



Life cycle approaches in the pharmaceutical and healthcare sector

ERM

Andy Whiting

30th March 2021

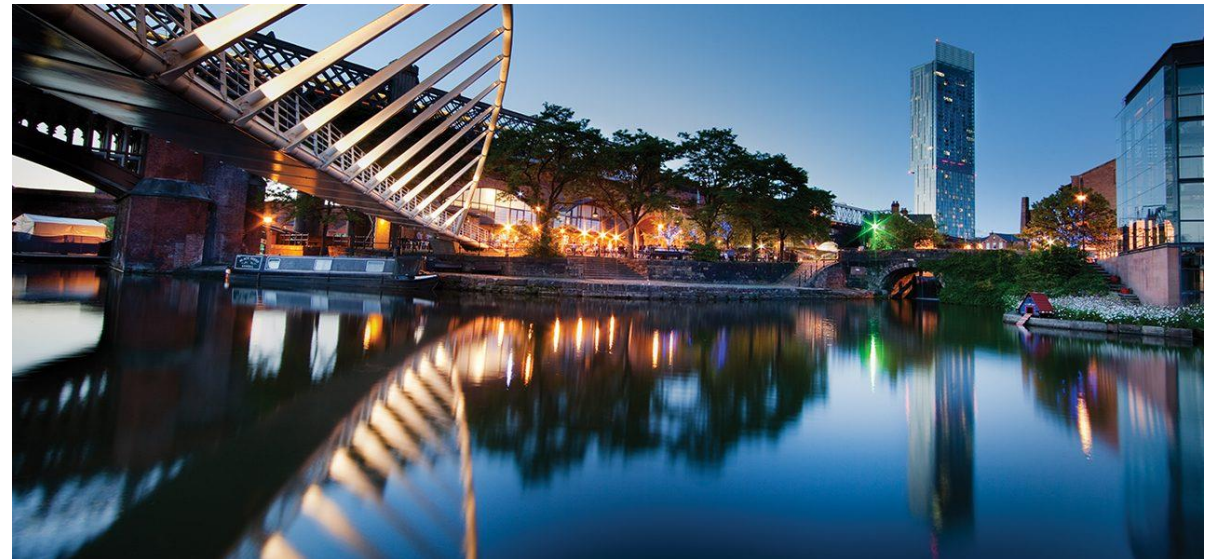
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The business of sustainability



About me

- **Doctorate: LCA and LCC of bioenergy in UK**
- **Consultant at ERM since November 2014**
- **Manchester office**
- **Product Sustainability team**
- **LCA & CF**
- **Many sectors but increasingly pharma focus**
- **Seconded to AstraZeneca since 2015**



ERM – Shaping a sustainable future with the world's leading organizations

50

Years of innovative sustainability

~1B\$

Revenue/y

170+

Counties & territories worked in over the last three years



Background

- The Sustainable Healthcare Coalition (SHC) – English National Health Service (NHS), pharma companies, ERM
- Product Sustainability team has been working with the SHC for a decade
- Published guidance
 - GHG Protocol Product Standard Sector Guidance
 - Care Pathways Guidance
- Published case studies using the guidance

We have developed relationships with individual members of the SHC and our reputation has led to work with non-member pharma companies.



Care Pathways: Guidance on Appraising Sustainability

[Main Document](#)

October 2015



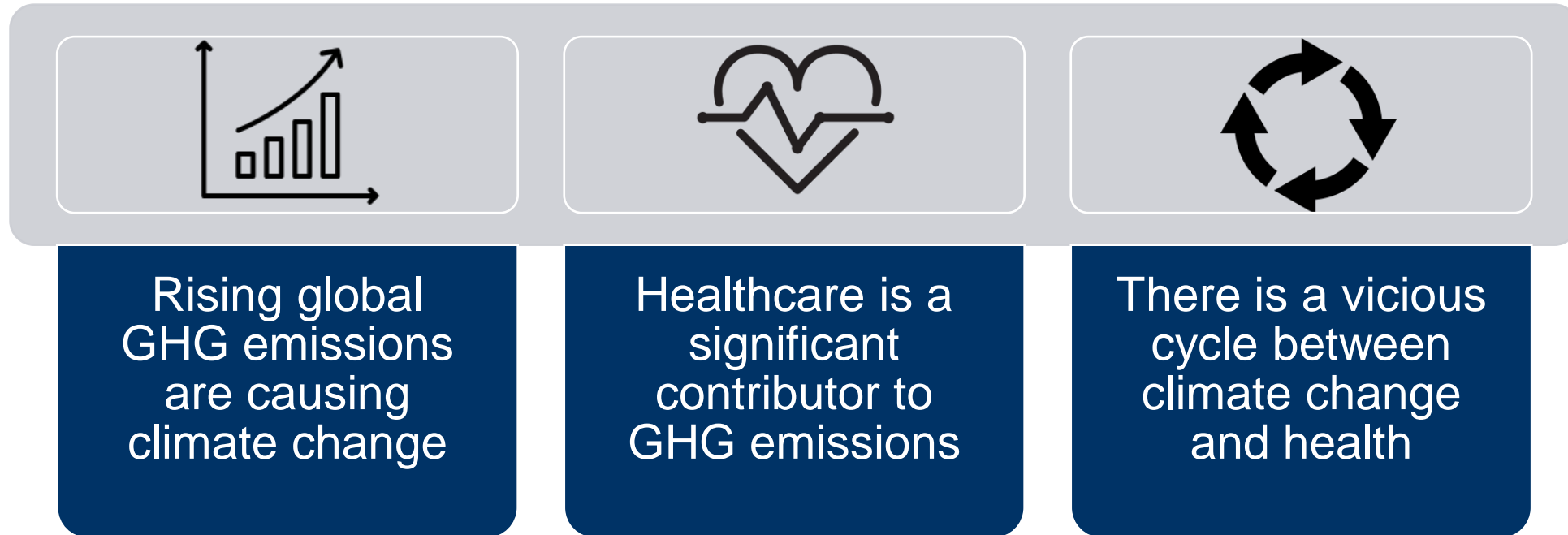
Greenhouse Gas Accounting Sector Guidance for Pharmaceutical Products and Medical Devices

GHG Protocol Product Life Cycle Accounting and Reporting Standard

November 2012



Drivers



- Health care sector – 5.5% of national carbon footprints
- Pressure on healthcare services to meet government targets
- e.g. NHS aims to be carbon neutral by 2045, no procurement from less ambitious suppliers 2030
- LCA results used in procurement process – competitive advantage, marketing

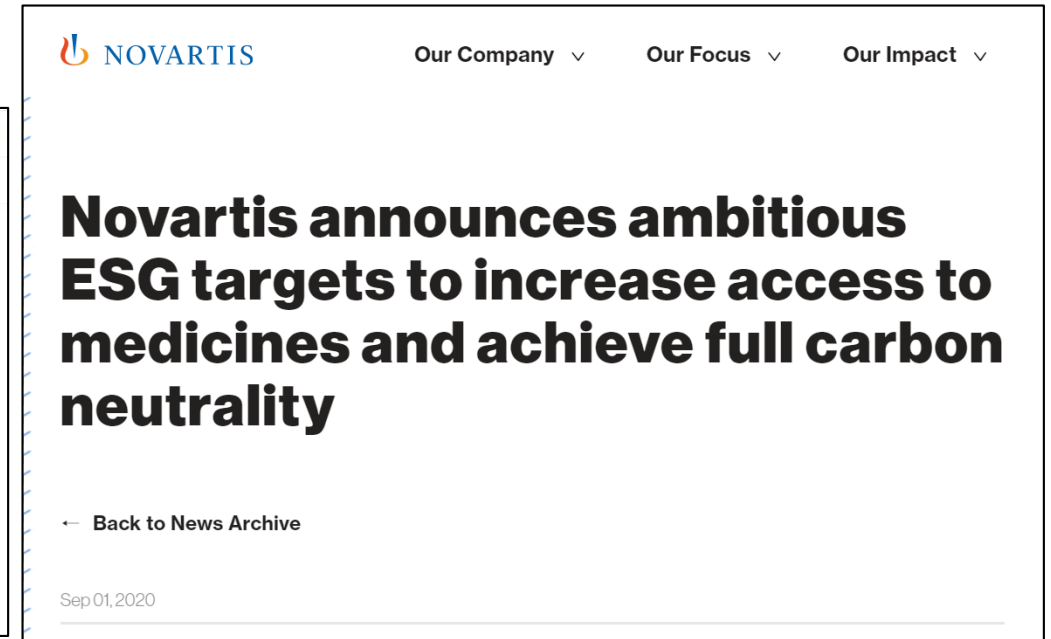
Background



AstraZeneca logo and navigation menu: What science can do, R&D, Our therapy areas, Our company, Careers, Investors, Media, Sustainability, Partnering.

AstraZeneca's 'Ambition Zero Carbon' strategy to eliminate emissions by 2025 and be carbon negative across the entire value chain by 2030

PUBLISHED
22 January 2020

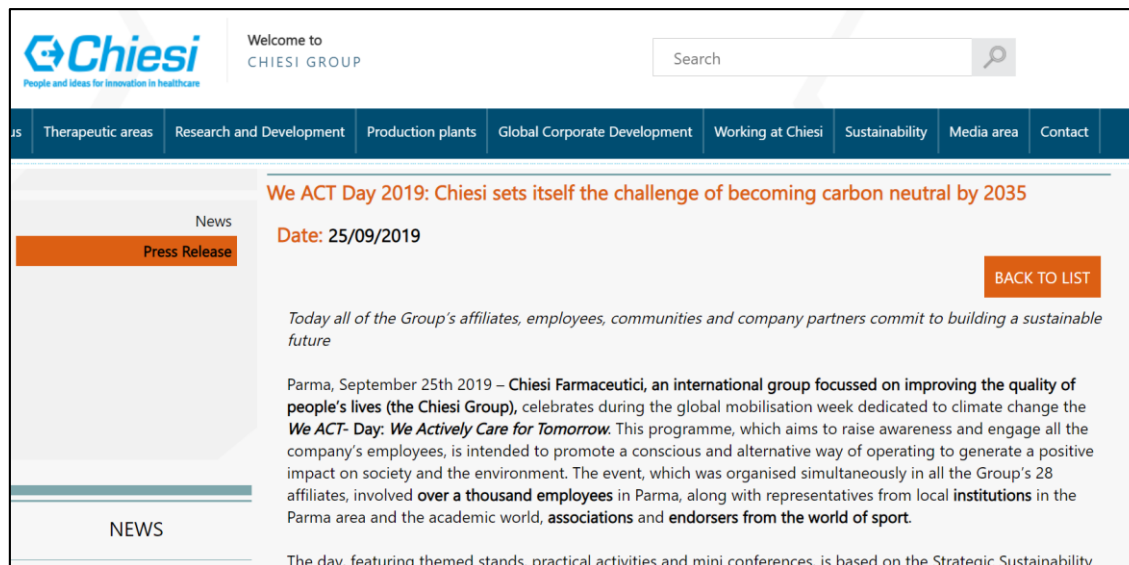


NOVARTIS logo and navigation menu: Our Company, Our Focus, Our Impact.

Novartis announces ambitious ESG targets to increase access to medicines and achieve full carbon neutrality

← Back to News Archive

Sep 01, 2020



Chiesi logo and navigation menu: Therapeutic areas, Research and Development, Production plants, Global Corporate Development, Working at Chiesi, Sustainability, Media area, Contact.

We ACT Day 2019: Chiesi sets itself the challenge of becoming carbon neutral by 2035

Date: 25/09/2019

Today all of the Group's affiliates, employees, communities and company partners commit to building a sustainable future

Parma, September 25th 2019 – Chiesi Farmaceutici, an international group focussed on improving the quality of people's lives (the Chiesi Group), celebrates during the global mobilisation week dedicated to climate change the **We ACT- Day: We Actively Care for Tomorrow**. This programme, which aims to raise awareness and engage all the company's employees, is intended to promote a conscious and alternative way of operating to generate a positive impact on society and the environment. The event, which was organised simultaneously in all the Group's 28 affiliates, involved **over a thousand employees** in Parma, along with representatives from local **institutions** in the Parma area and the academic world, **associations** and **endorsers from the world of sport**.

NEWS

The day, featuring themed stands, practical activities and mini conferences, is based on the Strategic Sustainability



GSK logo and navigation menu: Home, Media, Press releases, GSK sets new environmental goals of n...

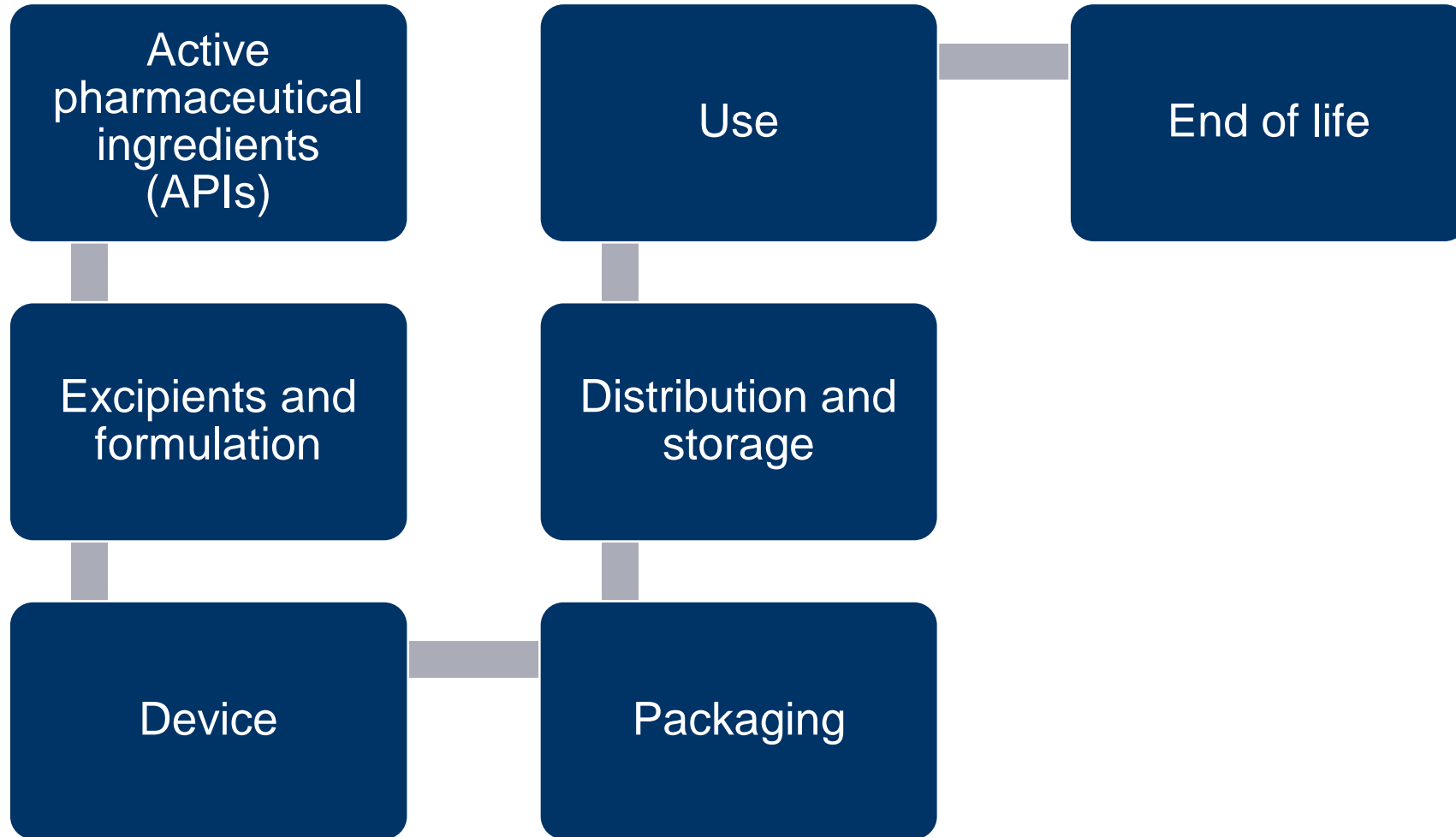
03 November 2020

GSK sets new environmental goals of net zero impact on climate and net positive impact on nature by 2030

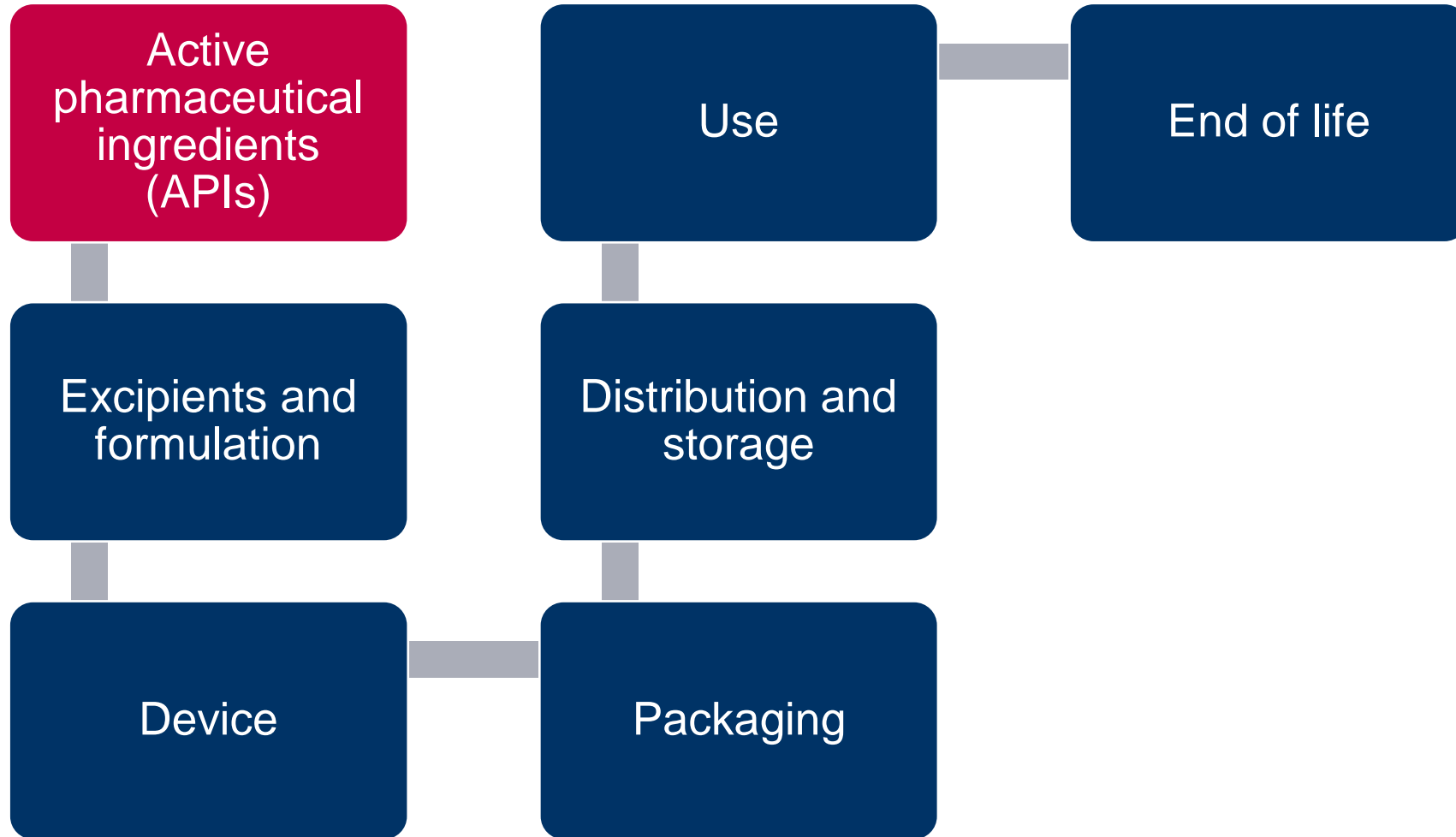
For media and investors only

Issued: London, UK

Simplified Life Cycle



API



API

Example product types where this life cycle stage can be significant:



Tablets



Capsules



Dry powder inhalers (DPIs)



Biologics and vaccines



Oral suspension powders

Issues:

Manufacturing type varies incl.

- Organic small molecule
- Biologics
- Plant or animal derived

High GHG per kg - typical range 100s – 10,000s kg CO₂e/kg

though used in small volumes

Solvents and their incineration

Catalysts – resource depletion

Energy used in manufacturing

Potential solutions:

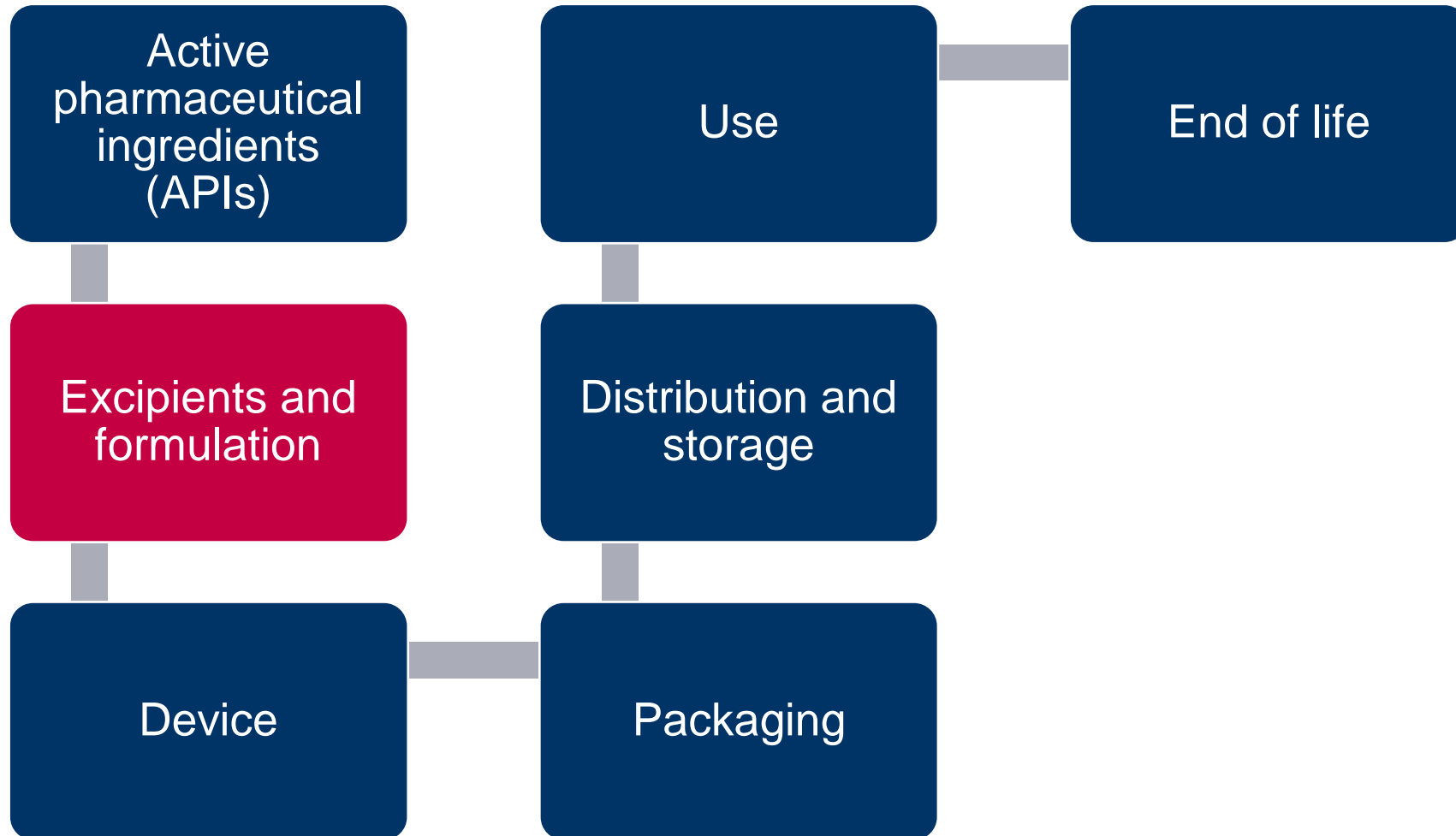
Don't waste API

Green chemistry

- Energy and material efficiency
- Solvent and catalyst recycling
- Bio-solvents
- Reduce # reaction steps & improve yields

Renewable energy

Excipients and Formulation



Excipients and Formulation

Example product types where this life cycle stage can be significant:



Pressurised metered dose inhalers (pMDIs)

Issues:

Production of F-gases

- Climate change
- Ozone depletion
- Resource depletion

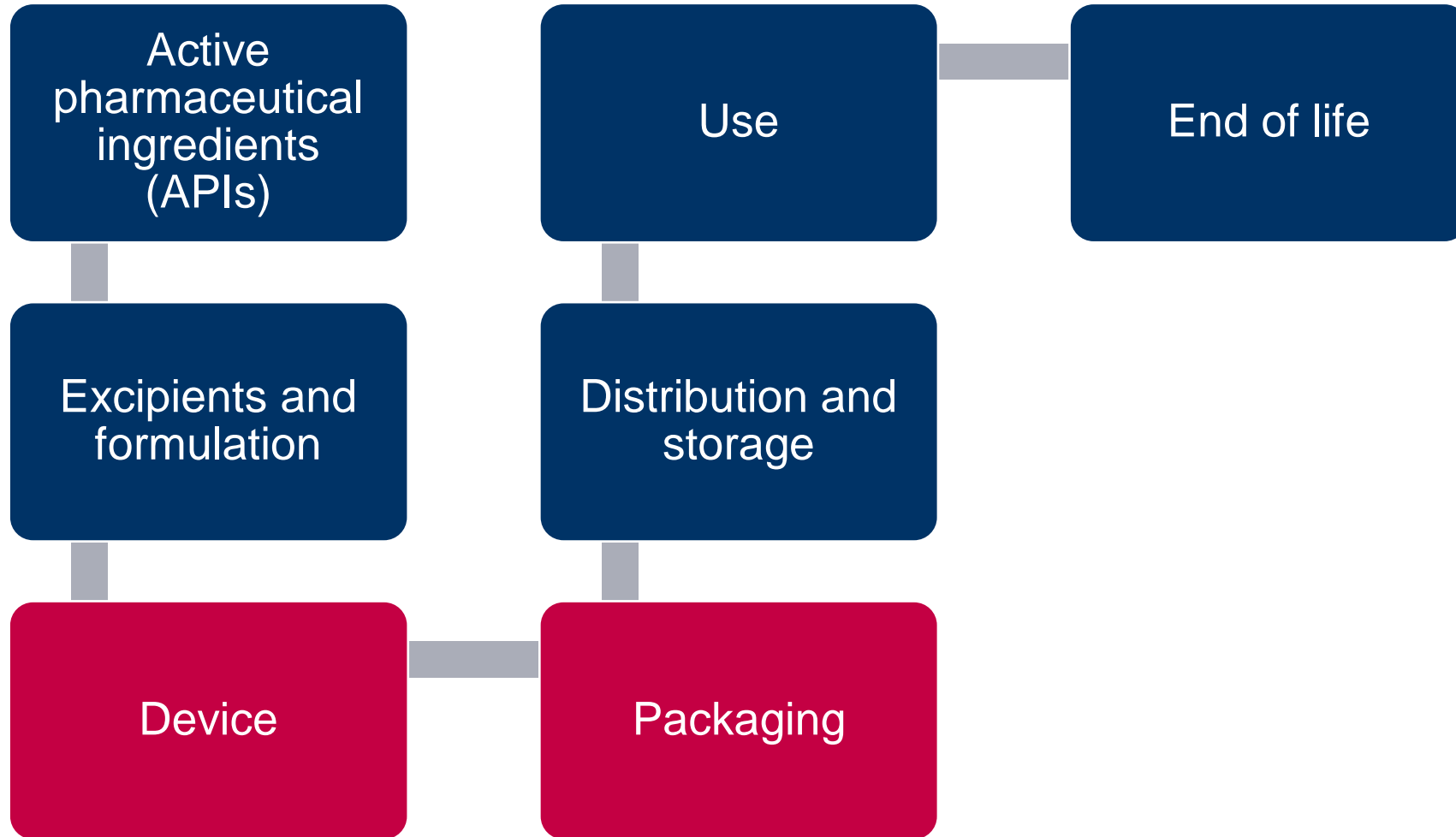
Potential solutions:

Capturing fugitive F-gases during production

Replacing high-GWP F-gases with low-GWP alternatives

Transition - inhalers that don't require F-gases (e.g. dry powder inhalers)

Device and Packaging



Device and Packaging

Example product types where this life cycle stage can be significant:



Pressurised metered dose inhalers (pMDIs)



Injector pens



Dry powder inhalers (DPIs)



Blister packs, foil pouches and sachets

Issues:

Energy use in assembly (HVAC and sterilisation)

- Climate change

Fugitive F-gas emissions

- Climate change

Stainless steel parts

- Ecotoxicity
- Resource depletion

Aluminium parts

- Resource depletion

Potential solutions:

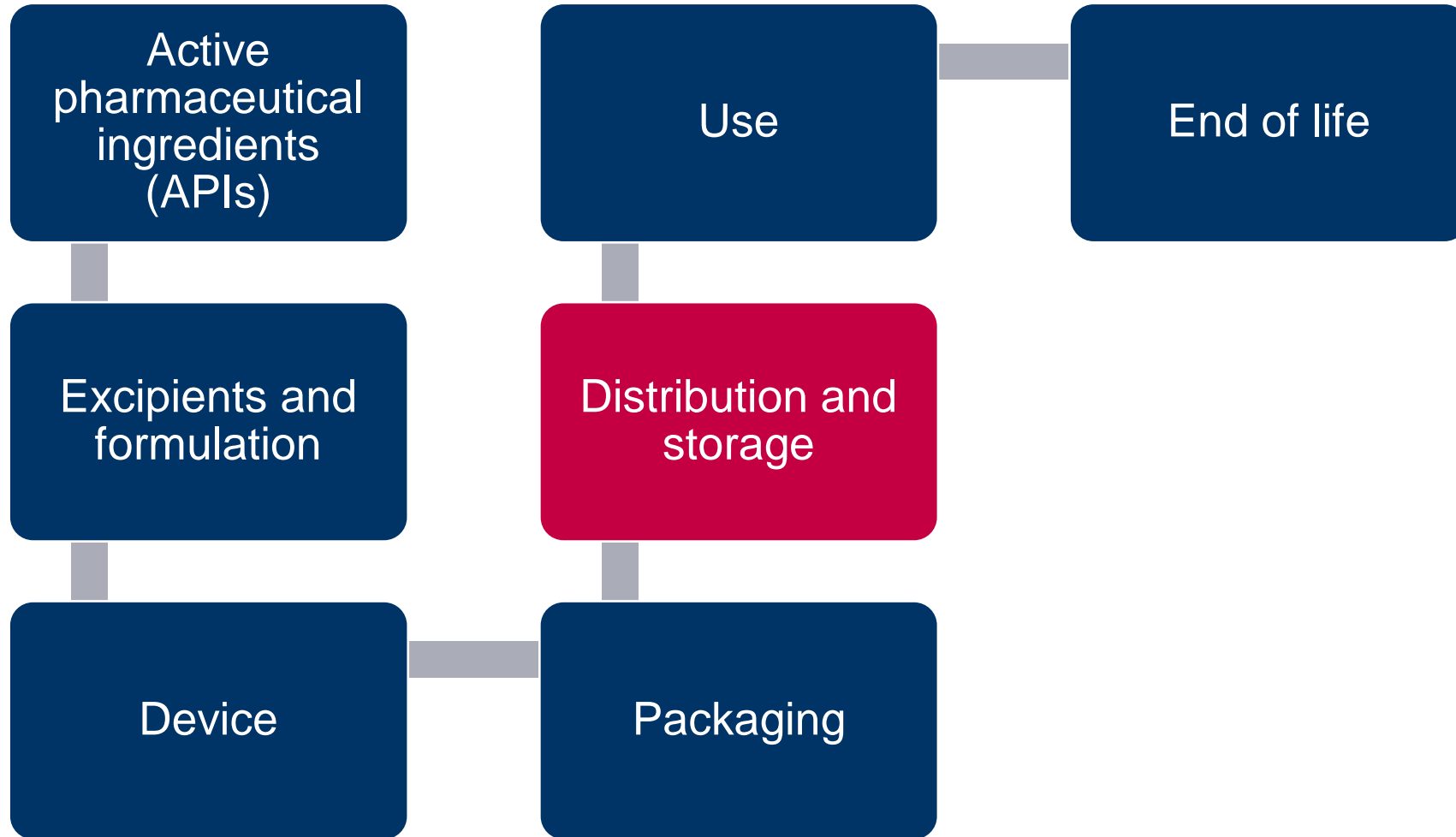
Renewable energy

Capturing fugitive F-gases

Lightweighting

Recycled materials

Distribution and Storage



Distribution and Storage

Example where this life cycle stage can be significant:



Air freight

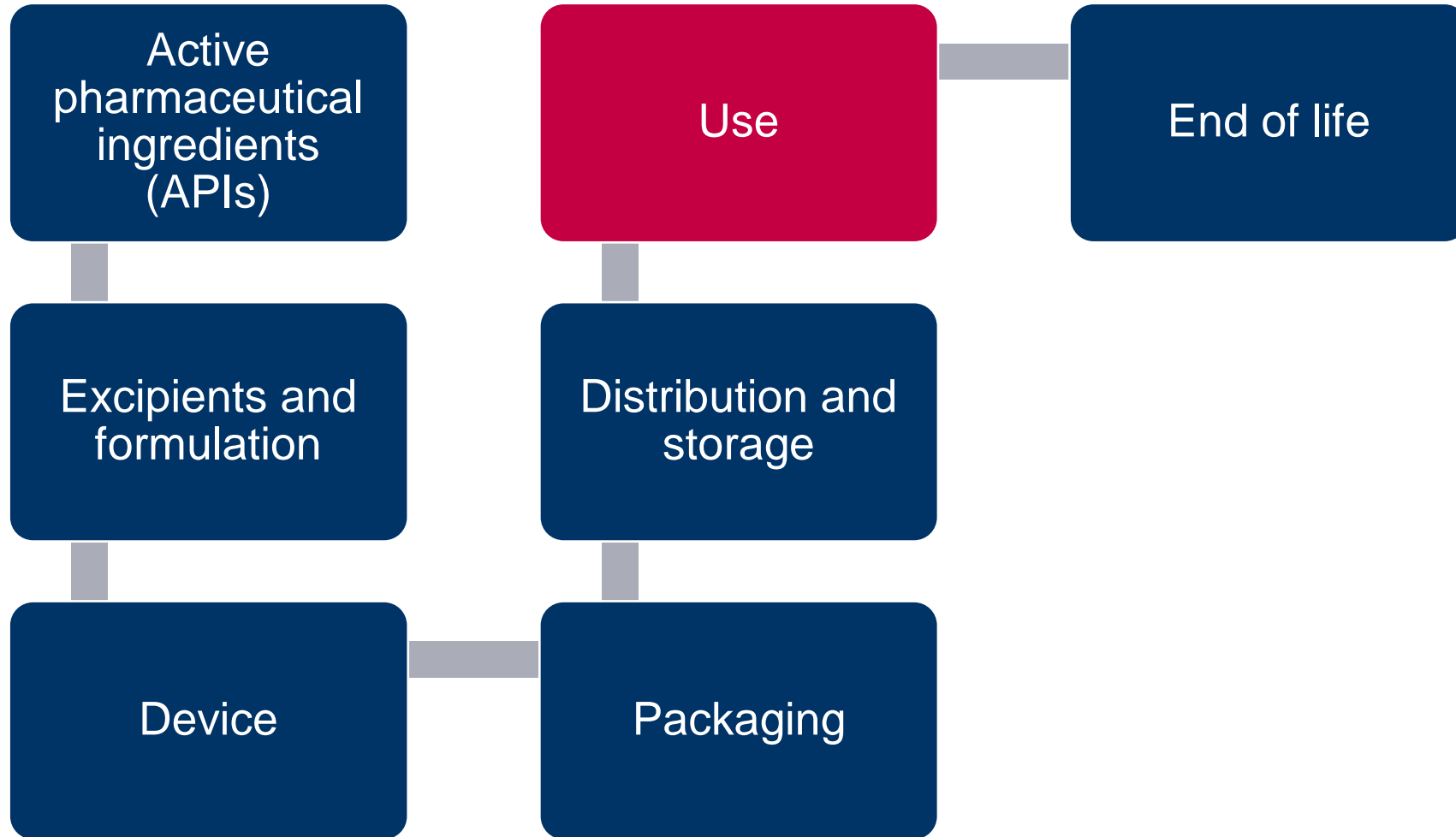
Issues:

Distribution only tends to be significant if air freight utilised

Potential solutions:

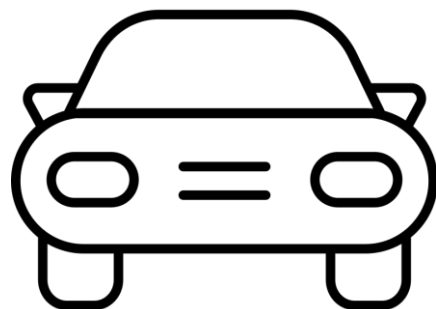
Replacing air freight with sea/rail freight

Use

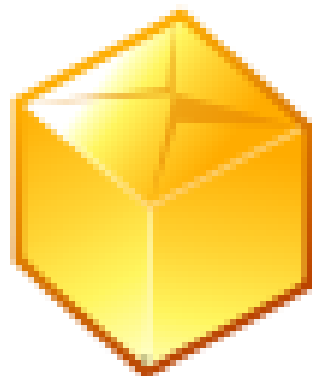


Use

Example where this life cycle stage can be significant:



Patient travel



Delivery



Pressurised metered dose inhalers (pMDIs)



Gaseous anaesthetics

Issues:

Patient travel to collect prescription or to have drug administered

Delivery of prescription to patient

F-gas emissions

Potential solutions:

Multipacks

Encourage delivery

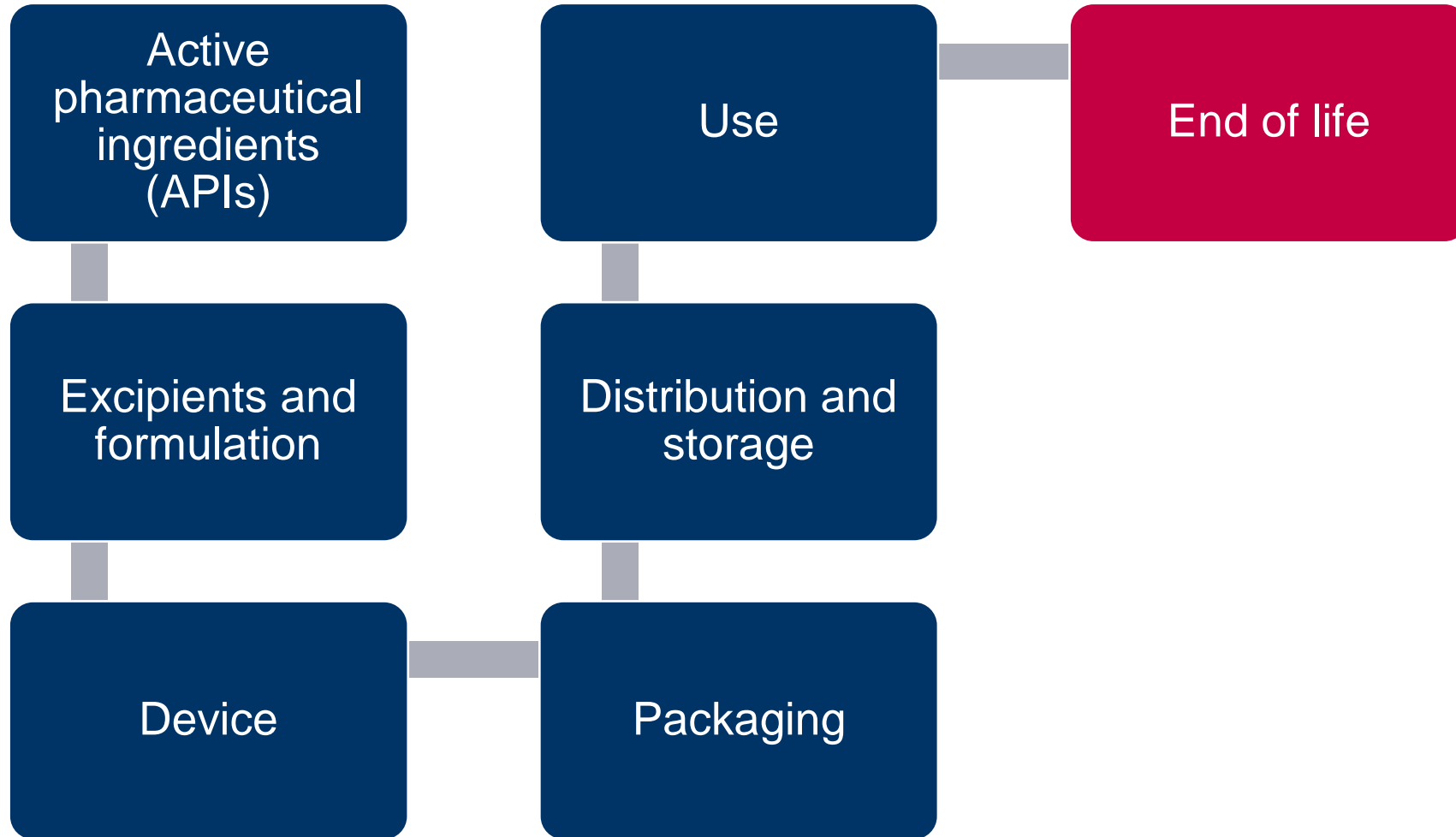
Electric vehicles

Capture anaesthetics

Replace high-GWP F-gases with low-GWP F-gases

Alternatives (DPIs, intravenous anaesthetics)

End of Life



End of Life

Example where this life cycle stage can be significant:



Pressurised metered dose inhalers (pMDIs)



Incineration

Issues:

F-gas emissions

Incineration of device and packaging

Potential solutions:

Take-back schemes

Replace high-GWP F-gases with low-GWP F-gases

Alternatives (DPIs)

Increase recyclability

Bio-plastics

Challenges

Data collection

Complex supply chains (outsourcing)

Characterising complicated starting materials

Allocating utilities

Confidentiality

Patient travel

Distance

Modes

Allocation between purposes

Pharmaceuticals in the environment (PiE)

UseTox characterisation of complex APIs

Metabolites

How much ends up in the environment?

Other

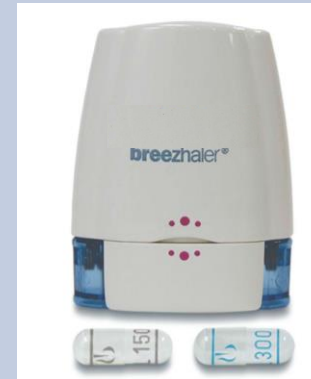
Single-use plastics

Regulations stifle design innovations to on market products

Messaging (e.g. cancer toxicity)

Novartis Case Study

- Novartis' new Breezhaler® device
- Pressurised metered dose inhalers (pMDIs) contribute due to HFA gases (3% of NHS carbon footprint)
- Novartis wished to examine the carbon footprint benefits of its technology and compare Breezhaler® against competitor devices with a similar function
- Potential advantages in marketing and sales globally
 - Low impact products are easier to market in a new environmentally-conscious world
 - Provide a competitive advantage over similar products with higher impacts
 - Win large contracts with healthcare providers
- Insight into a product's environmental hotspots, showing areas where work on product design can be focused further to reduce the impact



Breezhaler®

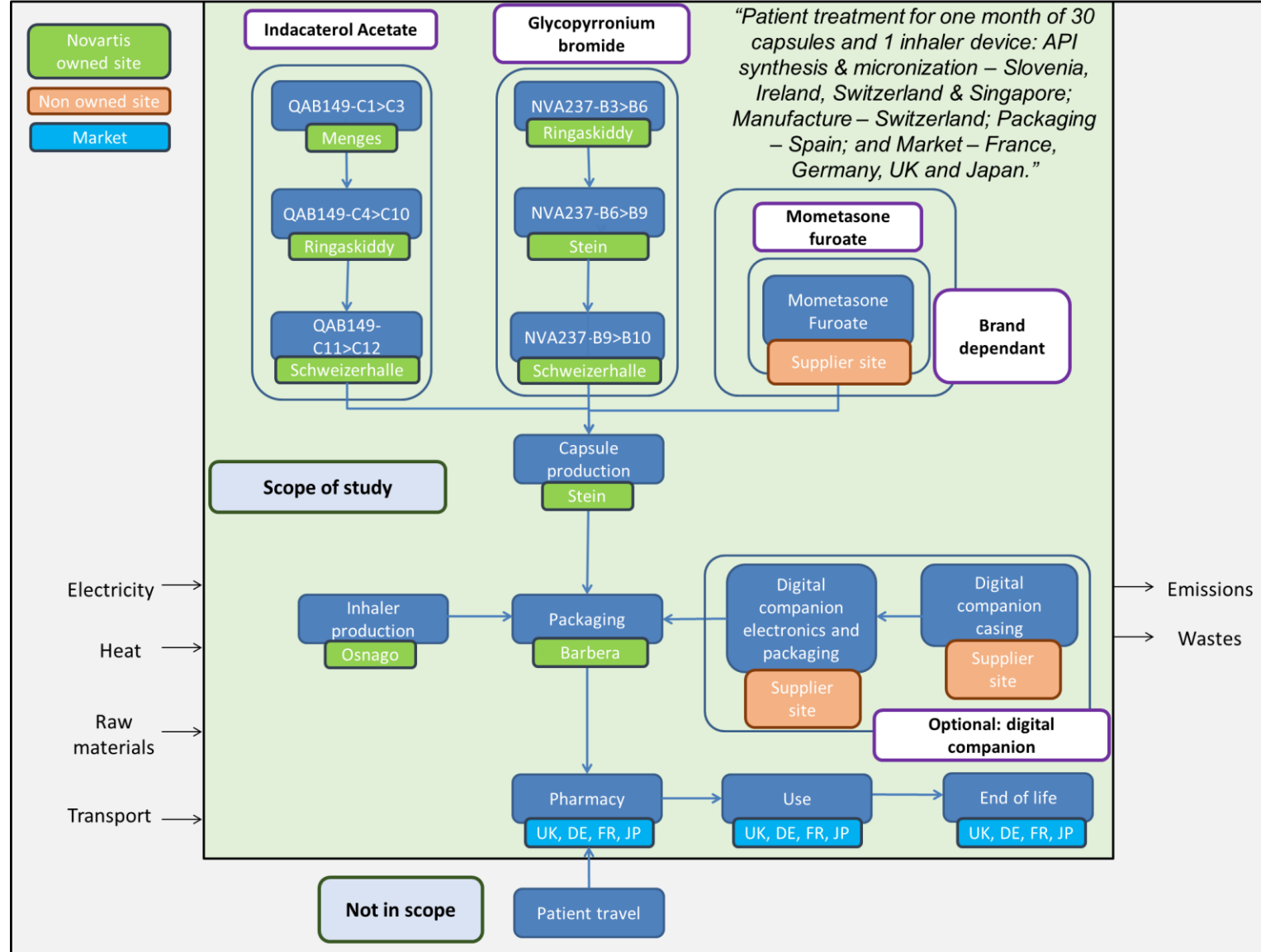


pMDI

- No HFA gas used
- Refillable
- Mainly plastic
- Optional digital companion

- HFA gas used
- Single-use
- Plastic casing and aluminium canister

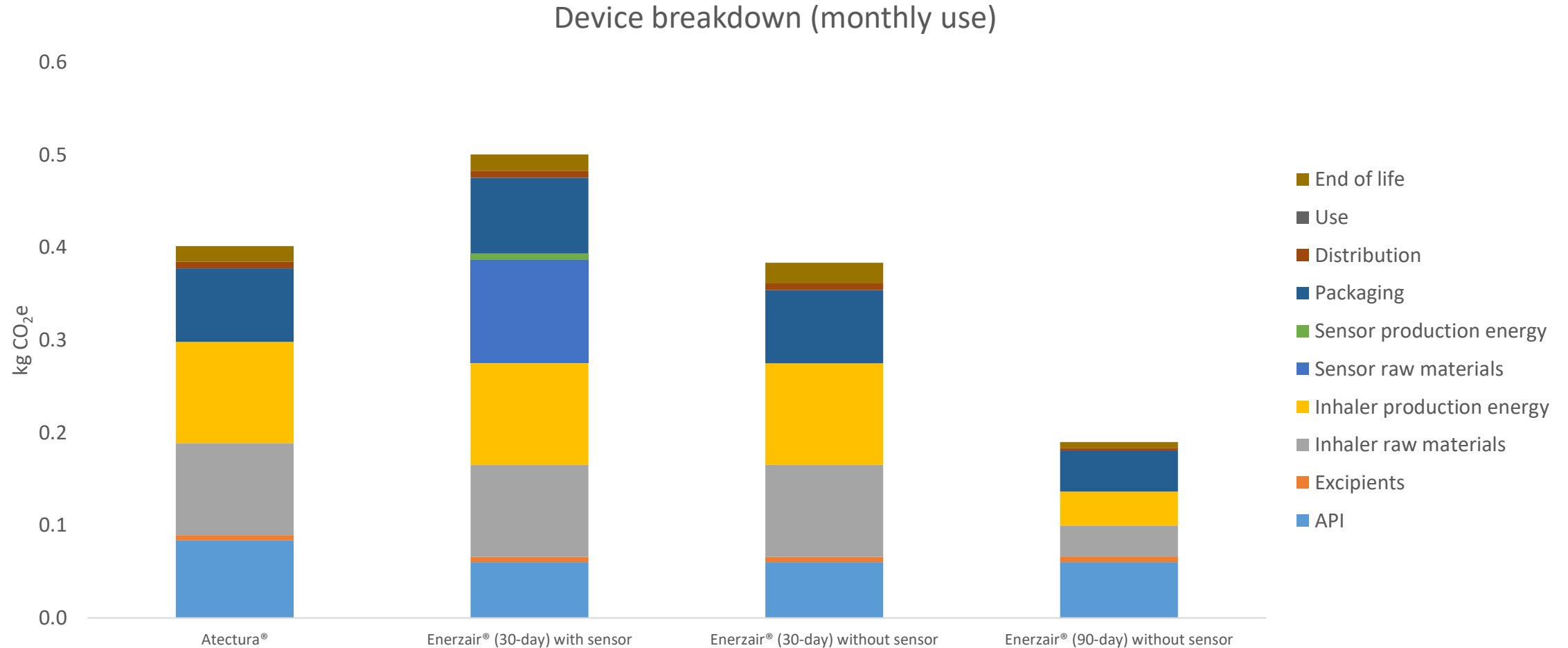
Breezhaler® Life Cycle



- Data collected for all inputs and outputs from each stage of the production life cycle
- Data included information on materials, energy use, locations and waste streams
- FU – 1 month of inhaler use

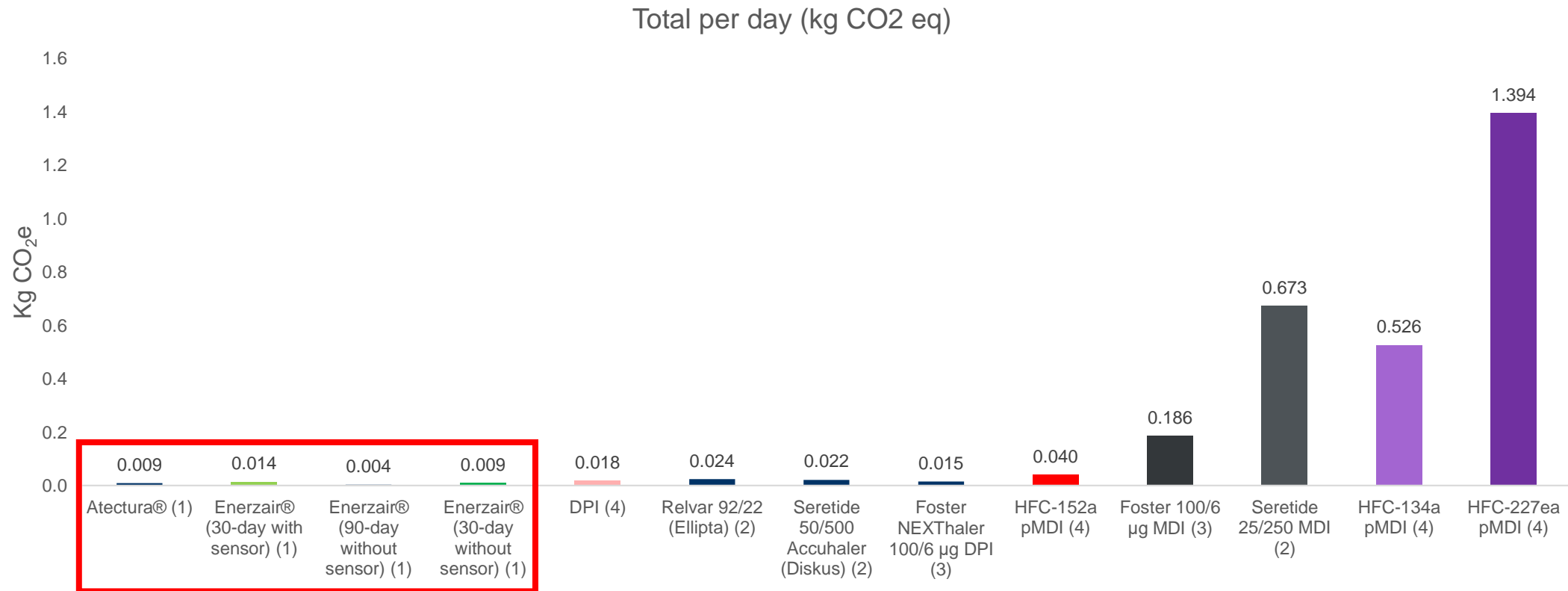
Results

- Results were extracted for four geographies (UK, Germany, France, Japan) - only UK results are shown below



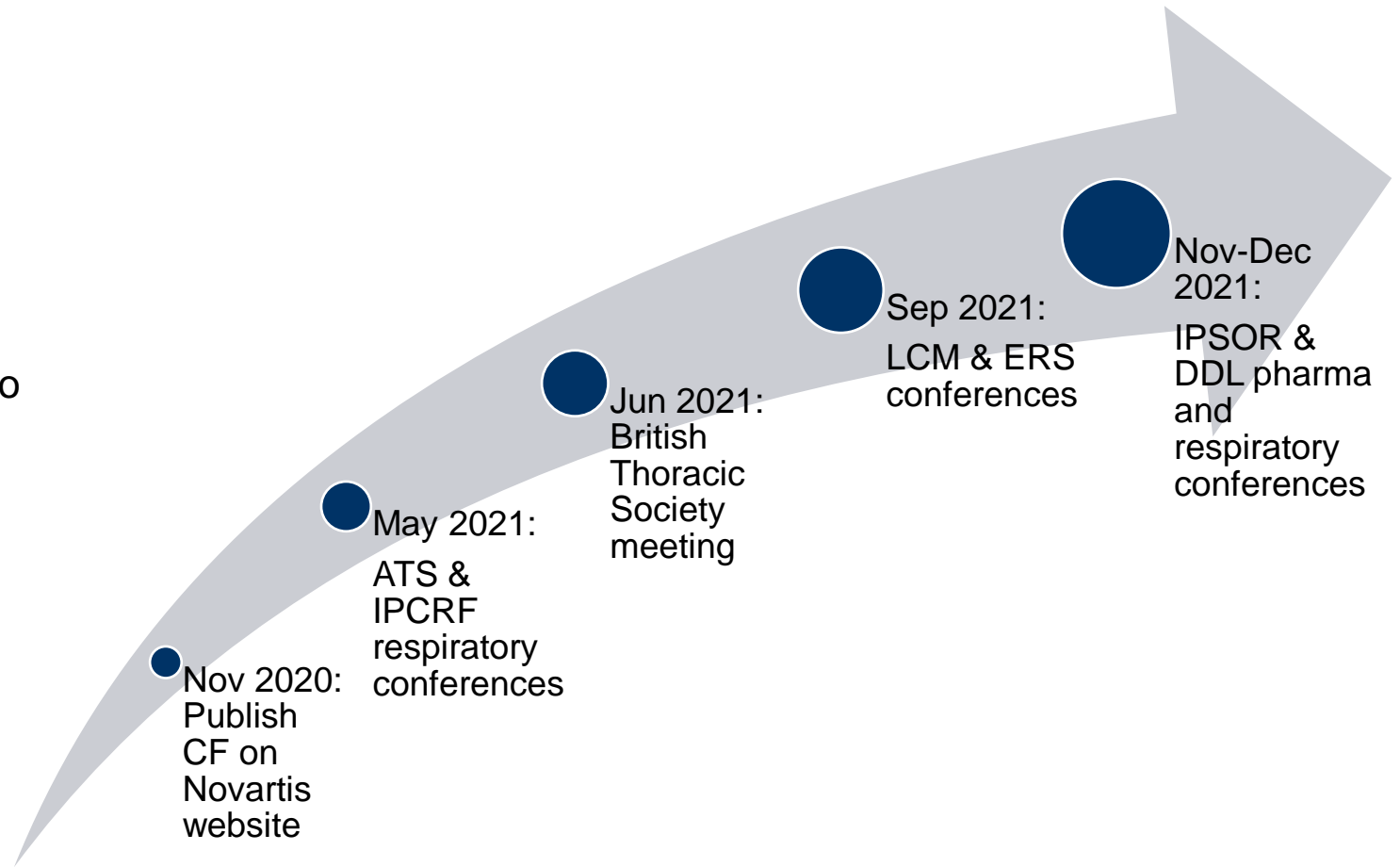
Comparisons with Similar Products

- Data for other inhaler products were taken from literature sources.
- This table compares products excluding API (not included in some studies), with the Novartis devices highlighted and showing their impact to be small
- Other DPI devices have a low footprint, far exceeded by those of pMDI products



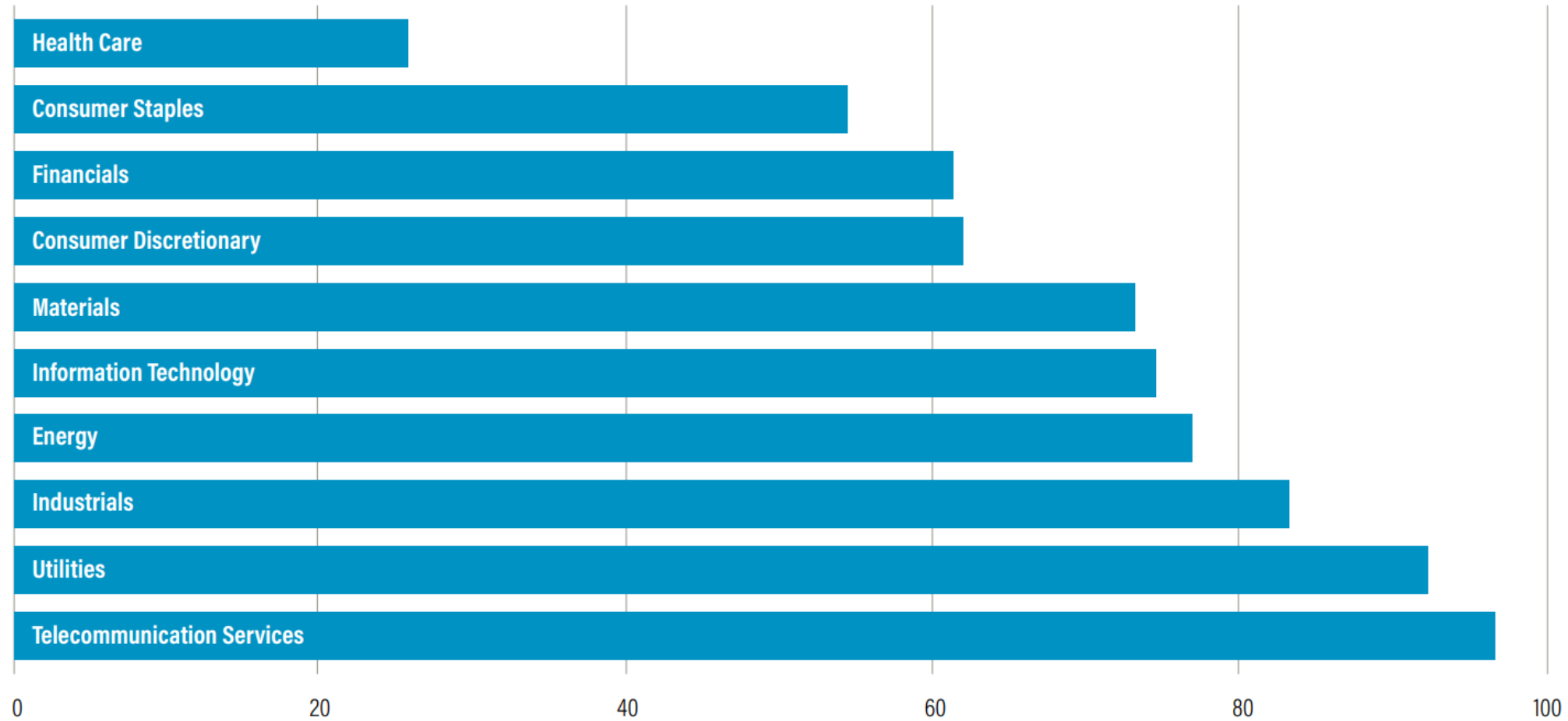
Publications Timeline

- Case study published on Novartis' website
- Study expanded to LCA, third party reviewed
- Meta-analysis and exacerbation study in preparation
- Paper presented at the Drug Delivery to the Lungs conference
- Paper accepted at the International Primary Care Respiratory Congress
- Paper accepted at the European Respiratory Society congress
- Abstract submitted to the American Respiratory Society conference
- Paper in preparation to submit to 'Sustainability'



Pharma: Environmental Benefits

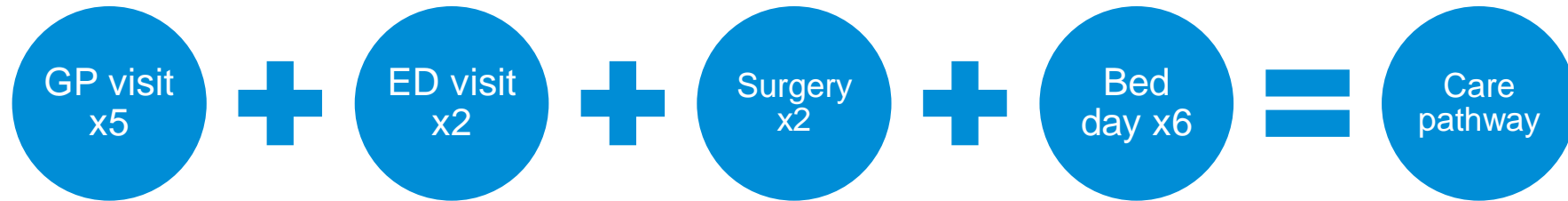
Figure 2 | Percentage of Companies in Different Sectors That Believe Their Products Have Positive GHG Impacts



Source: 2014 CDP Climate Change Questionnaire (total of 1,793 companies surveyed).

Care Pathways

- Care pathway = interventions in a patient's care
- Working with the Sustainable Healthcare Coalition, ERM has written guidance for assessing the carbon, water and waste impacts of care pathways
- Care pathways can be broken down into modules. For example:



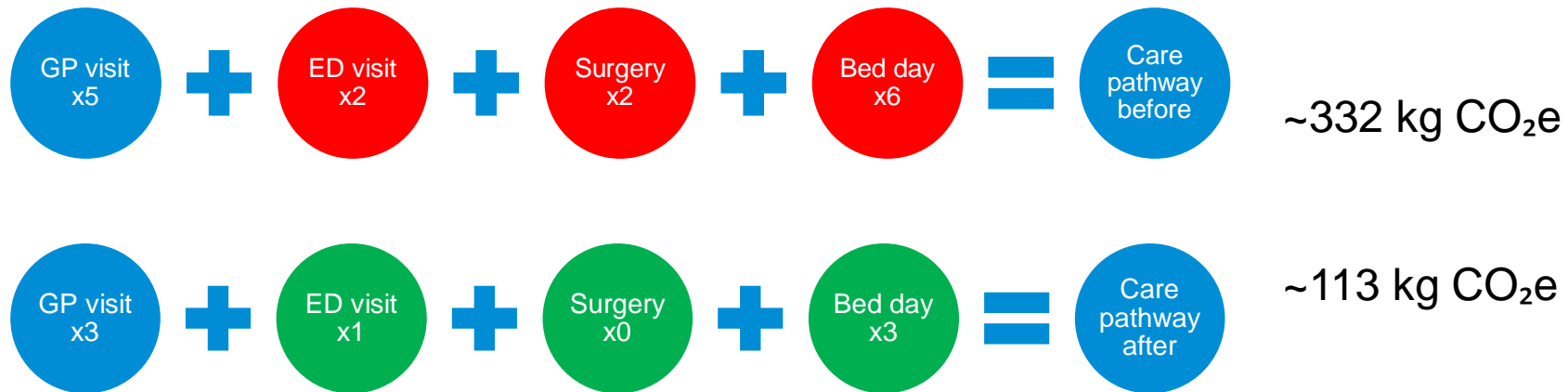
- The impact of each module assessed to create impact factors
- Module factors can be used as building blocks to assess patient care pathways
- Allows patient care pathways to be compared with alternative pathways



Adherence and Carbon

- Intervention to improve adherence -> improve typical patient care pathways
-> fewer emergency admissions, surgical interventions and hospital bed days etc.
- This leads to a carbon saving which offsets impact of intervention

Example:



- In this case, increased adherence leads to a saving of ~219 kg CO₂e.
- How would this compare with the carbon footprint of a pharma product itself?
- Would there be an overall saving in carbon emissions?
- Using life cycle assessment (LCA), ERM can quantify these environmental benefits

Smart Inhalers

- Regular inhalers enhanced with either built in or clip-on “smart” functionality
- Device records inhaler use by patient

Potential benefits

- Helps patient to adhere to proscribed inhaler routine
- Allows medical professionals to monitor adherence
- Increased adherence leads to improved patient outcome
- Consequent reduction in:
 - emergency admissions
 - surgical intervention
 - wasted inhalers

Potential negatives

- Life cycle environmental impacts of the device
 - Device production
 - Device disposal
- Additional cost



- Do the benefits of the smart inhaler outweigh the device’s carbon impact?

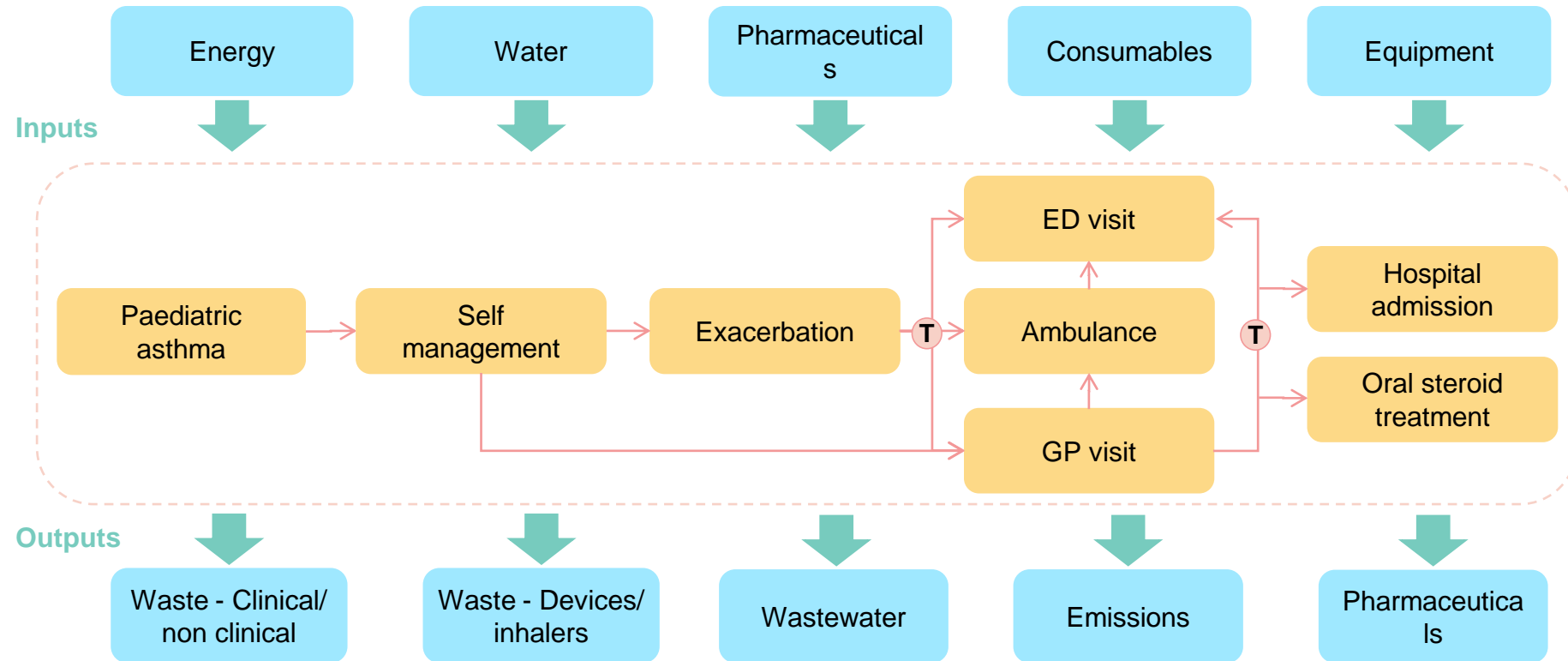
Smart Inhalers LCA

- Produced by Adherium
- SmartTurbo combines with AstraZeneca's Symbicort Turbuhaler
- Functional unit:

The annual management of a child with asthma aged 6 to 16 years old in the United Kingdom, taking regular inhaled steroids, typically with poorly controlled asthma



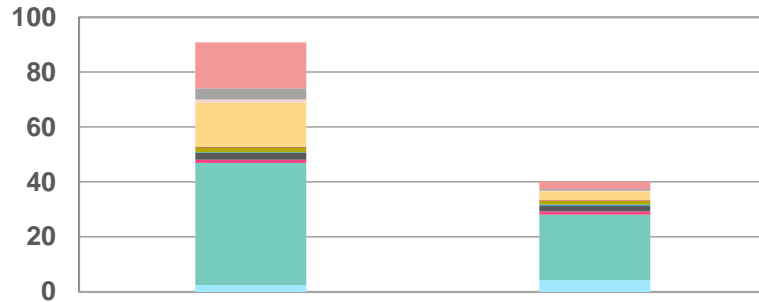
Paediatric asthma – Care pathway



Results

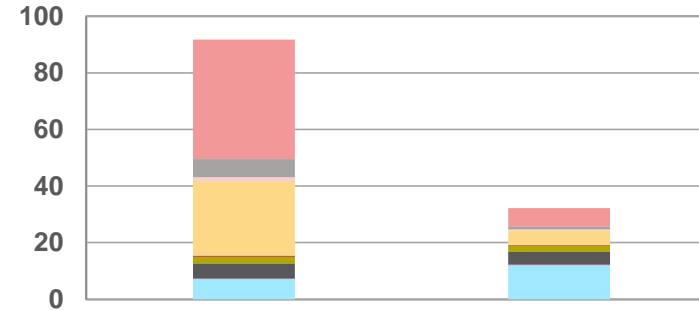
GHG emissions
(kg CO₂-eq/year)

56%



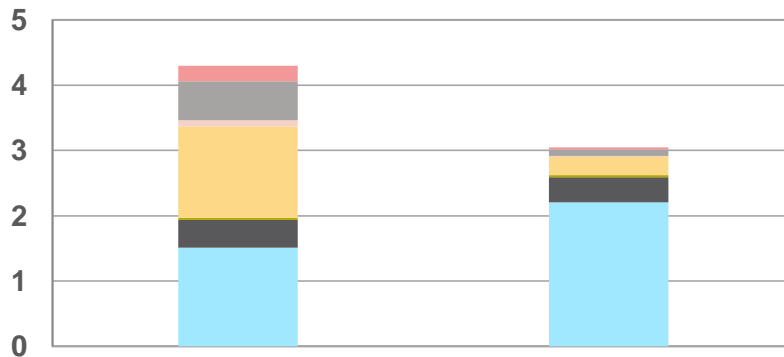
Water consumption (m³/year)

65%



Waste Produced (kg/year)

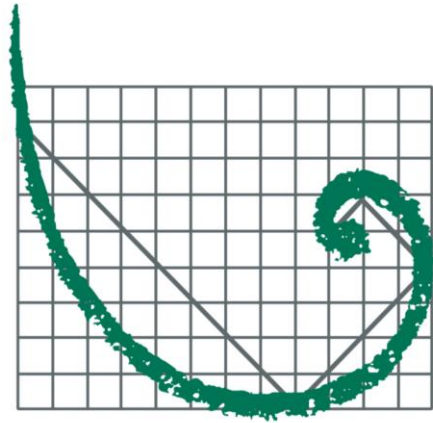
29%



- Self management: long acting inhalers
- Self management: short acting inhalers
- Patient travel to GP
- GP consultations
- Patient travel to A&E
- A&E visits
- Oral steroids
- Hospital admission: inpatient episodes
- Hospital admission: day-case episodes
- Hospital admission: intensive care unit
- Ambulance for hospital admissions

Concluding Remarks – Care Pathways

- The net environmental benefits of healthcare products can be quantified by comparing care pathways
- Care pathways guidance allows for the impact of patient treatment to be assessed
- Improved adherence can improve the environmental impact of care pathways
- This can offset the environmental impact of devices such as smart inhalers



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Thank you

Andy Whiting

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