



Rethinking Centralised Water Service Systems

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Outline of Presentation

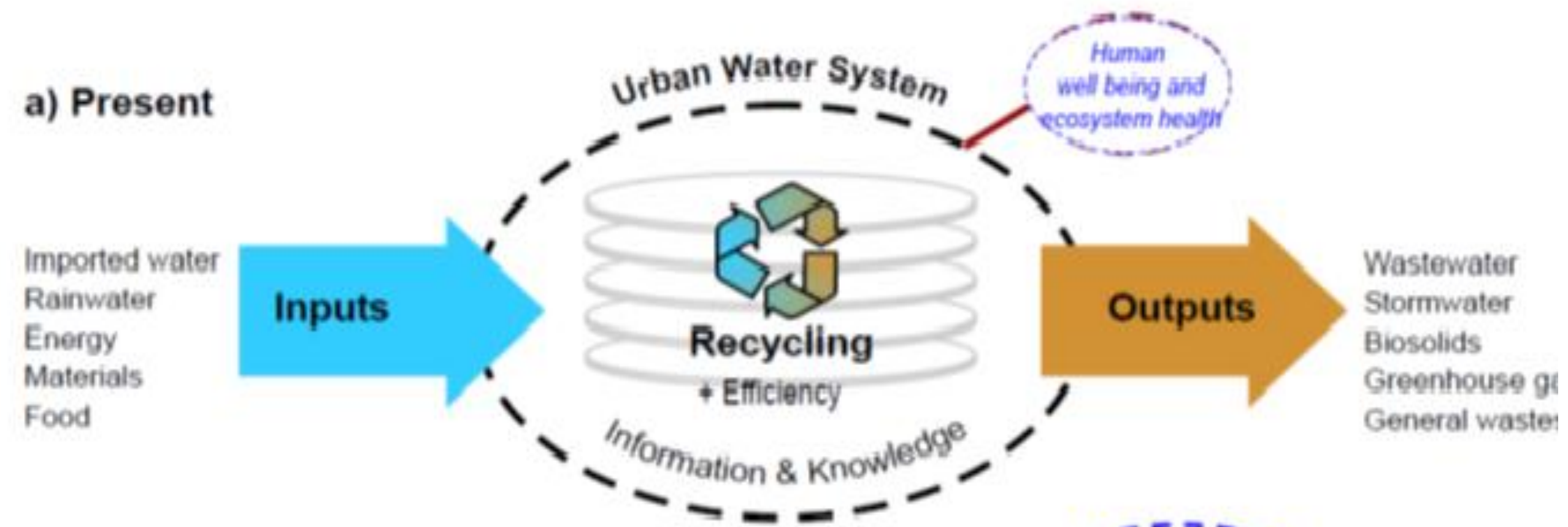
- Problems of Centralised Water Service Systems
- Need for a paradigm shift from Centralised to Distributed Recycling Water Systems
- Constraints of water circularity under current paradigm of water management
- Energy Intensity (EI) of Existing Centralised, Decentralised and Distributed Recycled Water Systems around the world and how EI varies with scale and technology
- Methodology
- Findings/Results
- Recommendations

Problems of Centralised Water Service Systems



- **Expensive and carbon intensive**
- **Energy Intensive** – Increased dependence on distance sources of water or deep aquifers or desalination- An average utility 30-40% and some even as high as 70%
- **Linear Systems** – over 80% water goes to drain – not sustainable
- **Single high-quality water** for all purposes which is not needed.
- **High operation and maintenance costs/Huge System Loss**

Need for a Paradigm Shift



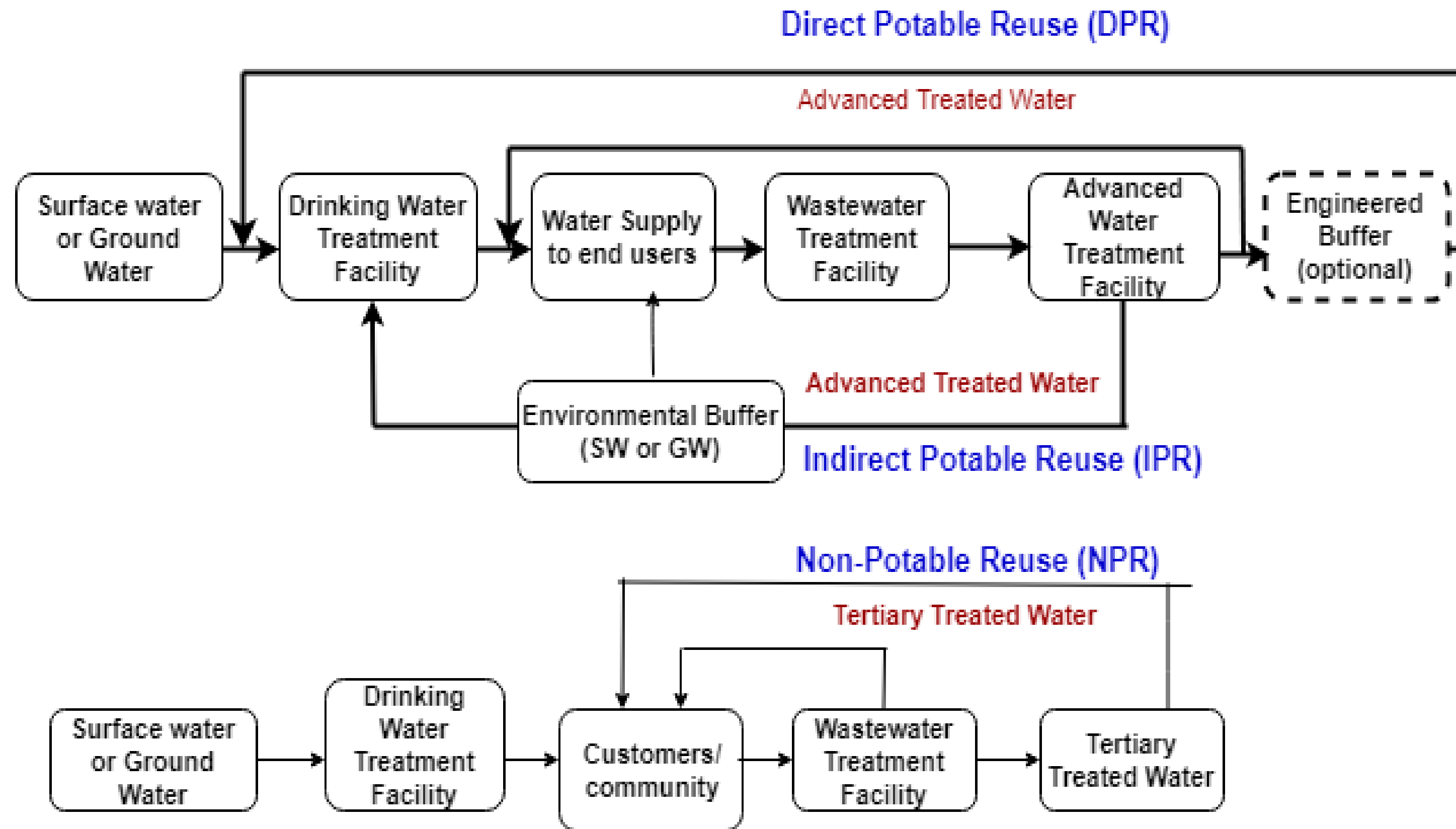
- High inputs and **outputs-High Metabolism**
- Little or no recycling
- Low well-being and poor ecosystem
- Depend on hinterlands for resources
- Not sustainable and climate-resilient



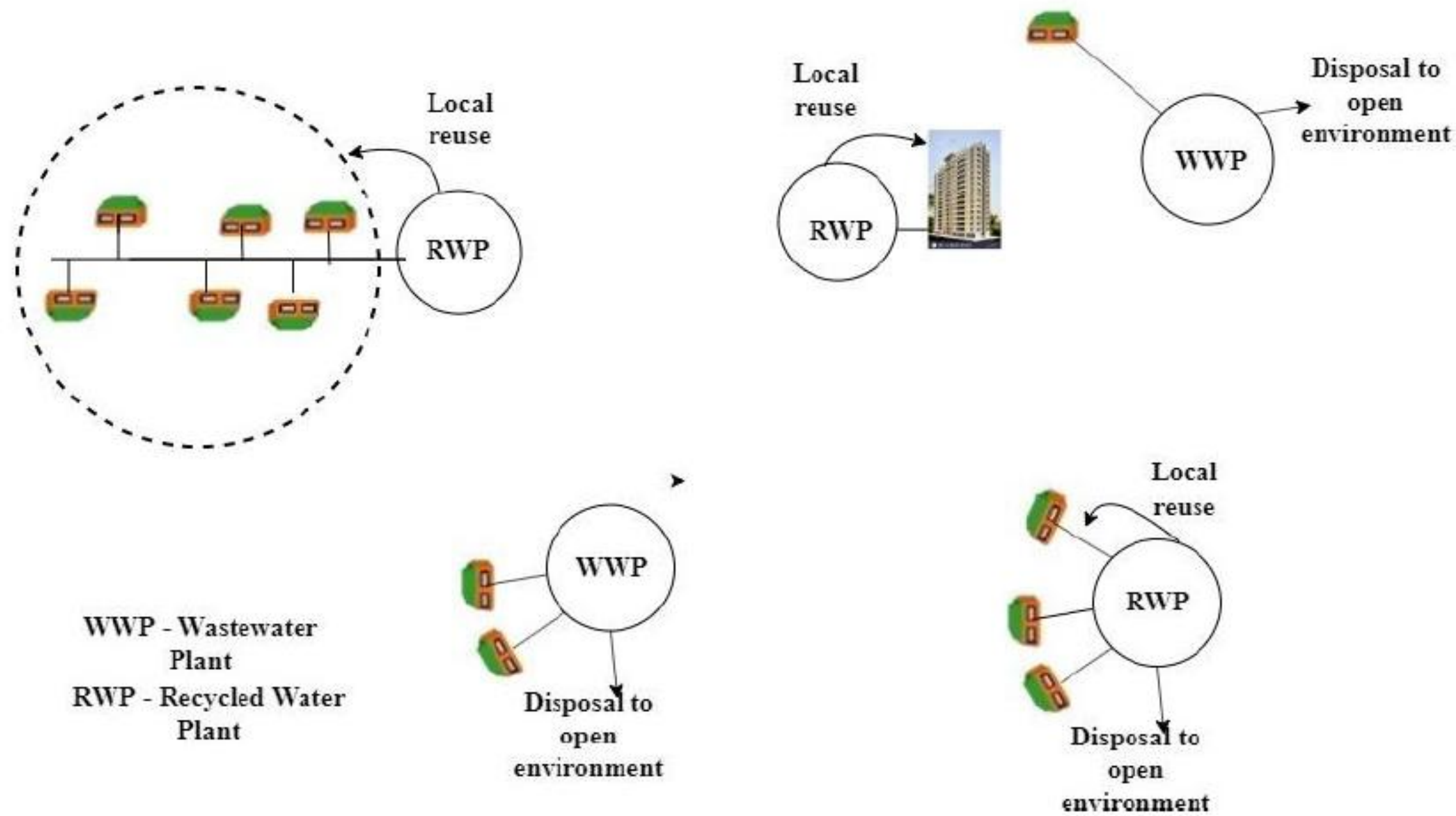
- Low inputs and outputs –**low metabolism**
- More recycling and circular
- Less dependent on hinterlands or self-sufficient
- Sustainable and climate resilient

But how???

Problems of Water Recycling Using Centralised Water Systems



Alternative/Decentralised Recycles Water Systems

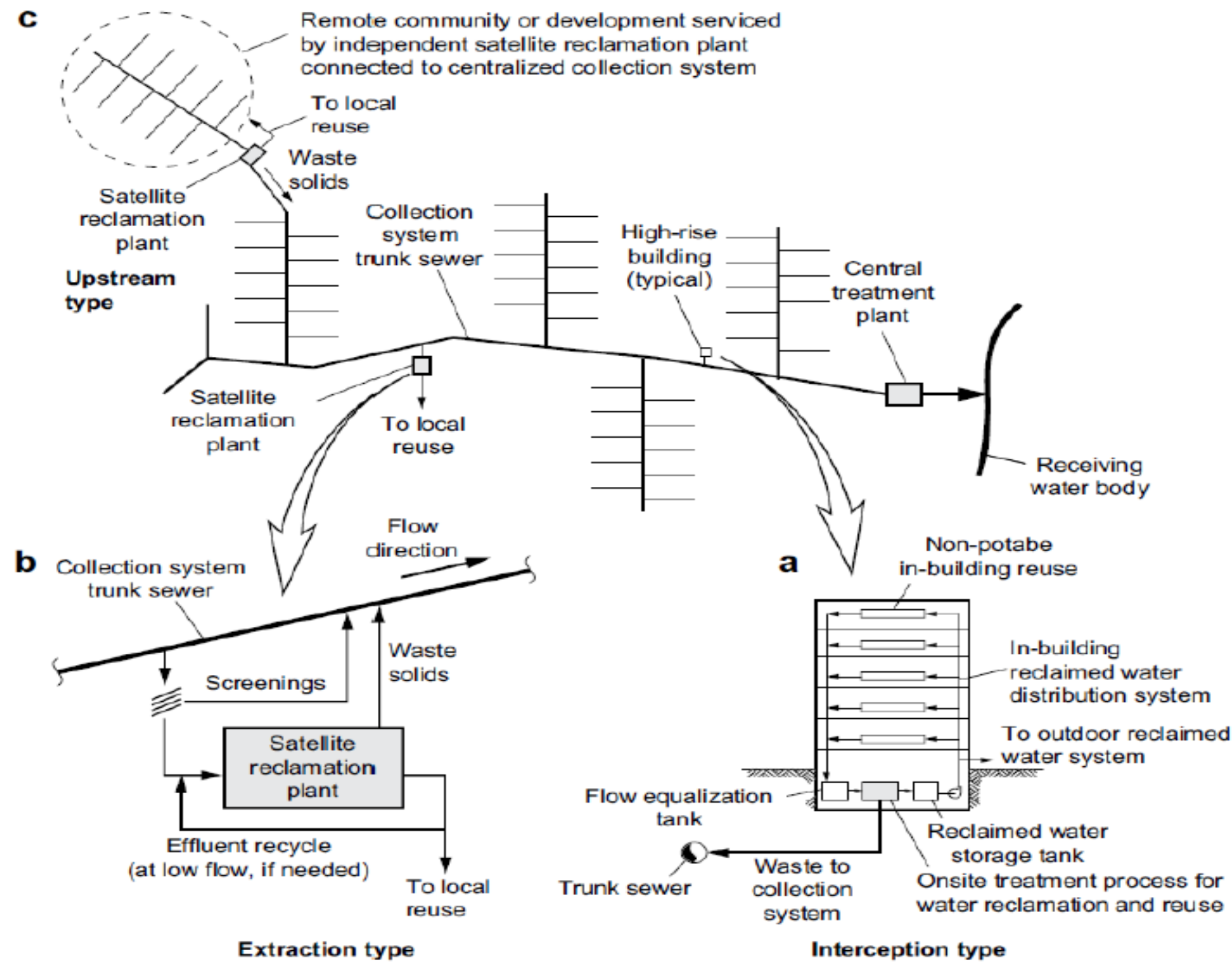


Decentralised systems are remote or stand-alone systems where solids after treatment are processed on-site or disposed to the environment.

Such systems are usually small and have high energy intensity.

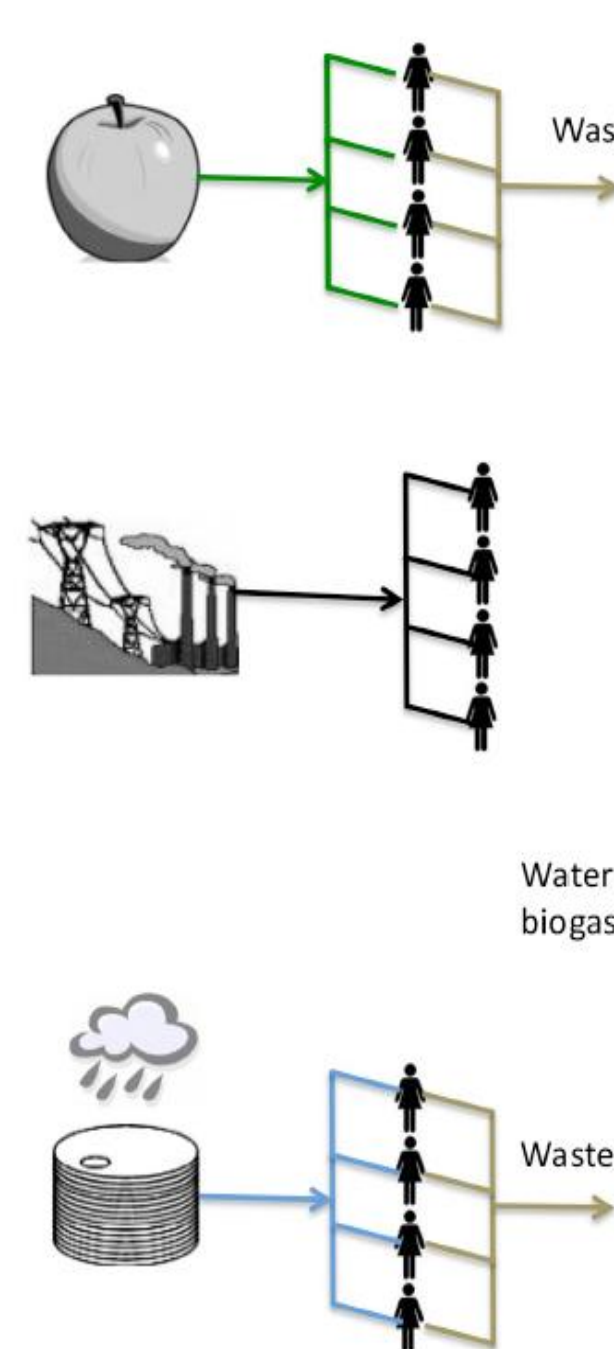
Many decentralised recycled water systems have been implemented but studies show those are not working properly because for many factors such as high energy costs, lack of skilled manpower, regulatory barriers and others.

Emerging Systems/Distributed/Satellite Recycled Water Systems

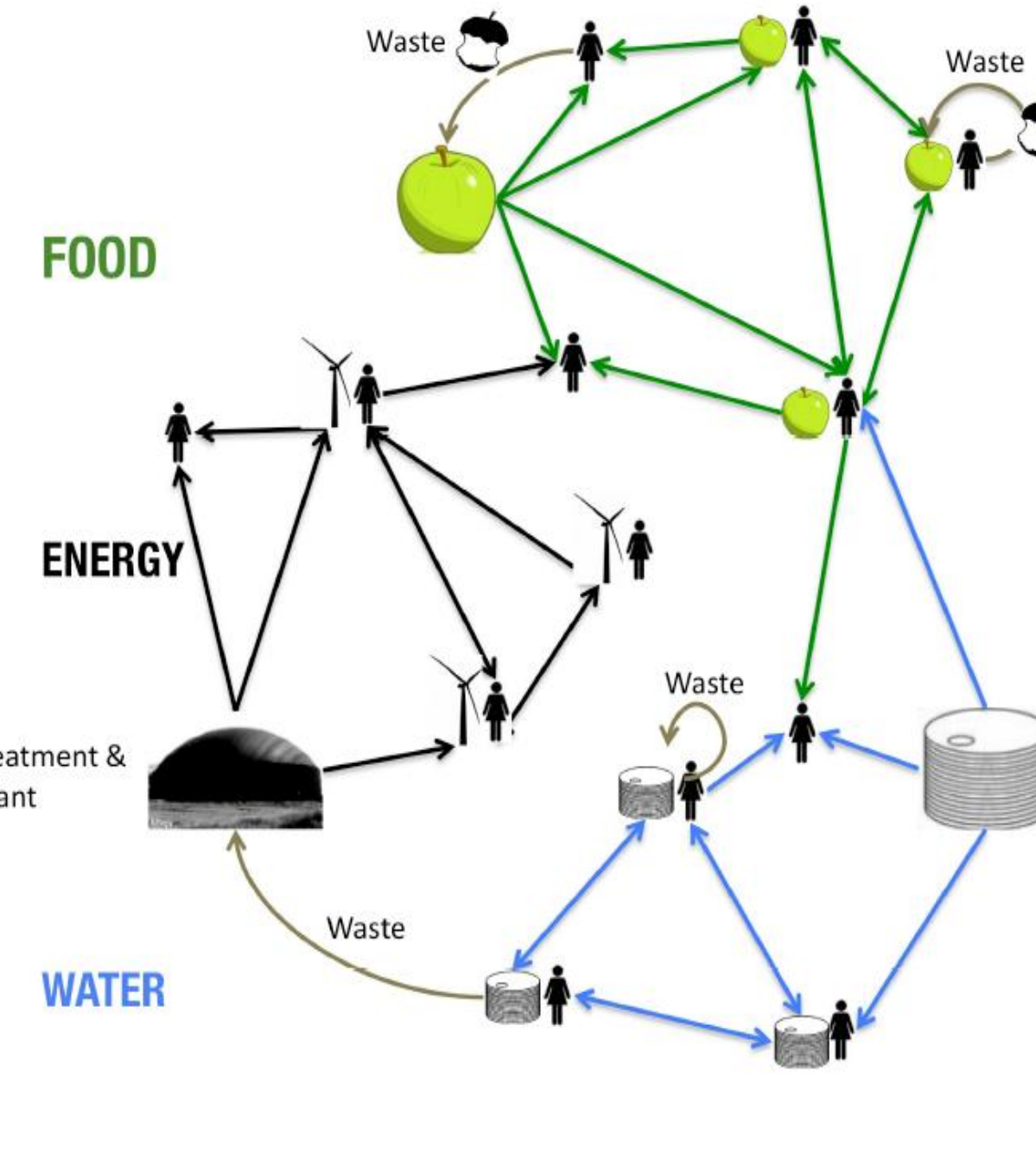


(Gikas & Tchobanoglous 2009)

Centralised production model



Distributed production model

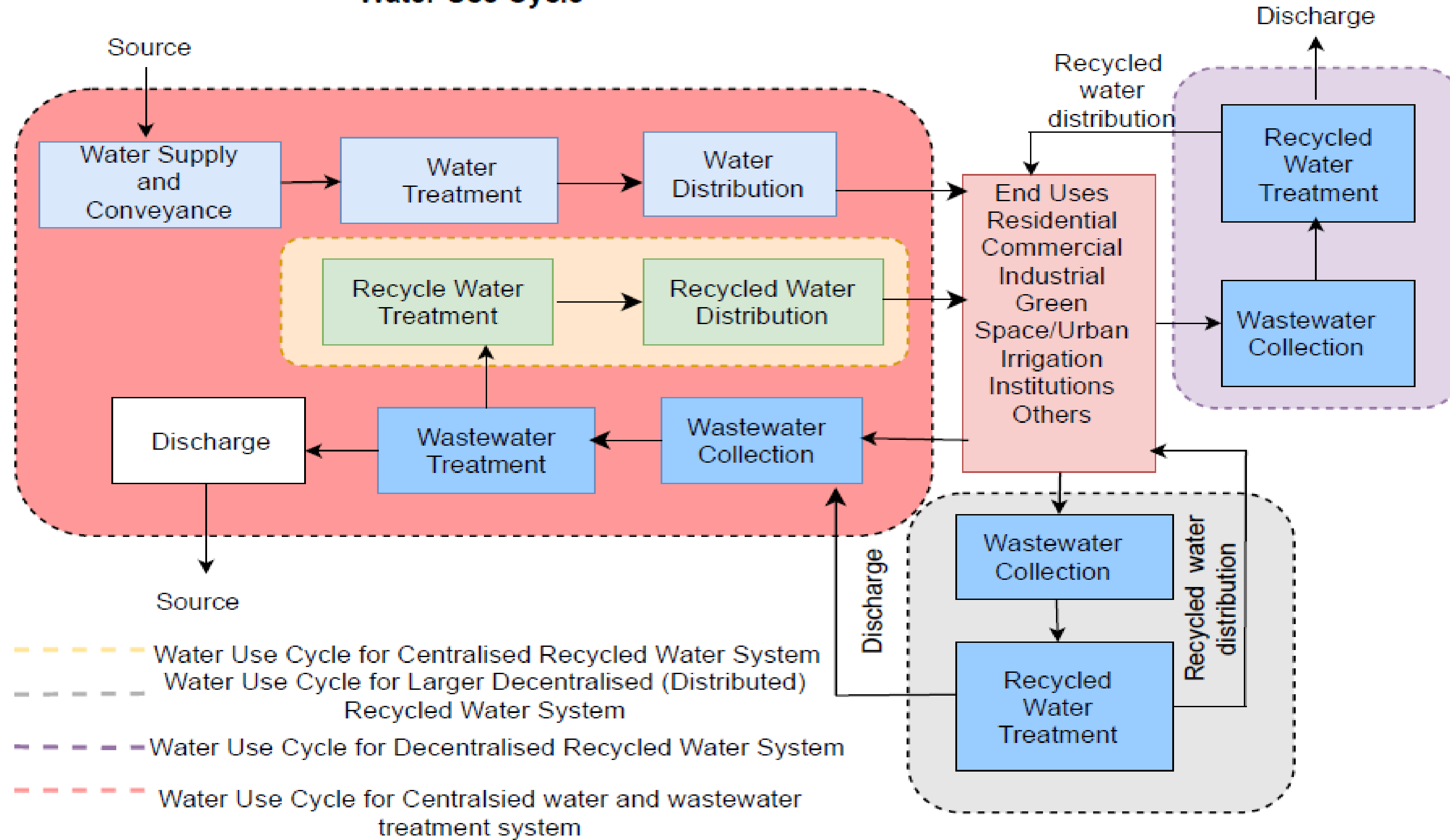


(Biggs 2009)

- Evolving Systems
- Systems are those which are connected or can be connected with existing sewerage networks.
- Effluent is processed at centralised wastewater treatment plants.
- Localized, networked/smart grid system, modular and open

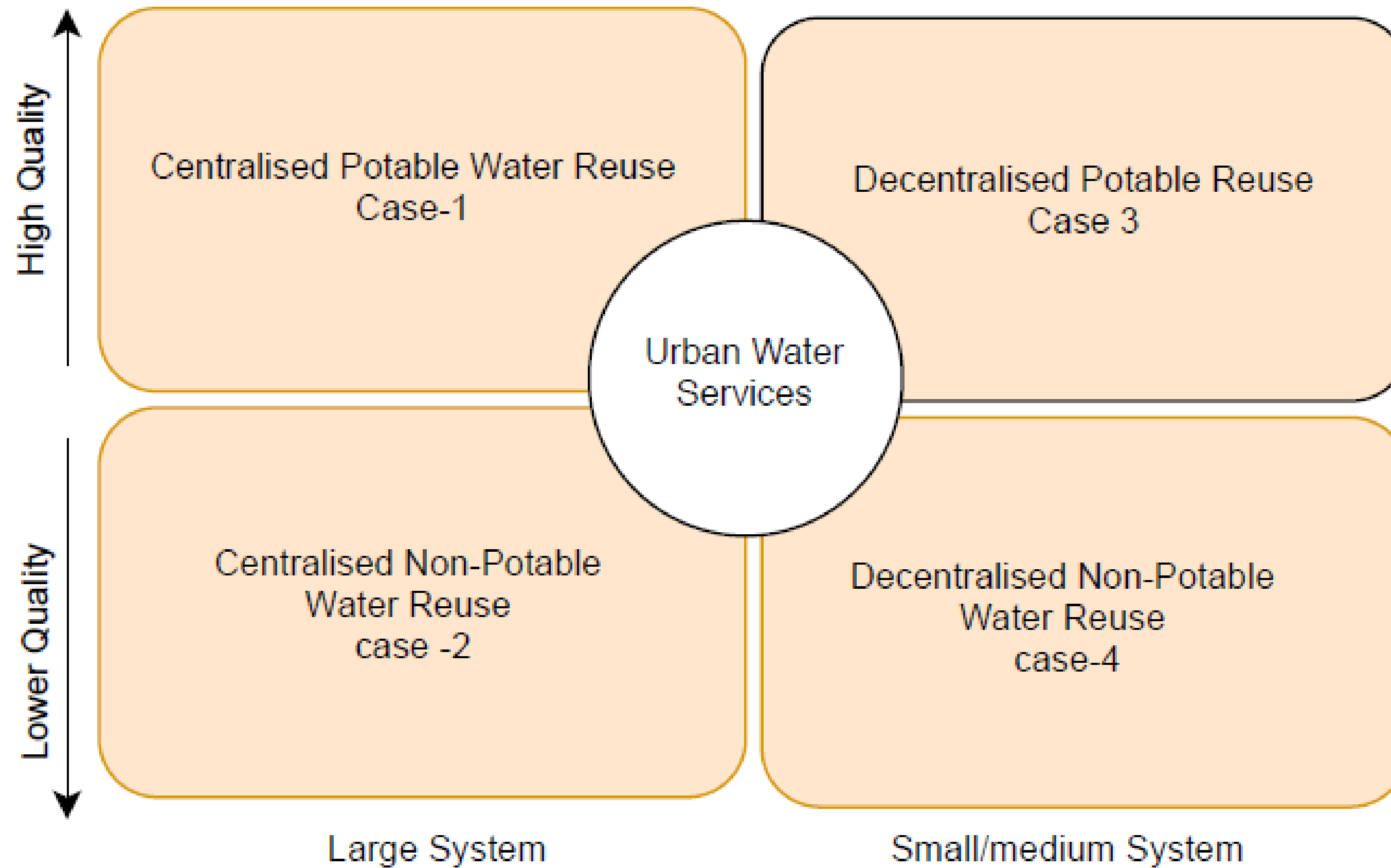
Methodology

Water Use Cycle



Paul et al. 2019

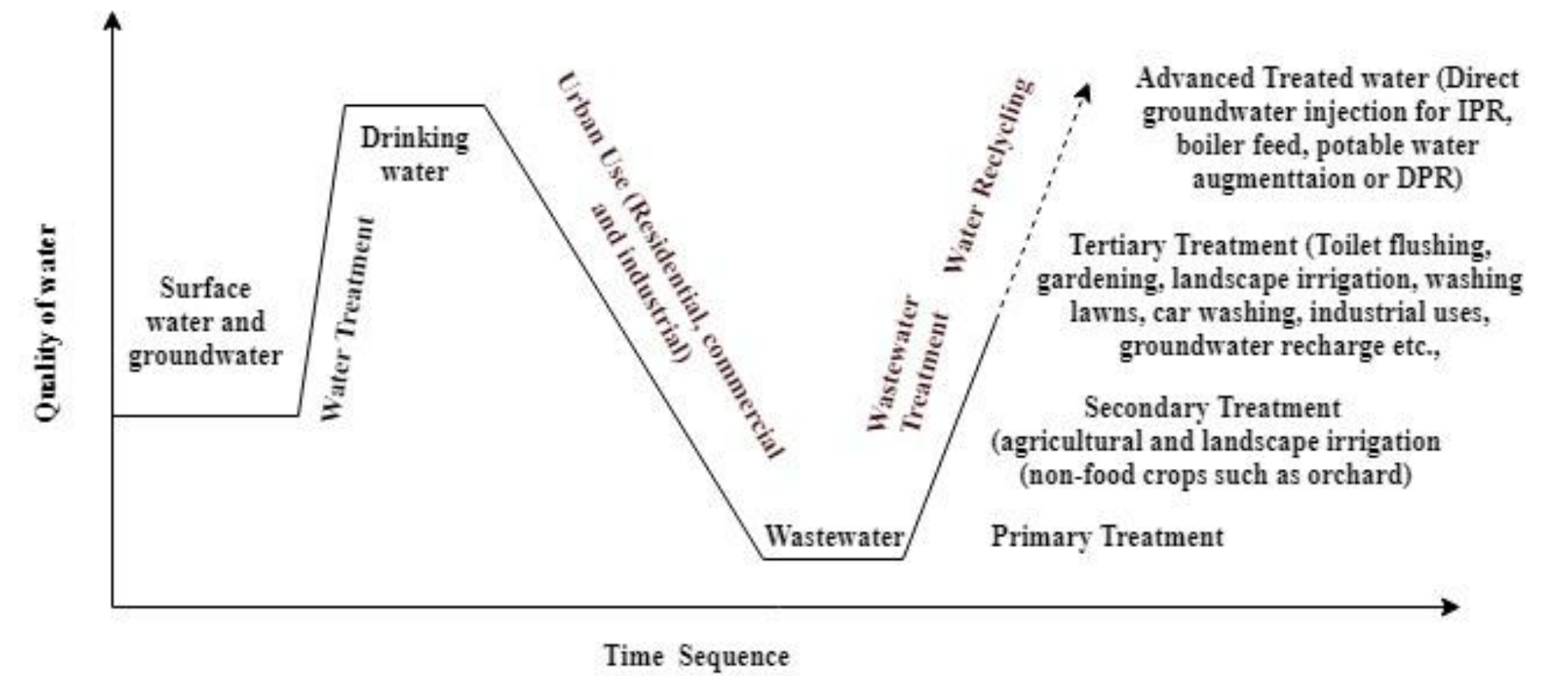
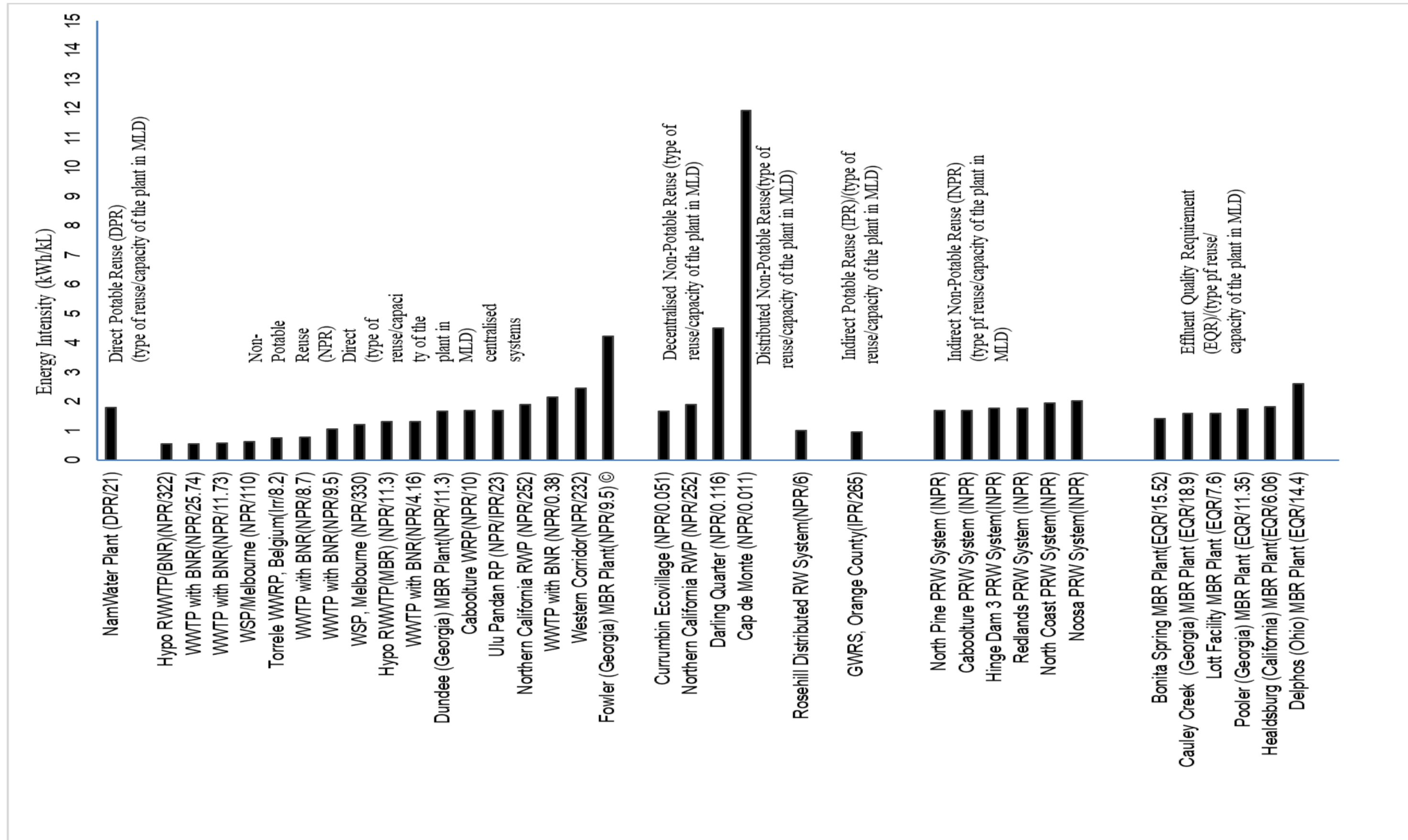
Analytical Framework to investigate how EI varies with scale and technology/fit-for-purpose use



Paul et al. 2019

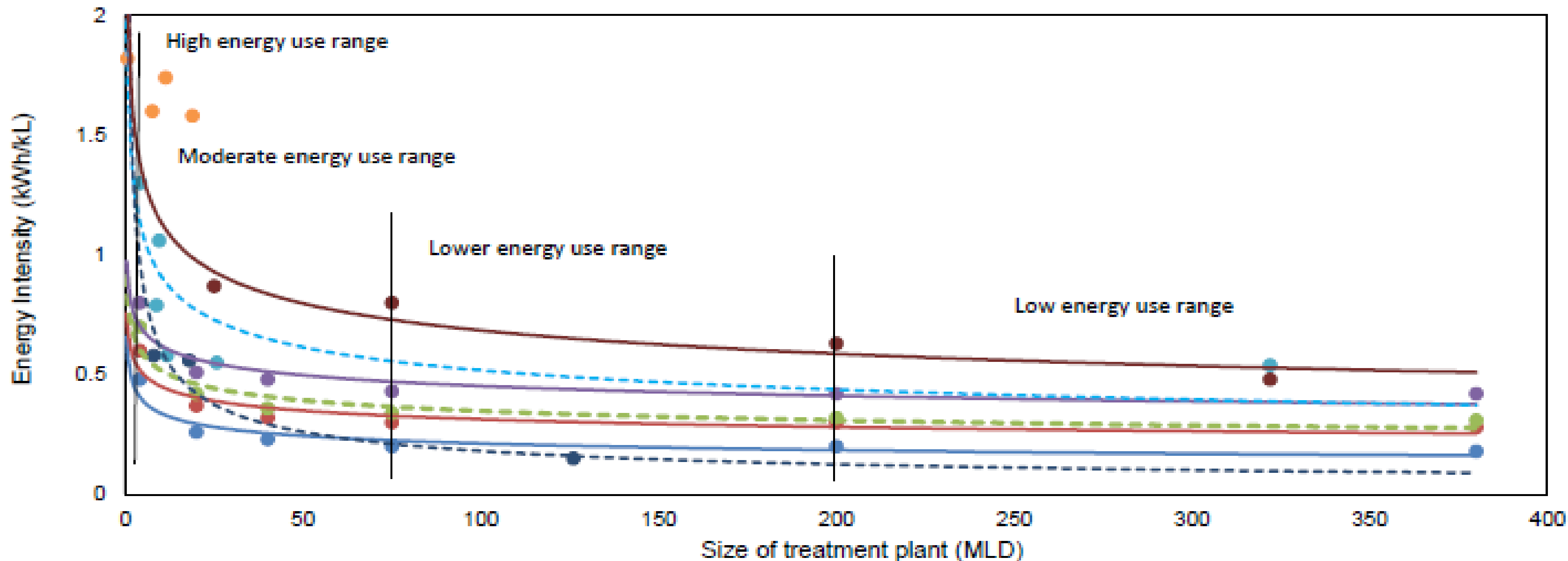
EI of Existing Recycled Water Plants around the World

(Centralised, Decentralised and Distributed Systems for Potable and Non-Potable Uses)



Asano 2002; Asano & Levine 1996; Crook, Mosher & Casteline 2005

Scale versus treatment energy for a particular technology and treatment train



- Tricking Filter (NPR)
- Activated Sludge (NPR)
- Advanced Treatment without Nitrification (NPR)
- Advanced Treatment with Nitrification (NPR)
- Biological Nutrient Removal (BNR)
- Membrane Bioreactor (NPR)
- Biological Activated Carbon (BAC)-Ozone (O3)-Ultrafiltration (UF) (PR)
- Advanced Water Treatment (Reverse Osmosis) (PR)

Size (MLD)	Energy Intensity (Potable Water Quality) kWh/kL	Energy Intensity (Non-Potable Water Quality)
< 5	2 - 0.75	2 - 0.48
5 - 75	0.9 - 0.4	0.75 - 0.3
75 - 200	0.8 - 0.2	0.55 - 0.25
>200	<0.8	<0.55

Paul et al. 2019

Way Forward

- Distributed Recycled Water Systems is Next Water Solution. Can be implemented at precinct level and sub-national level more economically.
- All new development should follow distributed recycled water systems and built systems should follow sewer mining for water recycling.
- Immediate need is regulatory changes for the use of 'fit-for-purpose' water to enable water circularity.
- Water management is still heavily dependent on centralised systems. Need more investment in distributed recycled water systems
- There are some challenges in this paradigm shift and Integrated/One Water management can help overcome these challenges.



(Mukheibir et al. 2015)

Thank you

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