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Copernicus Institute of Sustainable Development

From 3R to 10R in Circular Economy 3.0

Webinar II
10th Regional 3R and Circular Economy Forum in Asia and the Pacific (Series of Webinars)

Organized by United Nations Centre for Regional Development (UNCRD) of Division for Sustainable Development Goals (DSDG) / UN DESA & Ministry of the Environment, Japan (MOEJ)

dr. Walter J.V. Vermeulen

December 1st, 2020

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10th Regional 3R and Circular Economy Forum in Asia and the Pacific

Webinar II: 1 December 2020

Indochina Time:	12:30 PM-15:00 PM
Japan Time:	14:30 -17:00 PM
London GMT (UTC):	05:30 AM-8:00 AM
New York Time:	01:30 AM-04:00 AM
India Time (IST):	11:00 AM-13:30 PM
Utrecht CET:	06:30 AM-9:00 AM

Lessons learned from COVID-19 pandemic situation towards building resilient cities (-> SDG 11)

What can 3R and circular economy offer at local, national and regional level?

Presentation 2:

New conceptions of circularity by re-organising the 3R's concept into waste hierarchy

by Dr. Walter J.V. Vermeulen, Utrecht University, Netherlands (8 min)

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Introducing

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Full length article

The circular economy: New or Refurbished as CE 3.0? — Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options

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ABSTRACT

Over the last decade, the concept of the circular economy has regained attention, especially related to efforts to achieve a more sustainable society. The 'revival' of the circular economy has been accompanied by controversies and confusions across different actors in science and practice. With this article we attempt at contributing to advanced clarity in the field and providing a heuristic that is useful in practice. Initially, we take a focus on the historical development of the concept of circular economy and value retention options (ROs) for products and materials aiming for increased circularity. We propose to distinguish three phases in the evolution of the circular economy and argue that the concept – in its dominant framing – is not as new as frequently claimed. Having established this background knowledge, we give insights into 'how far we are' globally, with respect to the implementation of circularity, arguing that high levels of circularity have already been reached in different parts of the globe with regard to longer loop value retention options, such as energy recovery and recycling. Subsequently, we show that the confusion surrounding the circular economy is more far reaching. We summarize the divergent perspectives on retention options and unite the most common views a 10R typology. From our analyses, we conclude that policymakers and businesses should focus their efforts on realization of the more desirable, shorter loop retention options, like remanufacturing, refurbishing and repurposing – yet with a view on feasibility and overall system effects. Scholars, on the other hand, should assist the parties contributing to an increased circular economy in practice by taking up a more active role in attaining consensus in conceptualizing the circular economy.

1. Introduction to Confusions in Conceptualizing CE

policies on national level. In Europe, many states have implemented CE

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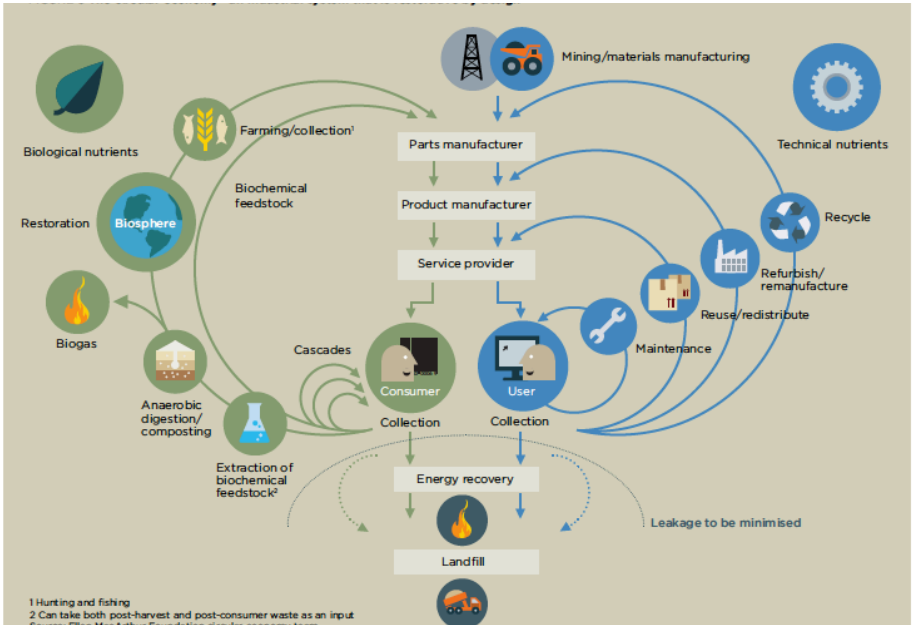
2010s: Circular Economy: new hype?

"We need to go from linear to circular"

"End the make-take-dispose system", . . .

2012+: Ellen MacArthur Foundation



Ellen MacArthur Foundation, 2013. Towards the Circular Economy Vol. 1. J. Ind. Ecol. 1, 4–8. doi:10.1162/108819806775545321

Mainstreamed in EU: Circular Economy

2015 Closing the loop - An EU action plan for the Circular Economy

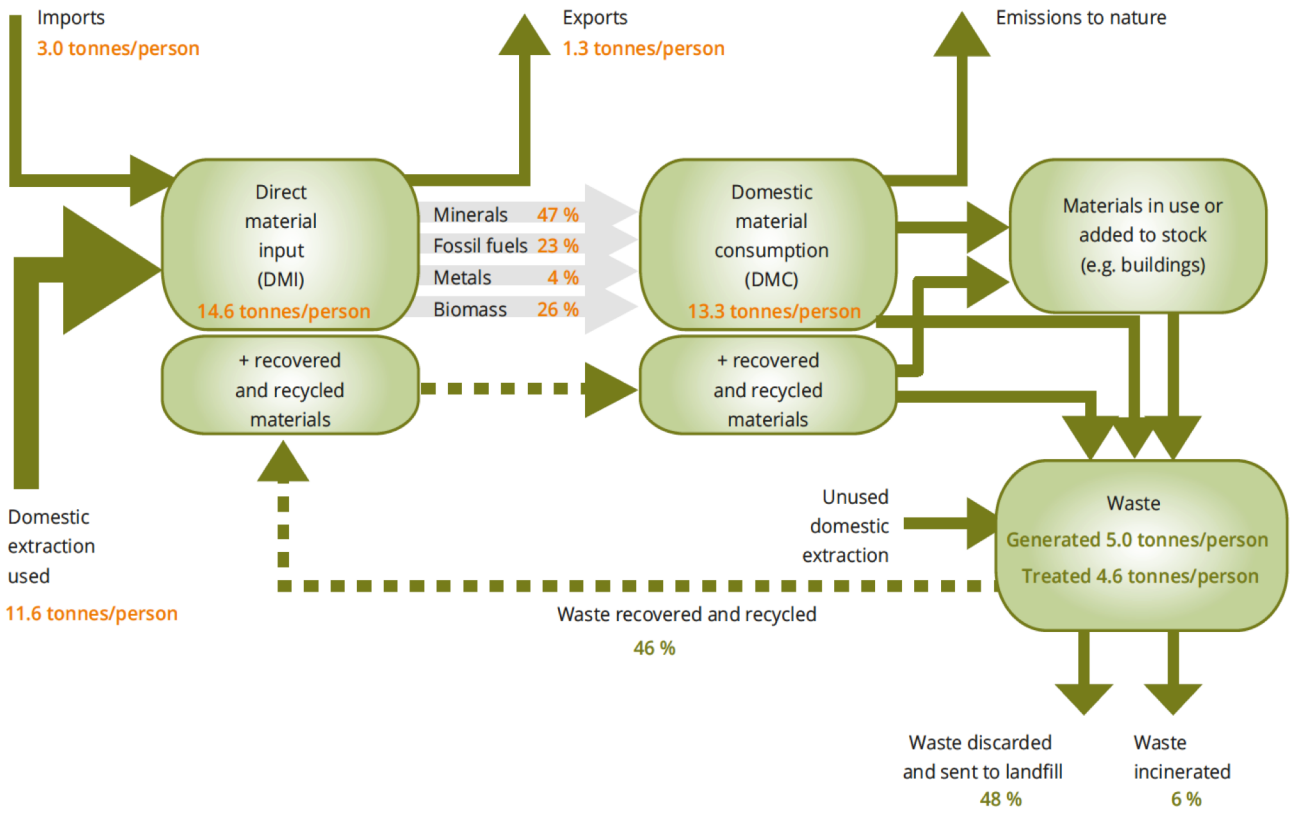
2020 new European Commission: Circular Economy Action Plan

EEA, 2016. Circular economy in Europe Developing the knowledge base. Copenhagen. doi:10.2800/51444

European Commission. (2020). Circular Economy Action Plan for a cleaner and more competitive Europe.

Current full EU picture: 46% circular?

Figure 3.1 Material flows and waste in the EU-28, 2012–2014



Note: For waste statistics, latest data are from 2012 (dark green figures); for material flows, data are from 2014 (orange figures).

Source: EEA, based on Eurostat 2015b, 2015c, 2015d.

Current picture: cases of 100% circular?

Tyre recycling EPR system in NL: 100% collection - 0% landfilling

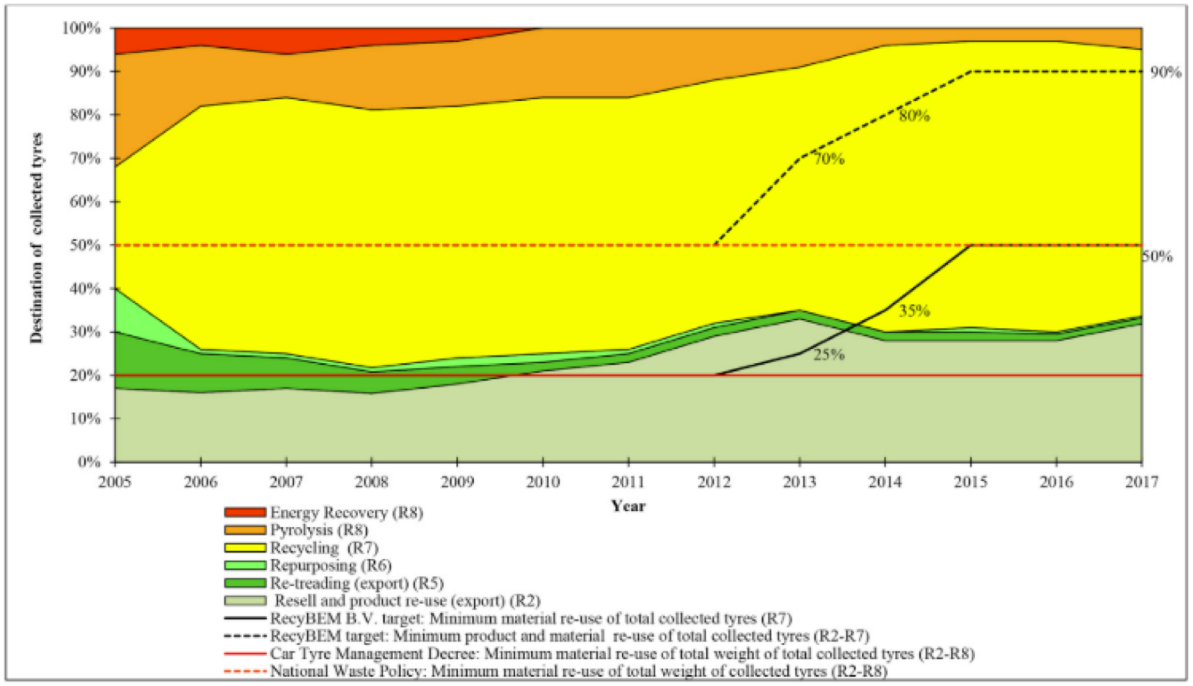


Fig. 6. Destination of collected used rubber tyres by RecyBEM B.V. between 2005 and 2017 (own work, source: annual reports Supplementary material).

Campbell-Johnston, K. *et al.* (2020) 'How circular is your tyre: Experiences with extended producer responsibility from a circular economy perspective', *Journal of Cleaner Production*. Elsevier Ltd, 270, p. 122042. doi: 10.1016/j.jclepro.2020.122042. OPEN ACCESS

3 era's of Circular Economy

Why still say: *"We need to go from linear to circular"*

Circular Economy 1.0 (1970 – 1990s)

- ***Away from landfilling:*** incinerate and first public recycling efforts
- First formulations of waste hierarchies like 3R: reduce, reuse, recycle / Ladder of Lansink
- Only output side of value chain oriented: what to do with waste after user phase?

Circular Economy 2.0 (1990's – 2010)

- ***Connecting input and output side*** in eco-efficiency strategies
- Input side: pollution preventions pays, environmental management systems, Design for Sustainability; Design for Disassembly, Industrial Ecology, Cradle to cradle etc.
- Output side: extended producer responsibility, eco-industrial parks, industrial symbiosis etc.

Circular Economy 3.0 (2010 – now)

- ***Maximizing Value Retention*** in age of resource depletion
- Replacing all virgin material inputs by secondary resources
- Relying on new business model incentives

BUT: different speeds in different part of the world

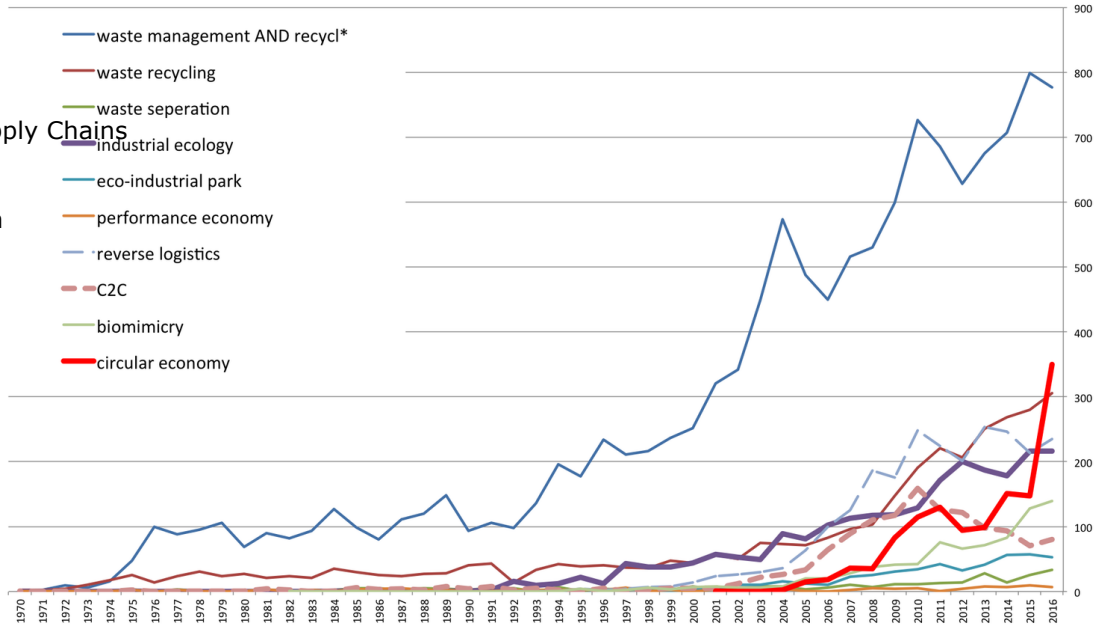
For more details see; Murray et al., 2015; Blomsma and Brennan, 20117; Calisto Friant et al., 2020

So: what's new about CE?

Four decades of experience / many disciplinary inputs:
"Mea culpa: disciplinary cacophony"

2018 article: review of 69 articles

- Environmental Science
- Industrial Ecology
- Ecological/Environmental Economics
- Reverse Logistics & Closed Loop Supply Chains
- Recycling & Waste Management
- Product Design & Cleaner Production
- "CE 2010+"



So: what are the imperatives?

The 3Rs?

Reike, D., Vermeulen, W.J.V. & Witjes, S., 2018. The circular economy: New or Refurbished as CE 3.0? — Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options. *Resources, Conservation and Recycling*, 135, pp.246–264. Available at: https://doi.org/10.1016/j.resconrec.2017.08.027.

40 years CE = messy use of R's in literature

Table 3
Representation of R-imperatives for circular economy in academic literature.
(Amelia et al., 2009; Badurdeen et al., 2009; Geng et al., 2012; Gerrard and Kandlikar, 2007; Guide et al., 2003; Ingarao et al., 2011; Kazazian, 2003; Kazerooni Sadi et al., 2012; Peng et al., 1997; Price and Joseph, 2000; Rahman et al., 2009; Rahman and Subramanian, 2012; Rusjanto et al., 2011; Sinha et al., 2016; Xin et al., 2014; Xing and Luong, 2009; Yan and Wu, 2011; Govindan et al., 2014) (For interpretation of the references to colour in the table legend, the reader is referred to the web version of this article).

#Rs	Count (Total/#R)	WM	RL/CLSC	CDCP	IE	CE2010+	Author Contribution
3R's	13 6 Green 2 Yellow 5 Orange	4	3	2	0	4	Yoshida et al. 2007; Amelia et al. 2009*; Xing & Luong 2009; Wang & Hsu 2010; Geng et al. 2012; Hassini et al. 2012; Jones et al. 2013*; Su et al. 2013; Bakker et al. 2014*; Ghisellini et al. 2014; Lieder & Rashid 2016*; Xin 2014; Diener & Tillmann 2015*
4R's	14 9 Green 4 Yellow 1 Orange	2	6	0	6	0	Greadel & Allenby 1995*; Ayres & Ayres 1996*; Cohen-Rosenthal & Musnikow 2003*; Guide et al. 2003*; Kazazian 2003*; Blackburn et al. 2004*; King et al. 2006*; Defee et al. 2009; Graedel et al. 2011*; Kazerooni Sadi et al. 2011; Hazen et al. 2012*; Loomba & Nakkashimi 2012; Rahman & Subramanian 2012; Stahel & Clift 2016*
5R's	19 13 Green 3 Yellow 3 Orange	6	6	3	4	0	Fleischmann et al. 1997*; Price & Joseph 2000; Tyler Miller & Spoolman 2002; Roine & Brattebo 2003*; Stahel 2003*;Fernández & Kekäle 2005; Gerrard & Kandlikar 2007*; Mitra 2007; Gehin et al. 2008; Rahman et al. 2009; Rusjanto 2010; Stahel 2010*; Li 2011; Yan & Wu 2011; Hultman & Corvellec 2012; Romero & Molina 2013*; Worrell & Reuter 2014*; Agrawal et al. 2015; Sinha et al. 2016*
6R's	12 5 Green 5 Yellow 2 Orange	1	7	4	0	0	Peng et al. 1997; Jawahir et al. 2006; Srivastava 2008*; Badurdeen et al. 2009; Jayal et al. 2010; Ingarao et al. 2011; Kuik et al. 2011; García Rodriguez et al 2013; Nagalingam et al. 2013; Yan & Feng 2014; Go et al. 2015; Govindan et al. 2015
7R's	4 3 Green 1 Yellow	0	2	0	2	0	De Brito & Dekker 2003*; Francis 2003; Liu et al. 2016*; Fercoq et al. 2016
8R's	2 1 Green 1 Orange	0	1	0	0	1	Thierry et al. 1995; Bilitewski 2012*
9R's	3 3 Green	0	3	0	0	0	Silva et al. 2013; Sihvonen & Ritola 2015; van Buren et al. 2016
10R's	2 1 Green 1 Orange	1	0	1	0	0	Allwood et al. 2011; Den Hollander & Bakker 2012
Total	69	14	28	10	12	5	

Author names with *: This/these author(s) use(s) a different terminology than 3Rs/4Rs or other units than products and materials, e.g. Ayres and Ayres (1996) 'strategies for raising productivity', Liu et al. (2016) 'repair companies, reuse companies'.
Color Coding: Refers to Clarity on Ranking of R-imperatives, see legend of Table 2

Value retention options "R" = ??

39x R

re-assembly, recapture, reconditioning, recollect, recover, recreate, rectify, recycle, redesign, redistribute, reduce, re-envision, refit, refurbish, refuse, remarket, remanufacture, renovate, repair, replacement, reprocess, reproduce, repurpose, resale, resell, re-service, restoration, resynthesize, rethink, retrieve, retrofit, retrograde, return, reuse, reutilise, revenue, reverse and revitalize.

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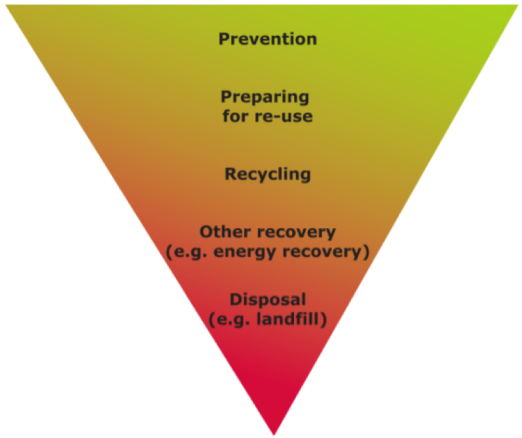
Example of confusion around the definition of 'Rs'

Description 're-use'	Author
Re-use as is, directly by consumers (product); consumer-to-consumer auctions, like e-bay and national equivalents	(Biliteweski, 2012); (Worrell and Reuter, 2014)
Second consumer, of a product that hardly needs any working, being referred to as 'as new' (product)	(Brito and Dekker, 2003)
Reusing with 'same purpose' (product)	(Bakker et al., 2014; Ghisellini et al., 2016)
'without refurbishment' (product)	(Silva et al., 2013);
re-using parts or components (parts)	(Jayal et al., 2010; King et al., 2006; Wang and Hsu, 2010; Yan and Feng, 2014)
're-use in fabrication' (unspecified)	(Graedel et al., 2011)
consumers and factory re-use (unspecified)	(Kuik et al., 2011)

From 3R to 10R's: synthesizing the definitions?

Old version CE 2.0:

Figure 2.1 The EU waste hierarchy

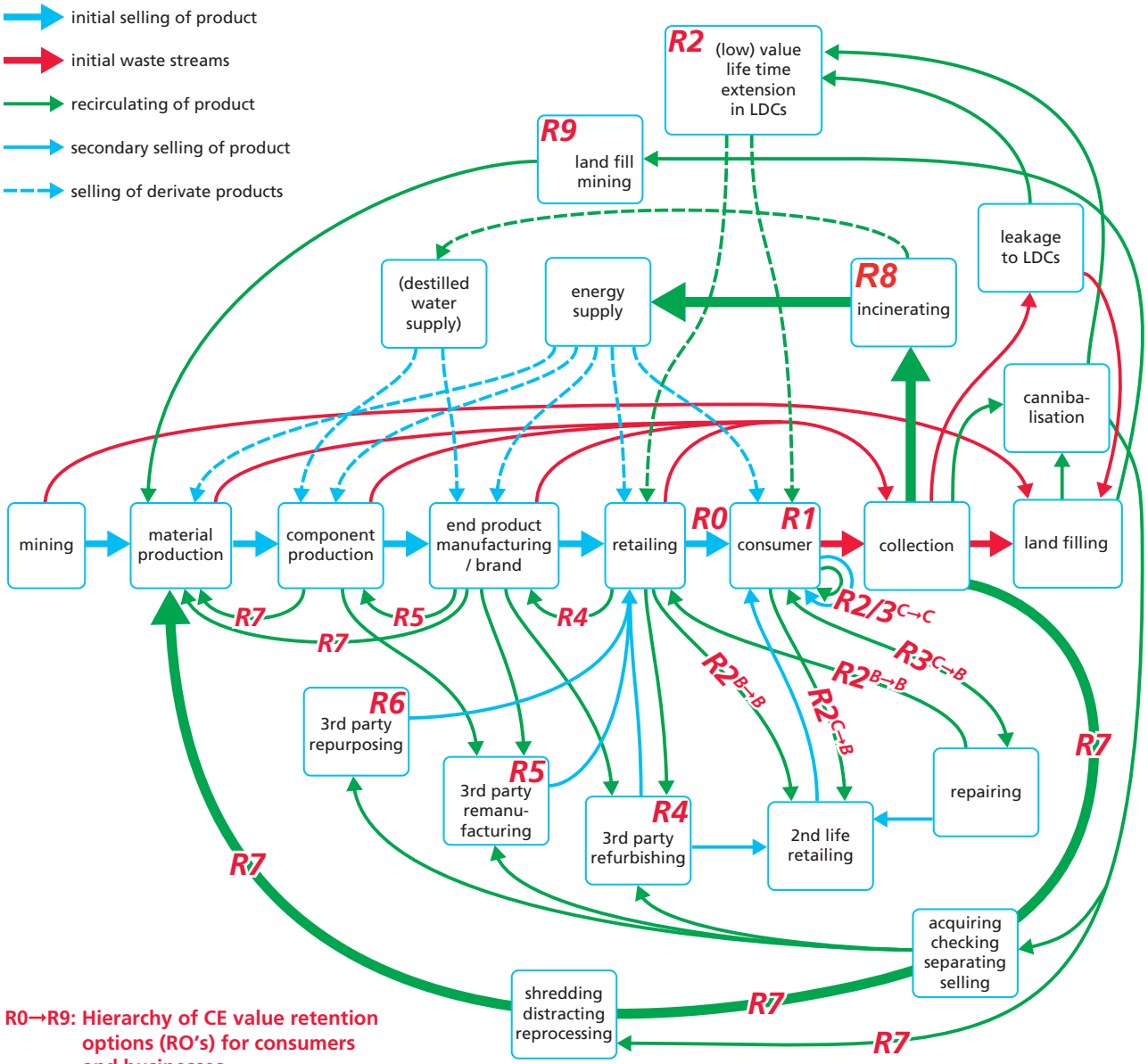


Source: ETC/SCP.

New synthesis CE 3.0:

R0 → R9: Hierarchy of CE options for consumers and businesses

R0 = Refuse
R1 = Reduce
R2 = Resell, reuse
R3 = Repair
R4 = Refurbish
R5 = Remanufacture
R6 = Re-purpose
R7 = Recycle materials
R8 = Recover energy
R9 = Re-mine



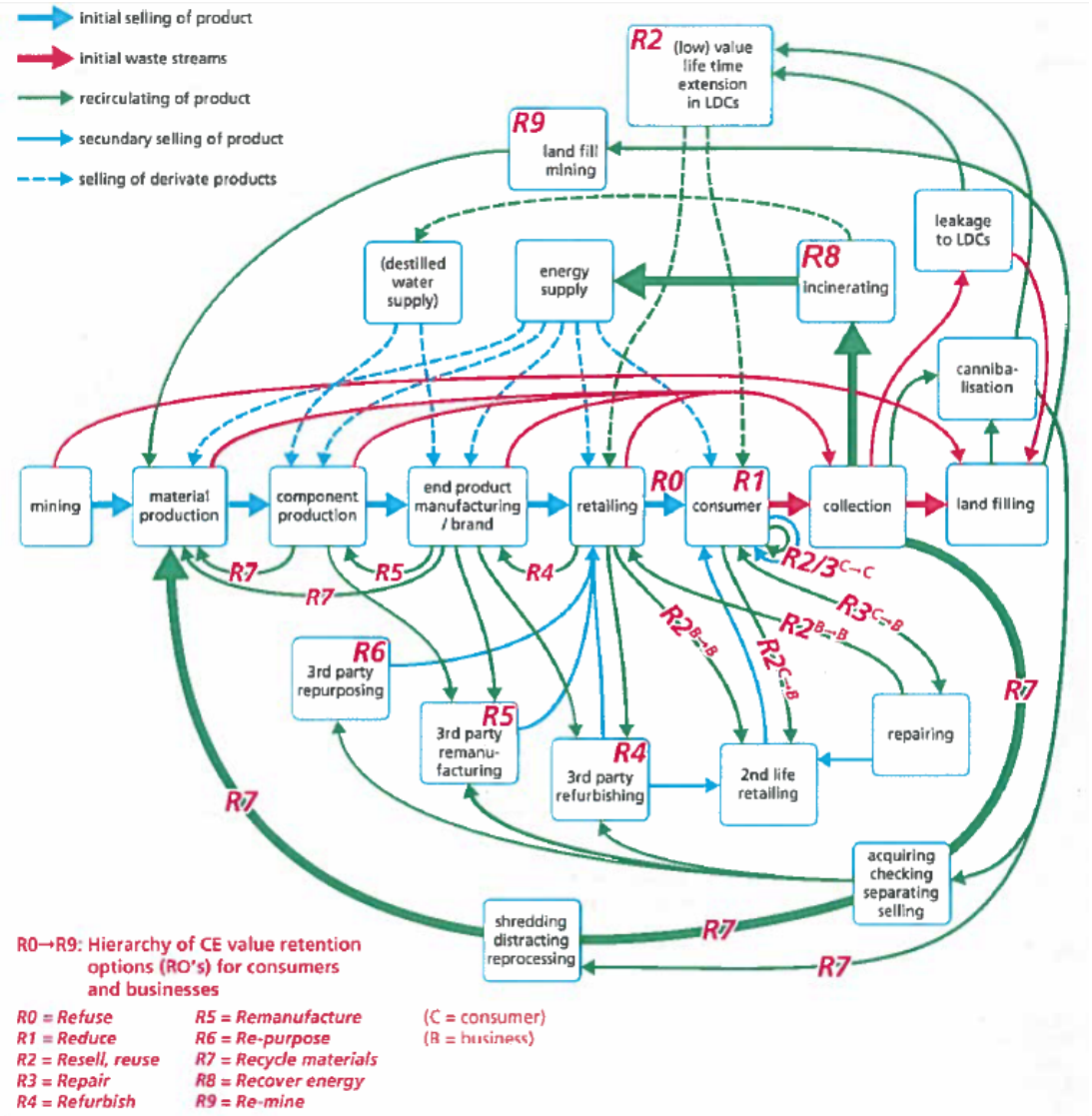
R0→R9: Hierarchy of CE value retention options (RO's) for consumers and businesses

R0 = Refuse	*R5 = Remanufacture*	(C = consumer)
R1 = Reduce	*R6 = Re-purpose*	(B = business)
R2 = Resell, reuse	*R7 = Recycle materials*	
R3 = Repair	*R8 = Recover energy*	
R4 = Refurbish	*R9 = Re-mine*	

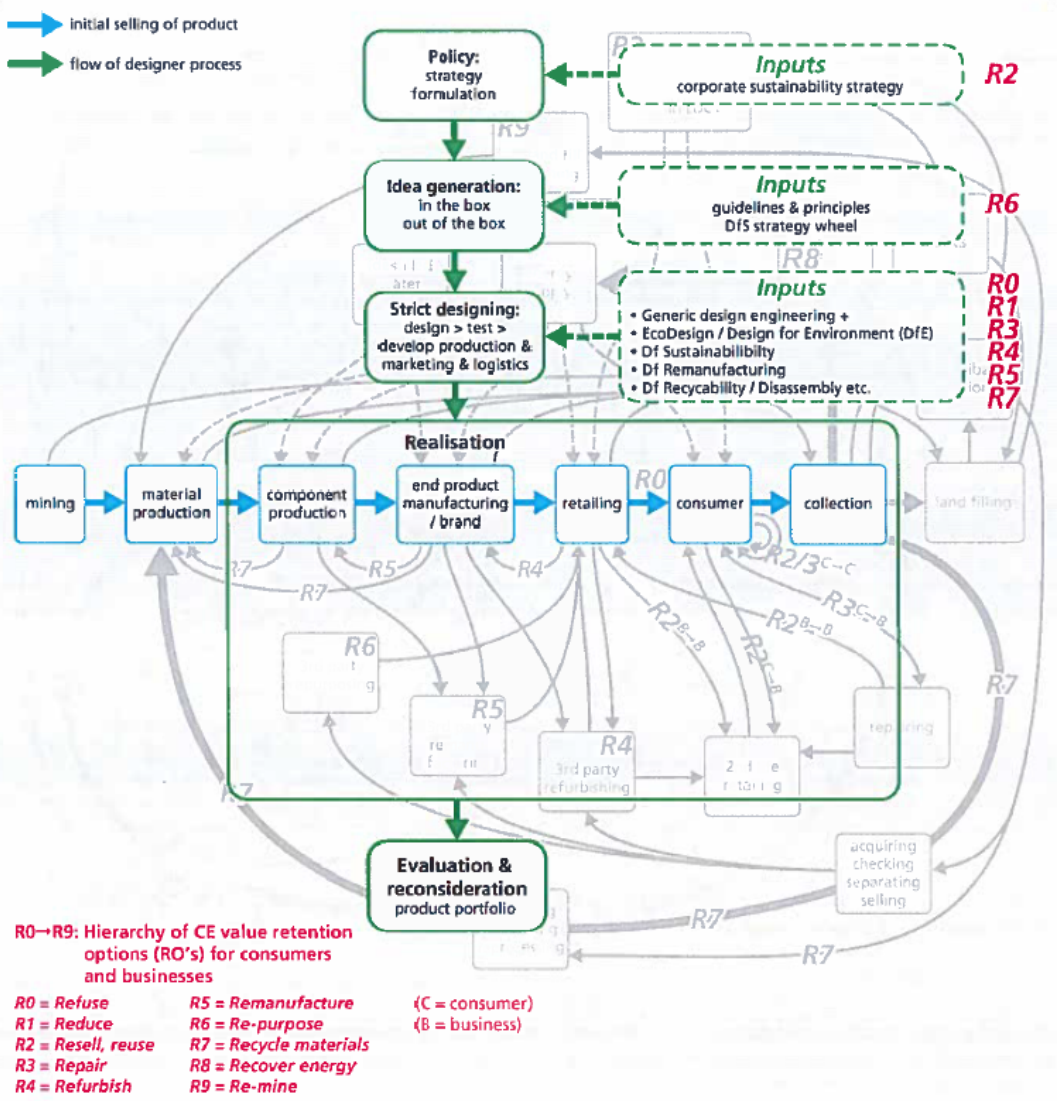
But also: 2 product life cycles

1. produce and use life cycle
2. concept and design life cycle

Cycle 1:
Product (produce & use) life cycle



Cycle 2:
Product (concept & design) life cycle



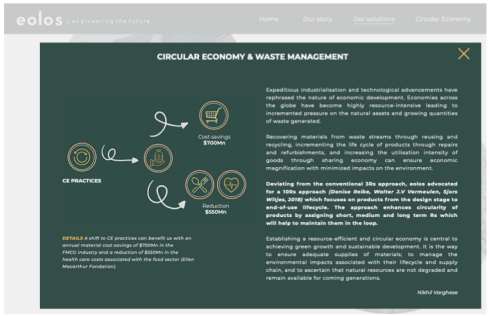
Current applications of 10R's synthesis

New synthesis CE 3.0:

R0 → R9: Hierarchy of CE options for consumers and businesses

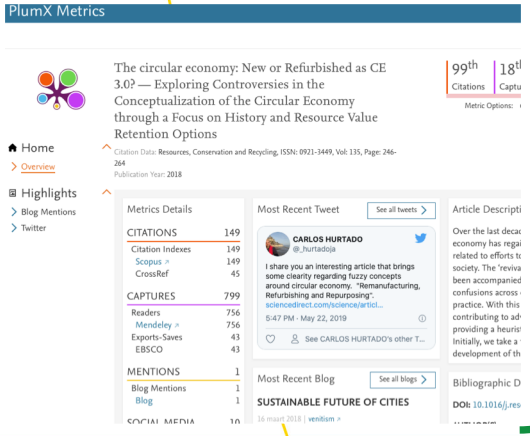
R0 = Refuse
R1 = Reduce
R2 = Resell, reuse
R3 = Repair
R4 = Refurbish
R5 = Remanufacture
R6 = Re-purpose
R7 = Recycle materials
R8 = Recover energy
R9 = Re-mine

Companies: search for strategies



Governments: policy development for the full spectrum of R - imperatives

Governments:
policy evaluation and monitoring



Scientists:
research framework
& common definitions

NGO's and consultants:
support tool for
awareness raising

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Challenges for CE 3.0

The confusion on CE definitions and business options stems from complexity, from various disciplines with own perspectives:

- Can be reduced by using the new common definitions of the R- 'reutilization options'
- Thus create a common ground for scientists, business & governments
- Re-think implications at the various levels of aggregation (macro – meso – micro)
- Include the forgotten cycles in CE policies …
  - R0, R1, R2: Consumer preferences / Activate shorter loops
  - R7: mixed results
    - EU South: raise current low recycling to 70-80%
    - EU North-West: from 70-80% further up
    - Still to start in global South
  - Redesign products: transparant about % use recycled
  - $R2^{LDC:}$ deal with leakages to LDCs
  - R9: mine old landfills just starting
- …

Challenges for CE 3.0

The confusion on CE definitions and business options stems from complexity, from various disciplines with own perspectives:

- …
- Acknowledge roles of new actors and forms of C2C, B2C and B2B collaboration: the shorter and middle long loops
- Go beyond business models ‘religion’ . . . to become transformative and to address R0 and R1

BUT still to be stresses: there is diversity in worldviews behind it:

we developed a matrix of 4 typical views:

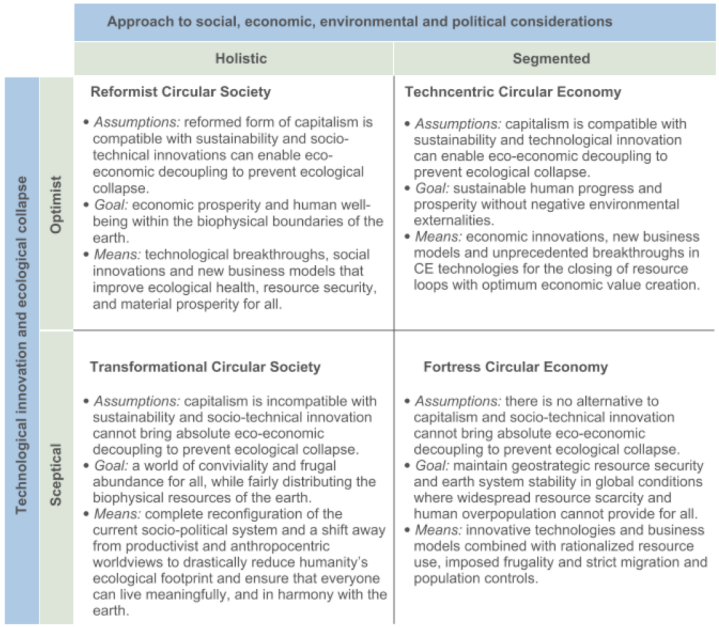

Fig. 5. Circularity discourse typology.

See Calisto Friant, M. C., Vermeulen, W. J. V and Salomone, R. (2020) ‘A Typology of Circular Economy Discourses : Navigating the Diverse Visions of Contested Paradigm’, *Resources, Conservation and Recycling*. Elsevier, 161(May), p. 104917.

doi: 10.1016/j.resconrec.2020.104917. OPEN ACCES

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Key readings:

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Suggested readings:

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