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

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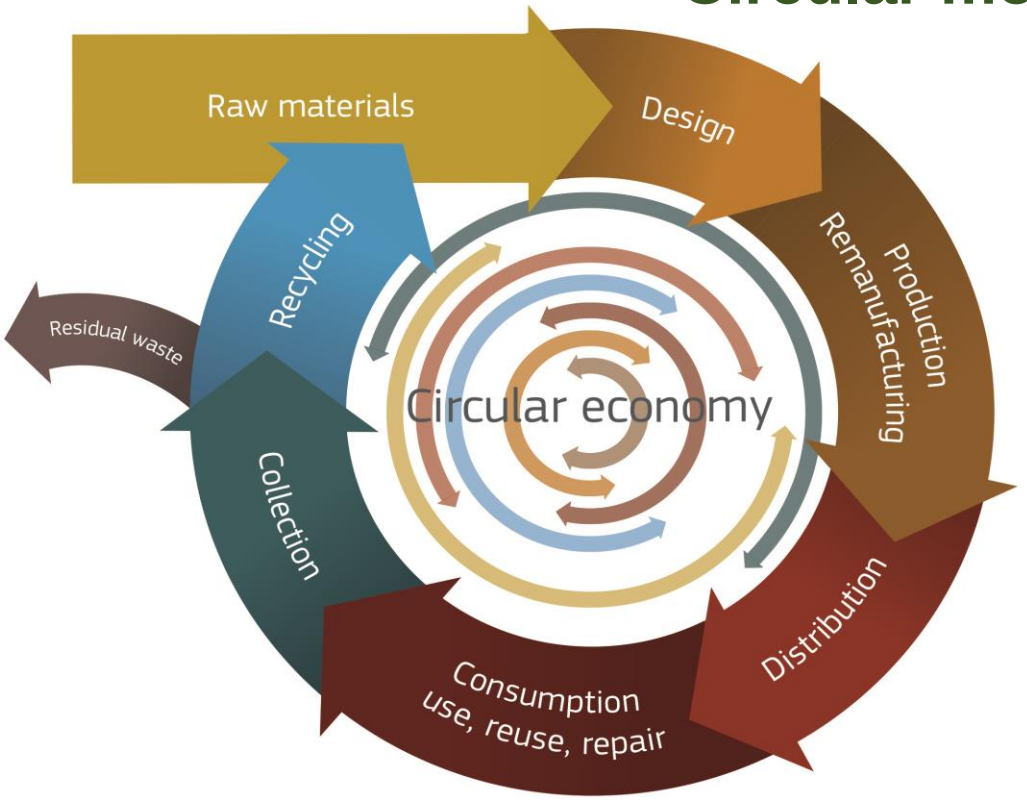
Linear vs Circular economy model

Linear model

Circular model

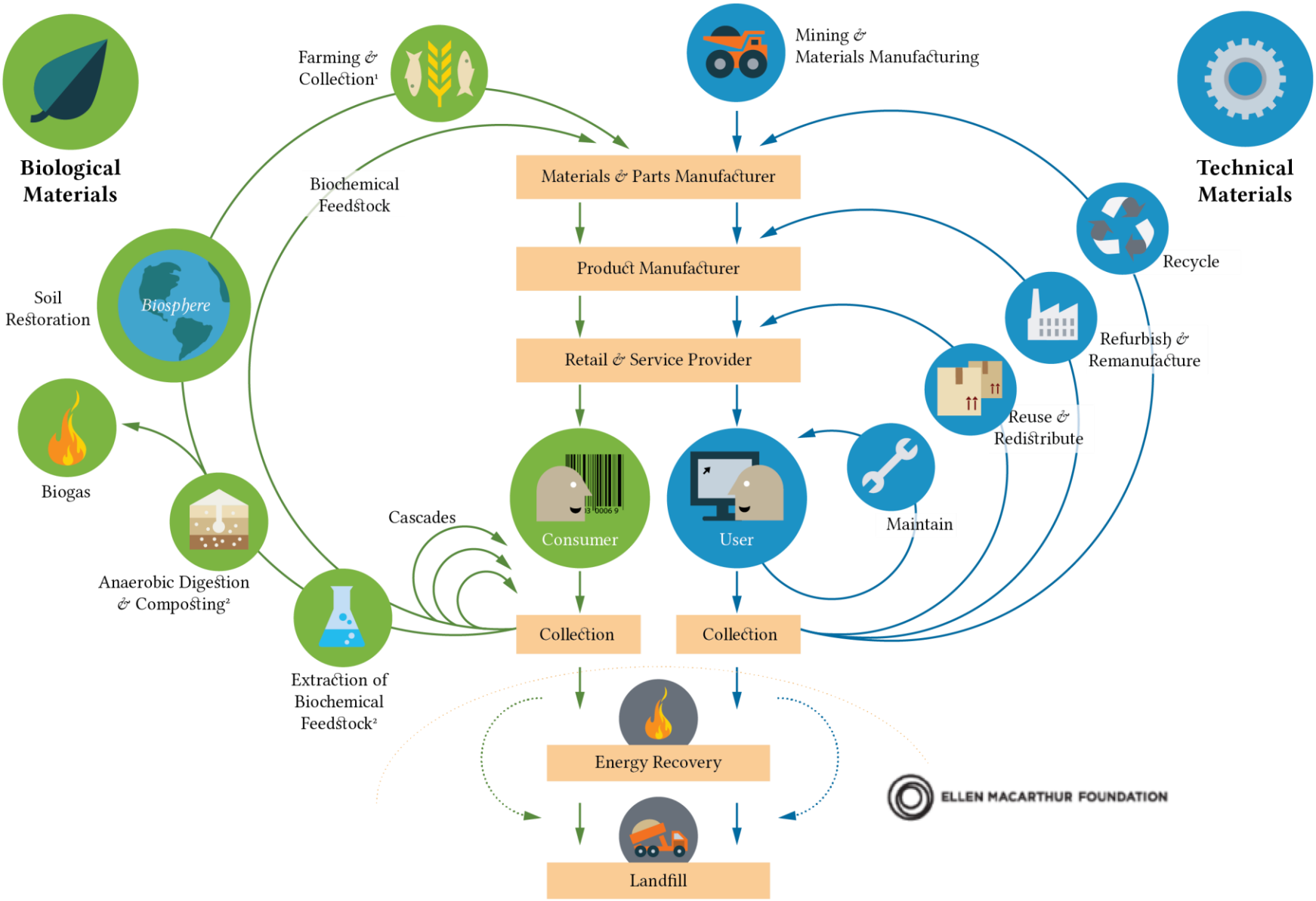


Source: European Comission

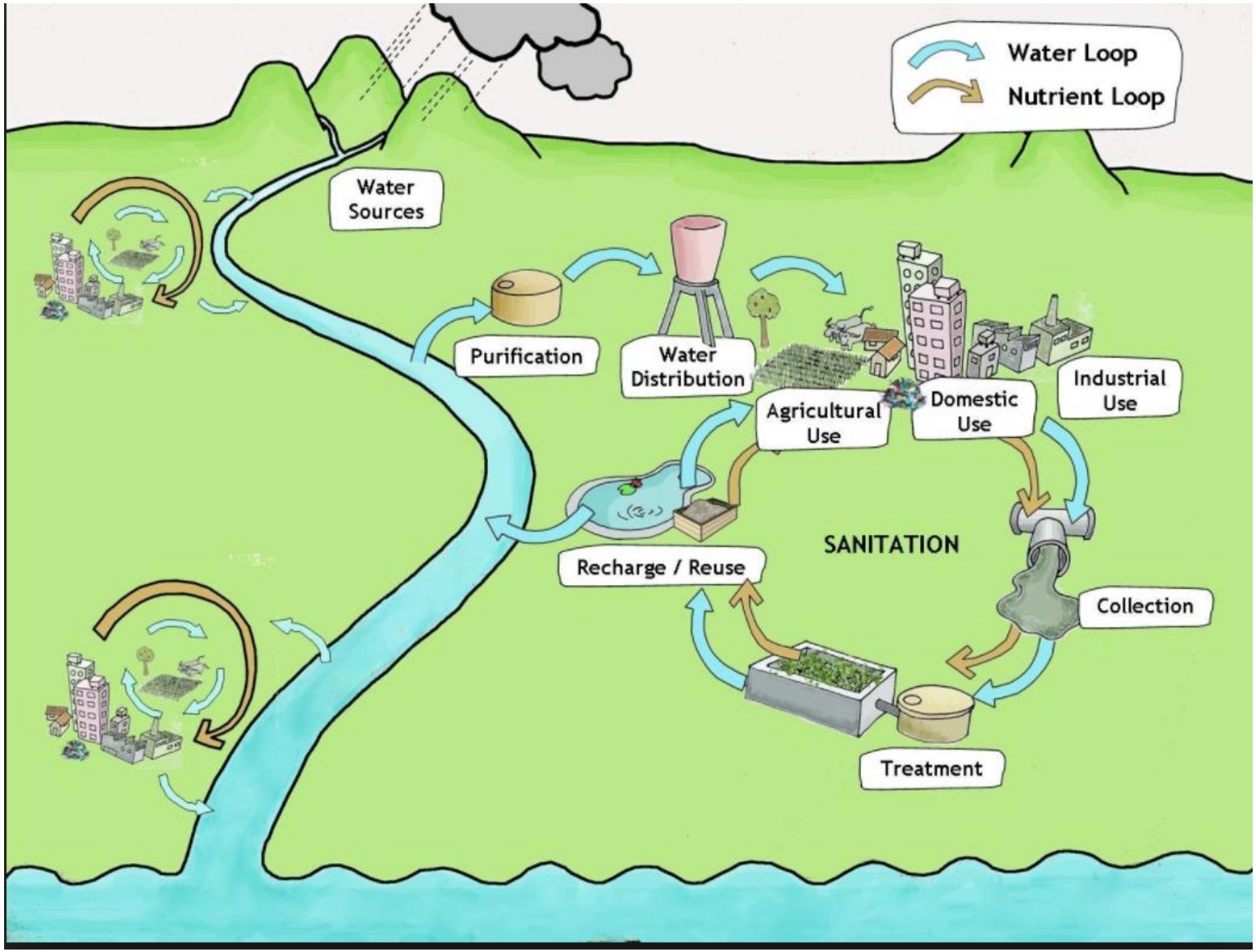
Fundamental characteristics:

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

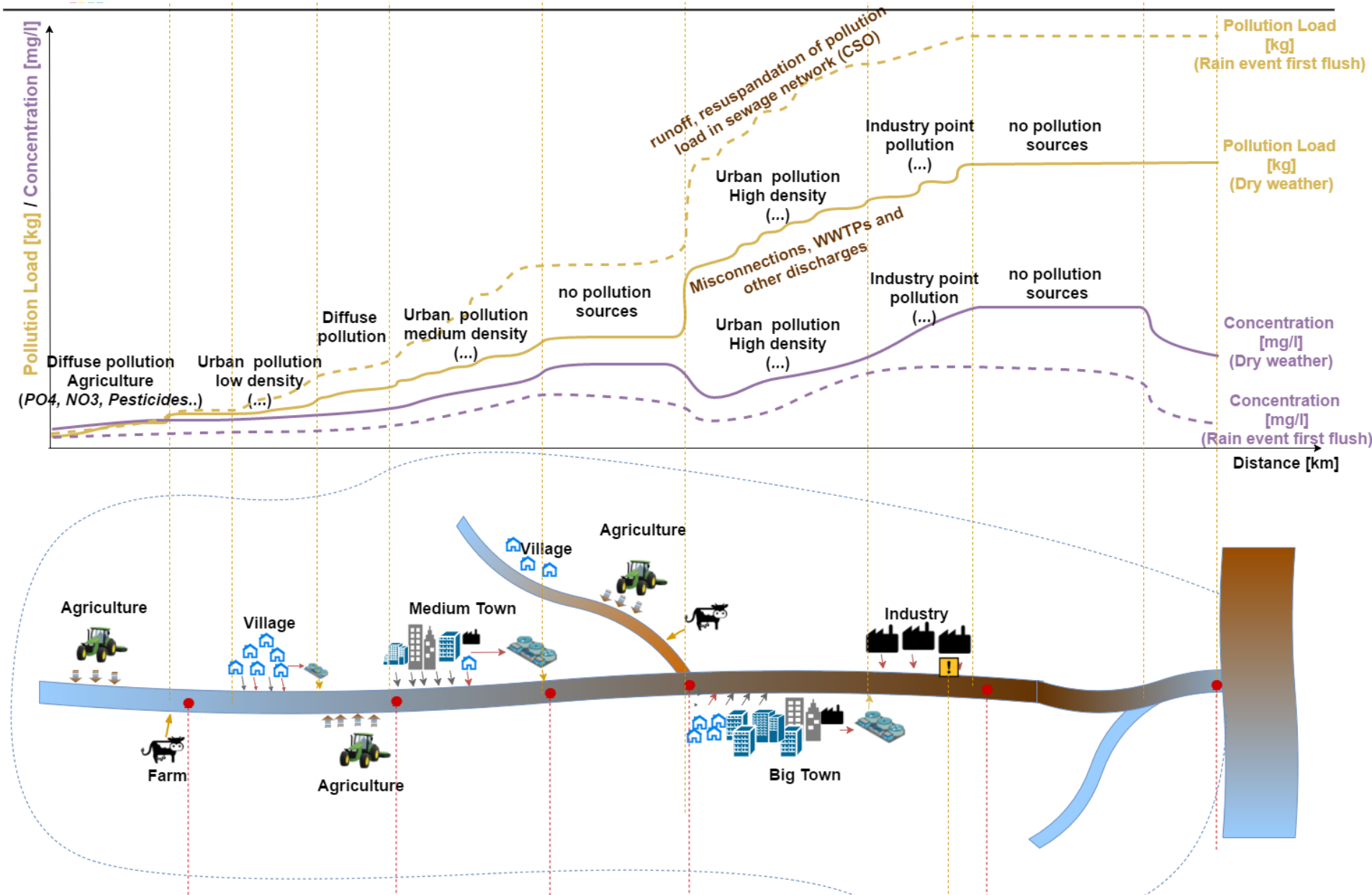
Circular economy in product based systems



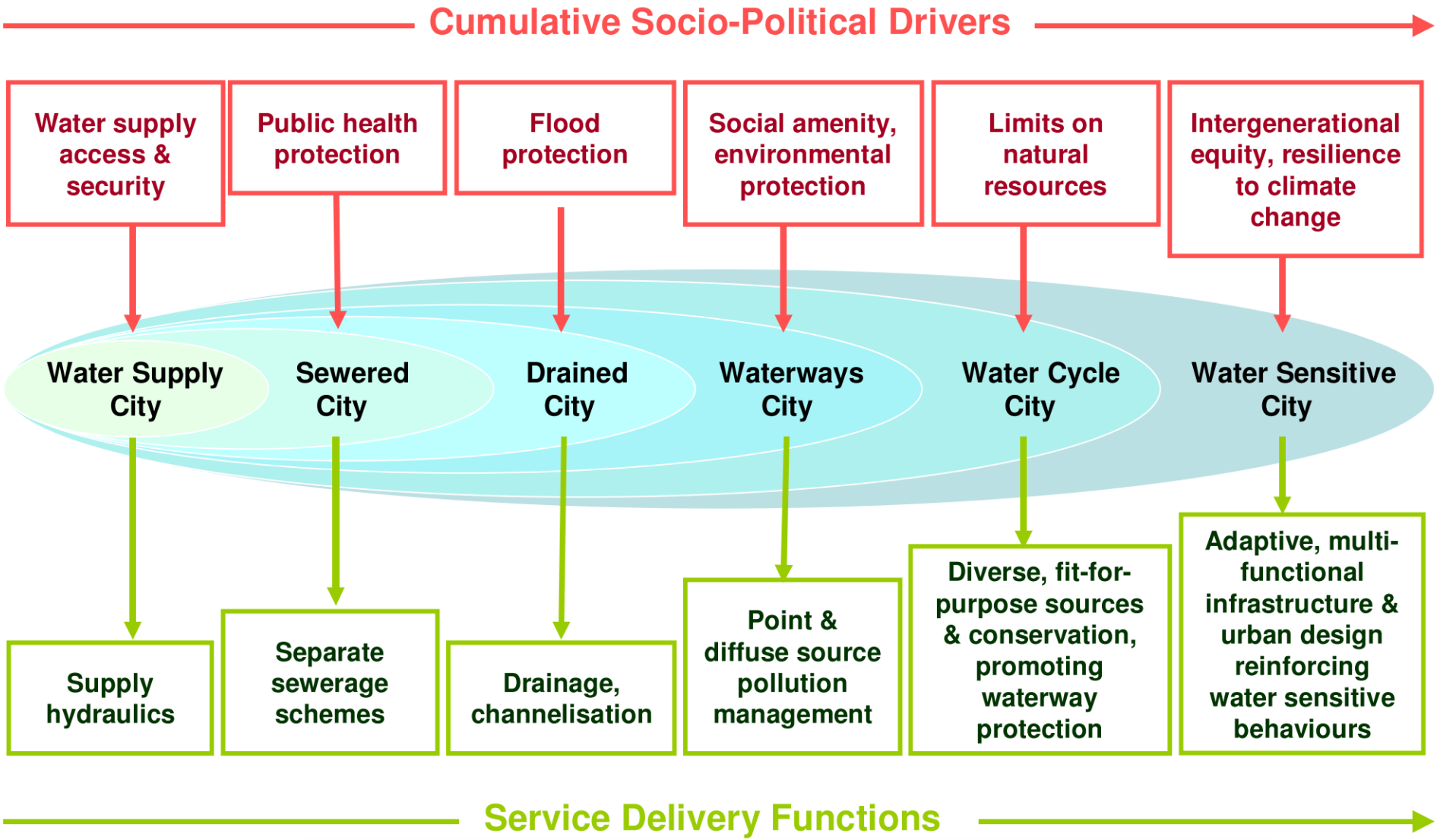
Natural and man-made water cycle



Water quality balance on catchment level

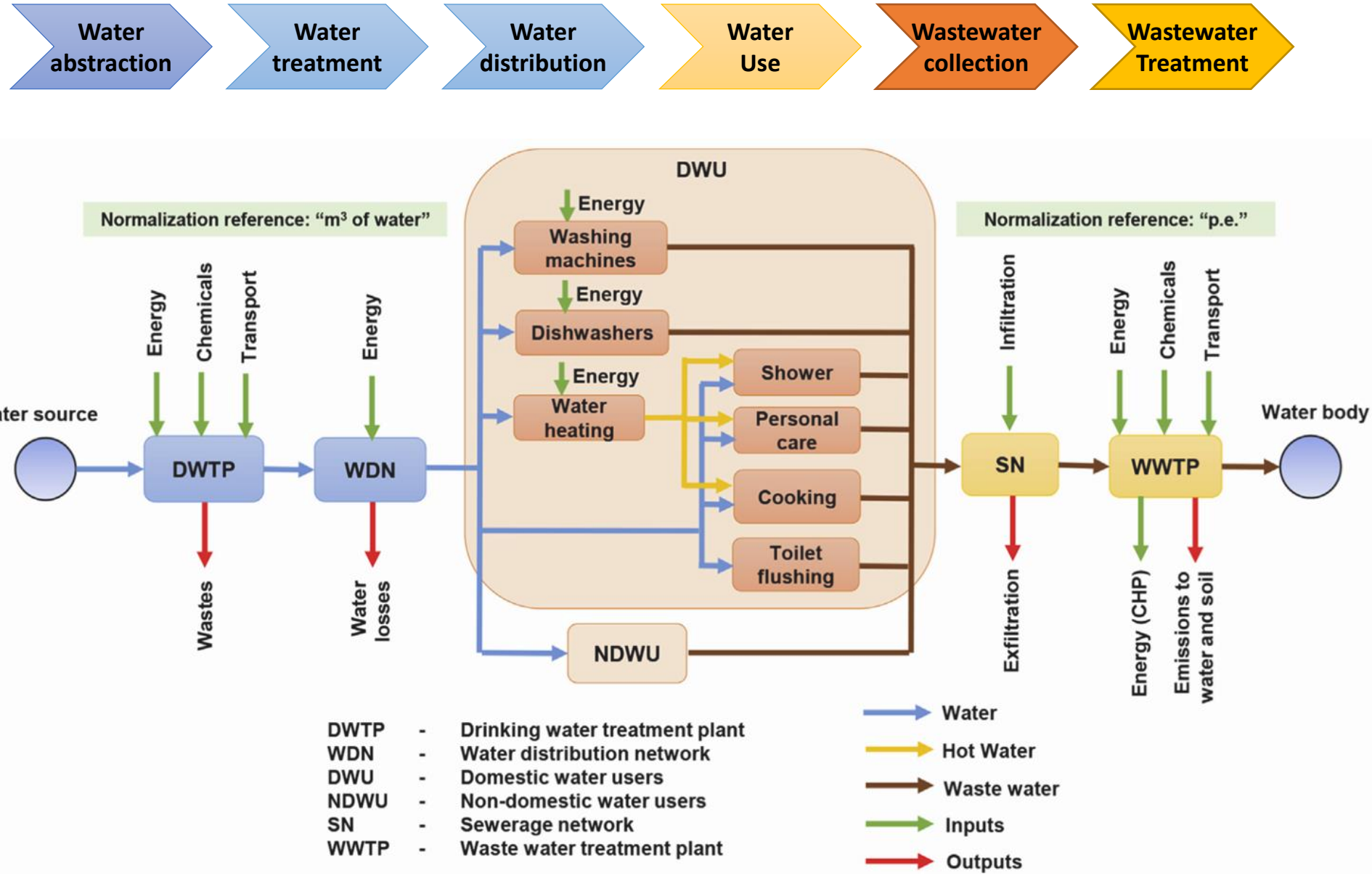


Historical transition of urban water systems

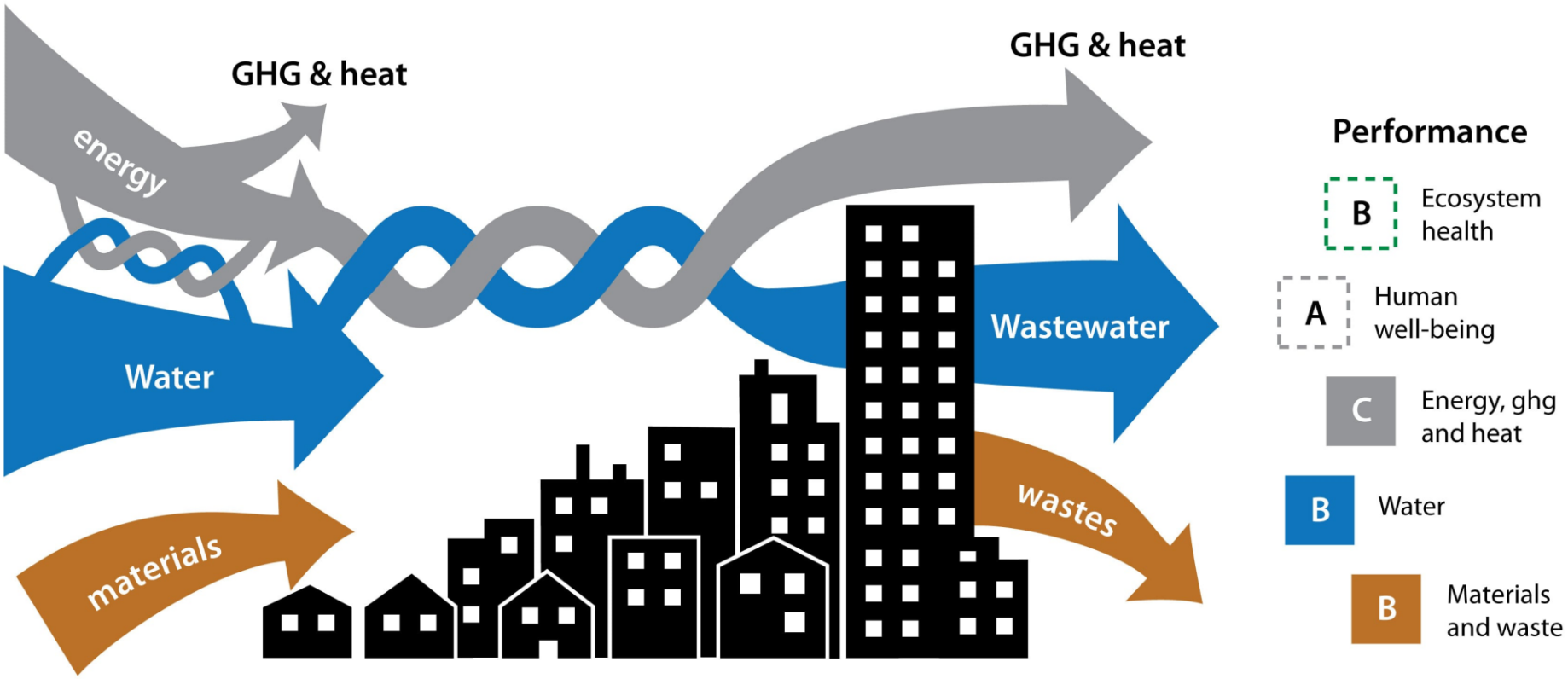


Source: Brown et al., 2008

Linear model of the urban water systems

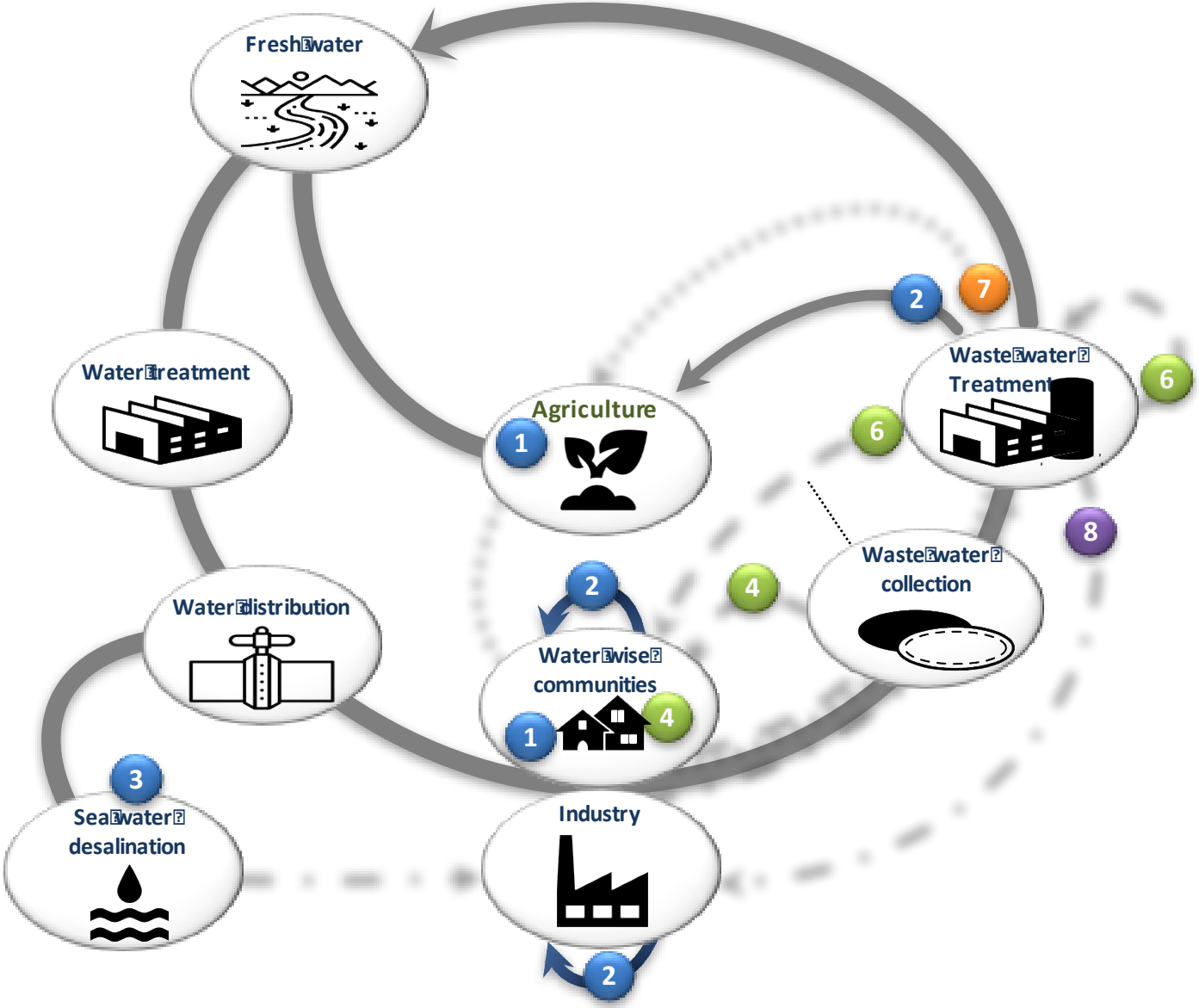


Water as medium of resources



Source: Kenway, S. J. 2013

Circular economy solutions in water sector



Water pathway

1: Water use efficiency
2: Water reuse
3: Alternative water sources

Energy pathway

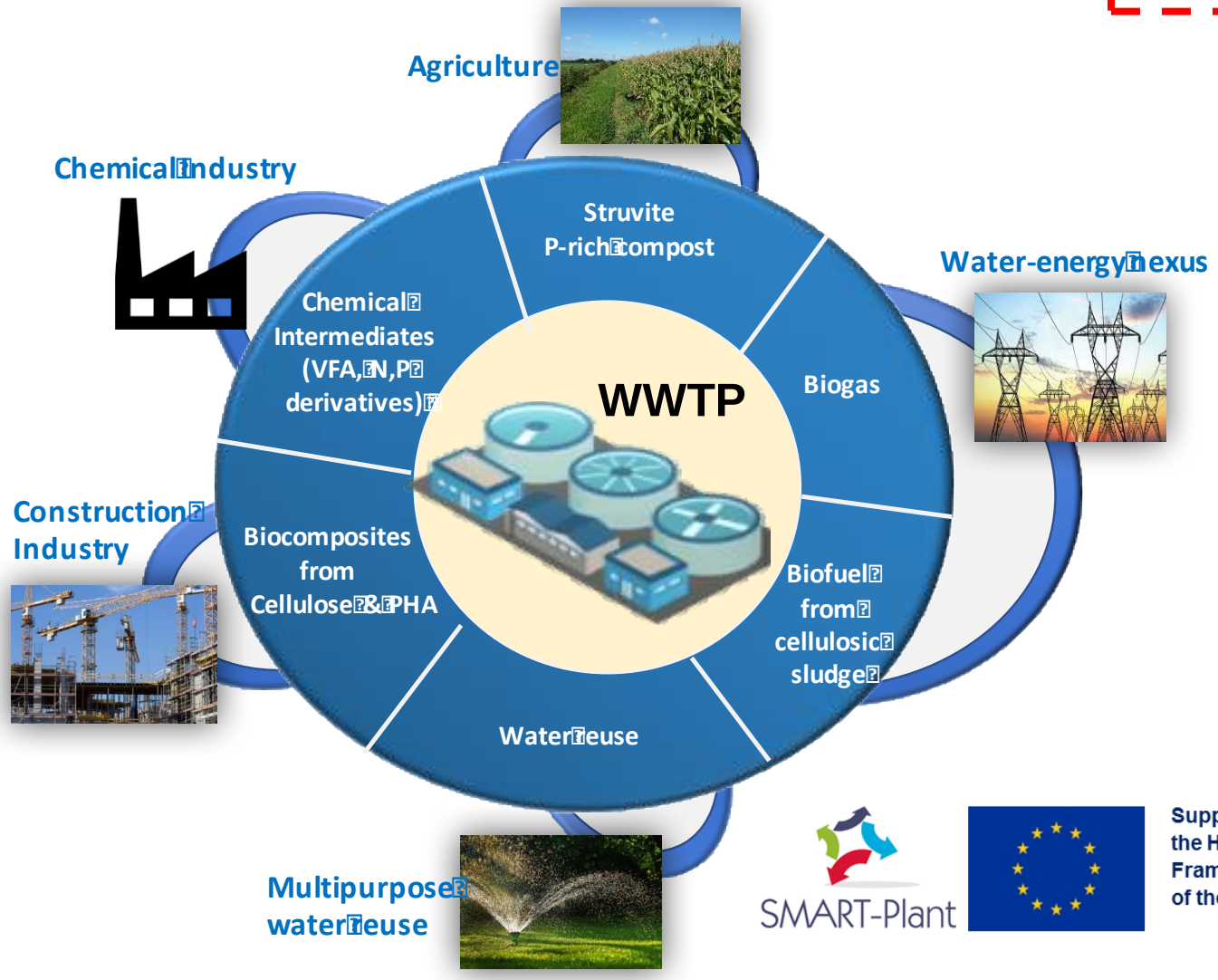
4: Energy recovery
5: Energy use efficiency
6: Biogas/biogas production

Nutrient / Material pathway

7: Nutrient recovery
8: Material recovery

Wastewater treatment in the circular economy

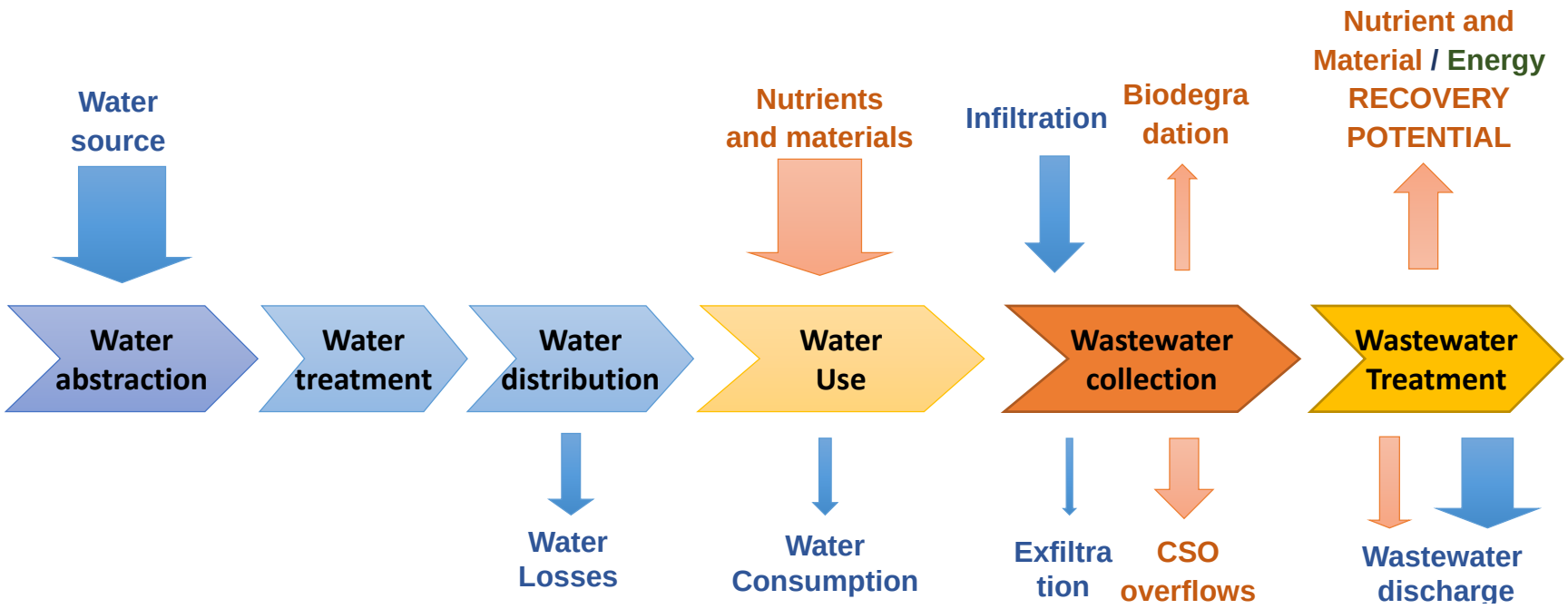
Water abstraction → Water treatment → Water distribution → Water Use → Wastewater collection → **Wastewater Treatment**

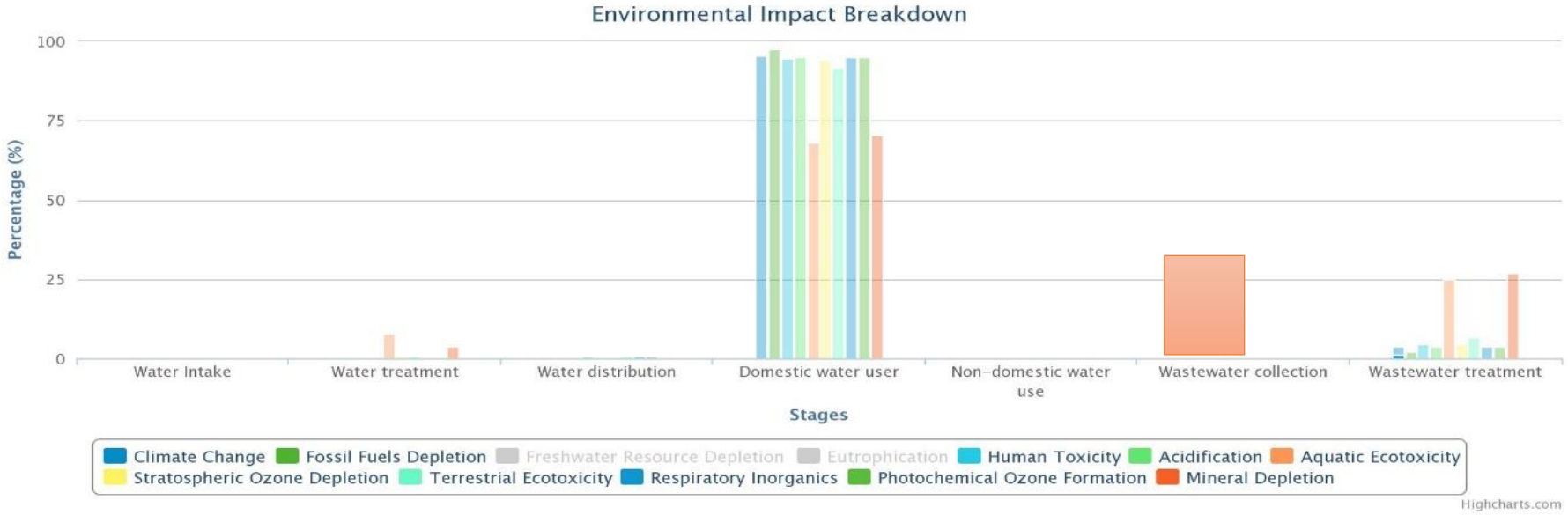


SMART-Plant

Supported by the Horizon 2020 Framework Programme of the European Union

Wastewater treatment in the circular economy



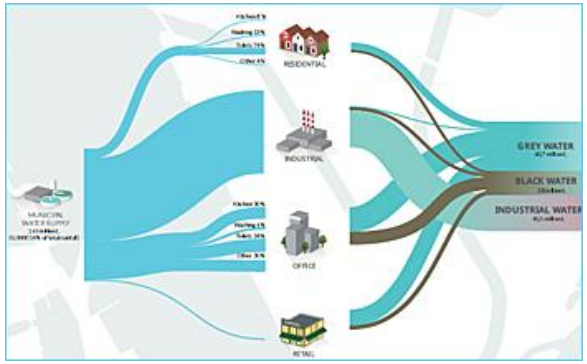


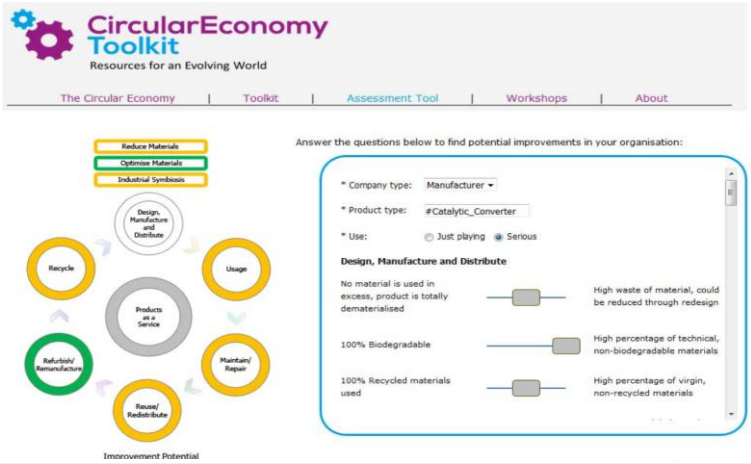
Closing the CE loops water systems

Source: GTZ

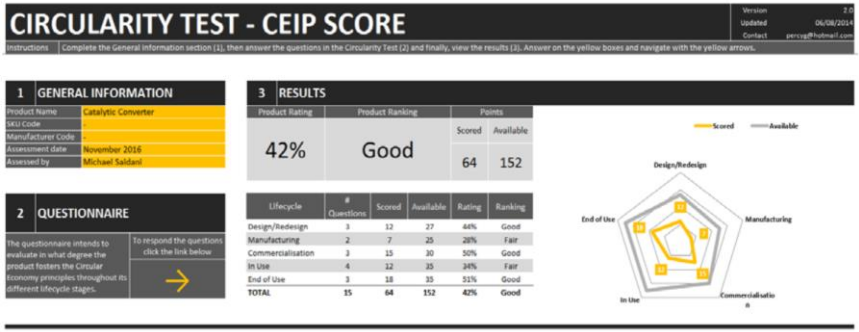
Measuring the circular economy

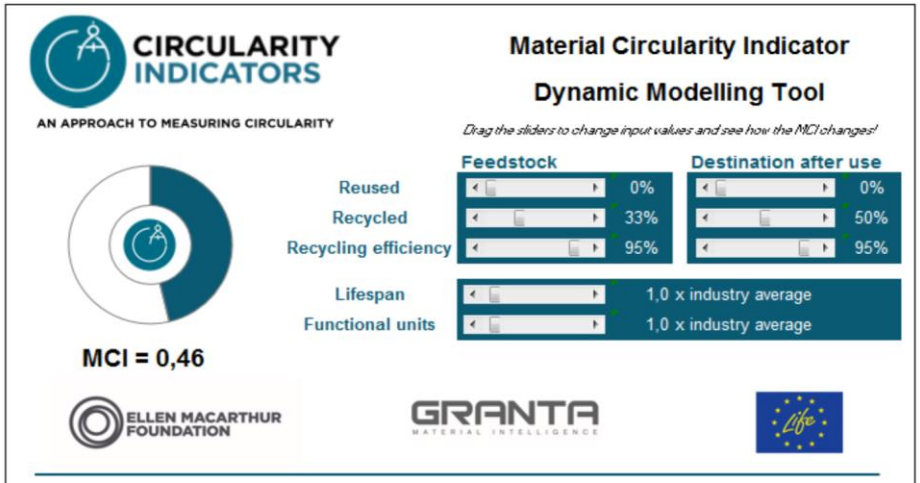
Material flow analysis





water footprint network



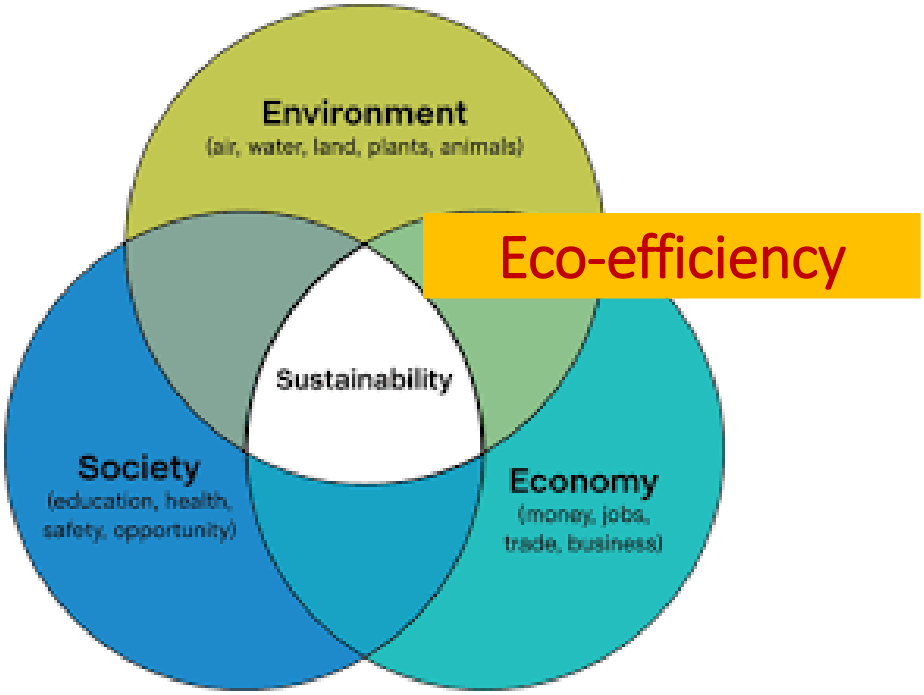


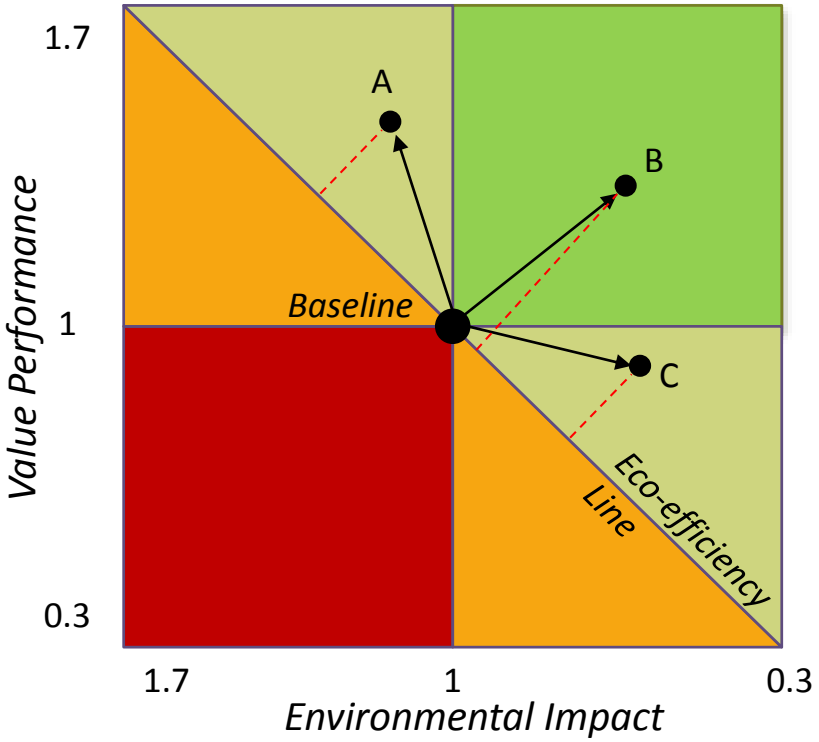
Eco-efficiency Assessment

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

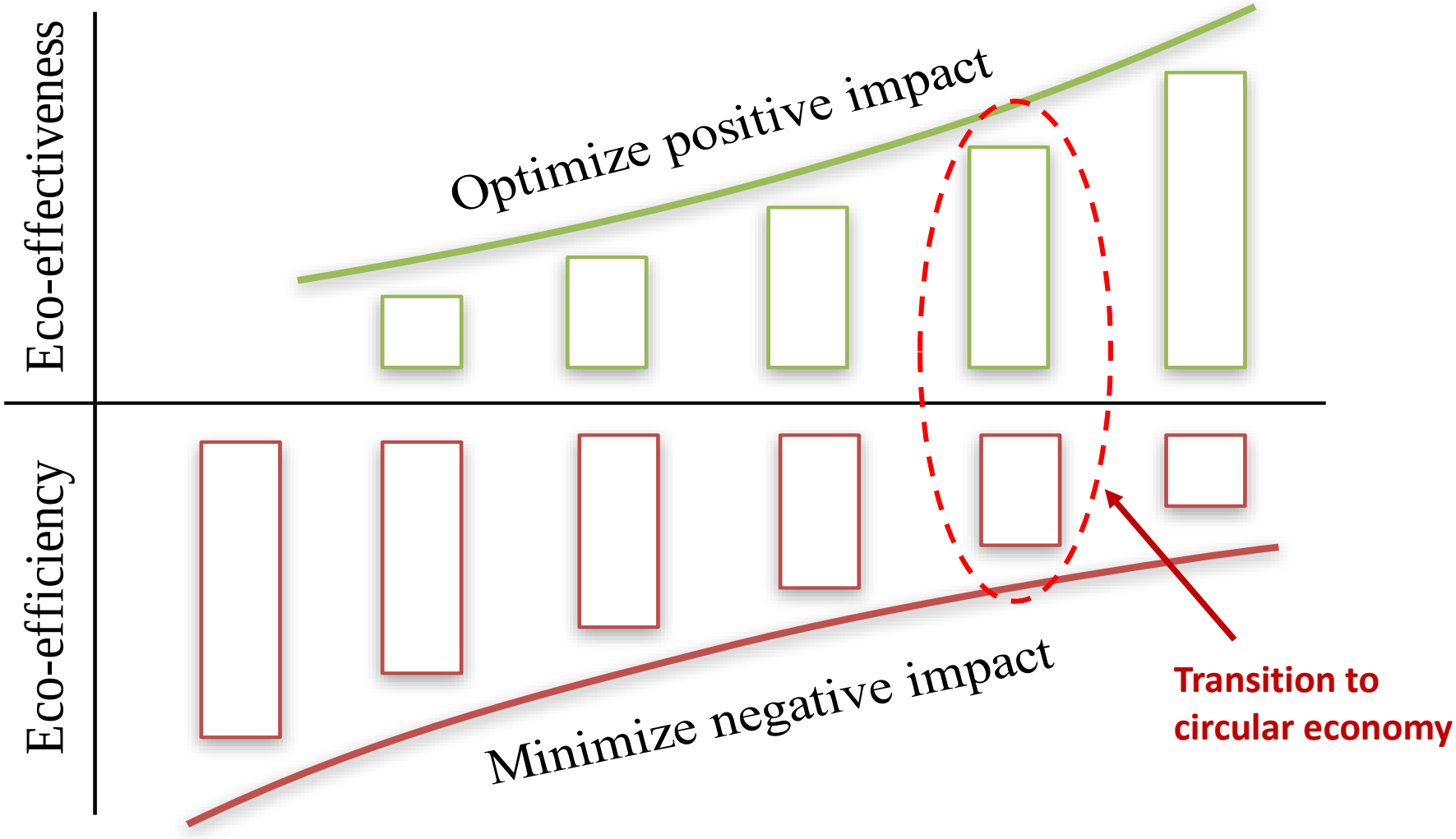
Delivering high value product/service
Less economic costs

Less resources,
Less emissions to air soil and water





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



Conclusions

- 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!