Optimisation of Water Use in Industry

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SSWM
sustainable sanitation and water management

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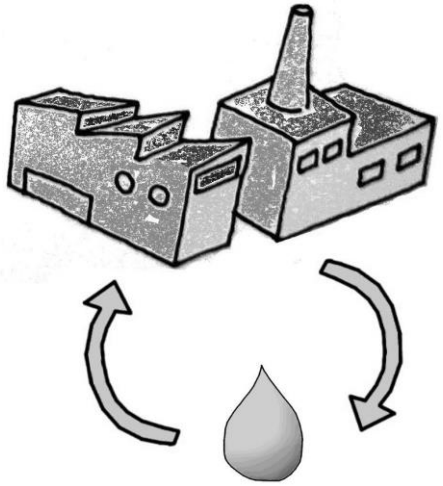
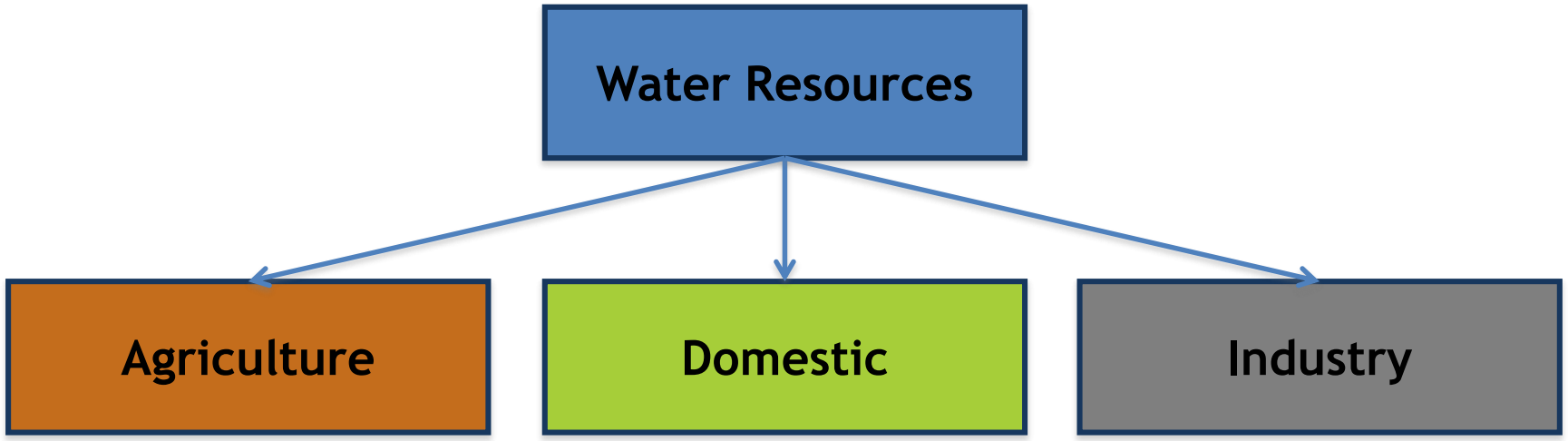
Depending on the initial situations and respective local circumstances, there is no guarantee that single measures described in the toolbox will make the local water and sanitation system more sustainable. The main aim of the SSWM Toolbox is to be a reference tool to provide ideas for improving the local water and sanitation situation in a sustainable manner. Results depend largely on the respective situation and the implementation and combination of the measures described. An in-depth analysis of respective advantages and disadvantages and the suitability of the measure is necessary in every single case. We do not assume any responsibility for and make no warranty with respect to the results that may be obtained from the use of the information provided.

Contents



1. Introduction

Water Allocation with Declining Water Resources



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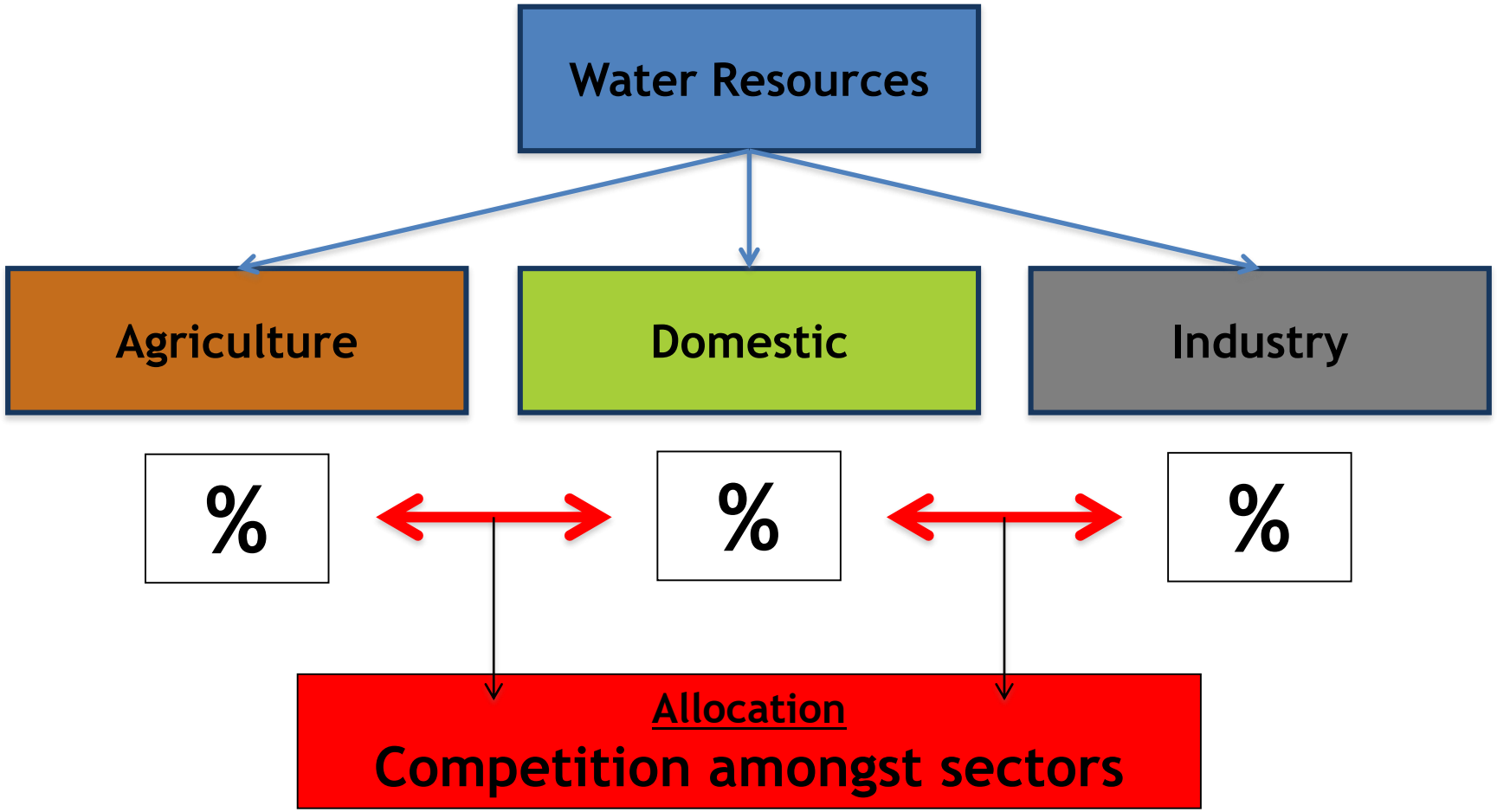

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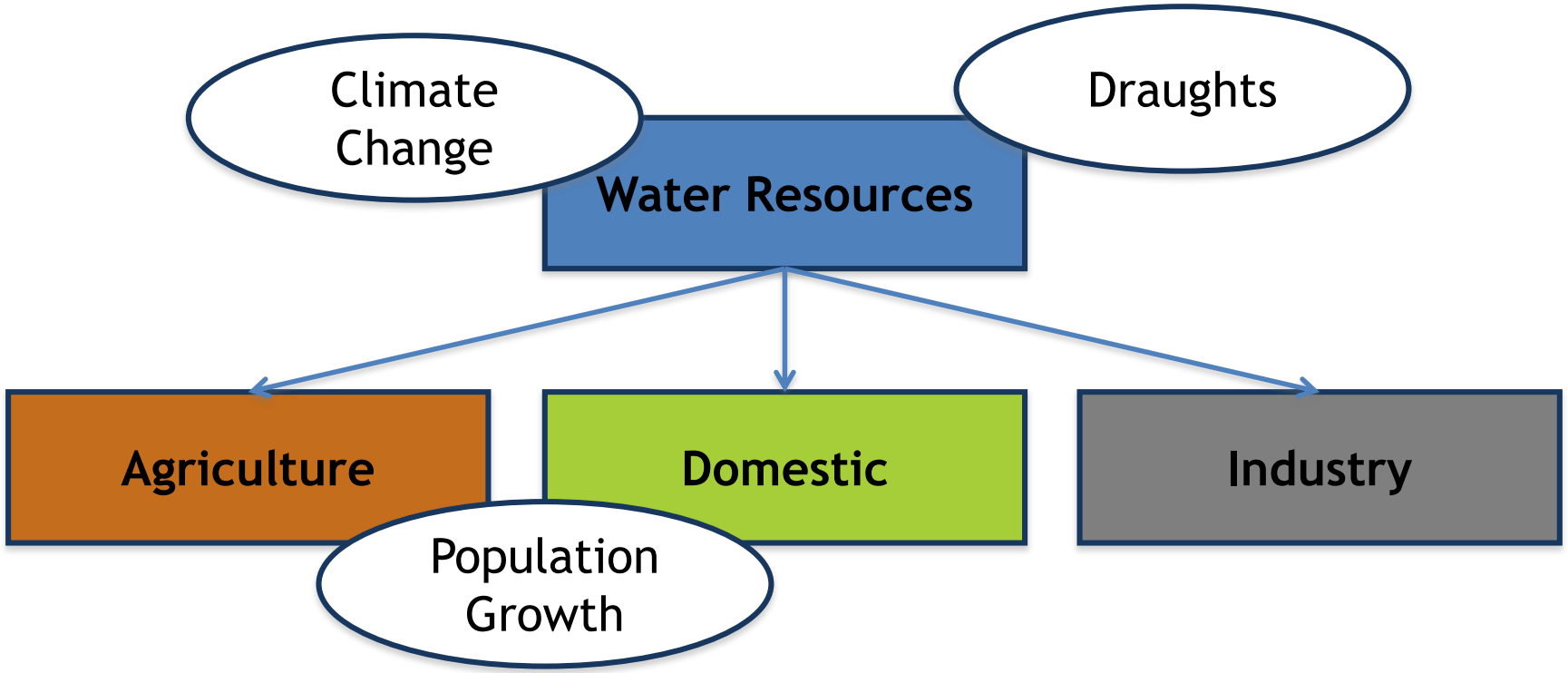

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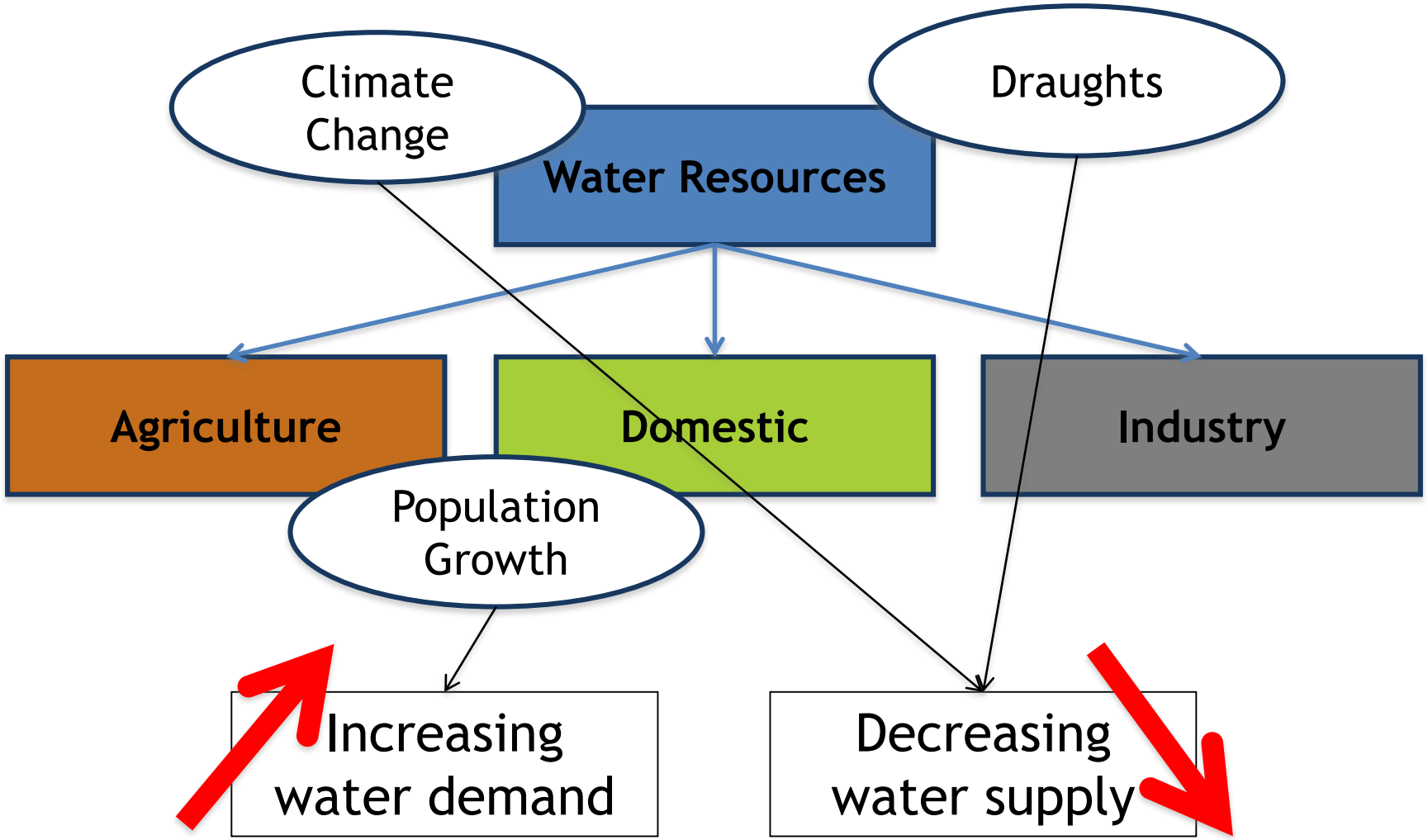

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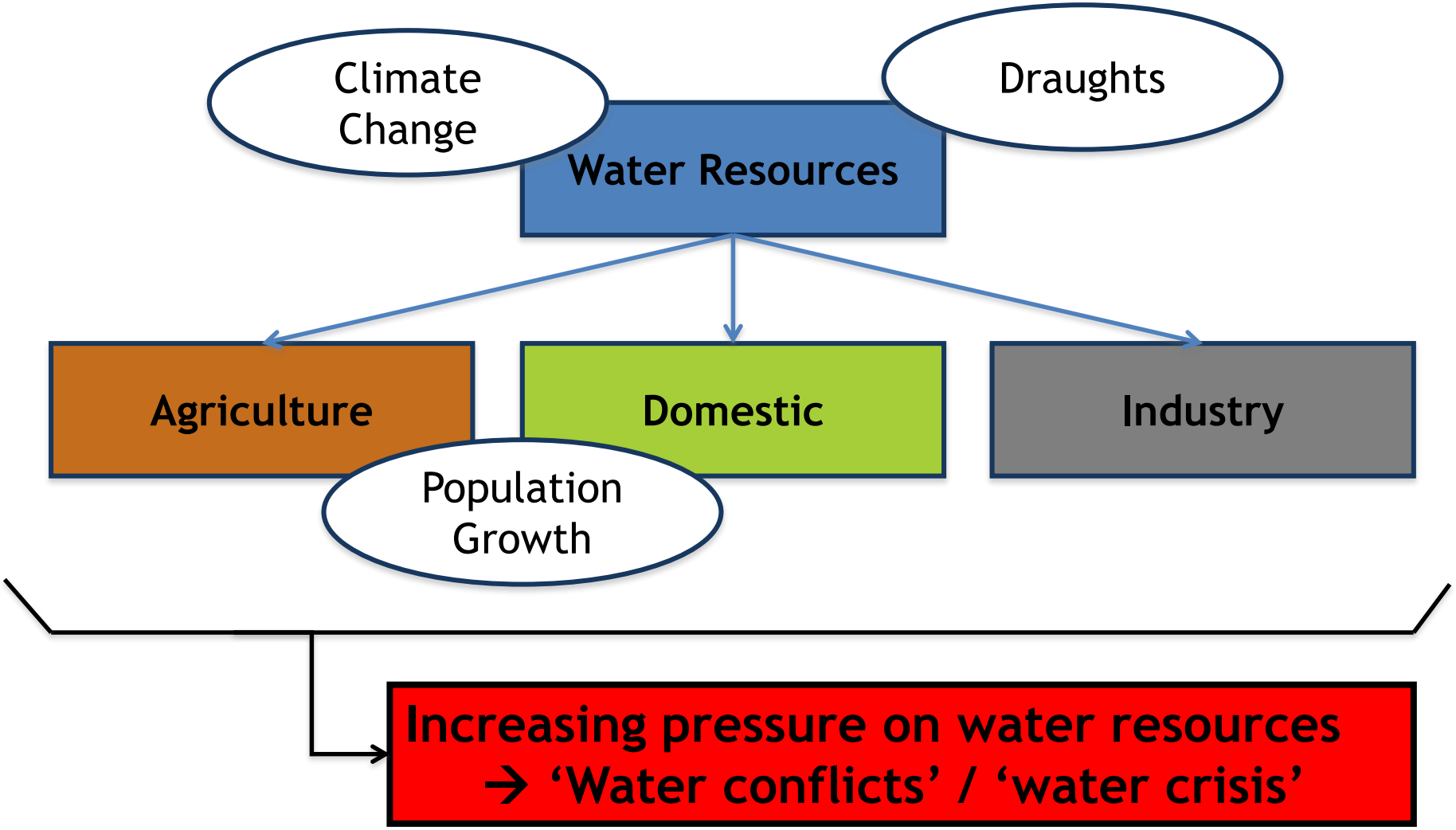
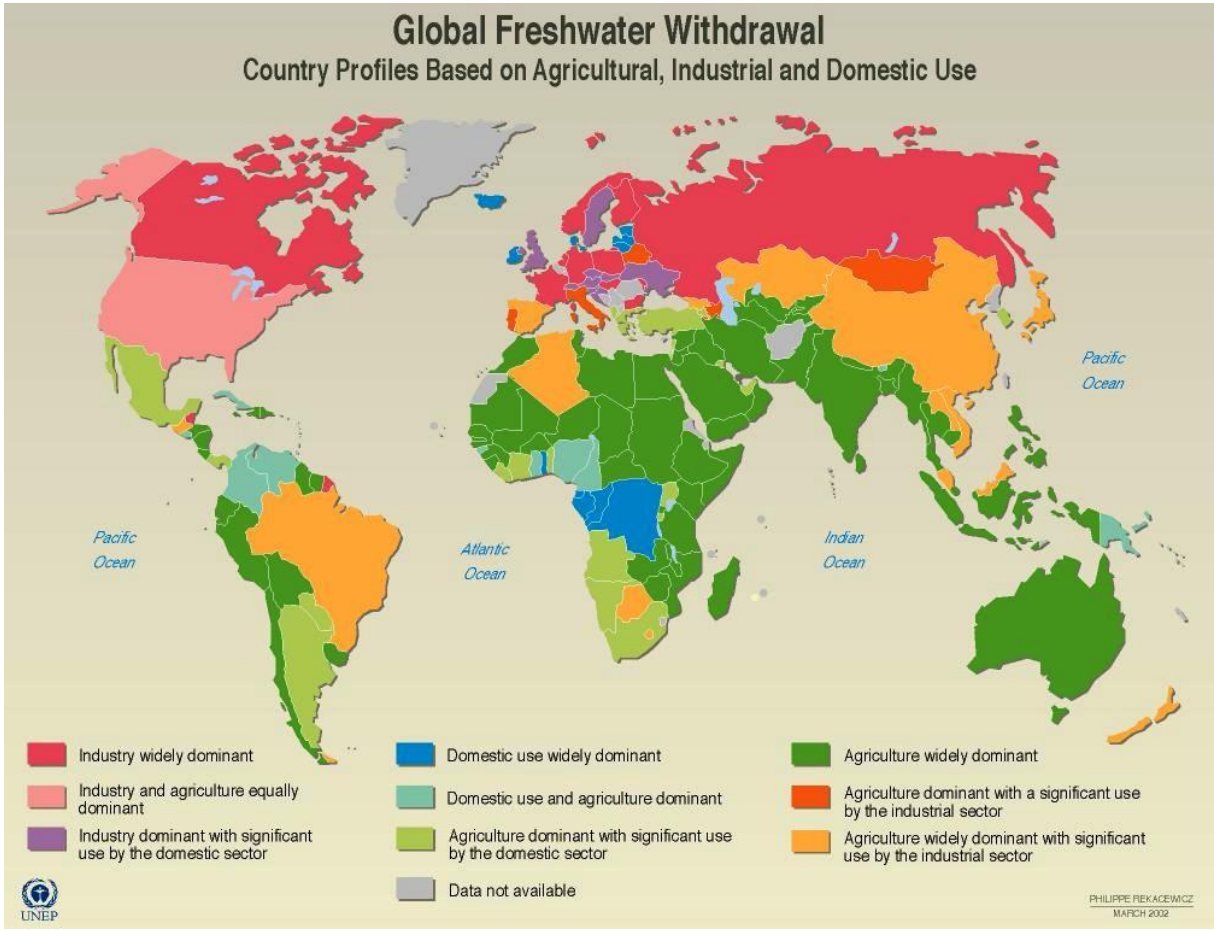


1. Introduction

Major Water Use per Country

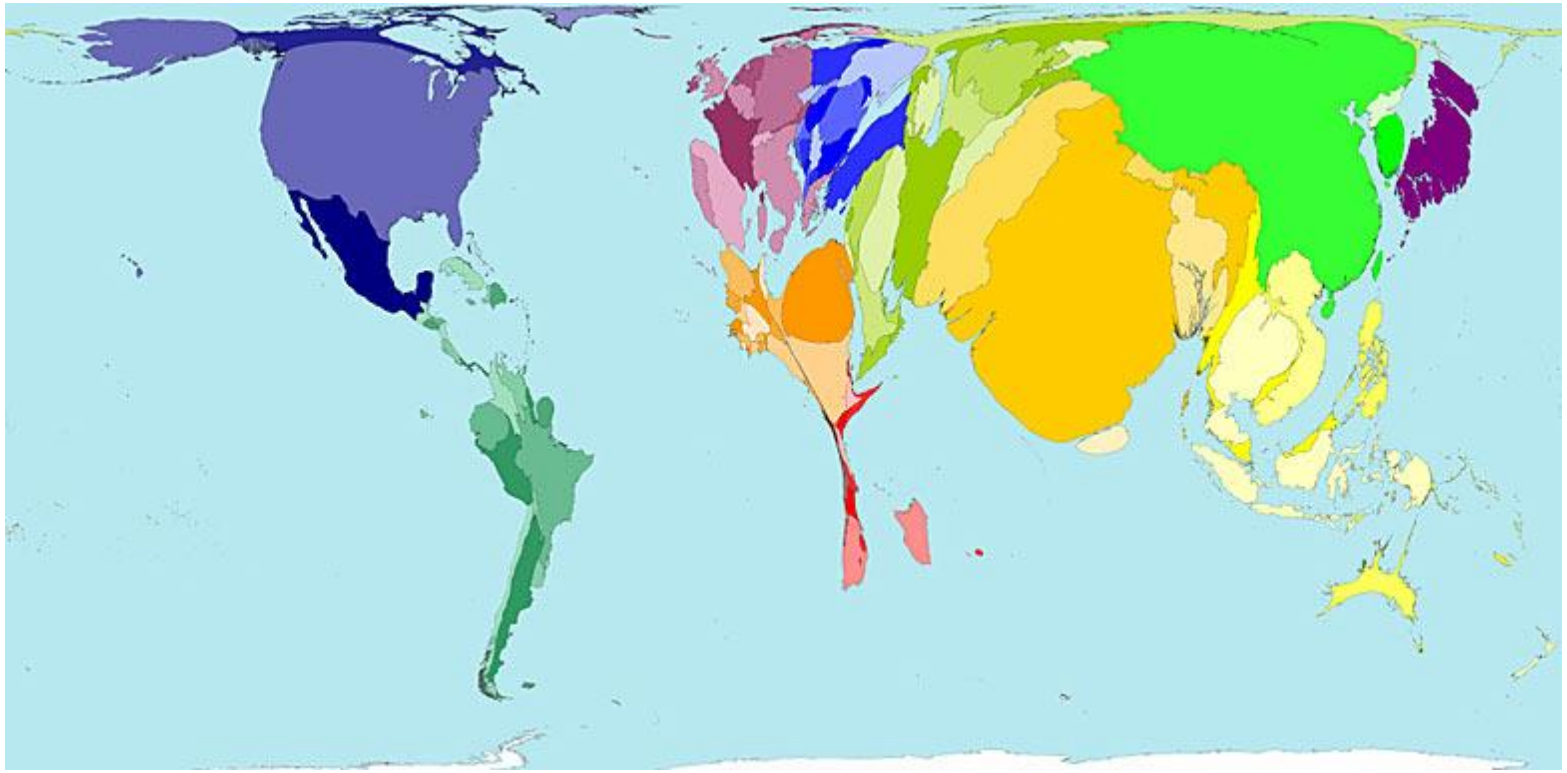


Global freshwater withdrawal – Country profile based on agricultural, industrial and domestic use

Source: UNEP (2002)

1. Introduction

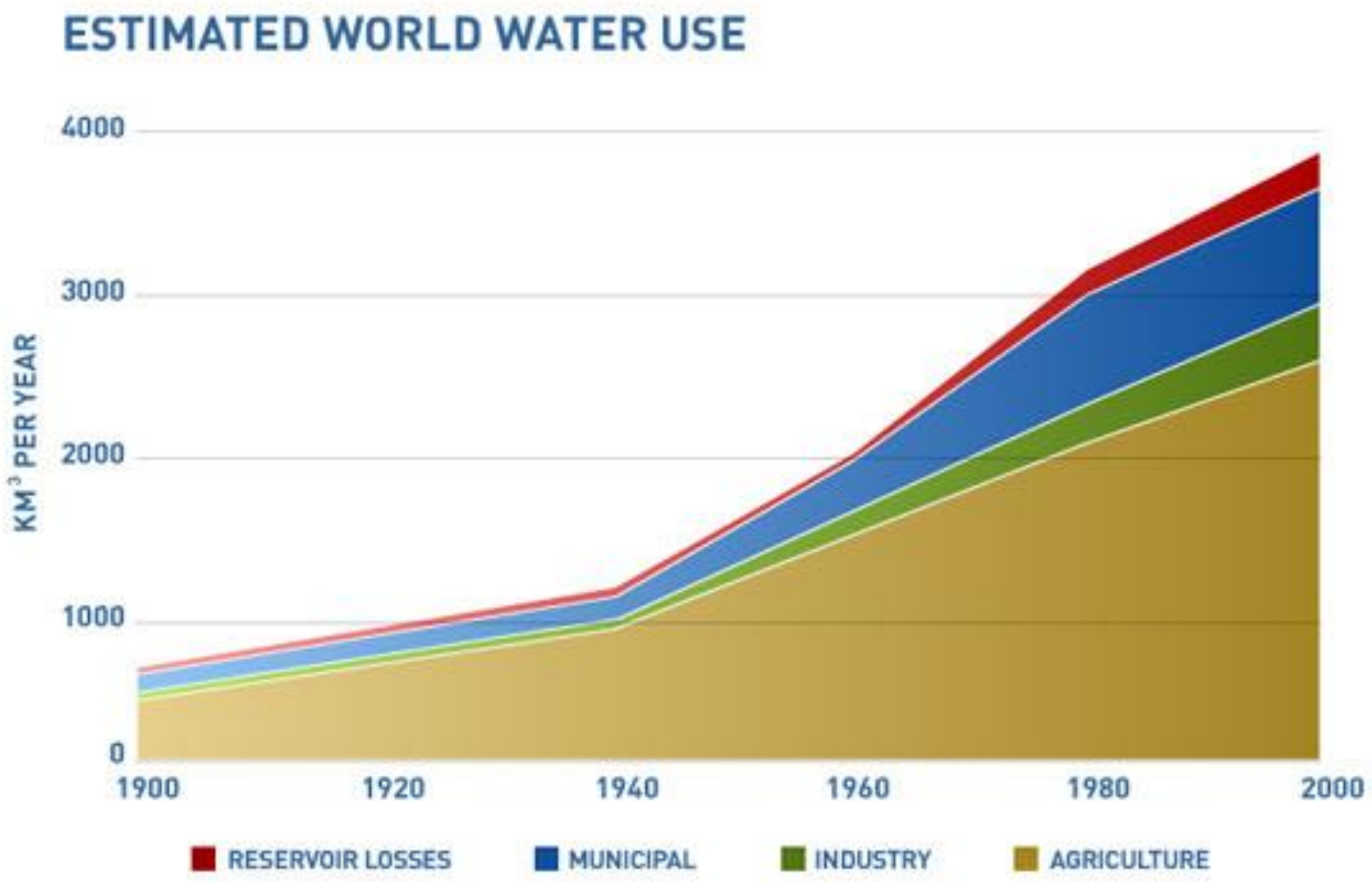
World Map According to Water Consumption



Source: http://images.forbes.com/media/2008/06/19/water_map.jpg [Accessed: 20.06.2012]

1. Introduction

History of Water Use



Source: http://www.fao.org/nr/water/art/2008/waterusegraph.jpg [Accessed: 20.06.2012]

1. Introduction

Why Optimise in Industry?

- After agriculture, industry is the largest user of water for development, consuming 5-10% of global water withdrawals.

  WORLD WATER ASSESSMENT PROGRAMME WWAP (Editor)(2009)

- The largest industrial consumers of water are thermal power, iron and steel, paper production, textiles, and petrochemical industry.

  GAO et al. (2008)

- From 1987 to 2003, industry used roughly twice as much water compared to households, whereas about a third of this water usage was recorded in the United States and about a thirtieth by all 19 territories of South-eastern Africa. *SASI GROUP & NEWMAN (2006)*

1. Introduction

Why Optimise in Industry?

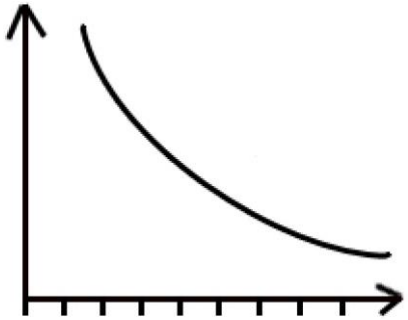
Optimisation of water use in industry can:

- Lower water withdrawals from local water sources thus increasing water availability and improving community relations;
- Increasing productivity per water input;
- Lowering waste water discharges and their pollutant load;
- Reducing thermal energy consumption and potentially processing cost.

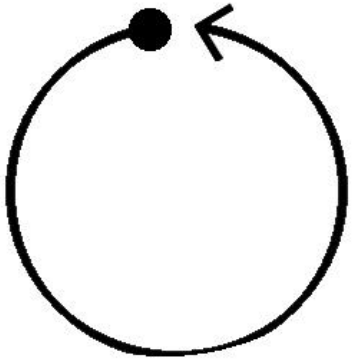
1. Introduction

The Three R's – A Concept of Natural Resources Management

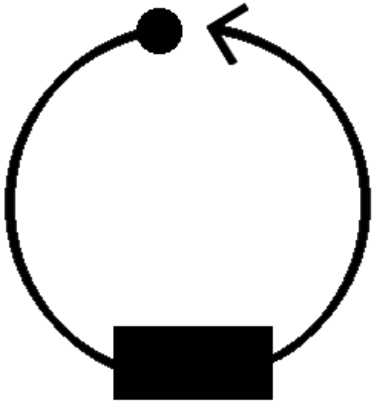
Reduce



Reuse (directly)



Recycle (treat & reuse)



Source: BRUNI (2012)

1. Introduction

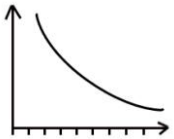
Implications of R-R-R

Reduction of water consumption, Reuse, Recycle leads to:

- Reduction of pressure on water resources,
- Less demand for large water supply systems and facilities (e.g. wells, pumps, distribution networks, collection, treatment),
- Less generation of wastewater → reduces energy demand and need for collection and treatment facilities, and
- Closing the water & nutrient cycle.

2. Reduce Water Consumption in Industry

Behaviour Changes vs. Modifying Equipment



Behavioural Changes
- Change routines
- Educate Employees

Operational Changes
- Overthink processes

→ Make them more water-efficient

Modify Equipment
- Replace equipment

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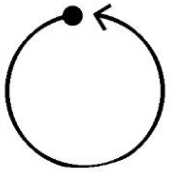
3. Reuse Water within a Business



Directly Reuse the Wastewater in Your Business

Options for Reusing Process Water:

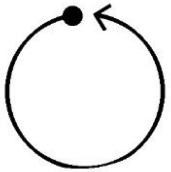
- Water cooling towers
- Transportation of materials
- Air purifiers
- Washing floors
- Sanitary fixtures (toilet flushing, etc.)
- Irrigation
- Running polishing and calibrating equipment

- Process rinse water
- Crate and pallet washing
- Hardstand and vehicle washing
- Industrial fire protection
- pH adjustment
- Dust suppression
- Dying and finishing textiles

However, the most common ways to reuse water are for heating and cooling purposes.

4. Reuse Water between Businesses

Make Use of Industrial Symbiosis



- Industries require different qualities of water and other flow streams like chemicals, energy, nutrients, etc.
- These by-products can be traded in order to optimise each industry's water and energy usage.
- **'Industrial symbiosis'**: references **ecological symbiosis** when two or more organisms "live" together for mutual benefit.
- In **industrial symbiosis**, traditionally separate industries engage in a long-term partnership to increase their competitive capacity by physically exchanging materials, energy, water, and/or by-products.
- **The three major opportunities for industrial symbiosis are:**
  - (1) Exchange by-products,
  - (2) Share management of utilities, and
  - (3) Share ancillary services.

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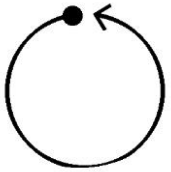
4. Reuse Water between Businesses



(1) Exchange By-Products

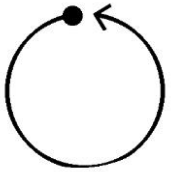
- By-product reuse requires information sharing between firms about what each one has to offer in order for firms to self organise.
- Firms also need to rely on a given quality level and consistency of the by-products.

Examples of By-Products and their Reuse Opportunities

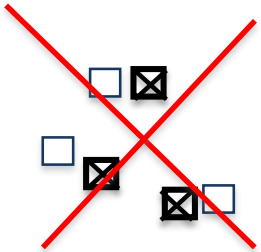
- Fly ash from power plants for concrete manufacturing;
- Organic waste from fermentation, brewery or pharmaceuticals for fertiliser manufacturing;
- Steam from power plants can be reused by oil refineries;
- Treated greywater and other wastewater can be reused in cooling towers for power plant.

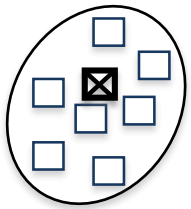
4. Reuse Water between Businesses

(2) Share Management of Utilities



- Another form of industrial symbiosis
- Example: **Solvent recovery programme**
  - Problem: Each firm may not use enough solvents to justify a system of solvent recovery, but several firms together can.
  - The idea: Several firms could share a closed-loop solvent recovery programme managed by a collectively run or in cooperation with a local wastewater treatment service.
  - Consequence: Pulling solvents out of the waste stream reduces the wastewater treatment necessary and creates the potential for reuse.





ASHTON (2008)

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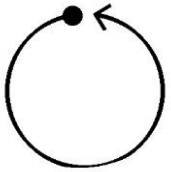
4. Reuse Water between Businesses



(3) Share Ancillary Services 1/2

- Geographically close firms can save money and energy by sharing ancillary services like transportation, landscaping, waste collection, and emergency management.
- Example:

  The term '**industrial symbiosis**' was popularised in the small town of Kalundborg, Denmark. Groundwater, surface water, wastewater, steam, sludge, gas, sulphur, fuel, etc. are shared between several different industries.

How does such a system look like?

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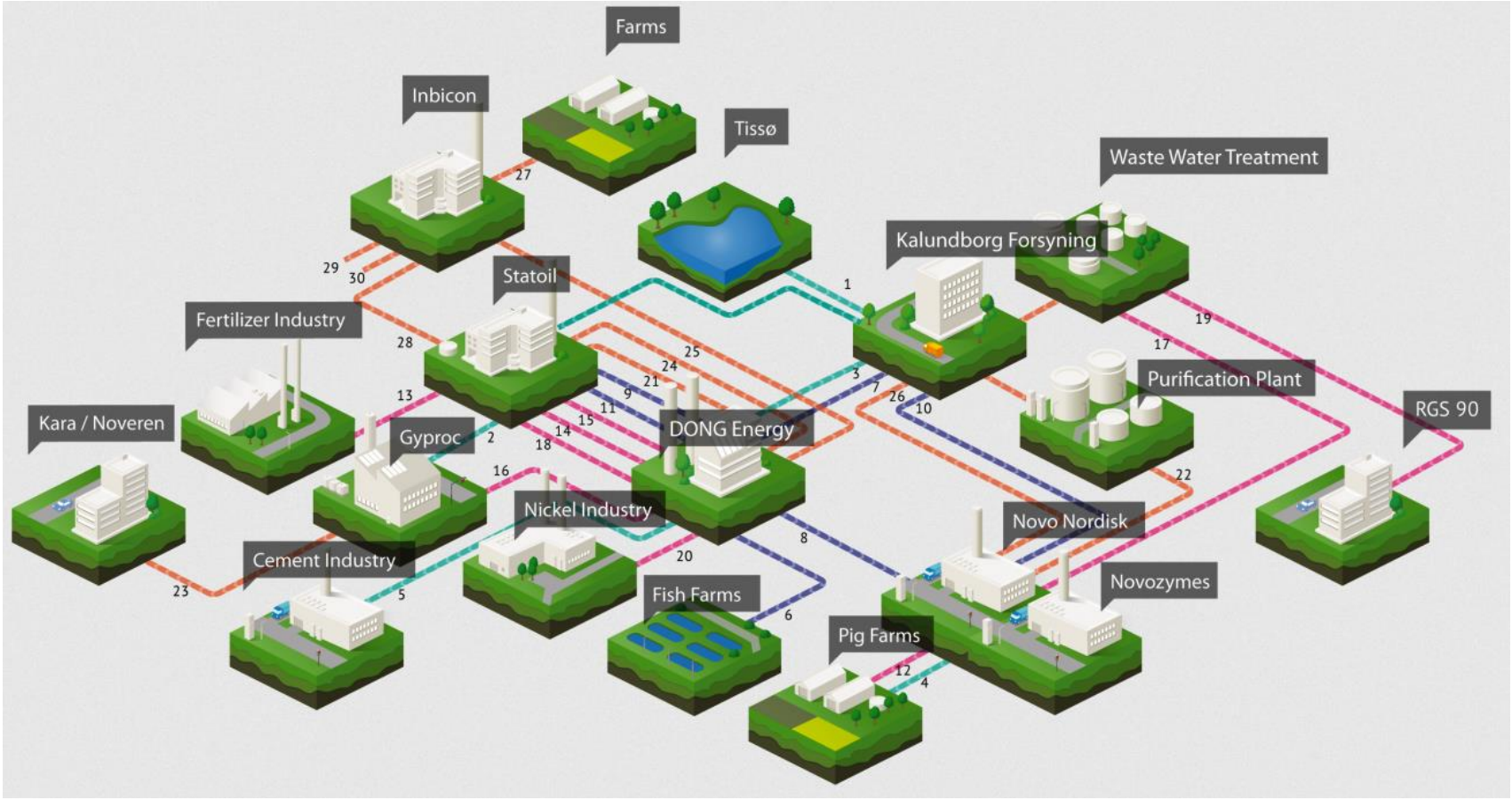
4. Reuse Water between Businesses

(3) Share Ancillary Services 2/2

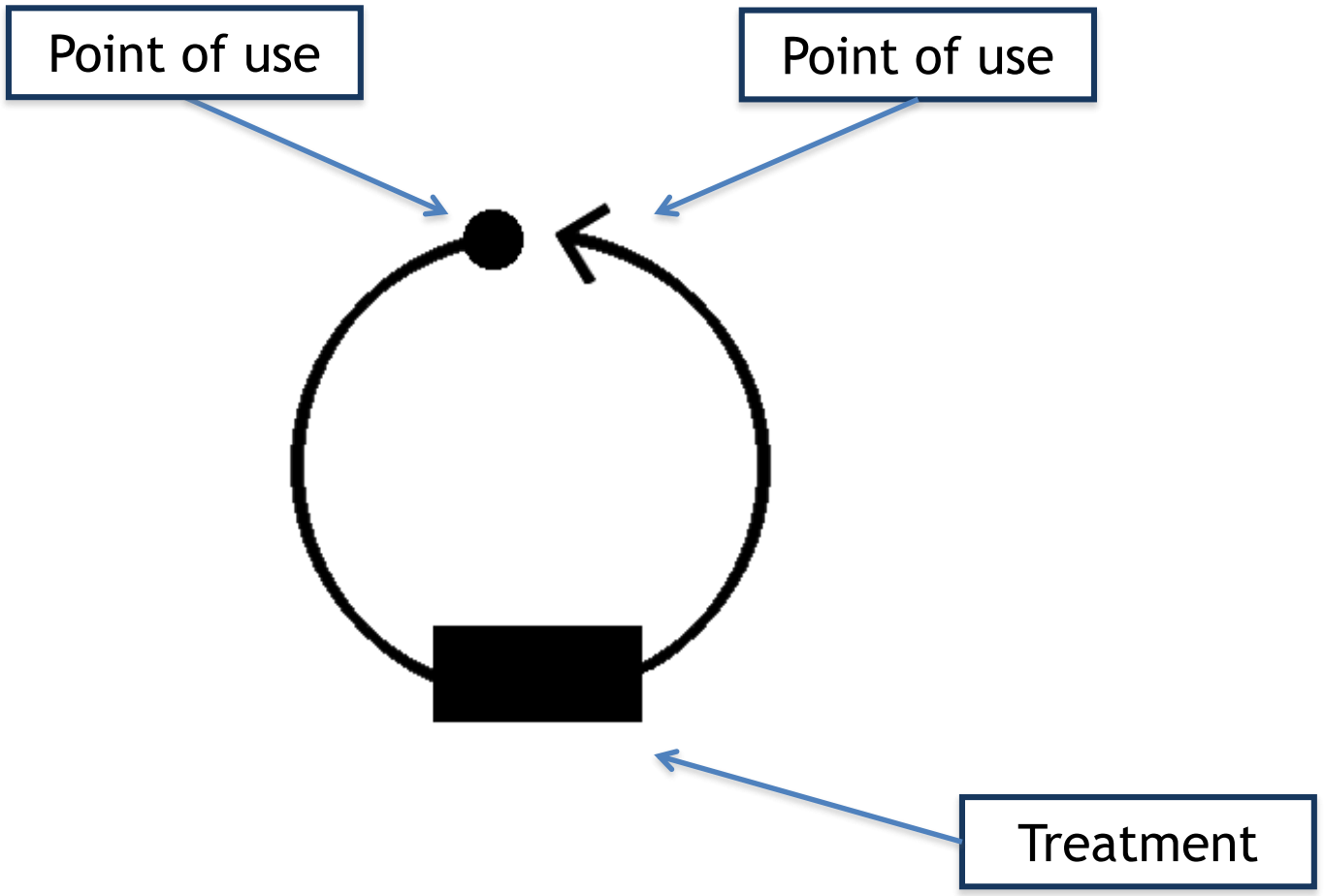
Example: Sharing ancillary services in Kalundborg, Denmark.



Source: http://www.symbiosis.dk/sites/default/files/symbiosediagram3dividedTL_bigger_fonts_JEPPEUK_0.png [Accessed: 19.06.2012]

5. Recycle Wastewater in Industry

Treat your Wastewater and Reuse It within and between Businesses

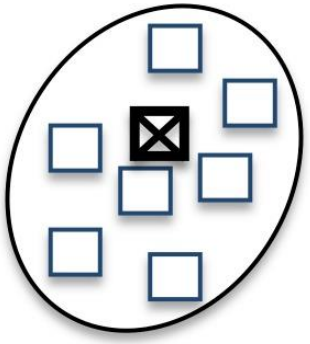


5. Recycle Wastewater in Industry

Treat your Wastewater and Reuse It within and between Businesses

- Process water can be reused for more purposes if treatment systems are installed to treat the water to the level required for reuse.
- Collective management of wastewater treatment plans can lower costs for all participants.

Decentralised Treatment Systems



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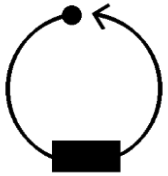
5. Recycle Wastewater in Industry

Step 1-3



Step 1 **Water Use**	Mind what you mix in your water in order to minimise treatment effort.
Step 2 **Treatment**	• Possible treatment options for water reuse include: waste stabilisation ponds, aerated ponds, trickling filters, vertical flow constructed wetland, hybrid constructed wetland, free-surface constructed wetland and horizontal flow constructed wetland. • Treatment options where Biogas can be produced: Anaerobic digestion, e.g. UASB reactors, biogas settlers. • Advanced (more high-tech options): Activated sludge, MBRS, advanced oxidation processes, ozonation, activated carbon.
Step 3 **Reuse**	Different water uses require different water qualities: Only reuse water for the purpose it was treated for!

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