

# Optimising Energy Use in Water Treatment – Sustainable Solutions

Water for Power and Industry

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1

## Industry drivers for energy optimisation

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# Industry drivers...

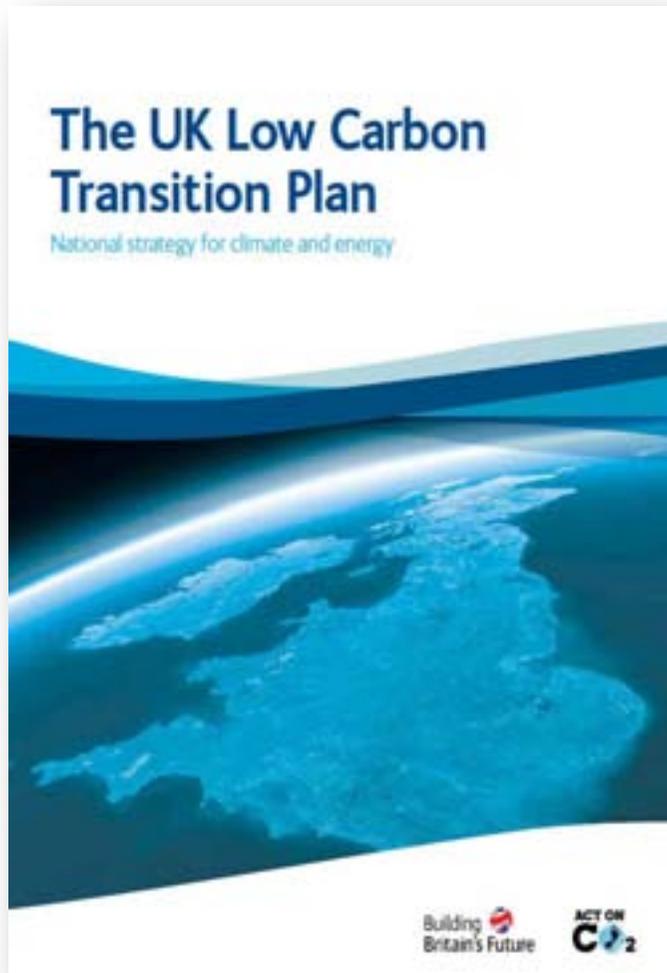
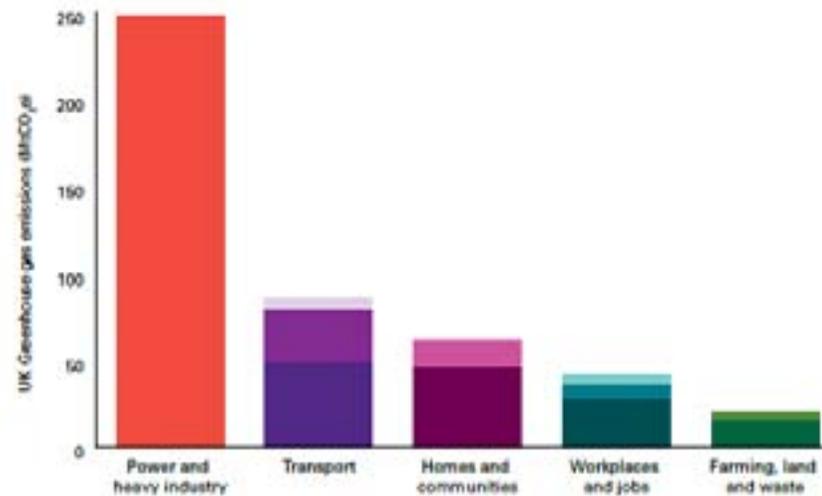


Chart 2

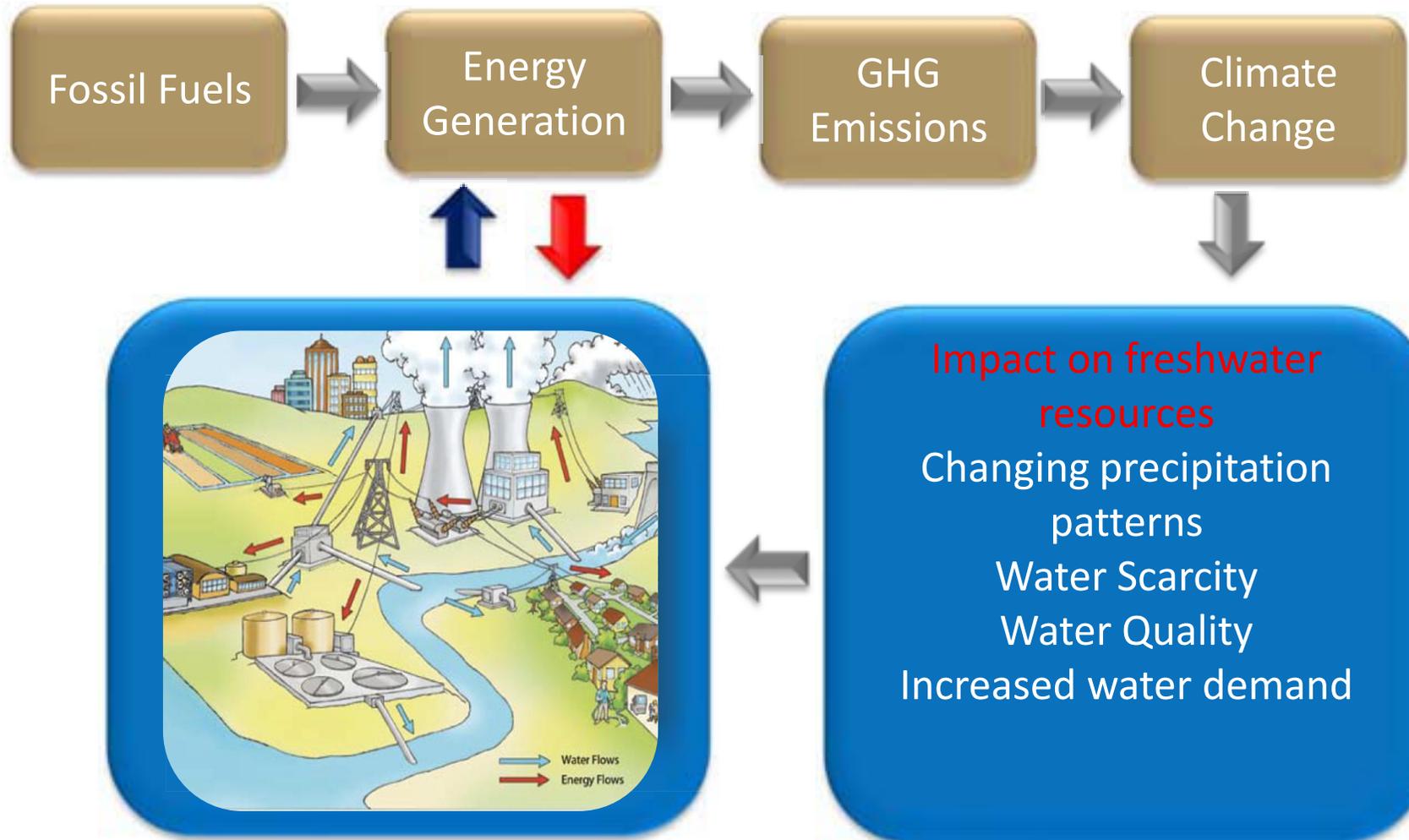
The main policies driving emission reductions are the EU Emissions Trading System, energy efficiency policies, and increased use of renewable energy for heat and transport.



- European Union Emission Trading System
- New vehicle CO<sub>2</sub> policies
- Additional renewable transport fuels
- Low carbon buses, car improvement technologies, driver training, illustrative rail electrification of 750km of track
- Energy efficiency, smart metering, Community Emissions Saving Programme, and zero carbon homes
- Clean energy cashback (renewable heat incentive)
- Clean energy cashback (renewable heat incentive)
- Climate Change Agreements and other policies
- Carbon Reduction Commitment and other policies
- Farming (crop management, manure management etc.)
- Waste policies (diverting waste from landfill, increased landfill tax)

Source: Department of Energy and Climate Change

# The water/energy relationship ...

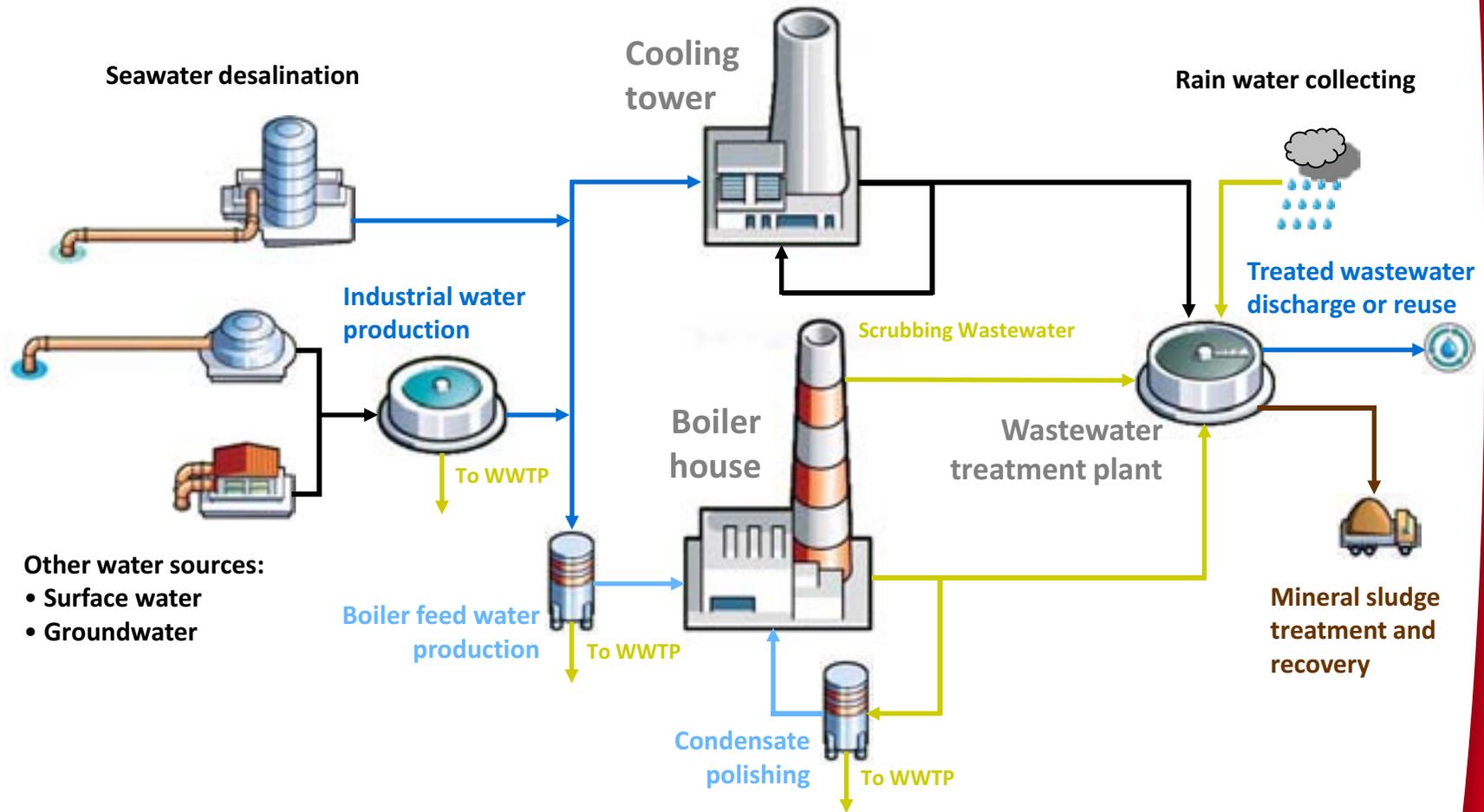


# 2

## Sustainable solutions – how to assess



# Water Use in Power Generation ...



# Technology selection water treatment & reuse ...





# Key technologies for water reuse

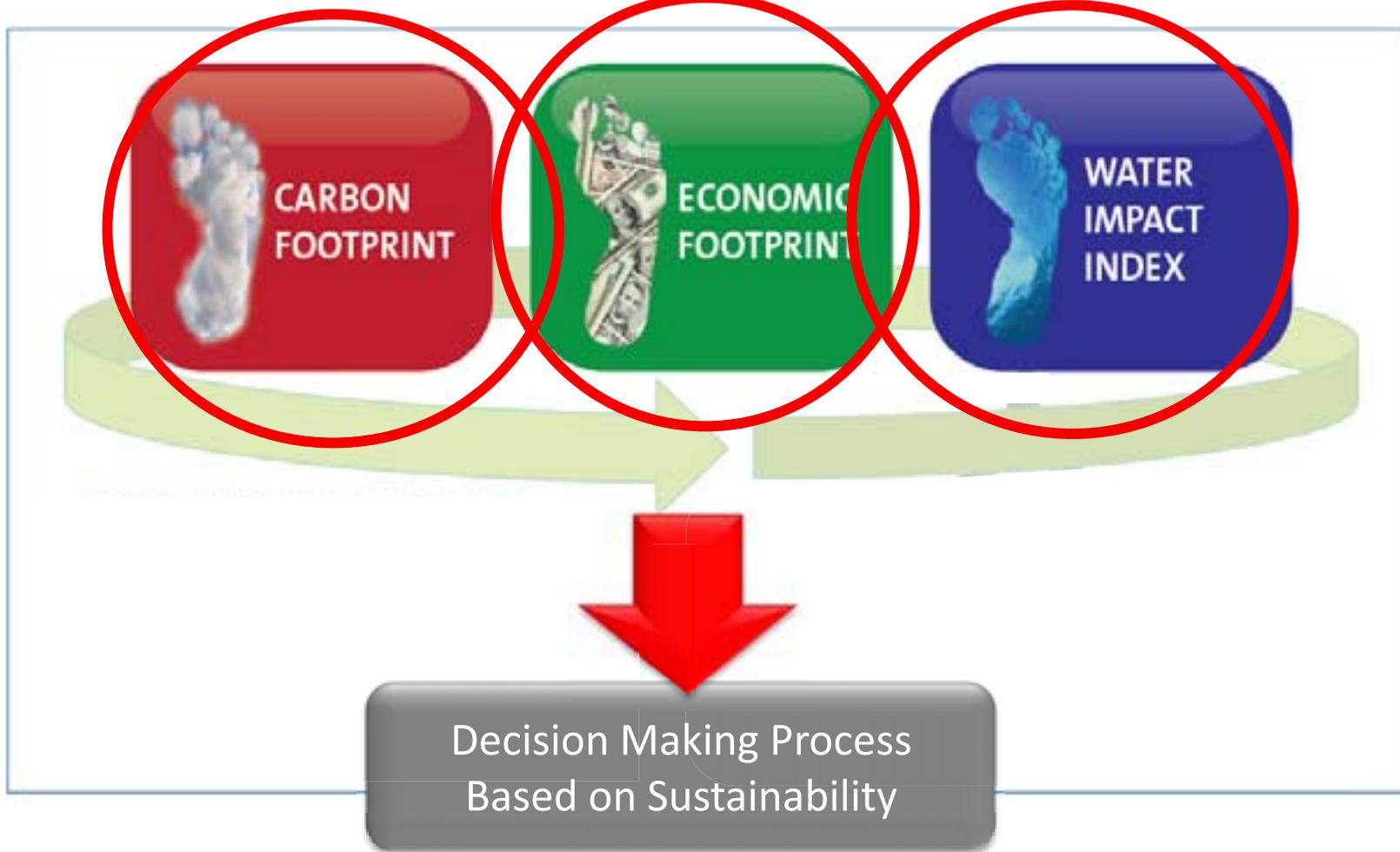
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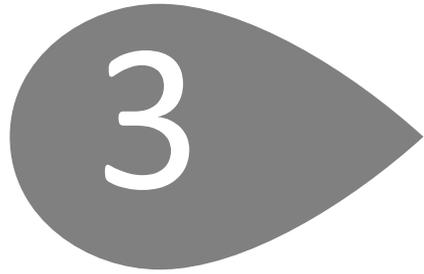
- Clarification: *Actiflo*<sup>®</sup>
- Filtration: *Filtraflo*<sup>®</sup> Large/Concrete Filters, *Multiflo*<sup>®</sup>, Multimedia Filters, *Recyclo*<sup>®</sup>
- Biological treatment: *Biosep*<sup>®</sup> / *Biosep Pack*<sup>®</sup>, *Biostyr*<sup>®</sup>, MBBR
- Membrane filtration systems: Microfiltration / Ultrafiltration / Nanofiltration / RO, Uflex
- Ion exchange systems: *Duo Eclipse*<sup>™</sup>, *Rapide*<sup>™</sup> *Strata*
- ZLD concepts: *Crystallizer*, *Evaled*, *Ceramem*
- Disinfection: *UVStar*<sup>®</sup>, ClO<sub>2</sub>, ozone
- Metal recovery systems: *Recon*<sup>®</sup> *Compact*, *Hardtac*<sup>®</sup>, *Metclean*<sup>®</sup>, *Auroclaim*<sup>®</sup>
- OPUS, CEDI-LXTechnologies
- GAC filtration or biofiltration for color, organic and micro-pollutants removal
- Low-pH or High-pH RO for acidic or basic baths recycling

# Sustainable solutions ...



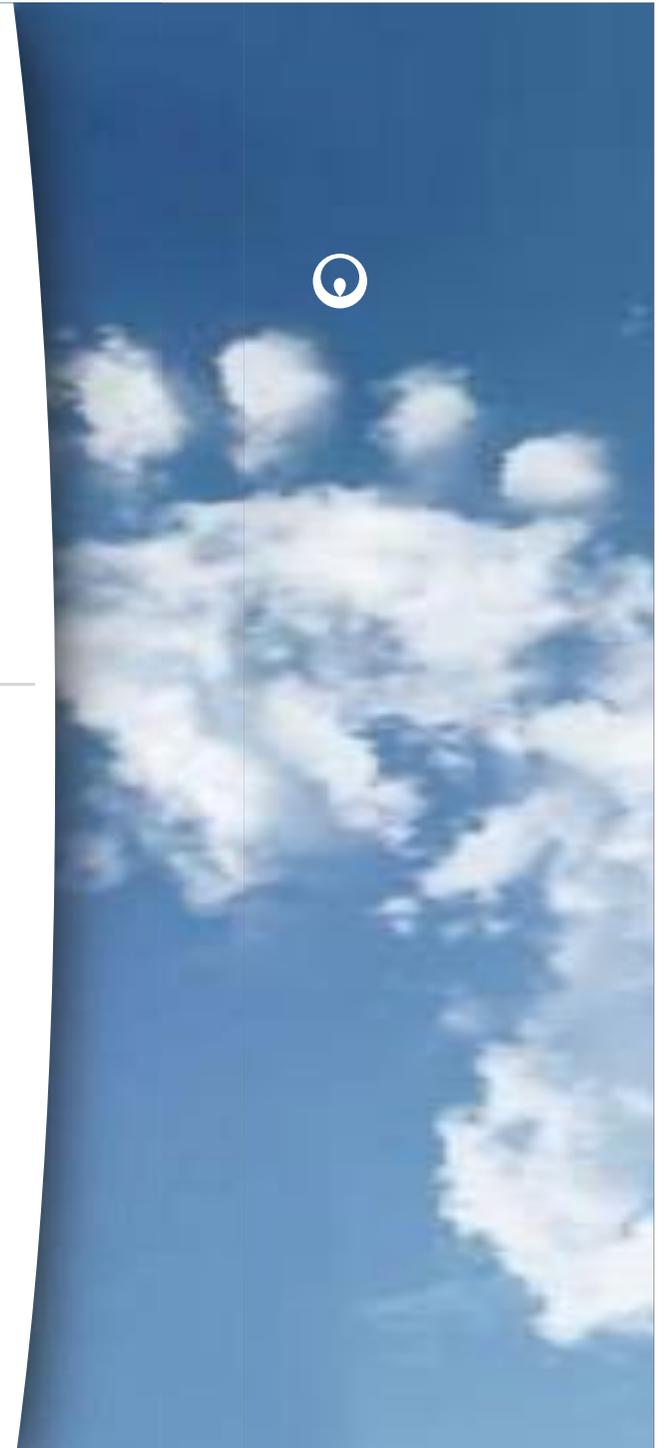
How do we select the most energy efficient, sustainable technology?





## Carbon footprint

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# Carbon footprint levels ...



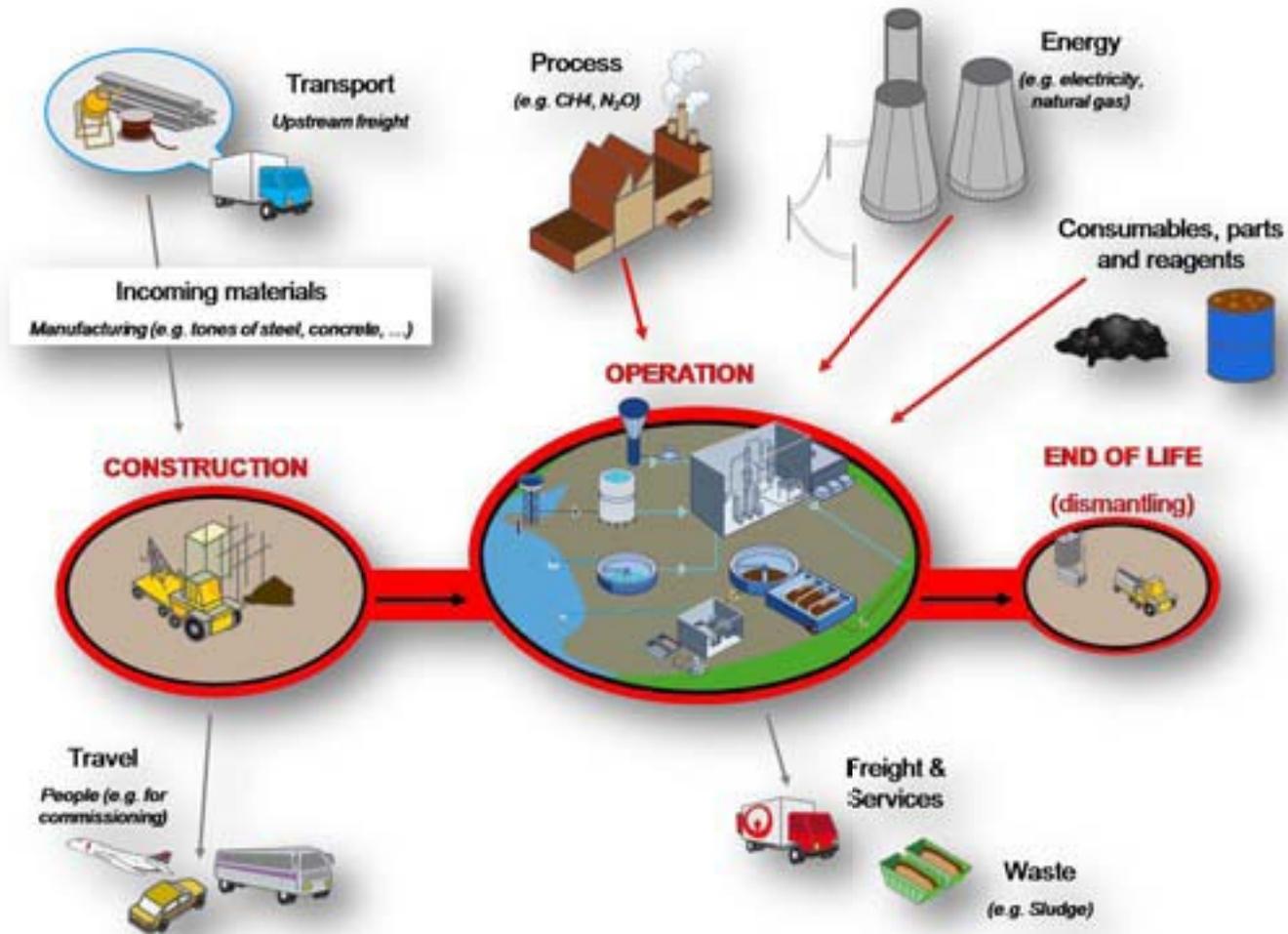
Water  
Chem

Process Optimisation

Water supply

The central screenshot shows a SCADA interface for a water treatment plant. It features several data graphs on the left side, each with a legend and a set of control buttons. The top graph shows a fluctuating signal over time. The middle graph shows a similar signal with a different pattern. The bottom graph shows a signal with sharp, periodic spikes. To the right of the graphs is a control panel with a list of parameters, each with a green indicator light and a label: 'Fase', 'Faselit', 'Hæveling', 'Returklam', 'Inns-SF', 'Inns-LT', 'ATS Hæveling', 'ATS Hæveling', 'ATS Kapasitet', and 'ATS Returklam'. Further right is a menu with options: 'Data og rapporter', 'STAR Konfiguring', 'Tidligere instillinger', 'Online Graf', 'Måler status', 'STAR Journal', and 'Tilbak'. At the bottom right of the screenshot is a detailed process flow diagram with various tanks, pumps, and pipes, labeled with terms like 'Sand- & leirfang', 'Finner', 'Fosforing', 'Avkalking', 'Luftingsstasjon', 'Etterbehandling', and 'Slur'. The interface also shows a taskbar at the bottom with several open applications like 'Microsoft Outlook' and 'Microsoft PowerPoint'.

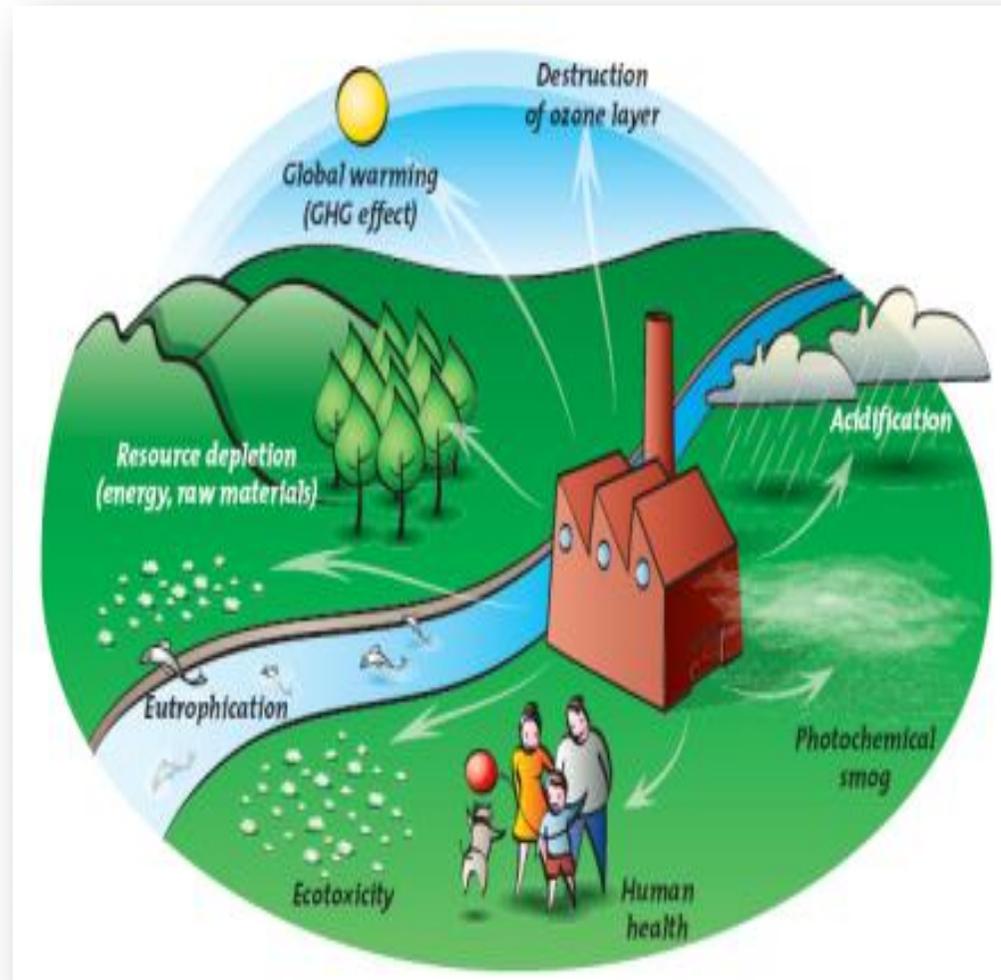
# Life cycle assessment ...



# LCA environmental impacts



- Global warming
- Fossil fuels depletion
- Acidification
- Smog
- Ozone layer depletion
- Eutrophication
- Toxicological pollutants
- Habitat destruction
- Desertification
- Land use
- Minerals depletion
- Etc.



# Carbon footprint assessment



Carbon Footprint =  $\sum_{i=1}^n A_i * EF_i$

Perimeter

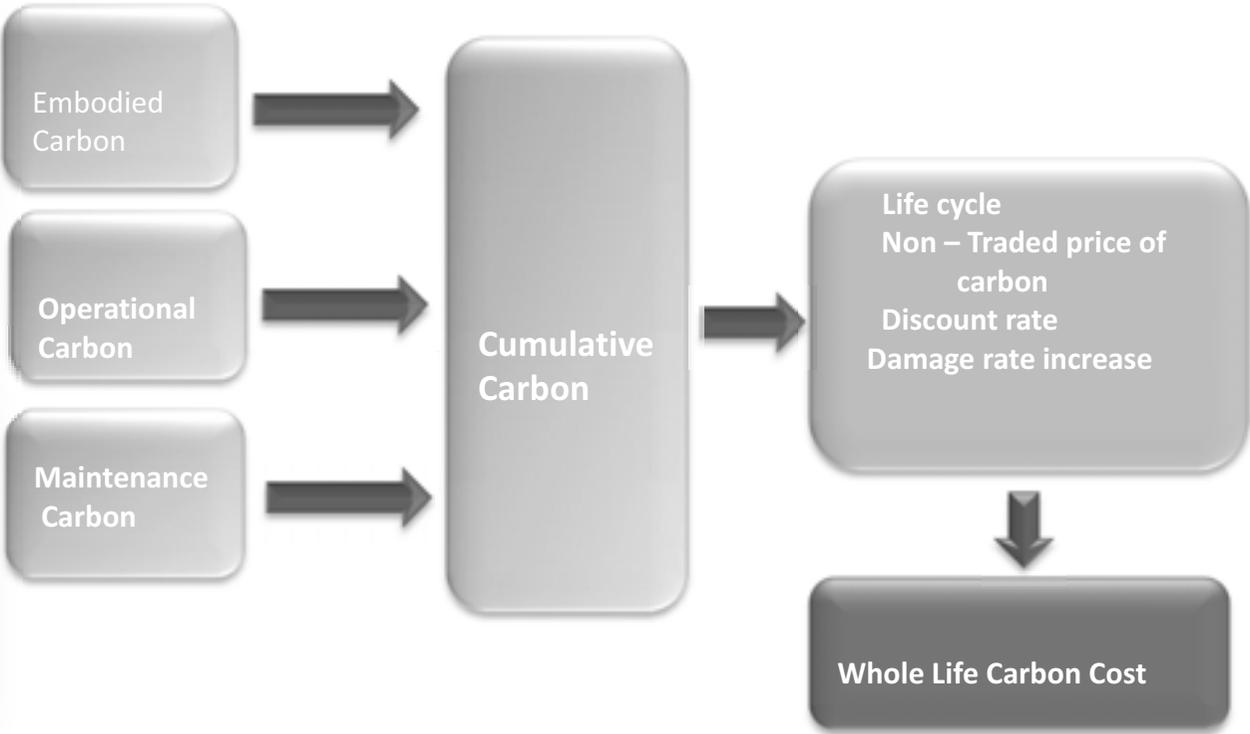
Emission factor

Activity data

Construction –  
m<sup>2</sup>/m<sup>3</sup>/tonnes  
Operation –  
kWhr/d  
Maintenance-  
5/10/20 years

Emission Factor Data Bases –  
ICE, UKWIR, ADEME, Eco Invent,  
AUDCC, VWS Specific Factors

# Bottom up concept ...



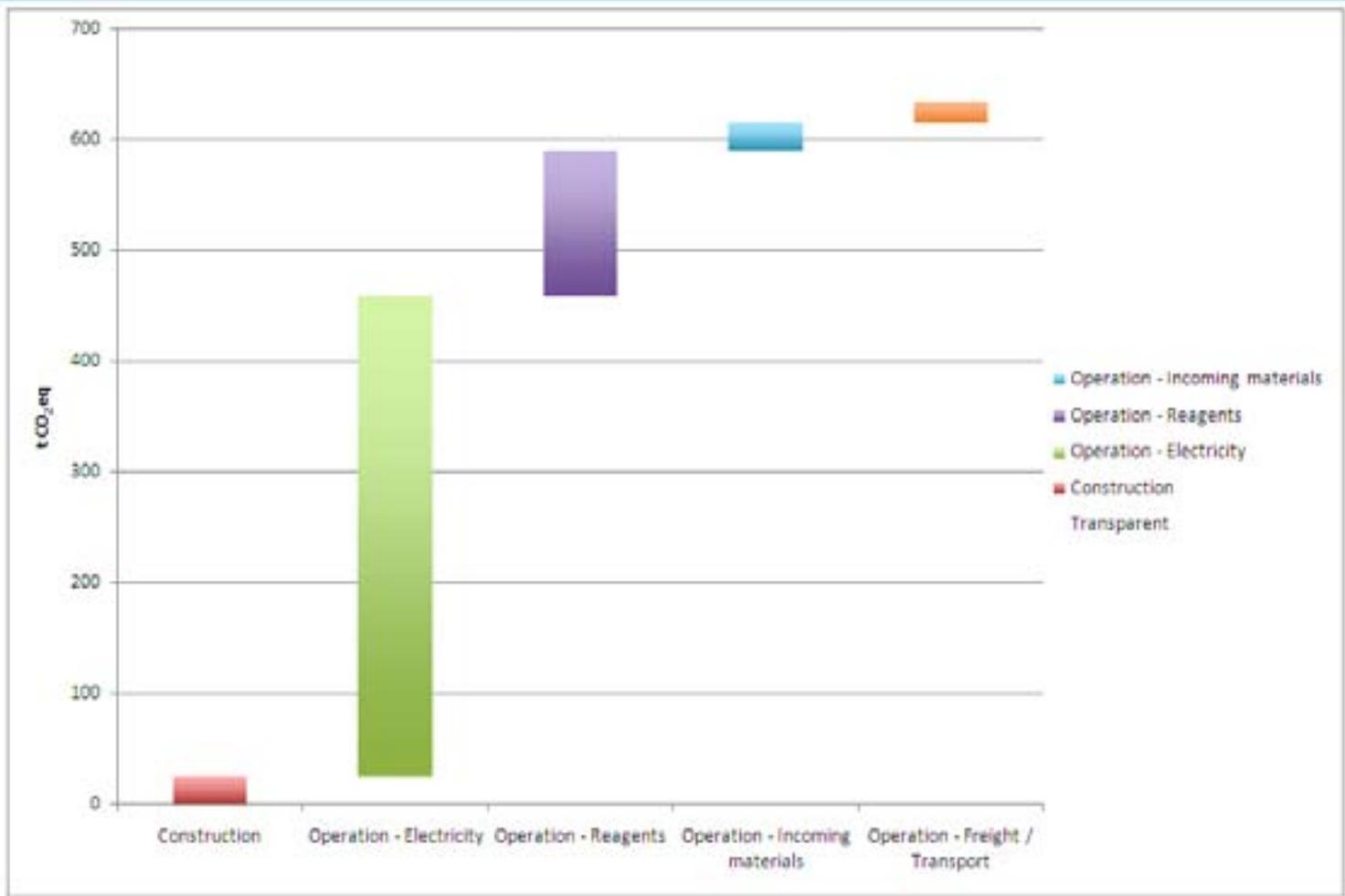
Life Cycle Costs  
(Capex + Opex)



Whole Life Carbon Cost

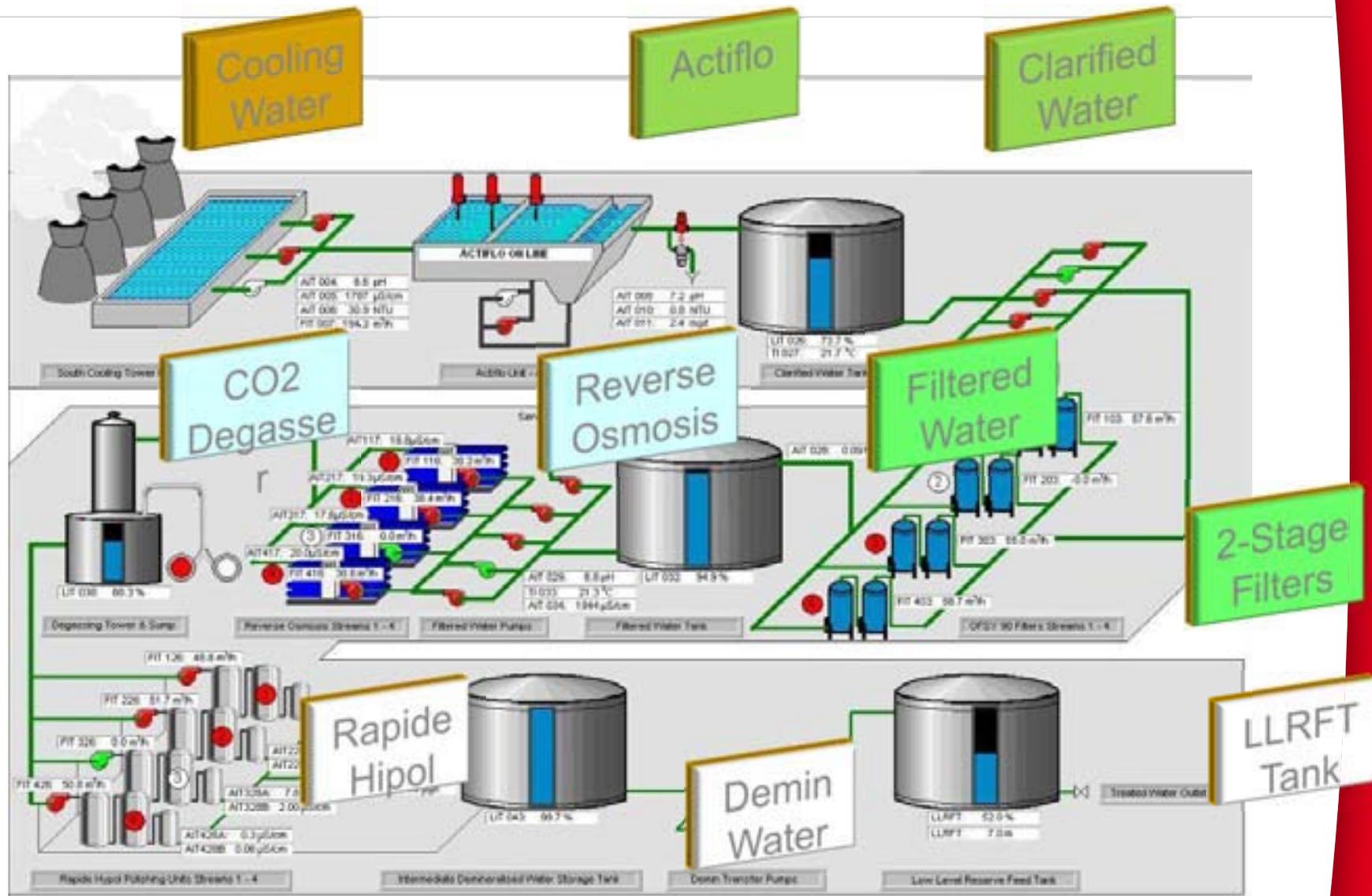


Total Cost for Cost Benefit Analysis



Category	Item	Value	Unit	CO <sub>2</sub> eq	CO <sub>2</sub> eq/Unit	Percentage
Transport	Polystyrene road freight	3,287	kg	0.04	0.0012	0.7%
	Polystyrene road freight	200	kg	0.04	0.0020	0.7%
	Polystyrene road freight	200	kg	1,449	7.245	1.2%
	Polystyrene road freight	200	kg	173	0.865	0.14%
Transport	Transport road	0	km	0	0	0%
	Transport air	0	km	0	0	0%
Energy	Road trip average	0.34	kg CO <sub>2</sub> /km	0.34	0.34	0.06%
	Air trip average	0.41	kg CO <sub>2</sub> /km	0.41	0.41	0.07%
Reagents	Polystyrene road freight	0.01	kg CO <sub>2</sub> /kg	0.01	0.01	0.002%
	Polystyrene road freight	0.55	kg CO <sub>2</sub> /kg	0.55	0.55	0.09%
	Polystyrene road freight	0.55	kg CO <sub>2</sub> /kg	0.55	0.55	0.09%
Incoming materials	Polystyrene road freight	0.01	kg CO <sub>2</sub> /kg	0.01	0.01	0.002%
	Polystyrene road freight	0.55	kg CO <sub>2</sub> /kg	0.55	0.55	0.09%
	Polystyrene road freight	0.55	kg CO <sub>2</sub> /kg	0.55	0.55	0.09%
Freight/Transport	Polystyrene road freight	0.01	kg CO <sub>2</sub> /kg	0.01	0.01	0.002%
	Polystyrene road freight	0.55	kg CO <sub>2</sub> /kg	0.55	0.55	0.09%
	Polystyrene road freight	0.55	kg CO <sub>2</sub> /kg	0.55	0.55	0.09%
				<b>434</b>	<b>kg CO<sub>2</sub> eq</b>	
				<b>110</b>	<b>g CO<sub>2</sub> eq/kg</b>	

# Solutions evaluation...



# EOLIA™ – decision support tool



## Top down concept ...

- Enables treatment configurations to be evaluated in terms of energy and GHG emissions
- Identification of process hot spots
- Effect of integration of new technology
- Can be used to as an optimisation tool for existing operations
- Quick evaluation of numerous treatment options based on local conditions



**Eolia™**  
**Life Cycle Analysis (LCA)**  
**applied to water treatment**

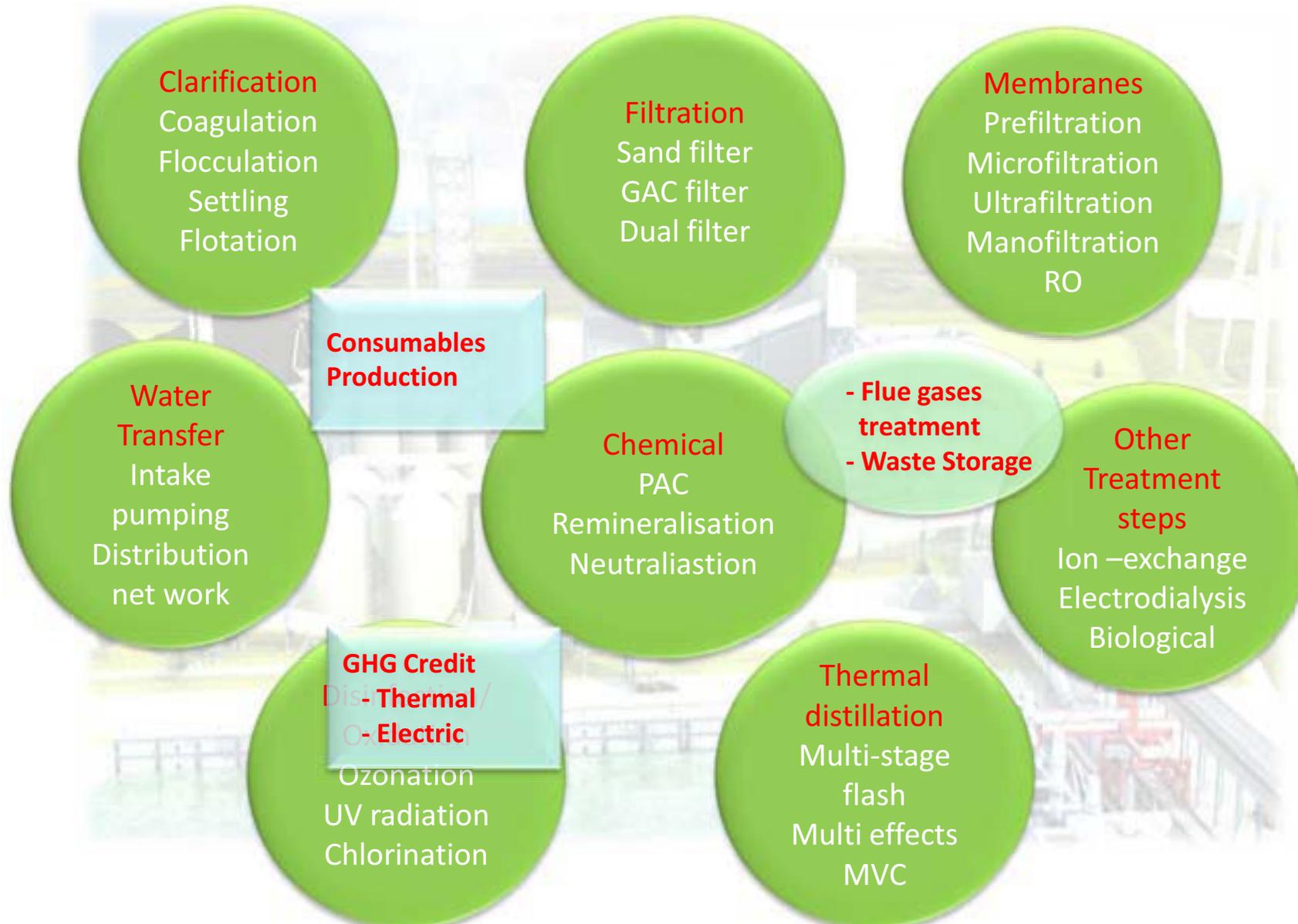
Eolia™ uses Life Cycle Analysis (LCA) to evaluate the energy consumed and produced by the different processes under consideration, along with the greenhouses gases (GHGs) they emit.

A tool to assist with decision-making to find the optimal choice for water, wastewater and sludge treatment processes.

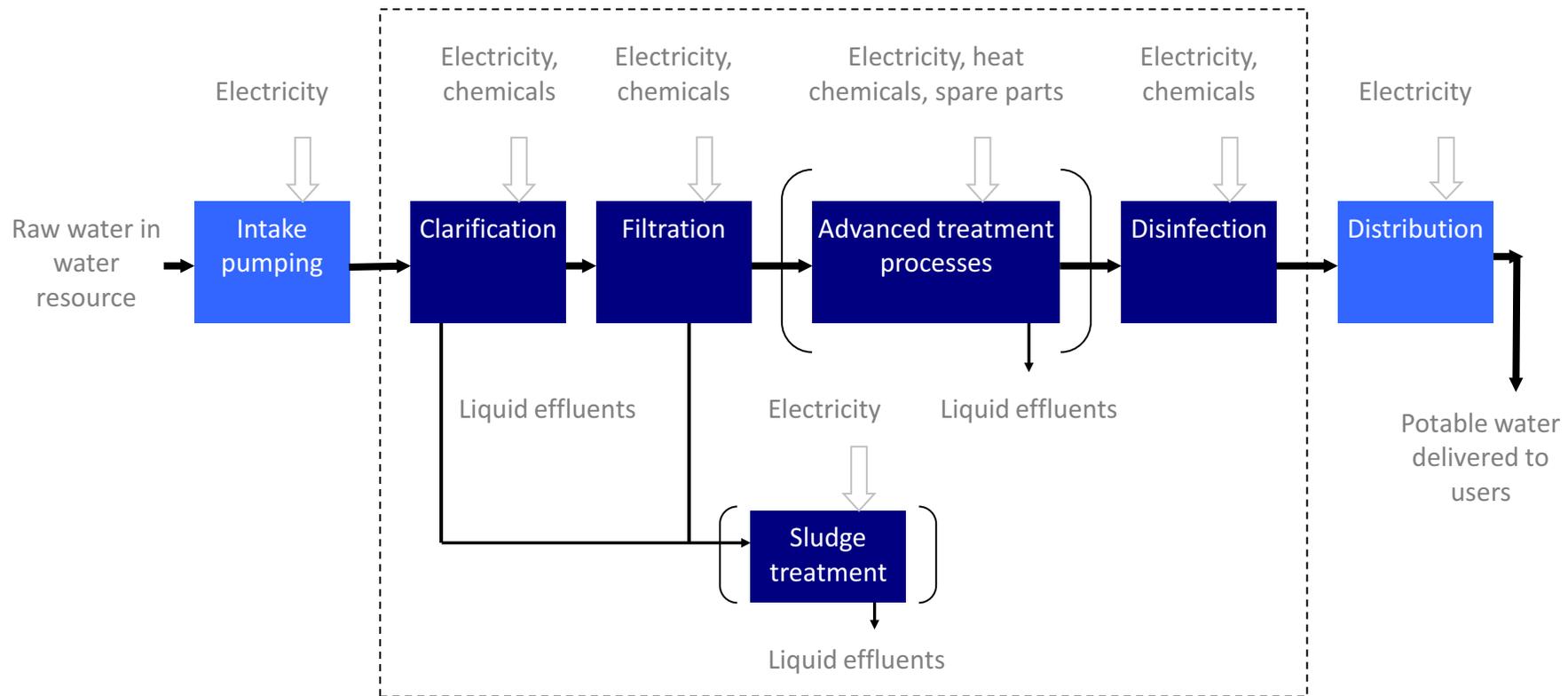
Eolia™ enhances the decision-making process and enables the optimal choice to be made on the basis of a major environmental criterion: the impact the process will have on global warming.

- Eolia™ evaluates and compares the energy and GHG balances of different processes
- Eolia™ identifies the improvement drivers of a process.

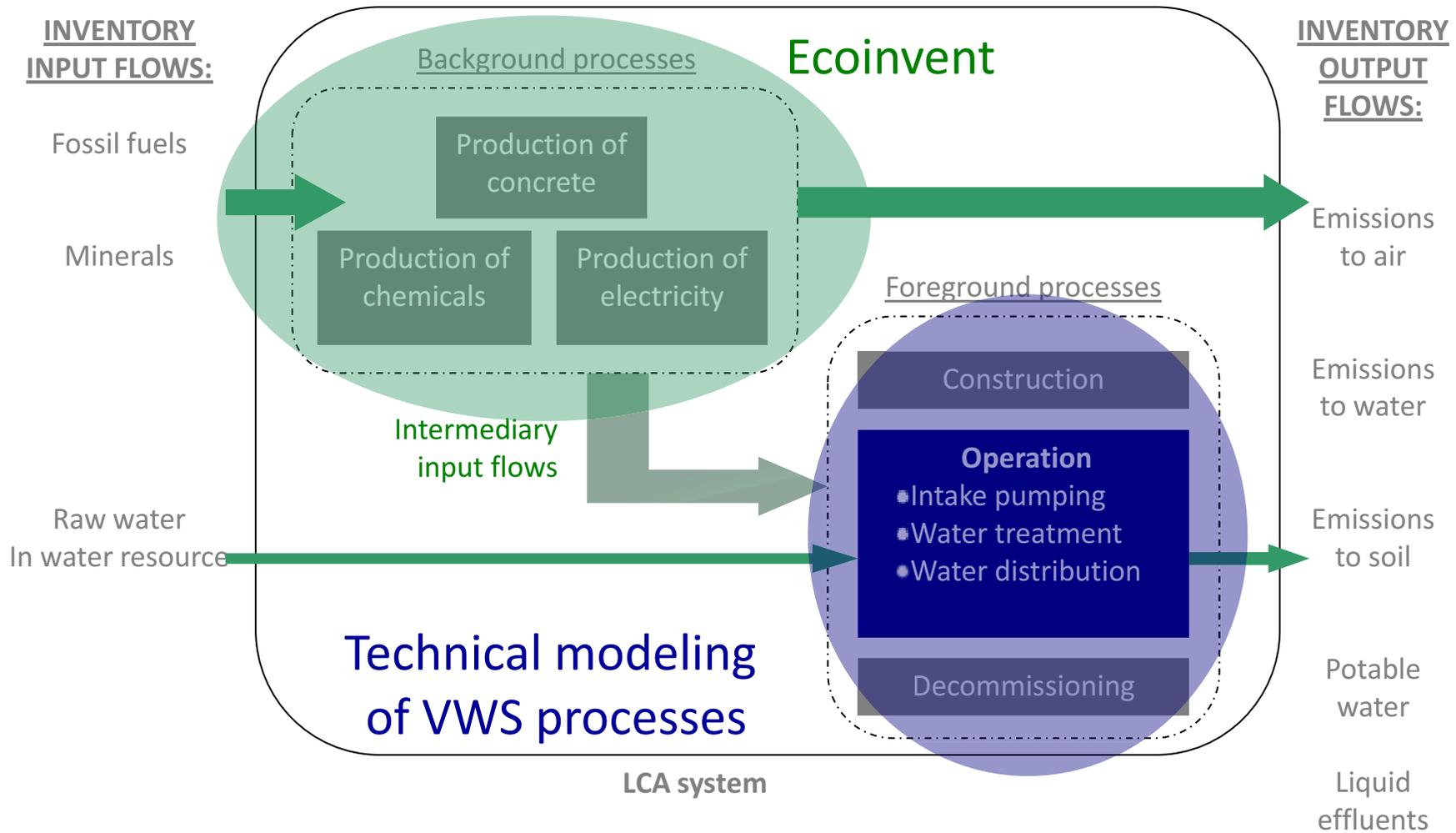
# Water treatment modules ...



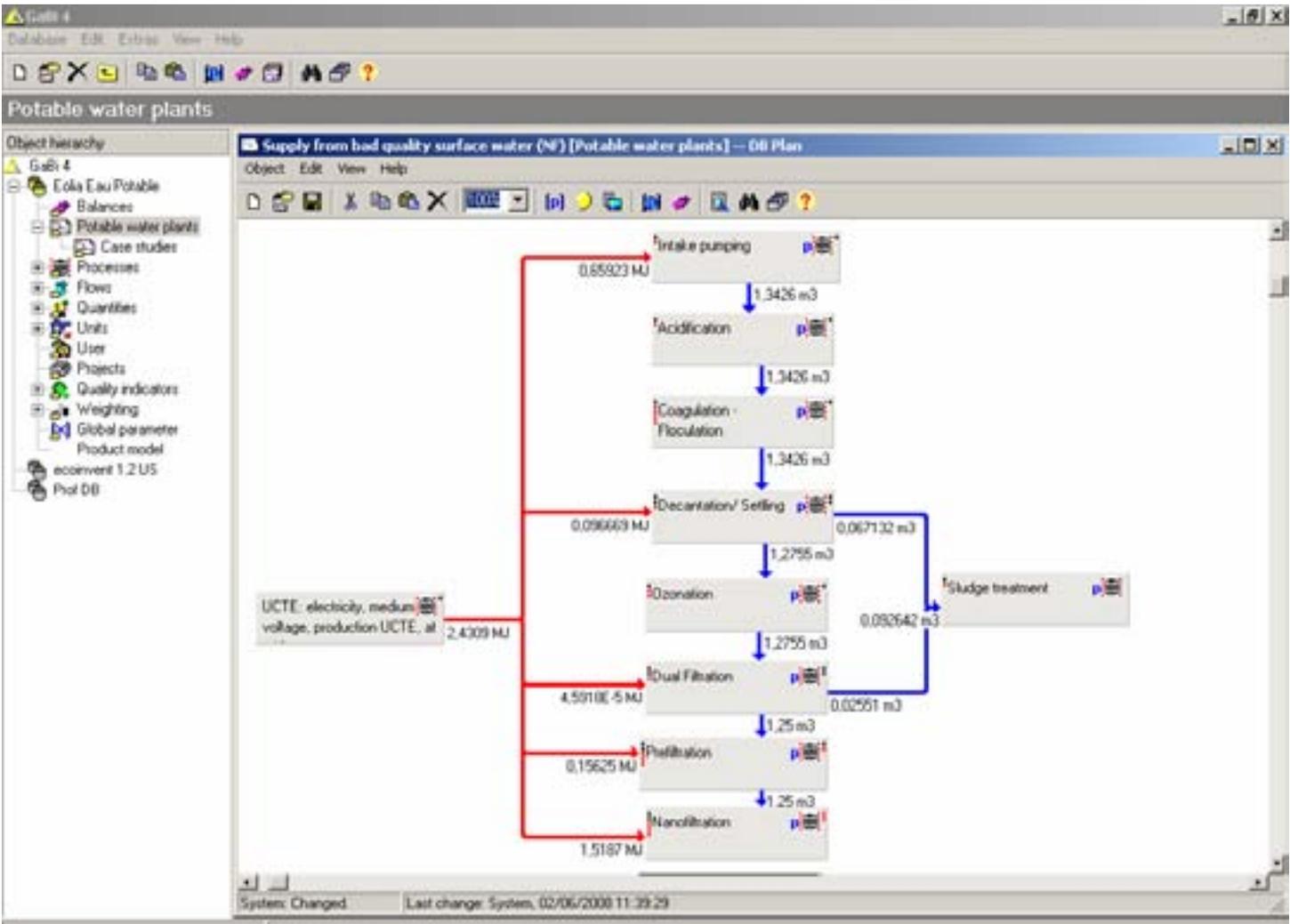
# Water treatment system



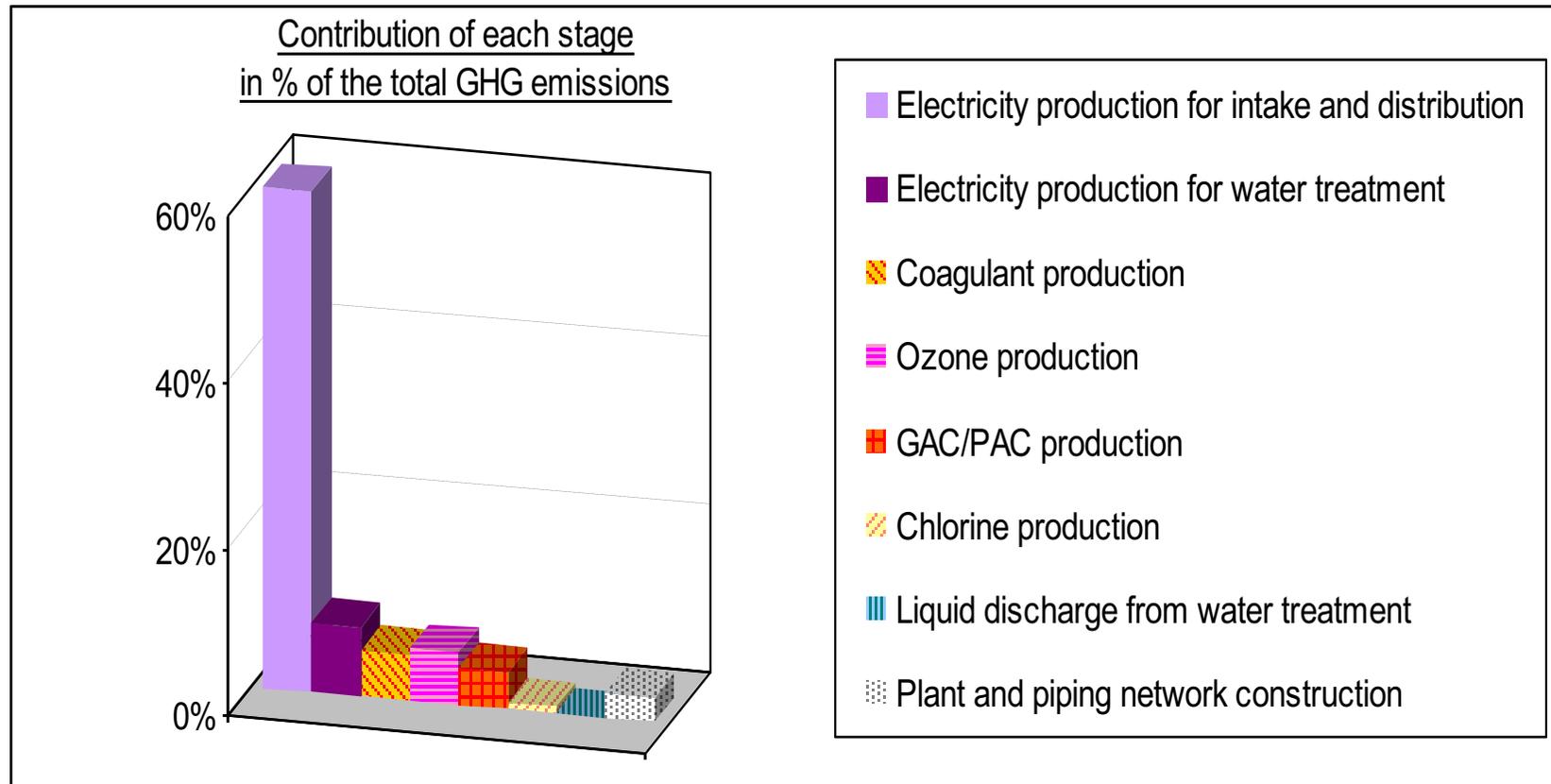
# LCA: System studied



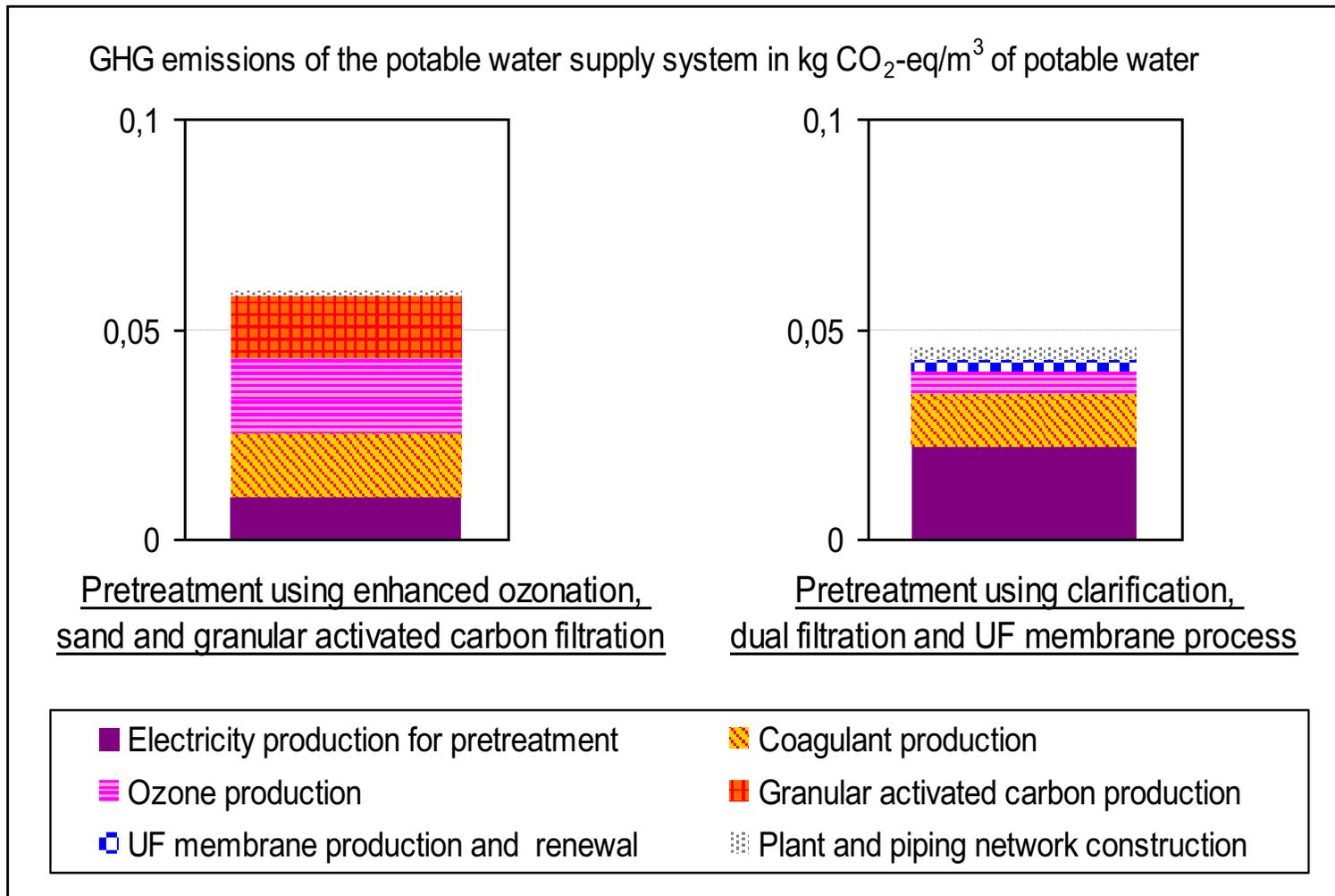
# User interface ...

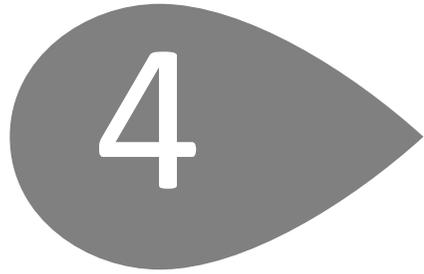


# GHG emission output ...



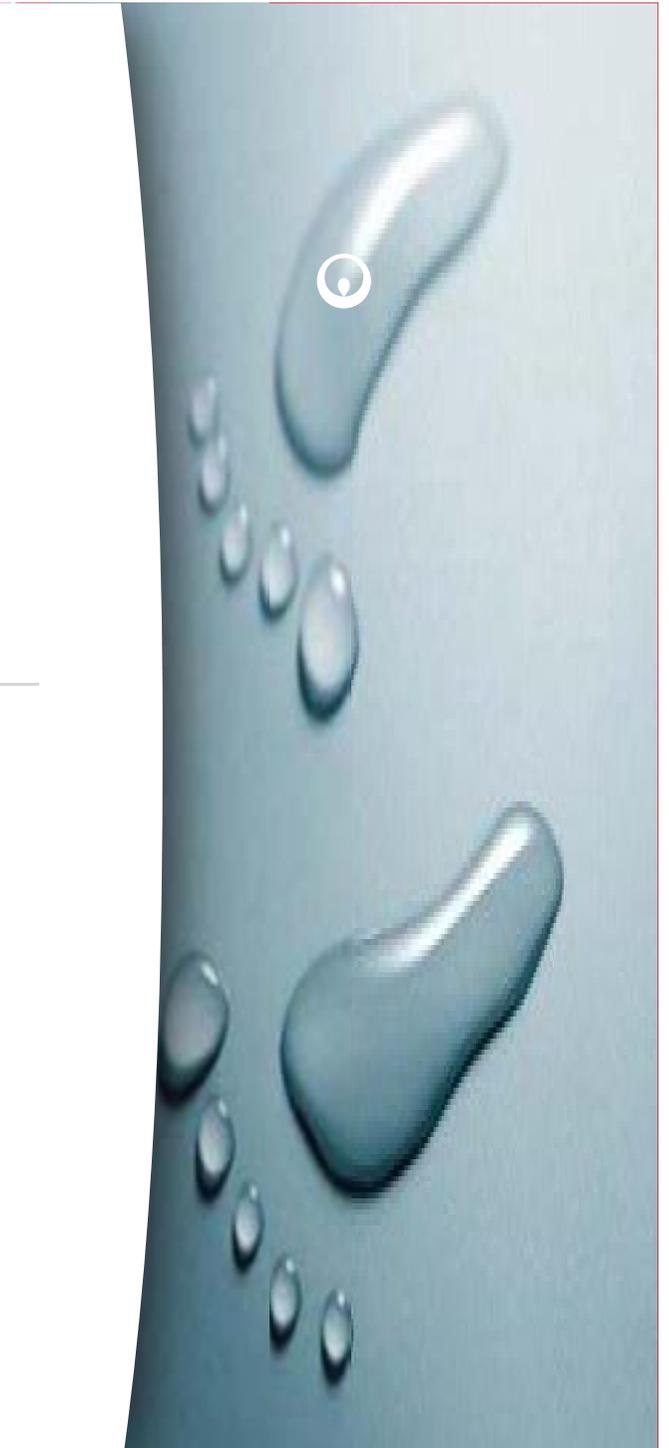
# Solution comparison ...



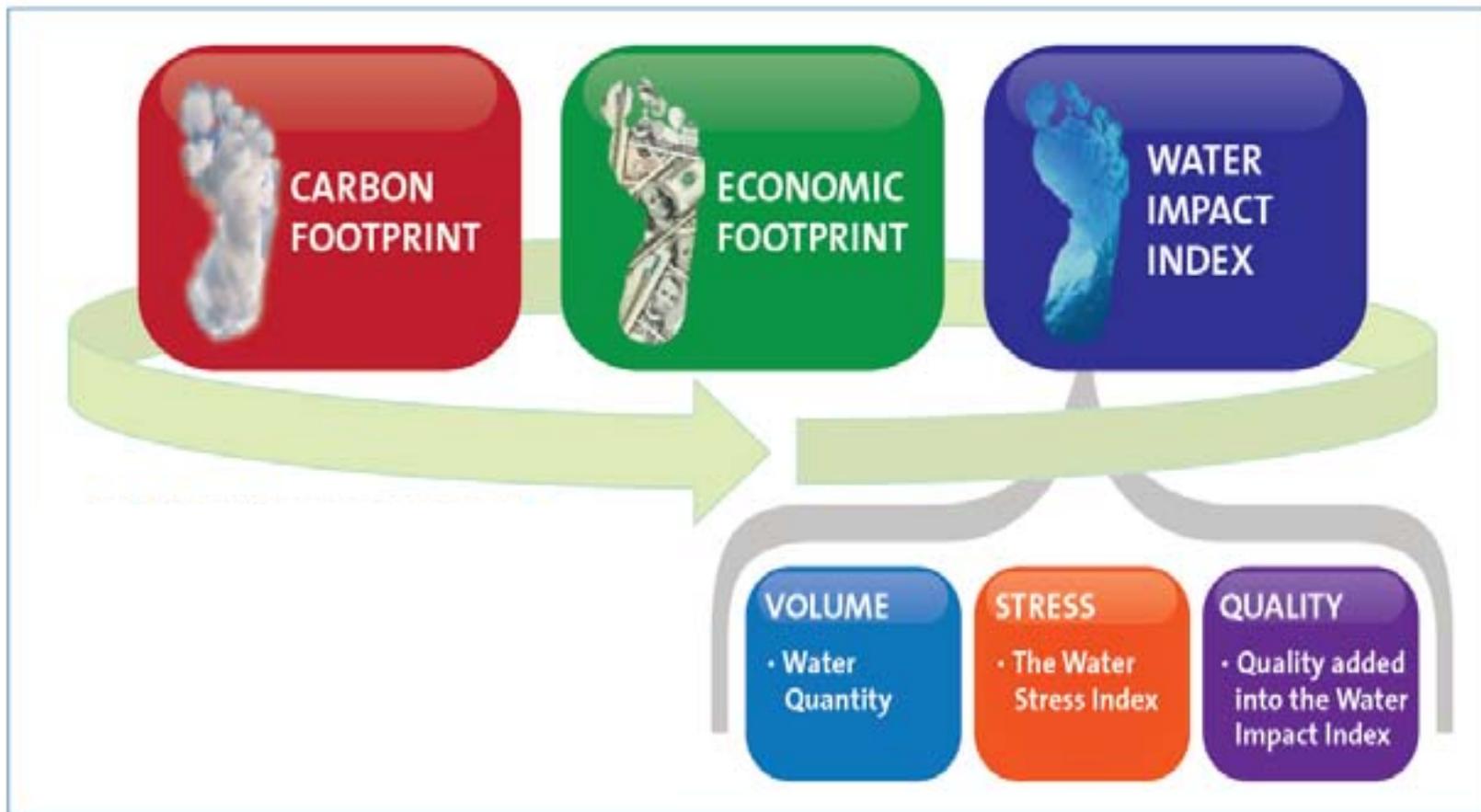


## The new Water Impact Index - WII

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# Water Impact Index ...



# Water Impact Index ...



## Why go beyond a volumetric approach?



*Peanut production: rain fed agriculture*

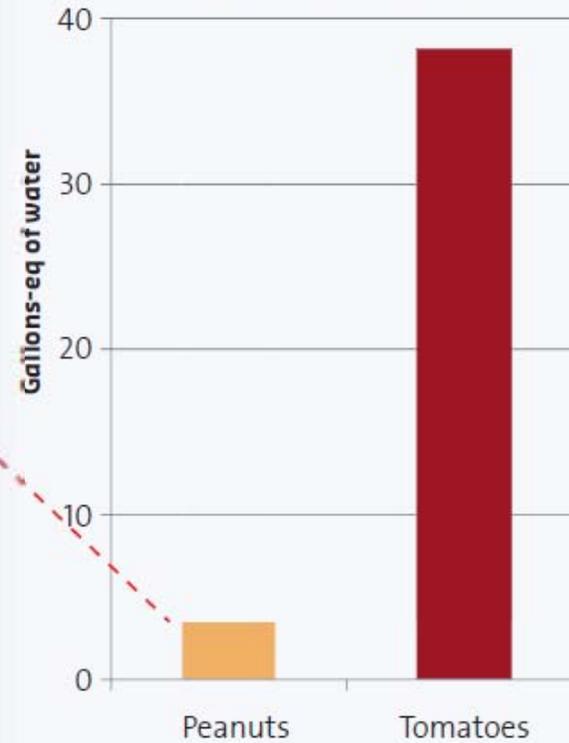


*Tomatoes are produced in water stressed areas*



*Tomatoes require more fertilizers (water pollution)*

**Stress-weighted water footprints**



# METHODOLOGY

A new metric for assessing water impacts.

## Direct Water Impact Index



$$WII = WSI \times [(V_{\text{extracted}} \times Q_{\text{extracted}}) - (V_{\text{released}} \times Q_{\text{released}})]$$

## Indirect Water Impact Index



Energy



Chemicals



Waste



$$WII = WSI \times [(V_{\text{extracted}} \times Q_{\text{extracted}}) - (V_{\text{released}} \times Q_{\text{released}})]$$

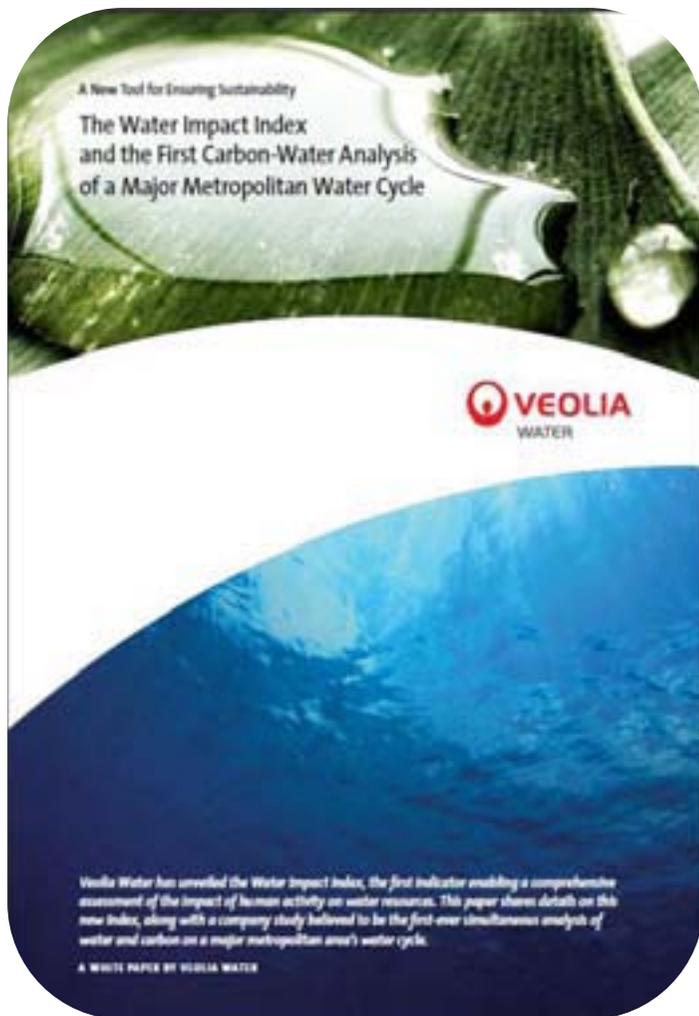


$$WII = WSI \times [(V_{\text{extracted}} \times Q_{\text{extracted}}) - (V_{\text{released}} \times Q_{\text{released}})]$$

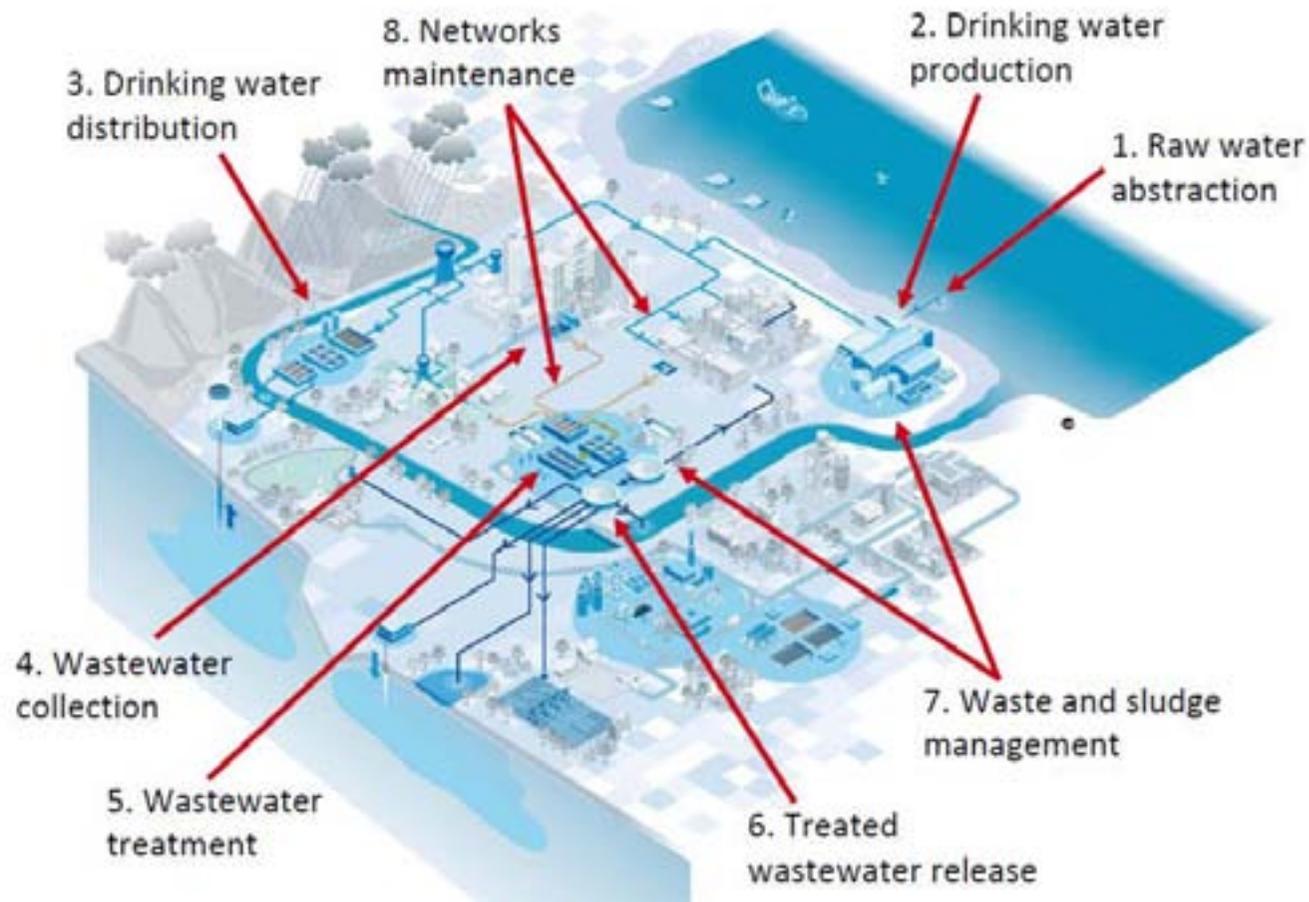


$$WII = WSI \times [(V_{\text{extracted}} \times Q_{\text{extracted}}) - (V_{\text{released}} \times Q_{\text{released}})]$$

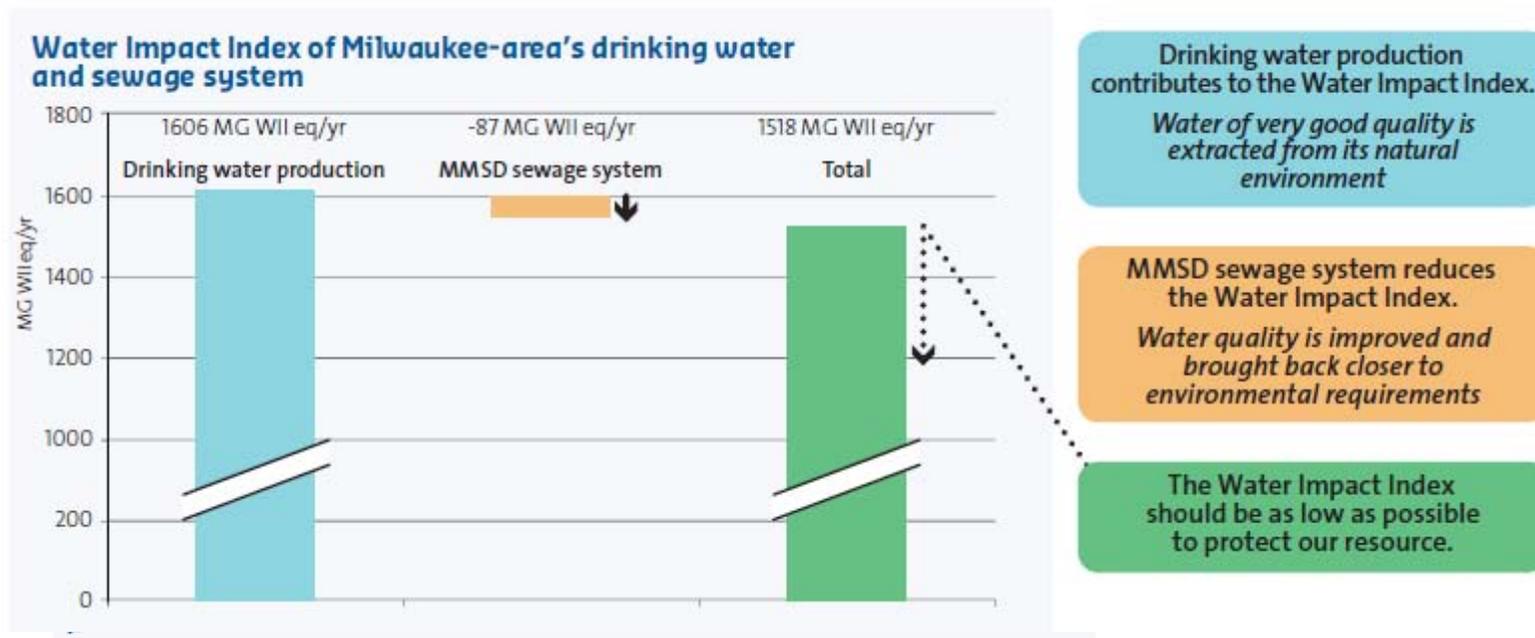
# First carbon – water analysis ...



# Water system evaluated ...



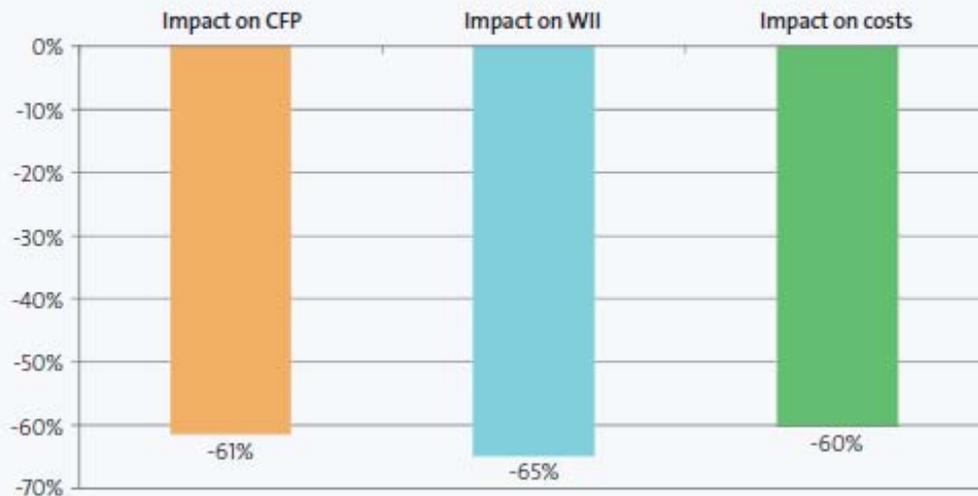
# Carbon - Water Impact assessment...



# Carbon - Water Impact assessment ...



## Chloramination represents a win-win-win situation



→ Switching from sodium hypochlorite disinfection to chloramination would reduce the Water Impact Index of chemicals, the carbon footprint and generate savings.

# Conclusions...

- Provision of water treatment solutions to meet the future requirements of Industry will require not only an innovative use of technology, but also an innovative approach to technology selection to ensure a sustainable solution
- Optimisation of energy use and reduction of GHG emissions in water treatment is intertwined with water use
- Veolia Waters combined carbon footprint and water Impact Index tools can be used to determine water treatment solutions that create minimal environmental impact
- Coupled with conventional economic analysis they provide a multi criteria analysis to achieve a « best in class » decision making process



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Thank You for your  
Attention

Any Questions Please !

