EBERHARD KARLS UNIVERSITÄT TÜBINGEN
MEDIZINISCHE FAKULTÄT
Klinik für Urologie
Universitätsklinikum Tübingen

Environmental and Human Health Impact of Flexible Ureterorenoscopy – Analysis of intra-hospital Factors for improved Life Cycle Assessment

Marlene Thöne[1], Jan Lask[2], Jörg Hennenlotter[1], Arnulf Stenzl[1], Steffen Rausch[1]

[1]Klinik für Urologie, Universitätsklinik Tübingen [2]Universität Hohenheim, Fachgebiet für Nachwachsende Rohstoffe in der Bioökonomie, Stuttgart

Background: Climate change is a global challenge and health systems are relevant contributors to CO_2 emissions. Therefore, concepts of *Planetary Health* have been implemented into urological practice. Earlier studies have specifically focused on Life Cycle Assessment (LCA) of reusable or single-use flexible ureterorenoscopes (fURS). The methodology used is highly data-dependent and knowledge on intra-hospital emissions is still limited. Here, we present a methodical approach for intra-institutional processes of LCA for fURS.

Methods: LCA was performed to assess the CO_2 equivalents of reusable fURS (use-phase, maintenance, disposal) to approximate the *Global Warming Potential (GWP)* per use. Associated *Human Health Impacts* were evaluated using the impact assessment method ReCiPe2016(H) and Disability-adjusted Life Years (DALYs) **(FIGURE 1,2).** Data were supplemented by systematic interviews of intra- and extra-clinical experts using likert-scaled questionnaires.

Results: Assuming 200 usages per fURS and maintenance after each 11th use, 7.3 kg CO_2-eq equal to 6,7E-06 DALYs resulted for one application of a fURS **(FIGURE 3, TABLE 1)**. Most influential parameters were electricity required per refurbishment and per use **(FIGURE 4 A-B)**. Qualitative assessment revealed a high relevance of clinical efficiency (5/5 "very high relevance") and results from clinical studies (4/5 "high relevance") for purchase decisions. Geographical criteria and trading conditions (0/5 "no relevance at all") were regarded as negligible while ecological criteria had medium relevance (3/5) in purchase decisions **(TABLE 2)**.

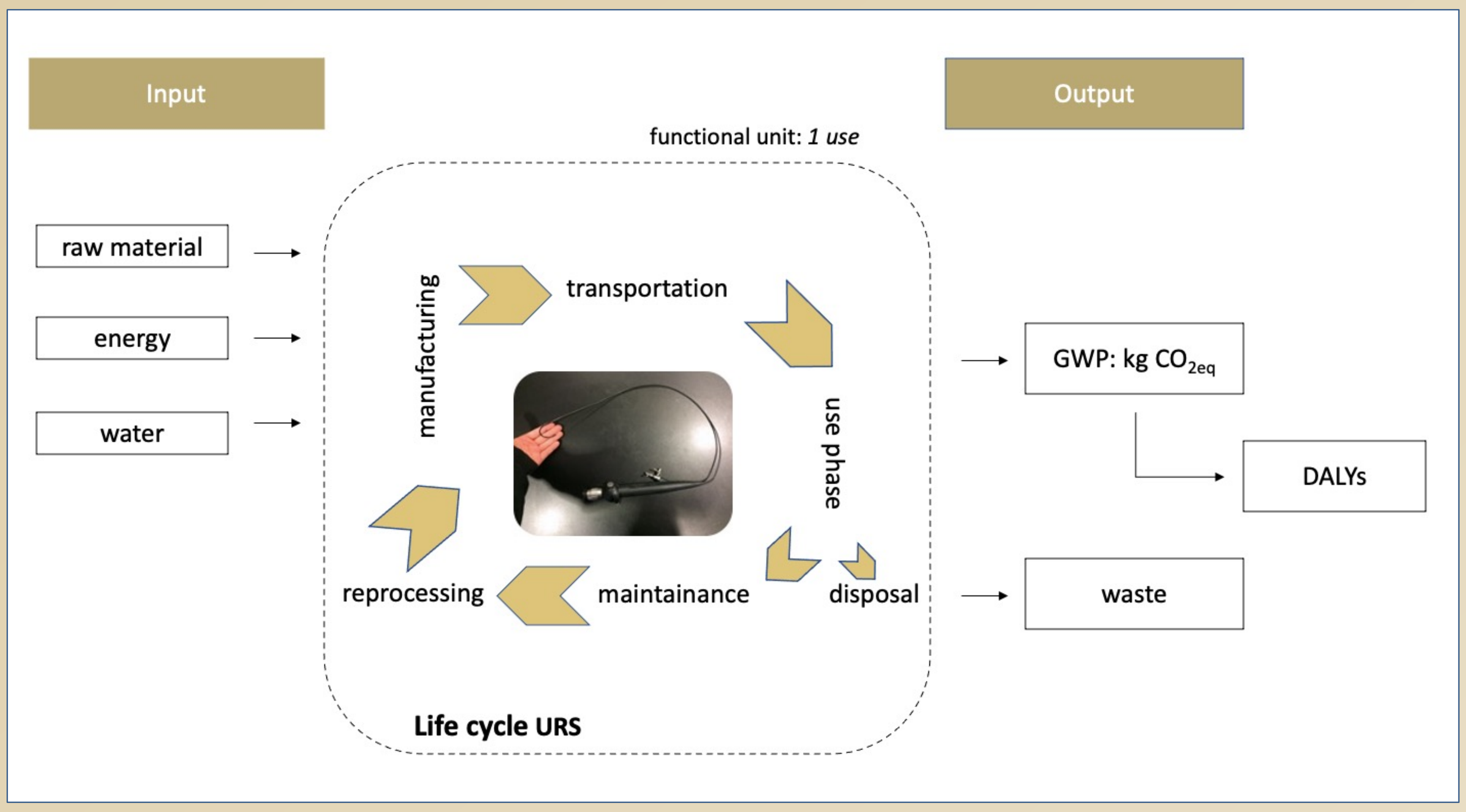

Fig. 1: **Product System and System Boundary** for reusable fURS according to ISO 14040: Life cycle with In- and Output to demonstrate the substance flows and resulting environmental and health impact.

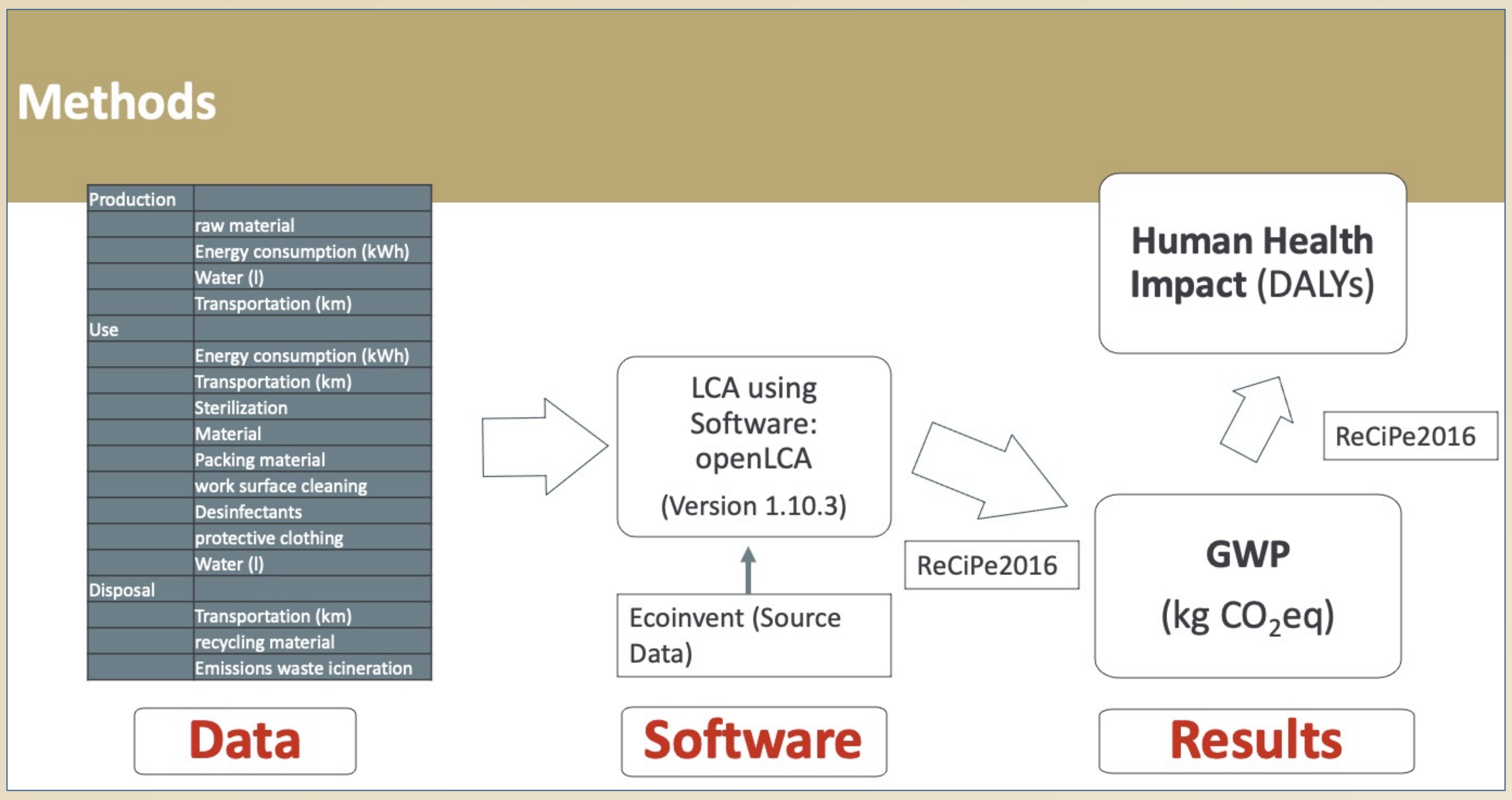

Fig. 2: Methods Life Cycle Assessment (LCA): Data collection, implementation of the data into software to calculate the Global Warming Potential (GWP) in kilogram CO_2 equivalents (kg CO_2-eq) and the Human Health Impact in Disability-adjusted life years (DALYs). One DALY represents the loss of one year of full health (2).

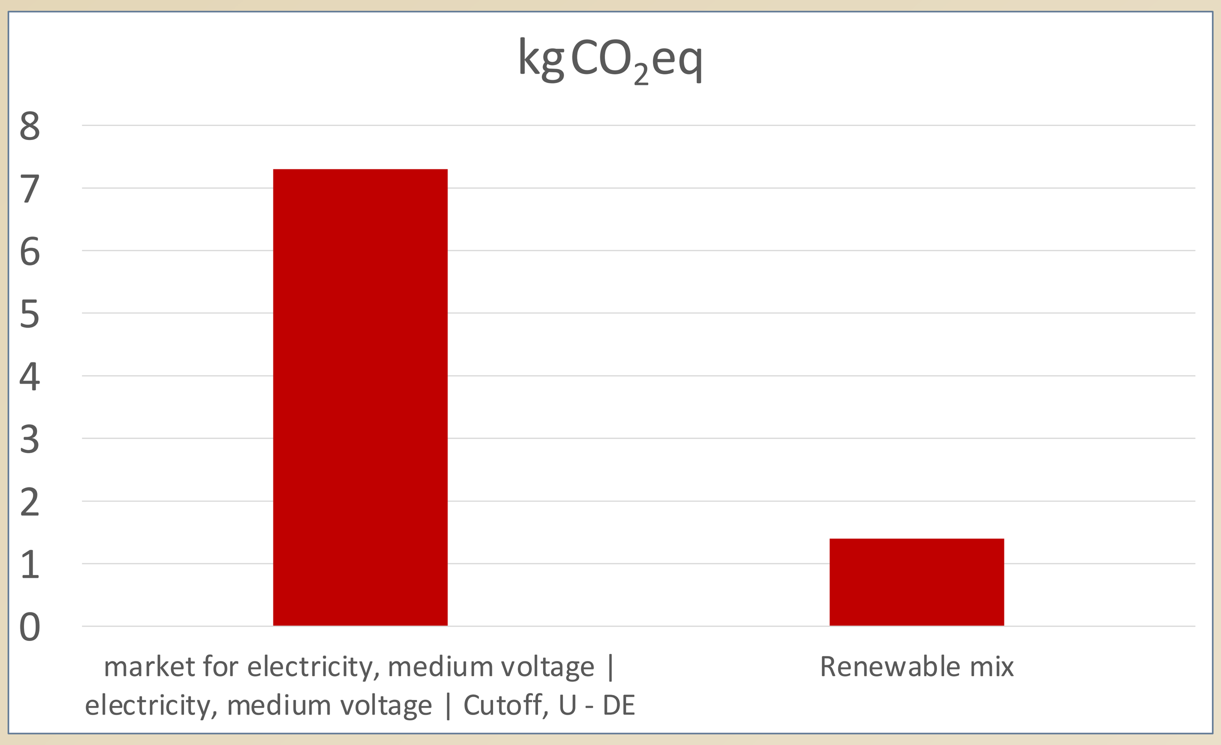

Fig. 3 Resulting CO_2 equivalents for one application of a reusable fURS using either German electricity mix (Electricity – German market mix) or Renewable mix (used in Universitätsklinikum Tübingen (UKT))

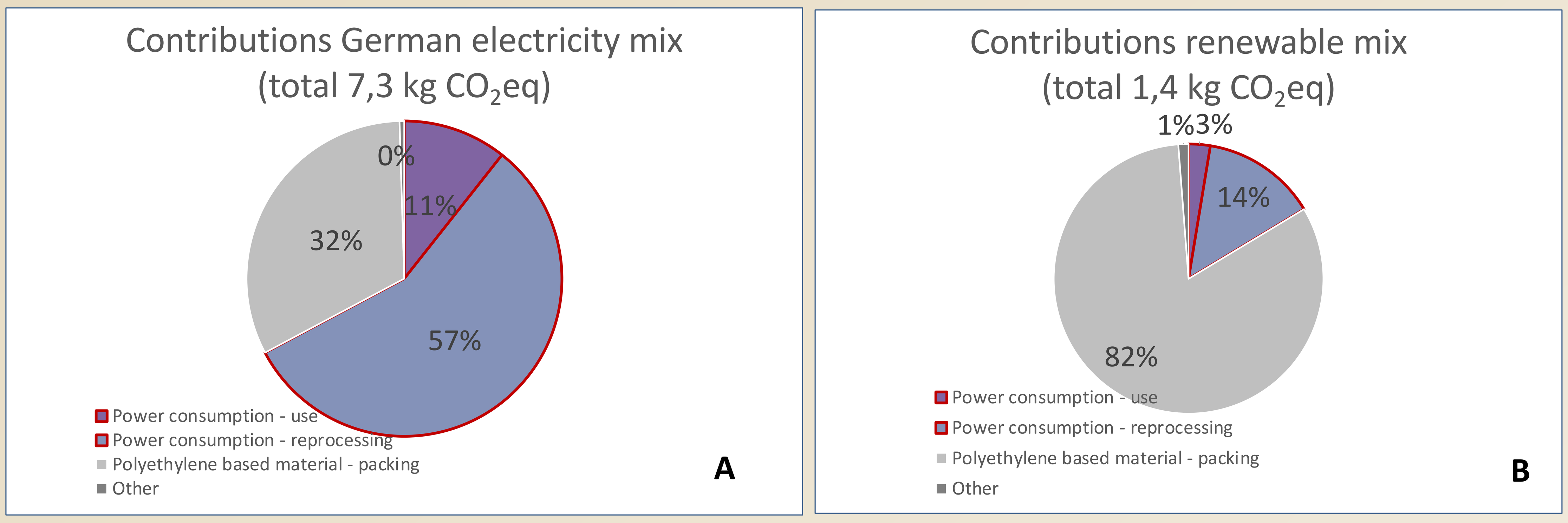

Fig. 4A-B. Contributions to CO_2 footprint of one use of one reuseable fURS. using different energy mixes: (**A**) conventional electricity mix (market for electricity, medium voltage | electricity, medium voltage | Cutoff, U – DE) or (**B**) 100% Renewable energies (Renewable mix, used in UKT)

	Germany (conventional energy mix)	Tübingen University Hospital (100% renewable energy)	
Environmental impact (*one use*)	7.3 kg CO_2eq	1.29 kg CO_2eq	*per use/sterilization*
Human Health impact (*one use*):	6.7E-06 DALYs	1.19E-06 DALYs	*per use/sterilization*

Table 1. Results: kg CO_2eq and DALYs resulting from one use of one reusable fURS using conventional electricity mix (Germany) or renewable mix only (Tübingen University Hospital (UKT)).

Criteria for purchase decisions for fURS (0=no relevance at all, 1=very low relevance, 2=low relevance, 3=medium relevance, 4=high relevance, 5=very high relevance)	
costs	5
clinical efficiency	5
results from studies	4
ecological criteria	3, growing relevance
faire trading conditions	0
geographical criteria	0

Table 2. Qualitative data: subjective purchase criteria for fURS. Data collected in controlling section UKT.

Conclusion: Electricity required for refurbishment and use are identified as crucial parameters of the CO_2 footprint and health impact of fURS. Ecological criteria are gaining importance for purchase decisions of fURS. More comprehensive LCA for the human and *Planetary Health* impact of reuse and single-use fURS is planned based on these data. This study may act as a basis for similar analyses and provide research in the field of climate change and health with stronger evidence.

References: (1) DAVIS, N. F., MCGRATH, S., QUINLAN, M., JACK, G., LAWRENTSCHUK, N. & BOLTON, D. M. 2018. Carbon Footprint in Flexible Ureteroscopy: A Comparative Study on the Environmental Impact of Reusable and Single-Use Ureteroscopes. *J Endourol*, 32, 214-217.
(2) https://www.who.int/data/gho/indicator-metadata-registry/imr-details/158