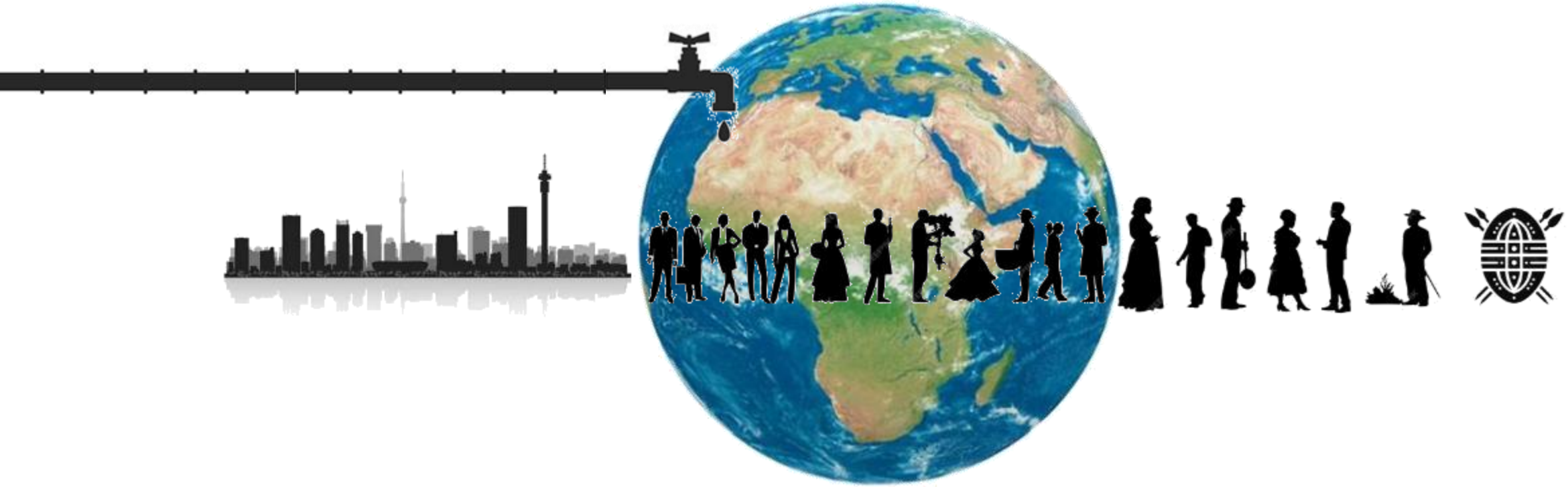
Seeking societal symbiosis for sustainably meeting human needs



Professor Mark Everard

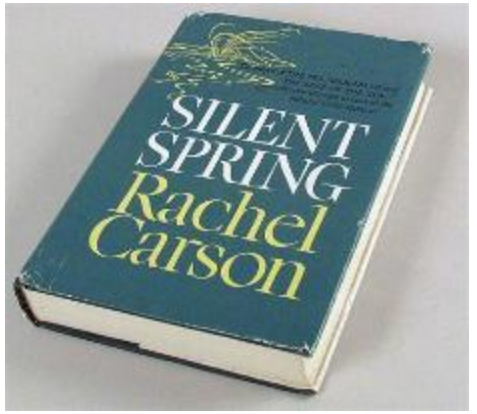
Pundamilia Ltd

mark.everard@uwe.ac.uk; +44-7747-120019

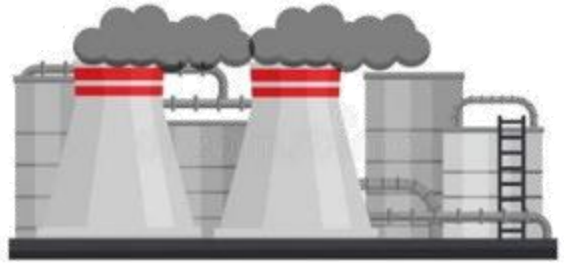
Seeking societal symbiosis for sustainably meeting human needs

- Tomorrow can't be like today
- Humanity and material use
- Refocusing on human needs
- Backcasting
- Seeking the level playing field
- Symbiosis for sustainability


SUGAR
POTATOES
CHICKEN PIE



"Life is what happens when you're busy making other plans"



- Biodiversity loss
- Climate instability
- Storm and flood damage
- Water scarcity
- Soil loss
- Fishery depletion
- Wealth inequity
  - (In US, the top 1% own as much as the lower 80%)

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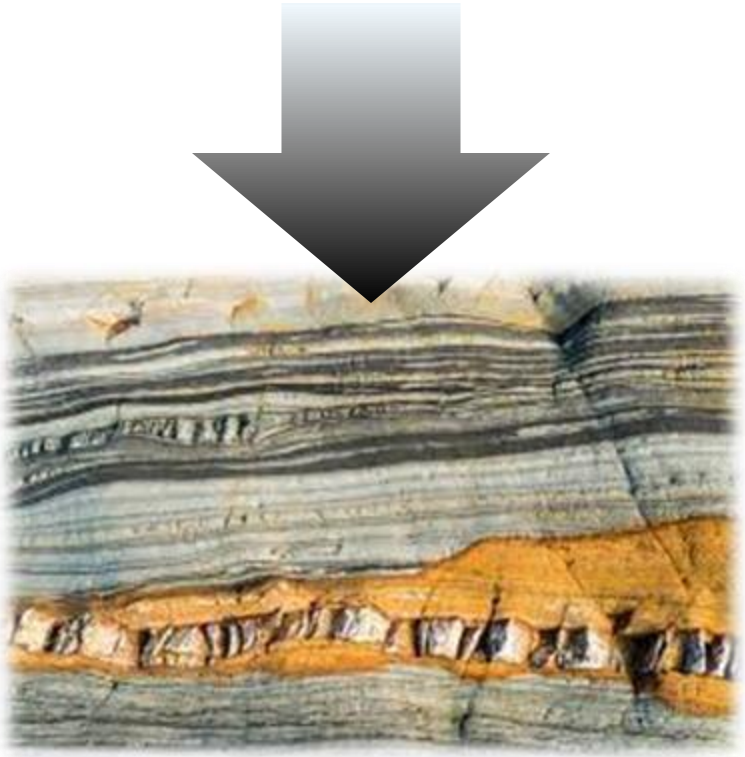
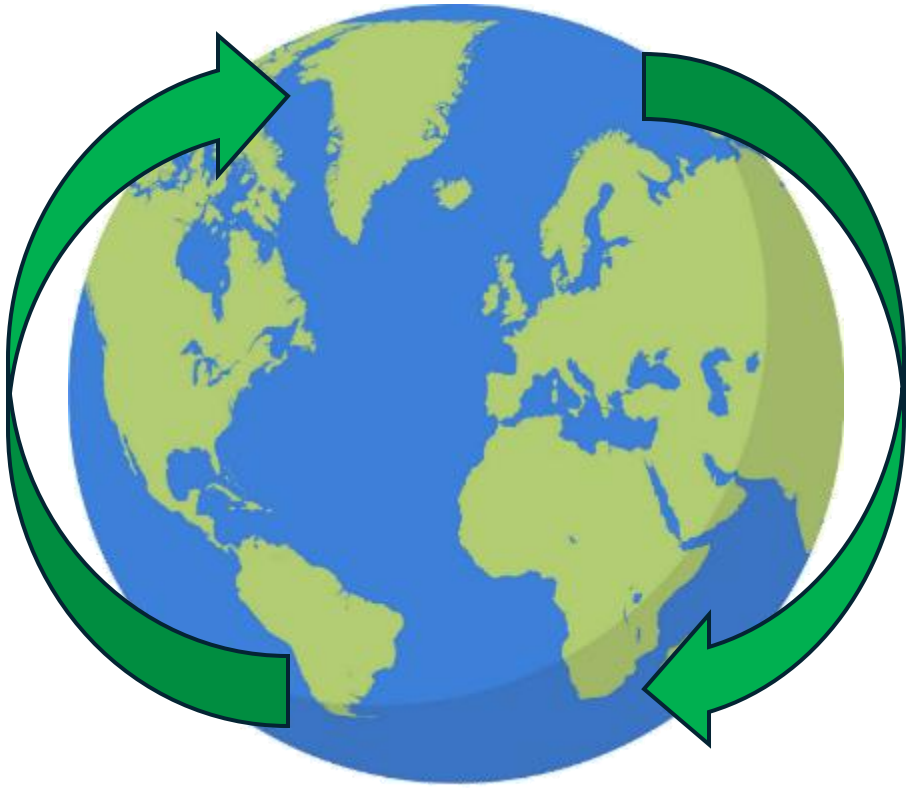
4.5 billion years...

- Physics
- Chemistry



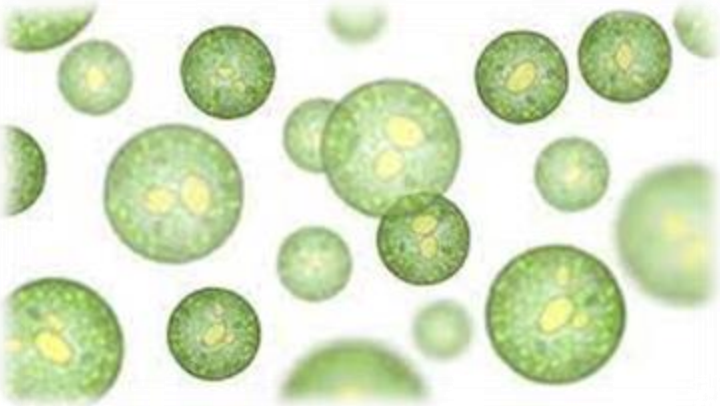


3.85 billion years...

- Biology

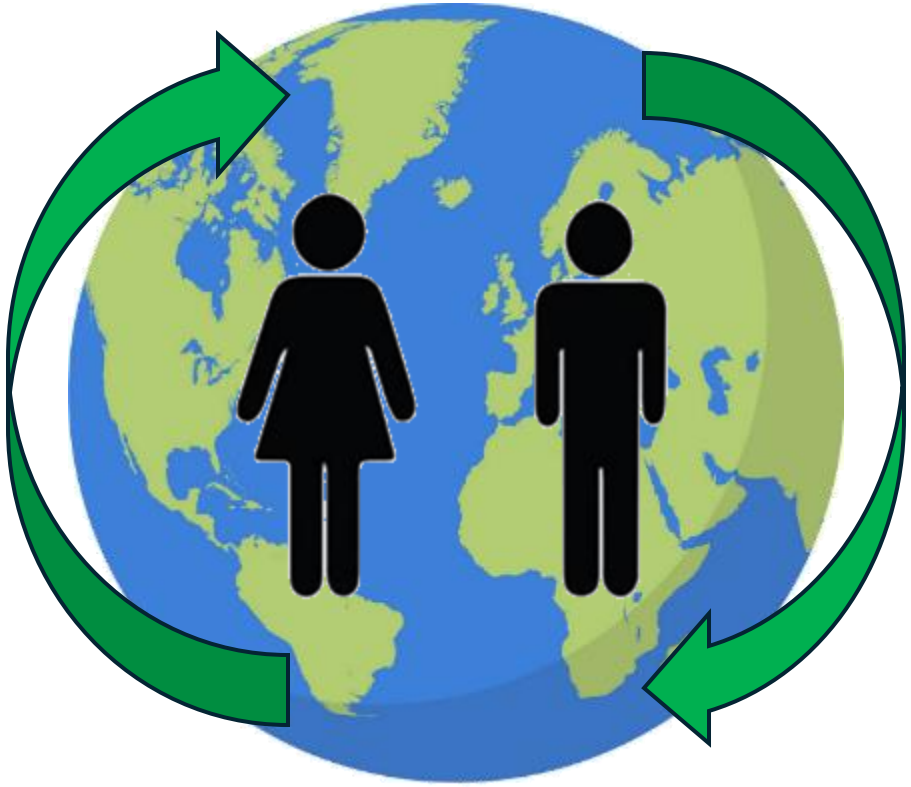
2.5 billion years

- Photosynthesis



100,000s years...

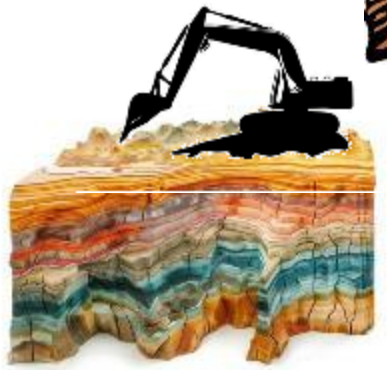
- Plants
  - Wood
  - Thatch
- Animal
  - Bone
  - Hide
- Stone-Bronze-Iron
  - Low intensity

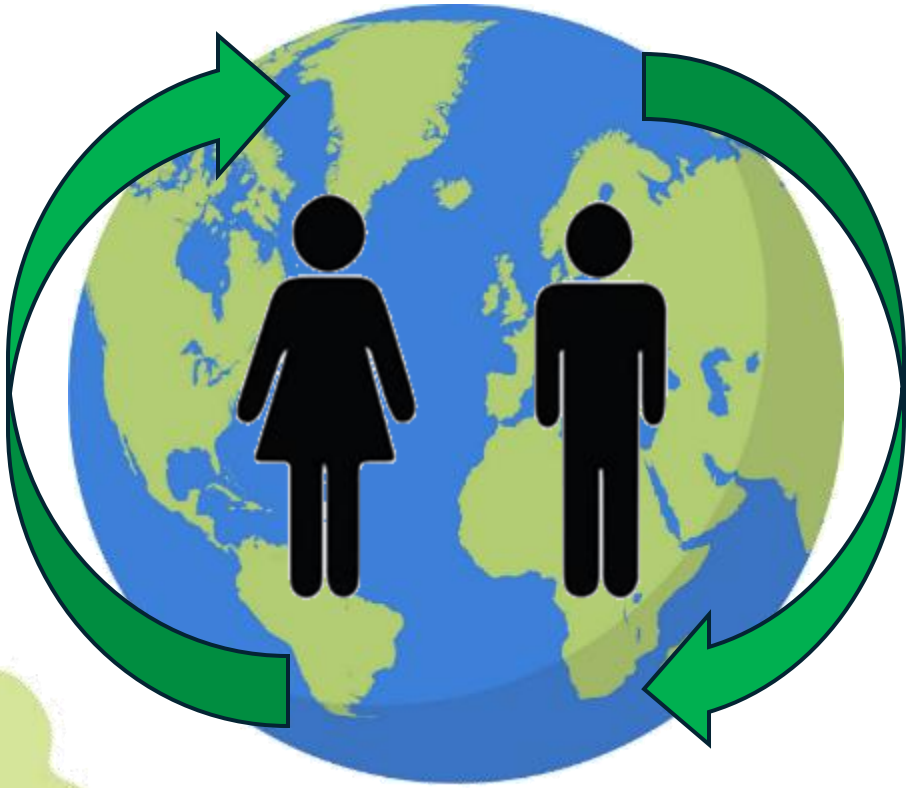


Centuries...

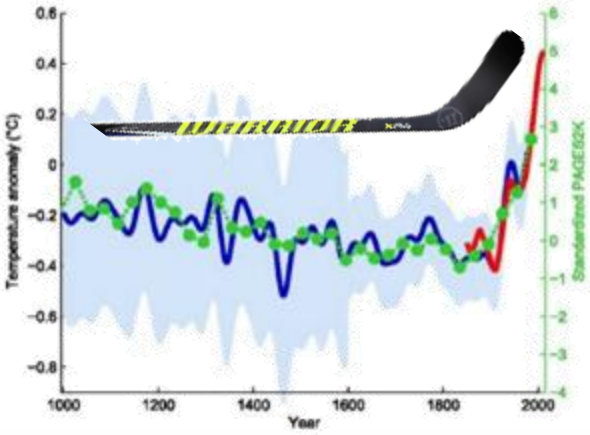
- Fossil carbon
- Rare earth metals
- Pesticides
- Semiconductors
- Ceramics
- PVC
- Other plastics

We didn't run out of stones... we just found better substances to meet our needs!





- Biodiversity loss
- Climate instability
- Water scarcity
- Soil loss
- Fishery depletion
- Storm damage
- Flood and drought
- Waste
- Wealth inequity
  - (In US, top 1% own as much as the lower 80%)



Al Gore: "An Inconvenient Truth"

Regulation, protocols, etc.

- 1200s: Animal waste
- 1863: Alkali Act
- 1972:
  - Stockholm Conference
  - UNEP
  - Limits to Growth
  - US bans DDT
    - Silent Spring + 10
- Chemical regulation:
  - EU REACH 2006+
  - US TSCA
  - RSA: Hazardous Chemical Agents Regulations (RHCA), 2021
  - Australia: Industrial Chemicals Act 2019
  - India: The Environment (Protection) Act, 1986

Supporting tools...

- LCA
- EPD
- PEF
- REACH process

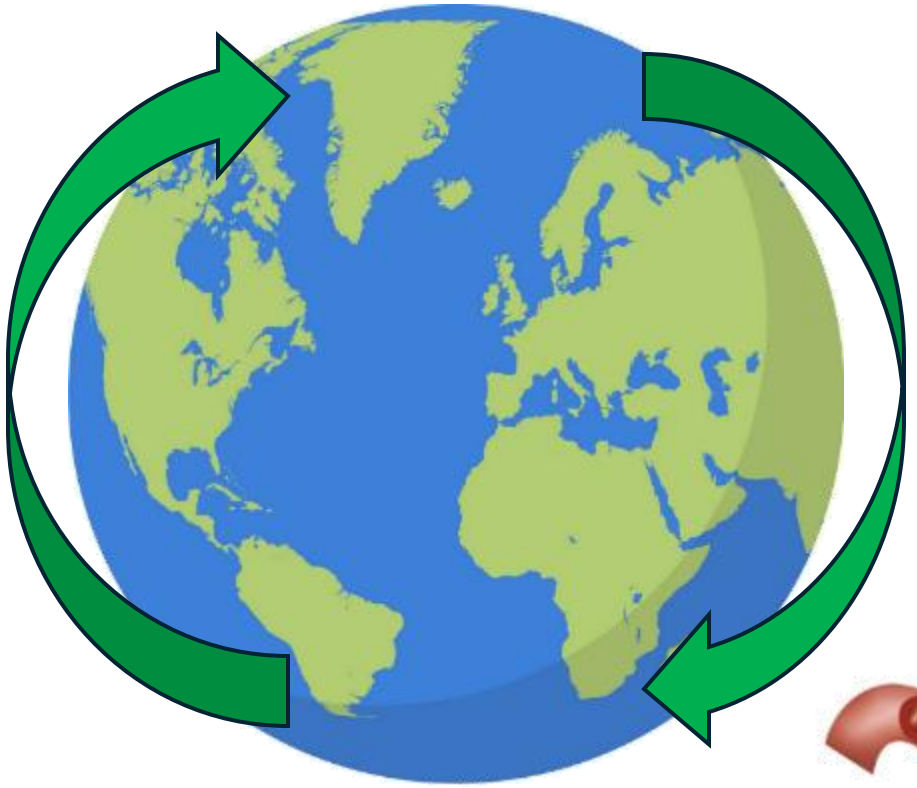
Focus on BAD stuff!

- Intrinsic chemistry
- HAZARD-based
- NEGATIVE aspects

Safe...

N_2

O_2



Hazardous...

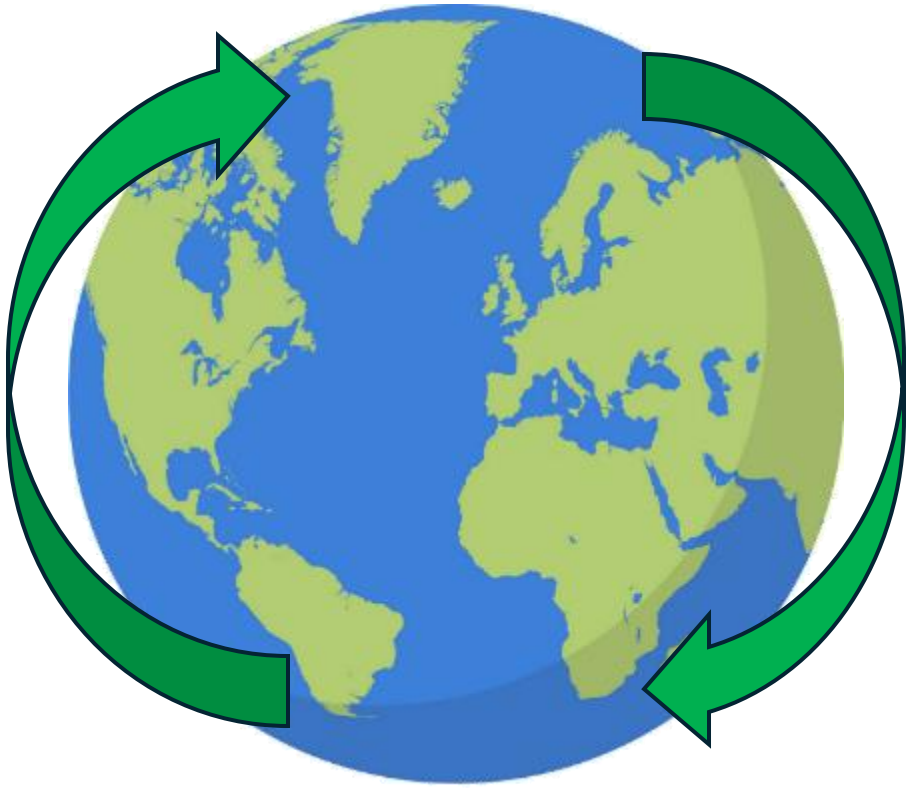
HCl

O_3

Context is EVERYTHING!!!

Risk = hazard x exposure

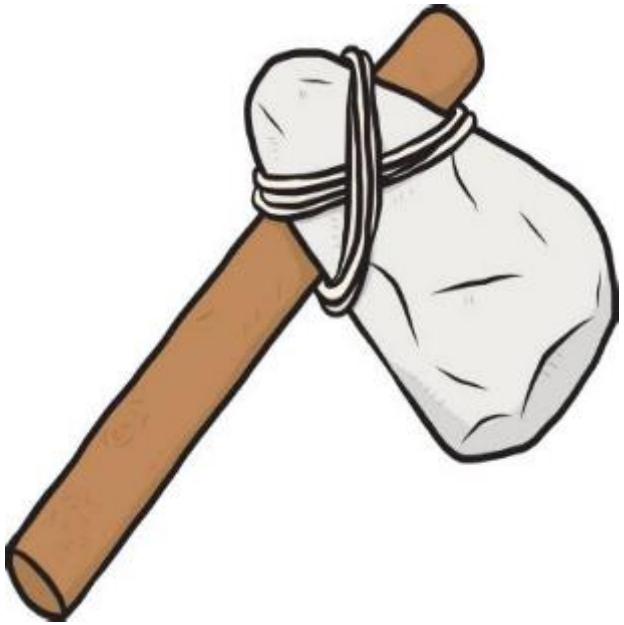
Bio-based...

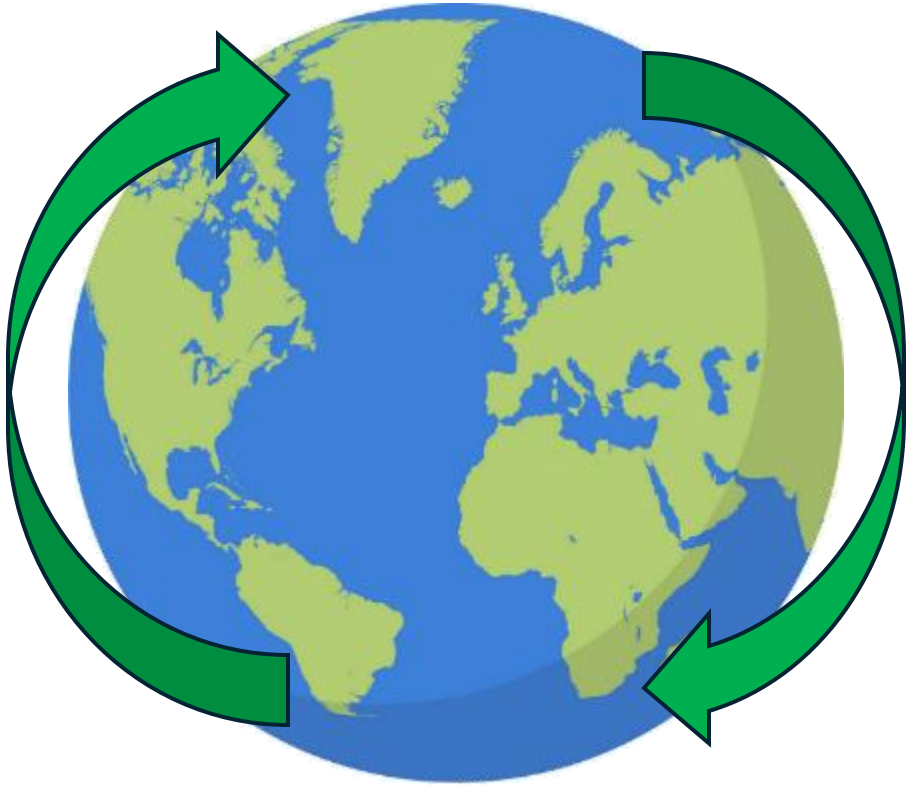


Context is EVERYTHING!!!

ALL dimensions across LIFE CYCLE

Back to the Stone Age?





WHO/UN IARC Group 1:

Rock dust

Silicosis

Wood dust

Context is EVERYTHING!!!

Spoiler alert → There is no such thing as a 'sustainable material'!

Seeking societal symbiosis for sustainably meeting human needs

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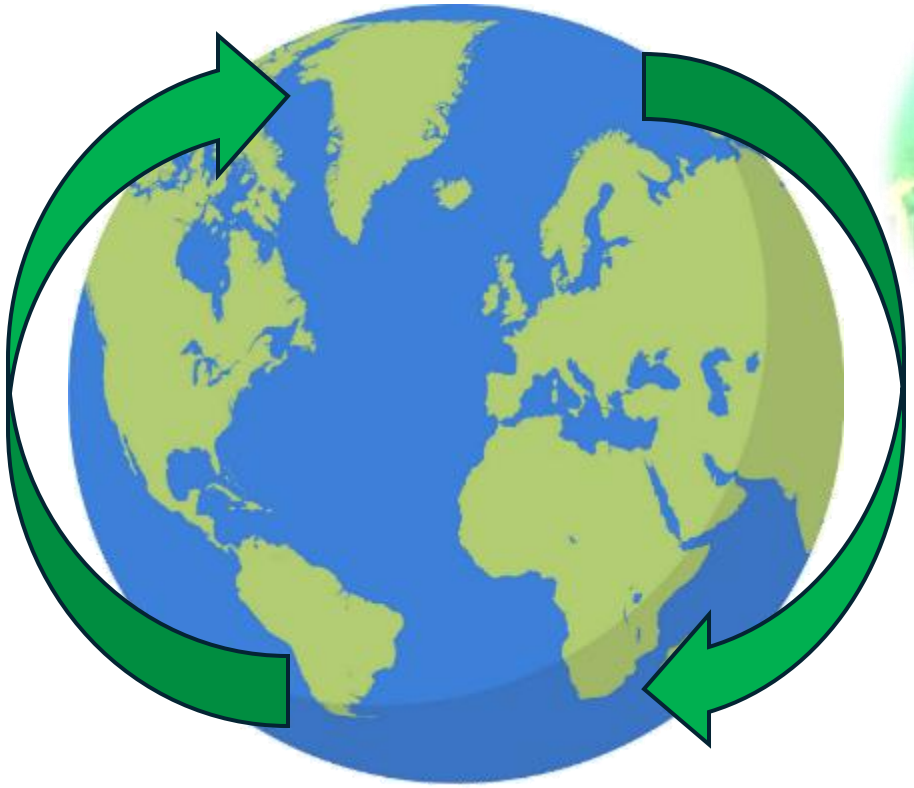
- Symbiosis for sustainability

‘Brundtland definition’

“…development that meets the needs of the present without compromising the ability of future generations to meet their own needs”



Global commitment

- WCED 1987
- Rio ‘Earth Summit’ 1992

Rules and supporting tools...

Focus to date on BADS:

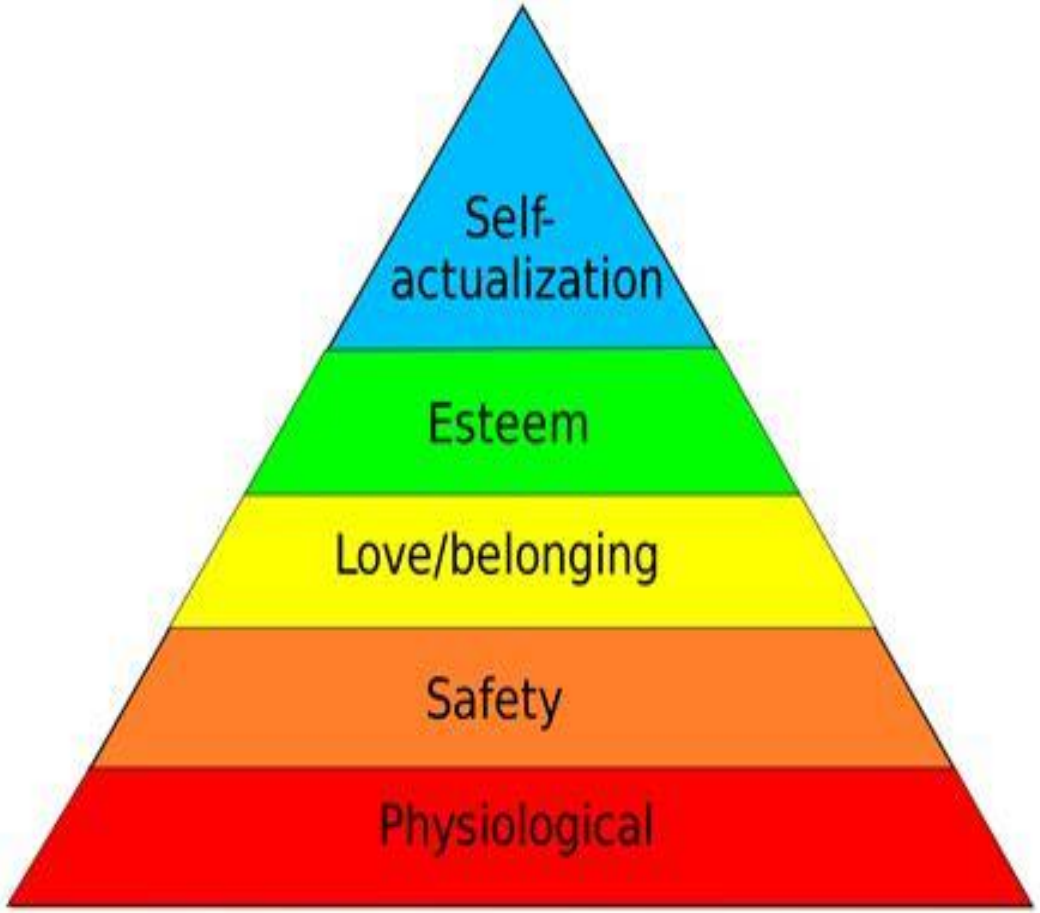
- Intrinsic chemistry
- HAZARD-based
- NEGATIVE aspects

Where are the GOODS?

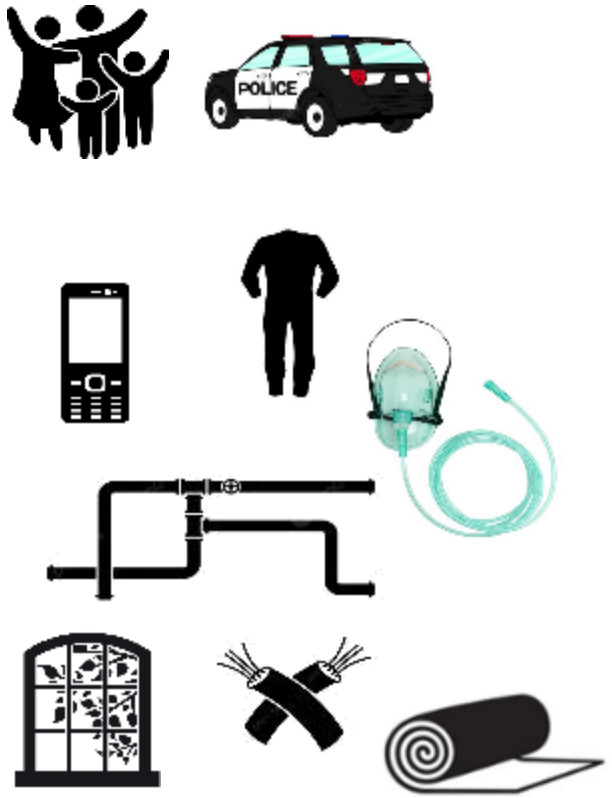
- Benefits in terms of meeting needs?

We innovate to meet needs, not to cause harm!

Needs



Satisfiers



A material world

Tomorrow can't be like today, but human needs will continue…

…how to profitably meet tomorrow's societal needs?

The ‘lost half’ of sustainable development


Science of the Total Environment

Reasserting the primacy of human needs to reclaim the 'lost half' of sustainable development

Mark Everard * , James W.S. Longhurst

The bad stuff

Paradigm shift

The good stuff

Meeting needs
(safely and efficiently)

Case studies: (1) Air quality; (2) Catchment management; and (3) EU PVC voluntary commitment

Everard, M. and Longhurst, J.W.S. (2018). Reasserting the primacy of human needs to reclaim the 'lost half' of sustainable development. *Science of the Total Environment*, 621, pp.1243-1254. DOI: https://doi.org/10.1016/j.scitotenv.2017.10.104.

Meeting human and environmental needs as end-goals

Global goals, 2015-2030

Recyclable PVC stabiliser additives contribute to product life cycles that better meet human and environmental needs in the safest and most efficient way

Positive contributions of stabilisers to PVC product life cycles

SDG6 (Water): More durable water pipes/infrastucture with longer service life

SDG11 (Sustainable cities and communities): Enhanced urban performance and durability

SDG12 (Responsible consumption and production): Long service life and recyclability

SDG13 (Climate action): Better insulating products with carbon recovery when recycled

SDG14 (Life below water): Long service life and recyclability reduces waste accumulation

SDG15 (Life on land): Long service life and recyclability reduces waste accumulation

Positive stories!!!

PVC meets some needs well…

…others may best meet other needs

From hazard to sustainability-informed risk

The bad stuff

Paradigm shift

We need BOTH sides of the coin!!

The good stuff

Meeting needs
(safely and efficiently)

EPD, PEF, LCA, etc...

EU REACH, SSbD Socioeconomics AFTER restriction

US scoreWISE Eco-efficiency + bio-based, not NEEDS

Plastic product life cycles

- Longevity (needs met per unit resource)
- Low/no inputs in use (energy/chemical)
- Inherent recyclability (more lifecycles)

How do other materials compare?

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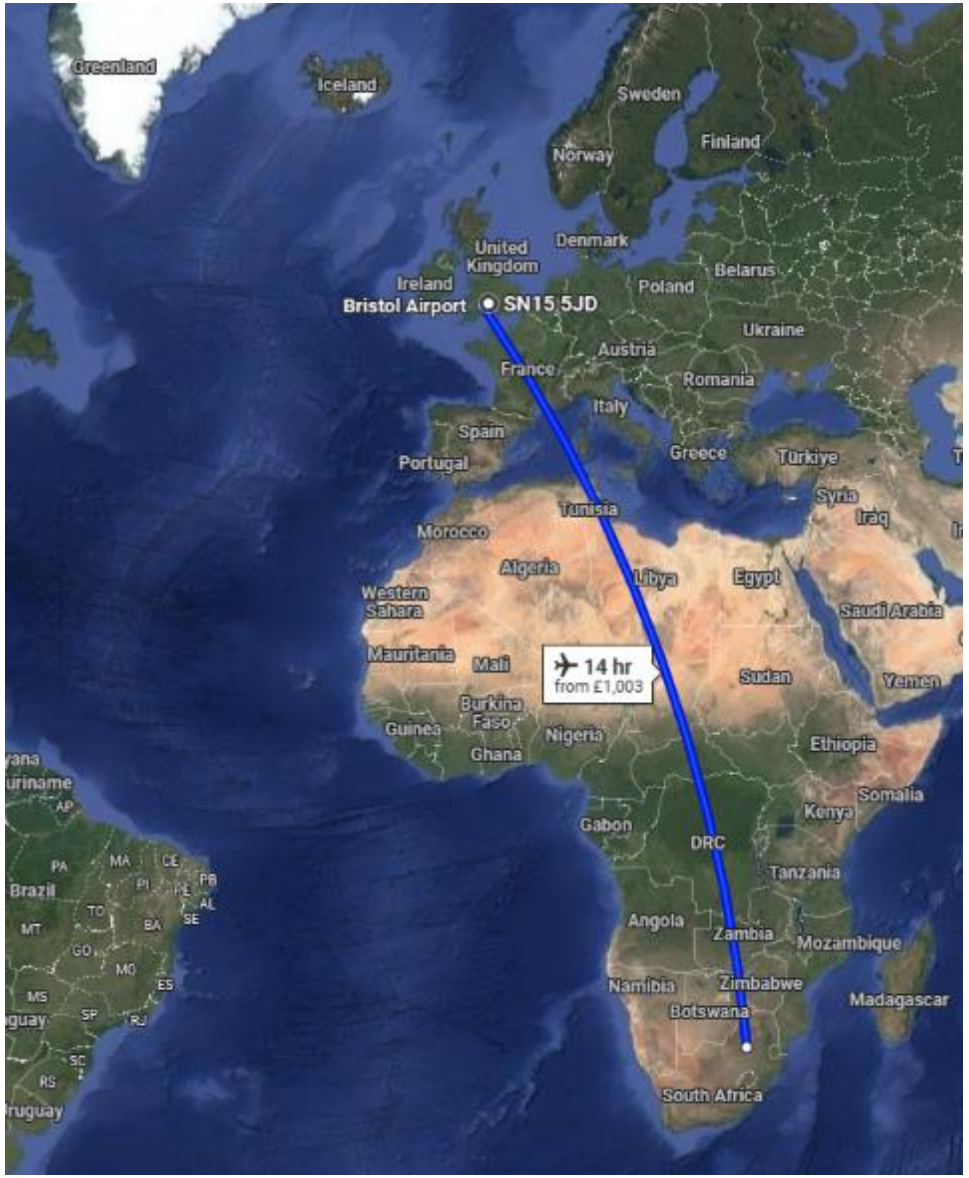
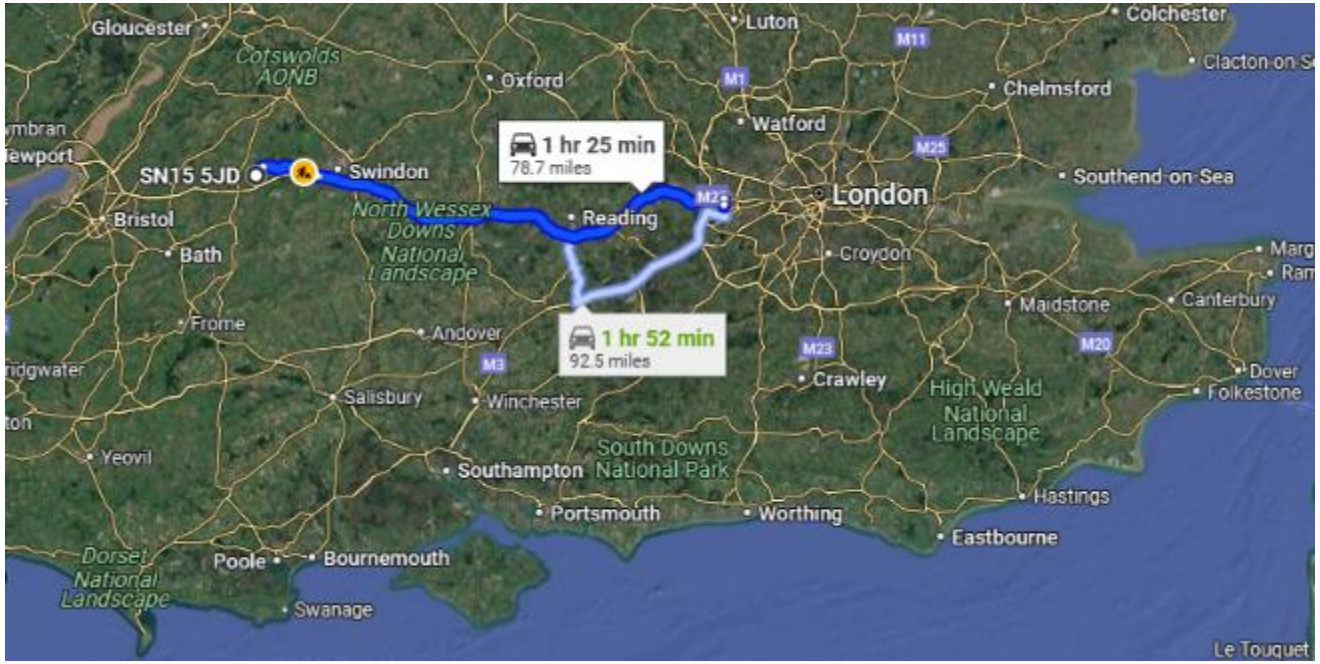
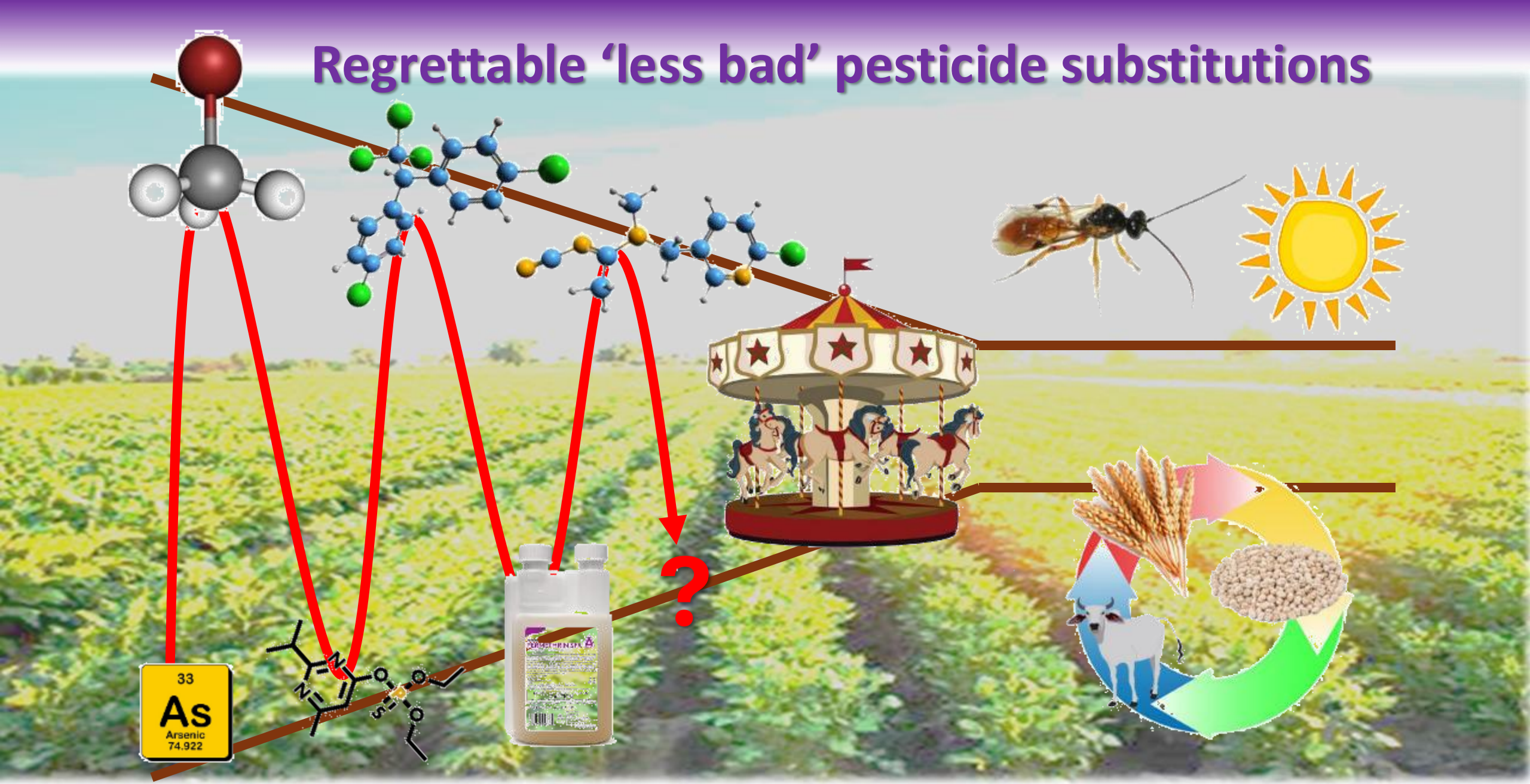
- **Backcasting**
- Seeking the level playing field
- Symbiosis for sustainability


Greenland
Iceland
Sweden
Finland
Norway
United Kingdom
Denmark
Ireland
Bristol Airport
SN15 5JD
Belarus
Poland
Ukraine
Austria
France
Romania
Italy
Spain
Portugal
Greece
Türkiye
Syria
Iraq
Tunisia
Morocco
Algeria
Libya
Egypt
Western Sahara
Saudi Arabia
Mauritania
Mali
14 hr
from £1,003
Sudan
Yemen
Burkina Faso
Guinea
Nigeria
Ghana
Ethiopia
Somalia
Kenya
Gabon
DRC
Tanzania
Angola
Zambia
Mozambique
Namibia
Zimbabwe
Botswana
Madagascar
South Africa
Brazil


Gloucester
Cotswolds AONB
Oxford
Luton
Colchester
Chelmsford
Watford
SN15 5JD
Swindon
1 hr 25 min
78.7 miles
Bristol
Bath
North Wessex Downs National Landscape
Reading
London
Southend-on-Sea
Croydon
Frome
Andover
1 hr 52 min
92.5 miles
Maidstone
Canterbury
Crawley
Dover
Folkestone
Salisbury
Winchester
High Weald National Landscape
Yeovil
South Downs National Park
Southampton
Hastings
Portsmouth
Worthing
Eastbourne
Poole
Bournemouth
Dorset National Landscape
Swanage
Le Touquet

Regrettable ‘less bad’ pesticide substitutions



Slavery

96%

70%

Carbon intensity

Pb, Cd, DEHP

Water

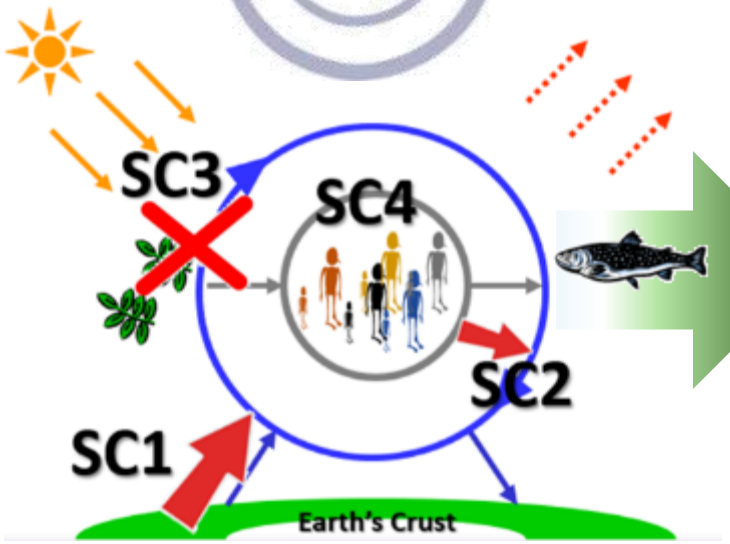
Social equity

Fugitive VCM

Asbestos

8.3 billion+; rising per capita consumption

the NATURAL STEP



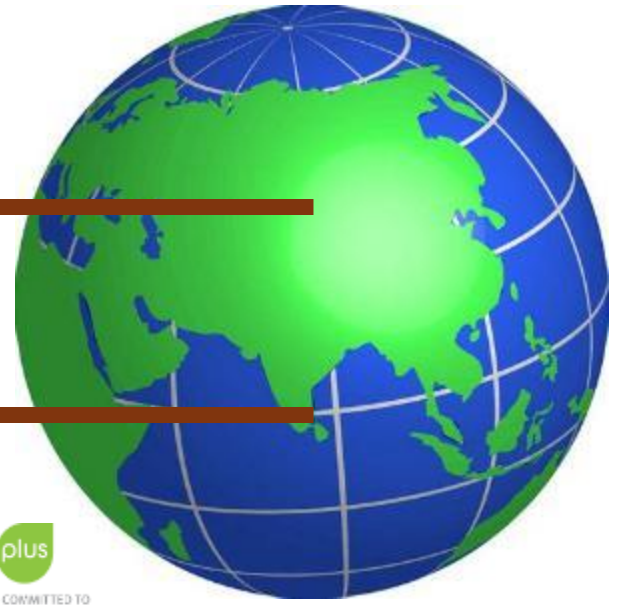
Non-contentious principles

- Thermodynamics
- Cellular processes
- Meeting human needs

TNS System Conditions

1.
2.
3.
4.

TNS (2000)



vinyl plus COMMITTED TO SUSTAINABLE DEVELOPMENT

Five TNS Sustainability Challenges for PVC

SAVA

South African Vinyls Association

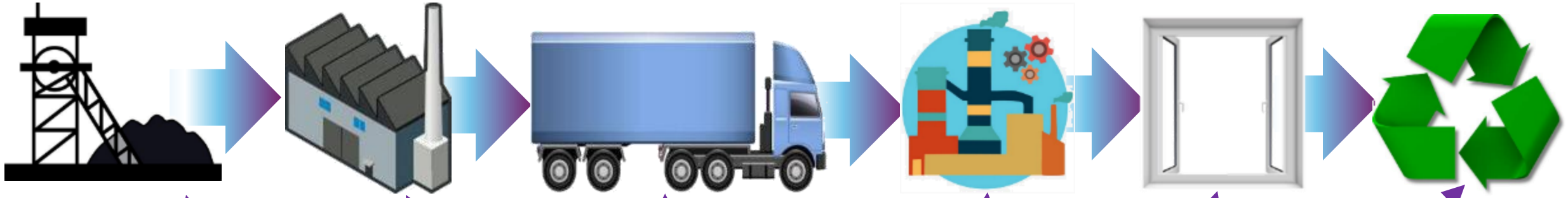
vinyl plus

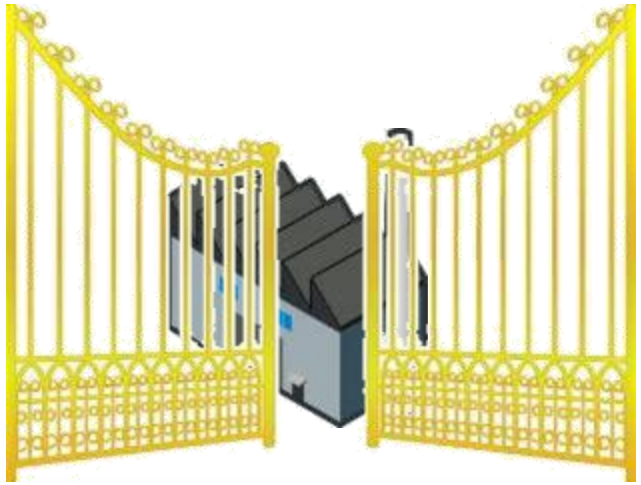
- Emissions
- Energy/climate
- Use of additives
- Controlled loop
- Value chain connections

- Sustainable manufacturing
- Sustainable use of additives
- Closed loop management
- Sustainability awareness

verified vinyl

Safe, Sustainable, Responsible PVC






Liability
uncertainty
debt
law
fan
profit
protect
money
lawsuit
safety
budget
high
finance
responsibility
urgent
hazard
policy
accident
business
assurance
agent
contract
reduce
protection
management
premium
risk
insurance
proble
payment
prevention
accounting
fee
danger
security
financial
trouble
dangerous
property
secure
liable
possibility
claim
legal
risky
safe
asset

Additive Sustainability Footprint (ASF): Sustainable USE of PVC additives

the NATURAL STEP

System Conditions

1. 
2. 
3. 
4. 

RISK across whole article life cycle (ISO 14040:2006)

Raw materials	Manufacturing	Transport	Compounding	Product use	Post-use
☹ Poor mining					☺ Closed loop
	☹ Poor manufacturing				☺
		☹ Knowledge gap		☺ Longevity/maintenance	
☺ Ethical sourcing			☹ Knowledge gap		☺ Value recovery

Sustainability contributions and hotspots... an innovation framework... and communication

Everard, M. and Blume, R. (2019). Additive Sustainability Footprint (ASF): rationale and pilot evaluation of a tool for assessing the sustainable use of PVC additives. *Journal of Vinyl and Additive Technology, 26(2), 196-208* DOI: https://onlinelibrary.wiley.com/doi/10.1002/vnl.21733.

Seeking societal symbiosis for sustainably meeting human needs

- Tomorrow can't be like today
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- Seeking the level playing field
- Symbiosis for sustainability

Seeking the level playing field:

Foundational principles about meeting needs safely and efficiently

Breaking out of hazard-based (intrinsic chemistry) → 'Real world' risk assessed by sustainability principles

- Full dimensions of sustainable development (chemical, physical, socioeconomic);
- Transparently and defensibly science-based;
- Full article life cycle risk (not just potential hazard in isolation);
- Recognises positive contributions to meeting human needs;
- Open access principles and general approach;
- Ideally free to use;
- Applicable to multiple product and material types;
- Ideally statutory; and
- Tested through peer-reviewed scientific literature.

Everard, M. (2022). Assessment of the sustainable use of chemicals on a level playing field. *Integrated Environmental Assessment and Management, 19(4), pp.1131-1146.*

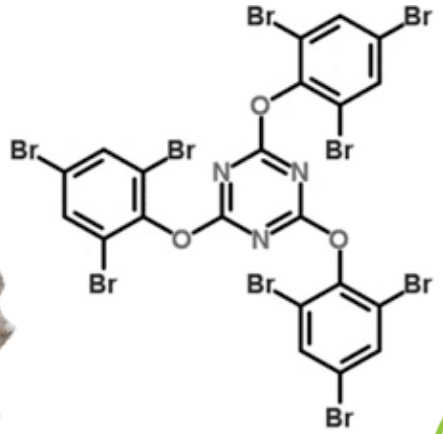
DOI: https://doi.org/10.1002/ieam.4723.

	Full dimensions of sustainable development	Transparently science-based	Based on full article life cycle risk (rather than potential hazard alone)	Recognises positive contributions to meeting human needs	Open access	Free to use (albeit with guidance and external auditing)	Applicable across products/materials	Statutory	Peer reviewed in science literature
Life Cycle Assessment (LCA)	NO	YES	Partially	NO	Partially	Partially	YES	NO	YES
Environmental Product Declaration (EPD)	NO	YES	Partially	NO	Partially	YES	YES	NO	YES
Product Environmental Footprint (PEF)	NO	YES	Partially	NO	Partially	YES	YES	NO	YES
EU REACH	NO	YES	NO	NO	YES	YES	YES	YES	YES
SciveraLENS©	NO	YES	Partially	NO	NO	NO	YES	NO	NO
Greensuite©	NO	YES	Partially	NO	NO	NO	YES	NO	YES
GreenScreen List Translator™	NO	YES	NO	NO	NO	NO	YES	NO	Partially
GreenWERKS	NO	YES	NO	NO	NO	NO	YES	NO	NO
Green Chemistry and Commerce Council (GC3)	NO	YES	NO	NO	Partially	Partially	YES	NO	NO
OECD Substitution and Alternatives Assessment	NO	YES	NO	NO	Partially	Partially	YES	NO	NO
ECHA Plastic Additives Initiative	NO	YES	Partially	NO	YES	YES	Partially	NO	NO
Cradle to Cradle	YES	YES	YES	NO	NO	NO	YES	NO	YES
Additive Sustainability Footprint (ASF)	YES	YES	YES	YES	YES	YES	YES	NO	YES
Ecoradis	YES	YES	NO	NO	NO	NO	YES	NO	NO
Carbon Handprint	NO	YES	YES	NO	YES	YES	YES	NO	YES
Material flow cost accounting (MFCA)	NO	YES	Partially	NO	NO	No	Partially	NO	YES
GRI 301: Materials	NO	YES	NO	NO	YES	YES	YES	NO	NO

A ‘material blind’ level playing field: ASF


Life Cycle & Sustainability

Assessment of the sustainable use of chemicals on a level playing Field



Co

Ca/Zn

verified vinyl® VinylPlus® Product Label

Everard, M. (2022). Assessment of the sustainable use of chemicals on a level playing field. *Integrated Environmental Assessment and Management*. 19(4), pp. 1131-1146. DOI: https://doi.org/10.1002/ieam.4723.

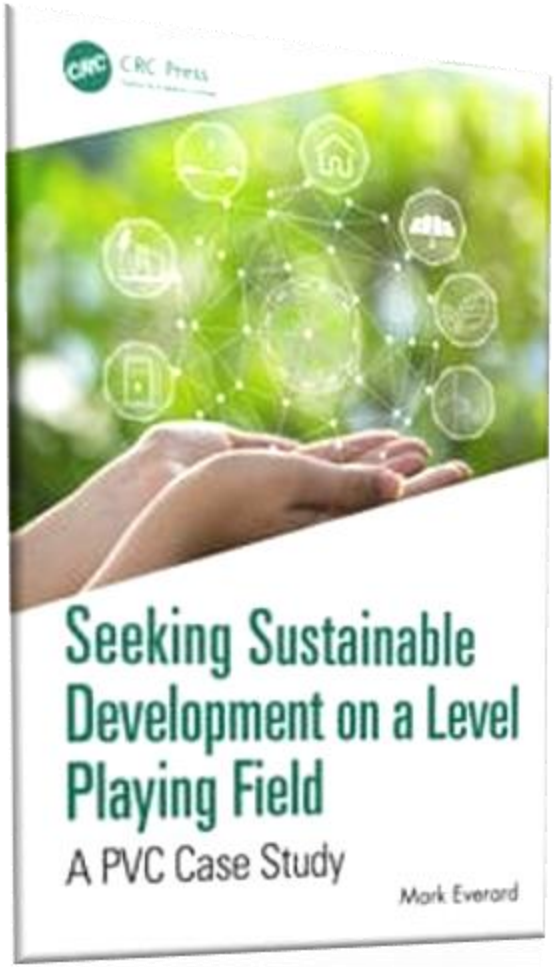
The ‘Age of Plastics’

Meeting many needs safely and efficiently…

…but other materials meet other needs better

Does society understand plastics and how they help us meet our needs?

The urgent need for a level playing field



- **Principles for the safe and efficient meeting of human needs…**
  - Unbiased about material type
  - ALL sustainability criteria
  - Whole product life cycles
  - Science-based sustainability principles

- **Informs:**
  - Optimal, context-specific choices to meet needs
  - Innovation and wise investment
  - Future risk management and profitability

Everard, M. (2024). *Seeking Sustainable Development on a Level Playing Field: A PVC Case Study.* Routledge.

Seeking societal symbiosis for sustainably meeting human needs

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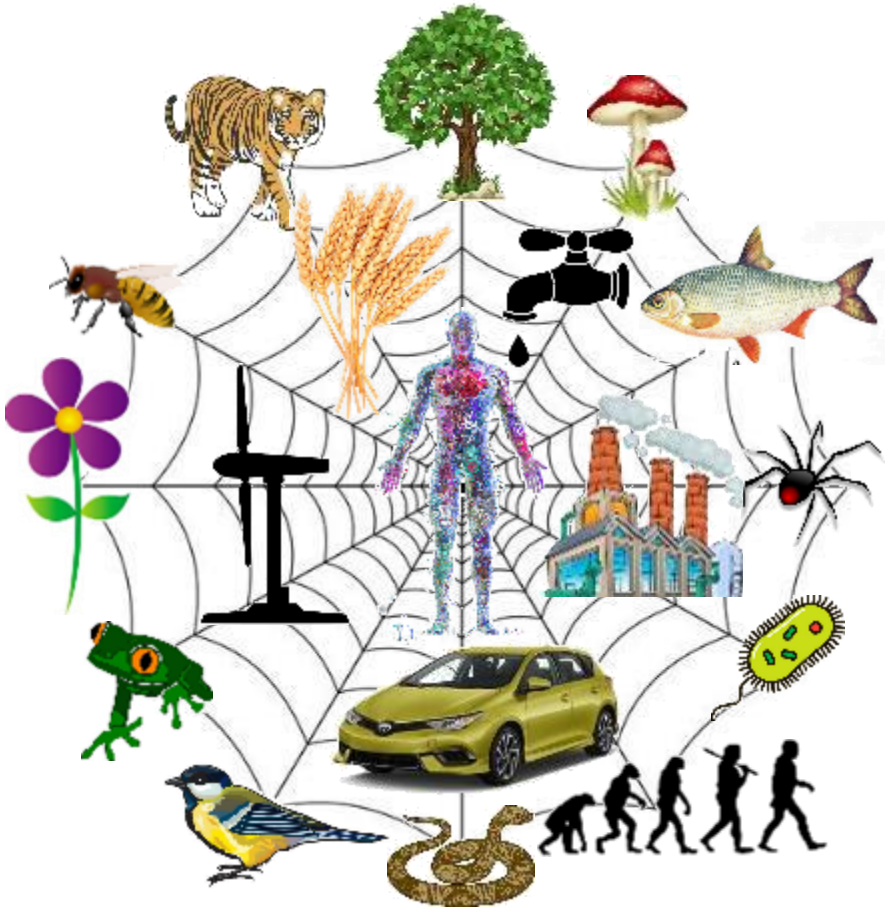
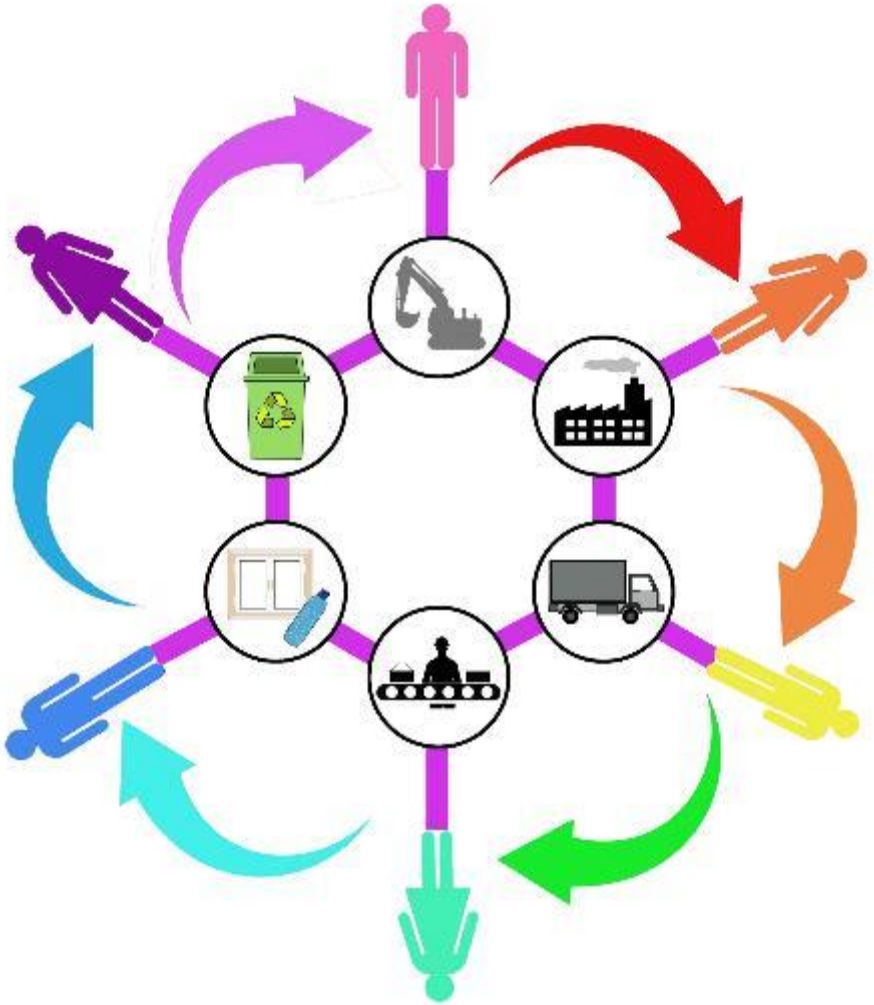
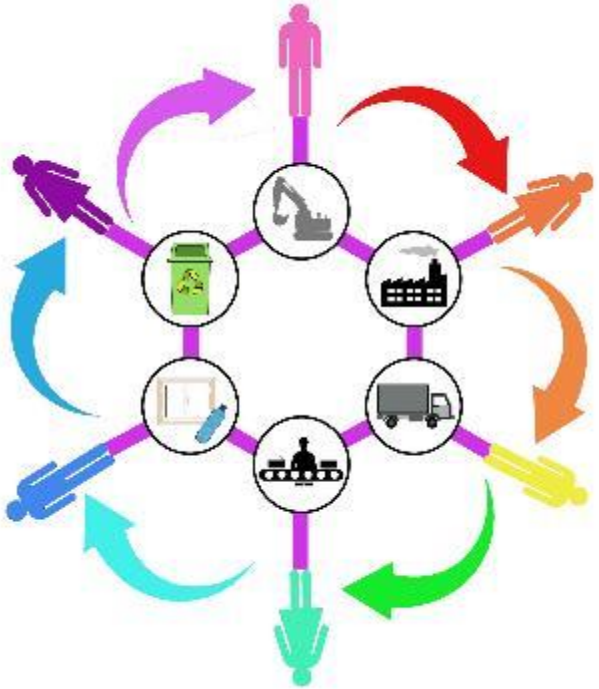
- Seeking the level playing field
- Symbiosis for sustainability

A symbiotic world



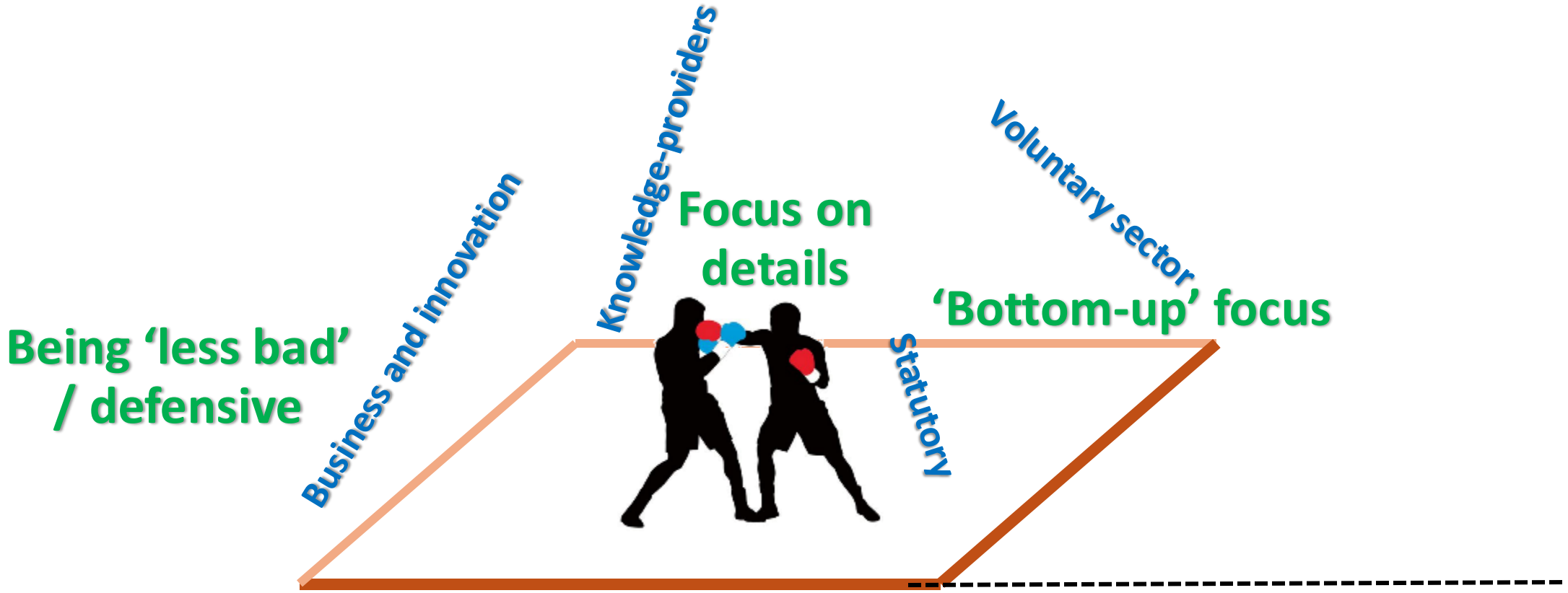




Mark Everard. (*2026*).
Seeking Societal Symbiosis for the Sustainable Use of Materials.
Routledge.

https://www.routledge.com/Seeking-Societal-Symbiosis-for-the-Sustainable-Use-of-Materials/Everard/p/book/9781041069225?srsltid=AfmBOopNew0kBffRBL06YTSuk_uKlQssM3qo_kAF2nEQ17H2e0lLwyNe

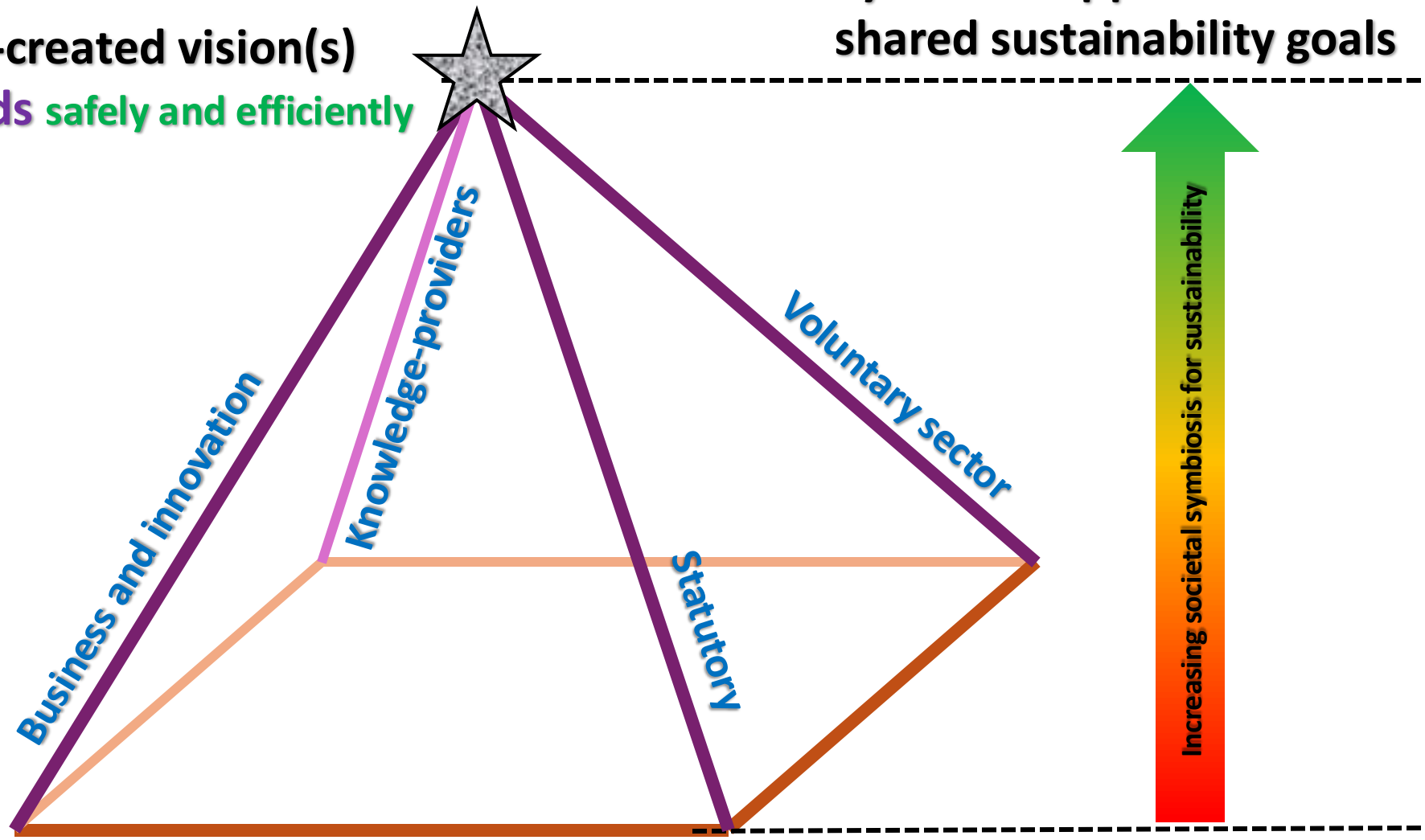
Societal divisions over the ‘bad stuff’



‘Pole star’ co-created vision(s)

Meeting needs safely and efficiently

Symbiotic approach around shared sustainability goals



Divisive fragmentation of energies and investments

Pragmatism and symbiosis for sustainable development

Consensual ‘pole star’ co-created vision(s)

Voluntary commitment by business sector

- Goal 3 ← Verification
- Goal 2 ← Verification
- Goal 1 ← Verification
- Enforcement on bad performers

Novel policy/regulatory approach

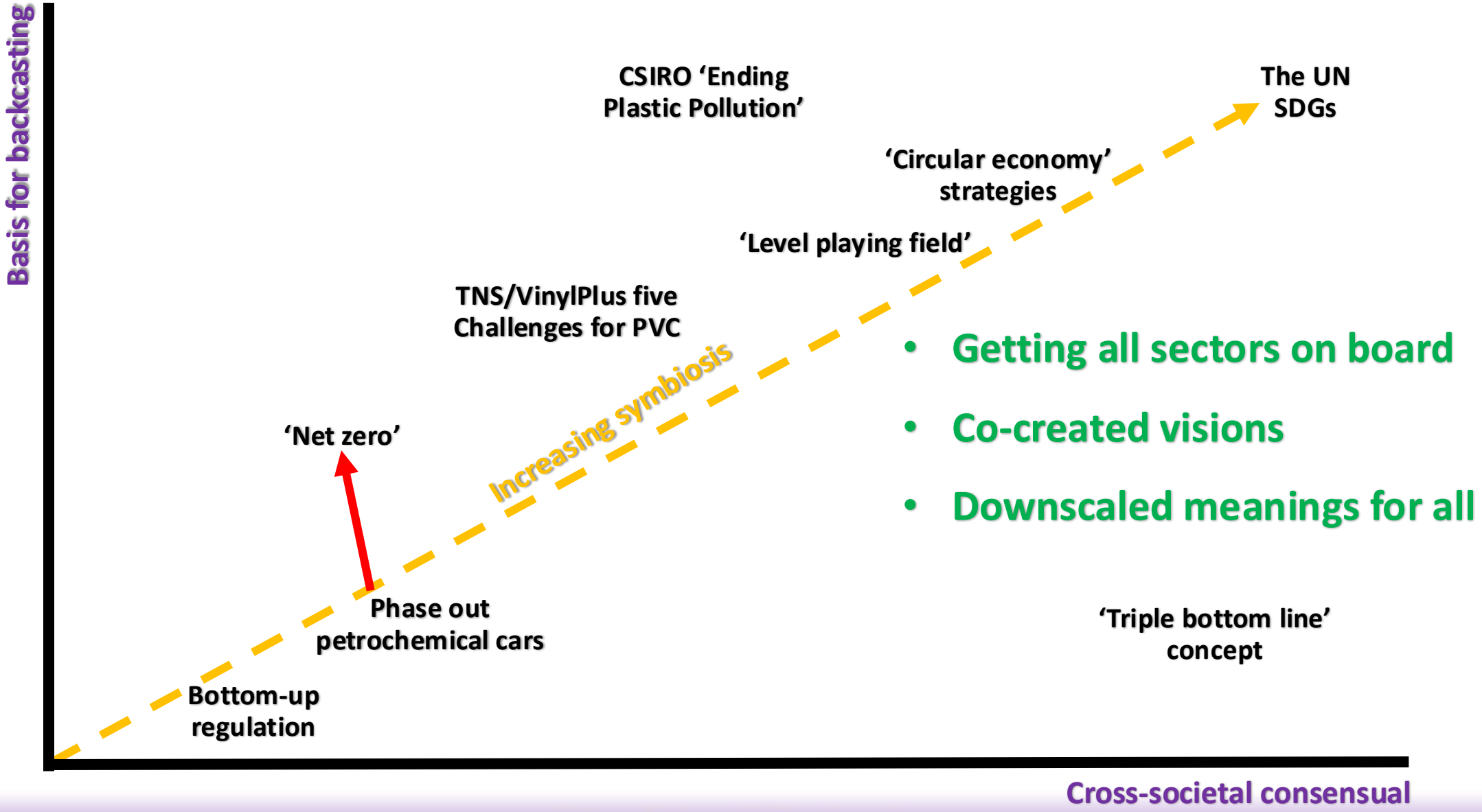
- Co-development of solutions
- Reform of obstructive policies
- Activism about bad performers

Voluntary sector

- Training professionals
- Systemic framings
- Advising on detail

Knowledge-providing sector

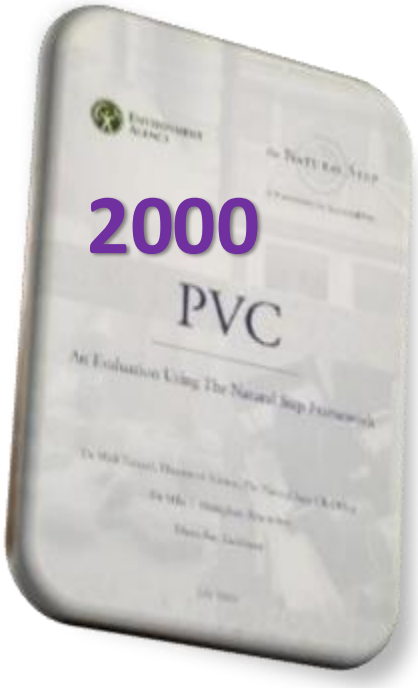
Models for further evolution of shared cross-societal visions



- Getting all sectors on board
- Co-created visions
- Downscaled meanings for all

Visioning is (or should be) an ongoing process

Sustainability pressures shift societal norms over a quarter-century



The five TNS Challenges

1. Carbon-neutrality
2. Controlled loop
3. Persistent organic compounds
4. Review all additives
5. Joining up the value chain

vinyl plus
COMMITTED TO SUSTAINABLE DEVELOPMENT

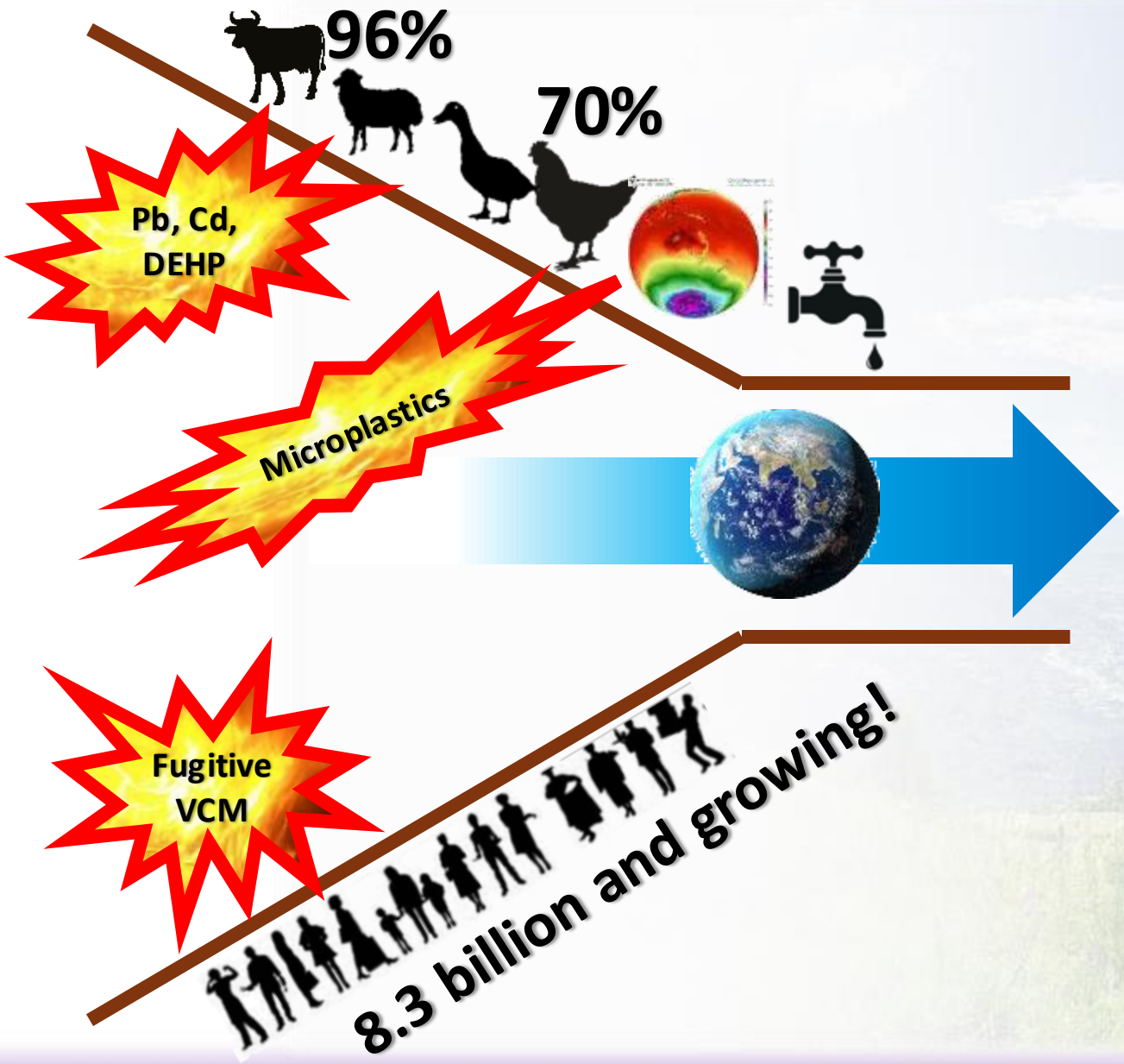
Voluntary commitments
Five Challenges to 2020
(+current target)

2025 norms include:

1. Carbon-neutrality
2. Circular economy
3. Persistent organic compounds
4. Review all additives
5. Joining up the value chain

Backcasting aided preparedness

New vision for voluntary commitment?



Serving tomorrow's needs and markets

- Transparently and comparatively:
  - Efficiently
  - Safely
  - Profitably

We have the tools...

- Material-blind 'level playing field'

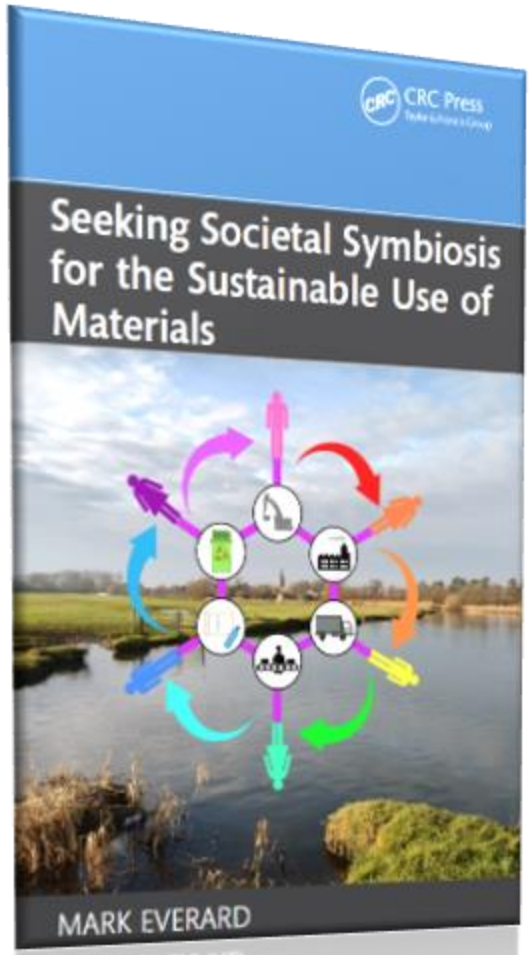
Can we build shared societal visions?

- Connecting ALL societal sectors
- Nationally and internationally

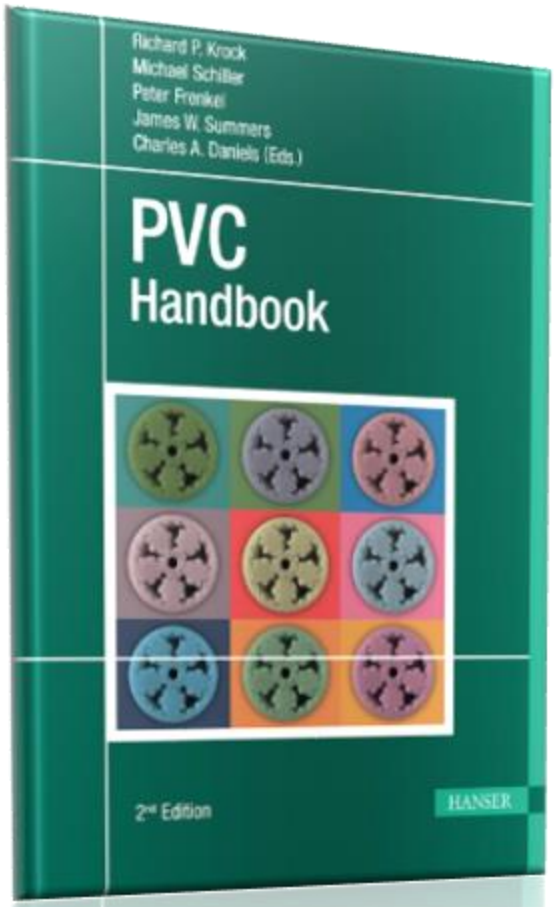
Plastics may choose to be there...

- ...or not!
- Decisions are in our hands

Everard, M. (2024).
Seeking Sustainable Development on a Level Playing Field: A PVC Case Study.
Routledge.

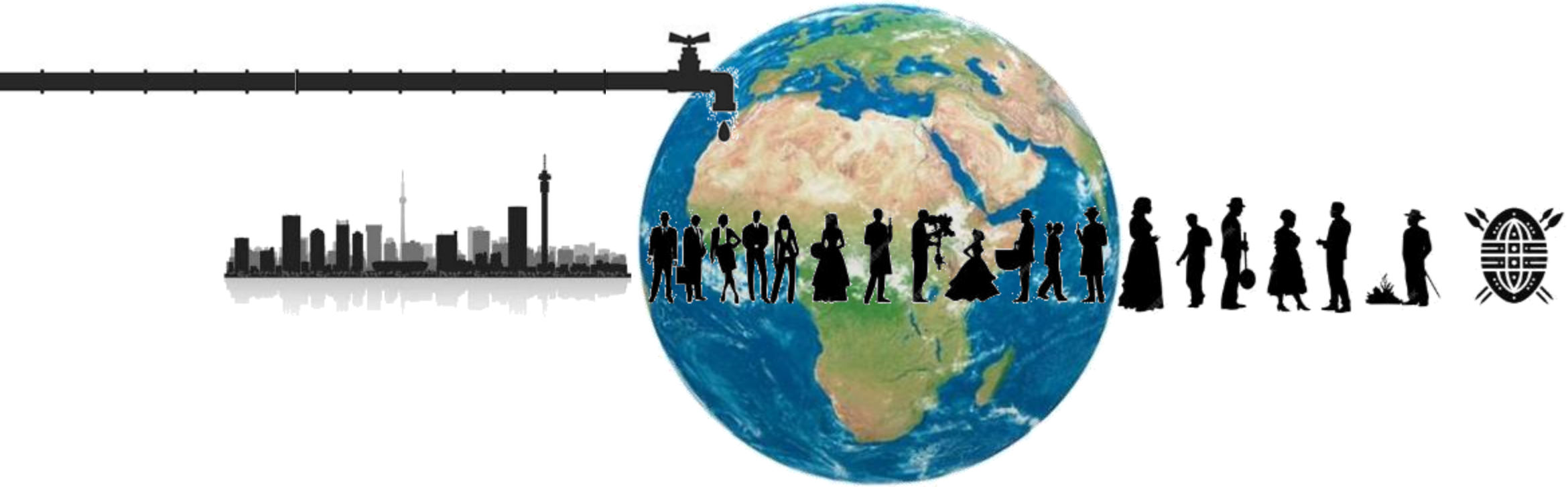


Mark Everard. (*2026*).
Seeking Societal Symbiosis for the Sustainable Use of Materials.
Routledge.



Everard, M. Leadbitter, J. and MacMillan, S. (2025).
Chapter 20: Sustainability of PVC.
In: Krock, R., Schiller, M., Frenkel, P., Summers, J.W. and C.A. (eds.)
PVC Handbook (2nd Edition). Hanser.

Seeking societal symbiosis for sustainably meeting human needs



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