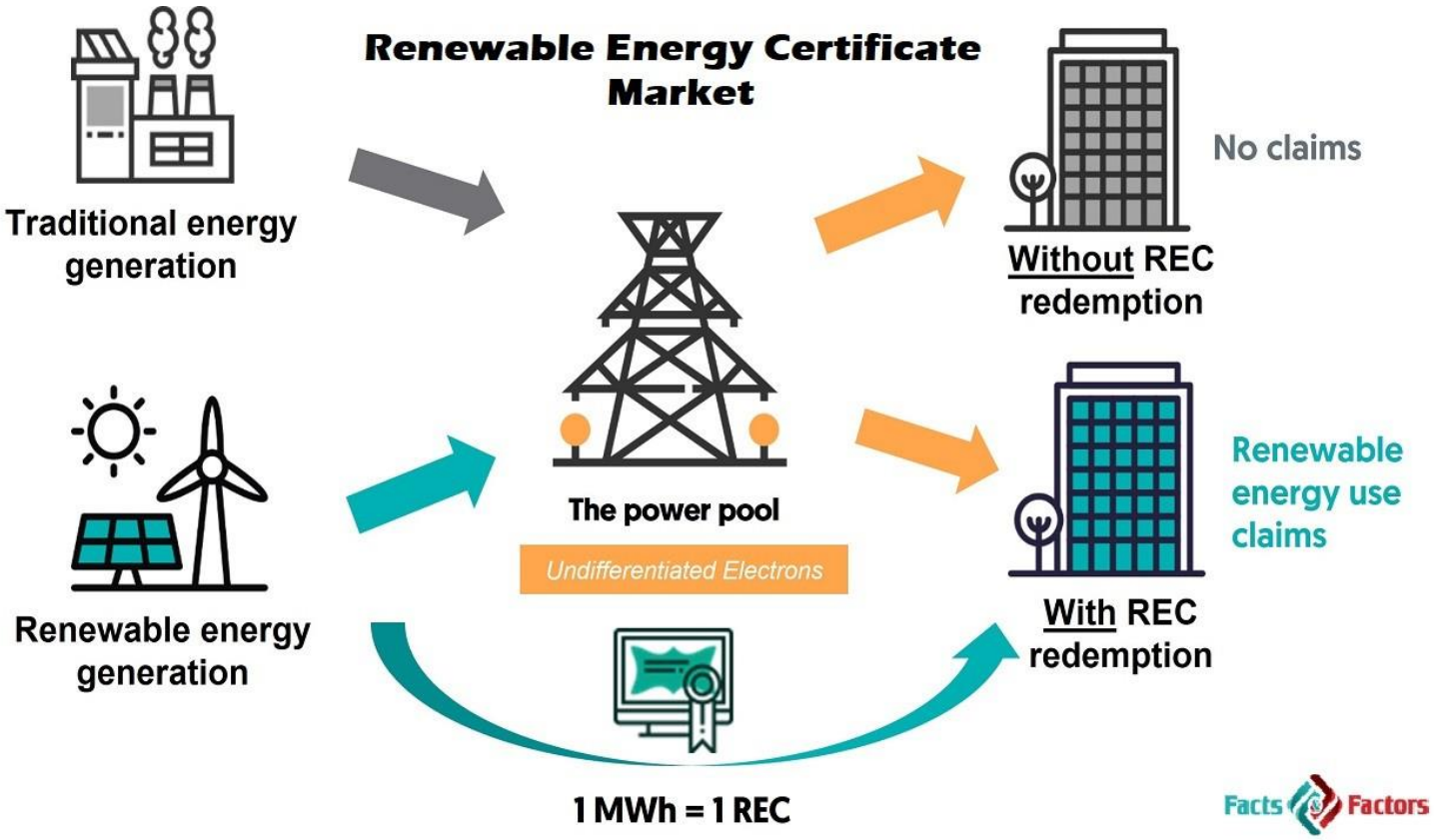


Collaboration is Essential for Sustainability

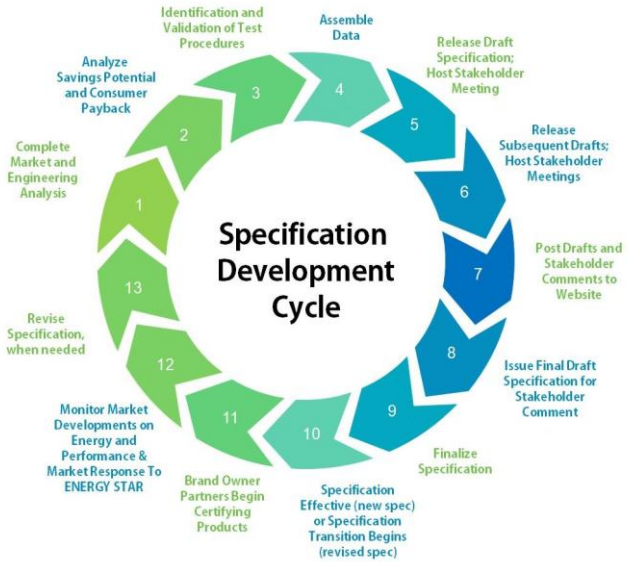
Patient Care · November 10, 2021

Siemens Healthineers and UCSF Create First Carbon-Neutral Radiology Imaging Service

New Agreement Focuses on Green Radiology and Improving Access to Quality Imaging

By Jess Berthold

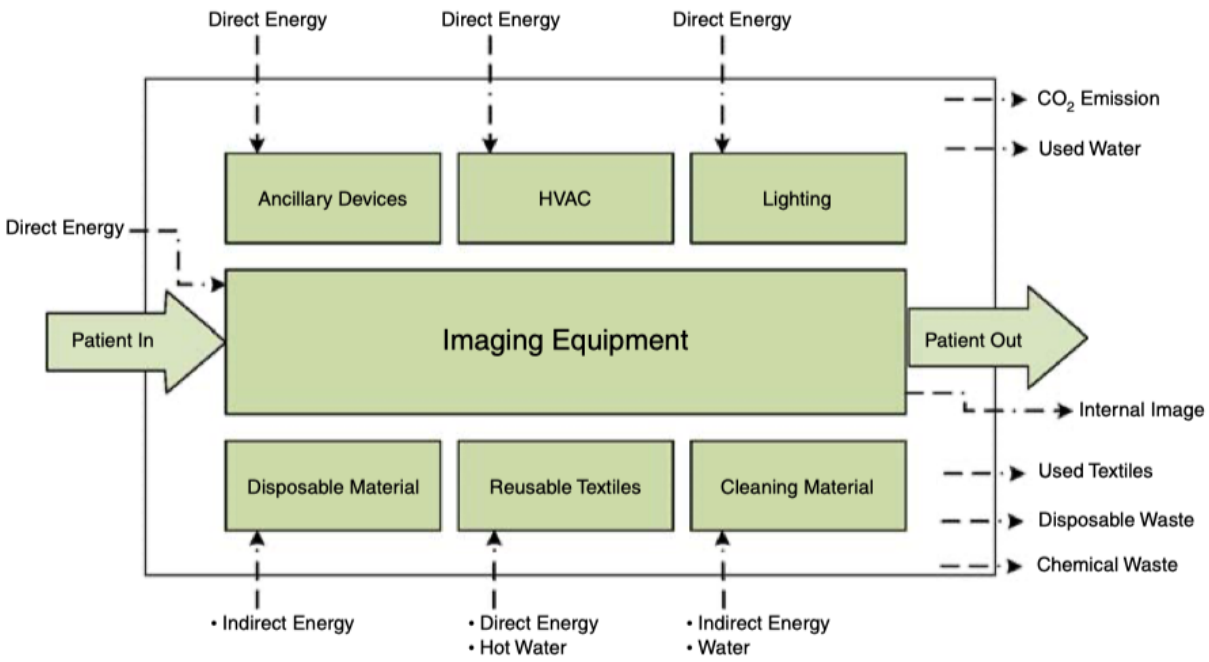
ENERGY STAR

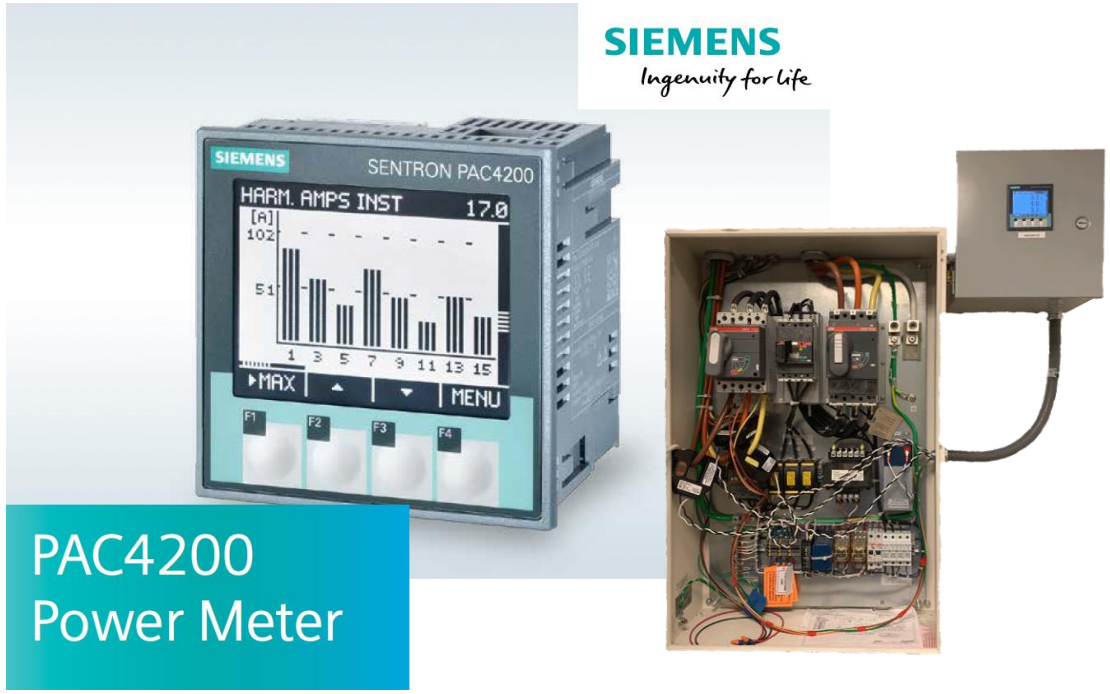


- US EPA
- Current interest in ready-to-scan and low-power modes
- Data collection initiated at multiple institutions
- Threshold for certification based on data analysis
- Analogous European Commission Regulation 1275/2008

Consumption Metrics for Imaging

- Basic measurement kWh ----> CO_2e (by weight, ie kg or tons)
- Normalization by sequence, by exam, by patient episode, by care pathway, ? by value
- Tools - Lifecycle Assessment (LCA), power meters (PAC4200), real-time monitoring





1. Esmaeli et al, *IJHCQA* 2018

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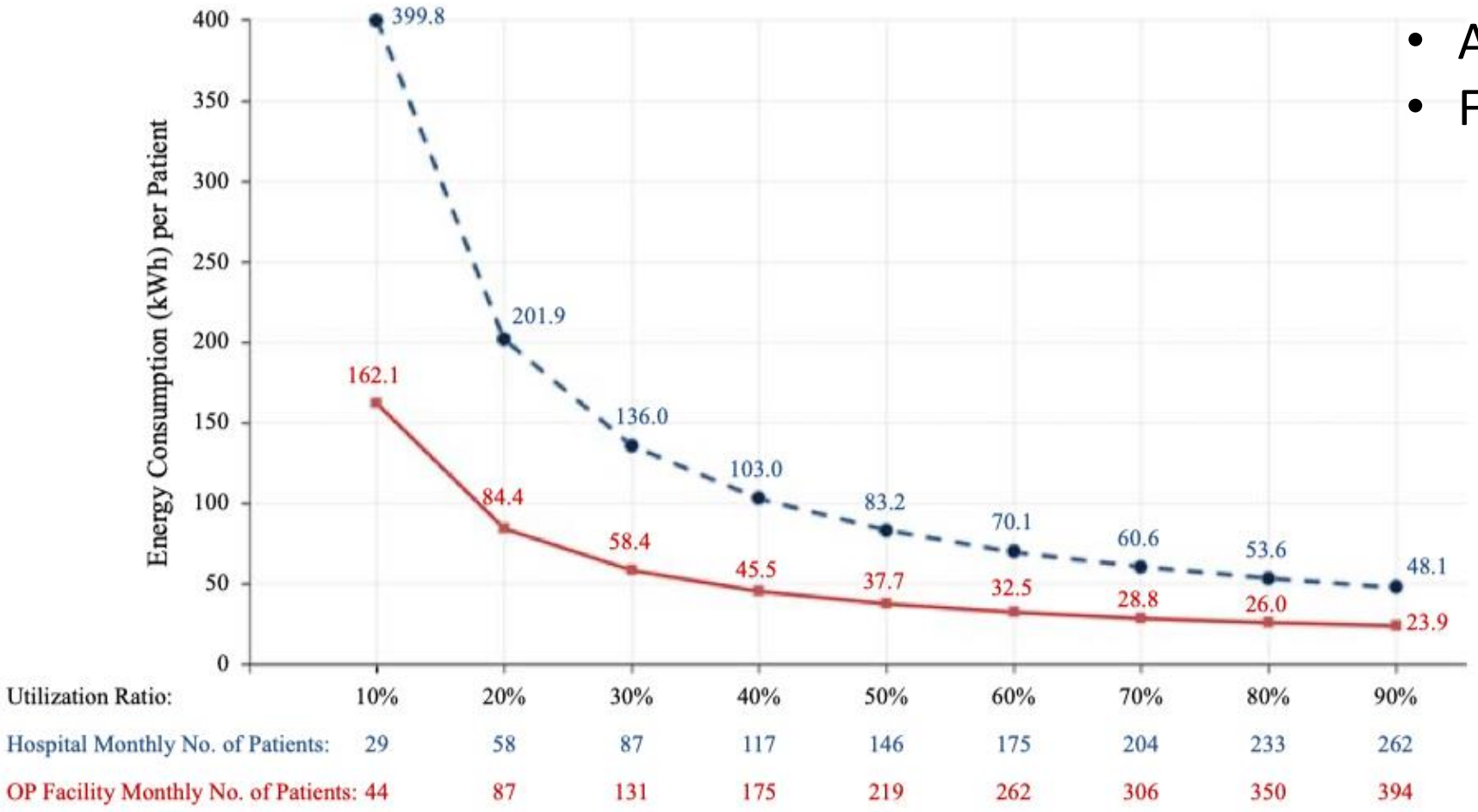
- Tools - Lifecycle Assessment (LCA), power meters (PAC4200), real-time monitoring
- Typical estimates from the literature:

Modalities	MRI CT US	20 kWh per exam[1] 1.2 kWh per exam[1] 0.2 kWh per exam[2]
IT	PACS workstation Data storage (cloud)	1662 kWh per year[3] 46.3 kWh per TB per year[4]
Compute	AI training	DLR: 500 kWh training GPT-3: 1287 MWh training[5] 260 MWh daily use[5]

1. Heye et al, *Radiology* 2019
2. Martin et al, *JACR* 2018
3. Hainc et al, *Academic Radiology* 2019
4. Zhang et al, *Env Sci Pollut Control* Ser 2021
5. Spanish Institute of *Engineering*
6. Estimate, K. Ludvigson 2023 (towardsdatascience.com)

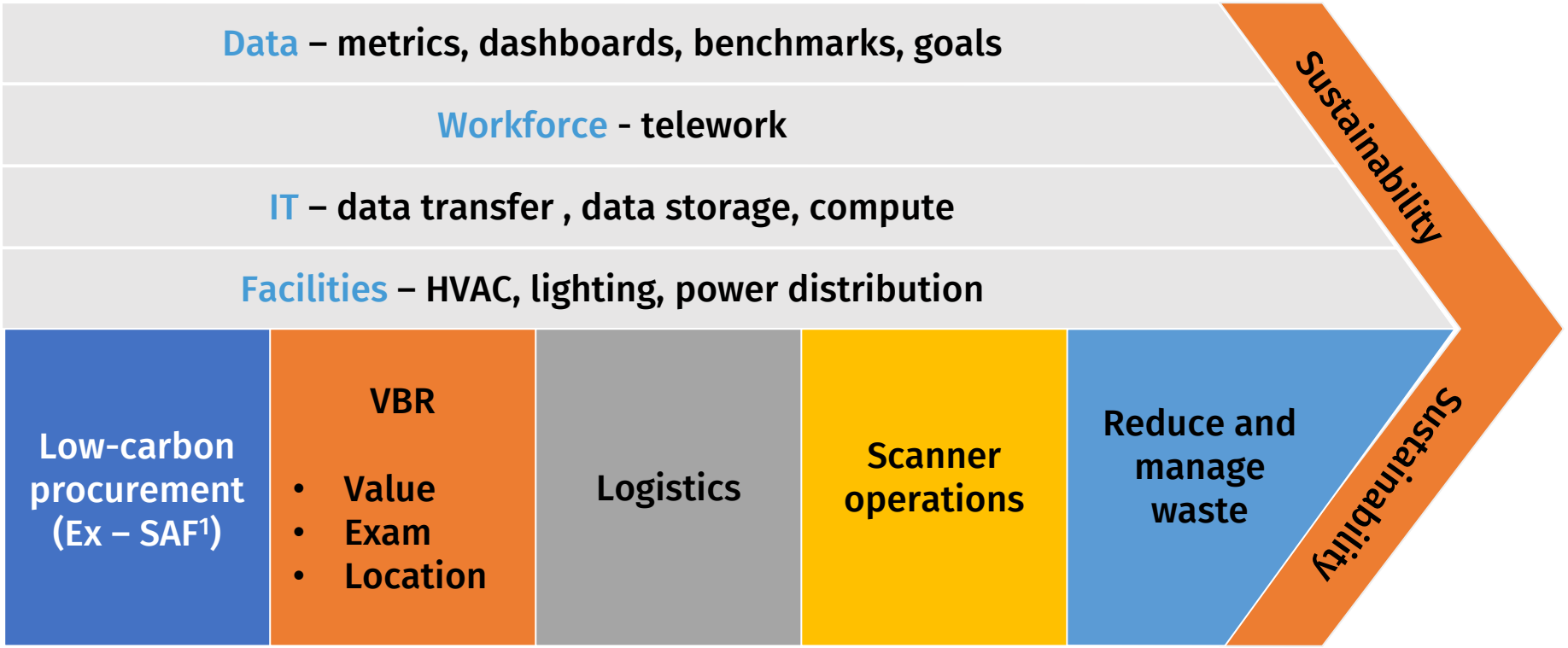
Example: Impact of MRI Operations



- Abbreviated protocols
- Fast scanning

1. Esmaeli et al, *IJHCQA* 2018

Reducing Consumption in Radiology



- ⬇ Cost
- ⬆ Utilization
- ⬆ Access
- ⬆ Brand
- ⬆ Patient satisfaction

1. https://www.technologyreview.com/2023/05/24/1073568/all-about-alternative-jet-fuels-safs/

Reducing Consumption: MRI Example

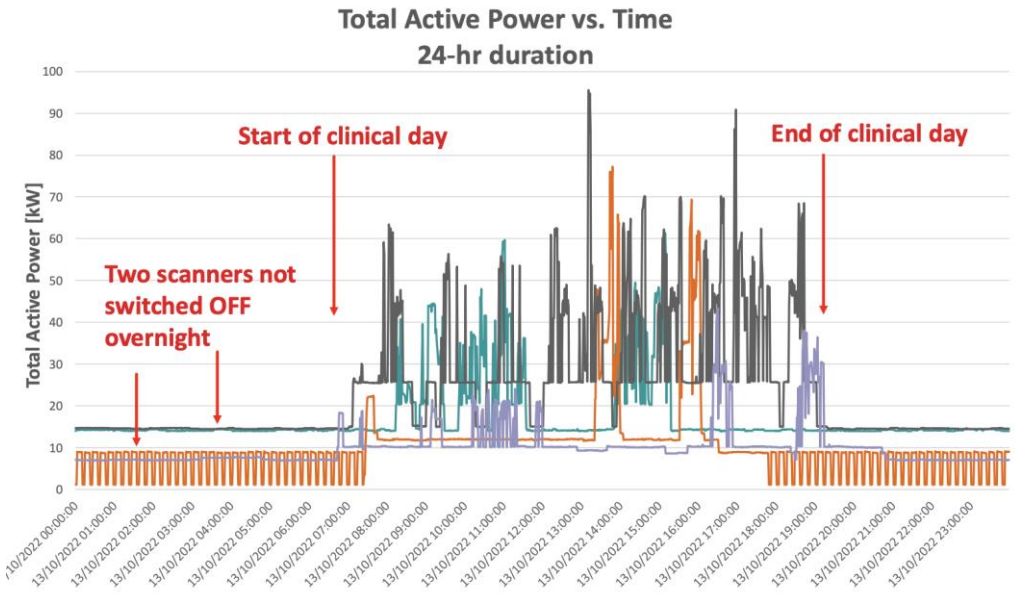
Radiology

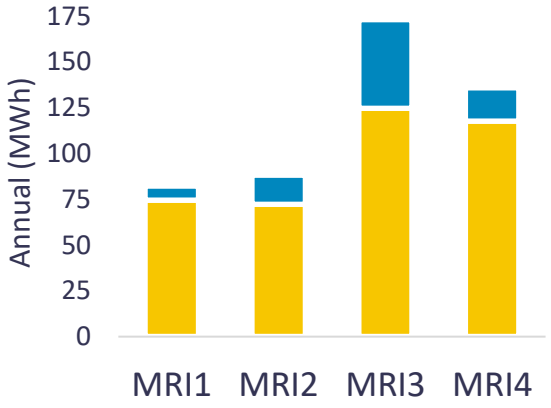
ORIGINAL RESEARCH · HEALTH POLICY AND PRACTICE

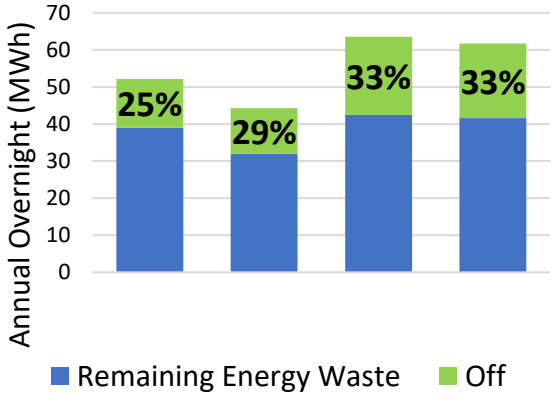
Ecodesign and Operational Strategies to Reduce the Carbon Footprint of MRI for Energy Cost Savings

Sean A. Woolen, MD, MSc • Amy E. Becker, PhD • Alastair J. Martin, PhD • Roland Knoerl, MBA • Vincent Lam, BSC, EE • Jerry Folsom, MBA • Christian Eusemann, PhD • Christopher P. Hess, MD, PhD • Vibhas Deshpande, PhD

- Non-productive time 72-91% energy
- Switching from “idle” to “off” mode reduces power use by 25-33%
- Further 25% savings with eco-off mode
- Annual savings up to 631 MWh ($88K)
- Next – rapid-switching, eco-design at sequence-level, predictive analytics





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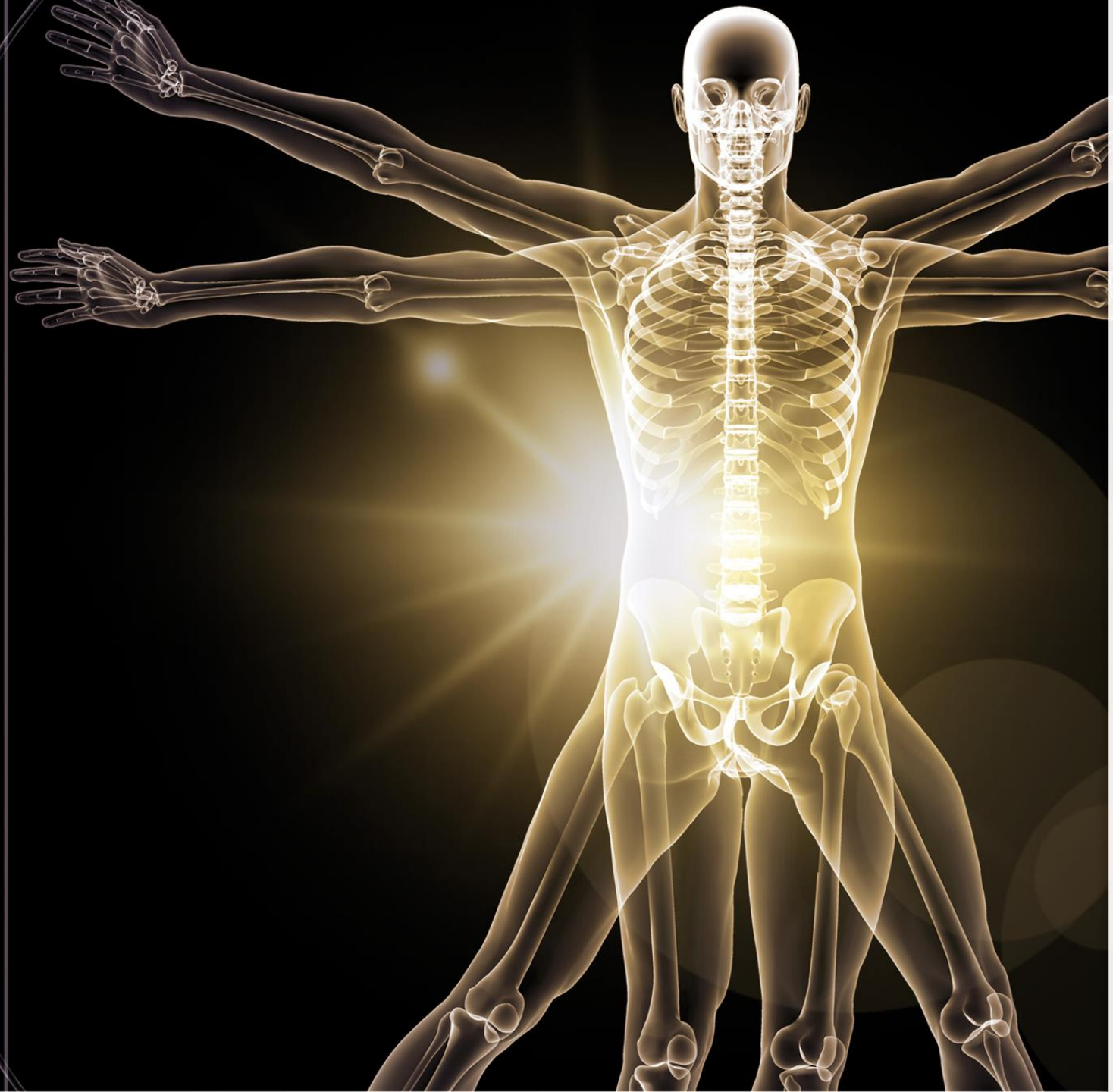
Conclusions

- Not about reducing energy, it’s about energy sources and efficient use
- It takes a village… progress is intrinsically transdisciplinary and collaborative
- Overall strategy: measure, message, manage
- Sustainability as a space that is wide-open for innovation



15th Biennial Symposium of the International Society for Strategic Studies in Radiology

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Berlin/Germany
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