



Practical Implications of LCAs

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LCAs: From Research to Recalibration, Advocacy and Engagement!

1. My first LCA: For my eyes were opened!
2. EEIO LCA: raising awareness, leading the zeitgeist policy change?
3. LCA Consequences versus Attributes
4. Spinal vs. General anaesthesia
5. Pathology, (Radiology), Pharmacology

LCA #1

2008: Anaesthetic Drug Trays Single-use vs. Reusable



Attributional Process Based LCA

Clearly defined Goal and Scope,
Functional Unit, System Boundary

Input data:

Things- plastic tray, cotton, paper,
electricity, gas

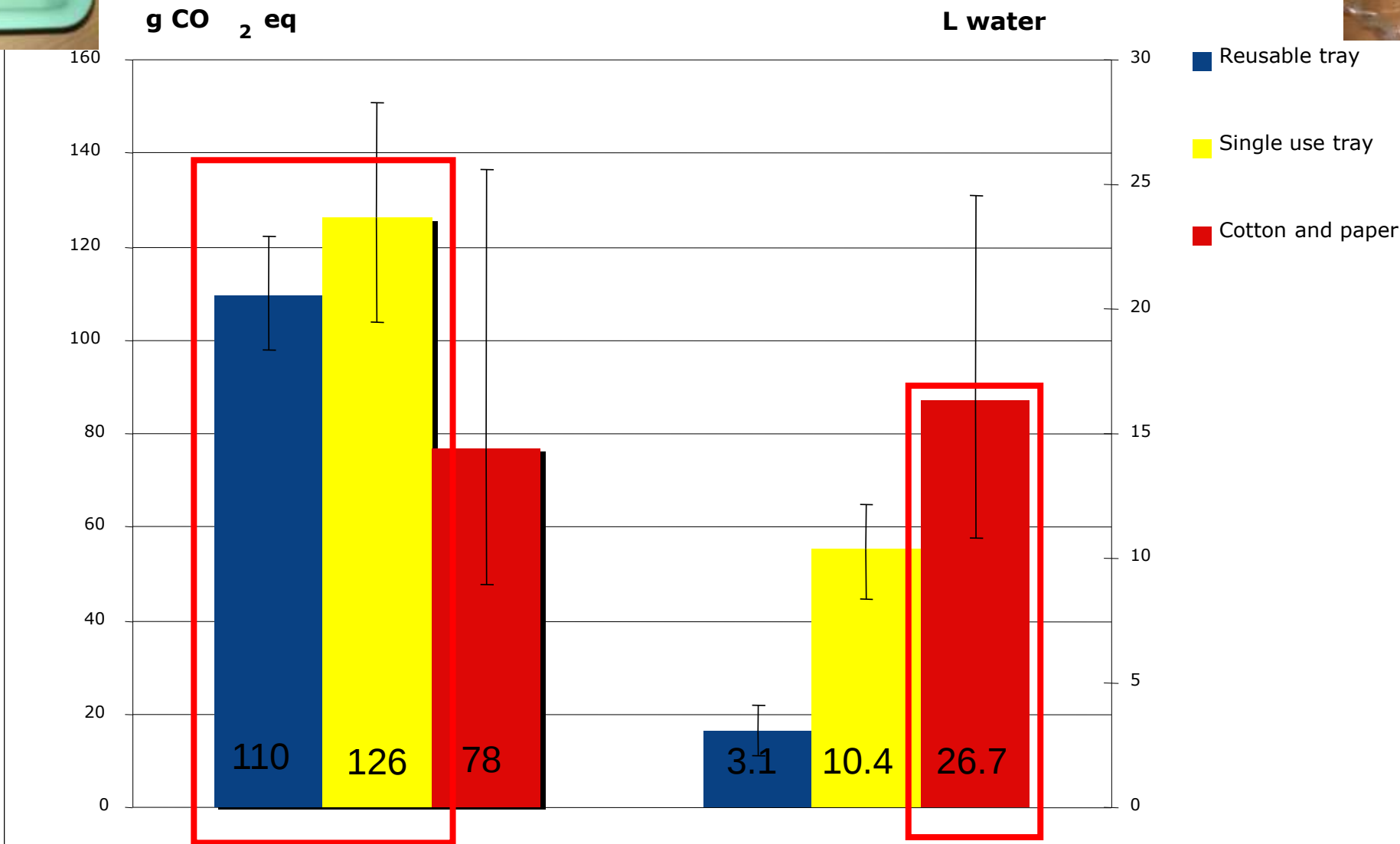
Amounts of these things

Where these things arise from

Copper	11.9 kg CO ₂ e/ kg
Cotton	27.2 kg CO ₂ e/ kg
Glass	3.6 kg CO ₂ e/ kg
Plastics-non PVC	3.3 kg CO ₂ e/ kg
Plastics -non PVC- recycled	1.8 kg CO ₂ e/ kg
Plastics- PVC	2.6 kg CO ₂ e/ kg
Plastics- PVC – recycled	1.1 kg CO ₂ e/ kg
Rubber- synthetic and natural	2.0 kg CO ₂ e/ kg
Stainless steel	6.8 kg CO ₂ e/ kg



CO₂ Production and Water Use



LCA #2

2018: Environmentally Extended Input Output Analysis

The carbon footprint of Australian health care

Arunima Malik, Manfred Lenzen, Scott McAlister, Forbes McGain

Summary

Background Carbon footprints stemming from health care have been found to be variable, from 3% of the total national CO₂ equivalent (CO₂e) emissions in England to 10% of the national CO₂e emissions in the USA. We aimed to measure the carbon footprint of Australia's health-care system.

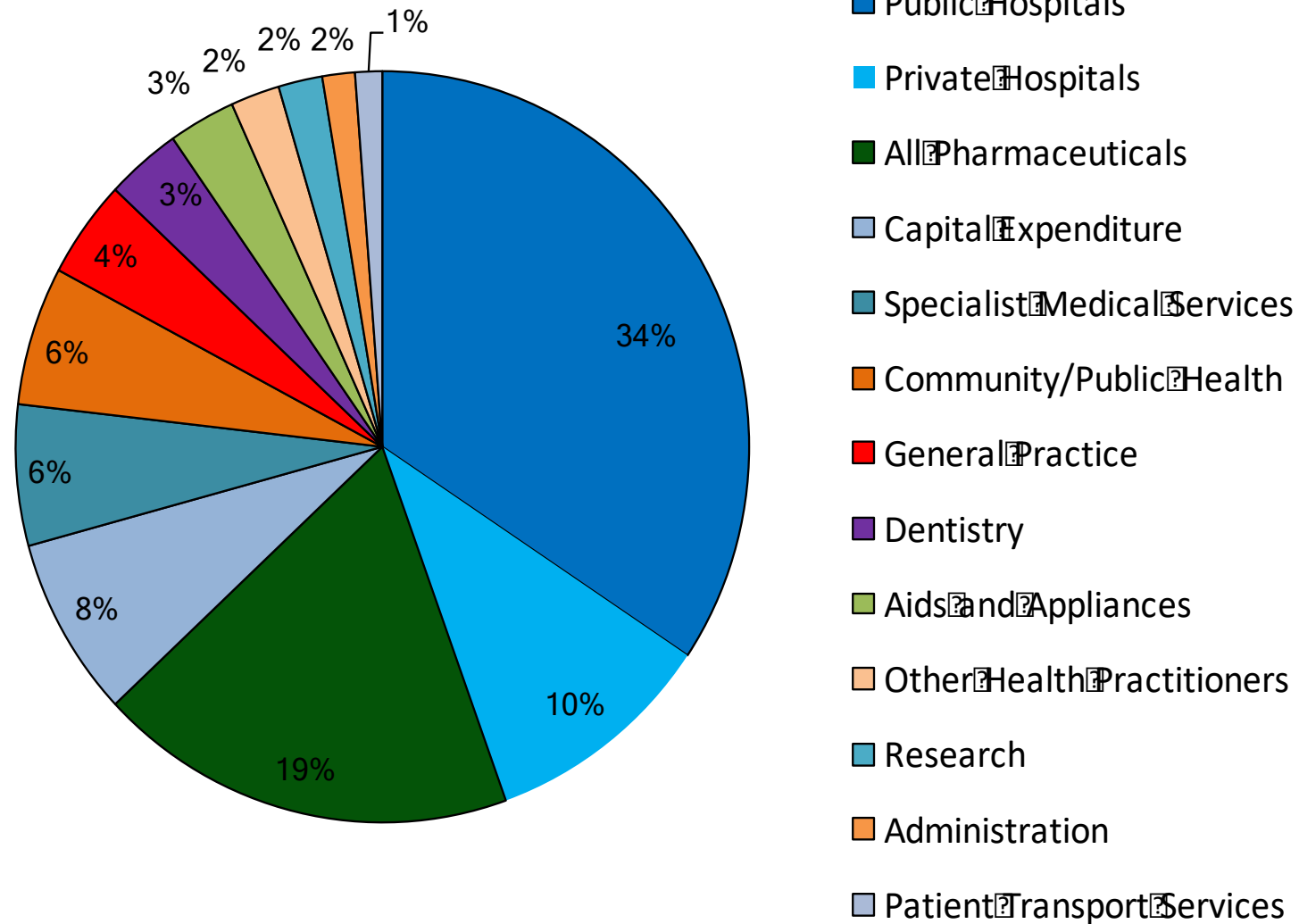
- There is a CO₂-e associated with each \$ spent
- Australian Healthcare = 7% of Australia's CO₂-e
- By far my most published, non mainstream medical article...
- Part of the reason for state/fed. Sustainable Healthcare Units?



Lancet Planet Health 2018;
2: e27-35

See [Comment](#) page e8

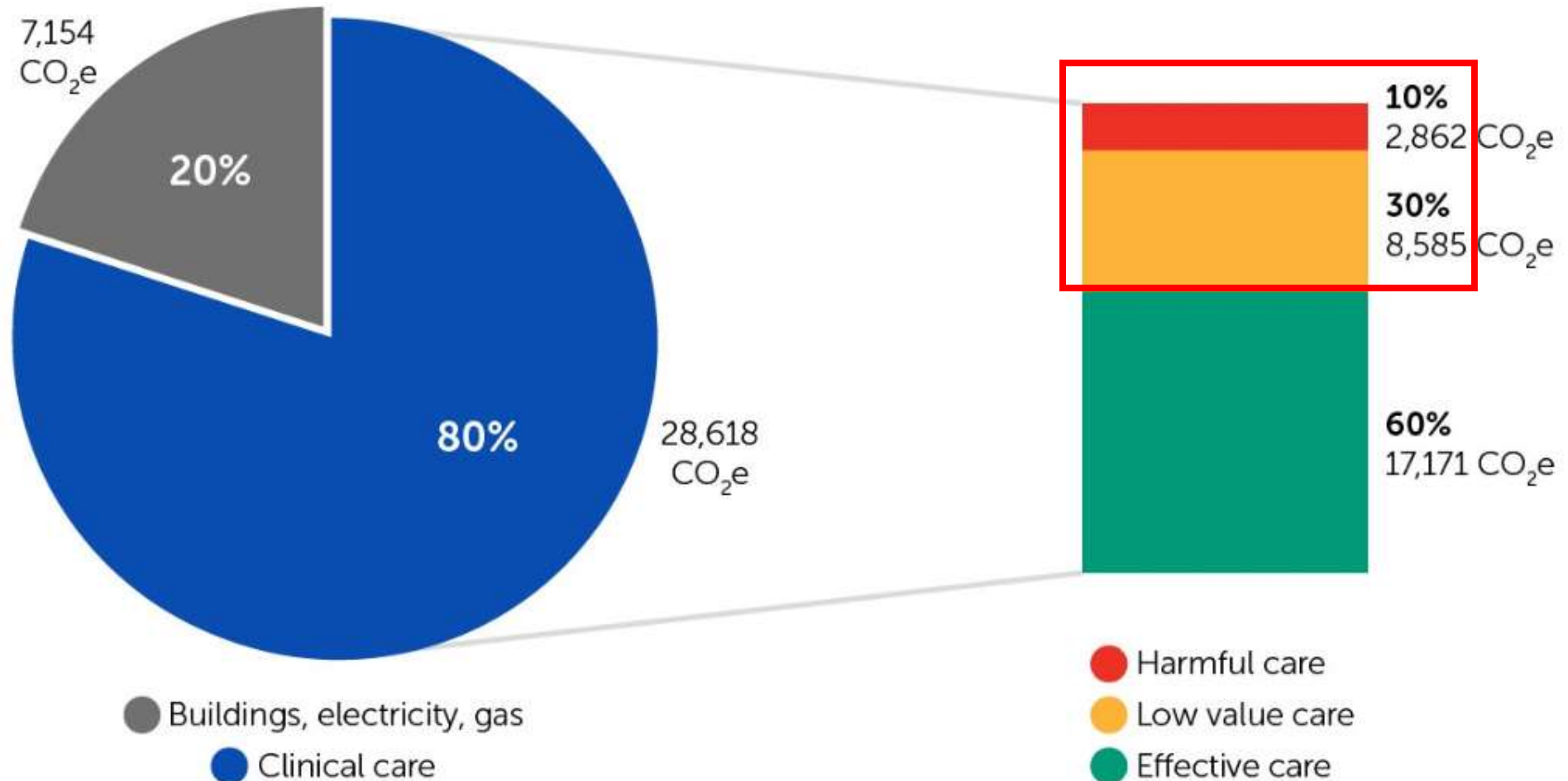
CO₂e Emissions for Australian Health Care Expenditure Categories (the 7%)



The carbon footprint of Australian health care and the share of its carbon emissions attributable to harmful, low value and effective care

Carbon footprint of health care
35,772 kilotonnes CO₂e emissions

Carbon footprint of clinical care
28,618 kilotonnes CO₂e emissions



CO₂e = carbon dioxide equivalent. Data sources: Malik et al,³ Tennison et al 2021,⁴ and Braithwaite et al.⁶ ◆

LCA #3

2017: LCA Consequences!

1. “We are going to go to all disposable anaesthetic equipment...”
2. What are the Consequences of this?
 - Effects on Operating Theatre flow, CSSD, \$, waste, etc.
3. Not: how do we Attribute the costs of such equipment (proportionally)
4. WH \$100, 000 Savings for Reusables prevented going totally disposable in Anaesthesia (localised only)
5. Led to *Renewables make Reusables Better*
6. *Getting off Gas (New Melton Hospital , RMH)*

A Consequential LCA



British Journal of Anaesthesia, 118 (6): 862–9 (2017)

doi: 10.1093/bja/aex098

Advance Access Publication Date: 15 May 2017

Clinical Practice

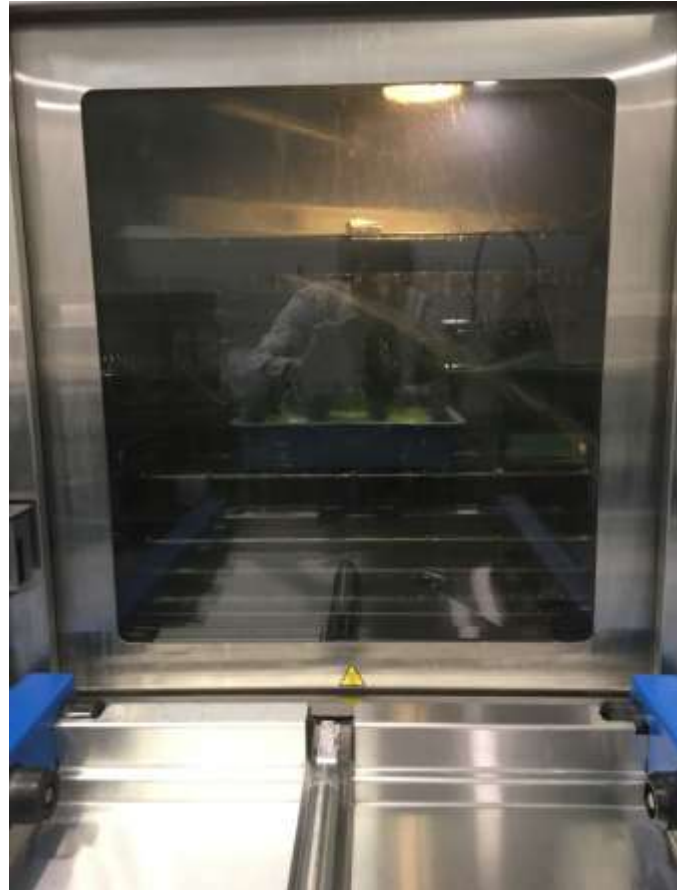
**A comparison between
two Melbourne Hospitals**

**Financial and environmental costs of reusable and
single-use anaesthetic equipment**

F. McGain^{1,2,*}, D. Story³, T. Lim¹ and S. McAlister⁴

Behind the Scenes in LCA Studies...

Holding trays for the washer The washer in action



A steriliser load



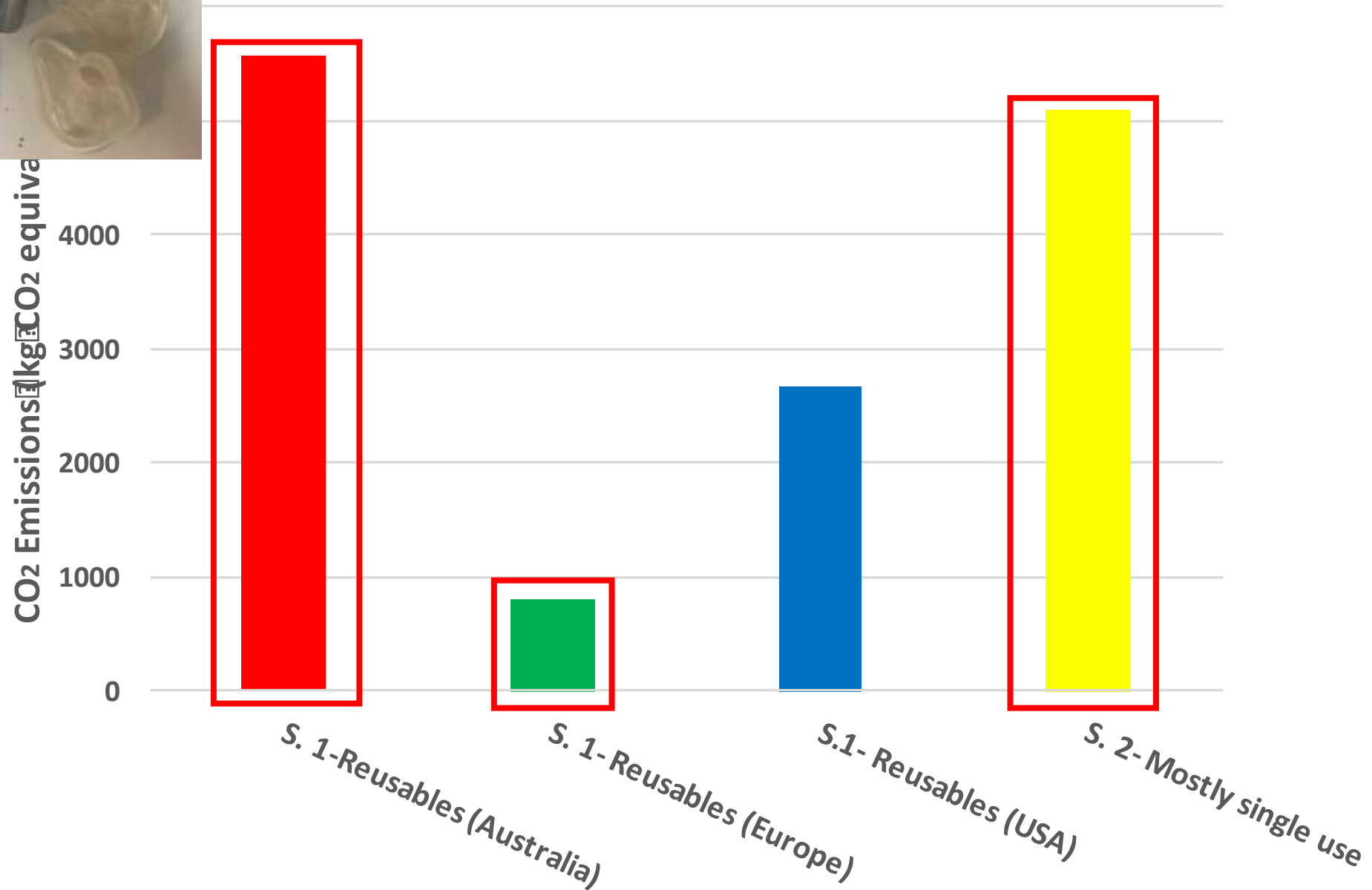
Steriliser Electricity and Water Consumption





Anaesthetic Equipment?

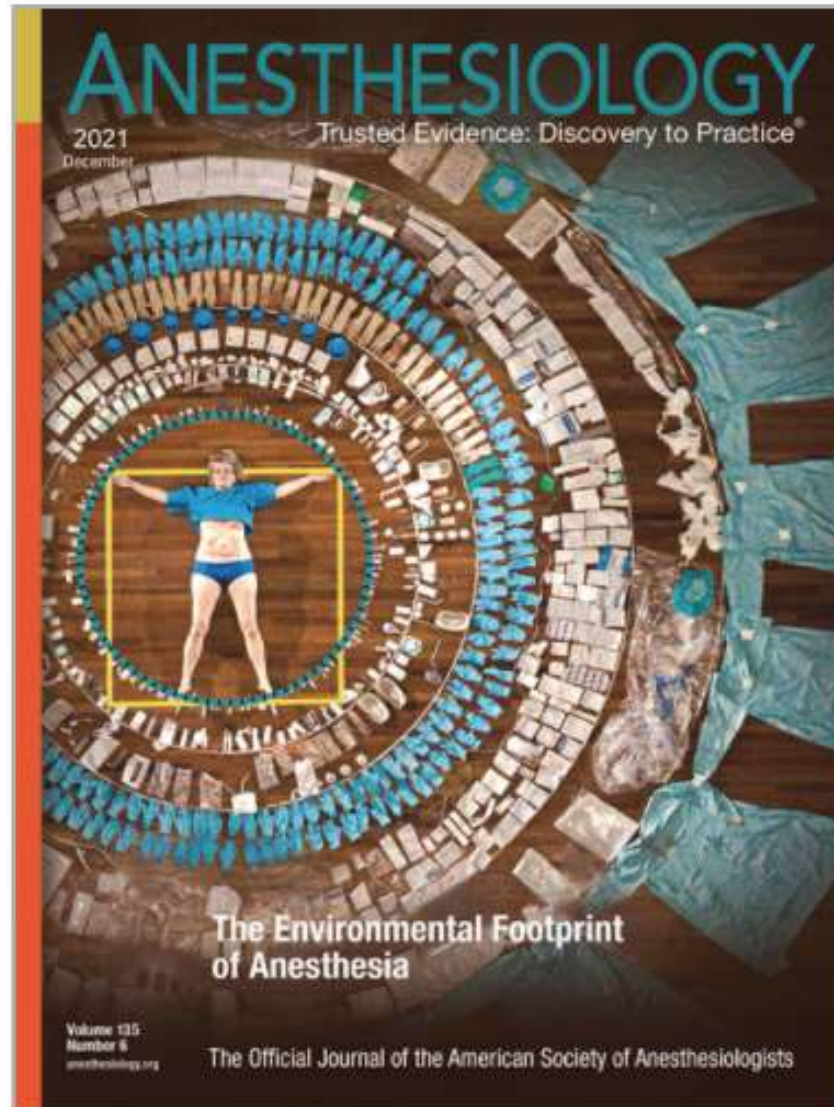
GHG Emissions (kg CO₂e)



LCA #4

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Perioperative Medicine | December 2021

Carbon Footprint of General, Regional, and Combined Anesthesia for Total Knee Replacements **FREE**



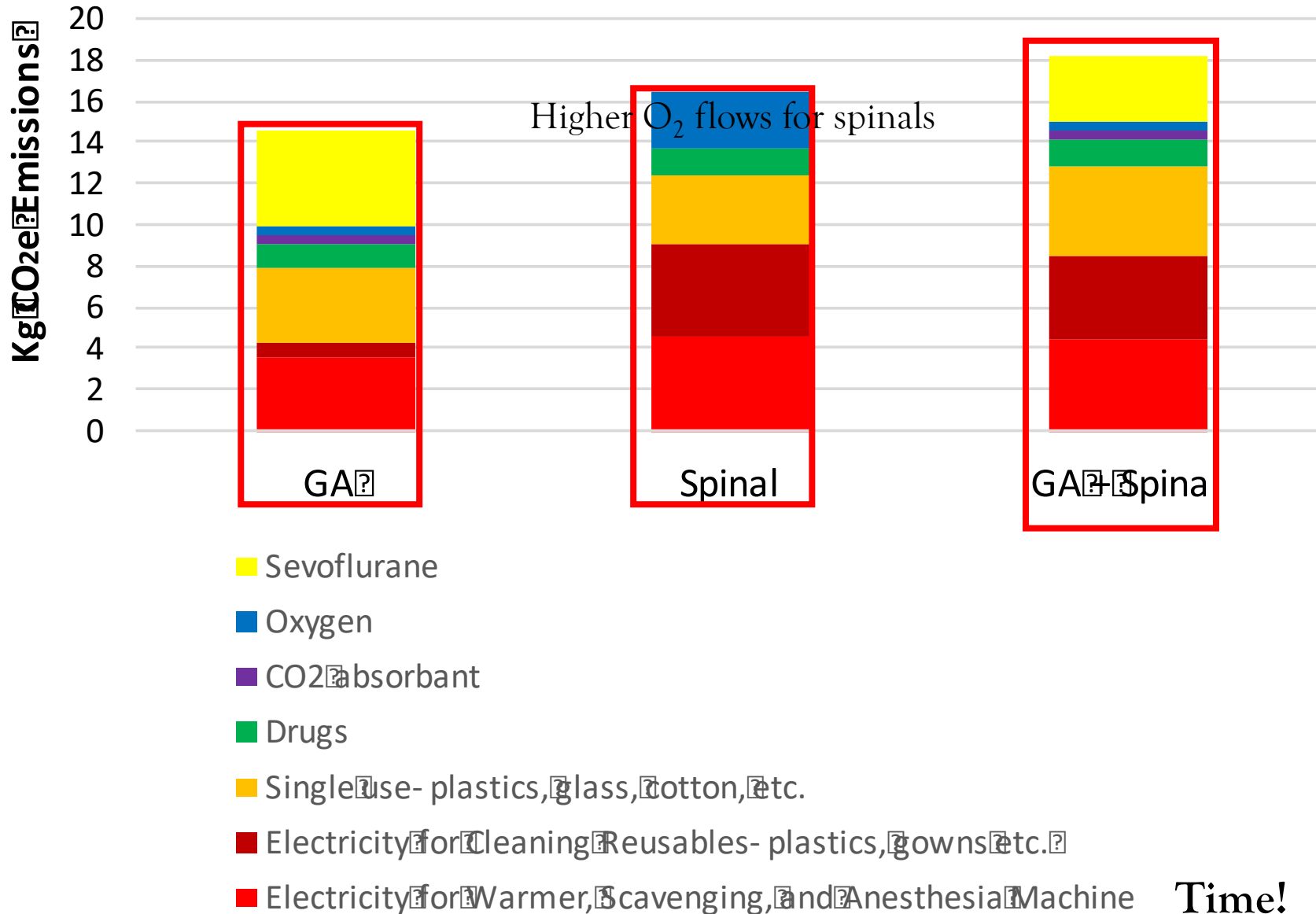
Forbes McGain, F.A.N.Z.C.A., F.C.I.C.M., Ph.D.; Nicole Sheridan, F.A.N.Z.C.A.;
Kasun Wickramarachchi, B.Sc., M.P.H., M.D.; Simon Yates, M.D.; Brandon Chan, M.B.B.S.;
Scott McAlister, B.Sc., P.grad., Dip.Sci., M.Eng.Sci.

+ Author and Article Information

Anesthesiology December 2021, Vol. 135, 976–991.

<https://doi.org/10.1097/ALN.0000000000003967>

GHG Emissions (kg CO₂e) for Anaesthesia for a T.K.R.: G.A., Spinal, and G.A. + Spinal





2021: Spinal vs. General Anaesthesia

1. Anaesthetic approaches had similar carbon footprints
 - Desflurane and N₂O already known
 - using TIVA reduces GA CO₂e emissions
- Spinal anesthesia
 - isn't low carbon in Victoria/China
 - But it is in Europe and the USA
- Choose Wisely!
- Reduce single use plastics
- Reduce O₂ flows as clinically indicated
- Advocate for energy efficiency and renewable electricity

The carbon footprint of pathology testing

Scott McAlister¹, Alexandra L Barratt², Katy JL Bell², Forbes McGain^{1,3}

Med J Aust. 2020 May;212(8):377-382.

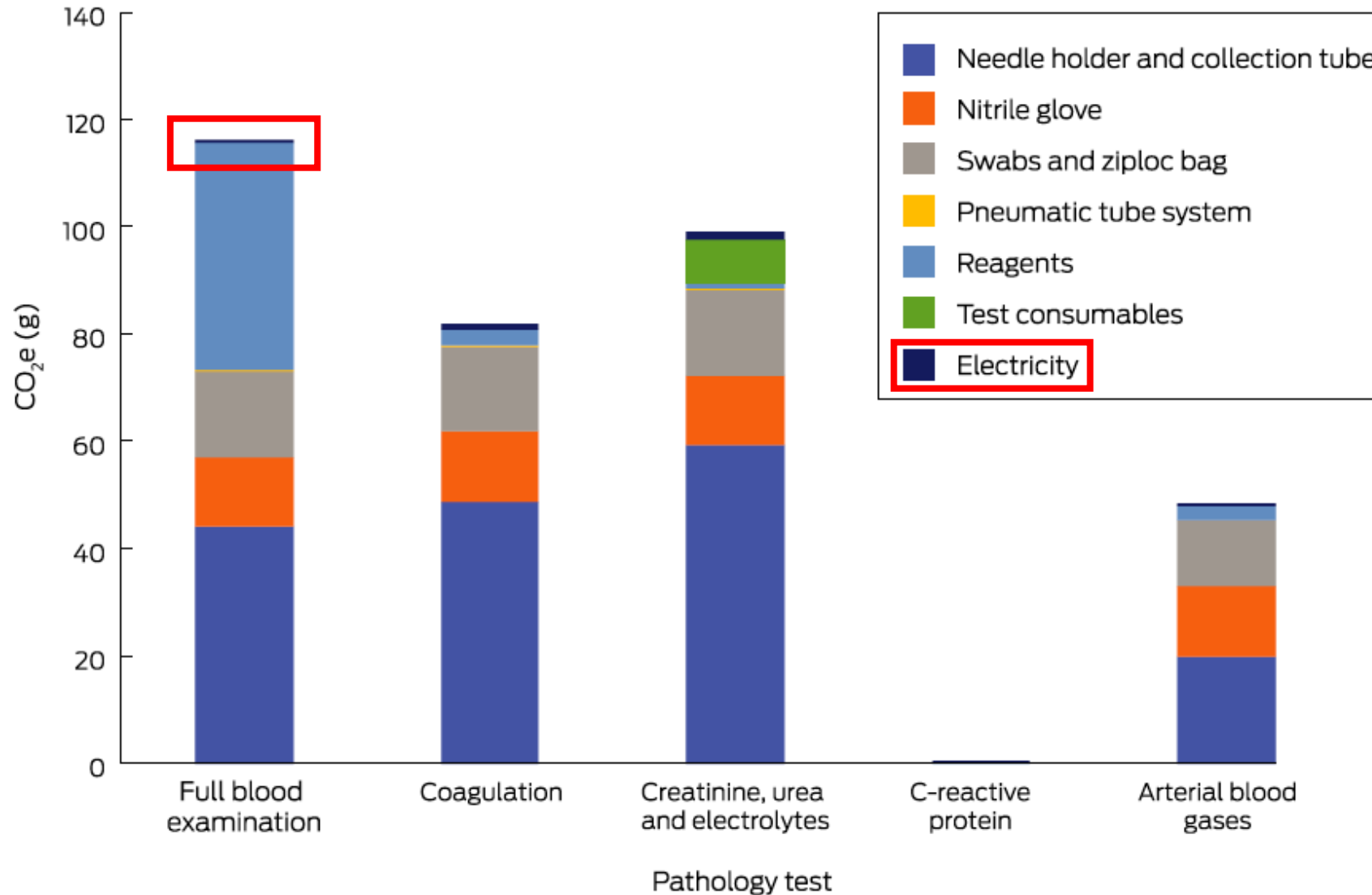
LCA_s #5

3 Carbon dioxide equivalent (CO₂e) emissions for five common hospital pathology tests, with distance driven in a standard car producing equivalent emissions

	Mean CO ₂ e (g) (95% CI)	Equivalent distance in car (km/1000 tests)
Full blood examination	116 (101–135)	770
Coagulation profile	82 (73–91)	540
Urea and electrolytes	99 (84–113)	650
C-reactive protein*	0.5 (0.4–0.6)	3
Arterial blood gases	49 (45–53)	320

CI = confidence interval. * Ordered in conjunction with urea and electrolyte assessment. ◆

4 Carbon dioxide equivalent (CO_2e) emissions associated with single pathology tests, by test component





Papaver somniferum

‘Strategic’ harvesting





The pelletising factory,
Tasmania



Poppy Pellets



Large 'kegs' of morphine- Final API Product

Off to Sydney!

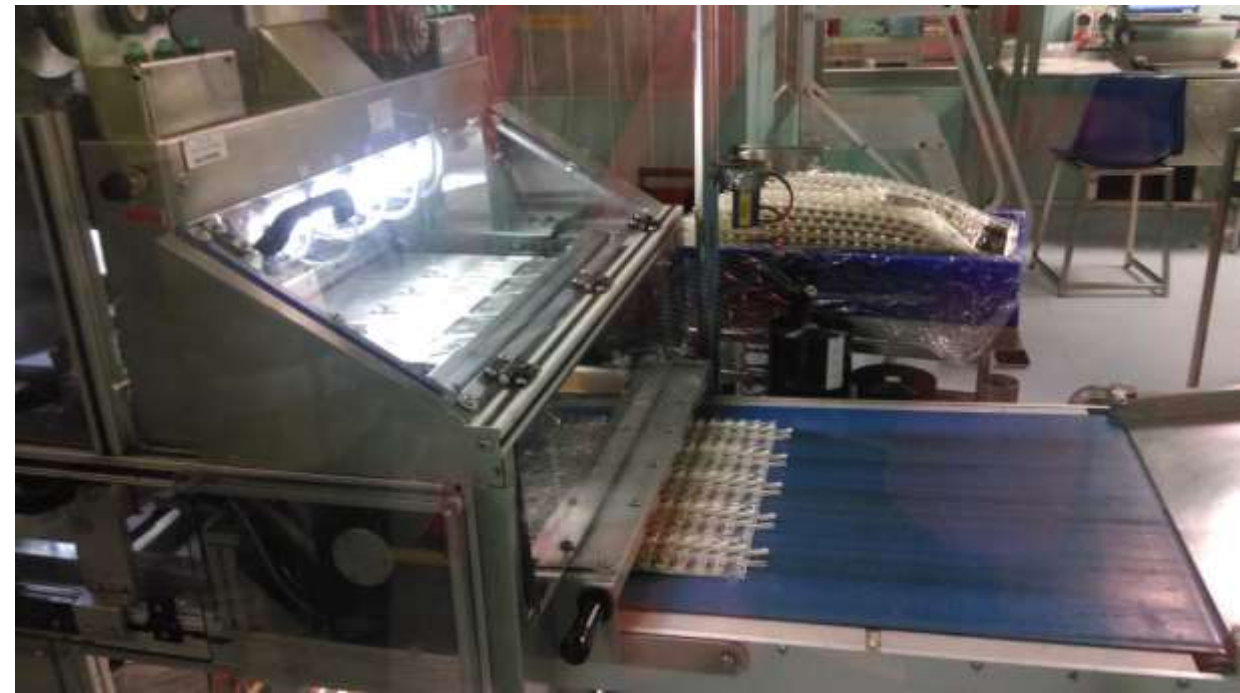


Bradley Keam- Toongabbie, Sydney



'Salt' bags

Extrusion of PVC bags





The Mixing Room



Clean Room

Robot packaging items





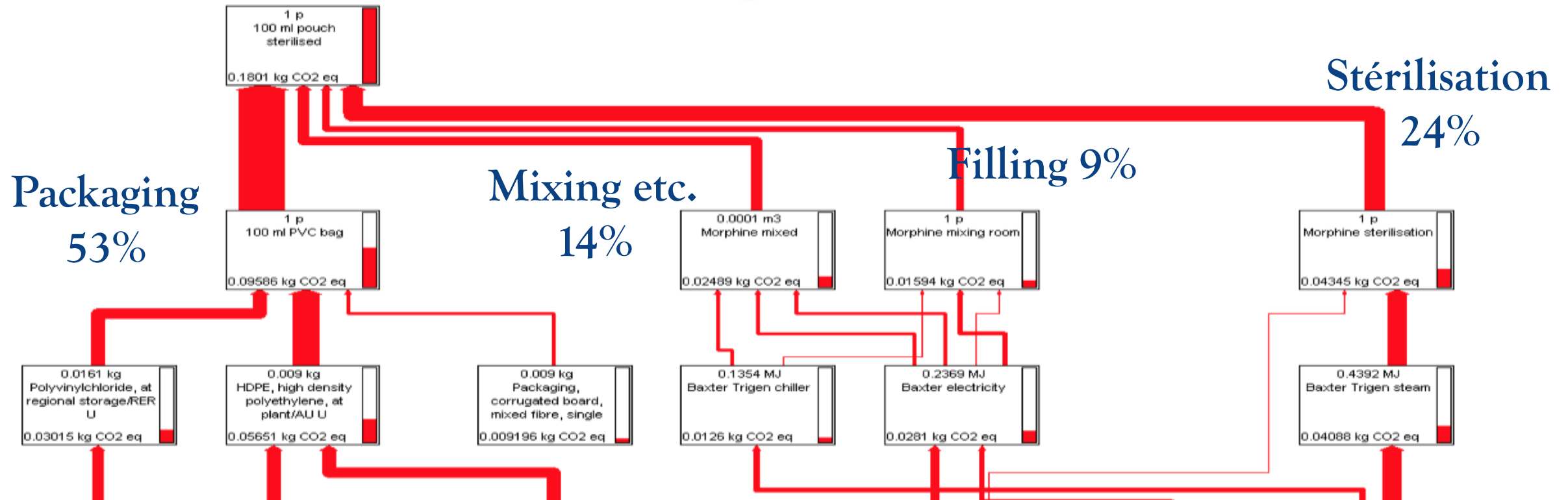
One million i.v. bags/week

Robot lifting i.v. bags onto 'trucks',
then on to the steriliser



CO₂ Emissions-Process Tree

At Toongabbie



Results for 100mg i.v. Morphine: 204g CO₂

1. Morphine production to the 'factory gate'
 - 24g CO₂ (12%)
2. Intravenous preparation
 - 84g CO₂ (41%)
3. Packaging
 - 96g CO₂ (47%)

What I'm about to show you is rare
In Australia!



LCAs within:

1. Gowns
(Overcash)
2. BP cuffs
3. pulse oximeters
4. CVC insertion
kits

A beginners guide to **Sustainability in the ICU**



LCA Studies

1. An opportunity to quantify what we think we know
2. Surprising findings abound (cotton, energy sources, medications, oxygen, sterilisation, HVAC)
3. Change is coming: electricity, electrify everything!
4. Much yet to achieve (NHS Greening Healthcare et al)
5. Full Sails On Our Journey!