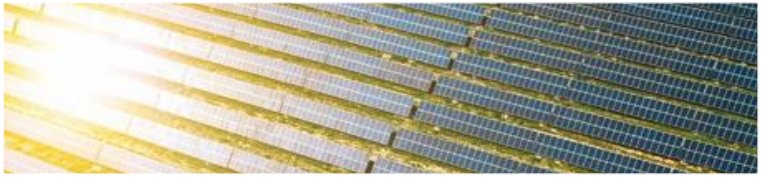
IChemE

Measuring Progress in the Circular Economy

Dr Jim Goddin, thinkstep-anz







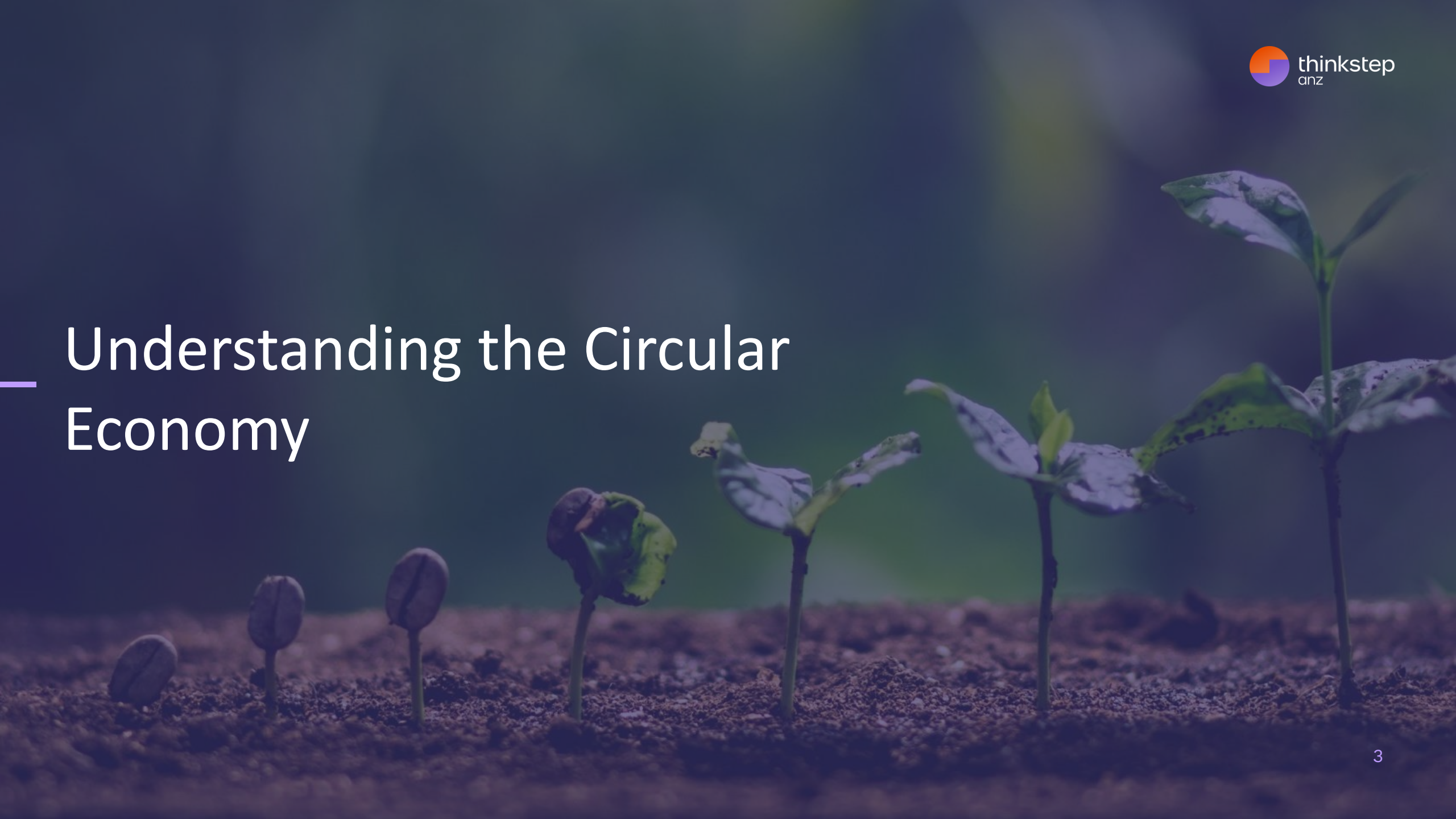



Circular Economy Webinar Series

Responsible production, innovation and industry

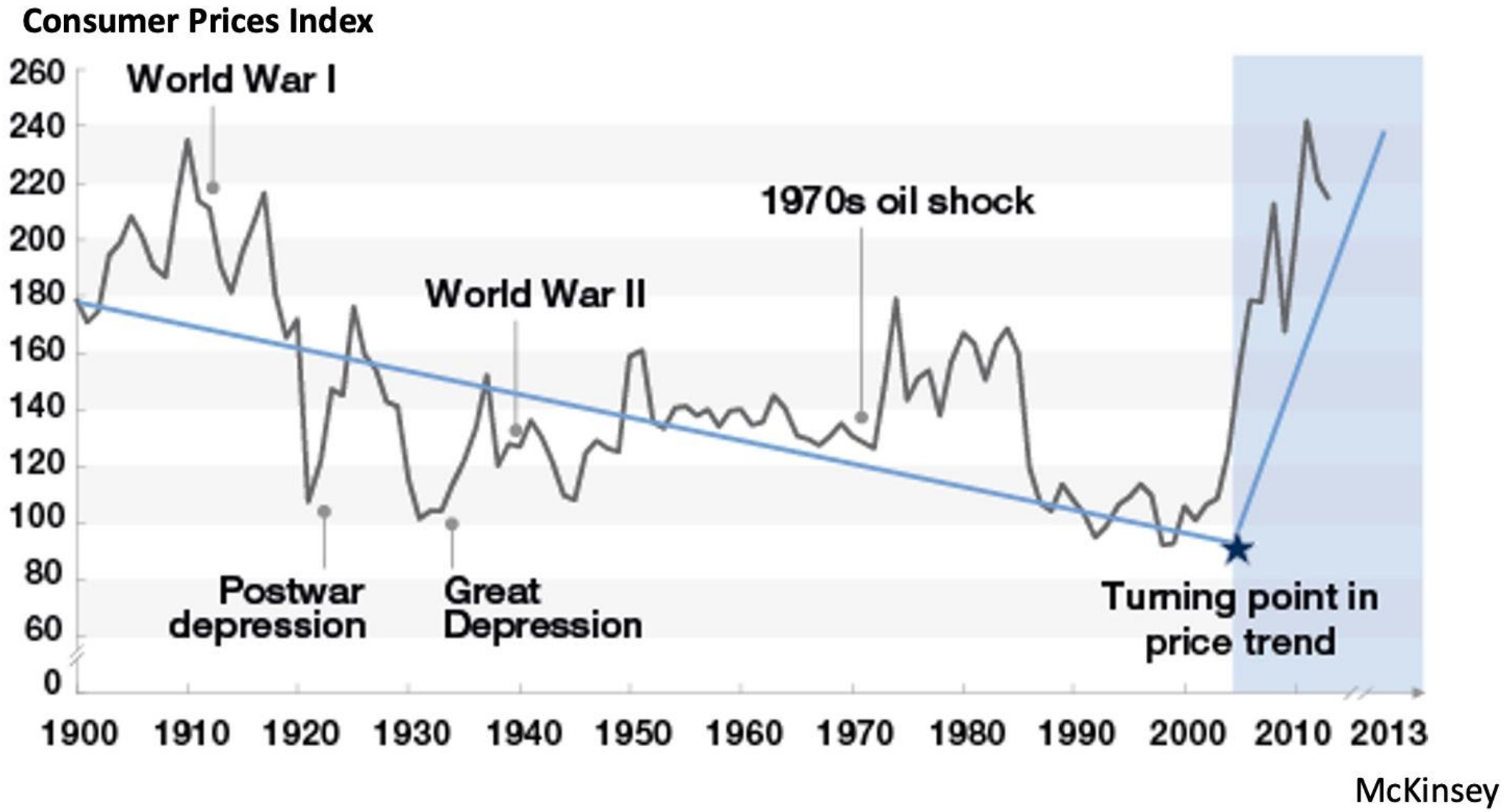
Agenda - example

Time	Description
5 mins	The Circular Economy
5 mins	The Need for Metrics
20 mins	Leading Circularity Indicators
10 mins	CE in Chemical Engineering
20 mins	Questions

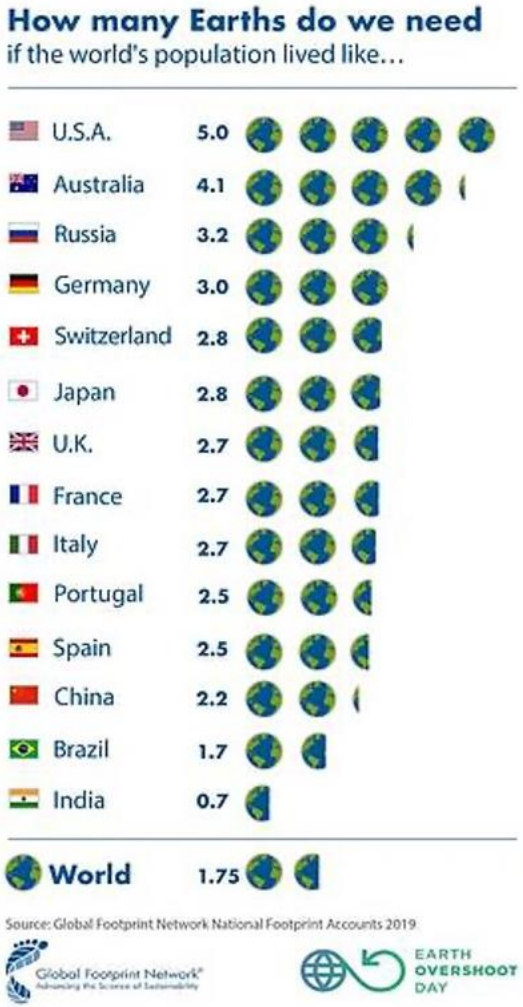


Understanding the Circular Economy

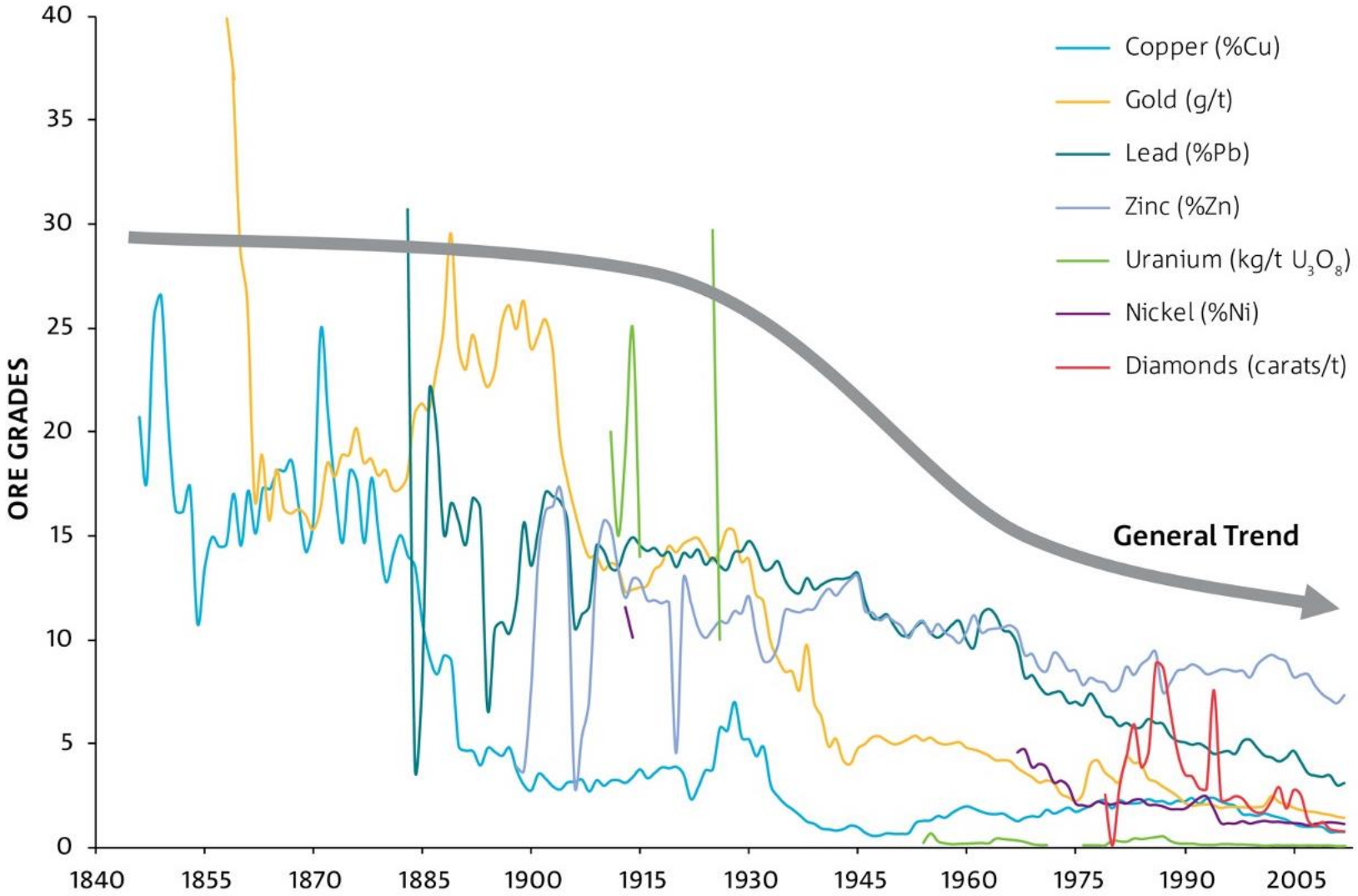
Market Volatility & Growing Demand



Growing demand for resources



Decreasing productivity



Source: G. Mudd, Monash University.

Not just metals

REUTERS®

World Business Markets Sustainability Legal More

Sand crisis looms as world population surges, U.N. warns

By Emma Farge

April 27, 2022 4:26 PM GMT+1 · Updated a year ago

Summary

- Global sand use hits 50 bln tonnes a year
- Sand is the second-most exploited natural resource
- UN report calls for new rules on sand mining
- Some rivers flow backwards, deltas sink

GENEVA, April 26 (Reuters) - A U.N. report on Tuesday called for urgent action to avert a "sand crisis," including a ban on beach extraction as demand surges to 50 billion tonnes a year amid population growth and urbanisation.

Sand is the most exploited natural resource in the world after water, but its use is largely ungoverned, meaning we are consuming it faster than it can be replaced by geological processes that take hundreds of thousands of years, the U.N. Environment Programme (UNEP) report says. read more

Timber shortage crisis far from over

May 18, 2022 Market Insight, News

The Confederation of Forest Industries (Confor) recently warned that the UK faces declining supplies of home grown wood due to lack of productive tree planting. With the country currently needing to import over 80% of its wood requirement, the UK could be sleepwalking into a timber shortage crisis in the not too distant future. Stuart Goodall, Chief Executive, Confor, examines the threats to supply and why the UK must urgently move productive tree planting up the agenda.

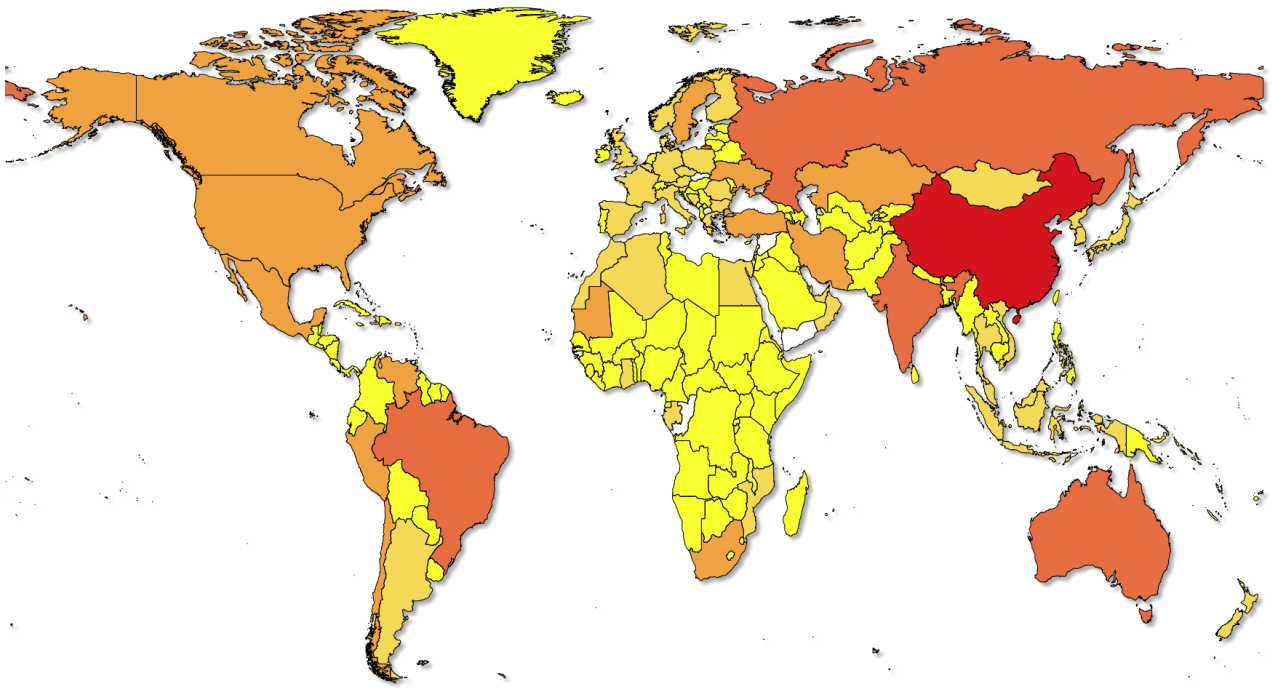
Beyond the UK, it is estimated by the World Bank that global demand for wood products will treble by 2050, driven by an increased population of 7.8bn today, to 10bn in less than 30 years.[4] This huge increase is being driven primarily by higher living standards, greater urbanisation – including China's almost inexhaustible need for timber for both construction and manufacturing – and greater use of what is increasingly seen as a more sustainable building material.

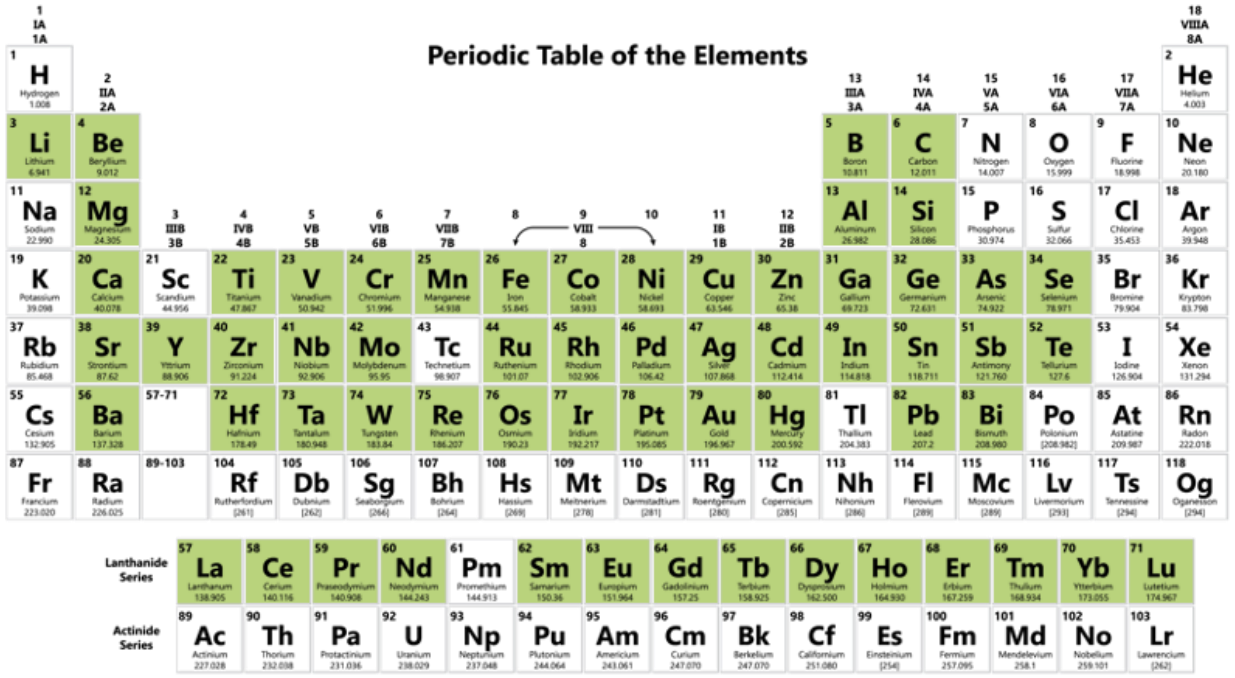
These trends are being compounded at a time when a number of other global developments are coalescing. In particular, security of supply of natural resources is under ever greater threat from geo-political upheavals, as witnessed by the Russian-Ukrainian crisis and soaring energy prices. While the UK may not be directly affected by Vladimir Putin's incursion into Ukraine – overall Russian timber imports into the UK are relatively small at only 1.25%[5] – Russia remains the world's largest supplier of timber globally. With potentially longer-term economic sanctions placed against Russian exports, there will inevitably be significant disruption to supply chains, price hikes and pressure on countries typically supplied by Russia, Ukraine and Belarus, to seek building material imports from other sources – including those Scandinavian countries that the UK relies upon so heavily.

Chemicals Regulations

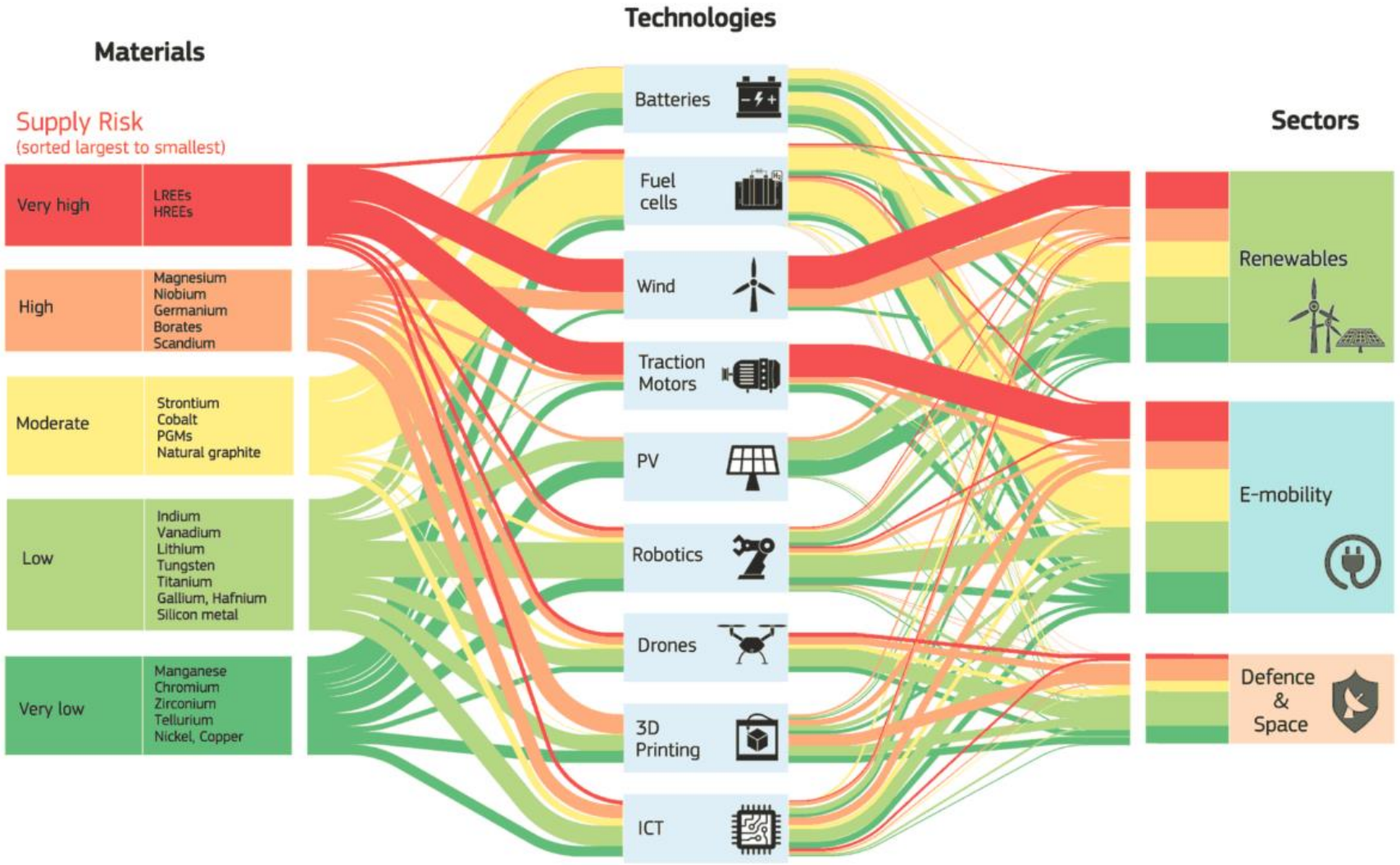
Monopolistic supply

Global (non –fuel) mineral production, tons, 2011



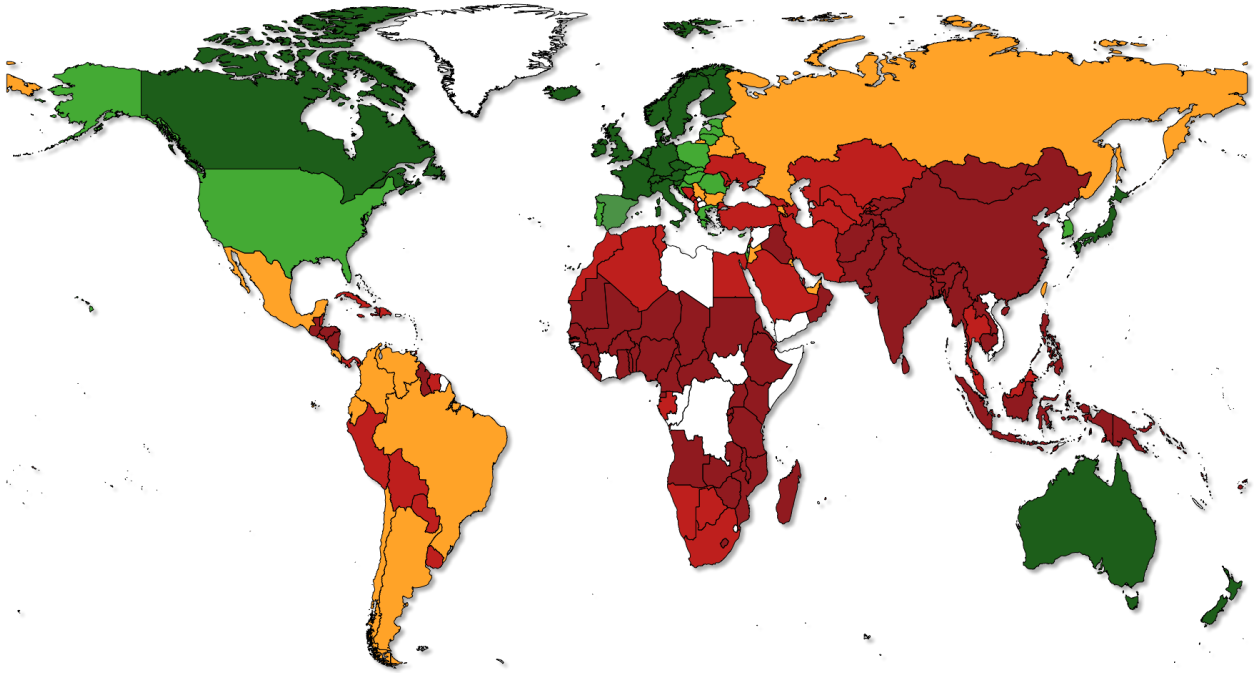


Resource nationalism

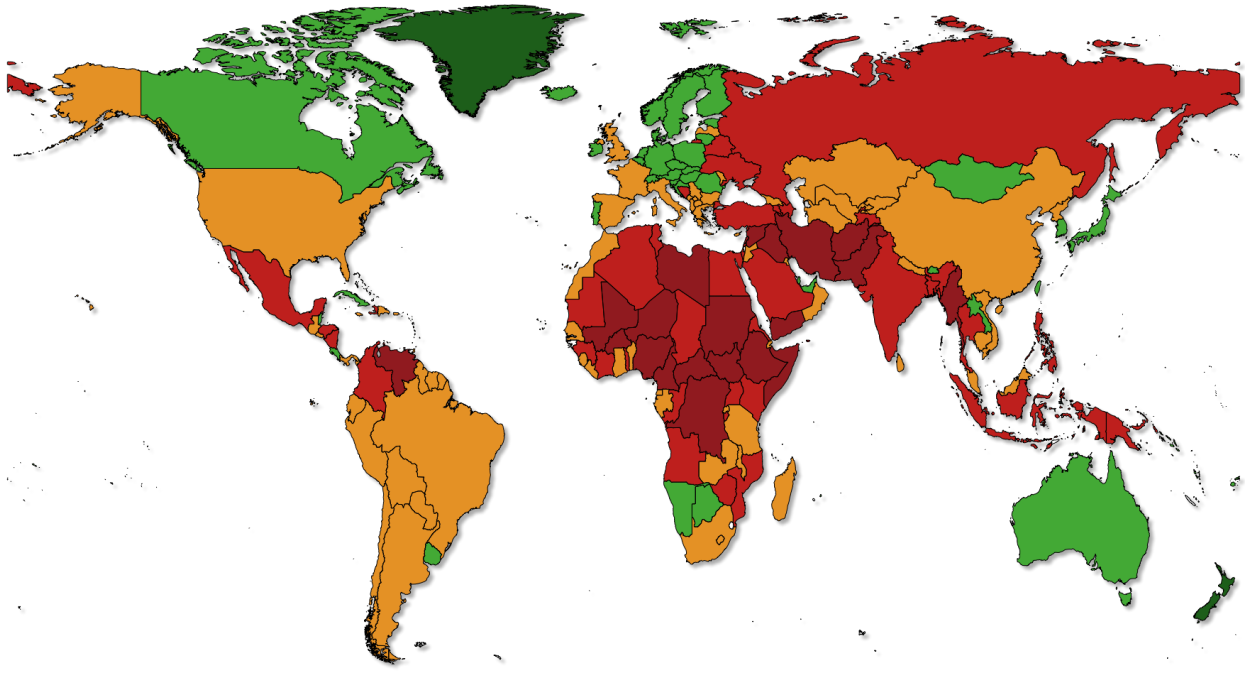


Regional Supply risks

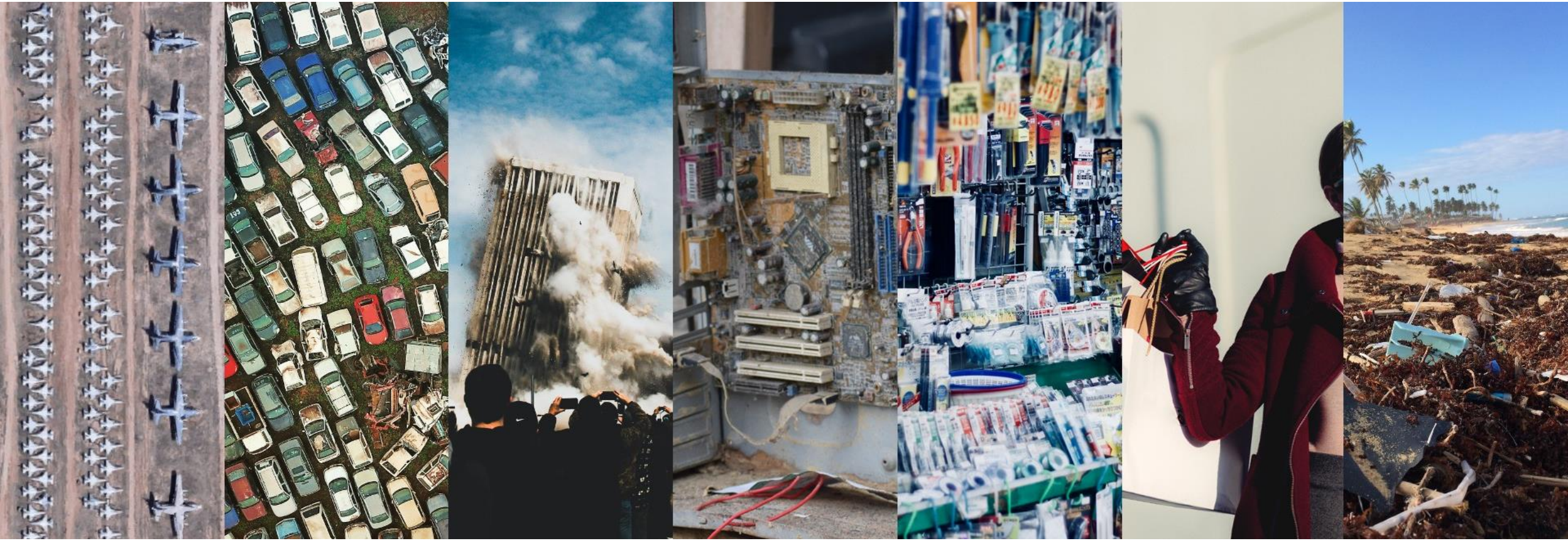
Environmental Performance Index, Yale



World Bank, Political Stability/No Violence



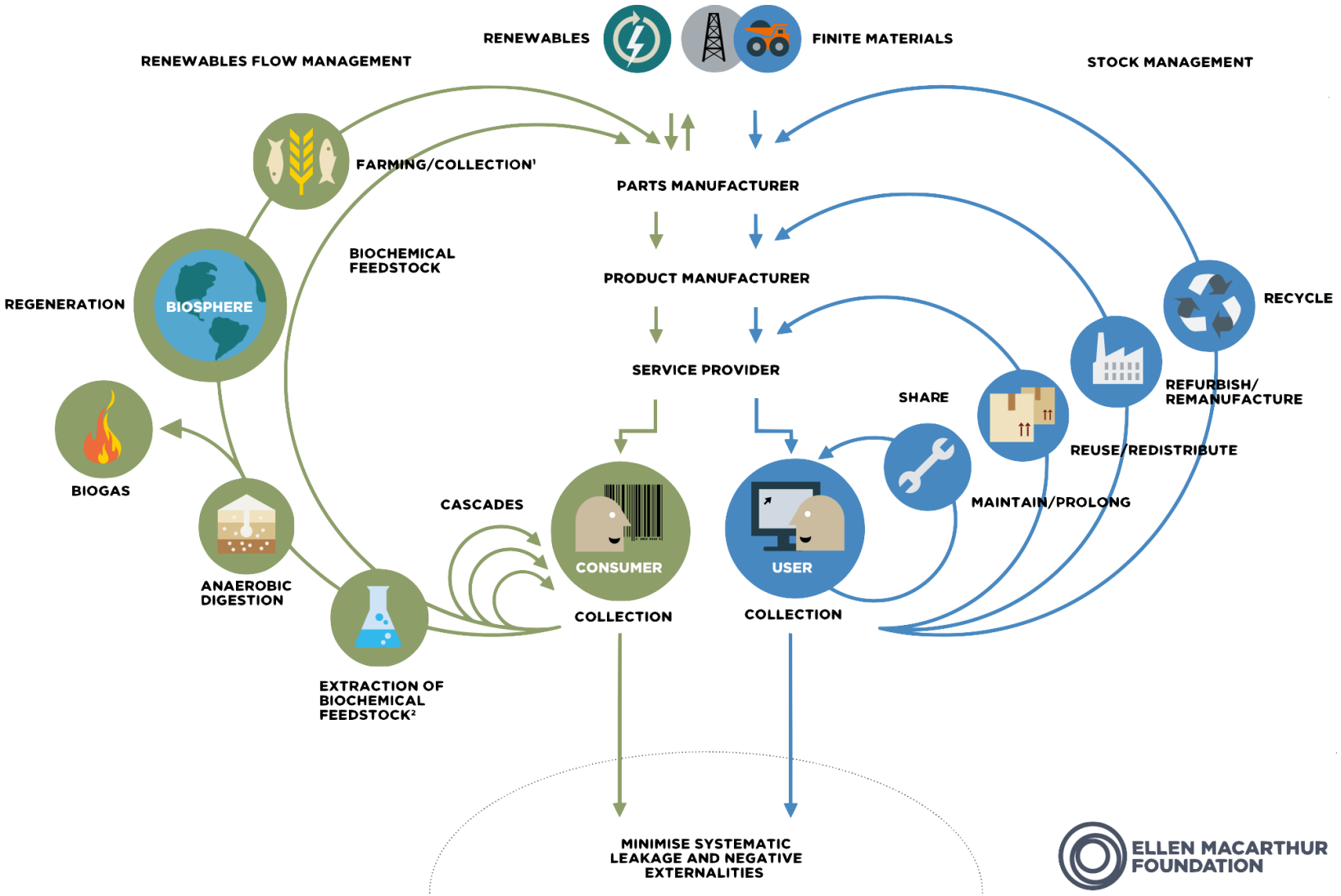
And we're incredibly wasteful...



Take → Make → Dispose

(Massive loss of Value)

US $4.5 Trillion Global Opportunity



Decouple growth from consumption

- Design out waste & pollution
- Keep products & materials in use
- Regenerate natural systems

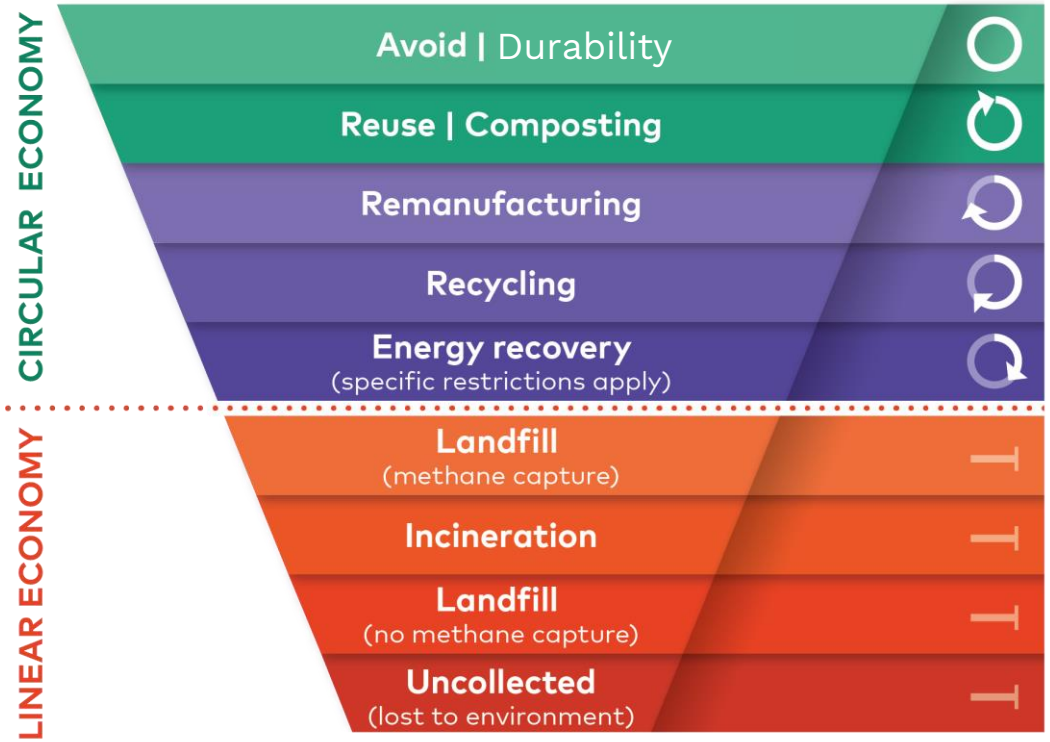
Renewable Energy

- Burning fossil fuel is not circular

Less Bad → More Good

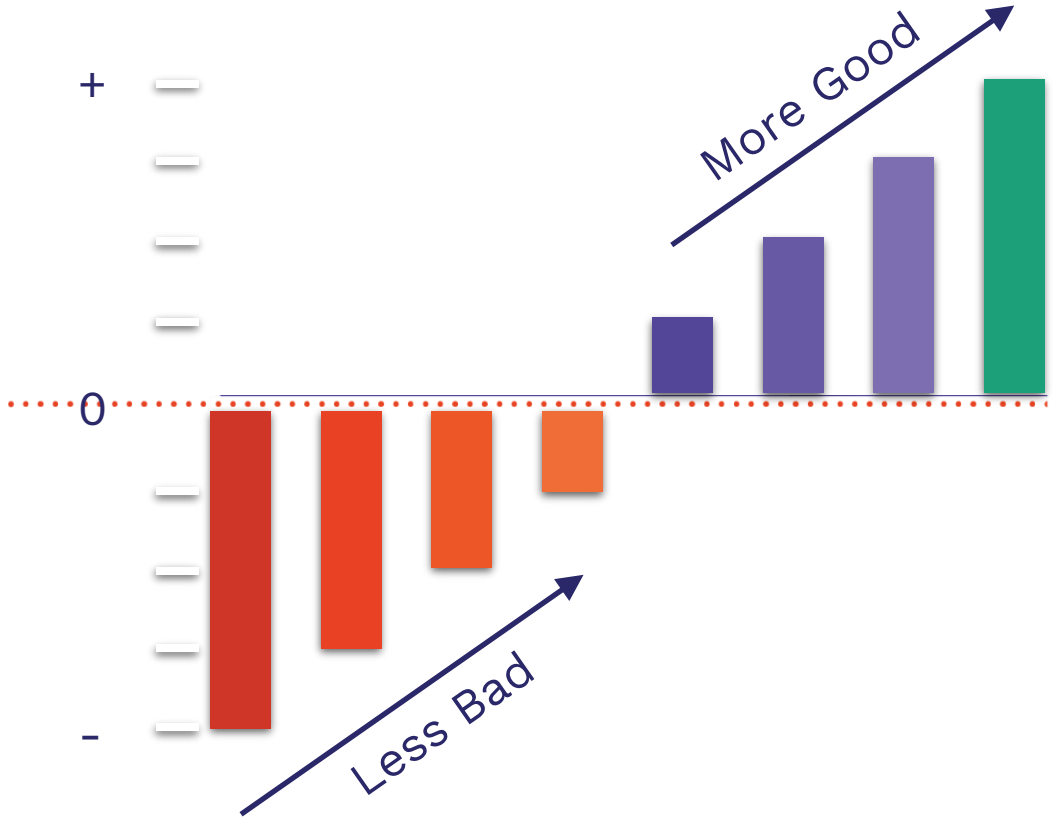
Hierarchy aligns with value retention & creation

Circular

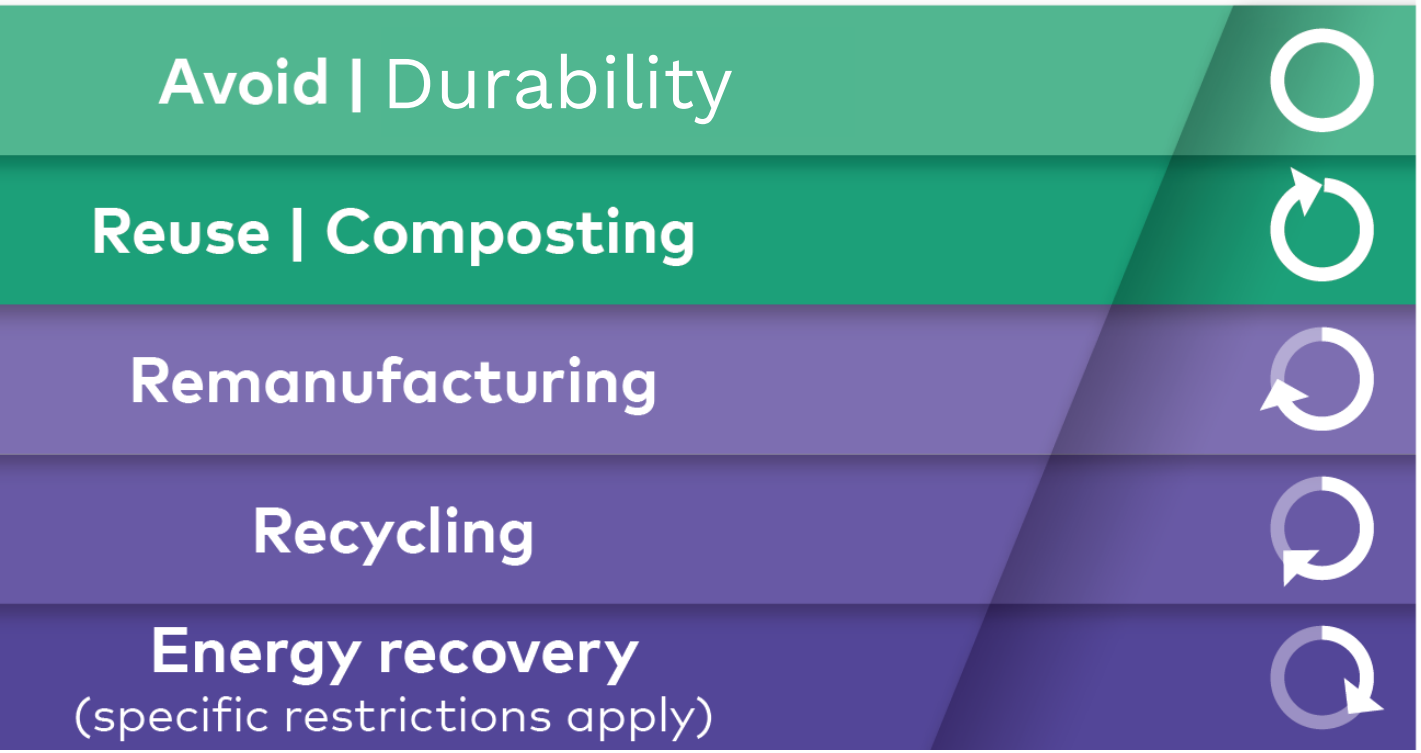


Economy

(also, Environment & Equity)



Where is value created in your products?



Source of Value	Relative Value
→ Installed Value	$$$$$
→ All Manufactured Value	$$$$
→ Most of Manufactured Value	$$$
→ Value of Materials	¢¢
→ Value of Energy	¢
• Cost of disposal	-$$$

A systems approach

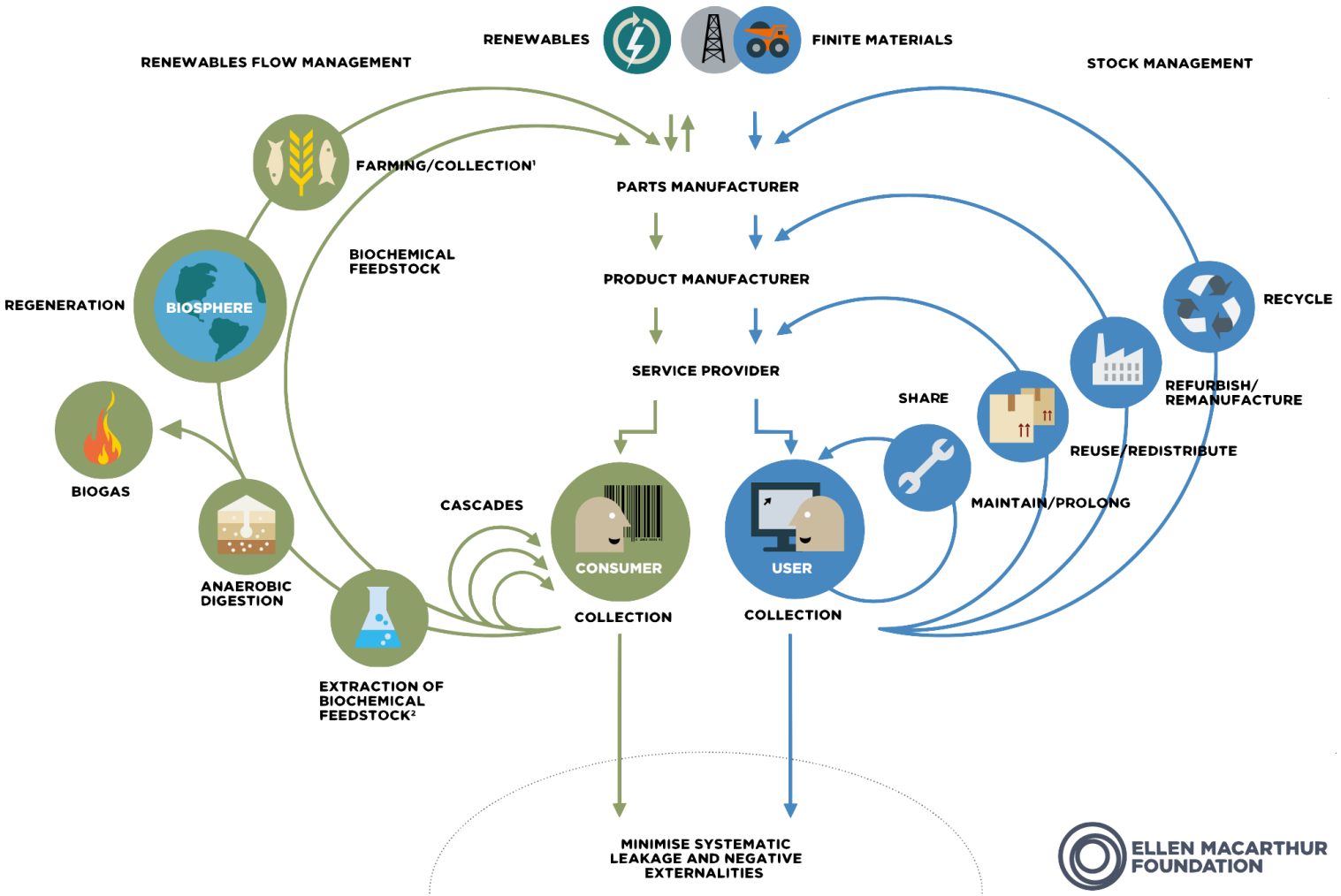
Provides a framework to optimize conflicting requirements

Rethink the systems we make in terms of the services they provide (Volume → Value)

A systems approach

The need for Circularity Metrics

What do we mean by ‘Circularity’?



‘Circular Economy System’

- What we’re trying to deliver
- Benefits of Circularity:
  - Economic (Direct/Risk)
  - Environmental
  - Social

‘Circularity’

- The flow of materials
- How we deliver the benefits
- How much we’ve decoupled growth from consumption & waste

Why do we need Circularity metrics?

Comparability

Circularity has multiple ‘levers’

- Design out materials
- Regenerative bio-materials
- Durability
- Shared Use (Utilisation)
- Reuse
- Remanufacturing
- Refurbishment
- Recycling
- Composting
- Energy Recovery (limitations)

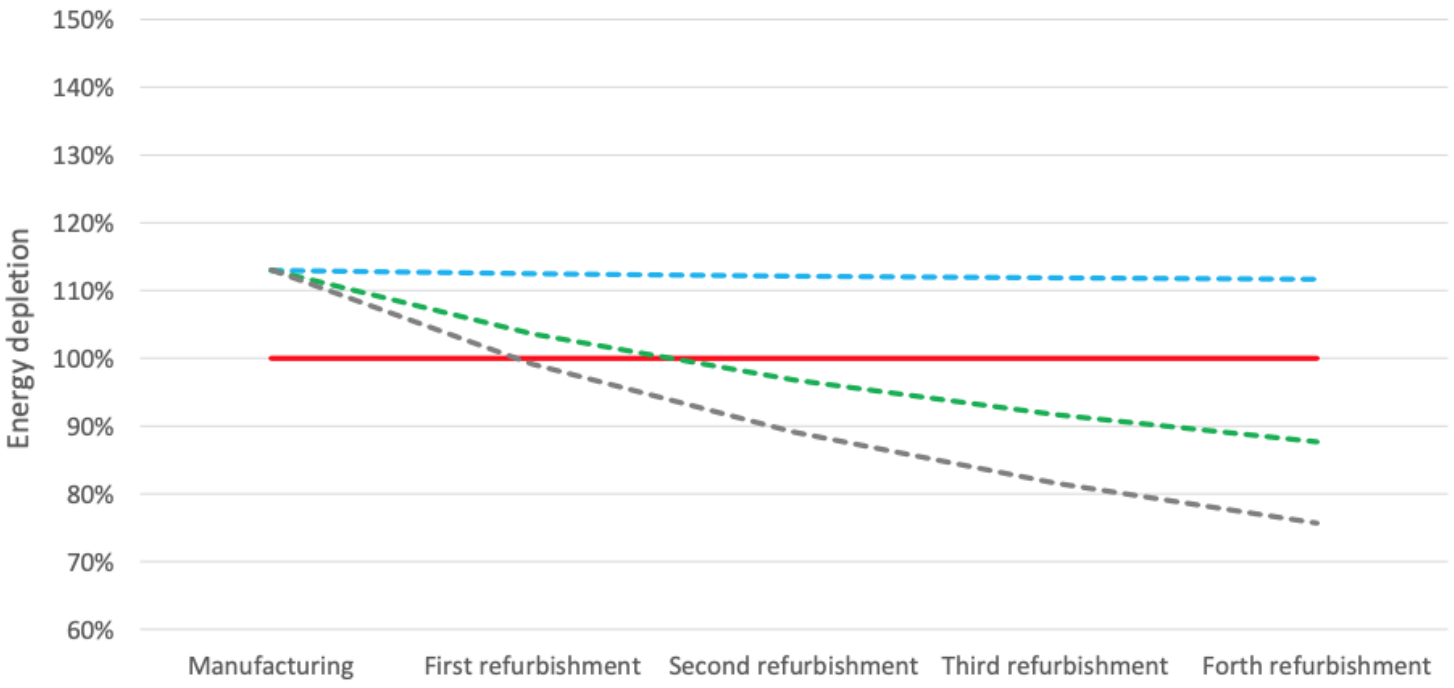
Can’t improve what you don’t measure

(Design, Benchmark, Evaluate, Market)

Optimizing the benefits from Circularity

(Economic, Environmental, Social)

Expand the boundaries

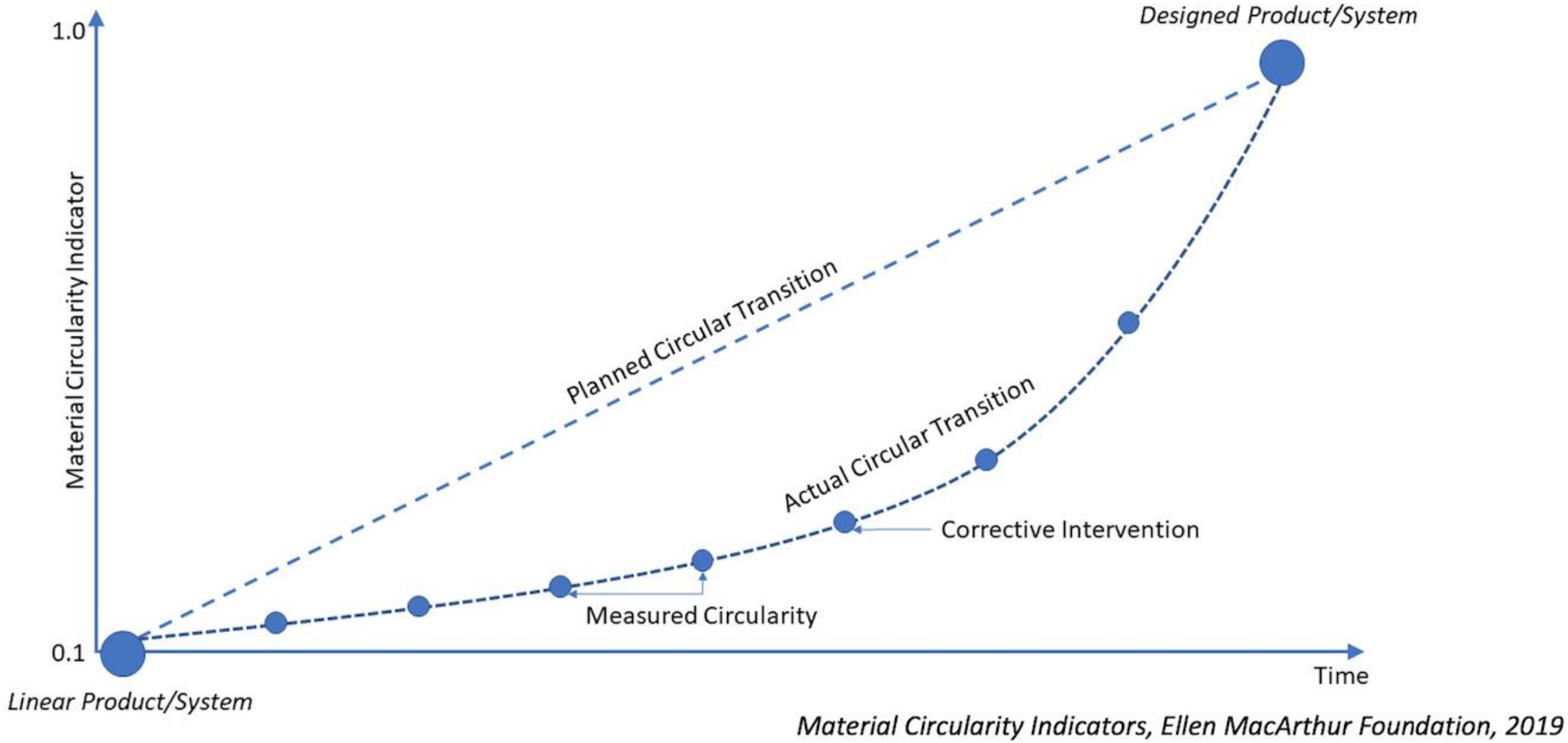


Circular systems may have larger initial impacts:

- More durable materials
- Modular designs
- More equitably sourced…

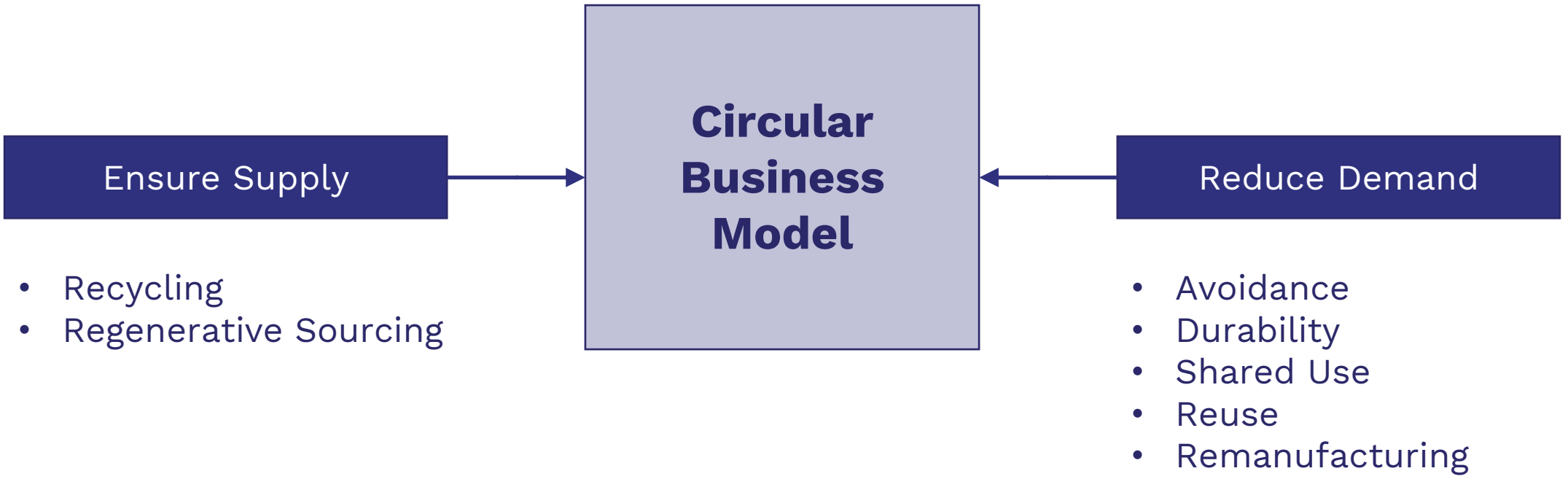
Need to consider longer term benefits & breakeven point.

Continuous improvement



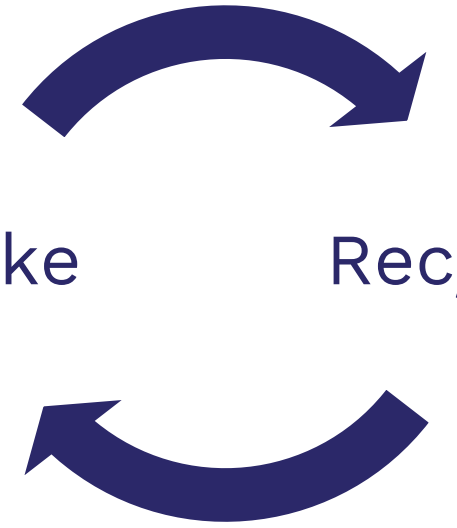
Material Circularity Indicators, Ellen MacArthur Foundation, 2019

Supply or Demand oriented?



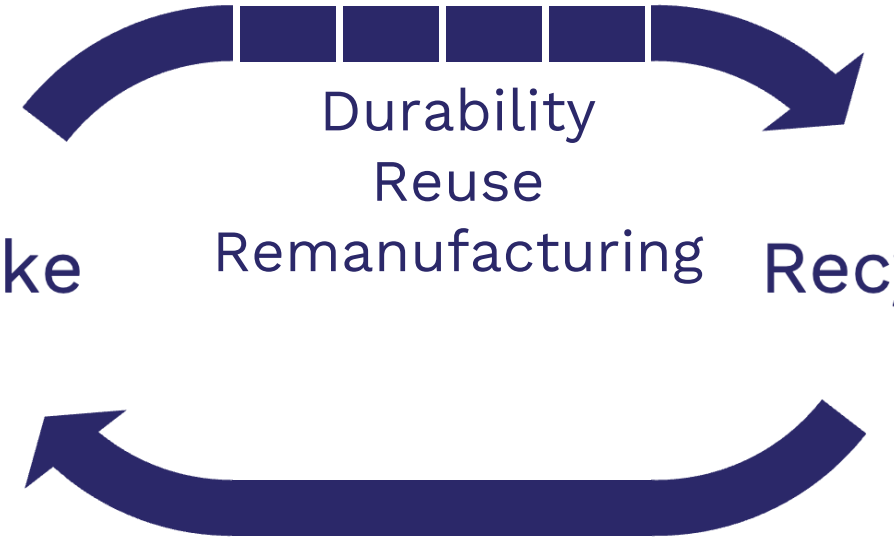
Supply or Demand Led Interventions

Supply Led
(Maintain flows)



0% → 15% recycled content

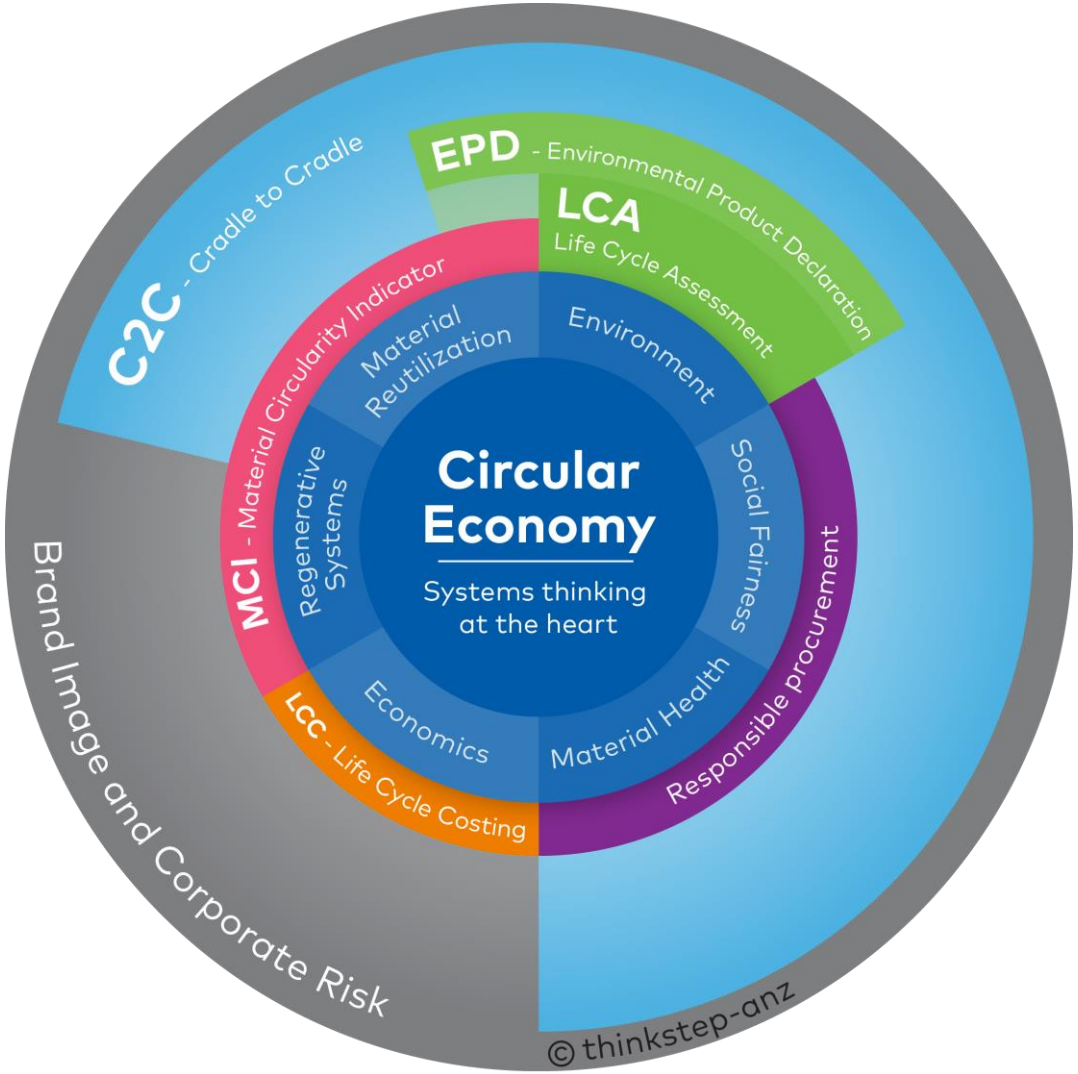
Demand Led
(Reduce flows)



12 → 13 months Use

Each give 7.5% circularity
(Together 15%)

Systems approach, a combination of metrics

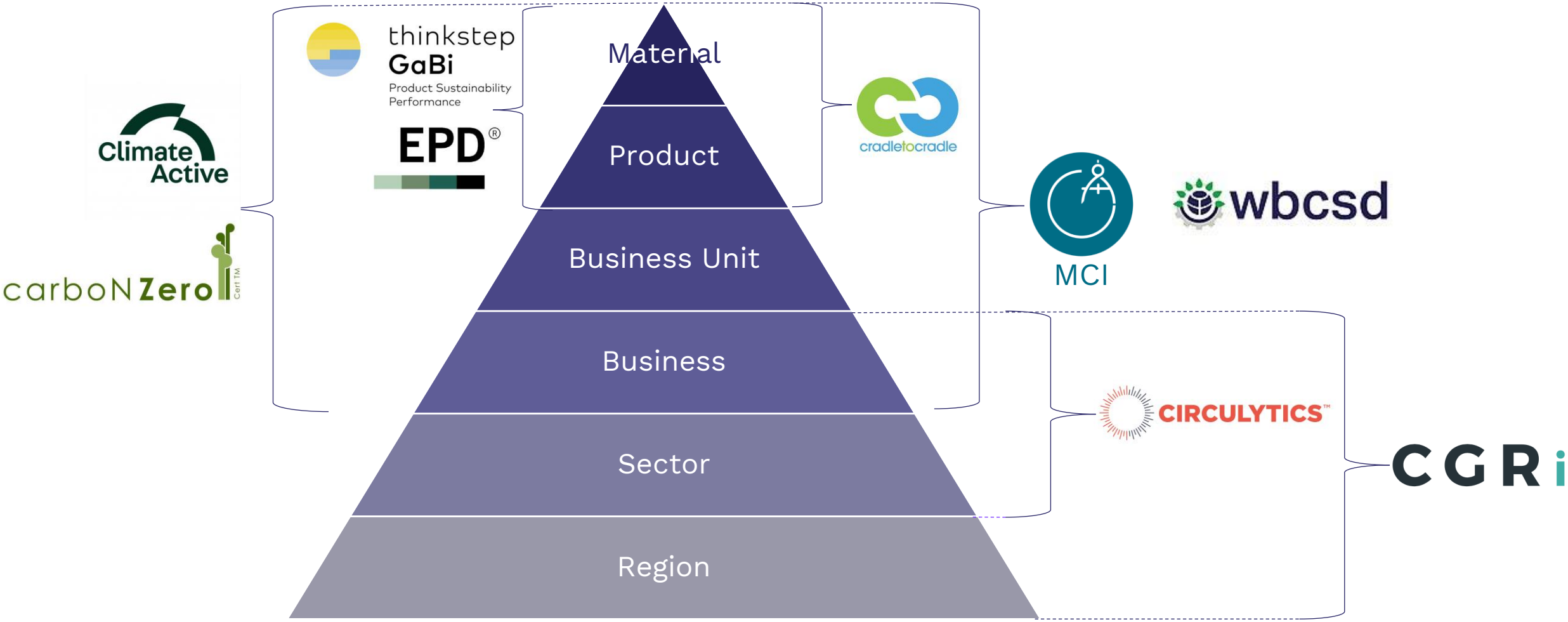


Leading Circularity Metrics

Metrics at different scales

Complementary Metrics

Circularity Metrics



ISO 59020 – Due out soon

Material Circularity Indicator (MCI)

Leading Circularity Metrics

Material Circularity Indicator (MCI)

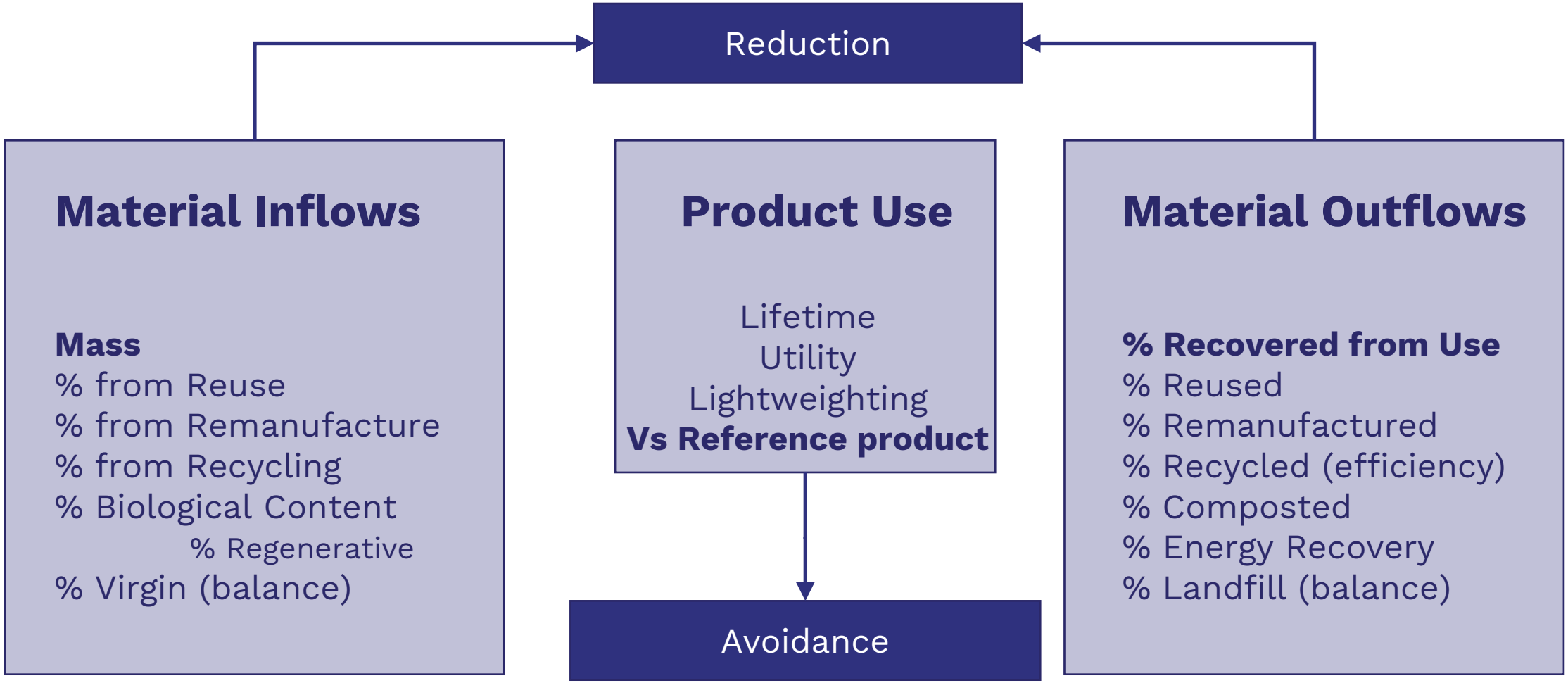
Timeline:

2013 – Started Development
2015 – First published
2019 – Updated (bio-materials)

Participants:

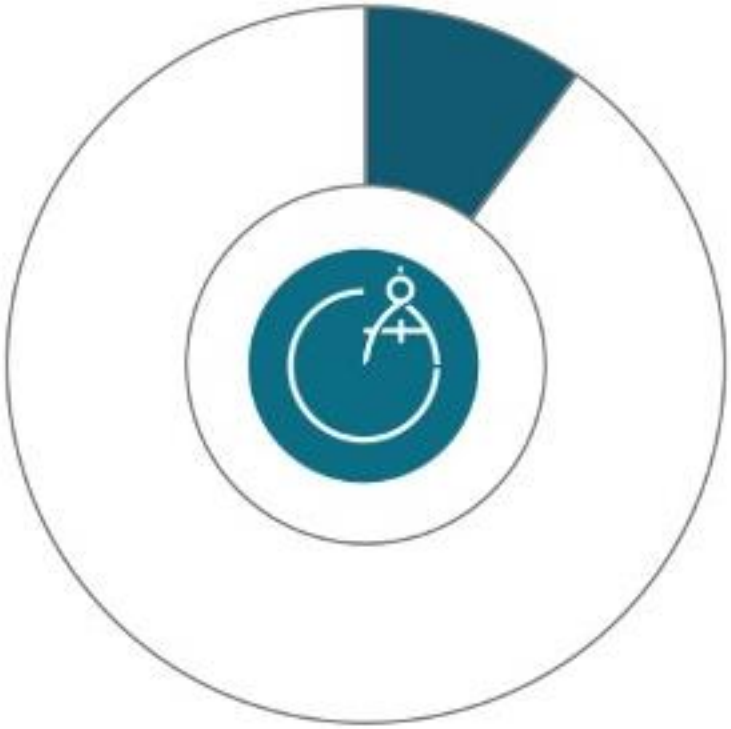
Businesses
Investors
Universities
Government bodies
Regulators
NGO’s

Three components



Material Circularity Indicator (MCI)

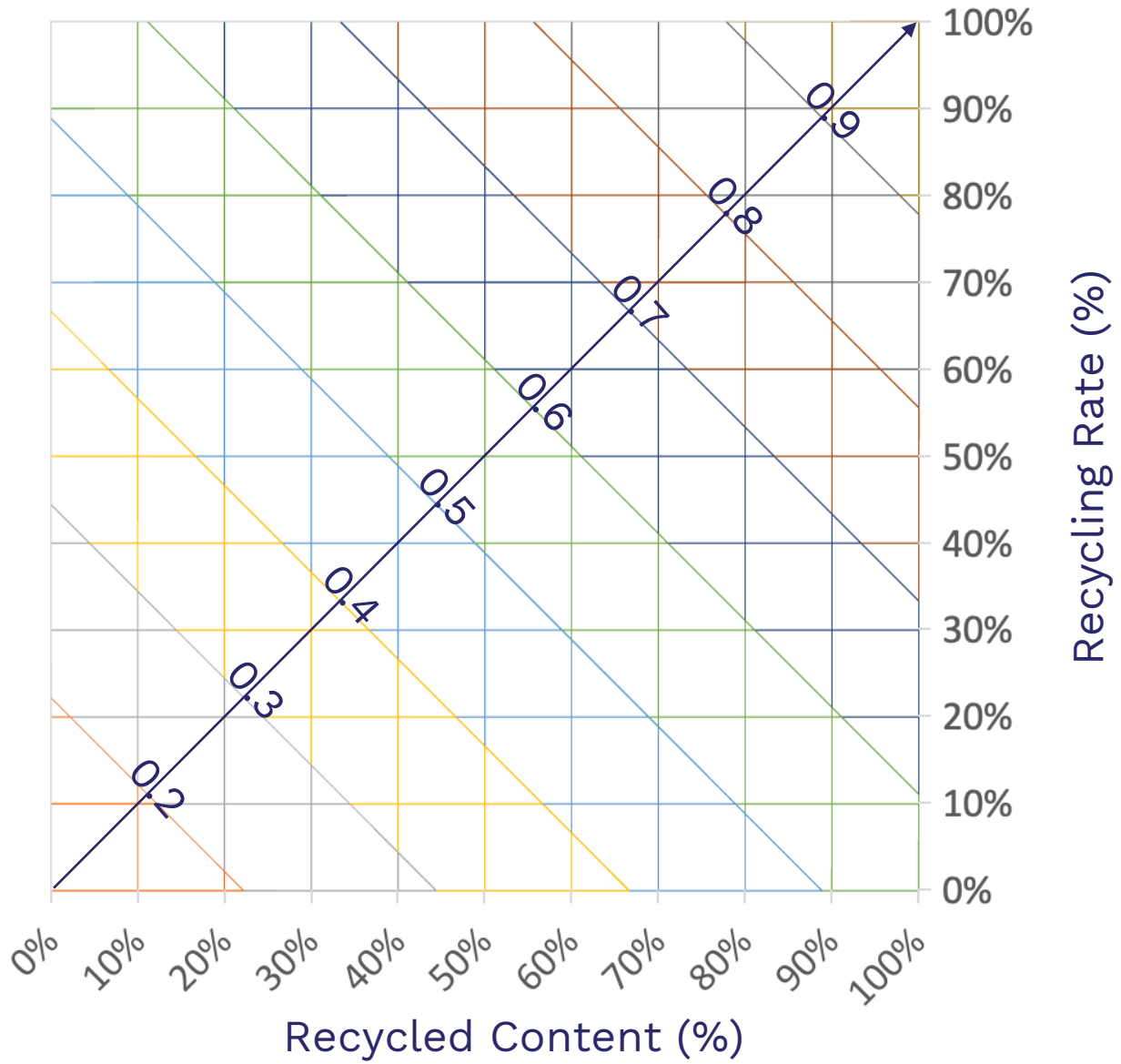
Single Metric



MCI = 0.1
Linear

MCI = 1.0
Circular

MCI for recycling



Caution:

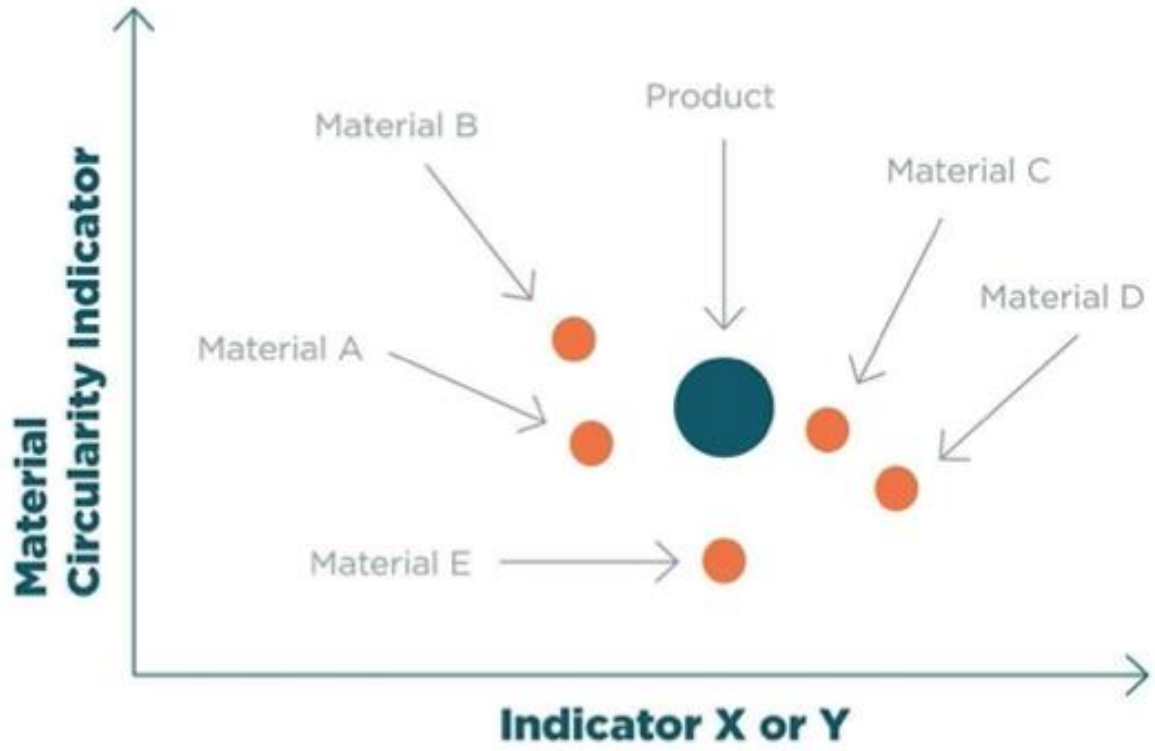
This diagram is simplistic

- Only illustrates recycling

- Regenerative content (100%)
- Composting (100%)
- Reuse (100%)
- Remanufacturing (95%)
- Reuse/Durability (Linear/n)
- Recycling (Varies)
- Energy Recovery (45%)*

Material Circularity Indicator (MCI)

Example:	Indicator X	Indicator Y	etc...
Product risk:	XX	YY	
Materials breakdown:			
Material A	XX	YY	
Material B	XX	YY	
Material C	XX	YY	
etc...			



Identify Hotspots & Priorities

Where to find it

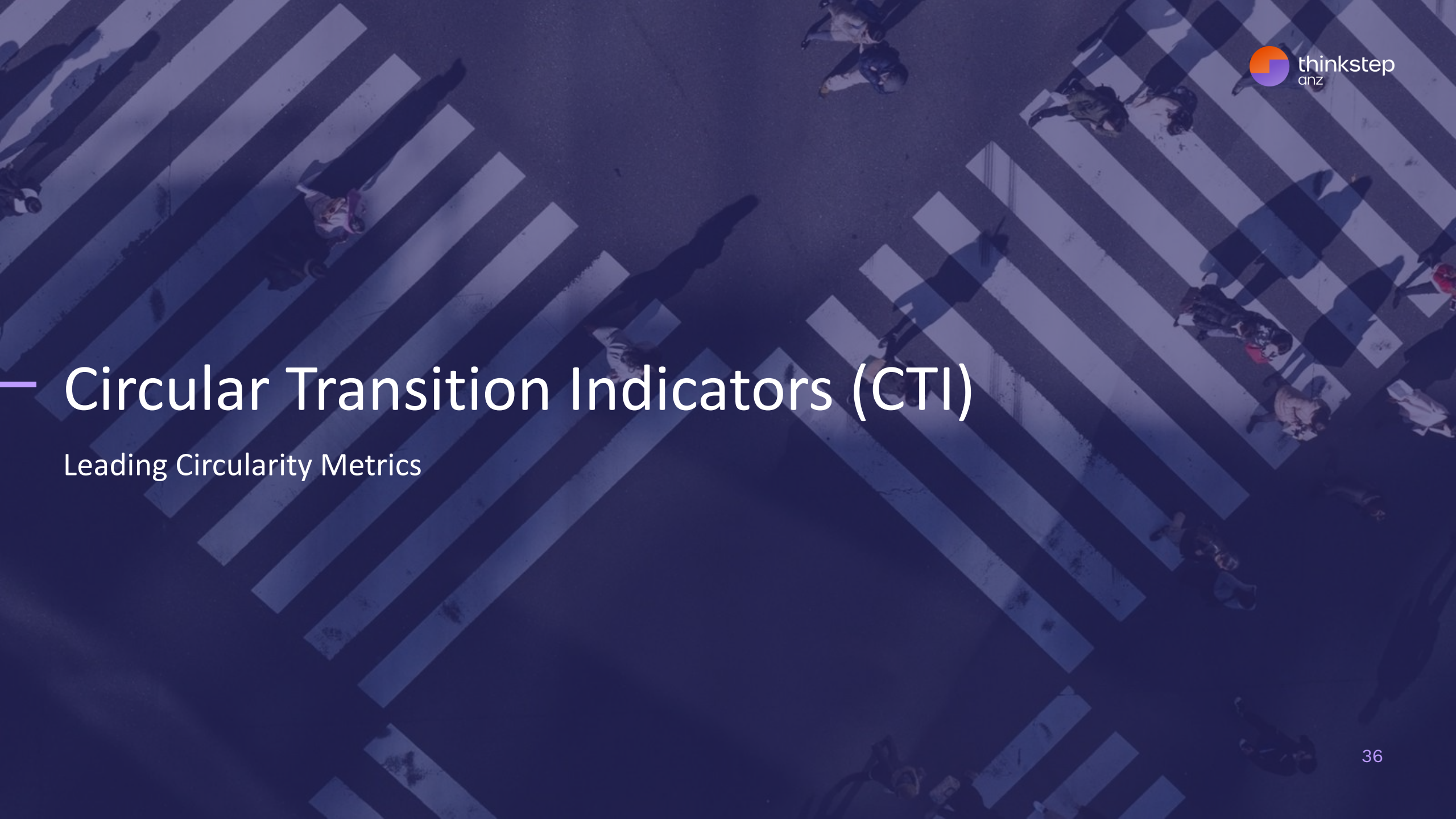
All of the main LCA packages

- Gabi
- Simapro
- OpenLCA

Being published alongside EPD's, ISC credits…

Free calculator also on our website:

https://www.thinkstep-anz.com/services/product/material-circularity-indicator-mci-calculator/



Circular Transition Indicators (CTI)

Leading Circularity Metrics

The challenge

→ Numerous metrics
→ Lack of consistency

→ common framework to measure circular performance

CTI TOOL

wbcsd

Created CTI Framework

GREENHOUSE GAS PROTOCOL

GhG Protocol is the standard globally

SUPPORTING STANDARDS:

GRI Empowering Sustainable Decisions

ISO

In alignment with:

GRI Empowering Sustainable Decisions

CIRAIG

CIRCLE ECONOMY

ELLEN MACARTHUR FOUNDATION

MVO NEDERLAND

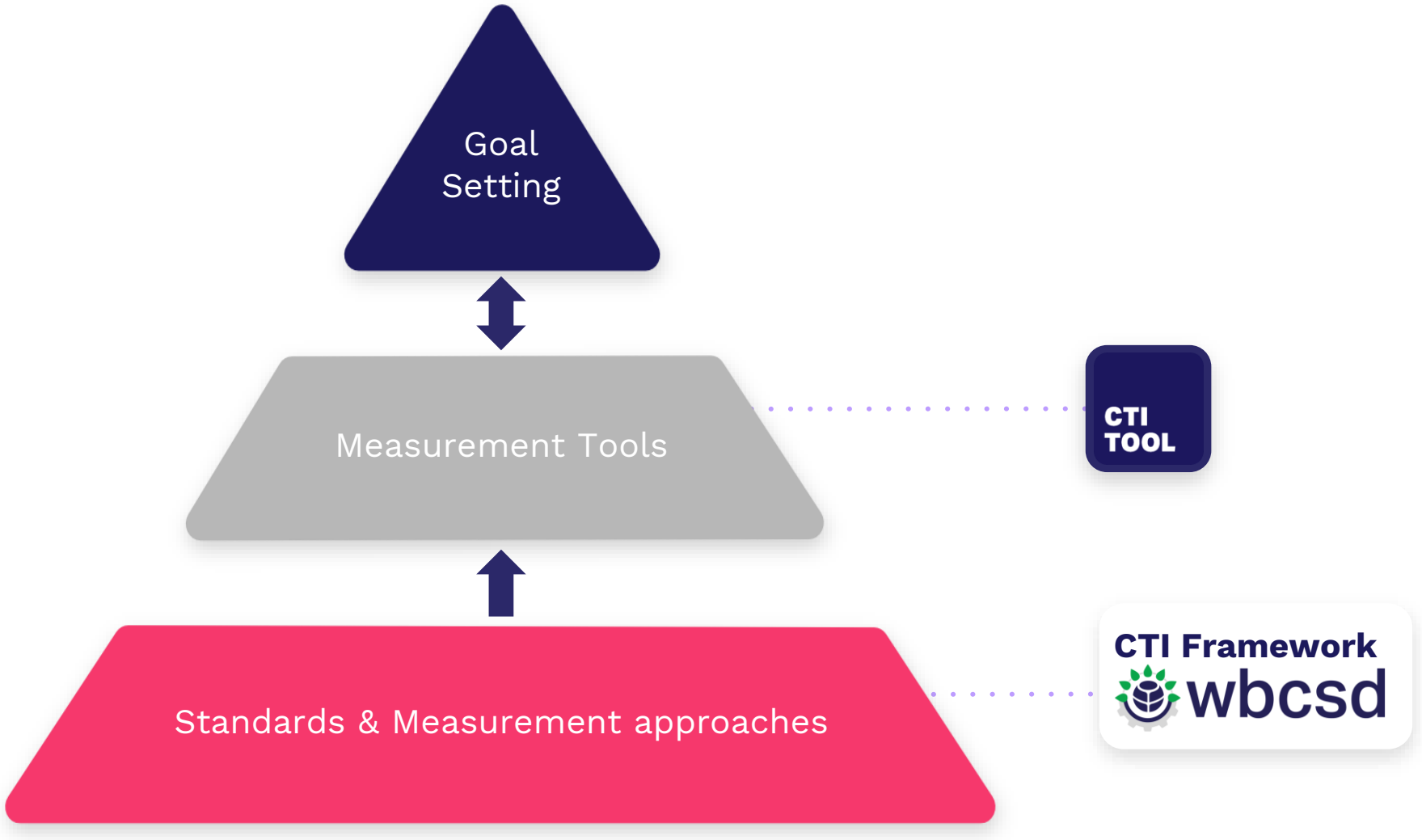
CRADLE TO CRADLE PRODUCTS INNOVATION INSTITUTE

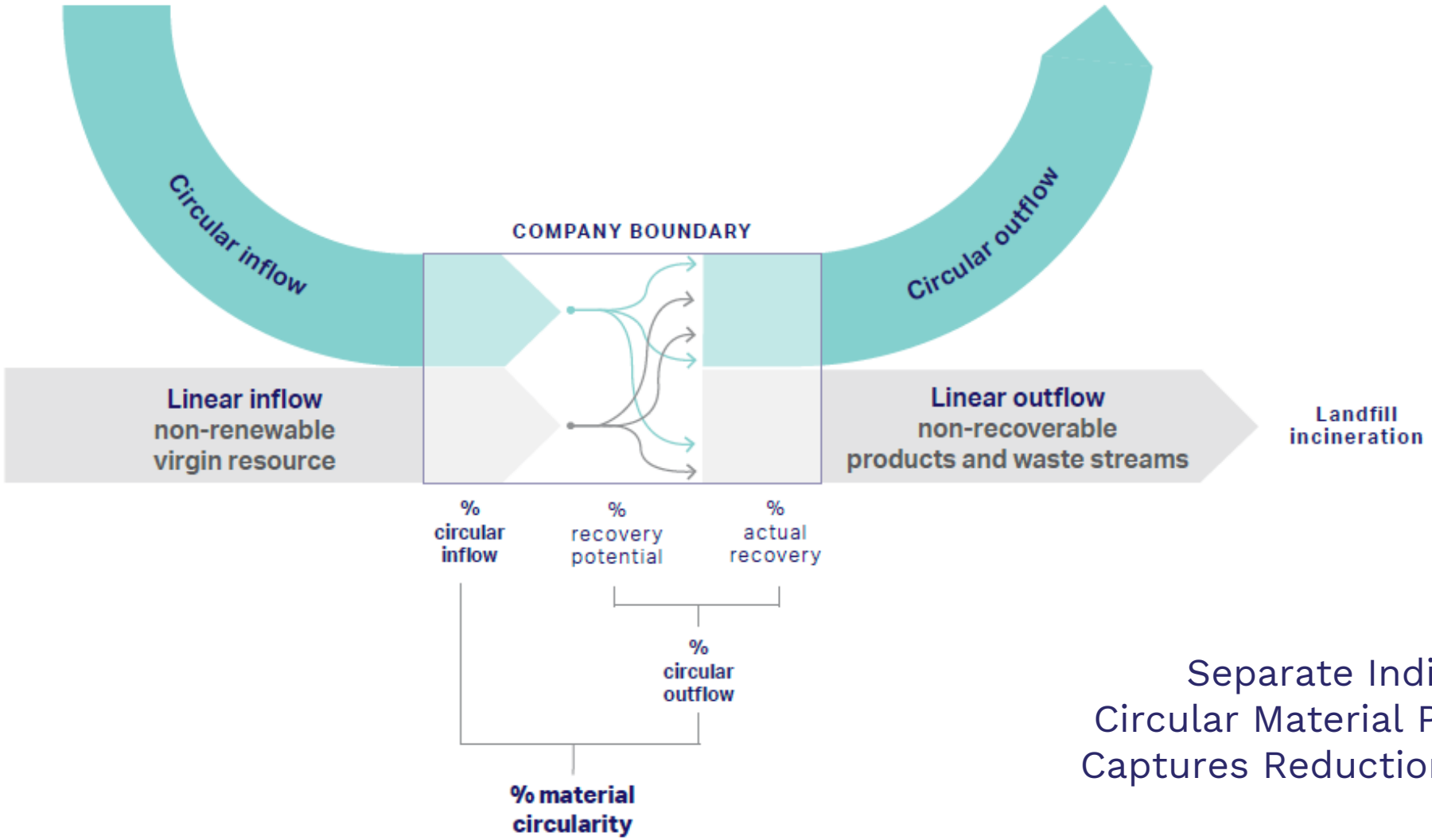
PACE Platform for Accelerating the Circular Economy

SITRA

GRI 301, ISO 14021 & ISO 20400

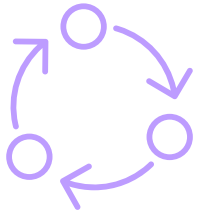
WBCSD and Circular IQ





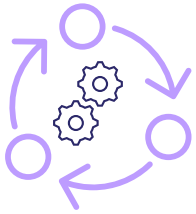
Separate Indicator
Circular Material Productivity
Captures Reduction Strategies

CTI Indicators



Close the loop

- % material circularity
- % water circularity
- % renewable energy



Optimize the loop

- % critical material*
- % recovery type
- Actual lifetime

*** OPTIONAL**

Value the loop

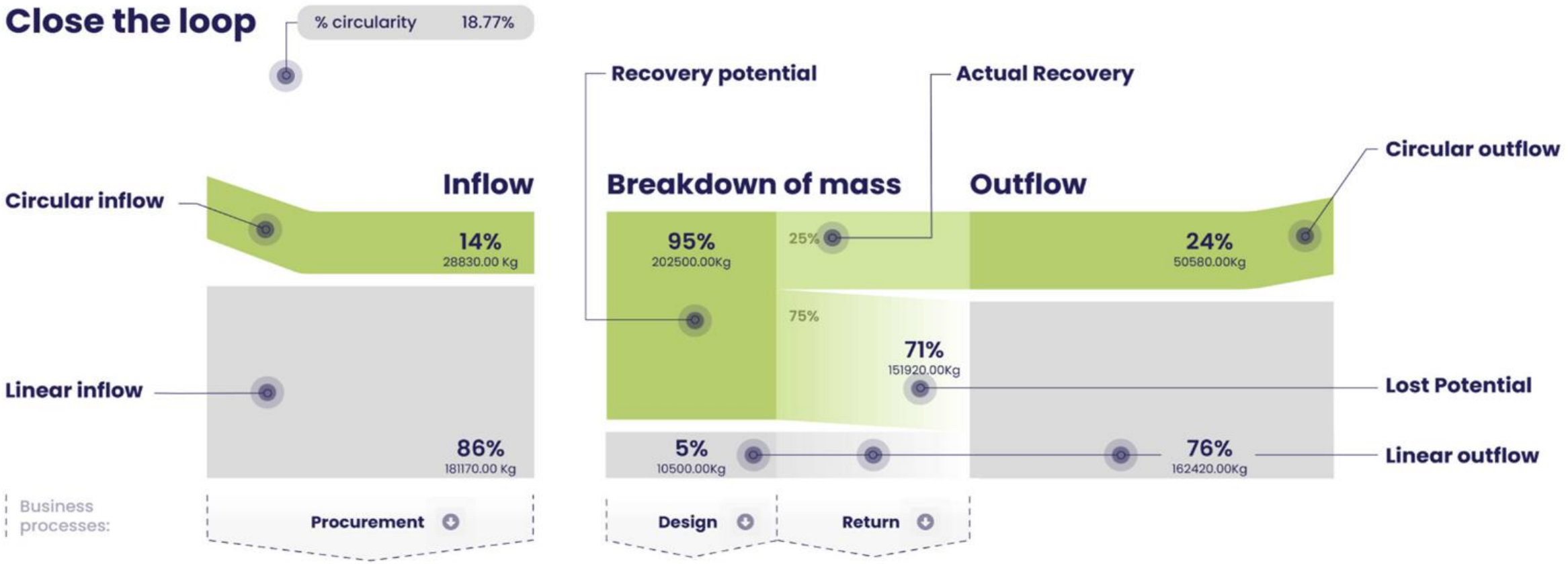
- Circular material productivity
- CTI revenue

OPTIONAL

Impact of the loop

- GHG impact

Example of “Close the loop” as an indicator



How circular is the sourcing of the resources, materials, products and parts?

How does the company design products to maximize recovery potential?

How much of the outflow does the company actually recover?

Where to find it

CTI Tool available from:

https://ctitool.com

List of Implementation Partners here:

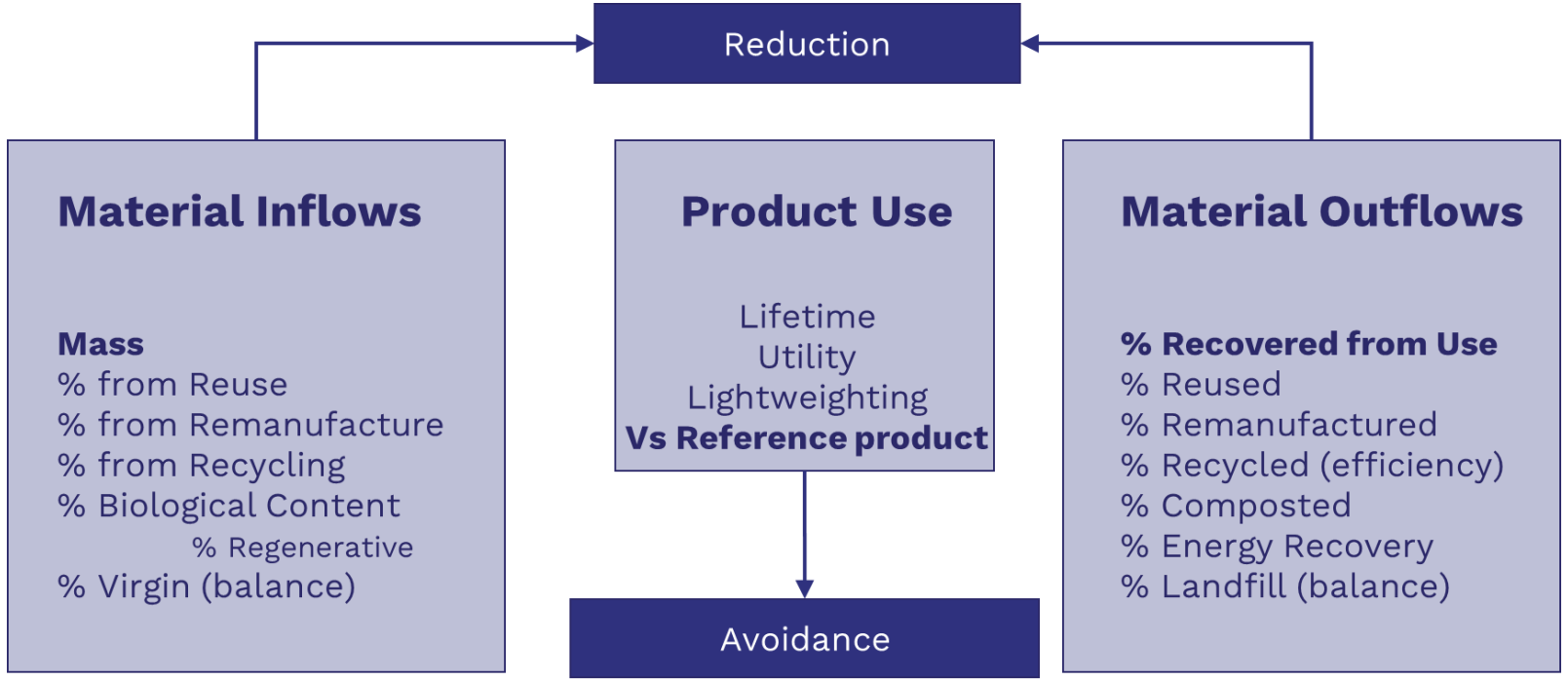
https://www.wbcsd.org/Programs/Circular-Economy/Implementation-partners-profiles

Trained to help you implement CTI

(Or you can speak to me afterwards!)

CE in Chemistry

What do we need to be thinking about?



Reduction

- Waste as feedstock (Industrial Symbiosis)
- Chemical Recycling
- Re-refining
- Regenerative Bio-based

Avoidance

- Less but higher performance
- Service life extension
  - Filtration
  - Catalysts
- Service-based models(e.g. leasing)
- Low water processes

Example: Corrosion Inhibitors

Circularity:

- Service life extension

Potential Pitfalls:

- Mass of inhibitor vs concrete

Other indicators:

- Economics
- Toxicity
- Carbon footprint

Photo: Uve Sanchez, Unsplash

Example: Timber preservatives

Circularity:

- Service life extension
- Regenerative sourcing
- Composting

Potential Pitfalls:

- Toxicity

Other indicators:

- Economics
- Toxicity
- Carbon footprint

Photo: Jack Blueberry, Unsplash

Example: Microdosing Fertilisers

Circularity:

- Lightweighting
- Composting

Potential Pitfalls:

- Cost (time/labour)
- Energy/CO_2

Other indicators:

- Economics
- Toxicity
- Carbon footprint
- Supply risks

Photo: Jason Blackeye, Unsplash

Example: Coolant Filtration

Circularity:

- Service life extension
- Product-as-a-Service

Potential Pitfalls:

- Quality
- Guarantees
- Sales of Consumables

Other indicators:

- Economics
- Carbon Footprint
- Toxicity

Photo: Jelifer Maniago, Unsplash

Example: Bacterial Seperation of Metals

Circularity:

- Lightweighting
- Regenerative production
- Composting

Potential Pitfalls:

- Efficiency
- Toxicity
- Biodiversity

Other indicators:

- Economics
- Carbon Footprint
- Toxicity

Photo: CDC, Unsplash

Example: Paint Recovery

Circularity:

- Recycling

Potential Pitfalls:

- Economics
- Quality
- Reverse Logistics

Other indicators:

- Economics
- Carbon Footprint
- Toxicity

Photo: Taelynn Christopher, Unsplash

Example: Self-healing Coatings

Circularity:

- Service life extension
- Lightweighting
- Product-as-a-Service

Potential Pitfalls:

- Economics
- Quality
- Toxicity

Other indicators:

- Economics
- Carbon Footprint
- Toxicity

Photo: Hortensia Siamese, Unsplash

Example: Simplification

Circularity:

- Recycling
- Recycling Efficiency
- Stewardship Scheme

Potential Pitfalls:

- Aesthetics
- Performance
- Cost
- Behaviour change
- Reverse logistics

Other indicators:

- Economics
- Carbon Footprint

Photo: Adidas FUTURECRAFT.LOOP

Example: Digital Product Passports

Circularity:

- Enabler for downstream circularity
- Reuse
- Remanufacturing
- Recycling

Potential Pitfalls:

- Transparency
- Cost
- Logistics & Standards

Other indicators:

- Economics
- Various – application specific

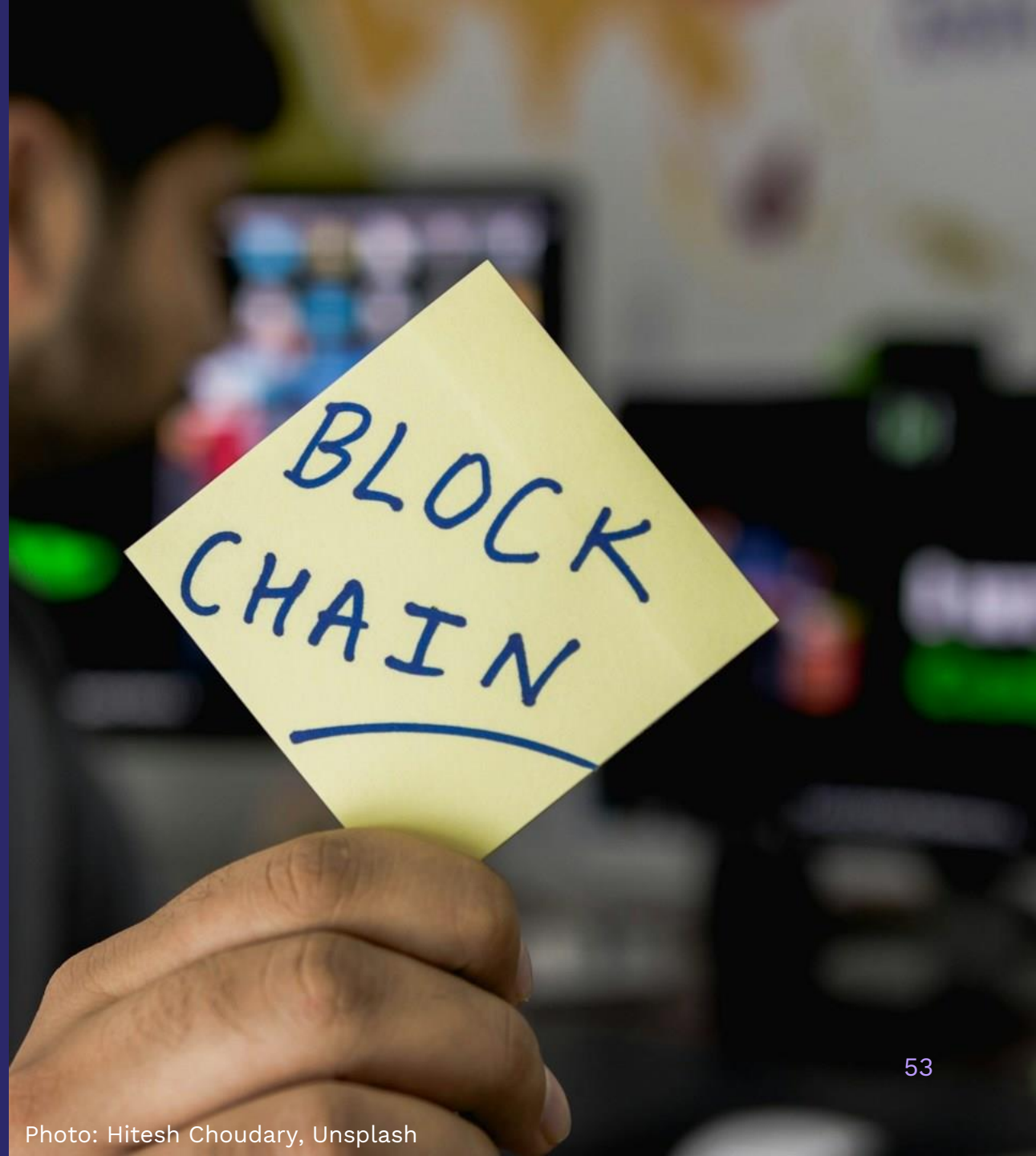


Photo: Hitesh Choudary, Unsplash

Example: Pre-emptive Compliance

Circularity:

- Enabler for downstream circularity
- Reuse
- Remanufacturing
- Recycling

Potential Pitfalls:

- Transparency
- Cost
- Logistics & Standards

Other indicators:

- Economics
- Various – application specific

Photo: © Schwad, Unsplash

Words of Caution

1. **Circular Economy is systemic**
   - → Circularity of your own systems
   - → Enabler for circularity in other systems

2. **Circularity is only one axis.**
   - → Intent is to deliver benefits (Economic, Environmental, Social)
   - → Poorly designed systems can do the opposite
   - → Beware of unintended consequences (“And then what?”)

3. **The transition is a journey.**
   - → Identify the easy wins and get started
   - → Continuous improvement mindset (includes data)
   - → Collaborate

4. **Transparency & Traceability**
   - → Tell the story of your journey, where you started, where you’re going and why.
   - → Be prepared to back it up – Show you know or that you’re finding out.

Questions?

jim.goddin@thinkstep-anz.com

thinkstep anz

Jim Goddin

Head of Circular Economy, thinkstep-anz

jim.goddin@thinkstep-anz.com

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ON A MISSION TO REDUCE EMISSIONS IN NEW ZEALAND

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

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