

Comparing health services: Advantages & disadvantages of different approaches

*Discussion Forum Life Cycle Assessment Nr. 81
«How to harmonize & compare LCA in the service industry»*

15.09.2022, 11:00, Wädenswil, Campus Grüental, GA203

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Sustainable Economy
National Research Programme



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DISCUSSION FORUM ON
LIFE CYCLE ASSESSMENT

You will learn about ...

...the environmental impact of hospitals



...different functional units & our insights

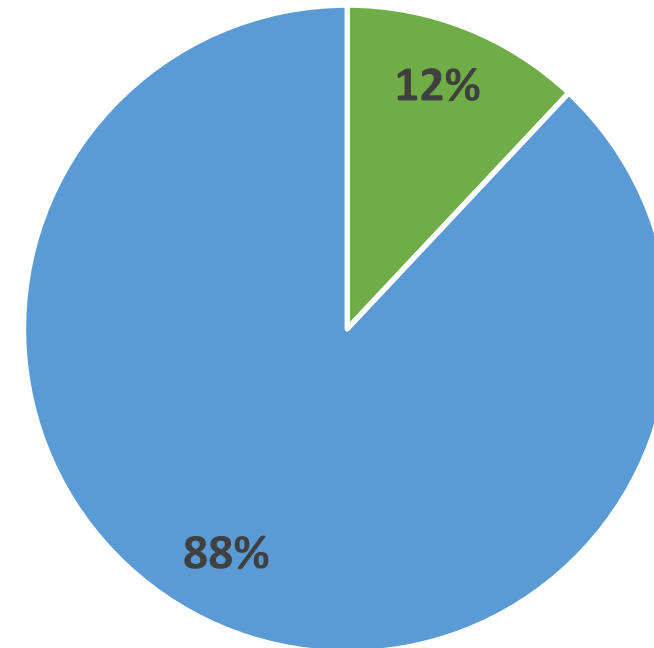


Relevance of health care

Workforce of Swiss health, veterinary and social work industry (2015)

- Share 12 % of the entire Swiss workforce
- Growth well above average (3.7 % per year, CH average 1 %)

Share of Swiss workforce



- health, veterinaay and social work
- other

Relevance of health care

Swiss health care (2014)

→ 6% of greenhouse gas emissions (EEIOT)

Private consumption of health (2005)

→ 7% of greenhouse gas emissions of private consumption




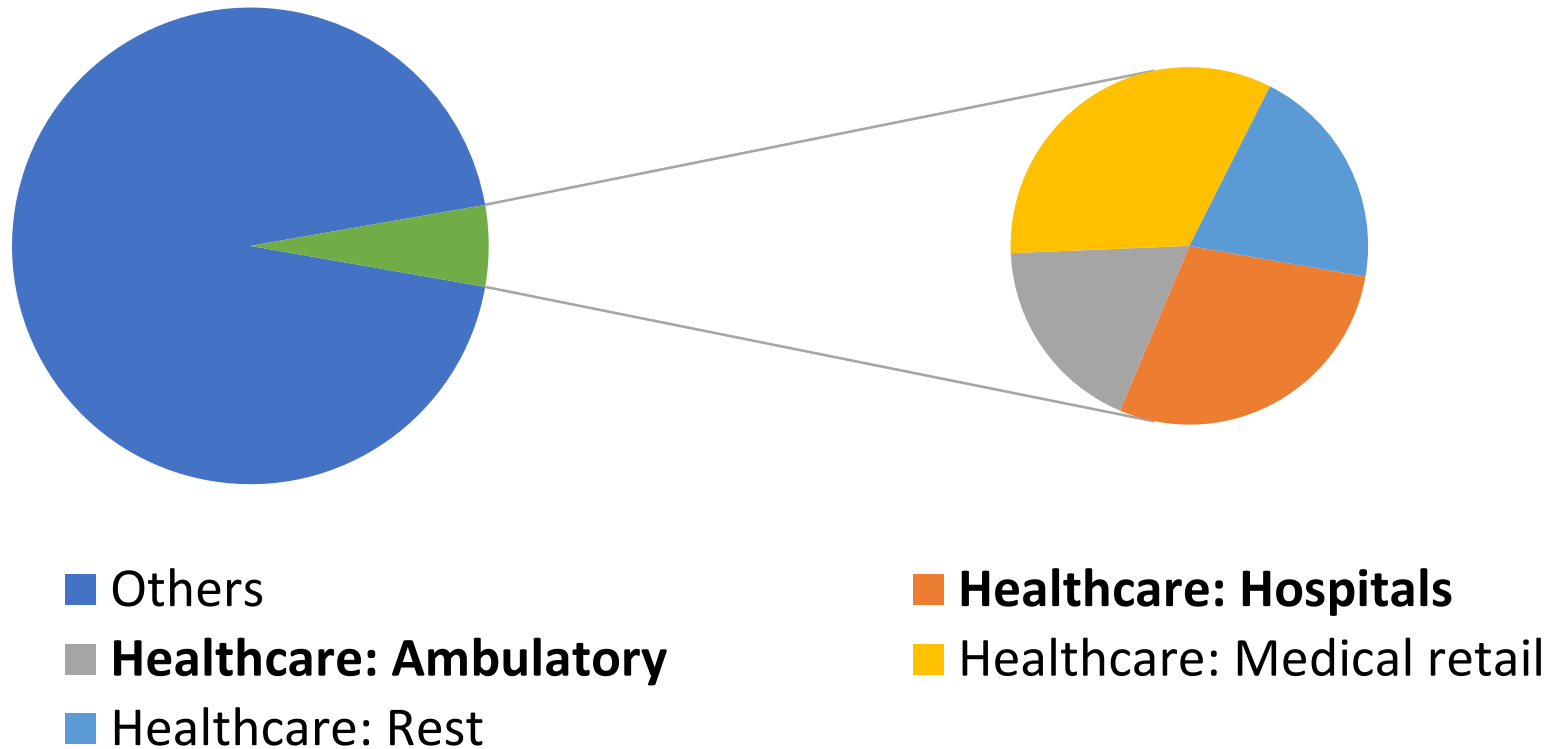
Pichler et al. (2019)

Jungbluth et al. (2011)

Relevance of health care

OECD health care (2014)

- 9% of gross domestic product 
- Average of 5% of greenhouse gas emissions (CH 6%)
- Share hospitals 30%, ambulatory health care 20%



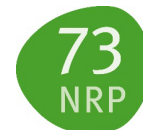


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- ❖ Swiss National Science Foundation
- ❖ Four years
- ❖ Three research groups



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- • • IWSB – Institut für Wirtschaftsstudien Basel
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Methods: data collection

- **Key data** collected in 2019 in Swisswide questionnaire
- **33** Hospitals responded, 60 % of full time equivalents (FTE)
- **Detailed data** collected at partner hospitals

Total 13'075'842 liter heating oil
per year (N=23)

Total 1'979'444 kg meat
per year (N=28)

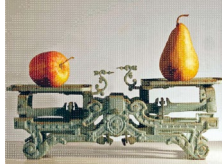


Methods: Modelling

3 Types of modelling

- **Directly** with survey data
e.g. electricity, heating, water use
- **Key data & detailed data**
e.g. infrastructure, waste
- **Statistical data**
e.g. costs & detailed data: pharmaceuticals, paper

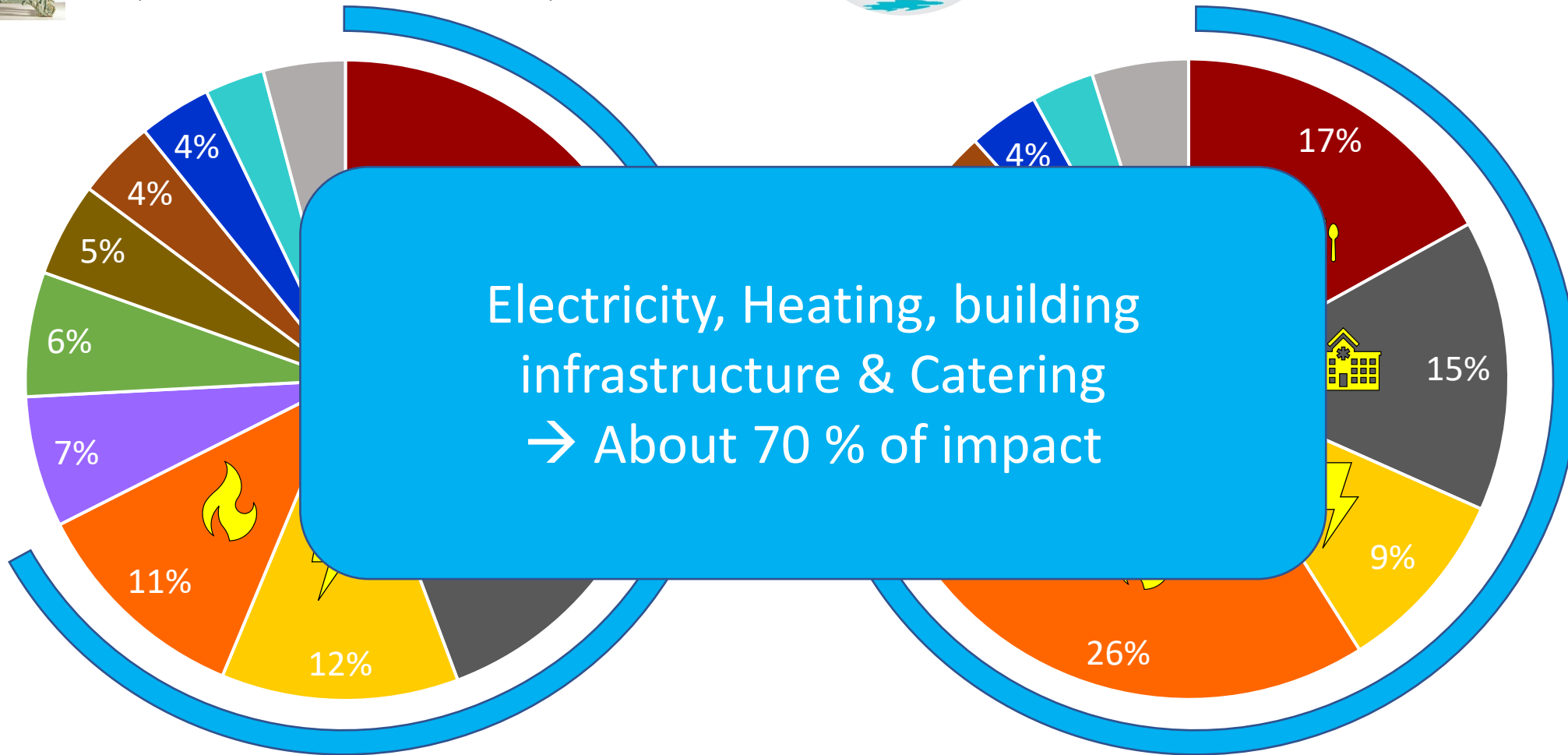
Average results



Ecological Scarcity (Frischknecht et al., 2013)



Greenhouse gas emissions (IPCC, 2013)



- Catering
- Building Infrastructure
- Electricity
- Heating
- Pharmaceuticals
- Textiles
- Waste & wastewater
- Electronic equipment
- Housekeeping products
- medical products
- Rest

Comparing Hospitals - Challenges

Different quantities and types of healthcare services



- Inpatient treatment



- outpatient care



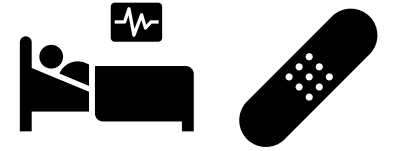
- intensive care

Comparing Hospitals: Full Time Equivalents

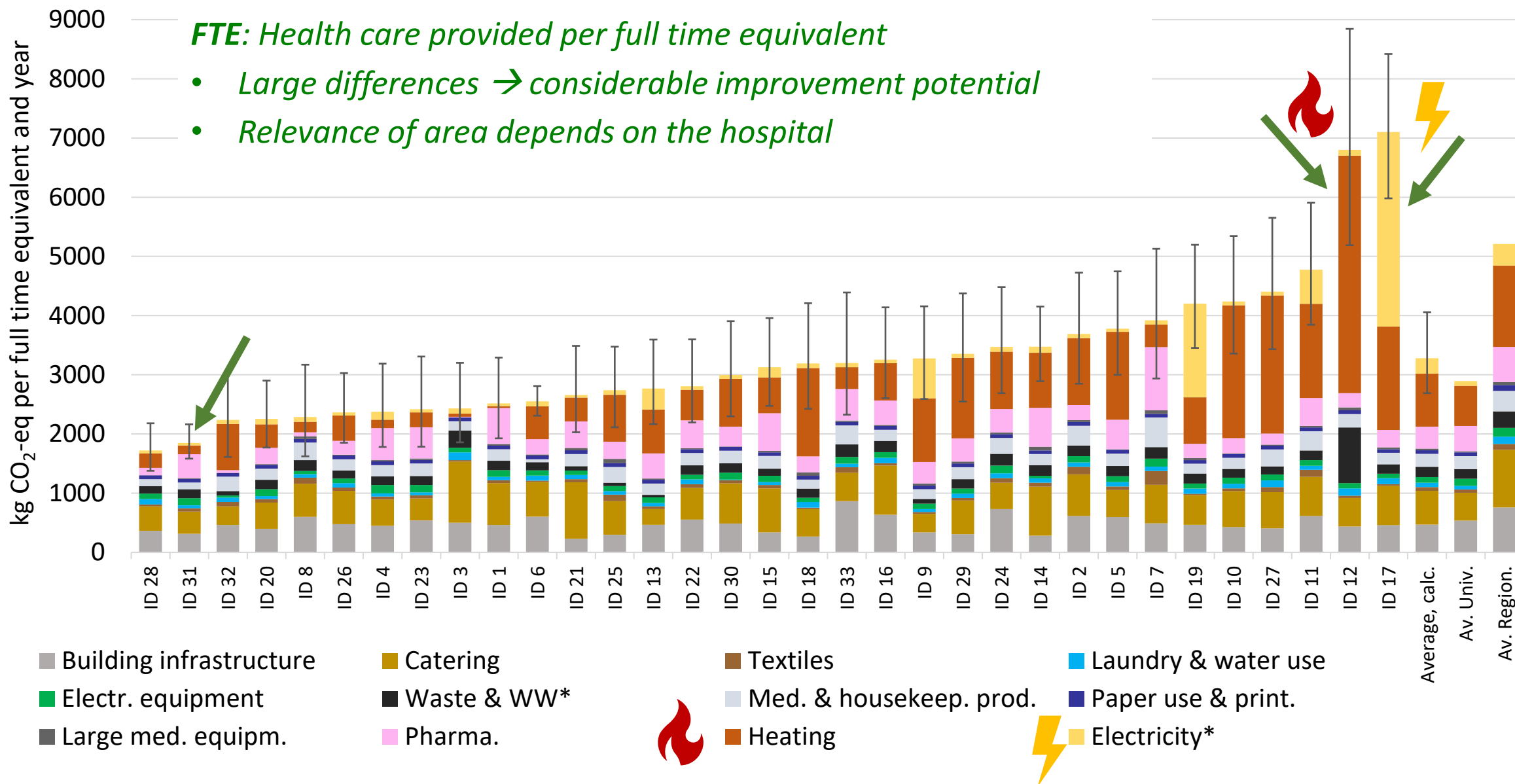


Full Time Equivalents (FTE)

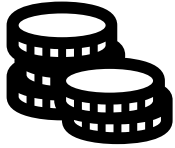
- Takes into account different **levels of care** & different ratios of **inpatient and outpatient care**
- Assumption: healthcare provision depends on staff working hours
- hospital services: inhouse personnel or by external providers?
- Inefficiency is not accounted for



Variation in climate impact of 33 Swiss hospitals



Comparing Hospitals: Different suggestions for a functional unit



Standardized revenue (CHF)

- Intensity of hospital partly reflected in costs
- Includes both inpatient and outpatient health services
- **higher costs do not necessarily reflect more intensive treatments**



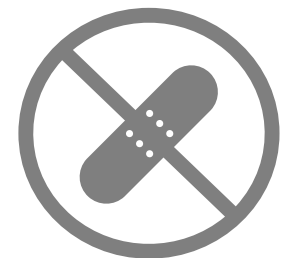
Energy reference area (ERA)

- No direct connection to health services
- Lower environmental impact for hospitals with a higher share of outpatient care

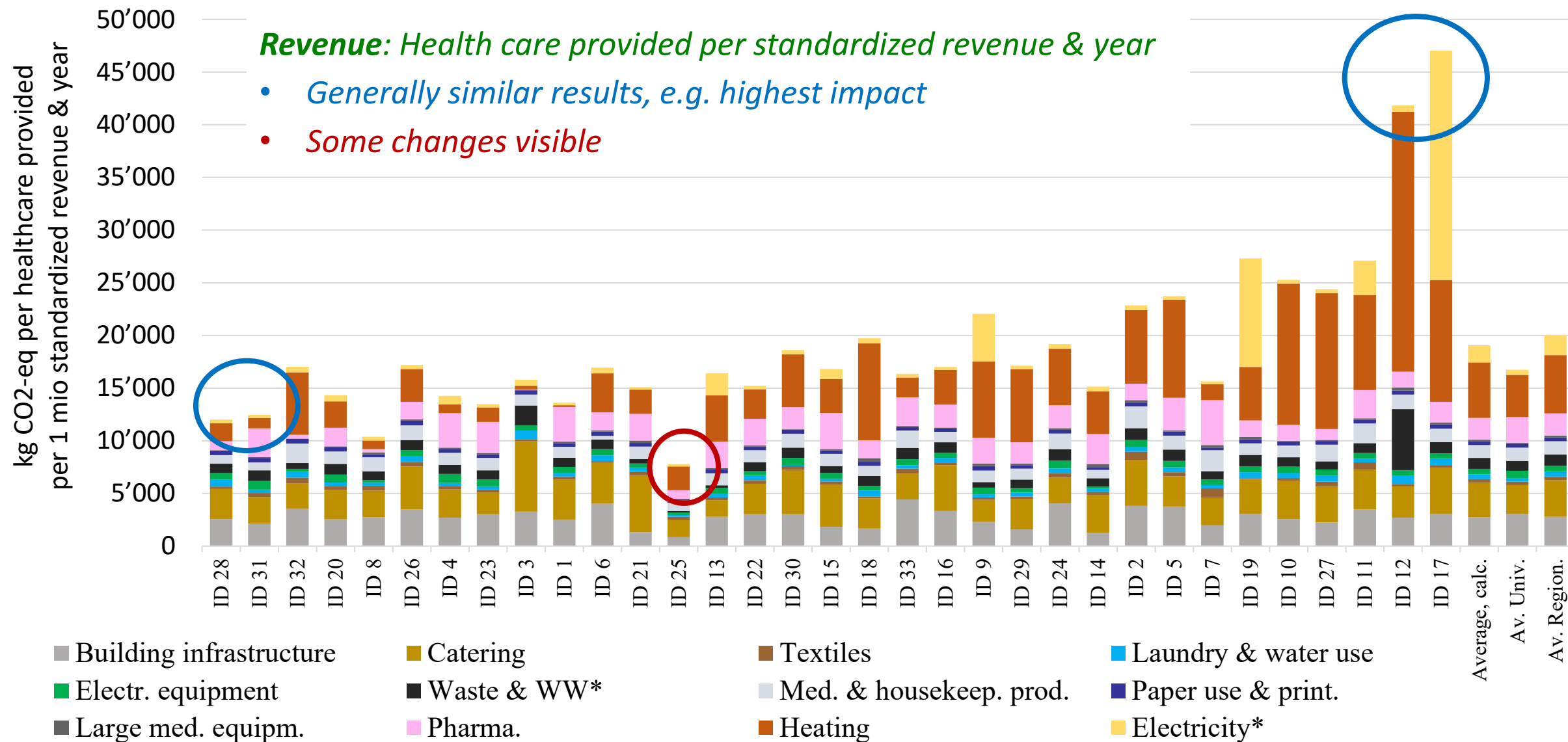


Inpatient beds

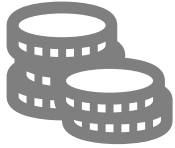
- intensity of hospital care not considered
 - Neglect outpatient health services provided (1/3 in CH)
- Shift from inpatient to outpatient treatment in Europe



Variation in climate impact of 33 Swiss hospitals



Comparing Hospitals: Different suggestions for a functional unit



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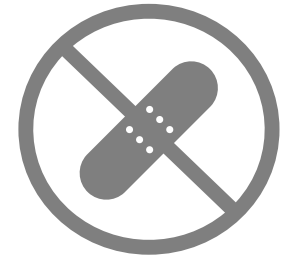
Energy reference area (ERA)

- **No direct connection** to health services
- Lower environmental impact for hospitals with a higher share of **outpatient care**



Inpatient beds

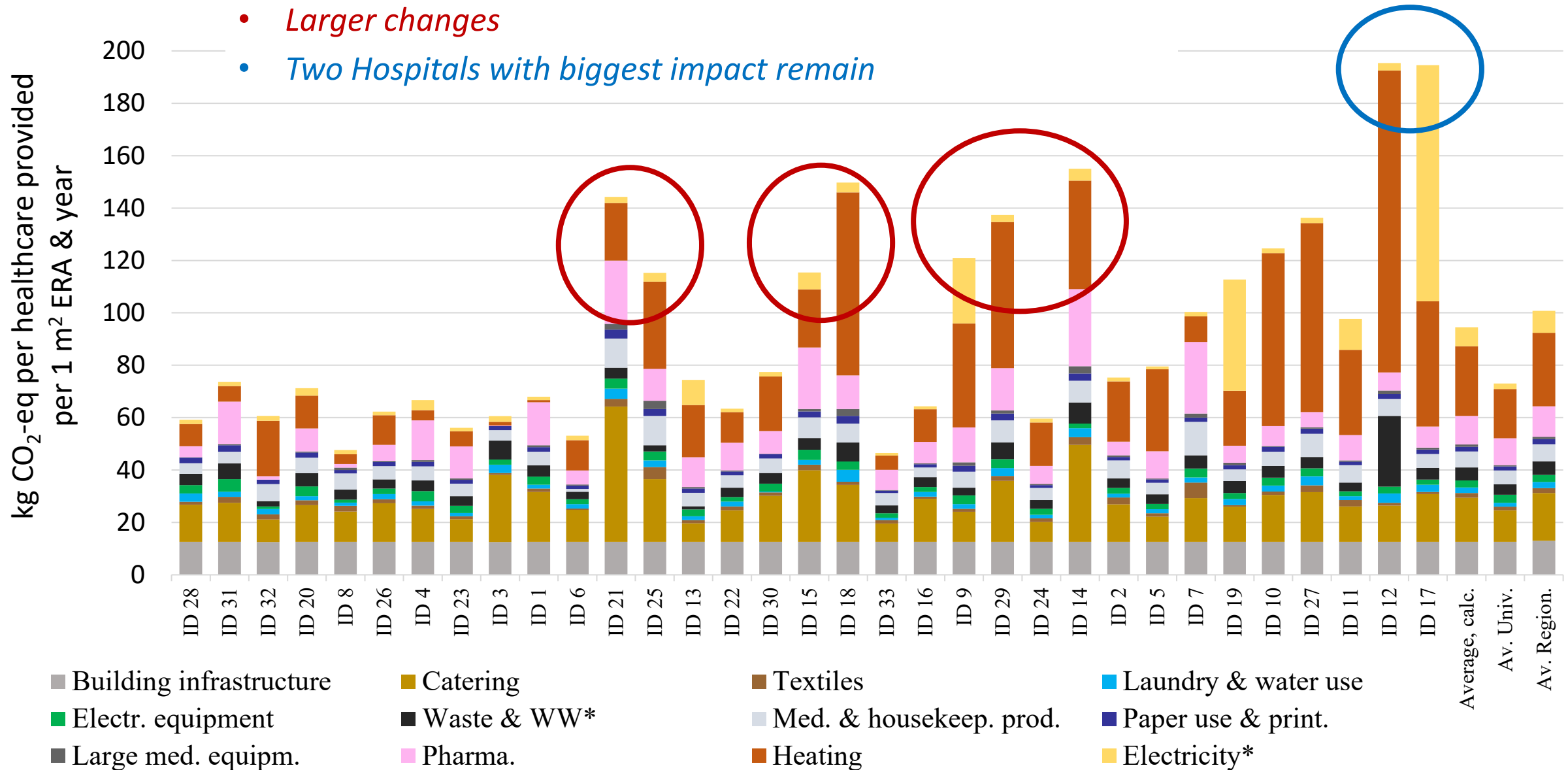
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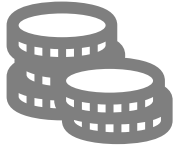
Variation in climate impact of 33 Swiss hospitals

ERA: Health care provided per energy reference area & year

- *Larger changes*
- *Two Hospitals with biggest impact remain*



Comparing Hospitals: Different suggestions for a functional unit



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Inpatient beds

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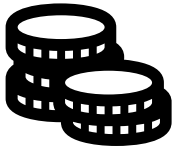
Comparing Hospitals – Change in rank

- **Full Time Equivalent (FTE) & revenue:** 60% of hospitals changed rank by maximal 3
- **Energy Reference Area (ERA):** Compared to both FTE and revenue:
 - Only 30% resp. 40% changed rank by max. 3
 - 25 % changed rank by 11 or more

Percent of hospitals with a change in rank

	FTE vs. CHF	FTE vs. ERA	ERA vs. CHF
...of up to +/- 3	60%	40%	30%
... between +/- 4 and 6	25%	25%	15%
... between +/- 7 and 10	0%	10%	25%
... of +/- 11 and more	15%	25%	25%

Comparing Hospitals – Evaluation of Functional Units



- **Energy Reference Area (ERA)** → Arbitrary unit
- **Inpatient beds** → strong trend to outpatient treatment speaks against this
→ healthcare service provided by 1 FTE per year
47 inpatient days & 113 outpatient consultations (*based on [BAG, 2020](#)*).
- **Standardized revenue (CHF)** → Certain treatments are more expensive but do not provide necessarily higher level of care, e.g. certain pharmaceuticals

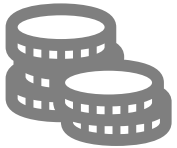
Comparing Hospitals – Suggestion for Functional Unit



- **Energy Reference Area (ERA)** → Arbitrary unit



- **Inpatient beds** → strong trend to outpatient treatment speaks against this
→ healthcare service provided by 1 FTE per year
47 inpatient days & 113 outpatient consultations (*based on BAG, 2020*).



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- **Best available solution: Full time equivalents**
“one average full-time equivalent staff member over the course of one year”
→ considers both **inpatient and outpatient** care
→ considers **intensity** of care
→ has a **direct connection** to care provided
→ staff related to health services outnumber staff for other types of services

Conclusions, insights, discussion



Conclusions



- Healthcare providers have a **large service portfolio** that largely varies among providers. **A fair comparison is challenging.**
- The choice of **functional unit** for complex healthcare services has a significant **impact on the environmental ranking** of different service providers.
- **All main impacts should be included for**, even staff commuting: the hospital can influence most areas and help reduce environmental impact.

Three overarching questions



1) The biggest challenge concerning the analysis of the service was ...

... find a **functional unit** that is accepted

... **comparing health care services is difficult**; but benchmark is requested by hospitals

... find data that includes **sensitive data** e.g. pharmaceuticals

... support stakeholders that were interested in **measures**, while our main aim was to provide **insight instead**.



Three overarching questions



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Zürich University
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Life Sciences and
Facility Management
Institute of
Natural Resource Sciences



2) My main recommendations are

... for the choice of functional unit **health care**

- *specific treatments: with specific functional unit, e.g. asthma treatment for 1p.*
- Various treatments: health care services provided by employees to the patients measured according to staff workload, represented by the **Full Time Equivalents (FTE)**

...for the choice of system boundaries of **health care**

- If possible: include **mobility** of staff and visitors: high share, leverage
- **Exclude** irrelevant aspects to save time, e.g. **paper** use
- Account for differences of **inhouse and external services**, e.g. laundry
- A **systemic view** that includes prevention & health promotion would be valuable

Three overarching questions



3) I see the following major differences between LCAs of services & common LCAs of products:

*The quantification of various health care is complex
Other challenges e.g. data collection remain the same*

Acknowledgements

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Life Cycle Assessment @ ZHAW



*Find out more about me and
my research:*



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Thank you for your
attention!



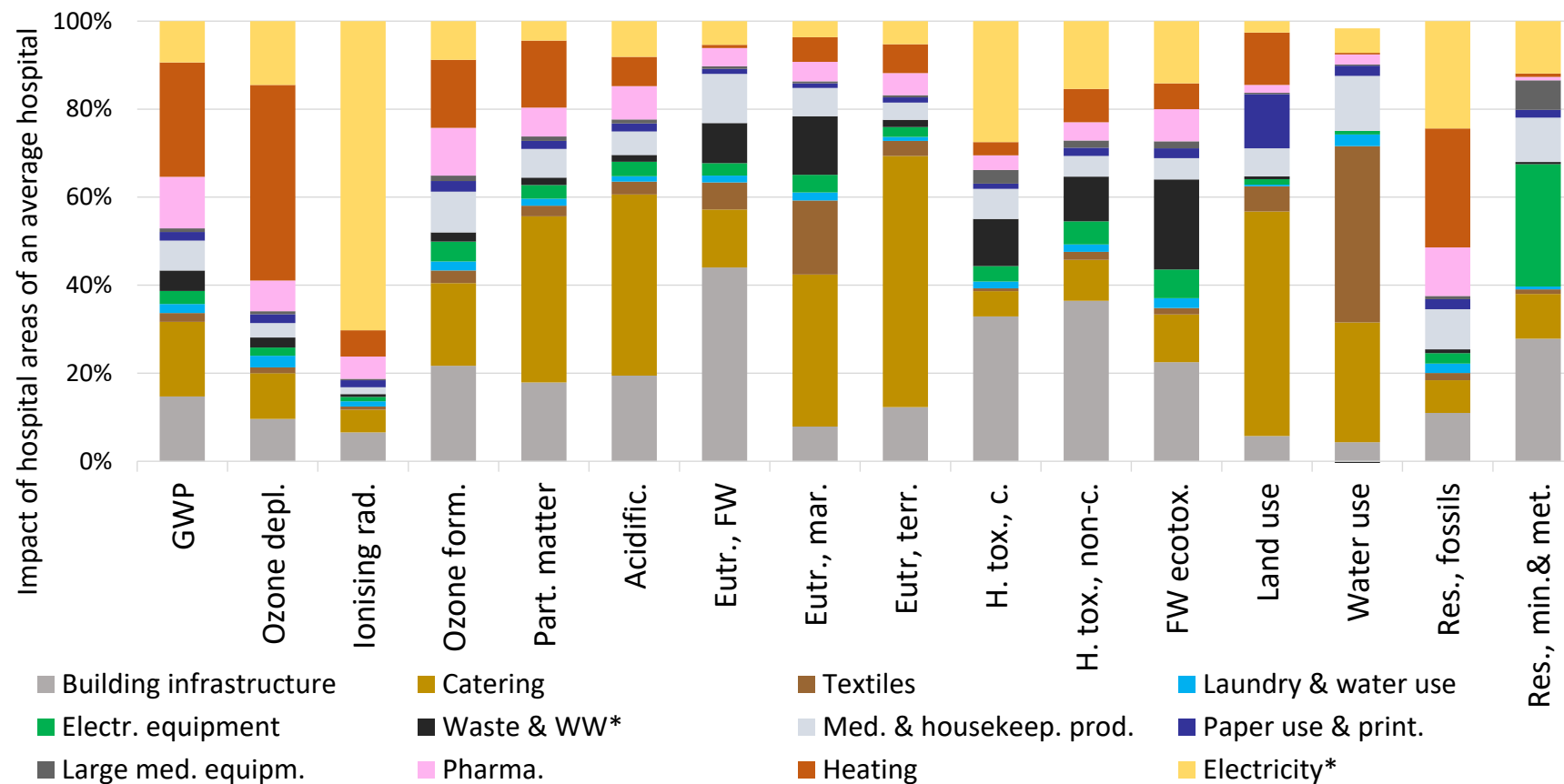
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Additional slides

Other environmental impact categories



Average share of environmental impact for e.g. Eutrophication (Eutr.), Human toxicity (H. tox), Freshwater ecotoxicity (FW ecotox), Resource use (Res.)



Tabelle 2: Schlüsseldaten der in der Umfrage erhobenen Spitalbereiche und die verwendete Berechnungsmethode.

Bereich	Erhobene Daten	Berechnung der Auswirkungen	Ansatz bei fehlender Daten (Anzahl betroffener Fälle)
Strom *	Jährlicher Verbrauch, Strommix bzw. Lieferant	Direkte Modellierung mit angepassten ecoinvent Datensätzen	Lokaler Strommix mix (17/33)
Wärme	Jährlicher Verbrauch, Energiequelle	Direkte Modellierung mit ecoinvent Datensätzen	Median für den Verbrauch & durchschnittlicher Wärmemix für die Energiequellen (2/33)
Verpflegung	Anzahl Mahlzeiten Anteil für Patienten, Mitarbeiter & Besucher Jährlicher Verbrauch von Fleisch, Fisch, Milchprodukte, Kaffee & Mineralwasser	Anhand von Daten aus zwei Spitälern wurde eine durchschnittliche Mahlzeit modelliert. Die Masse pro Mahlzeit wurde konstant gehalten, während Fleisch, Kaffee und Mineralwasser individuell modelliert wurden.	Medianwerte (3/33 Anzahl Mahlzeiten, 5/33 Fleisch, 3/33 Kaffee, 1/33 Mineralwasser)
Gebäude- infrastruktur	Energiebezugsfläche	Durchschnittswerte von drei Krankenhäusern, Daten von Architekturbüros	(Keine Fälle)
Wäsche	Jährliche Wäsche, Anteil interner Wäsche	Neuer Datensatz basierend auf Eberle (2007). *Wasser, Abwasser & Stromverbrauch wurden von den mit einem Stern markierten Bereichen abgezogen.	Median (5/33)
Wasser-verbrauch*	Jährlicher Verbrauch	Direkte Modellierung mit ecoinvent Datensätzen	Median (2/33)
Abfall & Abwasser*	Jährliche Menge Abfall (Jährlicher Wasserverbrauch)	Abwasser wurde als dem Wasserverbrauch gleichwertig betrachtet. Das Abwasser wurde mit einem angepassten ecoinvent Datensatz modelliert. Mischung der Abfallarten basierend auf Daten aus zwei Spitälern	Median für Abfälle (3/33).

Schlüsseldaten der Schweizer Spitalstatistik sind mit einem Hashtag # gekennzeichnet. Strombedarf und Abwasser, die im Zusammenhang mit der Wäscherei anfallen, werden von den mit einem Sternchen markierten Bereichen abgezogen und unter "Wasserverbrauch & Wäsche" ausgewiesen.



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Textilien	Haushaltskosten #	Eingekaufte Textilien pro ausgegebenen CHF. 33% der Haushaltskosten entfallen auf Textilien	(Keine Fälle)
Handschuhe & medizinische Produkte	Anzahl Handschuhe Anteil Nitril-, Latex- & Vinylhandschuhen	Die Handschuhe wurden auf der Grundlage der verwendeten Menge modelliert, die Menge der medizinischen Produkte entsprechend der Menge der verwendeten Handschuhe	Median für fehlende (6/33) & nicht plausible (2/33) Daten. Durchschnitt für Handschuhkomposition
Haushalts-produkte	Haushaltskosten #	Menge der Haushaltsartikel pro ausgegebene CHF. 20,3% der Haushaltskosten werden für die Haushaltsführung verwendet.	(Keine Fälle)
Papier-verbrauch	Keine	Menge des verwendeten Papiers pro Vollzeitäquivalent eines Spitals	(Keine Fälle)
Medikamente	Medikamentenkosten #	Aktive pharmazeutische Wirkstoffe pro ausgegebene CHF	(Keine Fälle)
IT-Infrastruktur	Anzahl Laptops, Tablets, Desktops, Monitoren, Drucker	Direkte Modellierung	Wenn keine Informationen zu einem Gerätetyp angegeben wurden, wurden keine gezählt.
Grosse medizinische Geräte	Anzahl der Geräte	Modellierung basierend auf Materialien in Environmental Product Declarations	Wenn keine Informationen zu einem Gerätetyp angegeben wurden, wurden keine gezählt.

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