Circular Economy

How to connect policy, research and business

May 10, 2019, Fondazione Eni Enrico Mattei, Milano

Circular Economy: Connecting research, industry, and policy

A background report for initiatives design

Roberto Zoboli

Catholic University, Milan, and SEEDS

UNIVERSITÀ CATTOLICA del Sacro Cuore

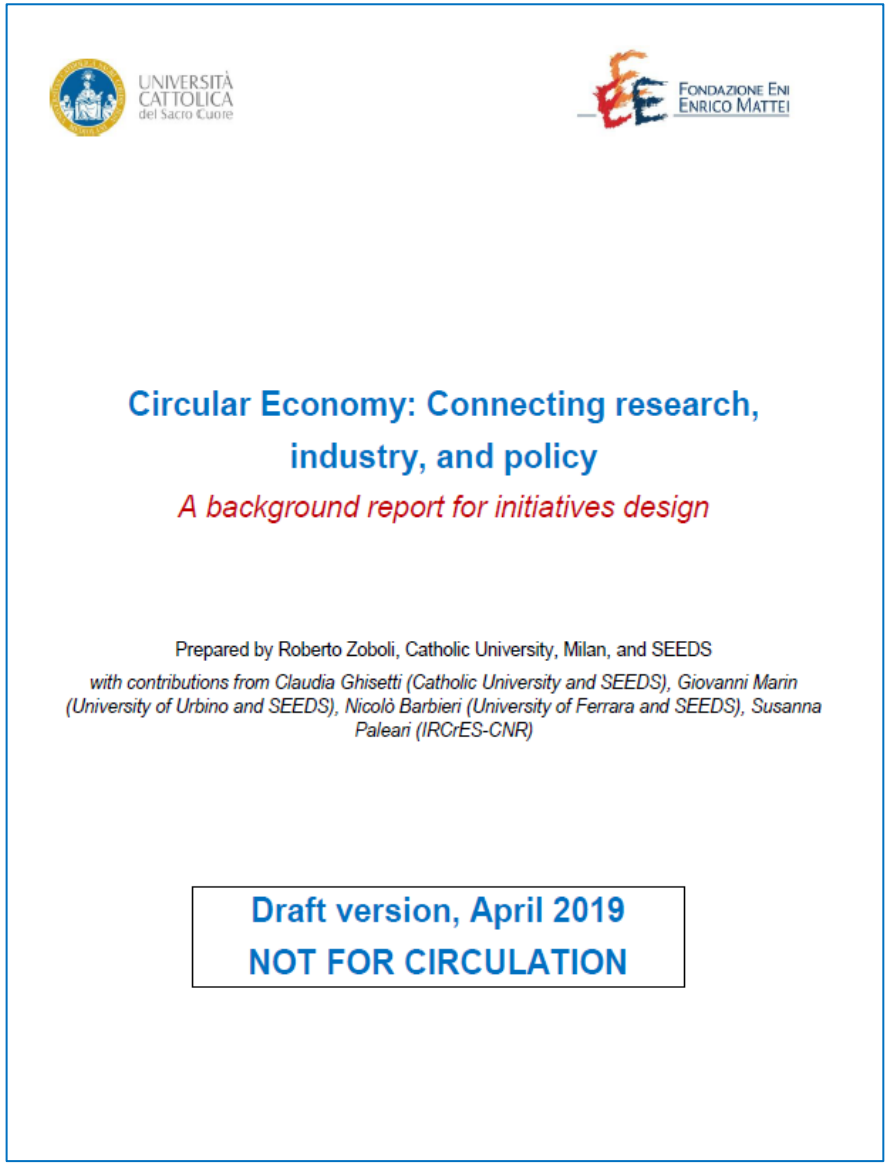
FONDAZIONE ENI ENRICO MATTEI

The report

- **Aim: Background for strategies/initiatives on the CE**

- **Part 1: Taking stock of the knowledge base:**
  1. Conceptual frameworks
  2. Evolving policy framework
  3. Quantifications
  4. Innovation
  5. Selected initiatives Europe – Italy

- **Part 2: Directions to expand the knowledge base**
  1. CE as an 'Innovation System'
  1. NEXUS: CE - Decarbonisation – Bioeconomy
  2. Open 'economics' issues



Features

- **Focus: CE knowledge base for industry-policy connection (gaps)**
- **Thread: 'Old CE' and 'New Innovation-based CE':**
  - ***'CE Package 2015-2018' a demarcation line?***
  - ***Innovation/industrial policies a new major driver?***
- **European scope, Italian examples: EU-level drivers/processes**
- **Selective in Part 1, especially on 'Conceptual frameworks' and 'Initiatives**
- **Preliminary in Part 2**

Part 1: Taking stock of the CE knowledge base

- 1. Concepts and ideas on the CE
- 2. Policy drivers
- 3. Quantifications
- 4. Innovation for the CE
- 5. Selected initiatives

1. Concepts and ideas on the CE

- Ellen MacArthur Foundation 2012
- Bochen et al. 2016 and OECD 2017
- Waste hierarchy (Lansink's Ladder 1970s)
- EEA 2015
- Academic research

Figure 1.1. The Circular Economy according to the Ellen Mac Arthur Foundation

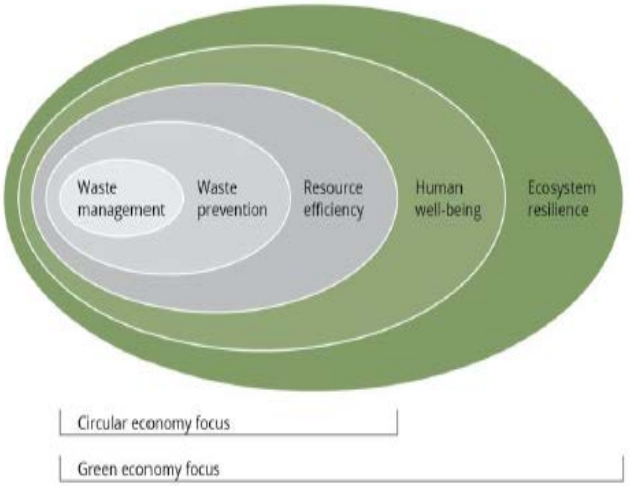
Figure 1.2. Definitions, features, and effects of the Circular Economy

DEFINITIONS CE FEATURE KEY EFFECTS

Figure 1.3. Decoupling and Circular Economy

Figure 1.3. The EU waste hierarchy

Figure 1.4: The Circular Economy within the Green Economy according to the EEA



Source: EEA, 2015 https://www.eea.europa.eu/soer-2015/europe/green-economy

2. Policy drivers

- *P1: The EU Waste Hierarchy*
- *P2: Extended producer responsibility (EPR)*
- The revised directives on waste and the Plastics Strategy (2018)
- The CE and the revision of the Bioeconomy strategy (2018)
- The CE in the 'Carbon-neutral economy 2050' strategy (2018)
- ➡ ***Section 6: NEXUS***

Figure 2.2 EU policy targets (binding) for 'waste and resources 2015-2050 (number and deadlines)

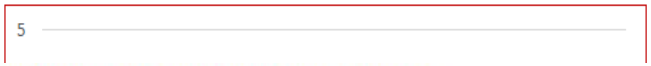


Figure 2.3. The economic size of the bioeconomy in the EU, 2015

Figure 2.4. Carbon neutral strategy: Overview of main scenario building blocks

Long Term Strategy Options

	Electrification (ELEC)	Hydrogen (H2)	Power-to-X (P2X)	Energy Efficiency (EE)	Circular Economy (CIRC)	Combination (COMBO)	1.5°C Technical (1.5TECH)	1.5°C Sustainable lifestyles (1.5LIFE)
Main Drivers	Electrification in all sectors	Hydrogen in industry, transport and buildings	E-fuels in industry, transport and buildings	Pursuing deep energy efficiency in all sectors	Increased resource and material efficiency	Cost-efficient combination of options from 2°C scenarios	Based on COMBO with more BECCS, CCS	Based on COMBO and CIRC with lifestyle changes
GHG target in 2050	-80% GHG (excluding sinks) ["well below 2°C" ambition]					-90% GHG (incl. sinks)	-100% GHG (incl. sinks) ["1.5°C" ambition]	
Major Common Assumptions	• Higher energy efficiency post 2030 • Deployment of sustainable, advanced biofuels • Moderate circular economy measures • Digitilisation					• Market coordination for infrastructure deployment • BECCS present only post-2050 in 2°C scenarios • Significant learning by doing for low carbon technologies • Signficant improvements in the efficiency of the transport system.		
Power sector	Power is nearly decarbonised by 2050. Strong penetration of RES facilitated by systemoptimization (demand-side response, storage, interconnections, role of prosumers). Nuclear still plays a role in the power sector and CCS deployment faces limitations.							
Industry	Electrification of processes	Use of H2 in targeted applications	Use of e-gas in targeted applications	Reducing energy demand via Energy Efficiency	Higher recycling rates, material substitution, circular measures	Combination of most Cost-efficient options from "well below 2°C" scenarios with targeted application (excluding CIRC)	COMBO but stronger	CIRC+COMBO but stronger
Buildings	Increased deployment of heat pumps	Deployment of H2 for heating	Deployment of e-gas for heating	Increased renovation rates and depth	Sustainable buildings			CIRC+COMBO but stronger
Transport sector	Faster electrification for all transport modes	H2 deployment for HDVs and some for LDVs	E-fuels deployment for all modes	Increased modal shift	Mobility as a service			• CIRC+COMBO but stronger • Alternatives to air travel
Other Drivers		H2 in gas distribution grid	E-gas in gas distribution grid				Limited enhancement natural sink	• Dietary changes • Enhancement natural sink

Source: European Commission (2018)

3. Quantifications

- Waste statistics
- Joining waste statistics and LCA data
- The European Reference Model for Waste
- Material Flow Accounts
- The Eurostat CE indicators
- Closing the circle: Input output data, EEIO, and other models

Figure 3.1 Management of municipal solid waste in the EU27, 1995-2017 (by codes, thousands tons)

Figure 3.3 Net greenhouse gas emissions from municipal waste in EU-27 + Norway and Switzerland, baseline scenario (million tonnes CO2-equivalents)

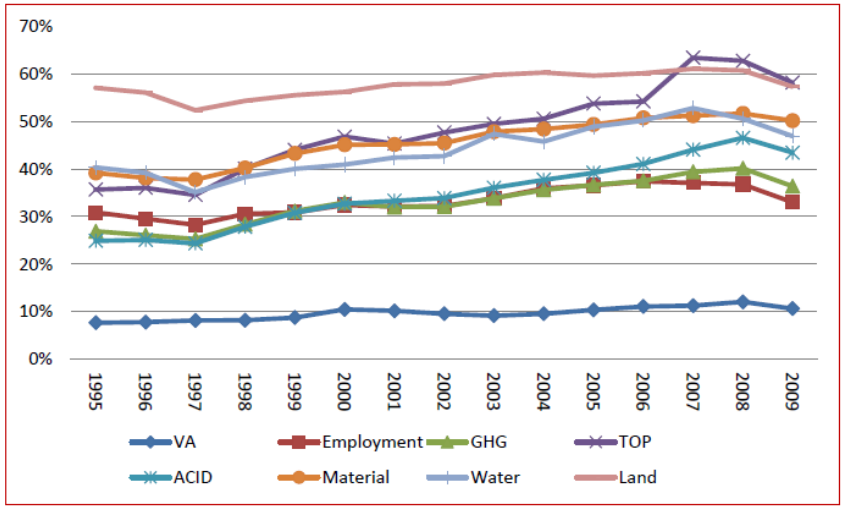
Figure 3.5 Basic structure of the European Reference Model for Waste

Figure 3.8 The 'Circularity in material use rate' indicator for the EU28

35

Figure 3.9 The Sankey diagram of materials and waste flows in the EU28, 2016, billion tonnes per year

Figure 3.14 Share of environmental pressures and economic activity occurred out of the EU27 to satisfy the final demand of EU27



Source: Marin and Zoboli (2017)

4. Innovation for the CE

- Evidence on patents for the CE
- Evidence on CE innovation adoption by enterprises
- Evidence on CE organisational innovation: compliance schemes in EPR value-chains
- ***Section 6: 'Innovation system'***

Figure 4.4 Trends in the number of patents (filing) in different waste/CE technologies, OECD Europe, 1990-2015

Figure 4.6 Patents on recycling and waste management technologies according to Eurostat CE indicators framework, 2000-2014, number of patents

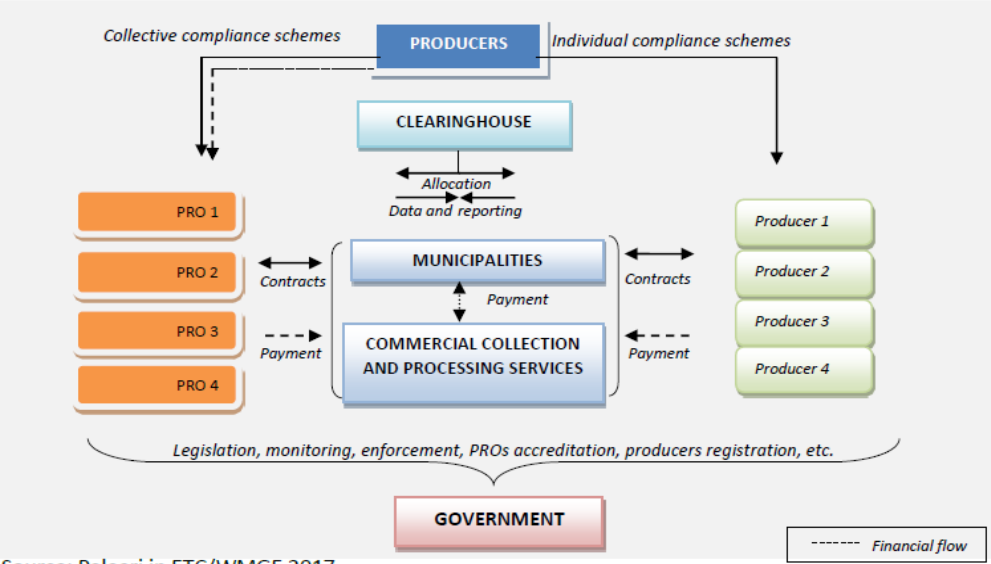
Figure 4.12 CIS: enterprises in Industry (excluding construction) introducing innovations to reduce energy/CO2 footprint and materials/water use, all size classes, % of introducing enterprises, 2014

70,0

Figure 4.15 Matrix of EPR responsibilities

Financial

Figure 4.17. Role of stakeholders in an EPR system



Source: Paleari in ETC/WMGE 2017

5. Selected initiatives

- ***Ellen MacArthur Foundation*** https://www.ellenmacarthurfoundation.org/
- ***EEA – European Environment Agency*** https://www.eea.europa.eu/
- ***European Circular Economy Stakeholder Platform*** https://circulareconomy.europa.eu/platform/
- ***MATTM, ENEA, ICEP (Italy)*** https://www.minambiente.it/pagina/economia-circolare
- ***Circular Economy Network, Istituto per lo Sviluppo Sostenibile (Italy)*** https://circulareconomynetwork.it/
- ***Confindustria (Italy)*** http://economiacircolare.confindustria.it/
- ***ASviS (Italy)*** http://asvis.it/#
- ***Lombardy Region (Italy)*** http://www.regione.lombardia.it/wps/portal/istituzionale/HP/lombardia-notizie/DettaglioNews/2018/10-ottobre/22-28/cattaneo-insediato-osservatorio/cattaneo-insediato-osservatorio

A few points from Part 1

- Overload of definition/conceptualisation work: useful?
- Shortage of quantifications based on 'circular' analytical tools
- Innovation:
  - (i) many stories of 'CE business models' and micro-innovations: what macro-implications?
  - (ii) scope of relevant innovations: to be redefined (beyond waste)?
- Hundreds of micro-initiatives: all relevant, credible, useful?

Part 2: Future directions

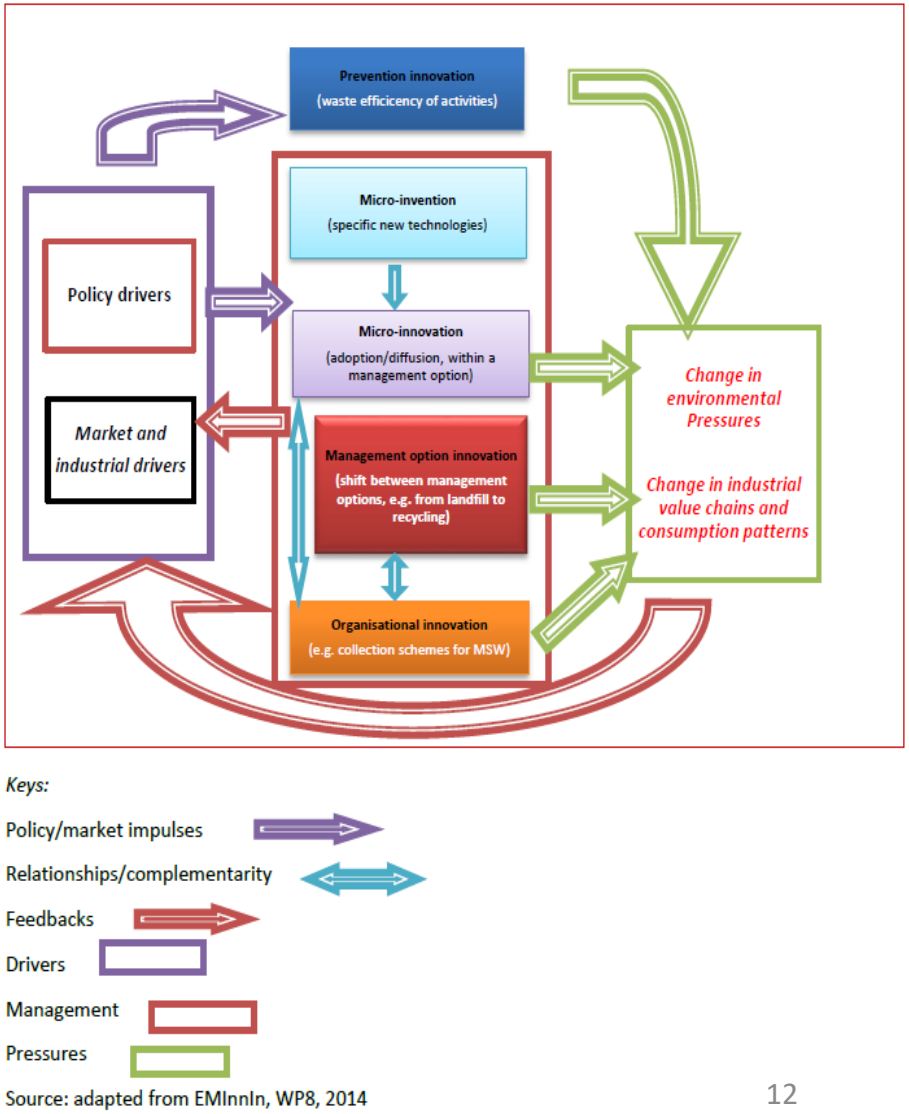
Enlarging the CE knowledge-base to connect research, industry, and policy

1. **Looking at the CE as an 'innovation system'**
2. A NEXUS approach: Linking CE, decarbonisation, and bioeconomy
3. Other open economic issues

Waste system/policy: Innovation view

- Prevention innovation *(e.g. dematerialising)*
- Micro-level invention and innovation *(e.g. chemical recycling)*
- Management-option innovation *(technology diffusion, moving to 'Zero landfill')*
- Organisational innovation *(e.g. EPR schemes)*
- Policy and market drivers, and feedbacks

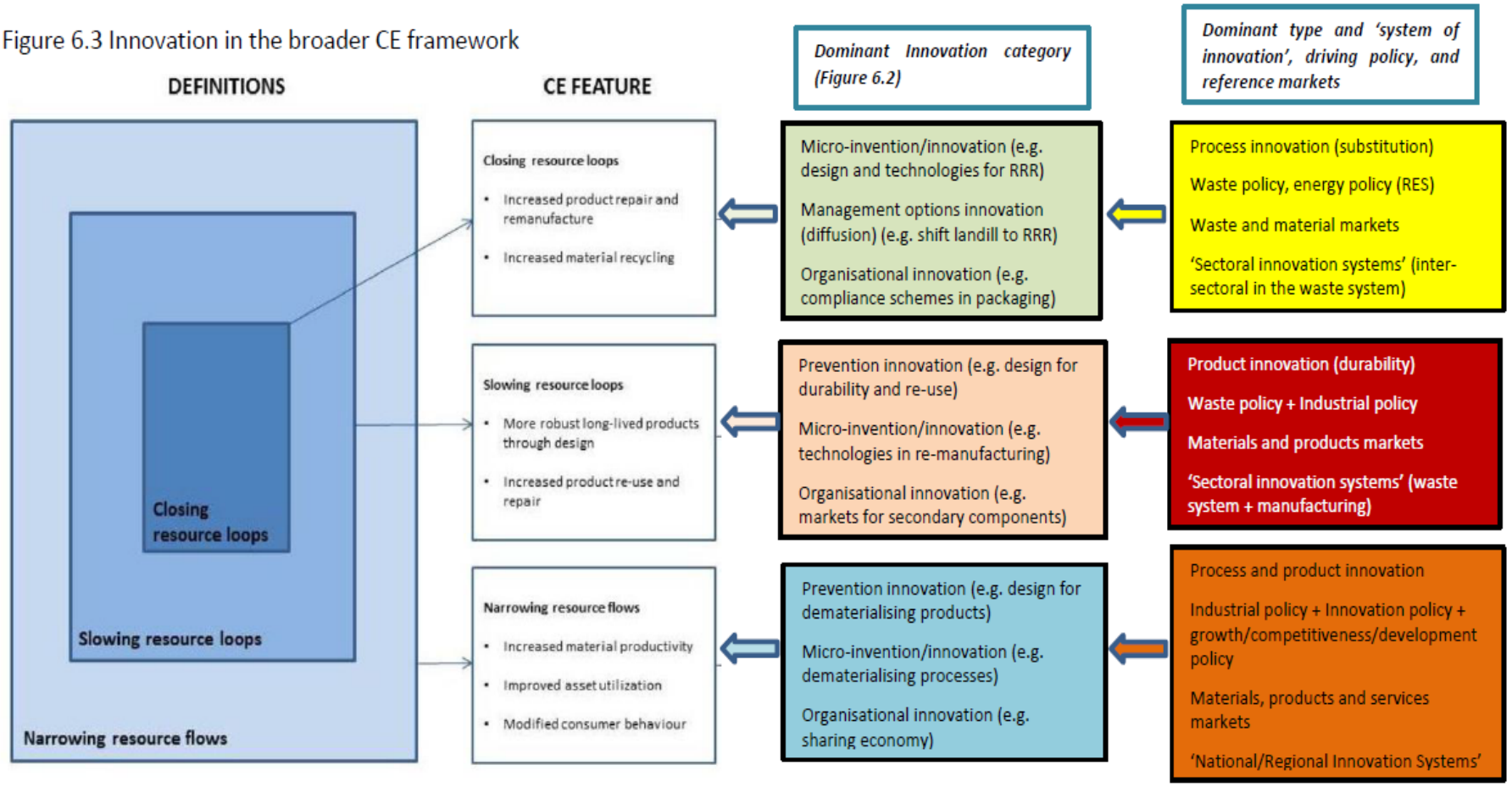
Figure 6.2. The waste system from the innovation angle



Source: adapted from EMInnIn, WP8, 2014

A broader CE-innovation perspective

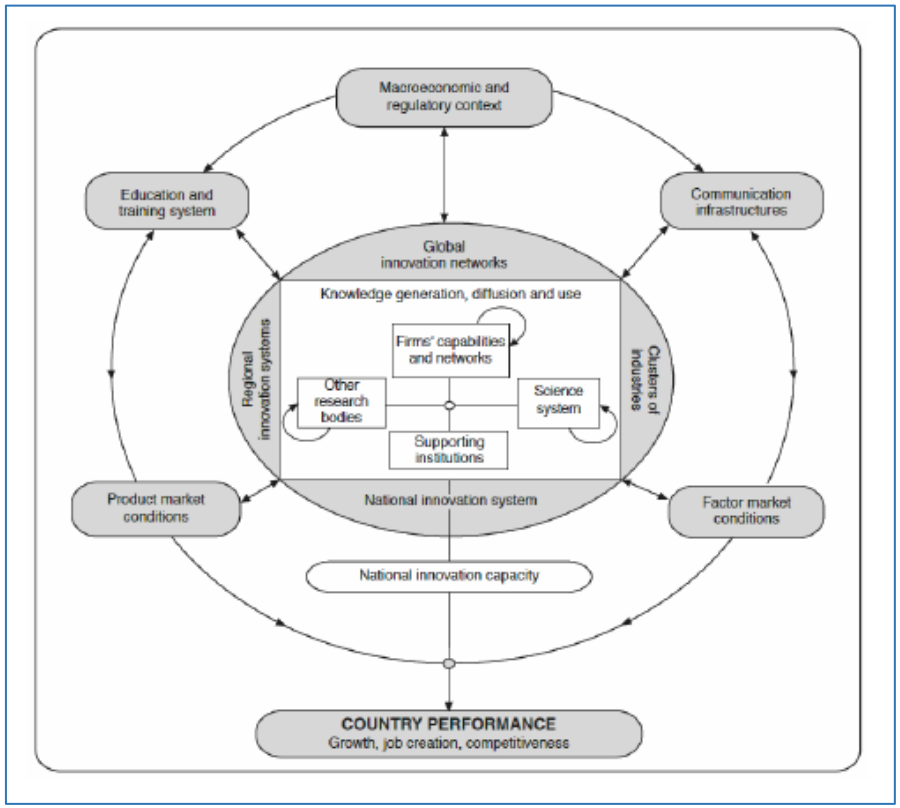
Figure 6.3 Innovation in the broader CE framework

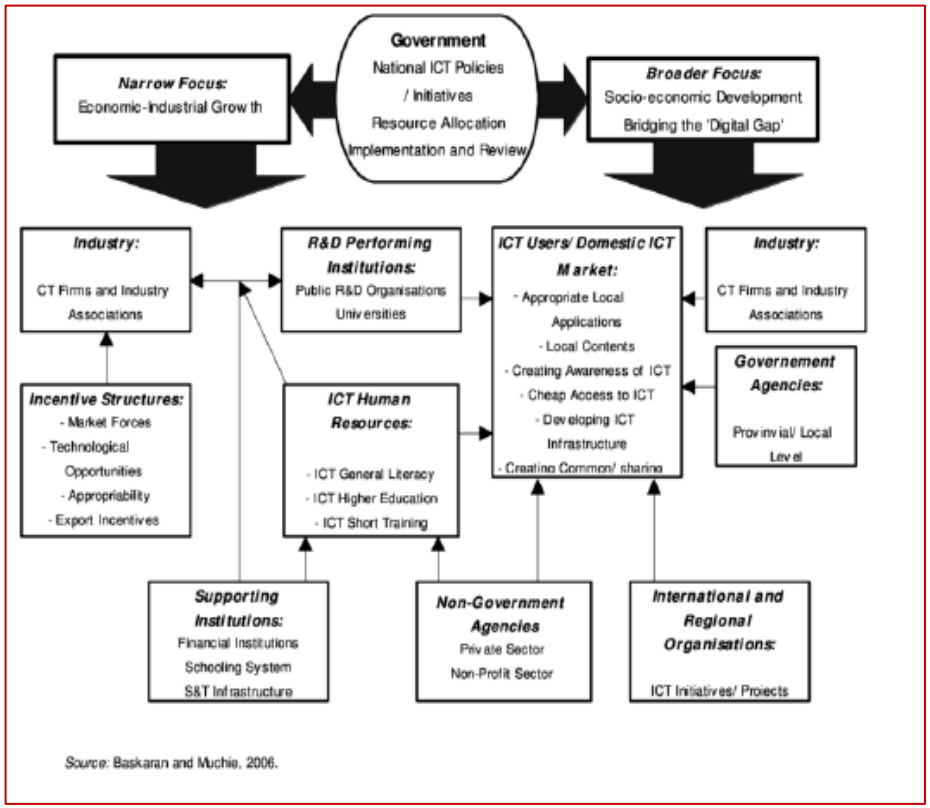


Source: own elaboration starting from OECD 2017, Figure 1.2, Section 1, and Figure 6.2 above.

The 'Sectoral/National Innovation Systems' approach

A National System of Innovation (OECD 1999) and example of a Sectoral System of Innovation (for ICT sector)





‘New Innovation-based CE’: Pushes from EU R&I policy (H2020, HE, MAFF)

H2020 Work Programme 2018-2020: Components of the Focus Area - 'Connecting economic and environmental gains – the Circular Economy'

Component	Budget
Leadership in enabling and industrial technologies - Nanotechnologies, Advanced Materials, Advanced Manufacturing and Processing, and Biotechnology (LEIT-NMBP): European high-tech building blocks serving the circular economy (Sustainable Process Industries (SPIRE) initiative)	€370 million
Societal Challenge 2 'Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy' (SC2): the bio-economy aspects of the circular economy	€256 million, including €100 million for access to risk finance
Societal Challenge 3 'Secure, clean and efficient energy' (SC3): reuse of carbon dioxide	€12 million
Societal Challenge 5 'Climate action, environment, resource efficiency and raw materials' (SC5): transition to circular economy business models and practices, and sustainable sourcing or raw materials, also from secondary sources	€326 million

Source: adapted from EC H2020 Work Programme 2018-2020

Part 2: Future directions

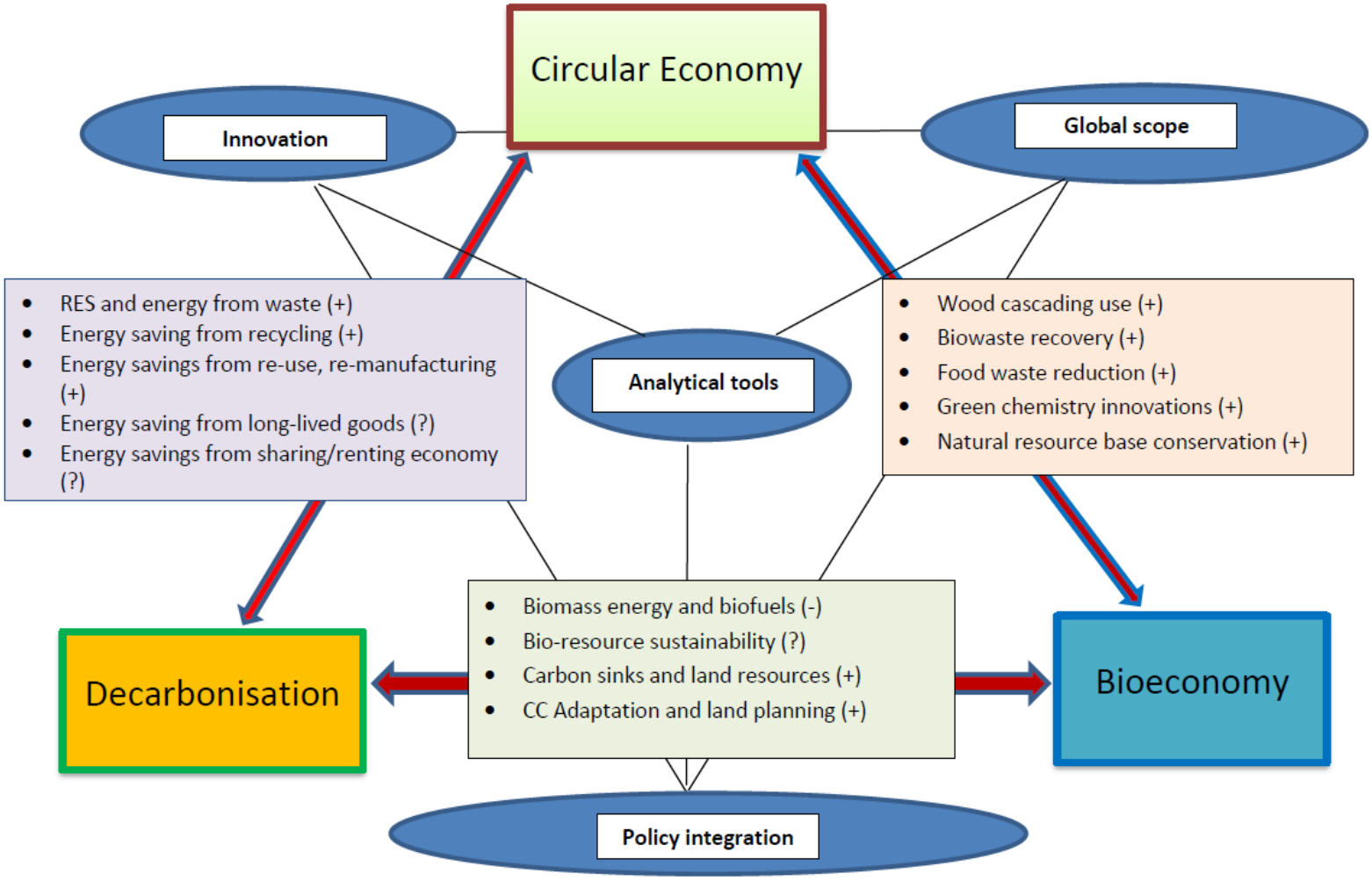
1. Looking at the CE as an ‘innovation system’
2. **A NEXUS approach: Linking CE, decarbonisation, and bioeconomy**
3. Other open economic issues

A NEXUS for the CE

- Interconnections: conventional sectoral approaches not effective or not efficient
- NEXUS approach: overcome fragmentation/separation of sectoral policies in systemic problems
- CE – Decarbonisation - Bioeconomy: interconnections often recognised/cross-referenced, but still separate strategies/policies/transitions with own scopes, objectives, instruments
- ***….. but companies/industries operate in a NEXUS framework***

A sketch of the CE-DEC-BIO NEXUS

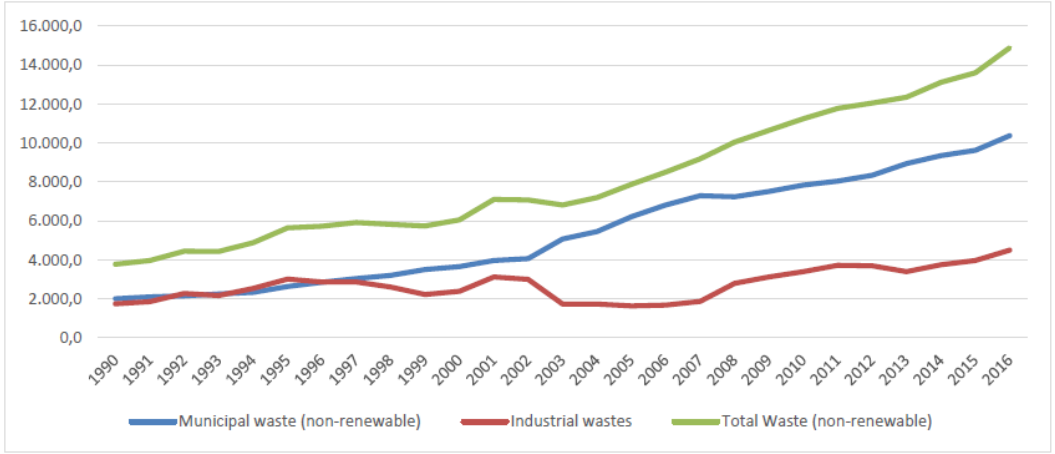
Figure 6.6. A sketch of the CE-DEC-BIO NEXUS



Example: Energy from waste, RES and biomass

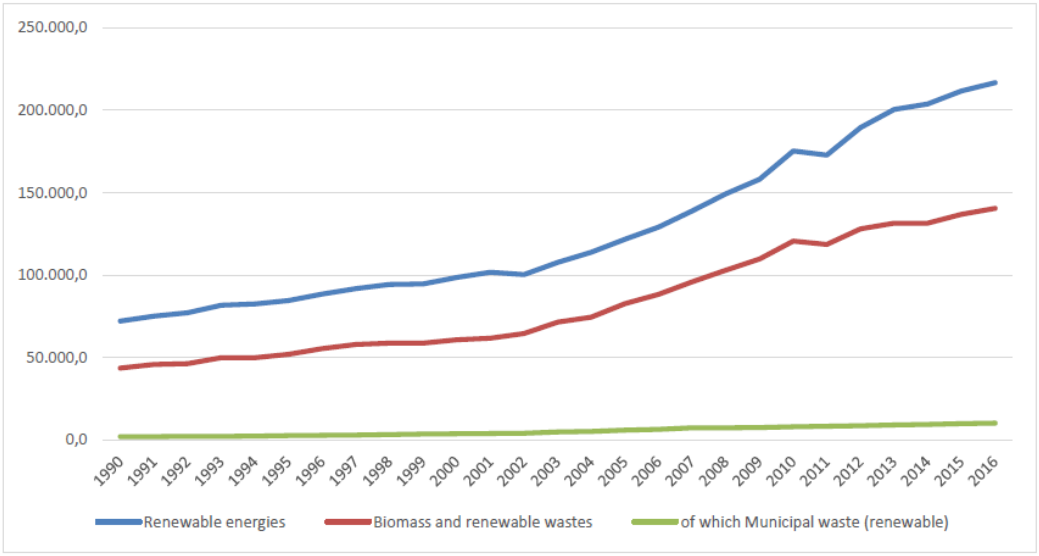
- 'Waste-to-energy' is increasing
- Energy from biomass and 'renewable waste' 65% of total RES consumption (2016)
- Pressures on biocapacity: CE can reduce

Figure 6.7 Gross inland energy consumption from non-renewable waste (municipal and industrial, EU28, 1990-2016, thousands TOE



Source: own elaborations on Eurostat data.

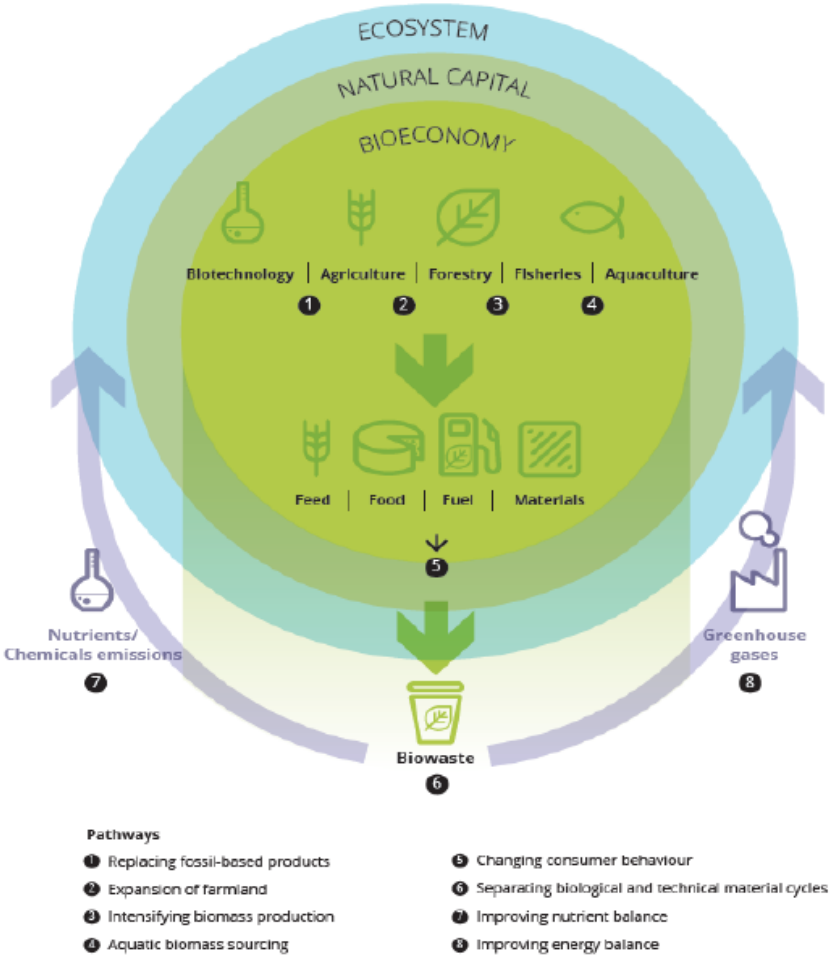
Figure 6.8 Gross inland energy consumption from Renewable Energy Sources and from 'biomass and renewable municipal waste', EU28, 1990-2016, thousands TOE



Source: own elaborations on Eurostat data.

Example: Circular bioeconomy

Figure 6.9: The 'Circular bioeconomy' according to EEA, 2018



Source: EEA, 2018

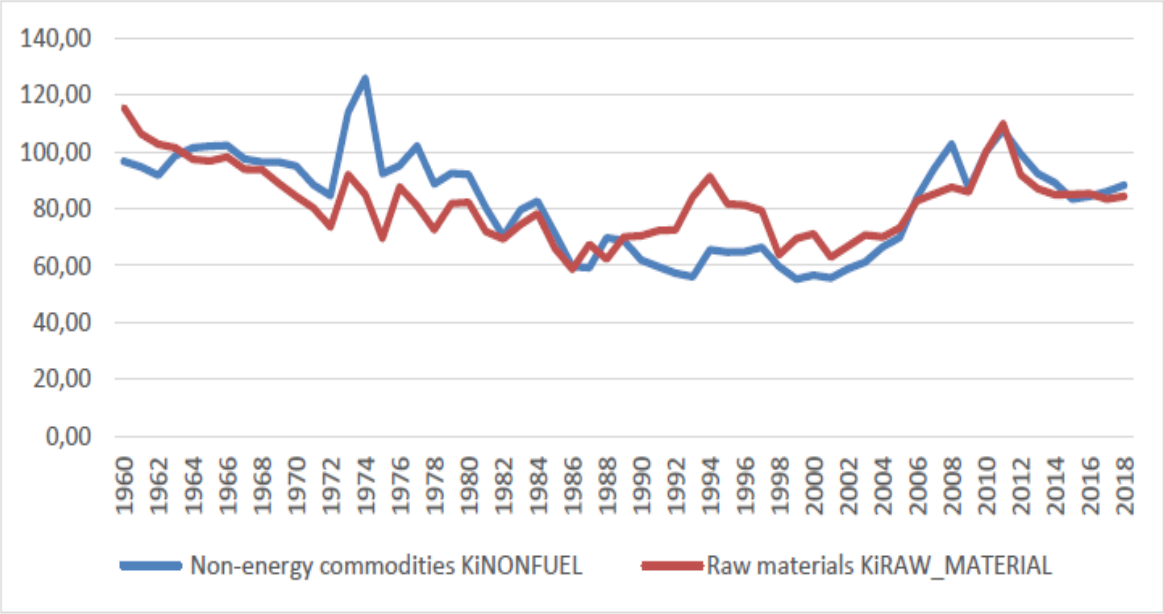
Part 2: Future directions

1. Looking at the CE as an ‘innovation system’
2. A NEXUS approach: Linking CE, decarbonisation, and bioeconomy
3. **Other open economic issues**

Weak knowledge on the 'economics' of the CE

- **Weak incentives to CE/RE from commodity market prices**
- **Policies (and people) have a central role**
- **Limited information on micro-economics of recycling/secondary materials**
- **Limited use of MBI and price-based policies, mainly EPR**
- **Limited knowledge on capacities (treatment, recycling, trade)**
- **Investment needs and finance for the CE**

Figure 6.10. Indexes of real prices of non-energy commodities and raw materials



Source: own elaborations on World Bank data

Comments and suggestions?

- ***How to expand/improve the knowledge base for industry-policy connection?***
- ***Is the 'Innovation System' approach useful?***
- ***Is the NEXUS approach useful?***
- ***How to fill knowledge gaps on the '(micro)economics' of the CE?***