Green strategies and possibilities all over the world.
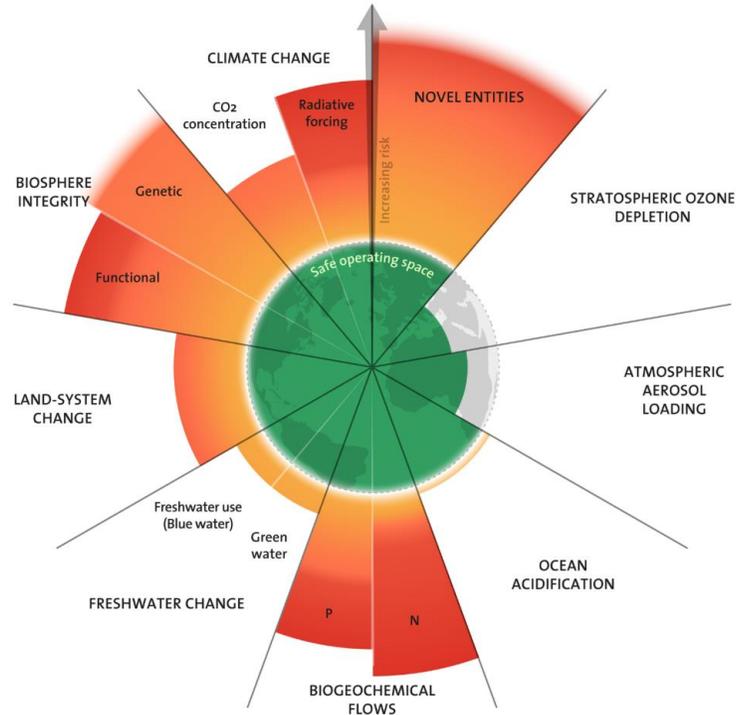
Cinthia Vera Fuentes
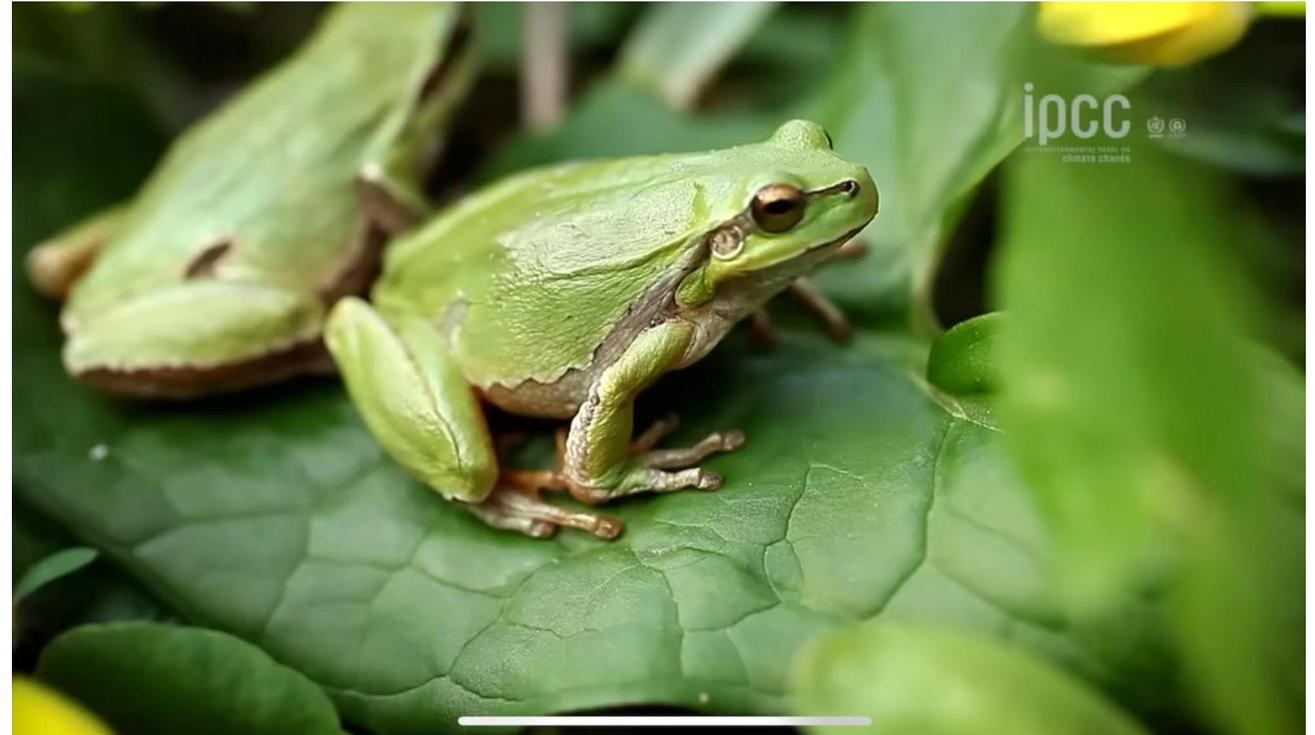**Green & Innovation Officer WFHSS**

Source: Health Care Without-smart health

1

Why today? Why now?

The 2025 update to the Planetary boundaries. Licensed under CC BY-NC-ND 3.0. Credit: "Azote for Stockholm Resilience Centre, based on analysis in Sakschewski and Caesar et al. 2025".

Source: IPCC – Intergovernmental Panel Climate Change

The Sixth Assessment Report (AR6) gathered evidence from more than 14,000 scientific studies and conclusions with an unequivocal consensus:

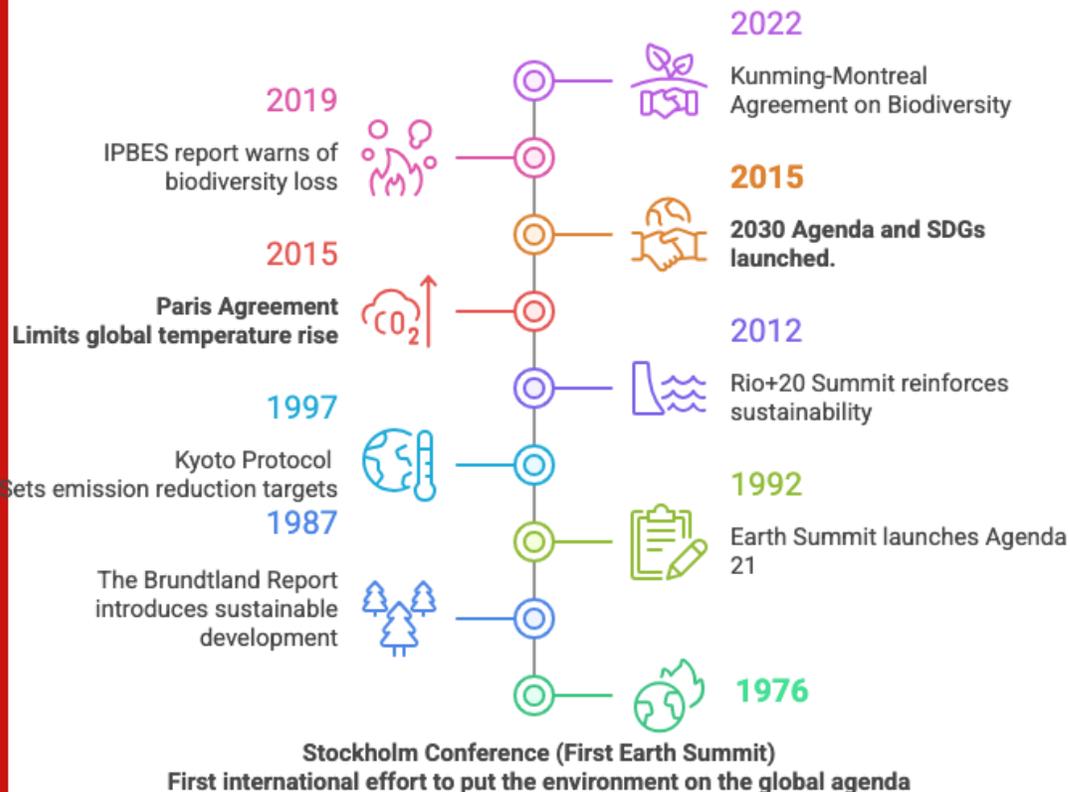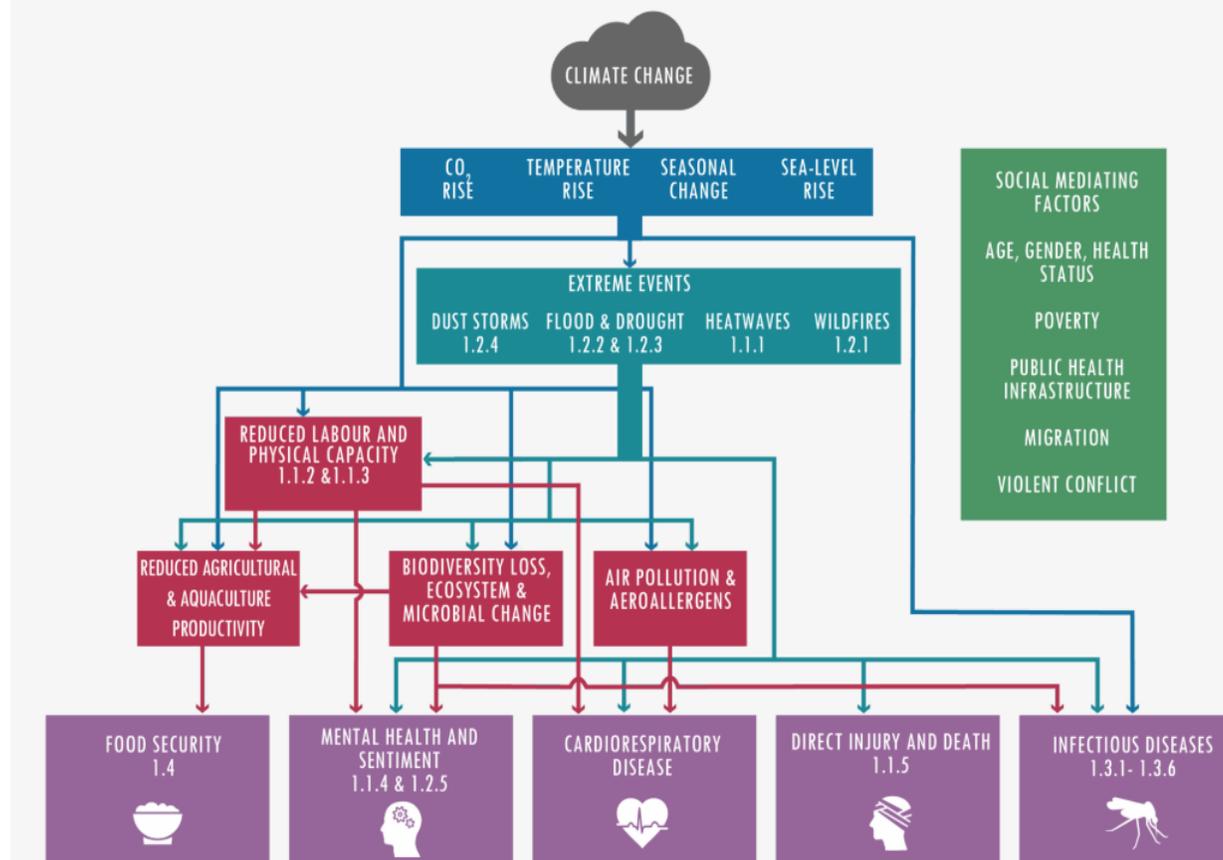**"Human influence has warmed the atmosphere, the ocean, and the land."**

How did we get here?

The Disengagement Crisis: the origin of the global **Multidimensional crisis**

Agreements over time

2022 — Kunming-Montreal Agreement on Biodiversity

2019 — IPBES report warns of biodiversity loss

2015 — **2030 Agenda and SDGs launched.**

2015 — **Paris Agreement** **Limits global temperature rise**

2012 — Rio+20 Summit reinforces sustainability

1997 — Kyoto Protocol Sets emission reduction targets

1992 — Earth Summit launches Agenda 21

1987 — The Brundtland Report introduces sustainable development

1976 — Stockholm Conference (First Earth Summit) First international effort to put the environment on the global agenda

INDICATORS OF CLIMATE CHANGE IMPACTS, EXPOSURES, AND VULNERABILITY

CLIMATE CHANGE

- CO_2 RISE
- TEMPERATURE RISE
- SEASONAL CHANGE
- SEA-LEVEL RISE

SOCIAL MEDIATING FACTORS
- AGE, GENDER, HEALTH STATUS
- POVERTY
- PUBLIC HEALTH INFRASTRUCTURE
- MIGRATION
- VIOLENT CONFLICT

EXTREME EVENTS
- DUST STORMS 1.2.4
- FLOOD & DROUGHT 1.2.2 & 1.2.3
- HEATWAVES 1.1.1
- WILDFIRES 1.2.1

REDUCED LABOUR AND PHYSICAL CAPACITY 1.1.2 &1.1.3

- REDUCED AGRICULTURAL & AQUACULTURE PRODUCTIVITY
- BIODIVERSITY LOSS, ECOSYSTEM & MICROBIAL CHANGE
- AIR POLLUTION & AEROALLERGENS

- FOOD SECURITY 1.4
- MENTAL HEALTH AND SENTIMENT 1.1.4 & 1.2.5
- CARDIORESPIRATORY DISEASE
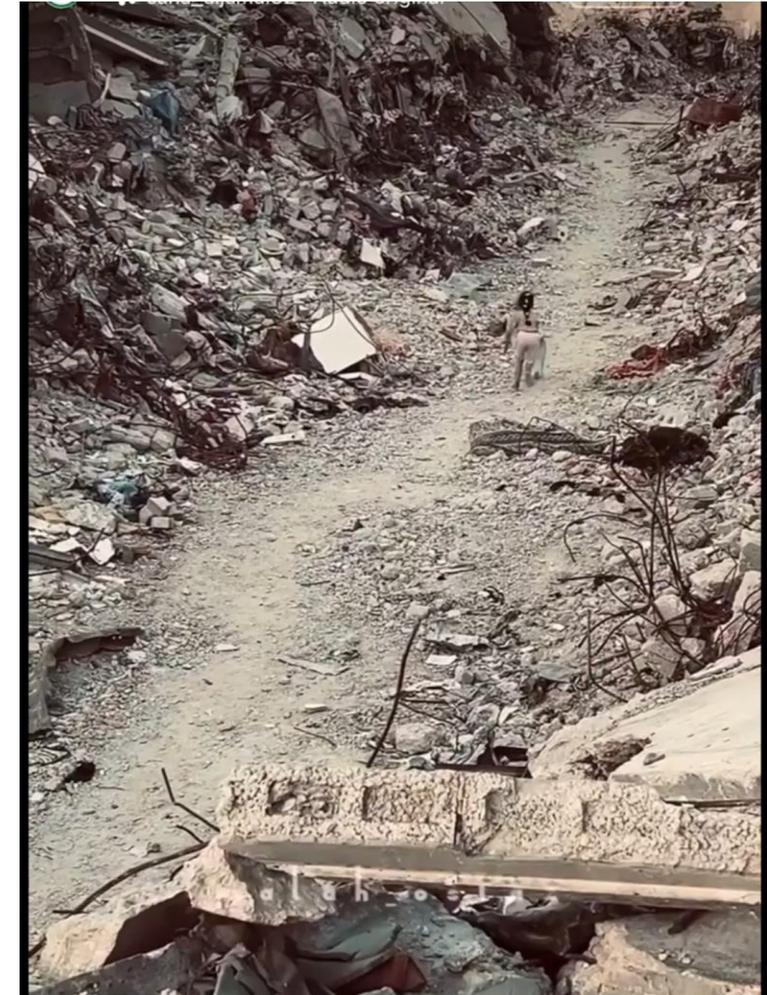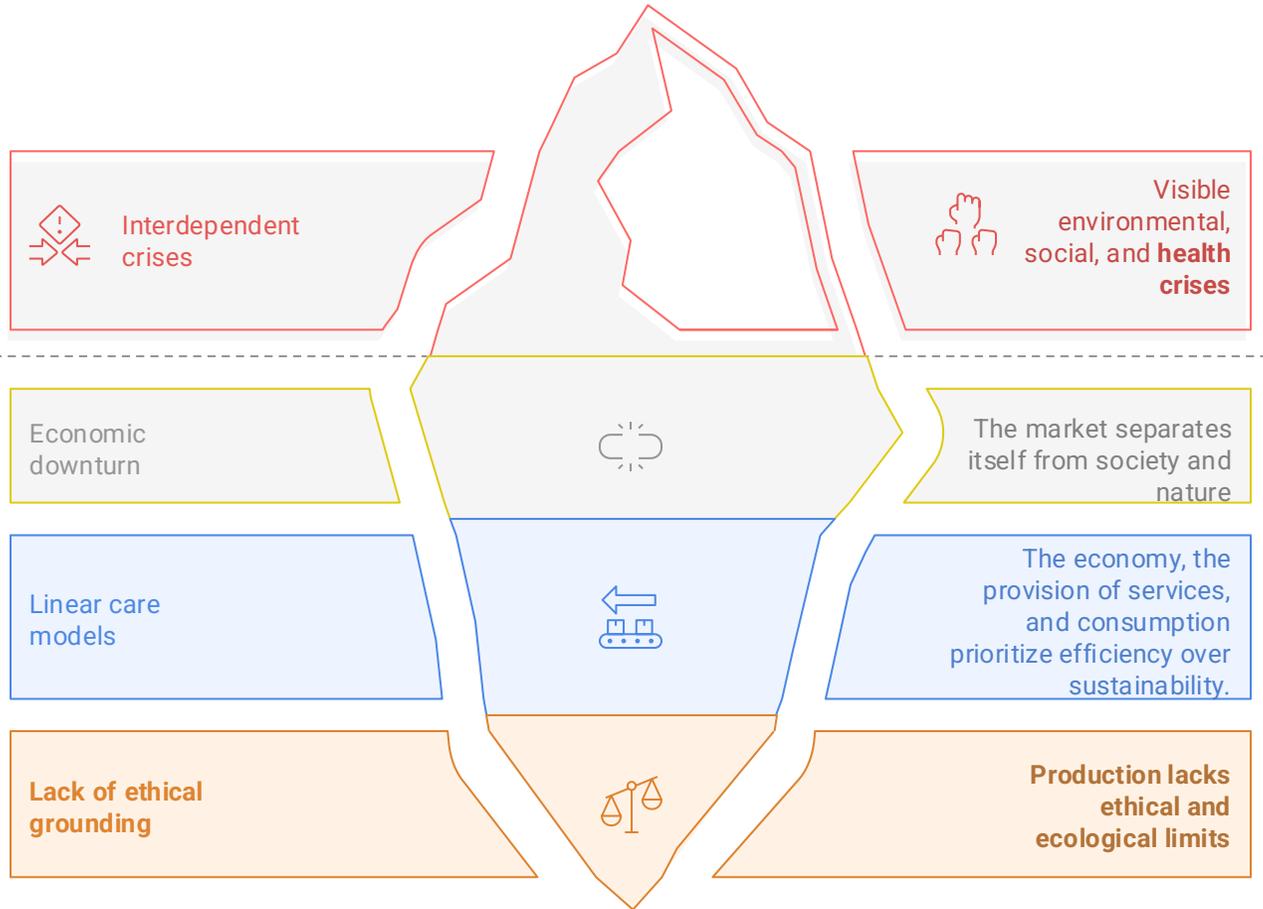- DIRECT INJURY AND DEATH 1.1.5
- INFECTIOUS DISEASES 1.3.1- 1.3.6

Source: Lancet Countdown

How did we get here?

The Disengagement Crisis: the origin of the global **Multidimensional crisis**

Interdependent crises

Visible environmental, social, and **health crises**

Economic downturn

The market separates itself from society and nature

Linear care models

The economy, the provision of services, and consumption prioritize efficiency over sustainability.

Lack of ethical grounding

Production lacks ethical and ecological limits

The multiple crises we are currently experiencing have their roots in the disconnect between the economy and society.

Source: TRT World / Palestine 2025

The real impact of the healthcare sector

HEALTH CARE'S CLIMATE FOOTPRINT

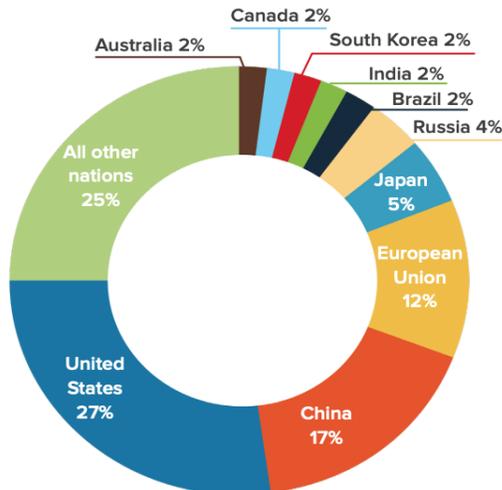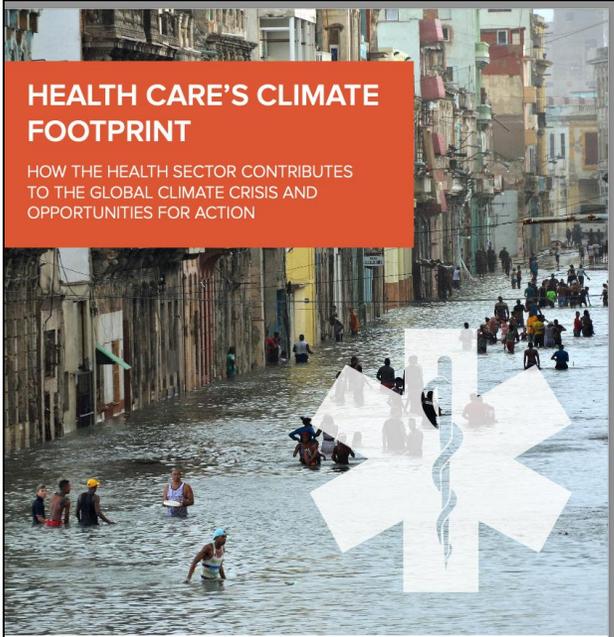HOW THE HEALTH SECTOR CONTRIBUTES TO THE GLOBAL CLIMATE CRISIS AND OPPORTUNITIES FOR ACTION

Figure 8: Top ten emitters as percentage of global health care footprint.

- Canada 2%
- South Korea 2%
- Australia 2%
- India 2%
- Brazil 2%
- Russia 4%
- Japan 5%
- European Union 12%
- China 17%
- United States 27%
- All other nations 25%

Global Emissions
The healthcare sector contributes **4.4%** of global **GES**

Major Contributors
USA, , China, and the countries of the European

Fifth Largest Issuer
If the healthcare sector were a country, it would be **the fifth largest** emitter on the planet..

Linear Economic Model
Model predominant.

Hospital Waste
30% of all hospital waste comes from disposable materials, which is equivalent to **15 million tons** of plastic per year.
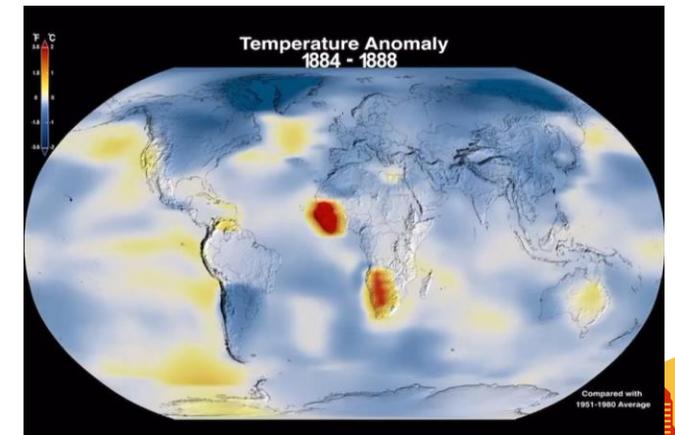
Sources of Emission
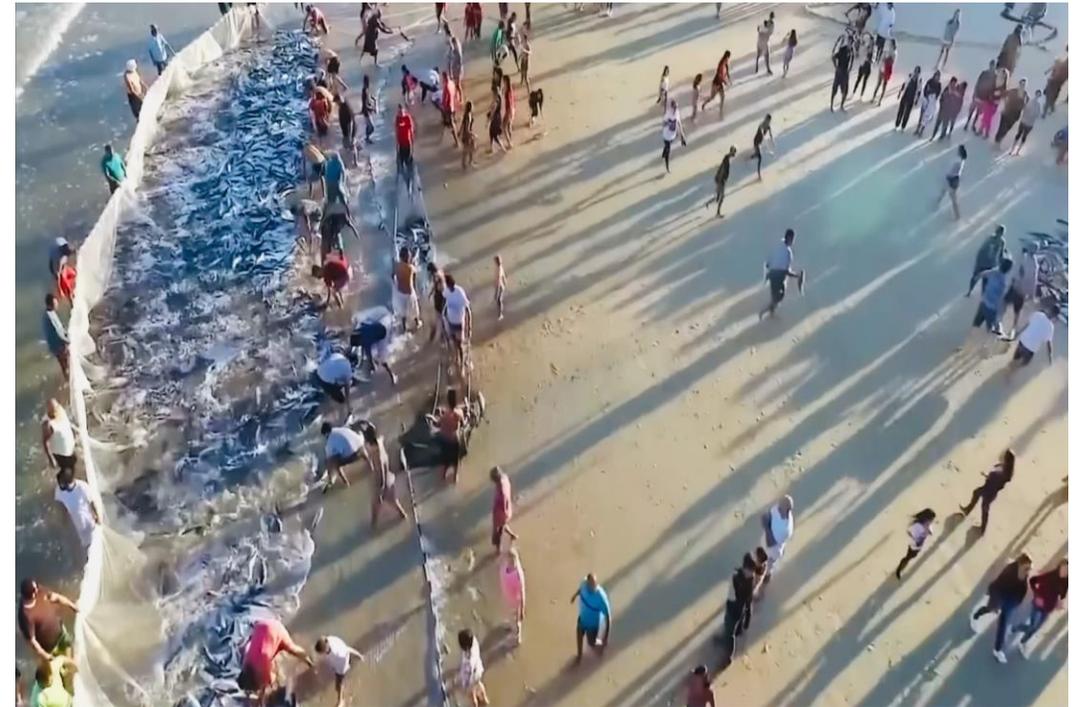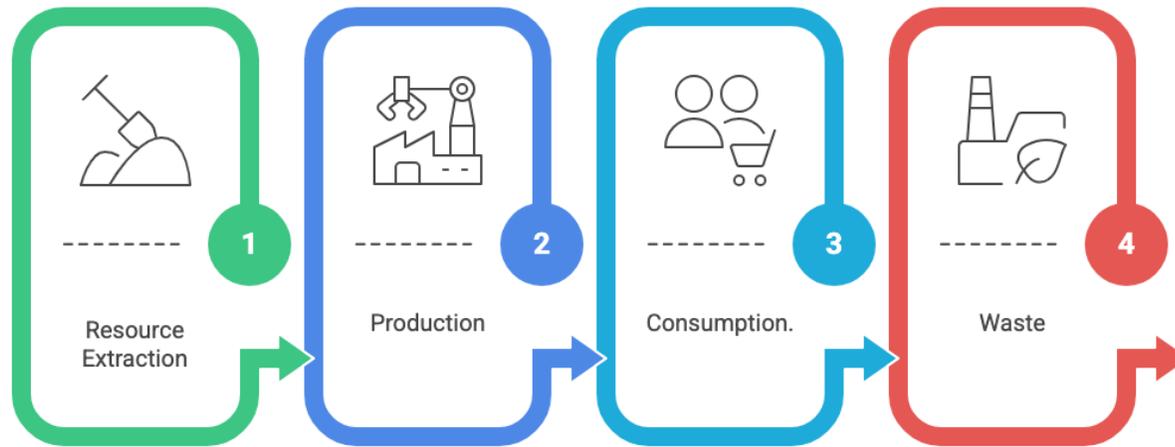**Energy consumption, transportation**, and **the manufacture, use,** and disposal of products.

Supply Chain Emissions
Most emissions—71%—come through the production, transportation, and disposal of goods and services.

Temperature Anomaly 1884 - 1888

Compared with 1951-1980 Average

Source: NASA

5

Health impact of the linear model

| Resource Extraction | Production | Consumption. | Waste |
| 1 | 2 | 3 | 4 |

Source: Oceana Org International

This linear model is not only environmentally unsustainable, but also vulnerable

And what about CSSDs?

The reprocessing of medical devices is not neutral

The Green Revolution in SPD: From Hidden Cost to Frontline Change

Author(s) Marjorie Wall, EDBA, CRCST, CIS, CHL, CSSBB

As climate change accelerates, health care's environmental impact faces increased scrutiny, with sterile processing departments (SPDs) emerging as key change agents. Often behind the scenes, SPD professionals can lead sustainability by turning routine practices into ecofriendly protocols that protect both patient and planetary health.

sterile processing PERSPECTIVES with Marjorie Wall, EDBA, MLOS, CRCST, CIS, CHL, CSSBB

Climate change is increasingly threatening global health, and sterile processing professionals are uniquely positioned to lead health care's sustainability transformation. Sterile processing departments (SPDs), often invisible to patients but essential to safe surgery,

Inefficient recycing Policies

High Consumption

Impact of the QMS

FREE

Impact of the Supply Chain

Health care's response to climate change: a carbon footprint assessment of the NHS in England

STERILIZATION ZENTRAL — Zeitschrift für Medizinprodukte-Aufbereitung — Volume 33 — 2 2025 — mhp-medien.de

High Consumption CO₂

Cycle diagram: USE → Point of use processing → Cleaning & Desinfection → Controls & Assembly → Packaging → Sterilization → Transport → Store

Use of Chemicals and plastic

PPE waste

Suboptimal Sets

Plastic Waste

Some critical environmental issues

Stage of the process	Energy consumption / Water	CO_2 production / Climate impact	Waste and packaging
Pre-disinfection	25 liters of water per bucket + disinfectant	High wastewater load with chemicals; ecologically questionable process	Disposal of disinfectant solutions after each use
Mechanical cleaning (washing and thermal disinfection)	High water and electricity consumption	It depends on the country's energy source.	Containers for detergents and chemical products
Drying and packaging	Variable consumption depending on the type of sterile barrier	CO_2 associated with the production and disposal of SBE packaging	Waste from single-use packaging
Sterilization	Significant energy consumption	Indirect CO_2 according to electrical and steam source	Disposal of filters, indicators, and packaging
Purchasing and supply chain	Indirect impact of suppliers	Local production in France reduces CO_2 emissions by 25% in gloves compared to Asia.	Reducing packaging by buying in bulk

Source: aalmann, E. (2025). *The role of sustainability and eco-efficiency in RUMED. Part 1: Eco-efficiency analysis. Zentralsterilization, 33* (2), 81–88._ MHP Medien Verlag. French Society for Hospital Sterilization (SF2S) 2025 . Guide Green´s.

Current gaps in the reprocessing value chain

Figure 1.6. More than three-quarters of all GHG in health are emitted in the supply chain

All GHG emissions, as allocated based on the Scope concept by the GHGP, 2018, OECD

Legend: Scope 1 | Scope 2 | Scope 3

Pie chart: 12%, 9%, 79%
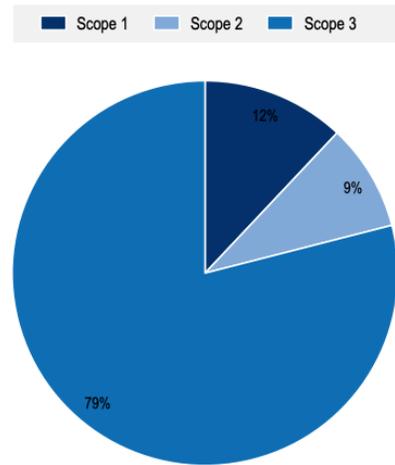
Note: Data refers to the OECD mean.
Source: OECD analysis based on data from OECD Health Statistics 2025, System of Health Accounts and ICIO data.

Green transition of the MedTech industry

Transparency
LCA, carbon footprint, traceability

Circular business models
Remanufacturing, rental.

ESG
Integrate environmental, social, and governance factors

Implement sustainable practices

Eco-design
Materials, circularity, repairability

Environmental impact
The MedTech industry pollutes

Sustainable MedTech industry
Sustainable MedTech industry

- **Supply chain emissions account for 79% of total emissions in the healthcare sector.**

- **Half of the emissions from the healthcare sector come from production and transport abroad.**

Challenges for sustainability in CSSD

Environmental metrics

Fragmented progress

Global scale

In progress

Today

Lack of redesign from the device's origin

Misalignment between manufacturers, hospitals, and regulators

Still a reactive, not systemic approach

CSSD Balance reprocessing

Maintaining Quality

Ensuring Safety

Promoting Sustainability

Maximizing Efficiency

4

3

1

2

Transforming reprocessing...

Design for Reprocessing

Ensuring Patient Safety

Optimizing Resource Use

Sterilize Safely

Reduce Waste

Cleaning and disinfection
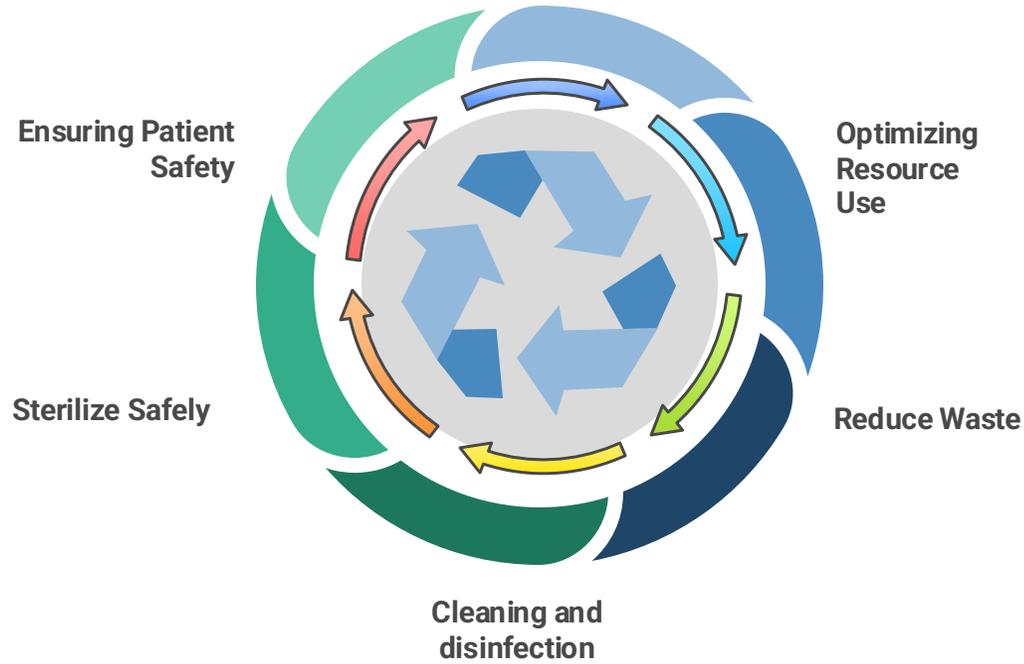
Sustainability	Circularity
Reduce harm	Redesign the system

Circularity in sterilization centers (the R model)

9R	Applicability in CSSD	Examples
Refuse	✅	**Refuse unnecessary single-use products or those with a high environmental impact**
Rethink	✅	**Redesign reprocessing flows and processes, taking into account energy consumption, time, and hot water reuse.**
Reduce	✅	**Minimize water, energy, and chemical use without compromising microbiological efficacy (e.g., adjustment of the A_0 parameter).**
Reuse	✅	**Reuse medical devices designed for multiple cycles with validation according to ISO 17664 and safety evidence.**
Recycle	✅	**Separation of recyclable materials: metals, cardboard, plastic packaging, containers, etc.**
Repair	Manufacturer	Requires the manufacturer to authorize safe repairs and maintenance
Remanufacture	Manufacturer	Applicable to certified reprocessed equipment or reconditioned instruments
Repurpose	Manufacturer	Only possible under industrial and regulatory conditions
Reuse	‼️	In hospitals, not directly applicable for regulatory and safety reasons, it could be applied in the recycling of materials outside of clinical use.

Transforming reprocessing...

MITIGATION	ADAPTATION	RESILIENCE

Reduce greenhouse gas emissions or environmental impact

Example: Energy efficiency, sustainable purchasing, waste management

Measures to **adapt** healthcare systems **to current and future changes**, ensuring operational continuity and patient safety. Example: Plans for floods or climate emergencies, resilient hospital infrastructure.

Capacity of health systems **to maintain** continuity of service
Example: Integrate climate into national policies, strengthen intersectoral governance, **staff training**, etc.

Transforming reprocessing...
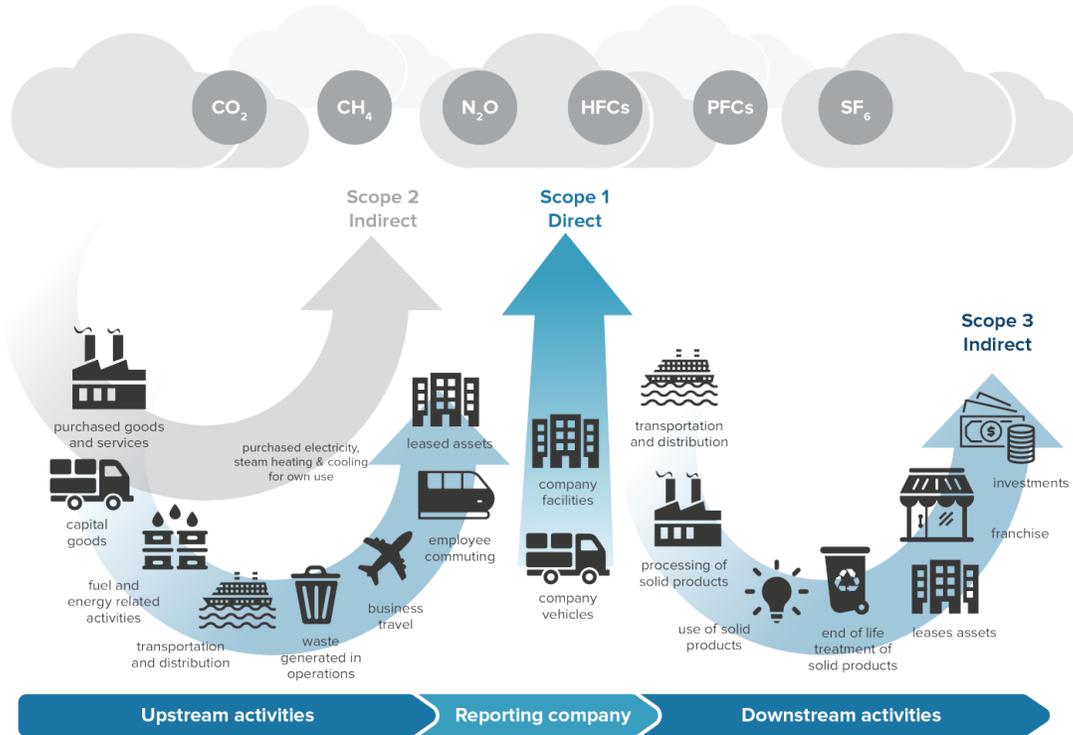
Figure 3: Greenhouse Gas Protocol Scopes 1, 2, and 3. (Source: Greenhouse Gas Protocol)
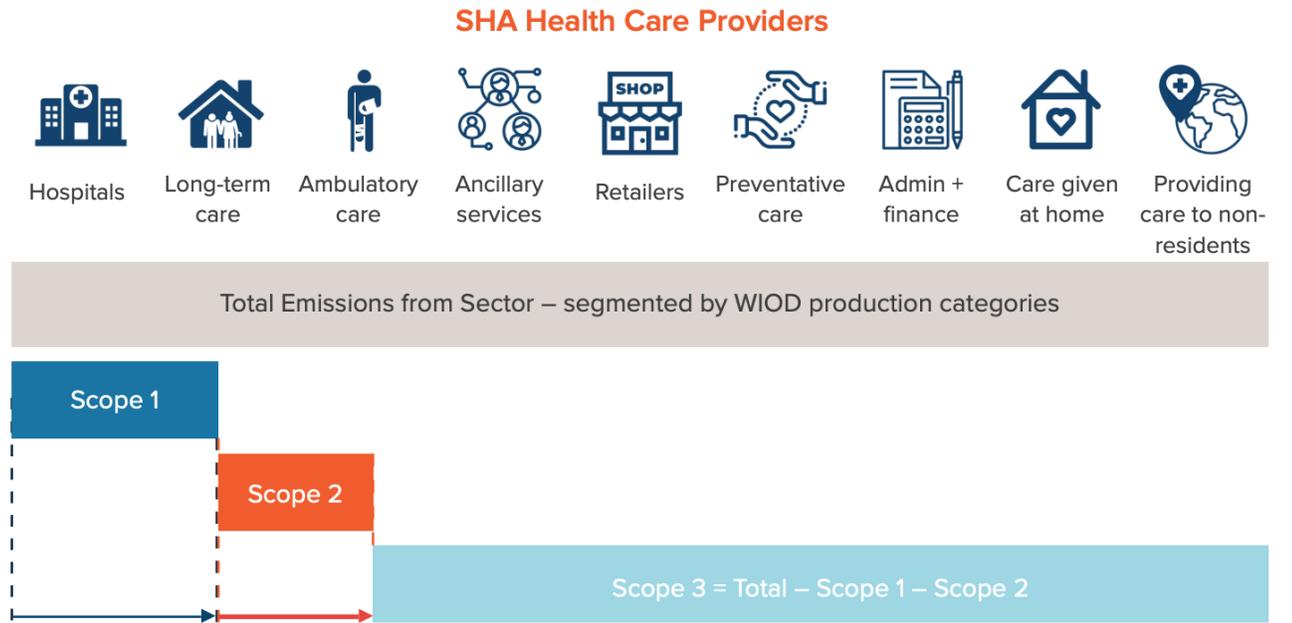
Figure 4: Approach taken for mapping emissions to GHGP Scope 1, 2, and 3 categories from the SHA and WIOD climate footprint assessment model

Source: Health Care Without Harm Climate-smart health care series Green Paper Number One. 2019. P. 15-16

"Measuring beyond carbon"

Source: Swiss Federal Office for the Environment (BAFU) (2022)
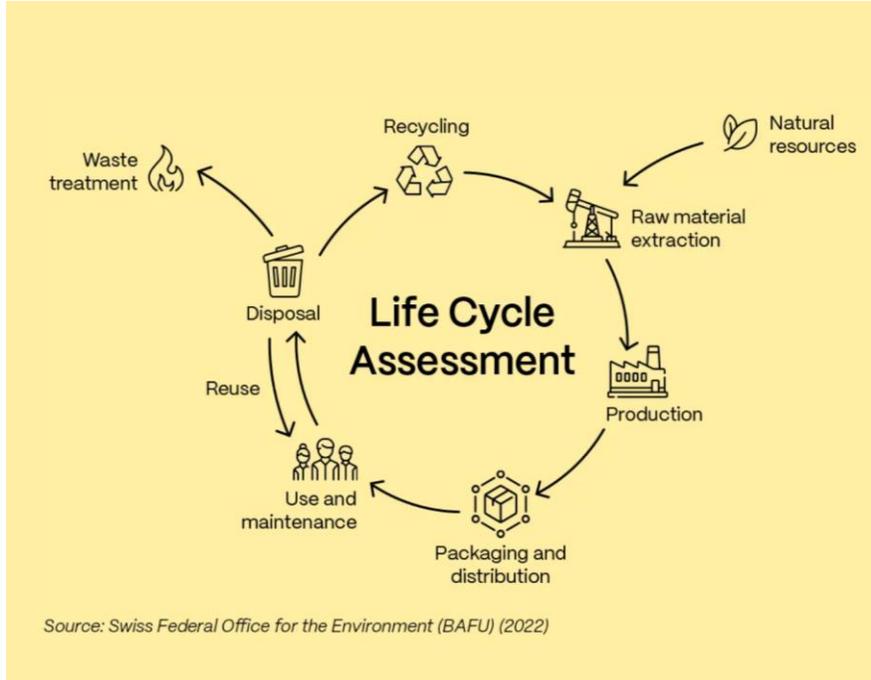
Source: www.ansell.com

- Methodology used to evaluate the environmental impacts of a product, process, or service throughout its entire life cycle **(ISO 14040:2006).**
- Measuring impact beyond CO2
- **Database :** ECOINVENT , Sima Pro, etc **+**, Software OPEN LCA
- **4 Phases ,** To date, there has been no specific development for the healthcare sector/CSSD.

🧮 **CO₂ emissions based on energy**

CO_2e (kg) = Energy (kWh) × Emission factor (kg CO_2e/kWh)

💧 **Impact of water**

Water (L) = Number of fillings × Volume per filling (15–20 L)

🧰 **Waste generation**

Packaging waste (kg) = Area (m²) × **0.0615 (kg/m²)** × Number of layers

The challenge now is to generate our database.

Global ecosystem: What the world is doing

Institutional initiatives and healthcare networks

Mitigation

Reducing greenhouse gas emissions to limit global warming

Adaptation

Adjusting practices to minimize the impacts of climate change

Resilience

Building capacity to recover and thrive despite change

Health Care Without Harm
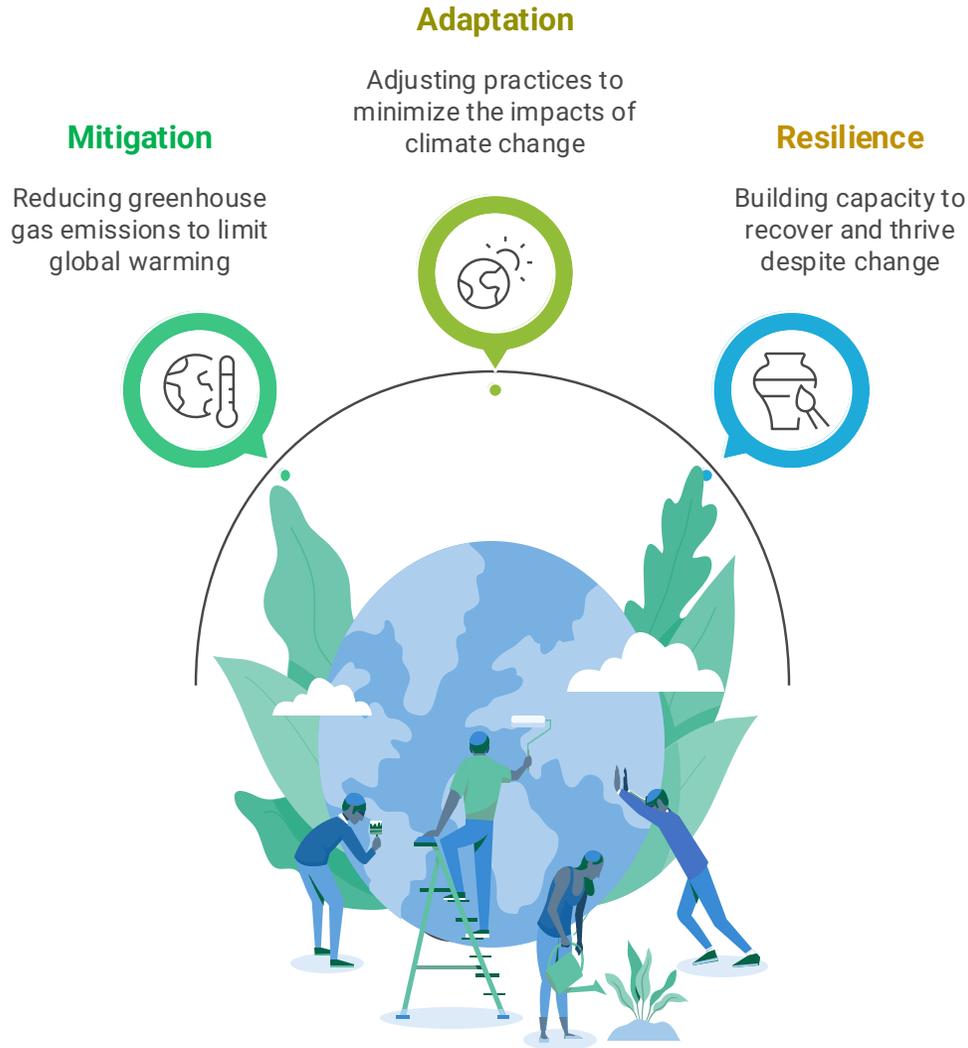
86 countries representing the interests of more than 70,000 hospitals and health centers.

GLOBAL GREEN and HEALTHY HOSPITALS

500 Hospitals
around the world

Design and construction of green hospitals

Energy savings, implementation of renewable energies

Optimization of water use and consumption

Waste management

Fight against plastic

Sustainable purchasing

Overview of Health Systems and Networks with Green Strategies

USA- CANADA

Canada
- Roadmap to a net-zero health care system by 2050 (CMA and industry partners)
- Net-Zero-Ready Program for health care infrastructure
- Lancet Countdown

UK

UK (NHS) A greener NHS – Net Zero Supplier Roadmap + Evergreen

LATAM

Latin America and the Caribbean
- PAHO/OPS "Smart Hospitals": resilience + energy efficiency and green technologies in hospitals (Caribbean and regional expansion).
- Lancet Countdown LATAM 2025

AFRICA

Health Care Without Harm (HCWH) implemented projects in Ghana, Madagascar, Tanzania, and Zambia to improve healthcare waste management.

EUROPE

DK Denmark – Legal Reform + Hospital Pilot Projects 2024: a joint strategy for hospital sustainability

NL Netherlands – Decentralized Hospital Projects Green Deal on Sustainable Healthcare in 2022

FR France SF2S– GREEN's: Green Guide to Hospital Reprocessing

DE Germany : EnEfG (Energy Efficiency Act, 2023):
DGSV: Development of a benchmark to establish comparability of CCSD in Germany , DGSV- Kongress

AT Austria's strategy towards a Net Zero healthcare system

AUSTRALIA

AU Australia
- National Health and Climate Strategy (2023): vision for a net-zero health system and 49 actions for 2024-2028 (resilience, mitigation, procurement, infrastructure)

21

Asia's role in the global green transition

HK **Hong Kong :** HK Government "Launching Ceremony for Energy Saving Charter 2025 and 4T Charter" – outlines city-wide energy-saving targets and green building strategies

- Wong K.S. "Hospital gets eco-friendly power" – Alice Ho Miu Ling Nethersole Hospital installs system generating electricity from landfill gas.

- Health Bureau (Hong Kong) Environmental Report 2023 – includes policies for waste reduction, resource saving, and environmental performance of hospitals.

- More resilient and sustainable health reforms.

- Climate and operational pressures in East Asia

- **Hong Kong's unique position .** Opportunity: Lead green standards in reprocessing for Asia-Pacific

- Hong Kong has the size, healthcare system, and capacity to become the regional benchmark for sustainable CSSD.

- Implementing circularity and environmental metrics reduces risks and operational costs.

Integrating sustainability is not a "nice-to-have" in Hong Kong: it is an operational resilience strategy.

ASIA

41 % of global medical device production and is a key driver of global supply chains

CN China
- Healthy China 2030: national framework integrating public health and sustainability (guiding system reforms).

SG Singapur El National University Hospital (NUH)
It was the first hospital to receive international certification for hospital sustainability.

Overview of Industries Networks with Green Strategies

USA – Canadá + 15
Efficient chemical dosing
Flexible packaging industry

Europa + 30
Flexible packaging industry
Environmentally friendly chemicals
Low-consumption equipment technologies

Asia + 15
Efficient chemical dosing
Flexible packaging industry
Low-consumption equipment technologies

Africa +- 5
Collaborative projects for energy efficiency

LATAM +- 5
Energy efficiency pilot projects

Australia +- 2
Waste management and DM remanufacturing

45% of the innovations identified come from the chemical sector, which is beginning to work on cleaner formulations and concentrated or returnable packaging.

35% Sterile packaging , recyclable materials or reusable systems are being explored.

15% Equipment, such as washing machines or sterilizers with lower energy consumption.

5% **Circular management and partnerships**, still in a very early stage.

Reprocessing as an opportunity

Maintaining Quality

Ensuring Safety

Promoting Sustainability

Maximizing Efficiency

4

3

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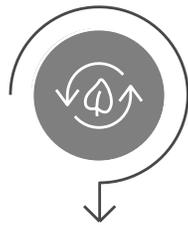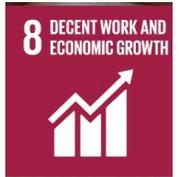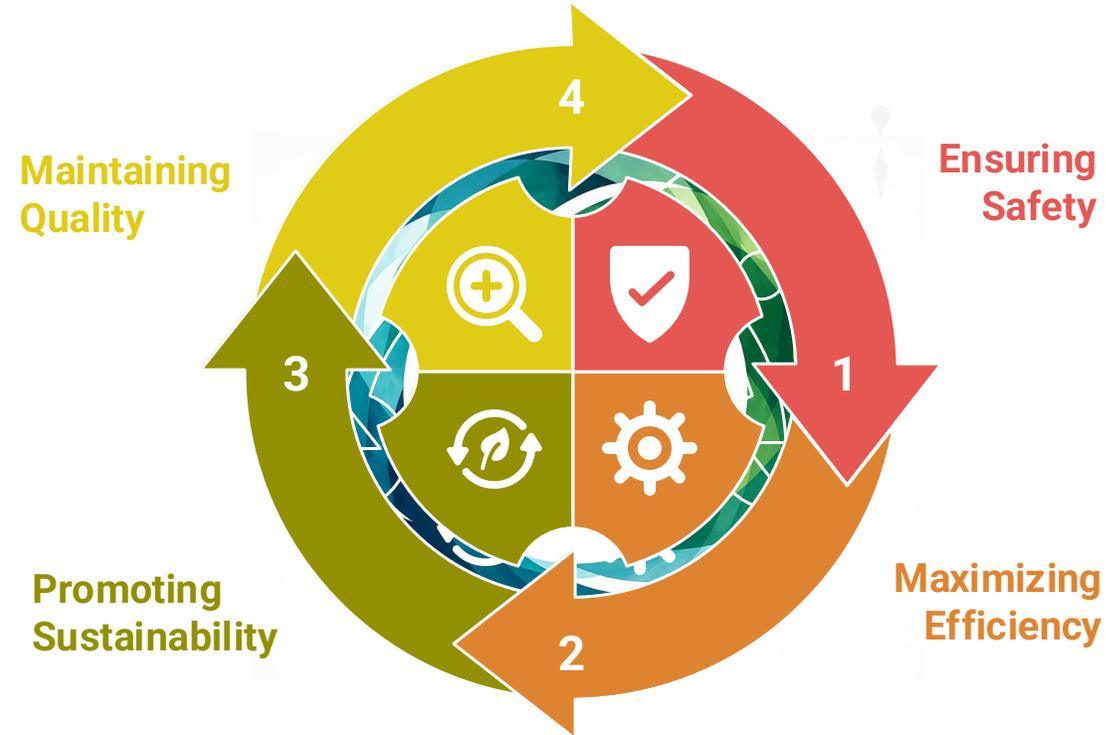
Current Status

Standardize Metrics

System Integration

Define KPIs

Improved Sustainability

Some examples of KPIs…

KPI	Typical range	Recommended KPI	Objective
Water per cycle	15–50 L	Liters per cycle + Trend	N/A
Energy per cycle	1.0–3.5 kWh (washers), 3–9 kWh (sterilizers)	kWh per cycle + kWh per set of instruments	N/A
Load capacity utilization	N/A	Weight of the load or number of sets / Maximum capacity	≥ 85% average load occupancy
Weight of packaging per load	80–250 g	Grams of packaging per sterilized load	Gradual reduction through recyclable or lighter materials
Chemicals per cycle	8–25 mL	mL of detergent or disinfectant per wash/disinfection cycle	Avoid overdosing + switch to concentrates

Future possibilities

OBJECTIVE	EXAMPLE OF CSSD CONTRIBUTION	MEASURABLE KPIs
MITIGATION OF CLIMATE CHANGE	Use of energy-efficient equipment	kWh/cycle kg CO_2e processed
ADAPTATION TO CLIMATE CHANGE	Resilient infrastructure design	No. service interruptions % systems with redundancy
SUSTAINABLE USE AND PROTECTION OF WATER AND MARINE RESOURCES	Installation of recirculation systems	L/cycle % water reuse
TRANSITION TO A CIRCULAR ECONOMY	Validated reprocessing of devices	No. of reuses per device % devices reused
POLLUTION PREVENTION AND CONTROL	Low-impact detergents	kg hazardous waste/month % biodegradable products
PROTECTION AND RESTORATION OF BIODIVERSITY AND ECOSYSTEMS	Responsibly-sourced purchases	% suppliers certified No. supplier audits

Climate Change Mitigation

Climate Change Adaptation

Sustainable Use and Protection of Water and Marine Resources

Transition to a Circular Economy

Pollution Prevention and Control

Protection and Restoration of Biodiversity and Ecosystems
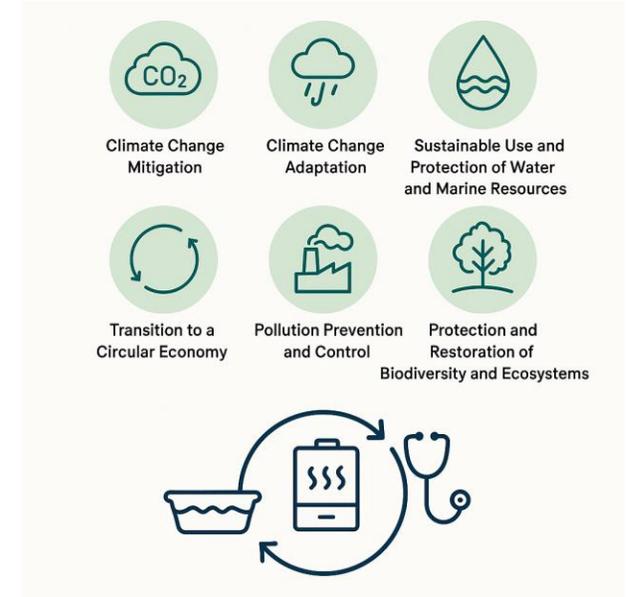
Healthcare sector taxonomy

How can we integrate ourselves into the green transition of the healthcare system?

Measuring the Footprint

Collect data on resource use to understand environmental impact.

Integrate Sustainability

Incorporate environmental metrics into quality management systems.

Collaborating Across Disciplines

Encourage dialogue between different departments for sustainable solutions.

Redefining Quality

Expand the definition of quality to include environmental responsibility.

GREEN CSSD

C. Vera WFHSS

Realistic actions

What can we do? Realistic and transformative strategies

1.-Read the available information and get started. Measure what you can	• Review the information published on WFHSS and the good examples of WFHSS member associations that have begun to develop green guidelines, such as the SF2S Greens Guide from France. • Track water and energy consumption per cycle • Estimate chemical use and waste generation monthly. • Record load capacity versus actual utilization

2. Optimize processes before technology	• Review the cycle parameters of the washing machine and autoclave to avoid overprocessing. • Implement preventive maintenance to keep equipment in optimal condition. • Group loads intelligently: avoid half-load cycles and redundant packaging.

3. Focus on synergies between water and energy	• Evaluate the possibility of reusing the final rinse for pre-cleaning (where regulations allow). • Recover heat from condensate to preheat water. • If possible, seek renewable energy alternatives.

What can we do? Realistic and transformative strategies

	4. Rethinking materials and packaging	• Transition to recyclable packaging and reduce single-use plastics. • Use reusable rigid containers where validated. • Audit your suppliers' packaging and request more environmentally friendly alternatives.
	5. Engange and train staff	• Appoint a "Green Ambassador" within the CSSD. • Incorporate sustainability key performance indicators (KPIs) into quality meetings. • Share environmental tips and success stories on a monthly basis.
	6. Sustainability in the supply chain	• Considers environmental, social, and ethical criteria in the supply chain
	7. Collaborate and compare at the local level	• Share anonymized performance data with nearby hospitals. • Participate in WFHSS pilot studies or working groups. • Document best practices: these will shape global indicators.

In summary…

Optimize Processes

Set Up Teams

Green supply chain

Promoting Policies

Promoting Culture

Measure

Engage

Replace

Optimize

Compare

GREEN CSSD

C. Vera WFHSS

The call to action

"**The reprocessing of medical devices will only be truly safe for people
when it is also safe for the planet.**
We cannot protect it while remaining tied to linear models
that deplete resources and perpetuate inequality.
There can be no real sustainability without social justice,
and no future if we fail to protect the lives of the most vulnerable."

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