3° workshop
Rifiuti e Life Cycle Thinking
verso un utilizzo circolare delle risorse
15 febbraio 2017
Politecnico di Milano

Circular Economy, gestione dei rifiuti e Life Cycle Thinking

- stato dell'arte sul tema della Circular Economy
- interpretazioni del tema
- leve (costi/impatti ambientali, rifiuti/risorse)
- strumenti Life Cycle (LCA, LCC, SLCA)

Serena Giorgi, Prof.ssa Monica Lavagna, Prof. Andrea Campioli

Dipartimento di architettura, ingegneria delle costruzioni e ambiente costruito (ABC)
Politecnico di Milano

"The Economics of the Coming Spaceship Earth"
Kennet Boulding
1966

1976
W. Stahel
"The Potential for Substituting Manpower for Energy"

"Biomimicry"
Janine Benyus
1997

2002
McDonough and Braungart
"Cradle to cradle"

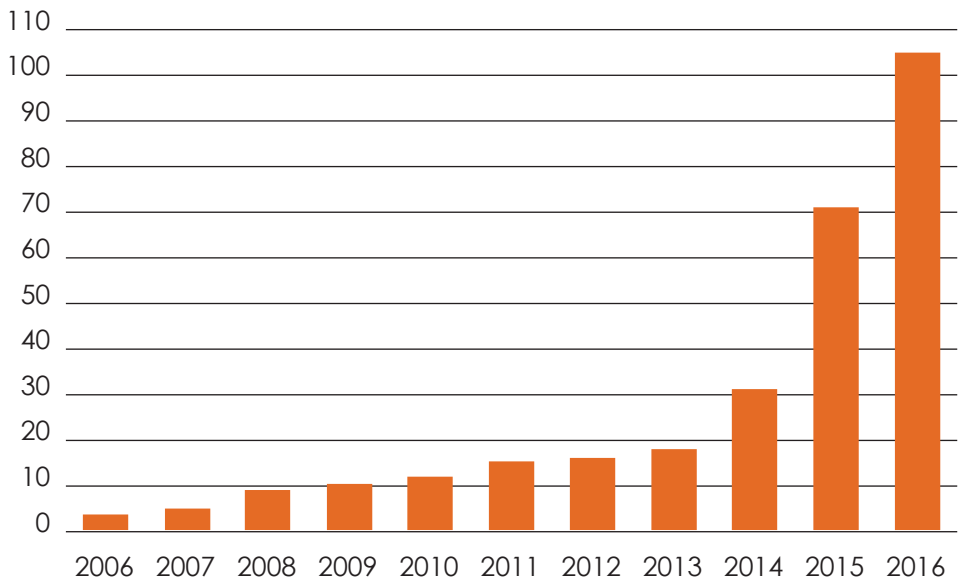
The Ellen MacArthur Foundation
2013

COM_**2014**
Verso un'**economia circolare**:
programma per un'Europa a zero rifiuti

COM_**2015**
L'anello mancante - Piano d'azione
dell'Unione europea per l'**economia circolare**

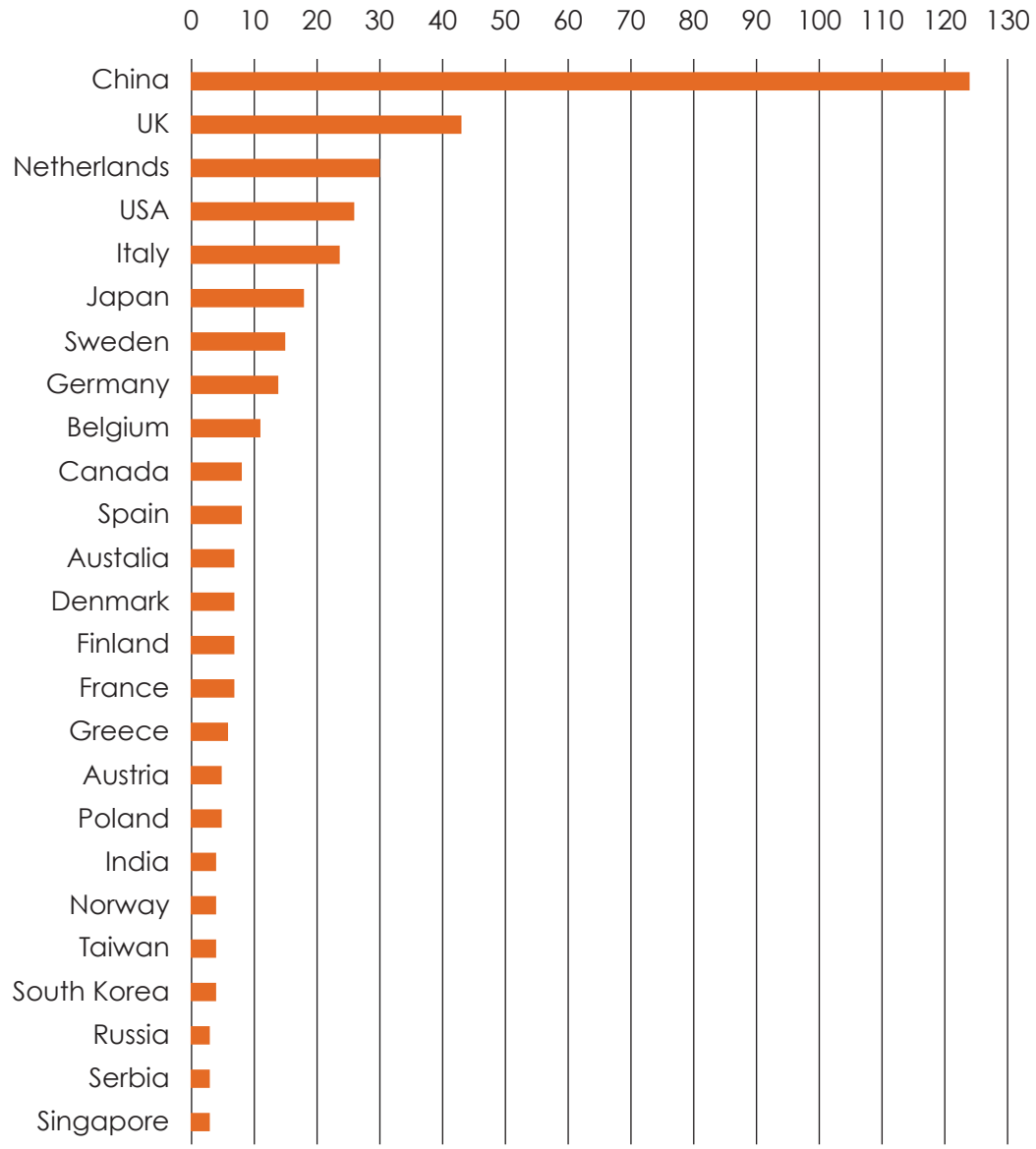
- RIDUZIONE DELLO SFRUTTAMENTO DELLE RISORSE NATUALI ➤ *COM_2011_Tabella di marcia verso un'Europa efficiente nell'impiego delle risorse*
- DIMINUZIONE DEI RIFIUTI ➤ *direttiva 2008/98/CE*
  direttiva 2006/12/CE

numero di pubblicazioni scientifiche*



- numero delle pubblicazioni scientifiche in forte aumento
- maggior numero di autori proviene dalla Cina

bacino geografico di riferimento**



**campione di 295 paper scientifici parola chiave di ricerca: circular economy.*
***aree geografiche degli autori che hanno più di tre pubblicazioni.*

Reference: M.Geissdoerfer et al., "The Circular Economy - A new sustainability paradigm?", Journal of Cleaner Production, 2016

CONCETTI LEGATI AL TEMA DELLA CIRCULAR ECONOMY

Industrial ecology
Industrial Symbiosis
Eco industrial park

Network tra le aziende

Cradle to Cradle

PRINCIPALI LEVE DEL CAMBIAMENTO

Riduzione dei rifiuti

Riduzione dei costi interni all'azienda

		PAPER			CONCEPTS RELATED TO CIRCULAR ECONOMY FIELD																	FIRST LEVER		SECOND LEVER	
		TITLE	YEAR	GEOGRAPHIC REFERENCE	KEY WORD: bio economy	KEY WORD: biomimicry	KEY WORD: Cradle to Cradle (C2C)	KEY WORD: ecological modernization theory (EMT)	KEY WORD: Urban mining	KEY WORD: Environmental economy	INTERPRETATION: Company network	KEY WORD: Industrial Ecology	KEY WORD: Eco-Industrial Park	KEY WORD: Industrial Symbiosis	INTERPRETATION: Riciclo all'interno del ciclo produttivo	KEY WORD: Cleaner Production	KEY WORD: Resource efficiency	KEY WORD: Material efficiency	INTERPRETATION: Design for changing	KEY WORD: chain resiliency/ resilience	KEY WORD: externalities	KEY WORD: circular building	problem of wastes	lack of resources	lower costs	reducing environmental impacts
CASI STUDIO	1	Biological processes for advancing	2016	nessuno							■														■	
	2	Fouling prevention, preparing for	2016	nessuno															■				■		■	
	3	Circular economy and the opportu-	2016	Jordan							■						■				■			■	■	
	4	Creating integrated business and	2010	China				■			■		■				■			■			■		■	
	5	The possible use of sewage sludge	2015	nessuno							■												■			■
	6	Ecological utilization of leather tan-	2010	China									■		■	■							■		■	
	7	A case study of a phosphorus chemi-	2014	nessuno													■		■					■	■	
	8	Circular economy of a papermaking	2015	China							■		■		■	■							■			■
	9	Waste management under a life	2016	Spain							■												■			■
	10	Transition towards Circular Economy	2015	nessuno							■	■			■		■			■			■			■
	11	Models of Circular Economy on Agri-	2011	China							■						■						■			■
	12	Energy conservation and circular	2009	China									■			■	■	■	■					■		■
	13	Creating integrated business and	2010	China				■				■	■			■	■		■	■			■		■	
	14	Circular Economy Strategies of oil	2011	China											■	■	■		■					■	■	
	15	The Research on Pricing Strategy for	2002	China																			■		■	
	16	Discussion on the Model of Mining	2012	China							■			■		■								■		■
	17	How China's Coal Enterprise Shrinks	2015	China							■					■			■						■	
TEORICI	1	Circular economy for the built envi-	2016	nessuno		■	■					■	■	■			■					■				
	2	Circular economy. A new relationship	2016	nessuno									■													
	3	The Circular Economy - A new sus-	2016	nessuno		■	■					■		■			■	■	■							
	4	The circular economy, design think-	2015	nessuno		■													■							
	5	An introductory note on the envi-	2006	nessuno								■		■		■					■					
	6	A review on circular economy: the	2015	nessuno	■	■	■					■	■	■		■	■				■					
	7	The Circular Economy: An Interdis-	2015	nessuno			■					■	■	■		■										
	8	Resource recovery from post-con-	2015	nessuno		■	■					■		■												
	9	Product biographies in servitization	2016	nessuno								■														
	10	Towards circular economy imple-	2015	nessuno		■	■	■				■	■	■		■	■									
	11	Towards a more Circular Economy:	2016	nessuno										■			■									
	12	Resource duration as a manage-	2016	nessuno										■			■	■								
	13	Institutional pressures, sustainable	2015	China								■	■	■				■								
	14	Skills and capabilities for a sustain-	2016	nessuno		■	■					■				■										
	15	Measuring circular economy strate-	2016	nessuno			■						■	■												
	16	Investigating public awareness on	2016	China													■									
	17	A circular economy model of eco-	2015	nessuno						■											■					
	18	Survey of officials' awareness on	2010	China													■									
	19	An exploration of firms' awareness	2014	China									■			■										
	20	Policy durability of Circular Economy	2015	China					■				■	■		■										
	21	Resource duration as a manage-	2016	nessuno					■	■		■		■												
	22	Driving Forces on China's Circular	2011	China																■	■	■				
	23	Research on the Circular Economy in	2011	China																						
	24	Development of circular economy	2011	China																						
	25	Promoting low-carbon development	2011	China													■									
	26	Closing the loop or squaring the	2015	nessuno			■	■				■	■	■			■									
	27	Circular economy practices among	2010	China				■			■		■			■										
	28	The Research on Quantitative Evalu-	2011	nessuno								■	■	■		■	■									

**campione di paper scientifici con parola chiave "circular economy" nel titolo.*

TIPO DI RECUPERO

Riciclaggio

Riciclaggio

ORIGINE DEL RIFIUTO

Scarti di produzione (riciclaggio pre-consumo)
Prodotti End of Life (riciclaggio post-consumo)

STRUMENTI LIFE CYCLE

LIfe Cycle Assessment (LCA)
Material Flow Analysis (MFA)

Cost-Benefit Analysis (CBA)

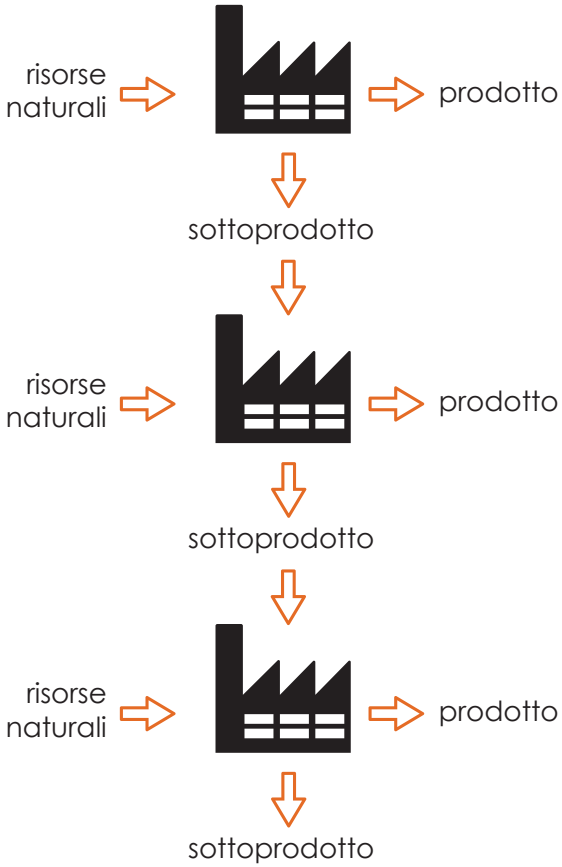
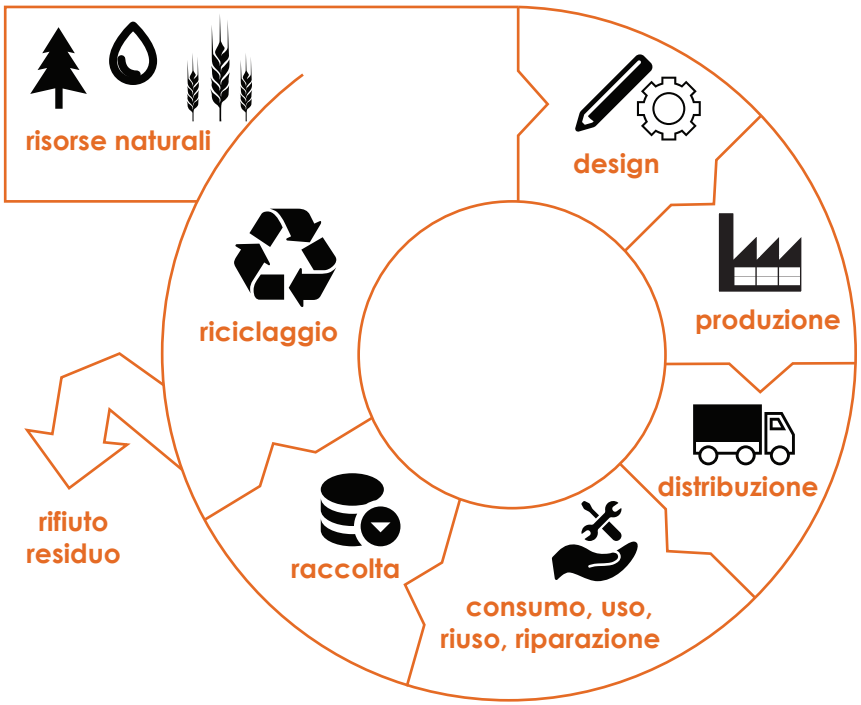
		PAPER			KIND OF RECOVERY				ORIGIN OF WASTES					LIFE CYCLE APPROACH							
		TITLE	YEAR	GEOGRAPHIC REFERENCE	energy recovery	recycle	reuse	Reduce	Extraction of Row material	Production	Distribution/ Packaging	Consumption	End of life	Life Cycle Assessment (LCA)	Life Cycle Costing (LCC)	Social Life Cycle Assessment (S-LCA)	Environmentally Extended Input-Output (EEIO)	Material Flow Analysis (MFA)	Substance Flow Analysis (SFA)	Cost-Benefit Analysis (CBA)	Cost-effective Analysis (CEA)
CASI STUDIO	1	Biological processes for advancing	2016	nessuno		■		■					■								
	2	Fouling prevention, preparing for	2016	nessuno		■	■	■					■	■							
	3	Circular economy and the opportu-	2016	Jordan		■							■							■	
	4	Creating integrated business and	2010	China		■							■							■	
	5	The possible use of sewage sludge	2015	nessuno		■							■								
	6	Ecological utilization of leather tan-	2010	China		■		■		■											
	7	A case study of a phosphorus chemi-	2014	nessuno		■		■		■									■		
	8	Circular economy of a papermaking	2015	China		■				■											
	9	Waste management under a life	2016	Spain		■				■				■							
	10	Transition towards Circular Economy	2015	nessuno	■	■	■	■		■		■	■								
	11	Models of Circular Economy on Agri-	2011	China		■				■		■									
	12	Energy conservation and circular	2009	China	■	■	■	■		■			■								
	13	Creating integrated business and	2010	China		■	■						■							■	
	14	Circular Economy Strategies of oil	2011	China	■	■	■	■	■												
	15	The Research on Pricing Strategy for	2002	China	■	■	■						■								
	16	Discussion on the Model of Mining	2012	China		■	■	■	■	■											
	17	How China's Coal Enterprise Shrinks	2015	China		■	■			■											
TEORICI	1	Circular economy for the built envi-	2016	nessuno		■	■							■				■			
	2	Circular economy. A new relationship	2016	nessuno		■	■														
	3	The Circular Economy - A new sus-	2016	nessuno		■	■														
	4	The circular economy, design think-	2015	nessuno		■	■														
	5	An introductory note on the envi-	2006	nessuno		■	■	■						■							
	6	A review on circular economy: the	2015	nessuno	■	■	■							■							
	7	The Circular Economy: An Interdis-	2015	nessuno	■	■	■	■													
	8	Resource recovery from post-con-	2015	nessuno	■	■	■														
	9	Product biographies in servitization	2016	nessuno	■	■	■														
	10	Towards circular economy imple-	2015	nessuno	■	■	■	■						■				■			
	11	Towards a more Circular Economy:	2016	nessuno	■																
	12	Resource duration as a manage-	2016	nessuno	■	■	■	■					■					■			
	13	Institutional pressures, sustainable	2015	China		■	■														
	14	Skills and capabilities for a sustain-	2016	nessuno	■	■	■							■							
	15	Measuring circular economy strate-	2016	nessuno	■	■	■							■			■	■	■		
	16	Investigating public awareness on	2016	China		■	■														
	17	A circular economy model of eco-	2015	nessuno		■	■														
	18	Survey of officials' awareness on	2010	China		■															
	19	An exploration of firms' awareness	2014	China		■	■														
	20	Policy durability of Circular Economy	2015	China		■	■	■													
	21	Resource duration as a manage-	2016	nessuno		■	■	■										■			
	22	Driving Forces on China's Circular	2011	China		■															
	23	Research on the Circular Economy in	2011	China	■	■	■														
	24	Development of circular economy	2011	China		■															
	25	Promoting low-carbon development	2011	China		■	■	■										■			
	26	Closing the loop or squaring the	2015	nessuno		■	■														
	27	Circular economy practices among	2010	China	■	■	■	■													
	28	The Research on Quantitative Evalu-	2011	nessuno		■	■										■	■			

**campione di paper scientifici con parola chiave "circular economy" nel titolo.*

CRESCITA ECONOMICA

SOSTENIBILITA' AMBIENTALE

riduzione rifiuti + efficienza delle risorse



life cycle + efficacia delle risorse