

Low impact urban design by closing the water cycle

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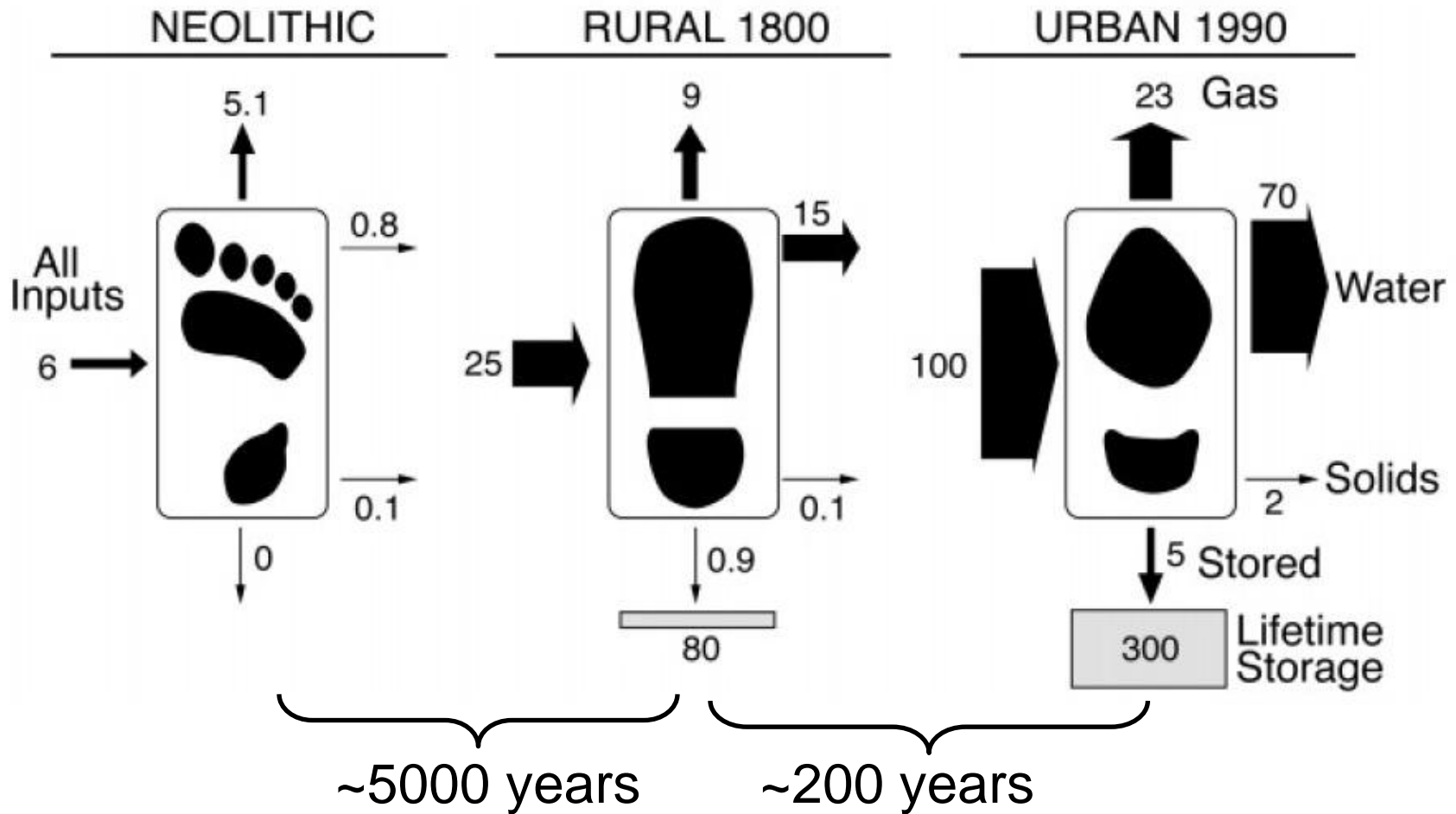


Problem definition

- Growing urbanization → increasing pressure on available resources
- Waste (water) production
- Lack of integration between urban planning & (water) resources management

Urban Footprint and metabolism

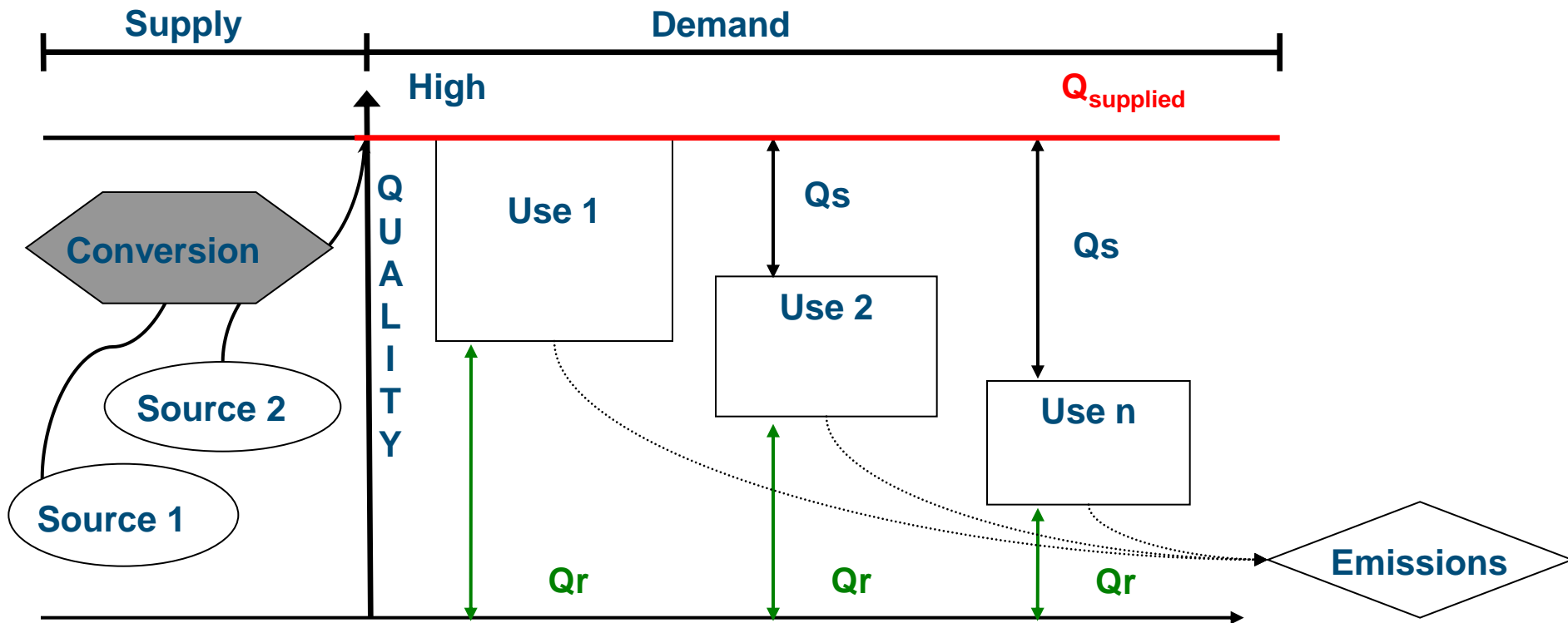
Ton/person - year



(Brunner and Rechberger, 2002)

Problem definition

Water qualities in Urban systems



2 kind of losses:

- Q_s = quality surplus supplied
- Q_r = unused quality of the remaining flow

Global resource network

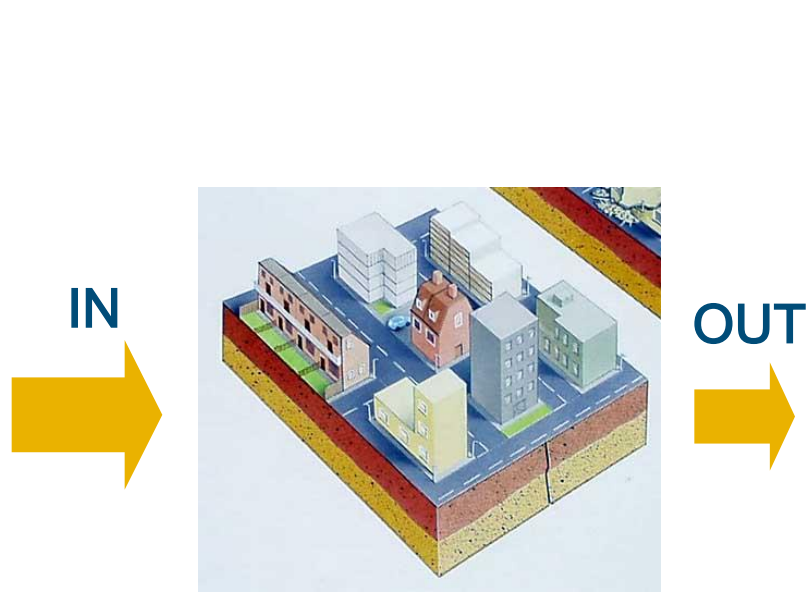


The solution

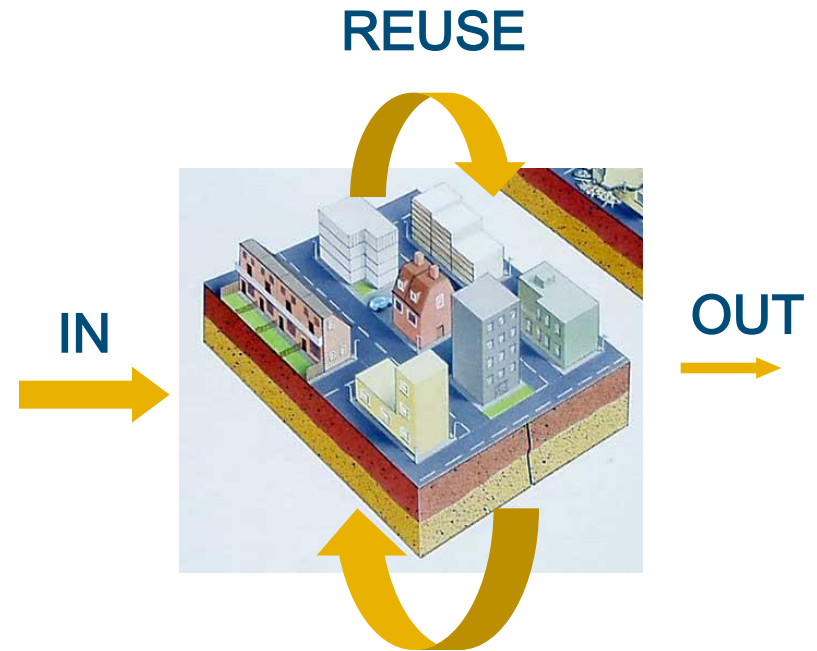
To solve current environmental problems, we
have to solve the metabolic problems of
cities



Concepts: urban metabolism

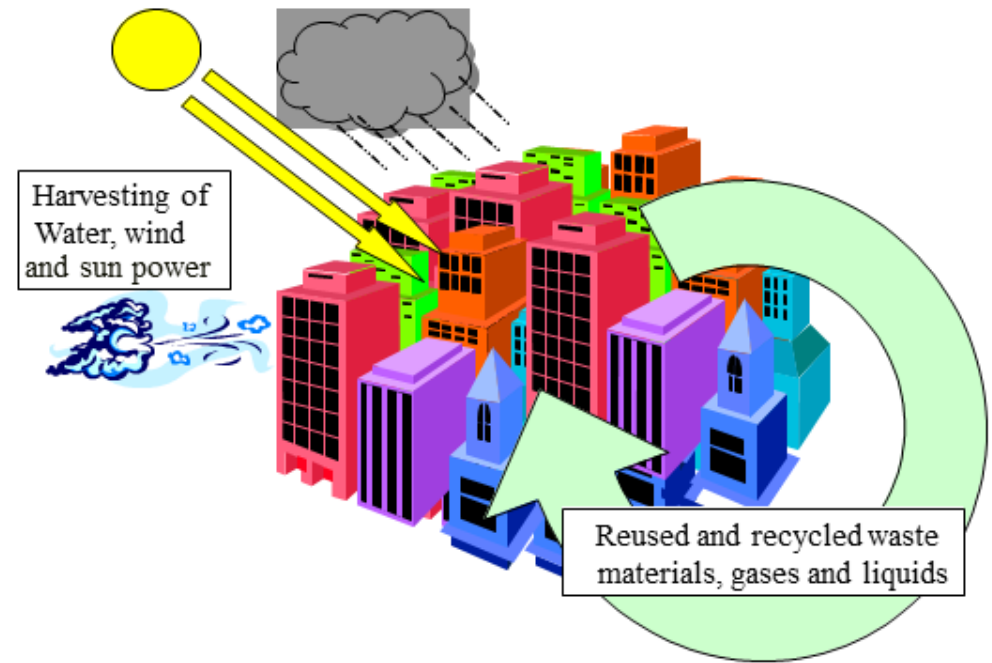


Linear Metabolism



Circular Metabolism

The URBAN Harvest approach has been developed as a strategy to investigate all possible options for harvesting local resources and (re)using emissions and wastes



Urban Harvest

Circular metabolism powered by
local and renewable sources

Planning parameters for resource management

- Quantity
- Quality
- Location
- Temporal
- Interactions among flows

Urban Harvest approach

- Focuses on improving resources management within urban system by using local potentials
- No waste, only resources in different qualities
- Unified methodology to manage urban flows
- Bridge the gap between technology and planning
- Urban resources management as key consideration of urban planning: Integrated flows / Integrating different scales



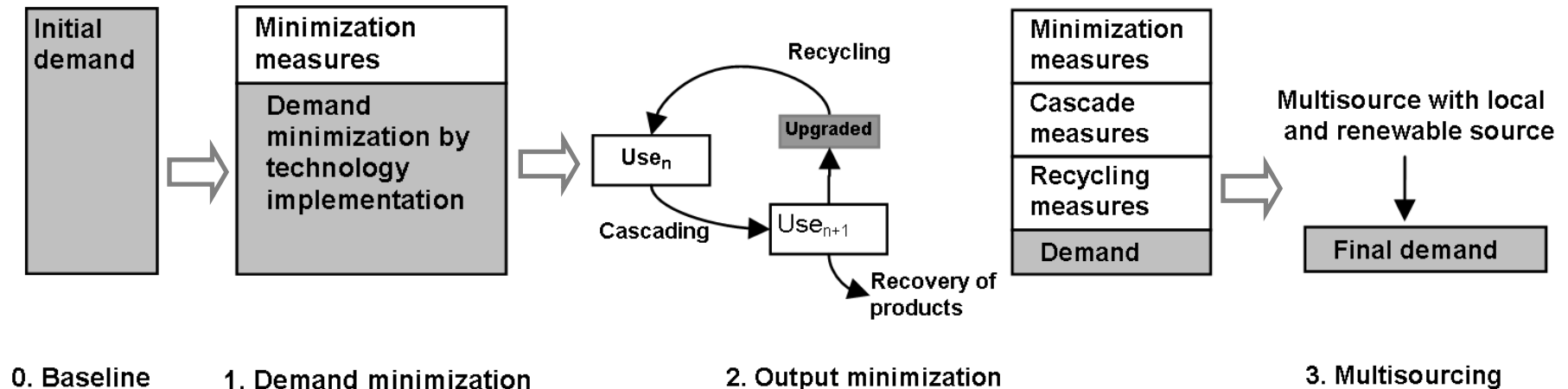
Harvesting potentials of urban water flows

It is not only about water!

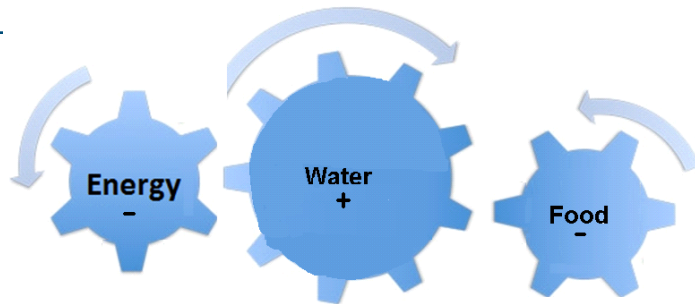
Water is a carrier for other urban flows

Urban flows	Water	Heat	Nutrients	Organic matter
Rain water	●			
Urban Wastewater (mixed)	●	●	●	●
Urban Wastewater (separated)				
Grey water	●	●		
Black water			●	●
Urine			●	

How to improve urban metabolism

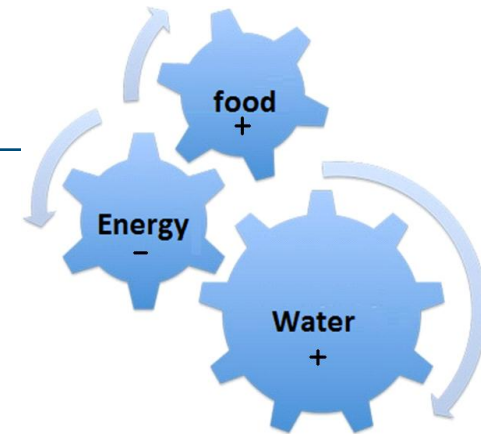
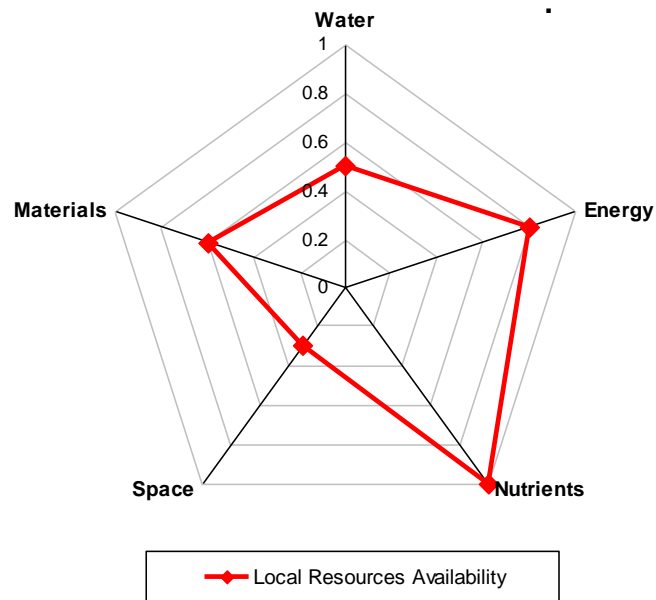


Valid for water, energy, materials



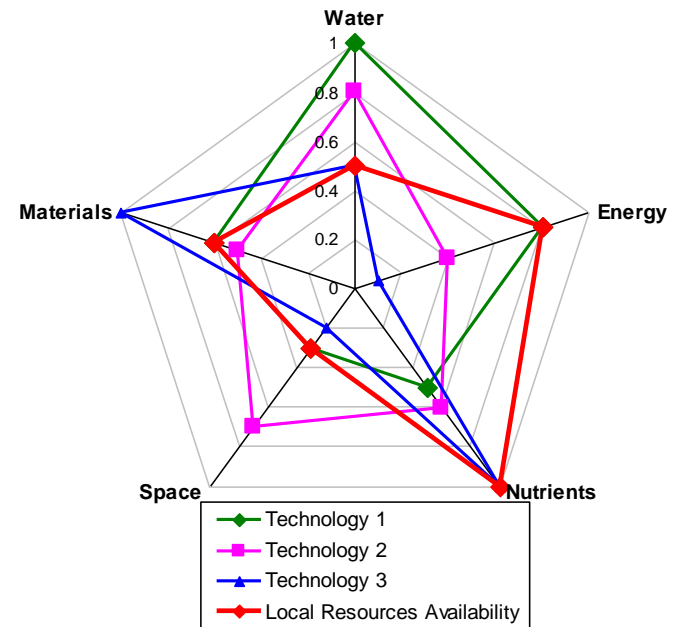
a. Single flow optimization

Local Context Characteristics



b. Smart linkages

Resources Use per Technology



Local potentials

How to evaluate the potentials

$$\text{Potential} = \text{Available resources} \times \Phi_{\text{tech}} \times \Phi_{\text{urban}}$$

Φ_{tech} : Reduction due to technical limitations

Φ_{urban} : Reduction due to urban characteristics

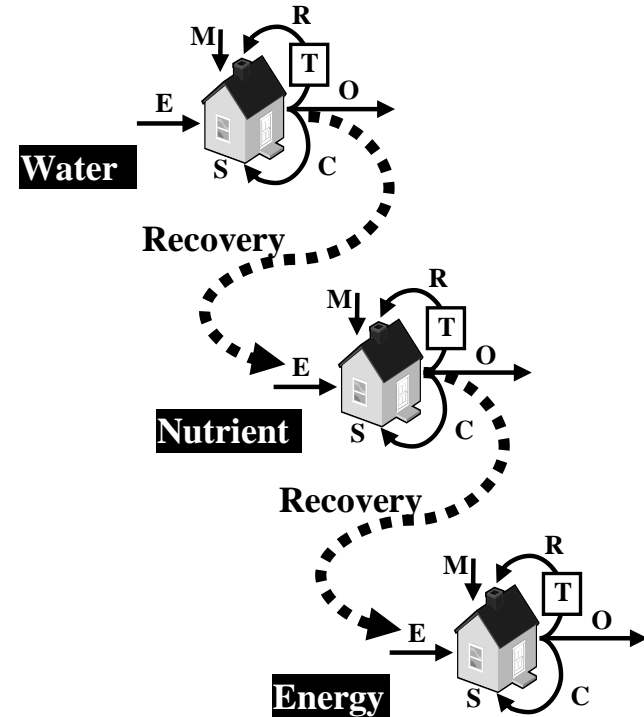
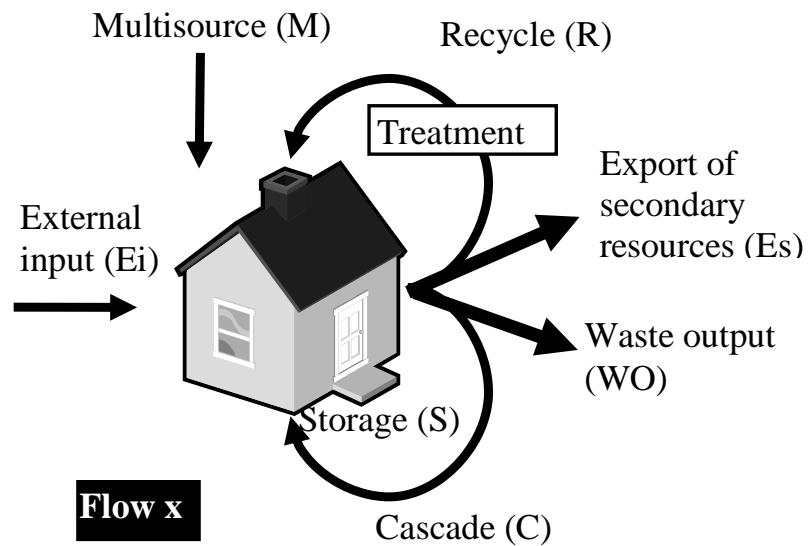
Local potentials

Summary of the Evaluation of potential for reuse of the different flows for the NL

	Rain water	Bathroom	Laundry	Kitchen	Mixed
Quality	+++	++	+	+	-
Quantity	++	++	+	-	++
Temporal	++	++	-	+	+
Location	+++	+	+	+	+

+++ very good, ++ good, + satisfactory, - bad,

UHA at household level



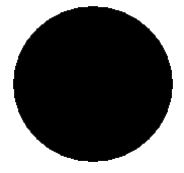
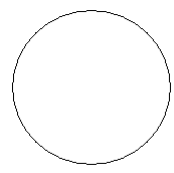
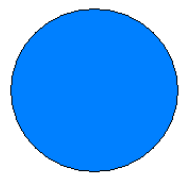
Water balance:

Total inputs = Total outputs + storage

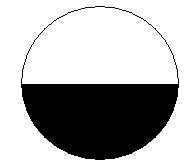
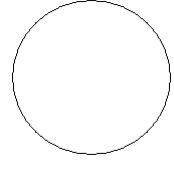
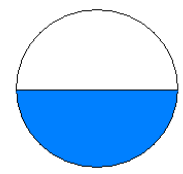
Results – Metabolic profiles (lt/dw-d) – Dutch household

Demand Self production Waste Output

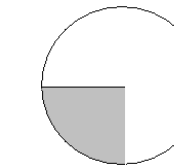
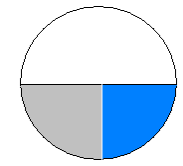
0. Baseline – Initial demand



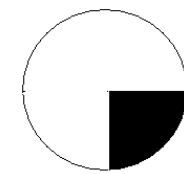
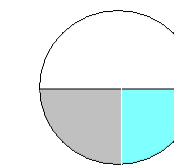
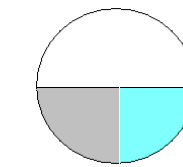
1. Demand minimization



2. Output minimization



3. Multisourcing



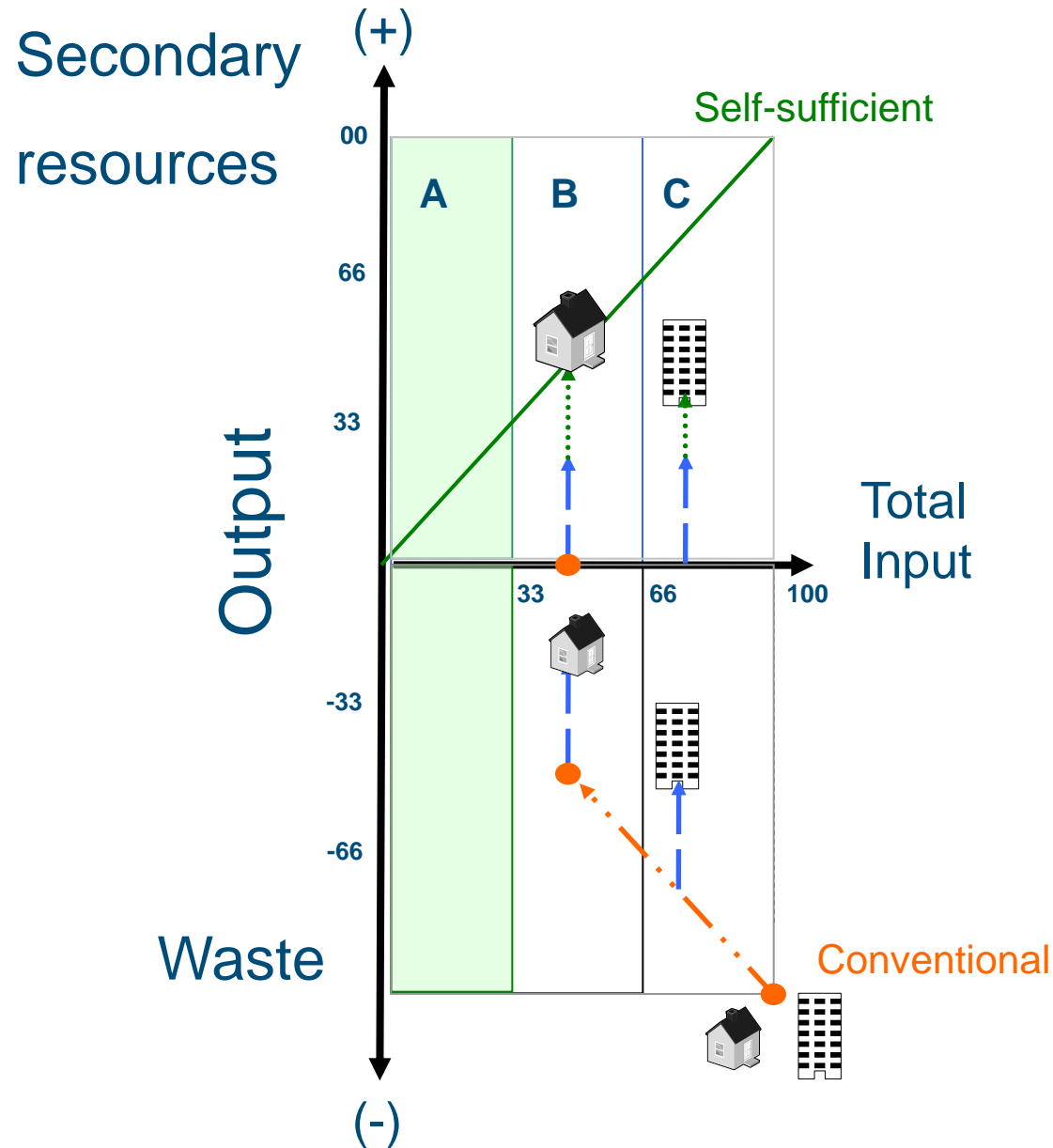
 Tap water

 Grey water

 Multisource water

 Black water

Metabolic profiles



1 Minimization

2 Cascade & recycling

3 Multisourcing

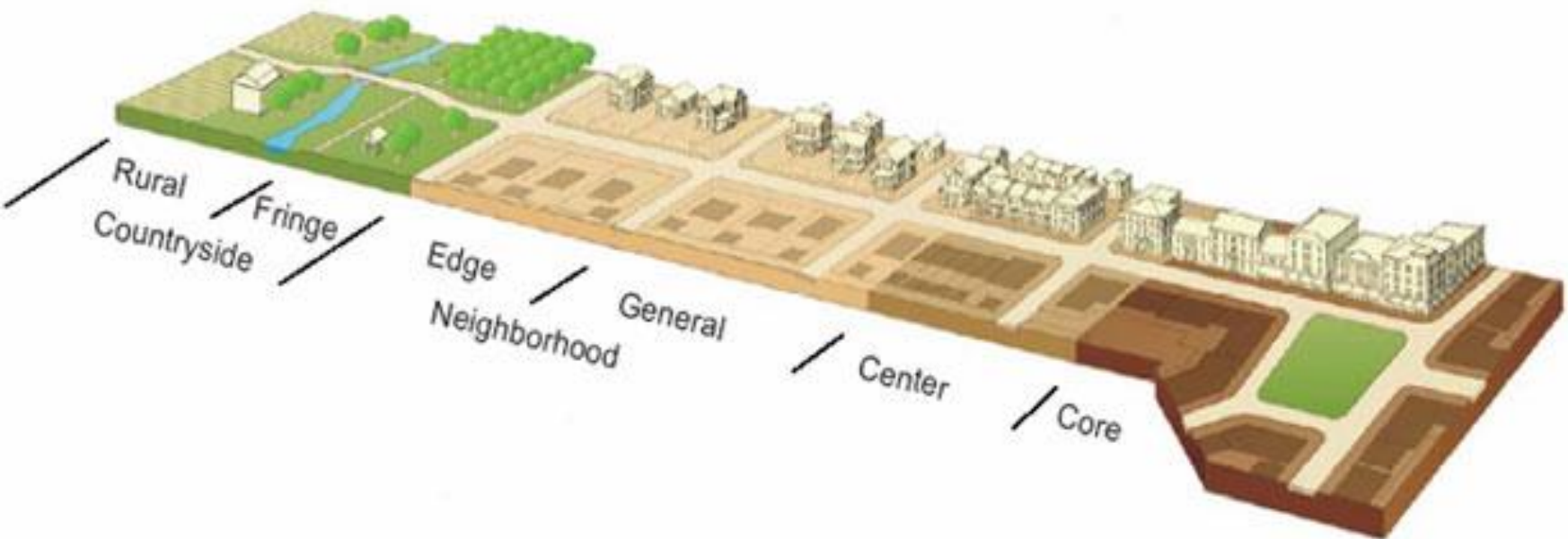


Demand Minimization Index

Waste Output Index

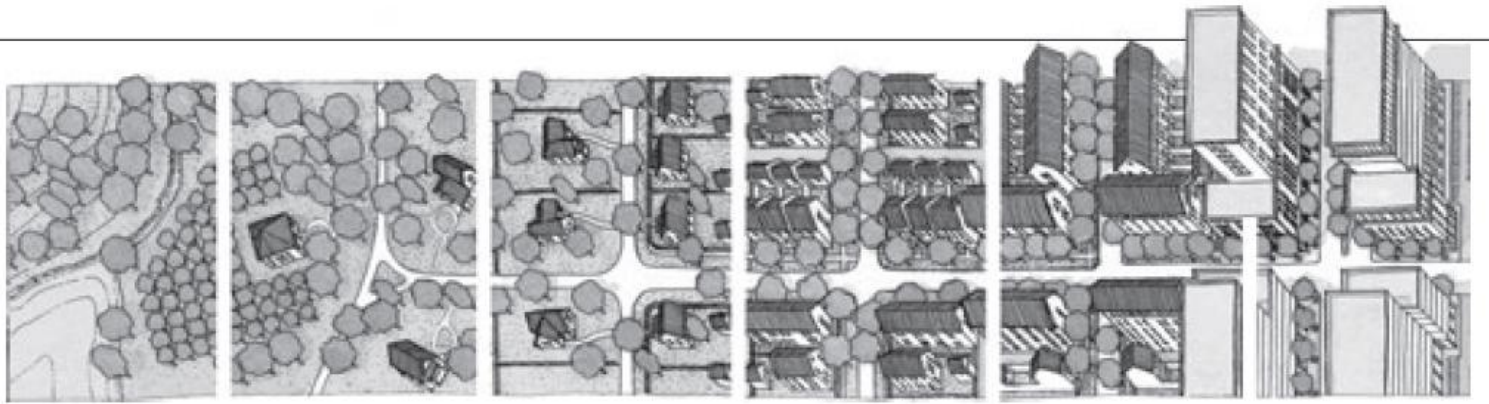
Self Sufficient Index

URBAN-TO-RURAL TRANSECT



Source: Duani, 2002

Urban water cycle at Block level



T1 RURAL PRESERVE

T2 RURAL PRESERVE

T3 SUBURBAN

T4 GENERAL URBAN

T5 URBAN CENTER

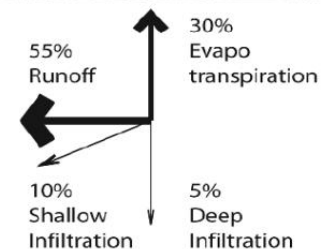
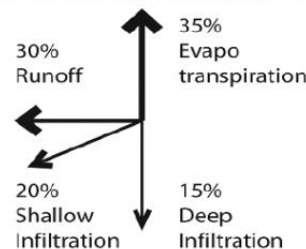
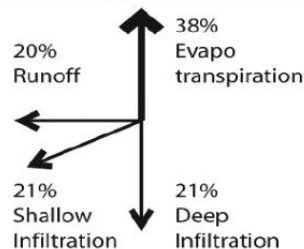
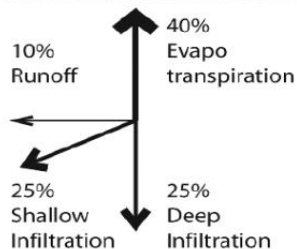
T6 URBAN CORE

Natural Ground Cover

10% - 20% Impervious Surface

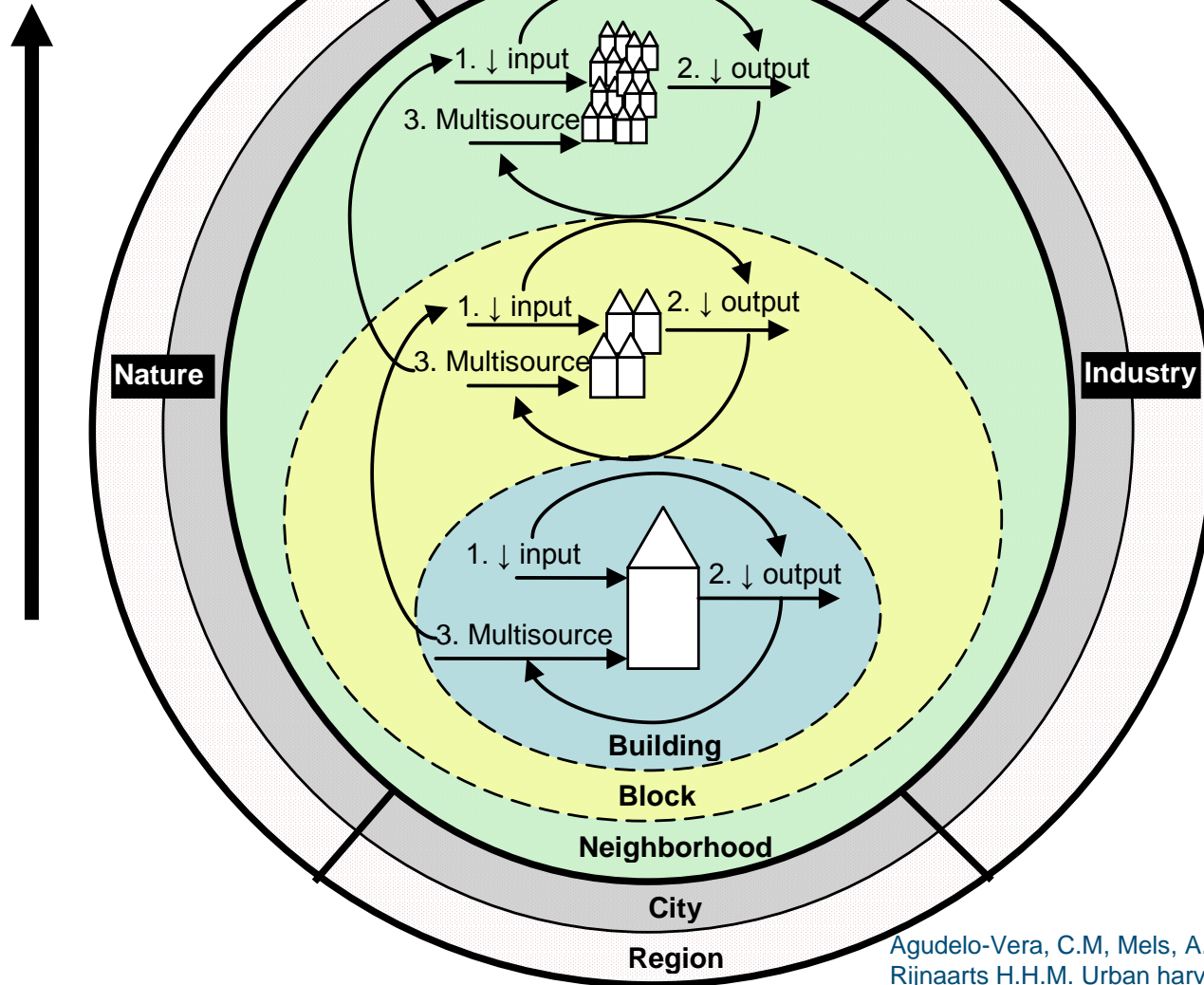
35% - 50% Impervious Surface

75% - 100% Impervious Surface

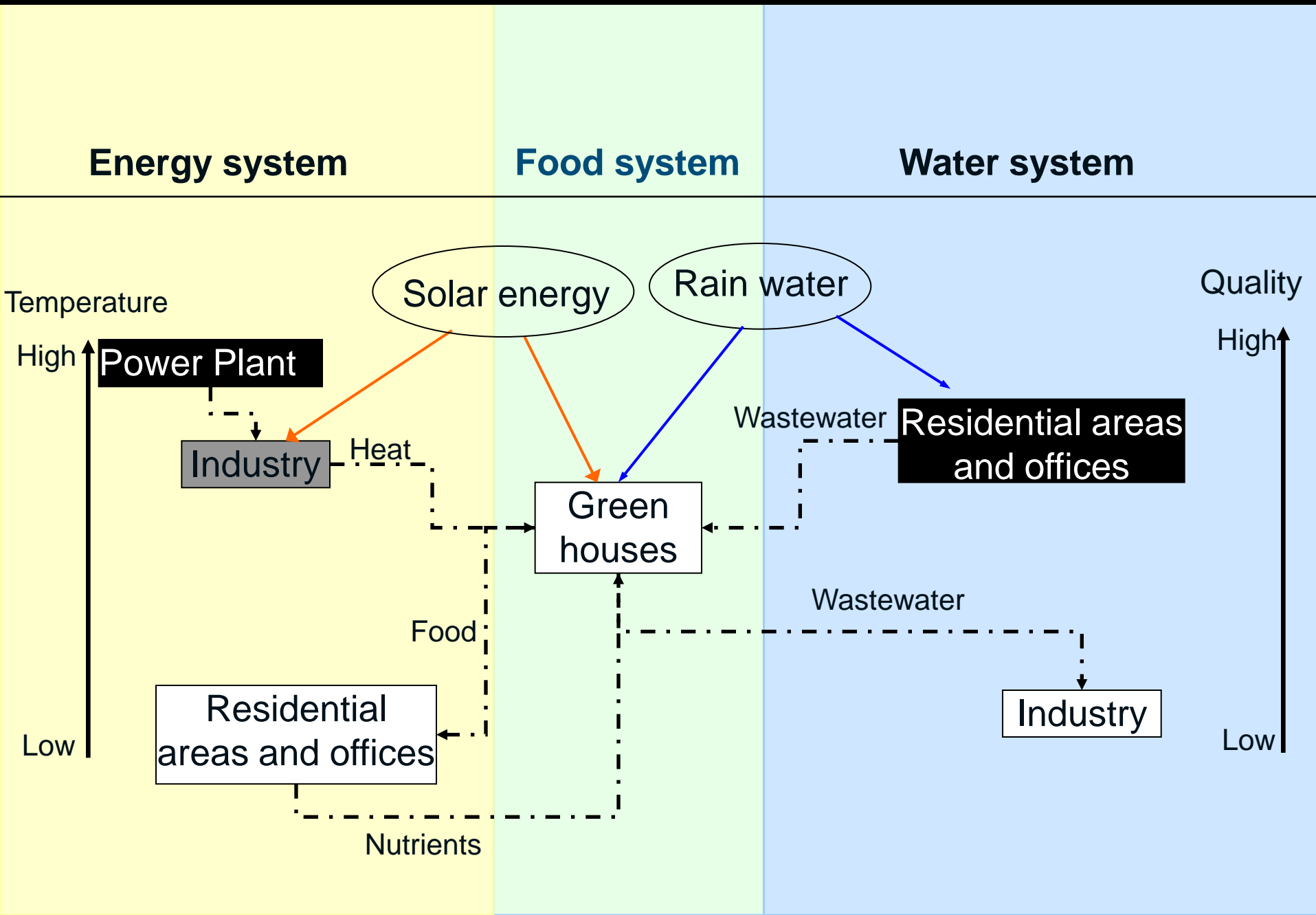


Urban Harvest as a tool for low impact urban design

- Increasing of complexity of measures
- Increasing of scale of measures
- Increasing of time span influenced
- Increasing of stakeholder involvement



URBAN SYSTEMS INTEGRATION



Conclusion

Waste flows are secondary resources ready to be harvested

Waste flows are not only indicators of systems efficiency but also infrastructure linkages



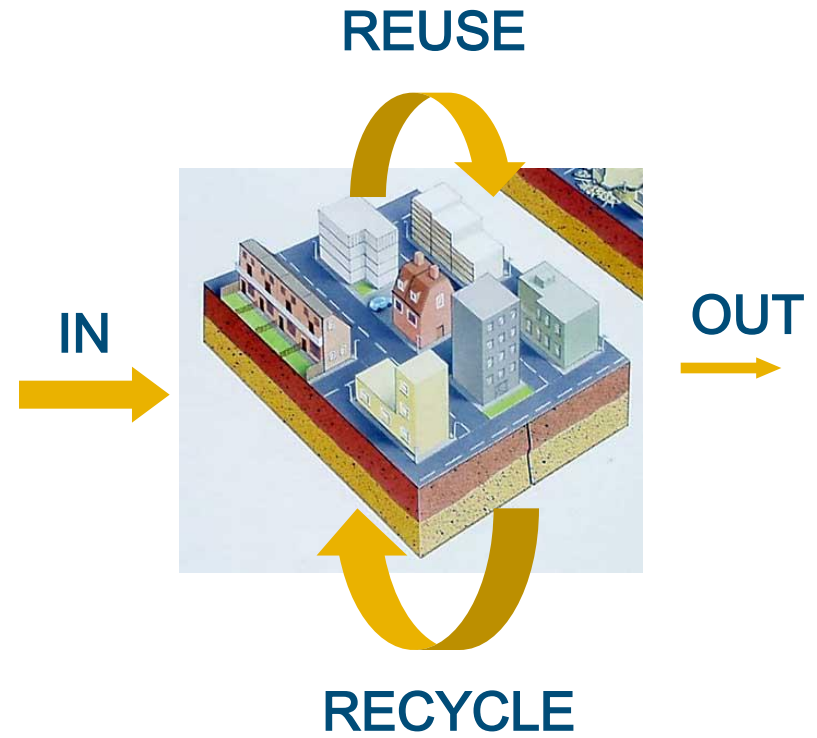
Conclusions

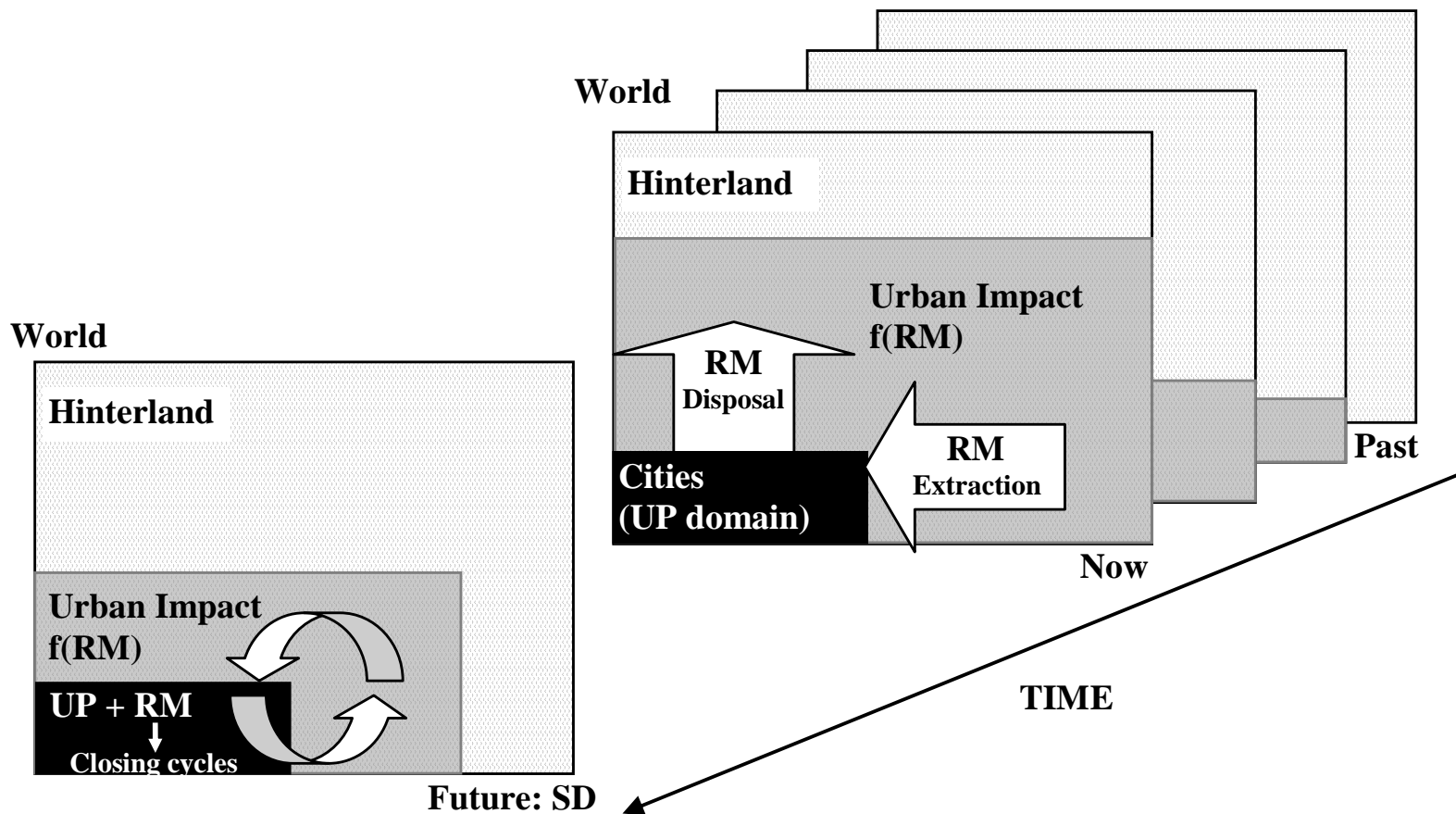
- Single measurement implementation is not enough. Strategies should be combined to achieve less impacting urban areas
 - minimization demand,
 - minimization output
 - multi-sourcing urban
- Urban areas are reservoirs of resources, therefore urban resources management is a key element of future city design

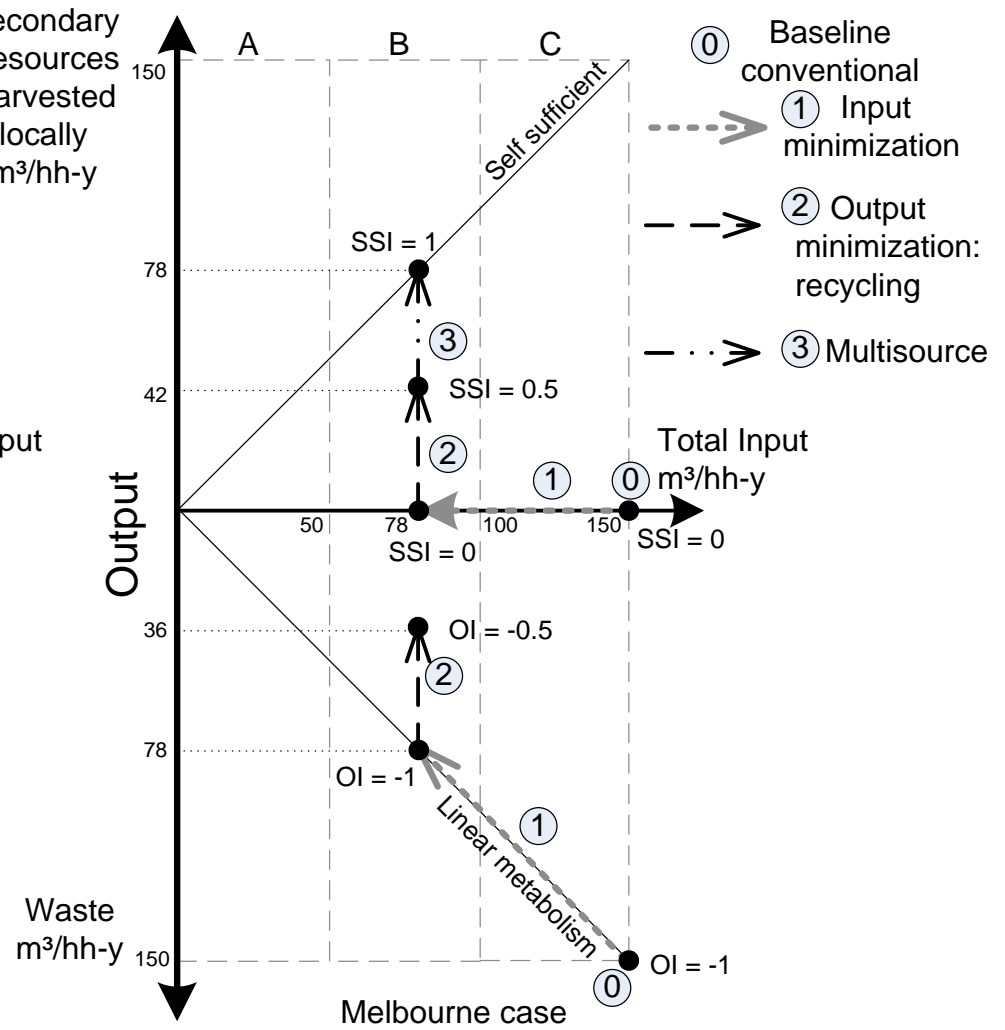
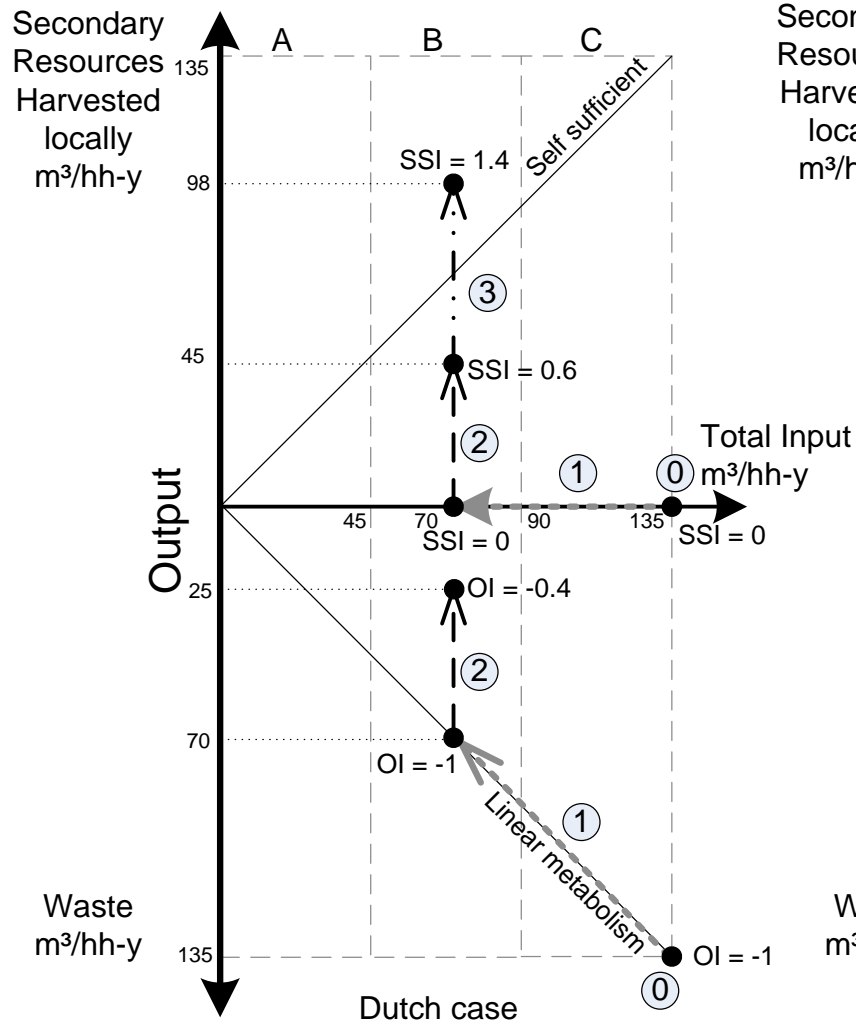
Urban planning is an urban environmental management activity. Urban planners and managers must be aware of potential linkages of flows, to facilitate exchange among different urban functions



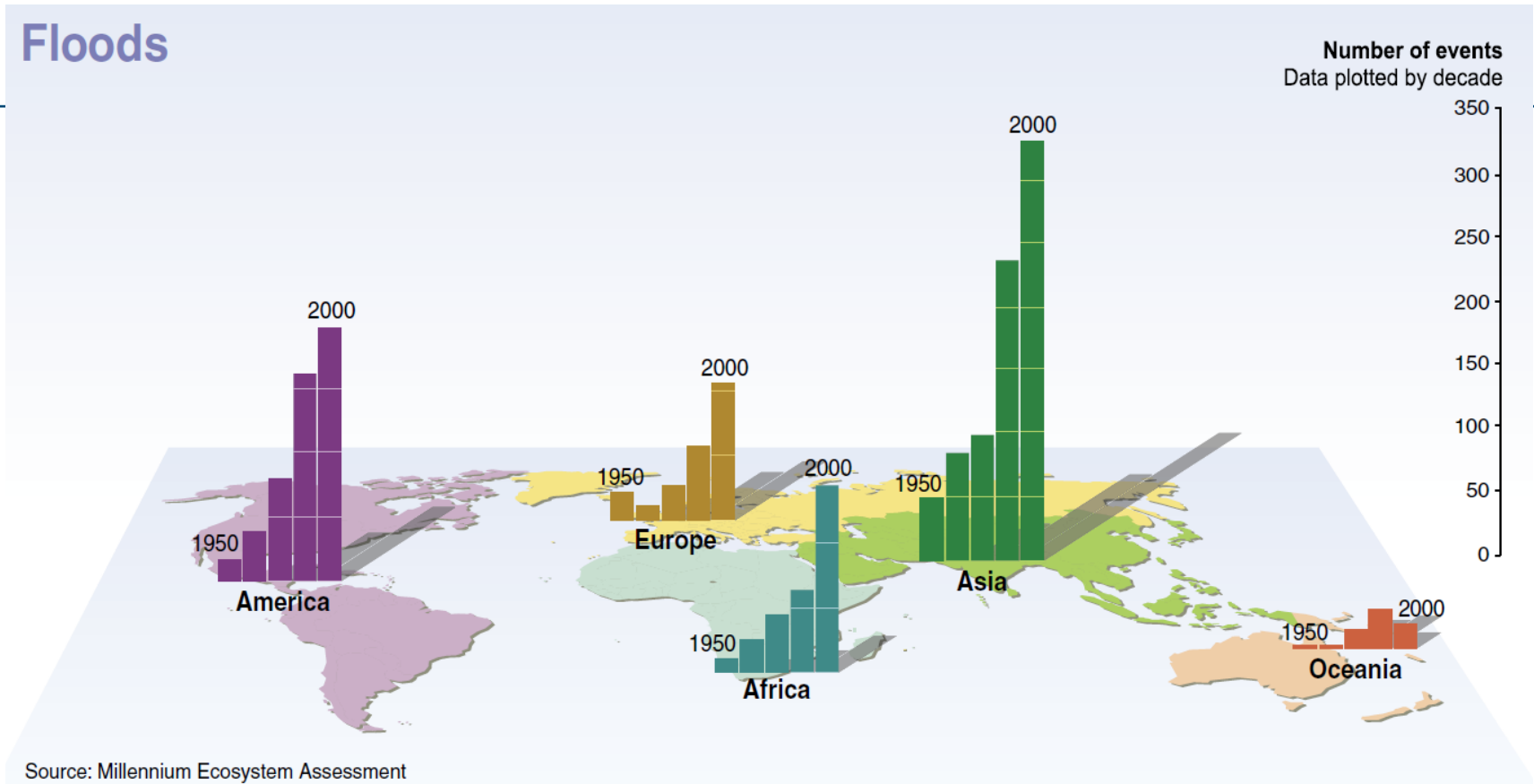
Questions?







Floods



<http://www.maweb.org/documents/document.356.aspx.pdf>

Ecosystems & human well-being : synthesis [Monograph]

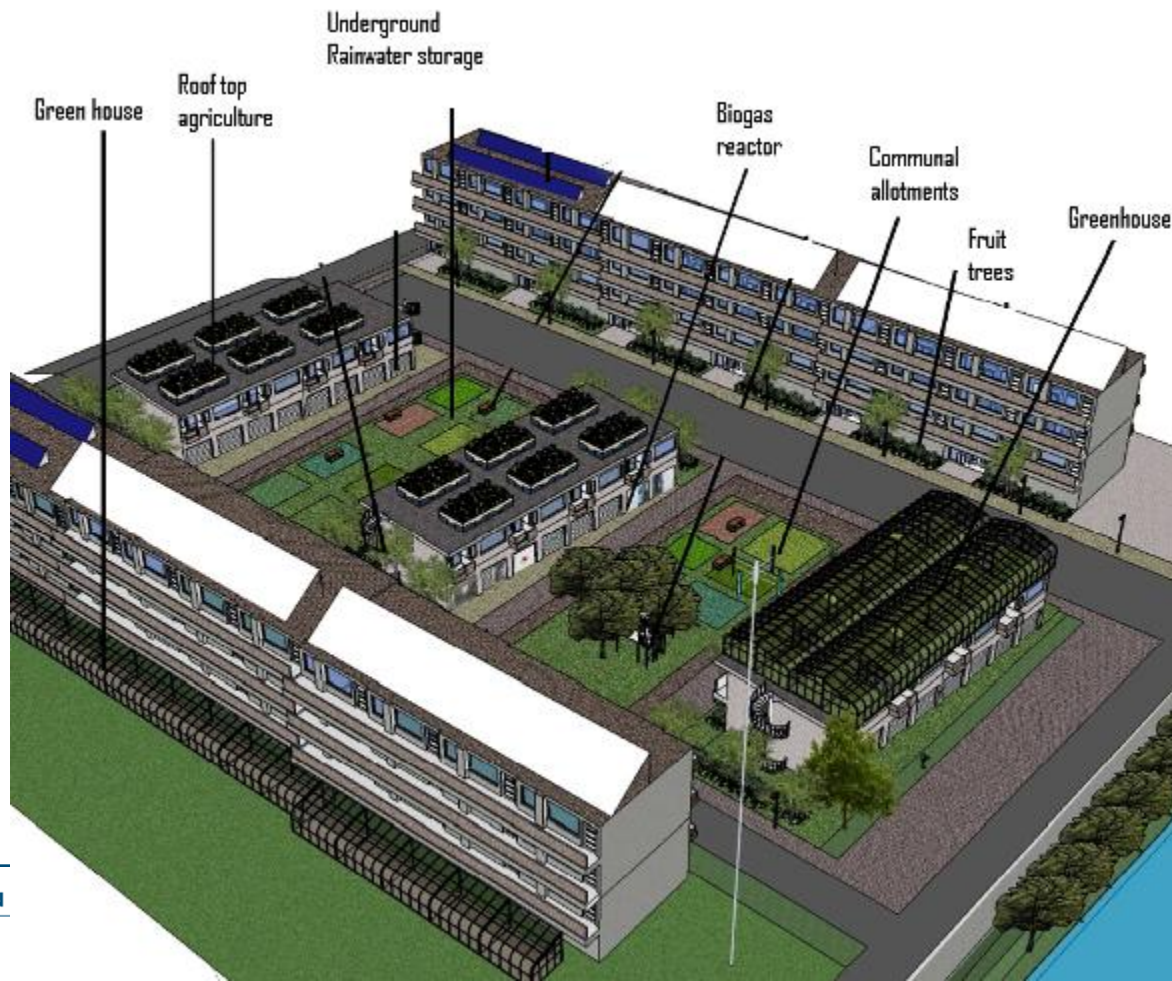
Reid, W.V. \ 2005



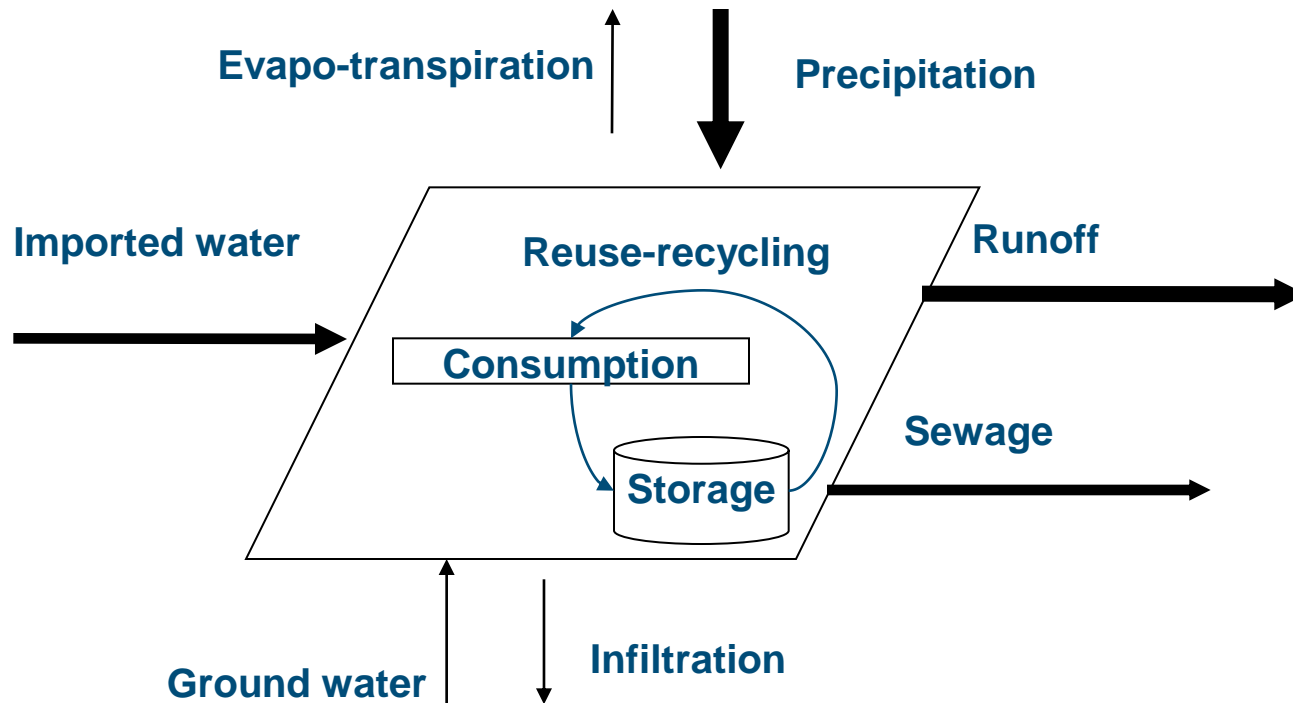
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Waste (water) solutions:

Not only about designing new technology systems
But about **Re-designing communities**



Urban water cycle at Block level

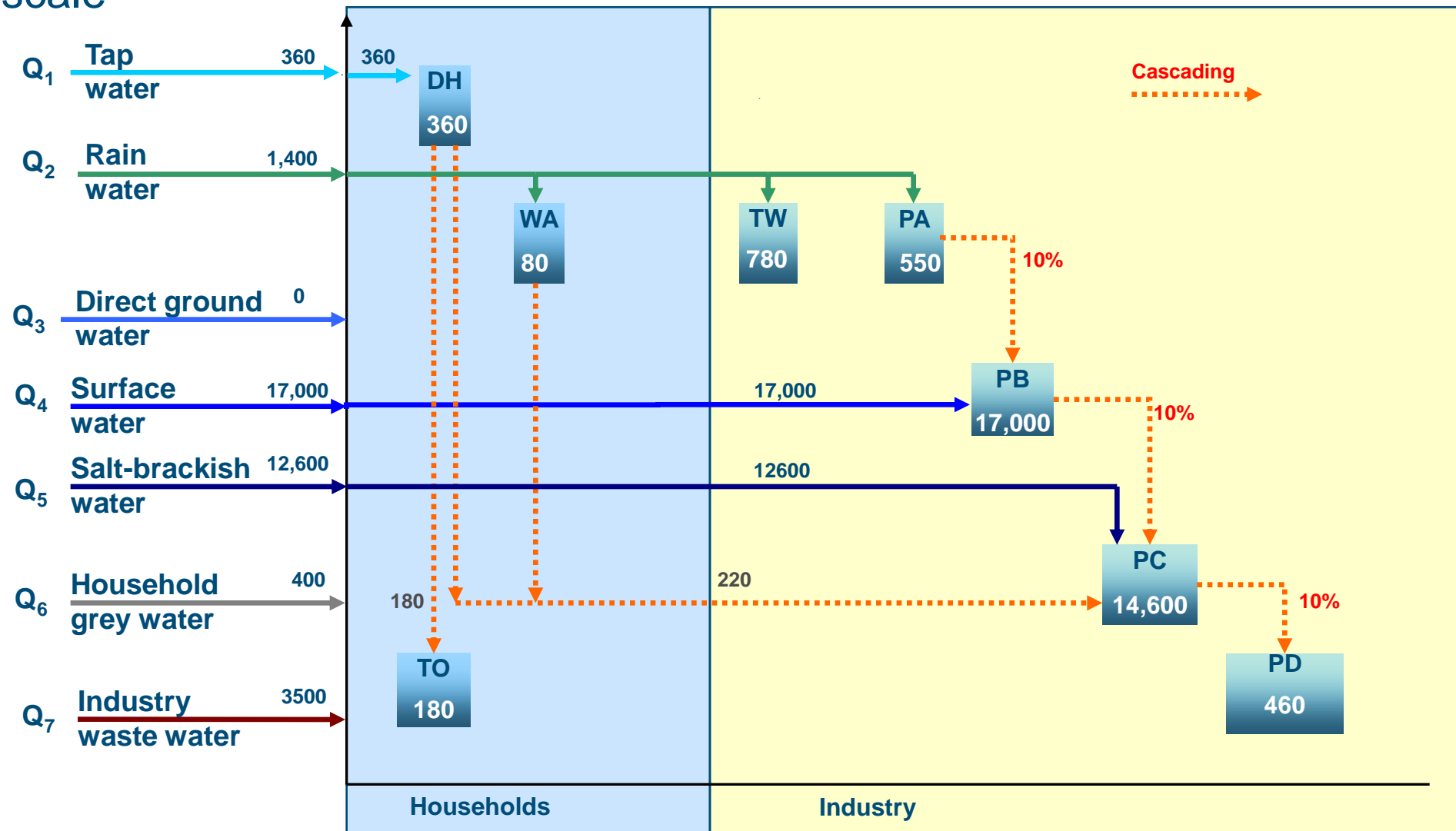


Conclusions

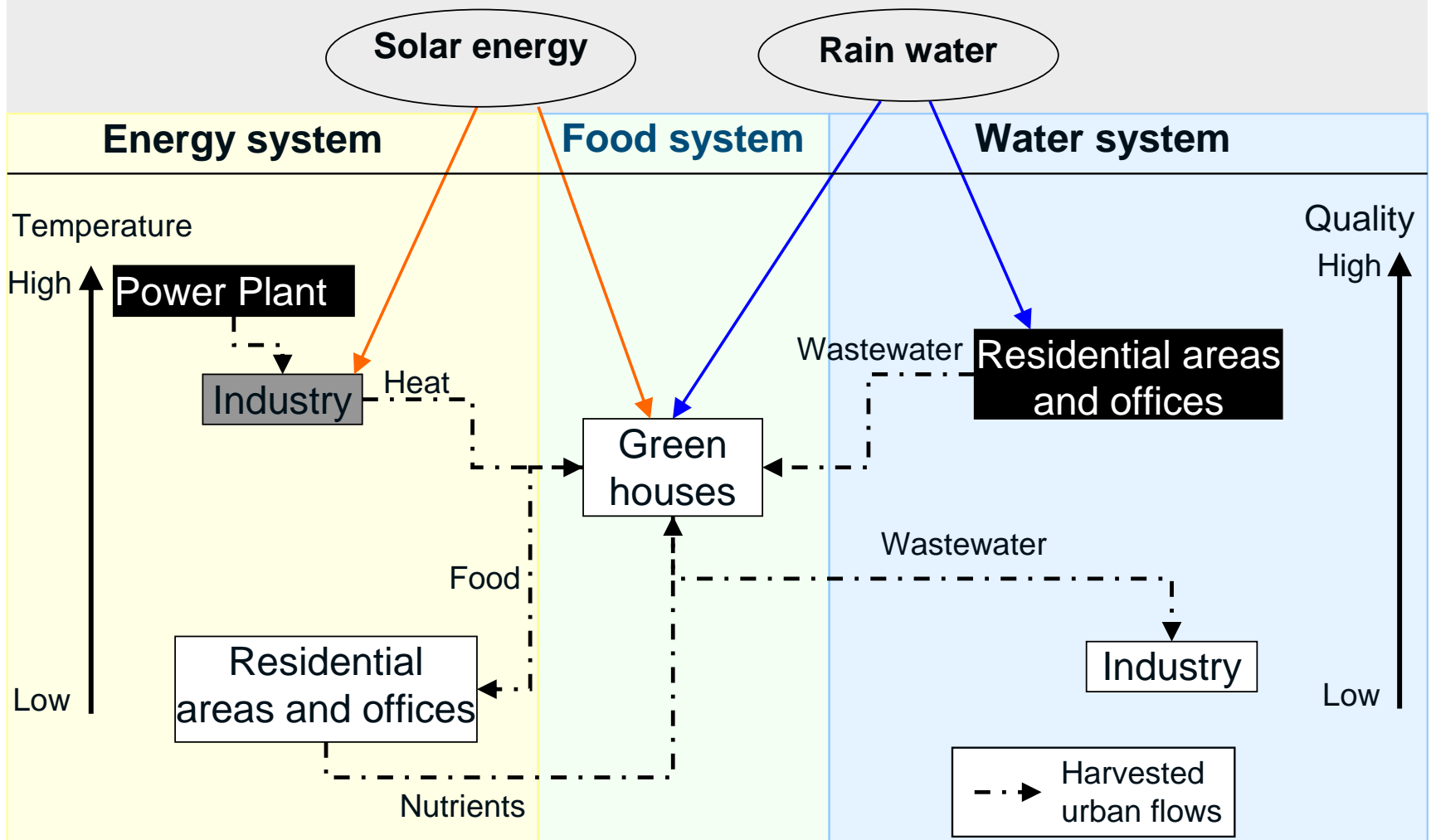
- Bottlenecks of innovative infrastructure of technology is because planners are not aware that when they allocated urban functions they allocate resources.



Water Match supply and demand (m³-ha/year) – Dutch case – national scale



Natural Local Potentials



Quality of domestic water

