

# MEASURING THE CIRCULAR ECONOMY OF WATER SECTOR IN THE THREE-FOLD LINKAGE OF WATER, ENERGY AND MATERIALS

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**5<sup>th</sup> International Conference**  
on  
**Sustainable Solid Waste Management**  
21–24 June 2017

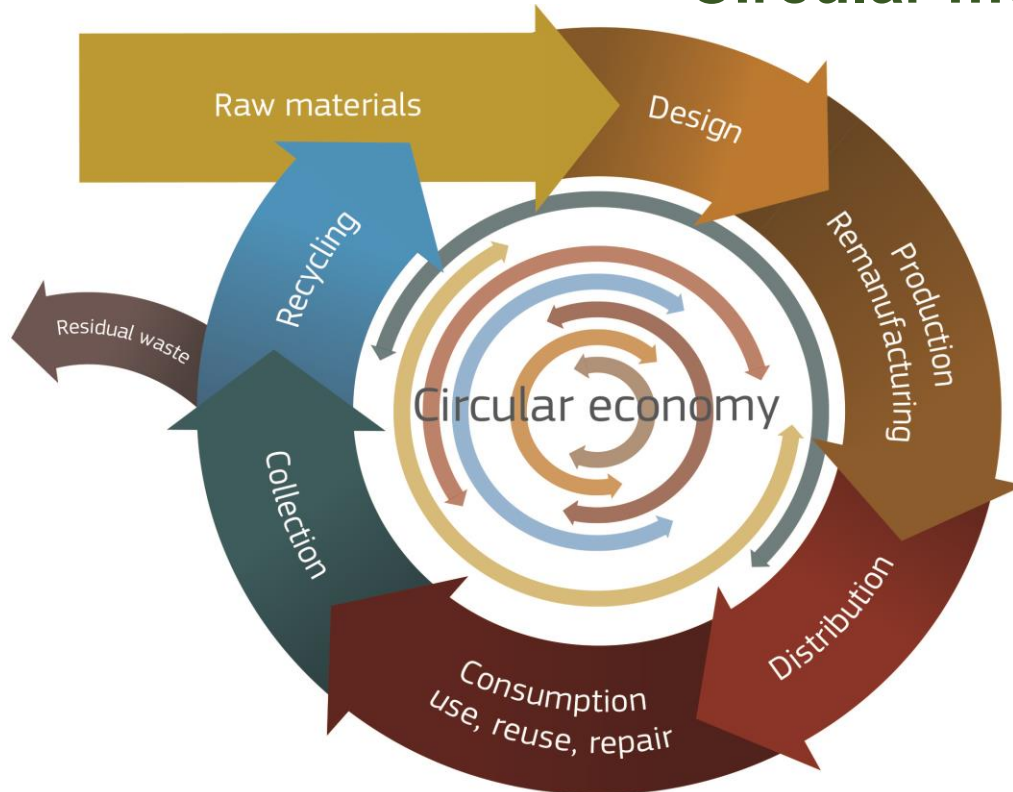
**ATHENS2017** 

# Linear vs Circular economy model

## Linear model



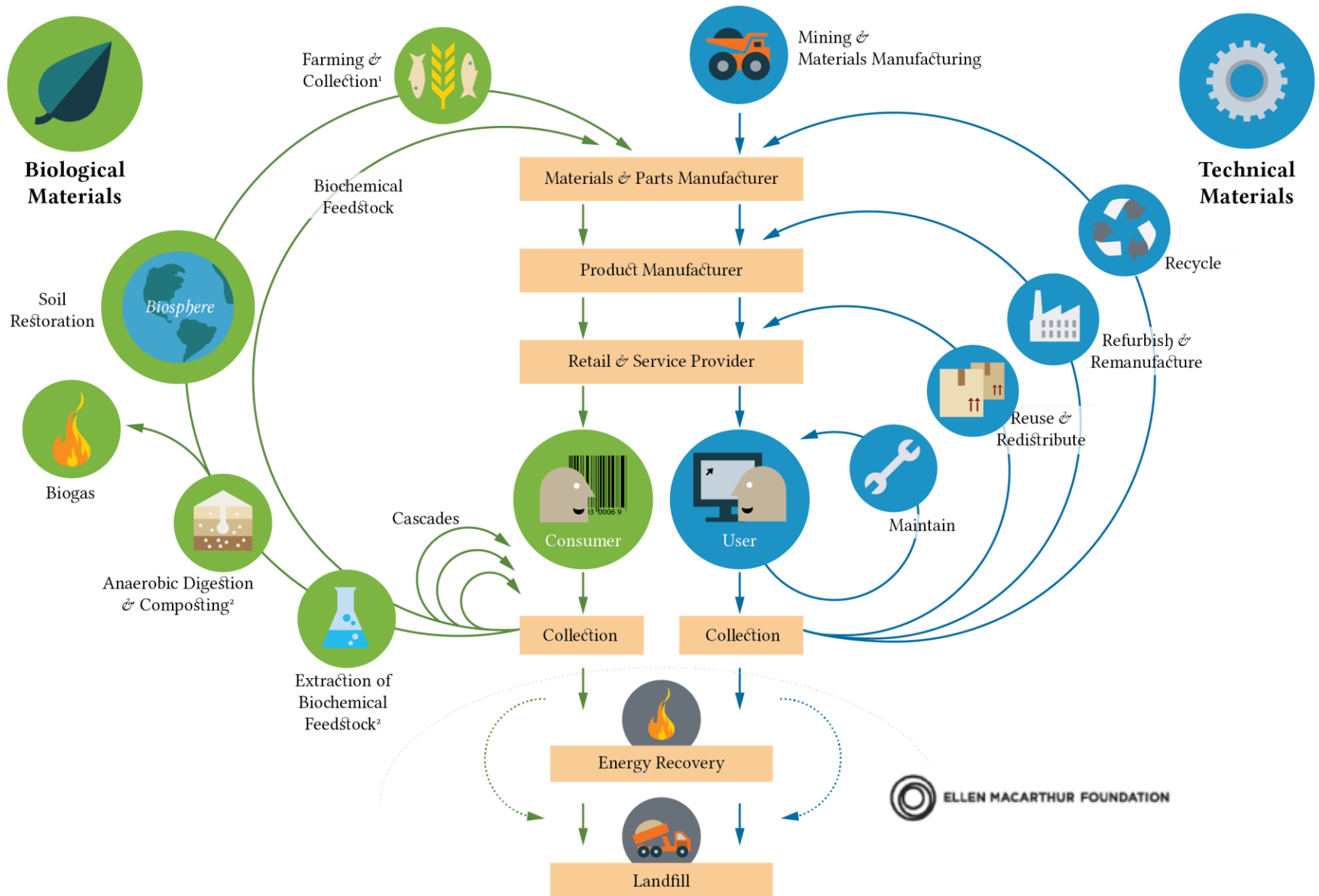
## Circular model



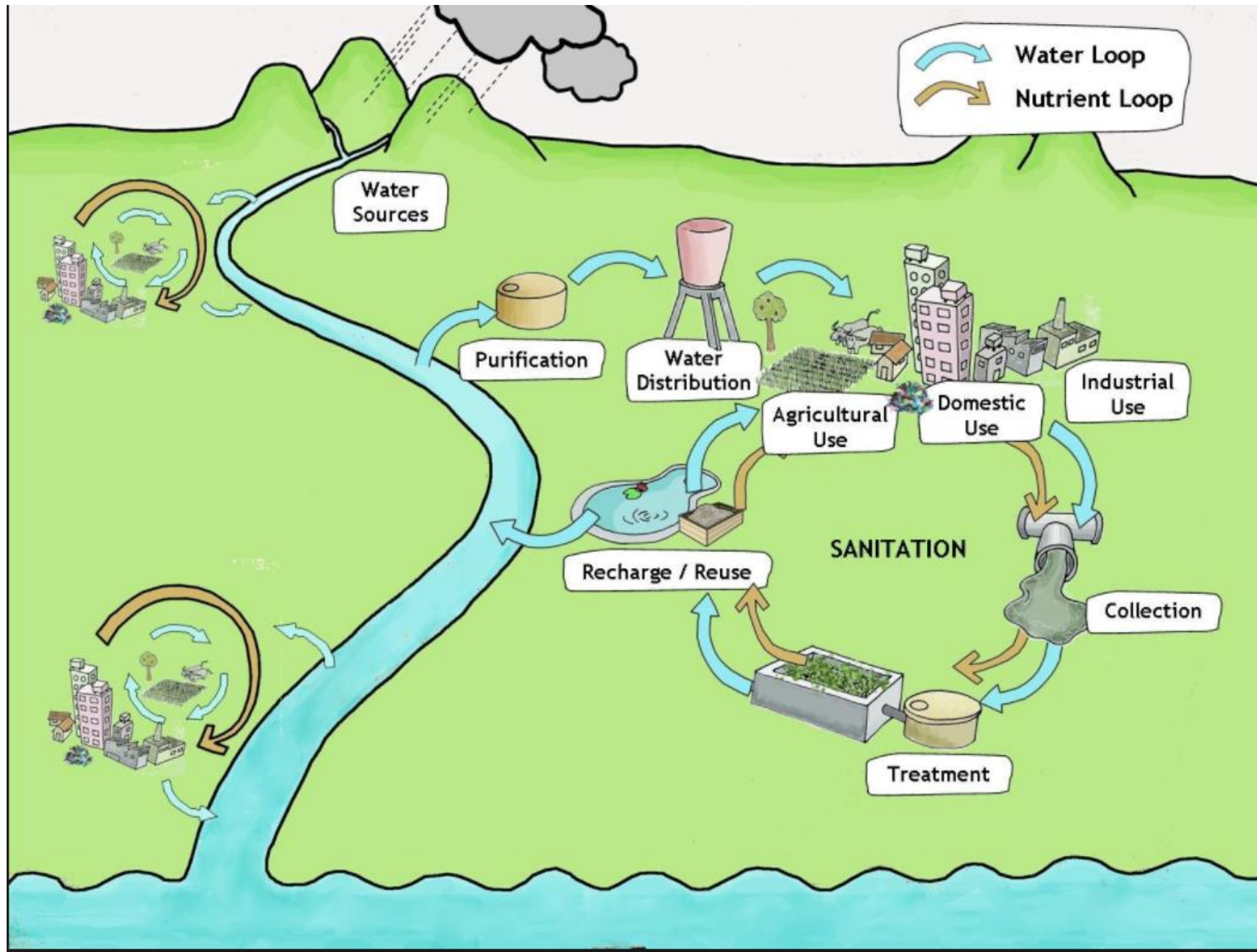
### Fundamental characteristics:

- Design out waste
- Build resilience through diversity
- Work towards energy from renewable sources
- Think in systems
- Think in cascades

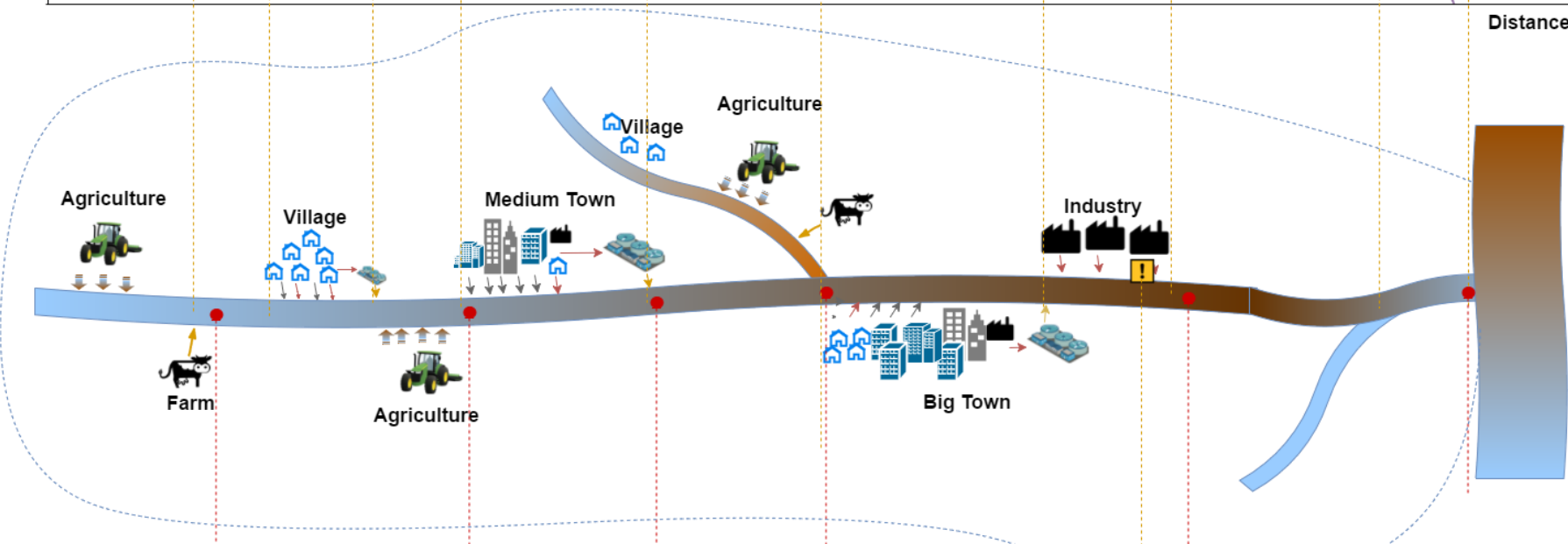
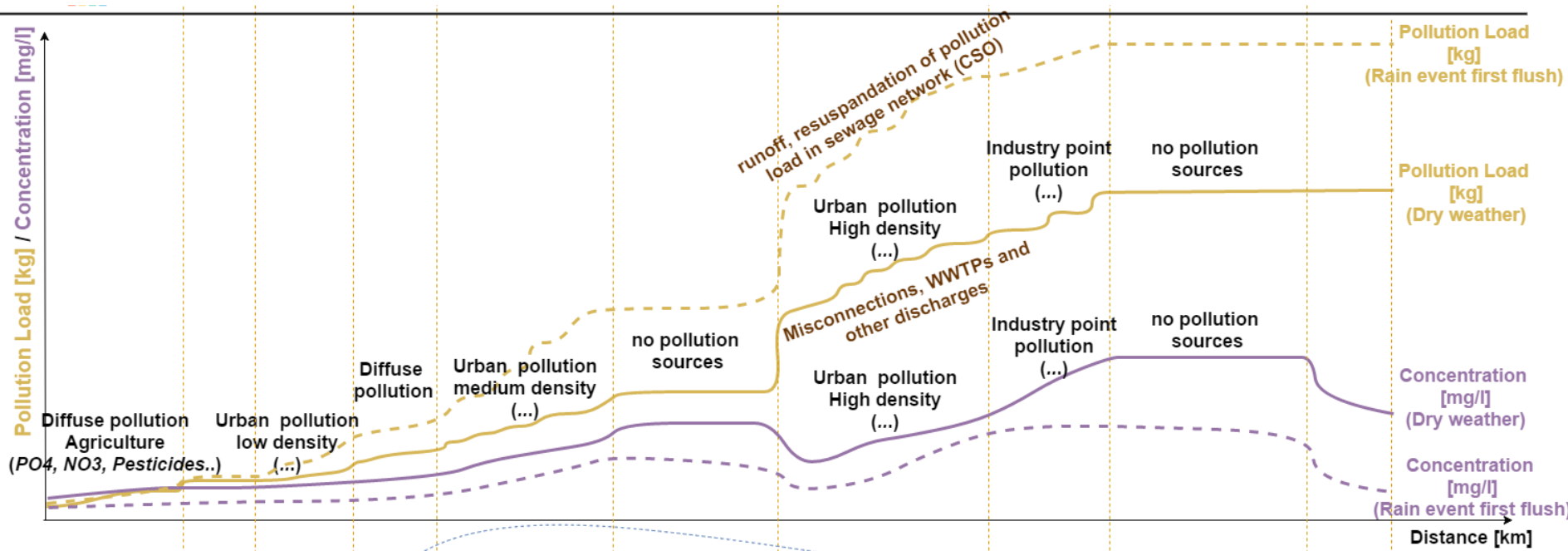
# Circular economy in product based systems



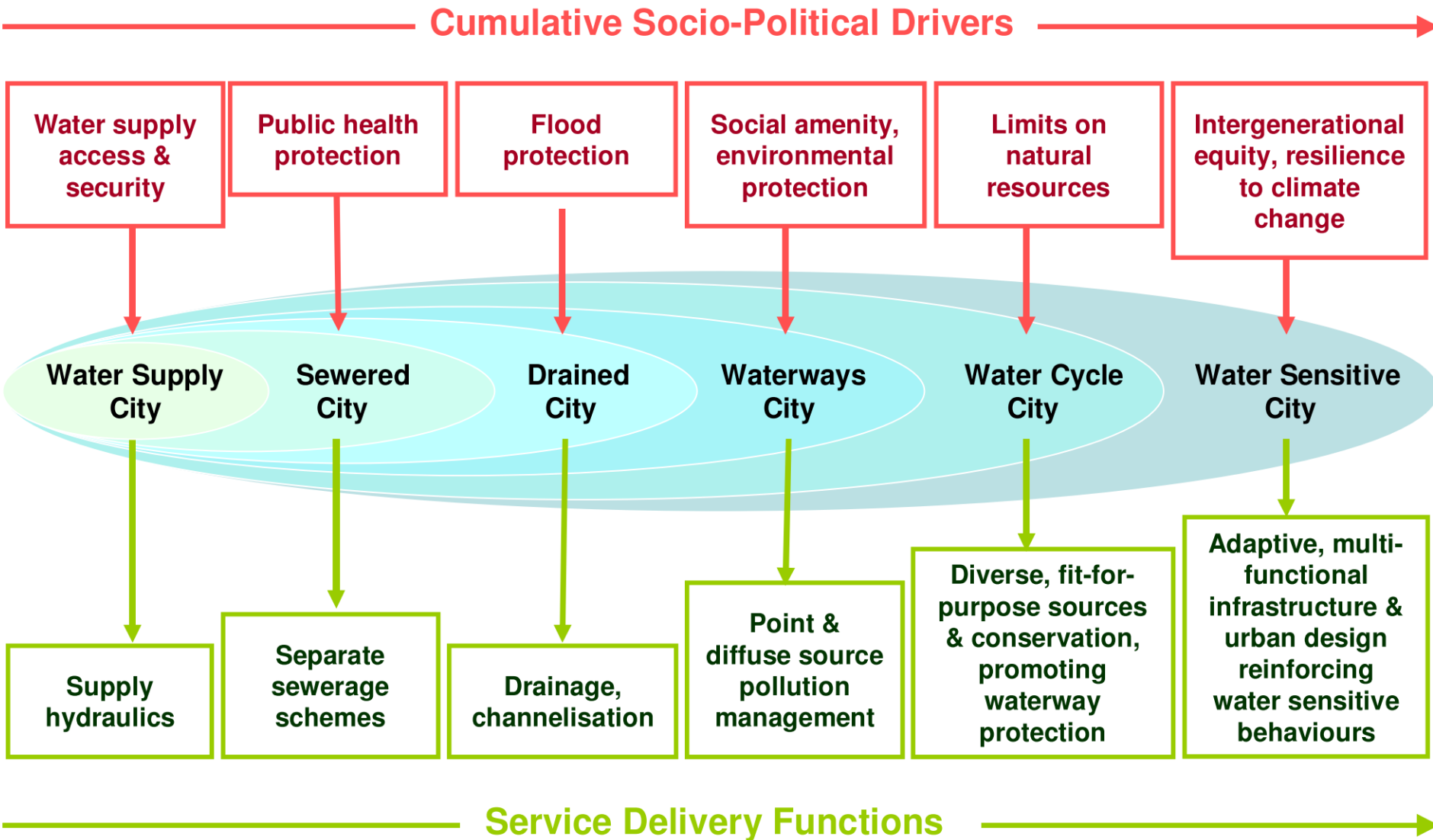
# Natural and man-made water cycle



# Water quality balance on catchment level

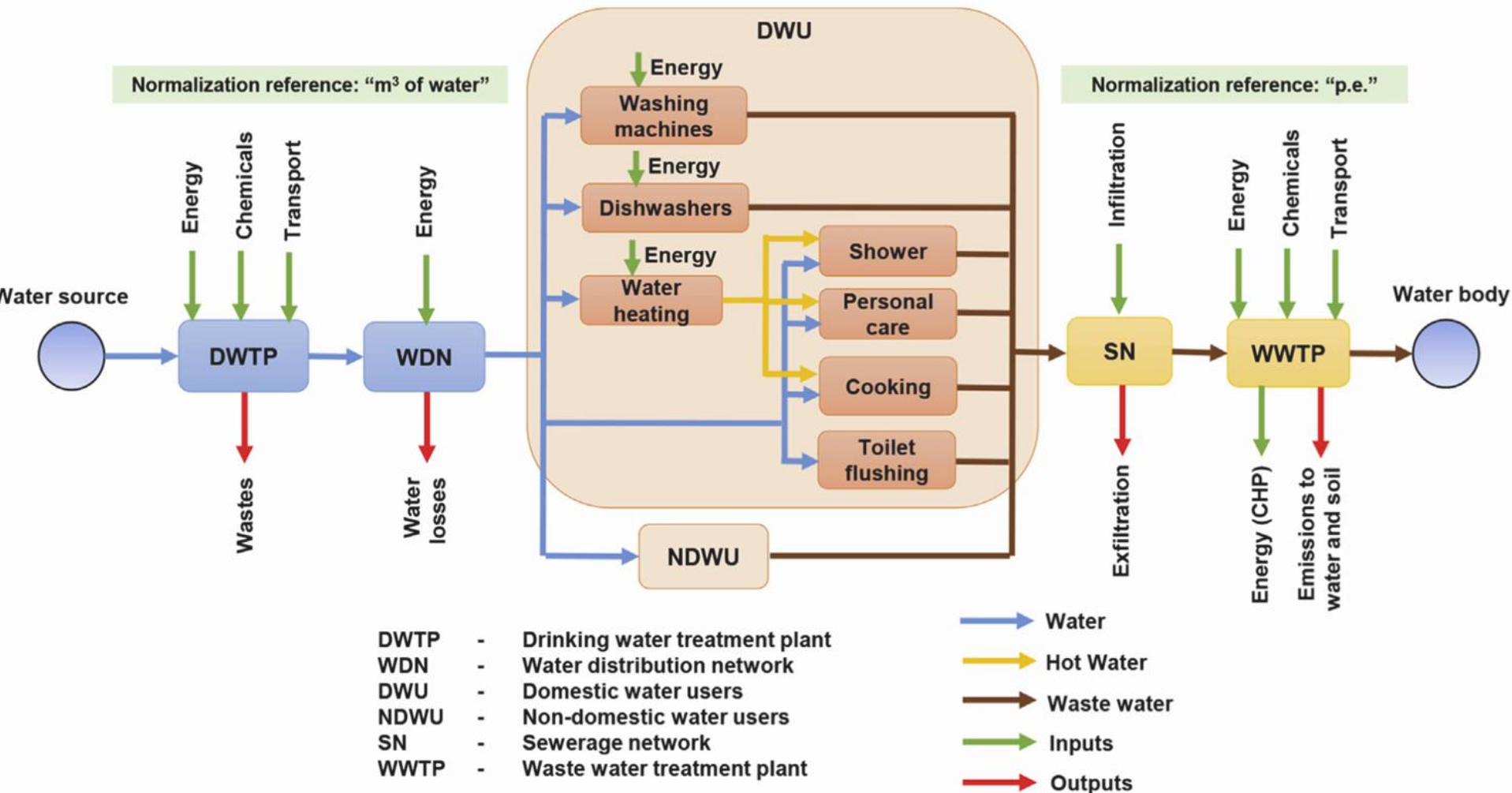
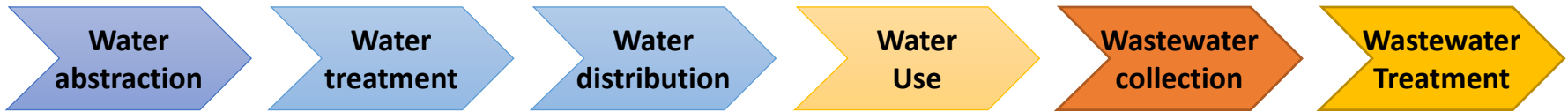


# Historical transition of urban water systems

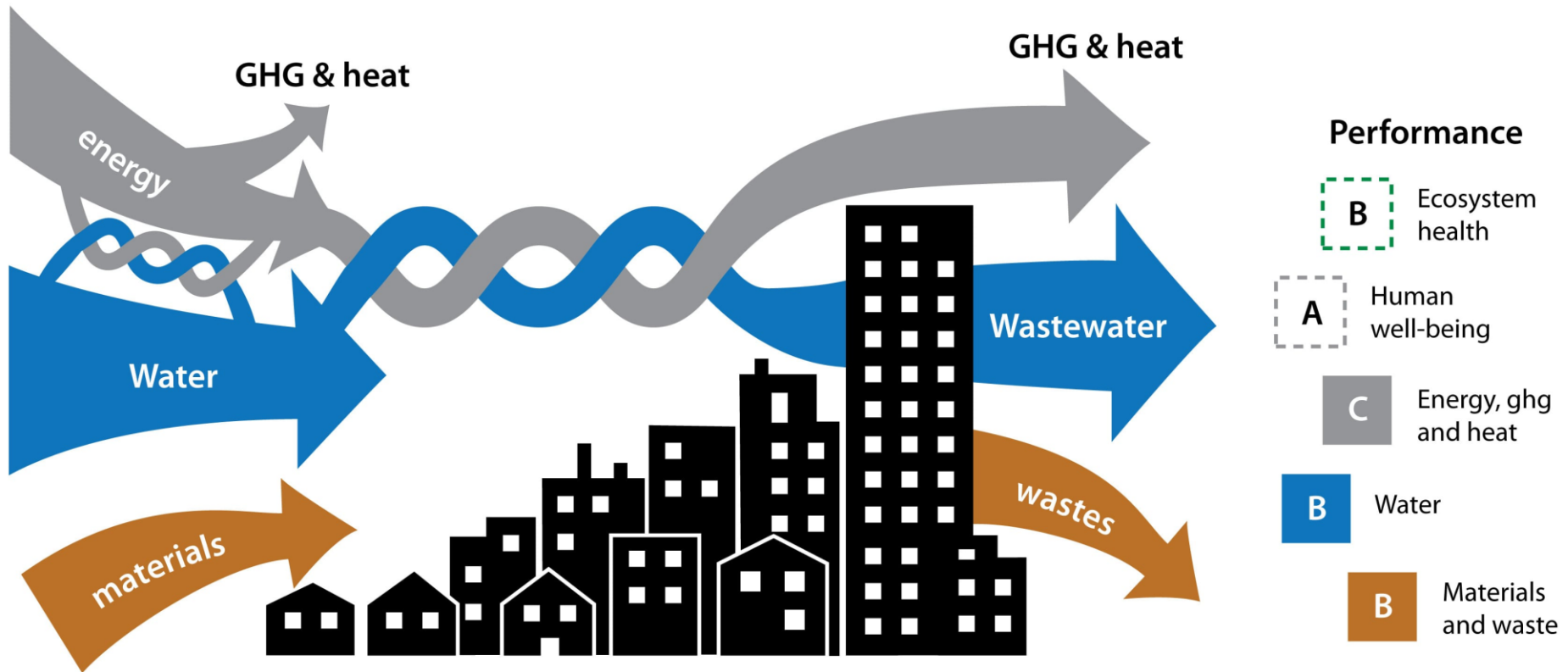




# Linear model of the urban water systems



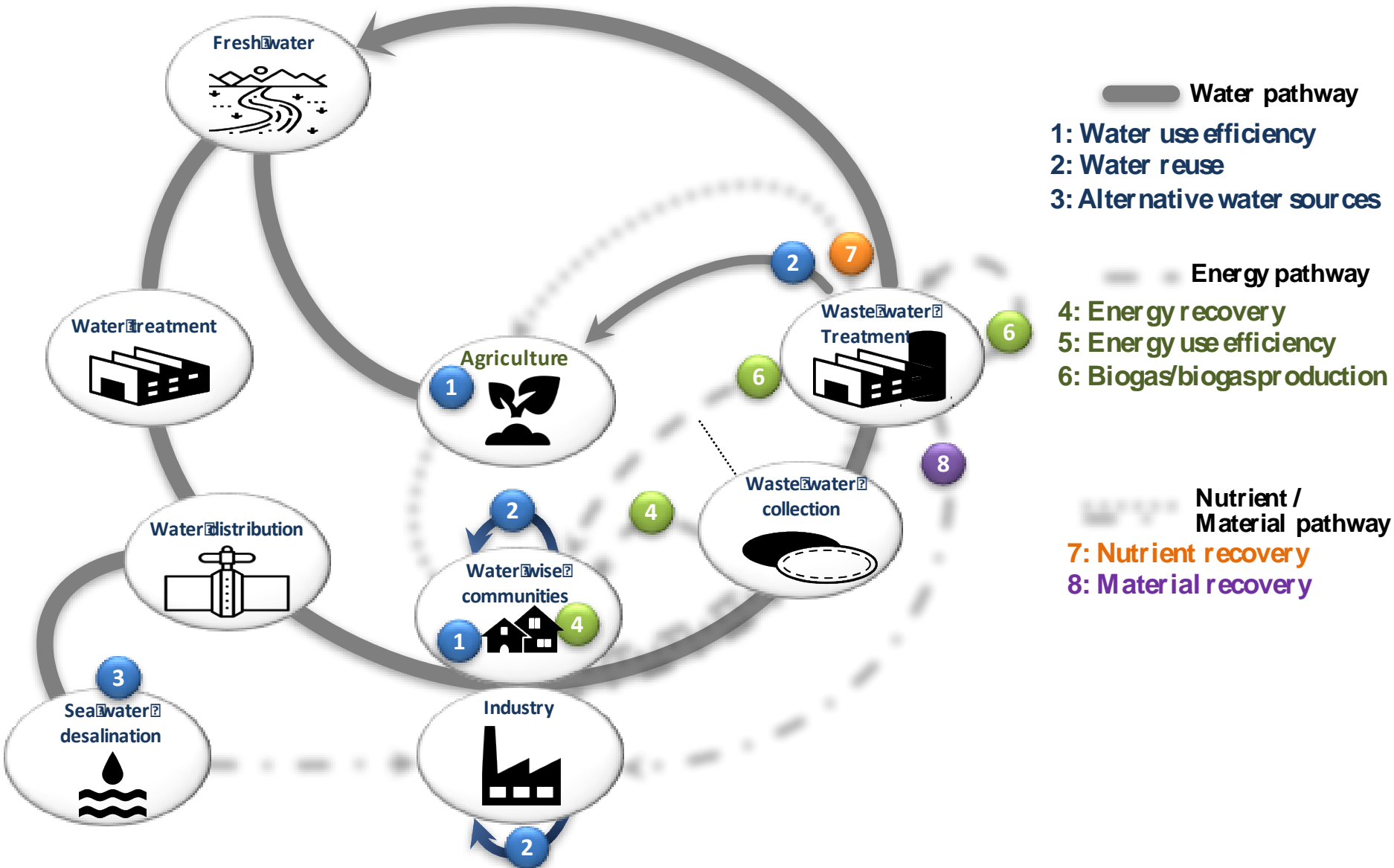
# Water as medium of resources



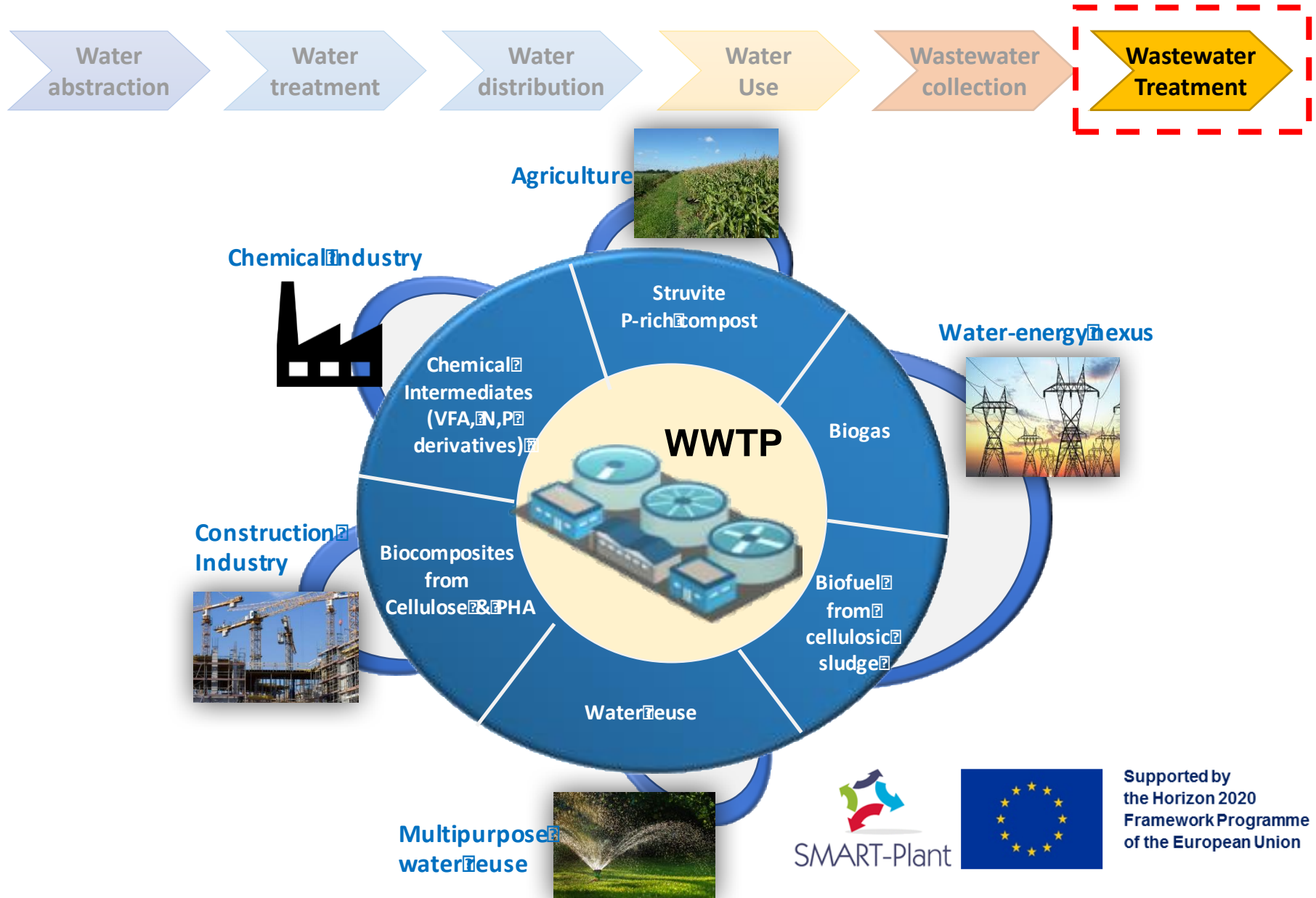
Source: Kenway, S. J. 2013



# Circular economy solutions in water sector



# Wastewater treatment in the circular economy



Water abstraction

Water treatment

Water distribution

Water Use

Wastewater collection

**Wastewater Treatment**

Agriculture

Chemical Industry



Struvite  
P-rich compost

Water-energy nexus



**WWTP**

Biogas

Chemical Intermediates  
(VFA, N, P derivatives)

Construction Industry



Biocomposites  
from  
Cellulose & PHA

Biofuel  
from  
cellulosic  
sludge

Water reuse

Multipurpose  
water reuse

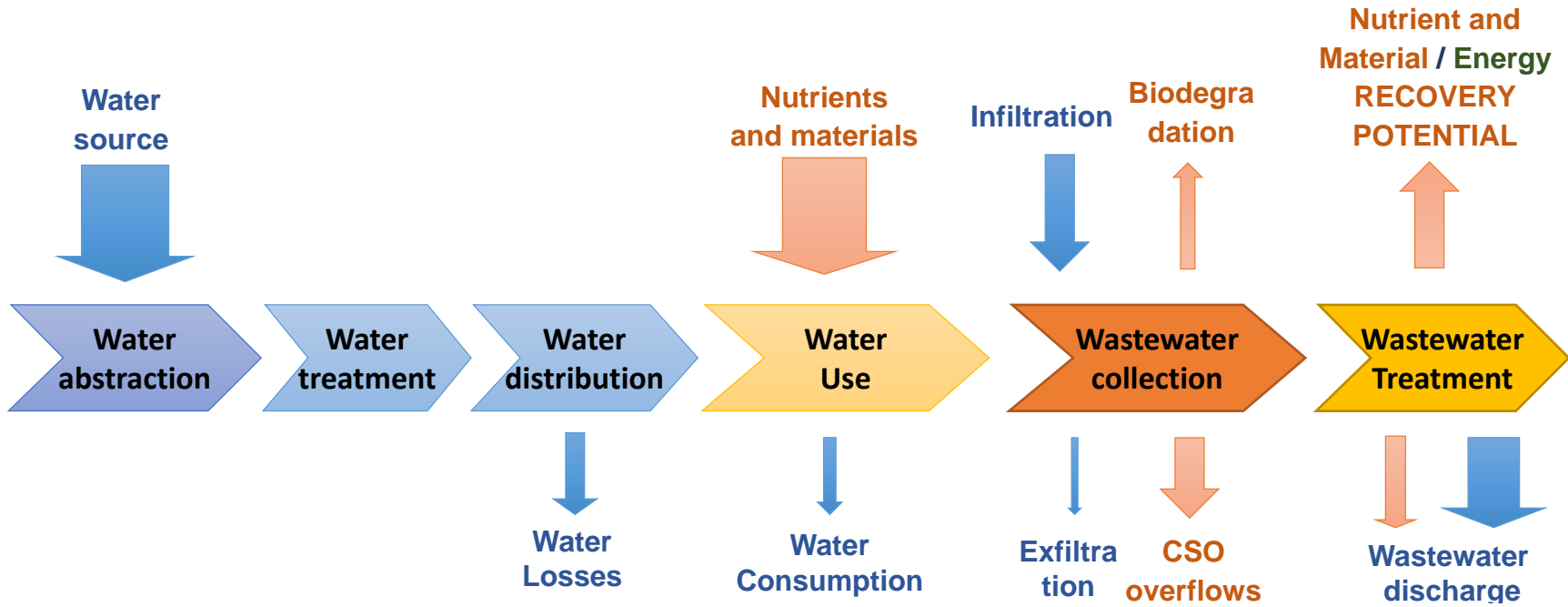


SMART-Plant

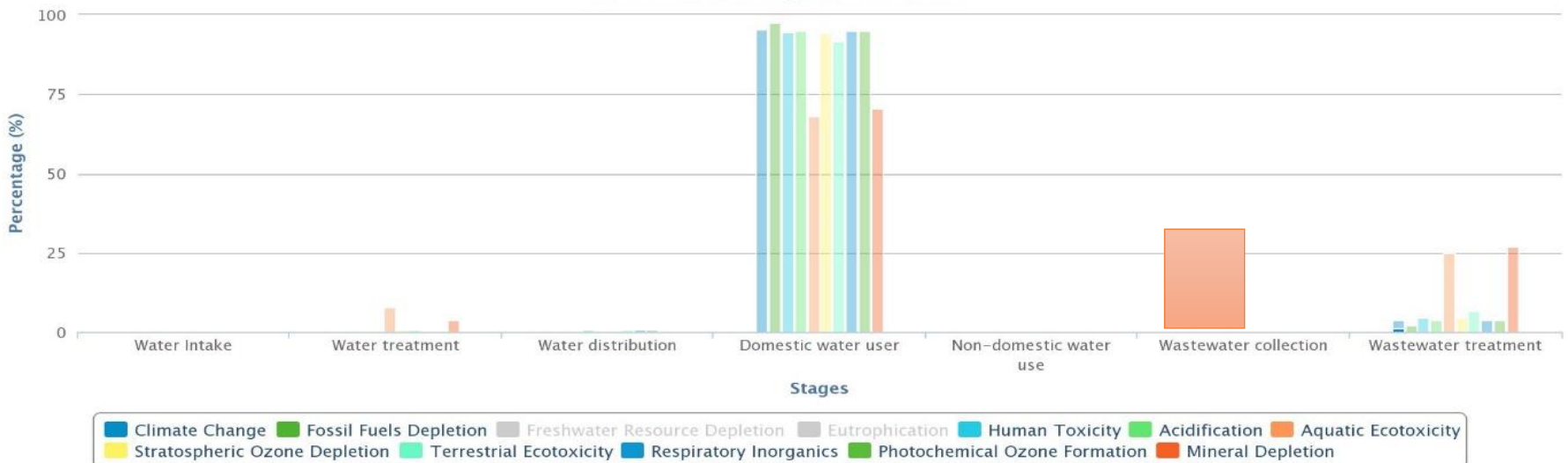


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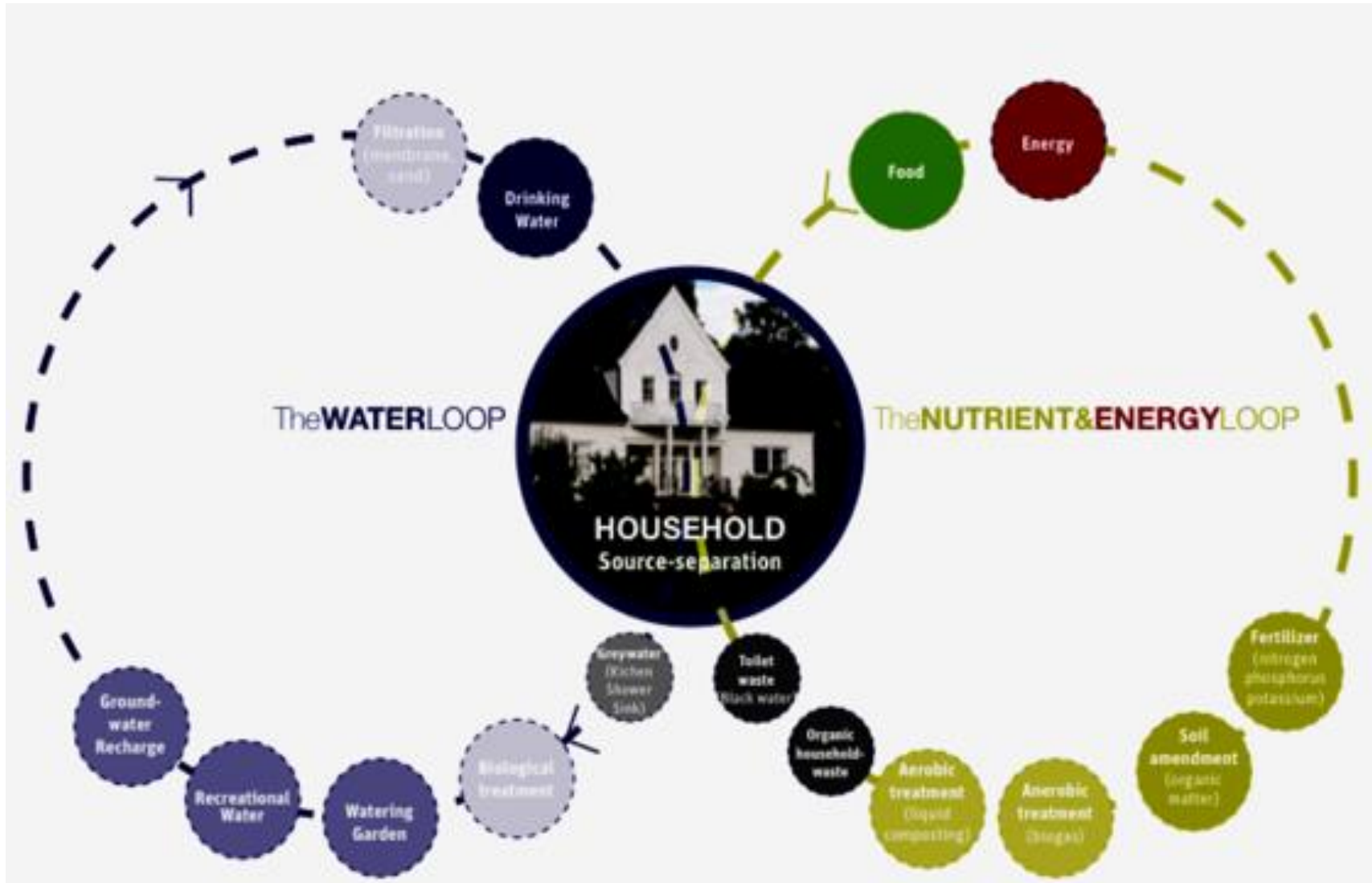
# Wastewater treatment in the circular economy



Environmental Impact Breakdown



# Closing the CE loops water systems

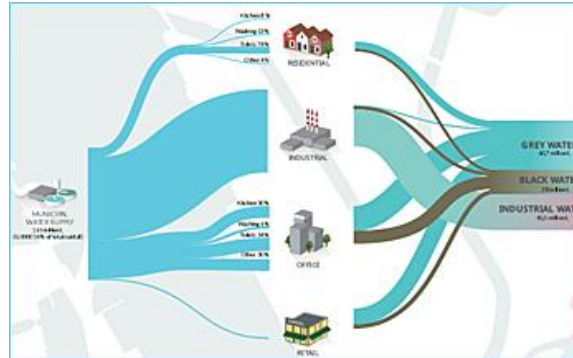


Source: GTZ

# Measuring the circular economy



## Material flow analysis



**CircularEconomy Toolkit**  
Resources for an Evolving World

The Circular Economy | Toolkit | Assessment Tool | Workshops | About

Answer the questions below to find potential improvements in your organisation:

\* Company type: Manufacturer  
\* Product type: #Catalytic\_Converter  
\* Use:  Just playing  Serious

**Design, Manufacture and Distribute**

No material is used in excess, product is totally dematerialised  
100% Biodegradable  
100% Recycled materials used

High waste of material, could be reduced through redesign  
High percentage of technical, non-biodegradable materials  
High percentage of virgin, non-recycled materials

Improvement Potential



water footprint network

## CIRCULARITY TEST - CEIP SCORE

Instructions | Complete the General Information section (1), then answer the questions in the Circularity Test (2) and finally, view the results (3). Answer on the yellow boxes and navigate with the yellow arrows.

Version: 06/08/2014  
Updated: 06/08/2014  
Contact: info@granta.com

1 GENERAL INFORMATION		3 RESULTS			
Product Name	Catalytic Converter	Product Rating	Product Ranking	Points	
SKU Code		42%	Good	Scored	Available
Manufacturer Code				64	152
Assessment Date	November 2016				
Assessed by	Michael Subiant				
2 QUESTIONNAIRE					
The questionnaire intends to evaluate in what degree the product fosters the Circular Economy principles throughout its different lifecycle stages.		To respond to the questions click the link below			
		➔			
Lifecycle	# Questions	Scored	Available	Rating	Ranking
Design/Redesign	3	12	27	44%	Good
Manufacturing	2	7	25	28%	Fair
Commercialisation	3	15	30	50%	Good
In Use	4	12	35	34%	Fair
End of Use	3	18	35	51%	Good
<b>TOTAL</b>	<b>15</b>	<b>64</b>	<b>152</b>	<b>42%</b>	<b>Good</b>



**CIRCULARITY INDICATORS**  
AN APPROACH TO MEASURING CIRCULARITY

**Material Circularity Indicator Dynamic Modelling Tool**

Drag the sliders to change input values and see how the MCI changes!

Input	Value	Target
Reused	0%	0%
Recycled	33%	50%
Recycling efficiency	95%	95%
Lifespan	1,0 x industry average	1,0 x industry average
Functional units	1,0 x industry average	1,0 x industry average

**MCI = 0,46**

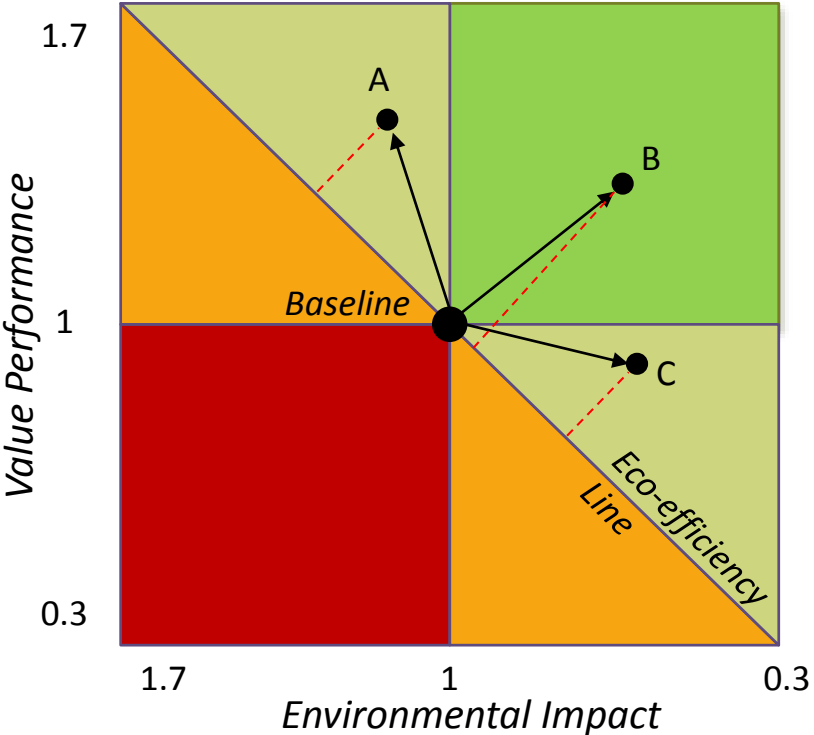
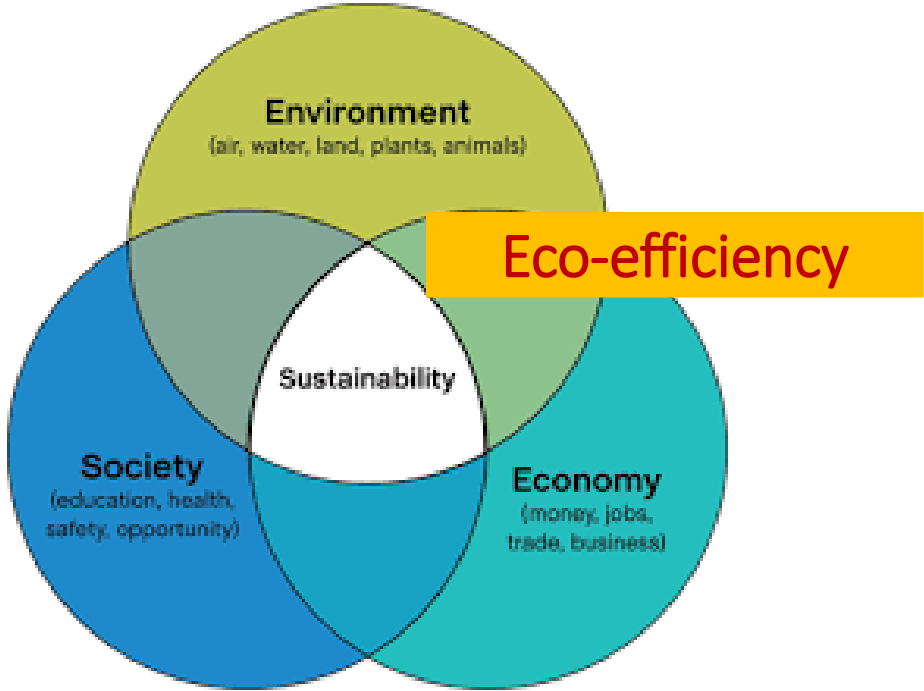
ELLEN MACARTHUR FOUNDATION | GRANTA MATERIAL INTELLIGENCE

# Eco-efficiency Assessment

$$Eco\text{-}efficiency = \frac{Economic\ output \uparrow}{Environmental\ impact \downarrow}$$

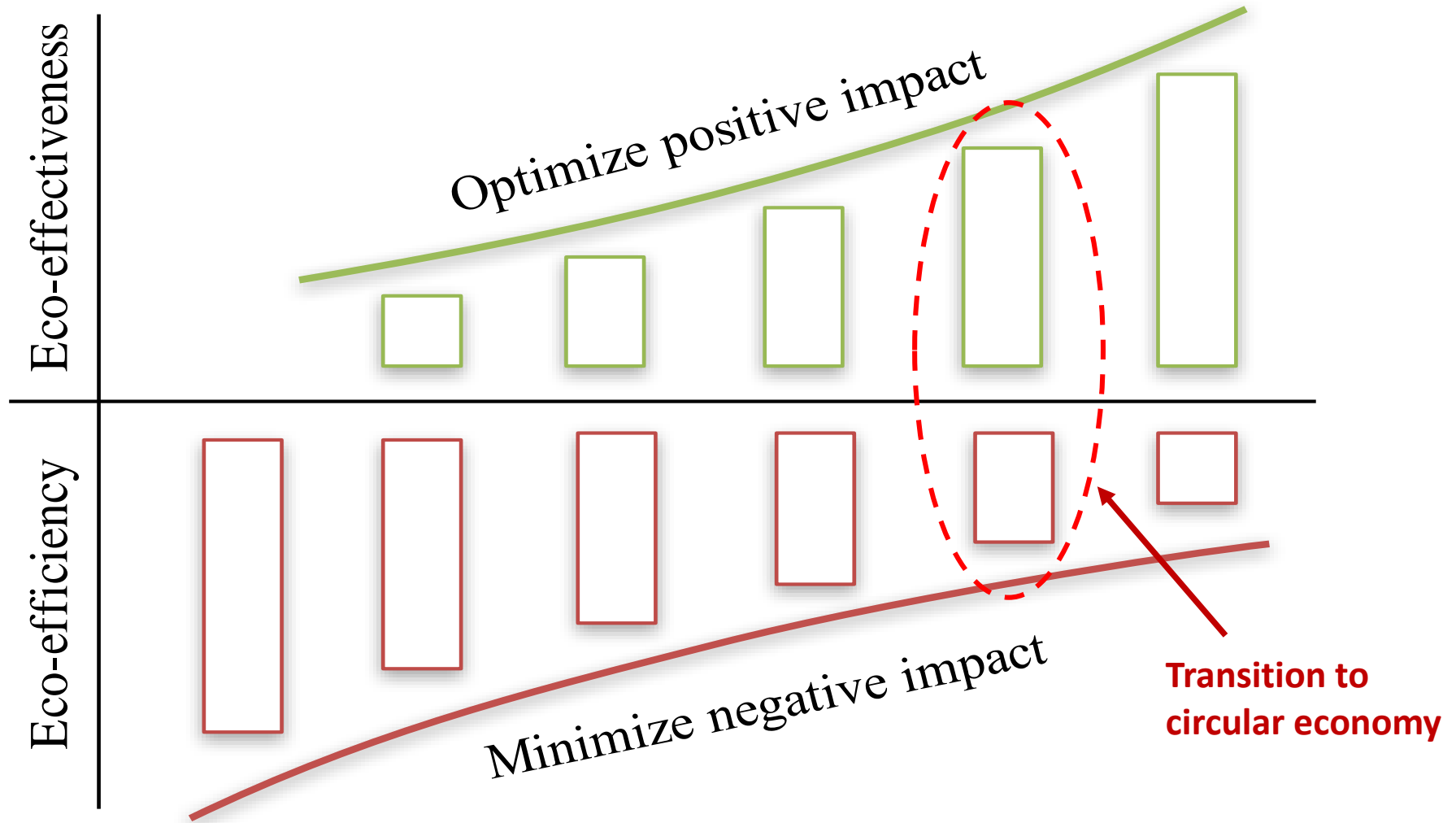
Delivering high value product/service  
Less economic costs

Less resources,  
Less emissions to air soil  
and water





# Eco-efficiency vs Eco-effectiveness and relation to the Circular economy



# Conclusions

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- The application of **circular economy to water sector** changes fundamentally the perception of the water supply chains – **water is seen as medium of valuable resources**, while water infrastructures are considered as a part of an **inter-sectoral value chain system**
- **Straightforward application** of circularity approach (focusing on recycling) could **shift the environmental** impact into other impact categories and **even increase the net environmental impact**
- The fragments of circular approaches on water resources management **have yet to be translated** into systematic methods and **standardized metrics** to evaluate different circular models
- A **methodological framework** needs to be developed considering all **three pathways to water circularity** (energy, materials, water)

**Thank you for your attention!**

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