THE BLUE FOOTPRINT ™
IN MILWAUKEE

First-ever Water Impact Index and Carbon-Water–Economic Analysis

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Veolia Water North America

August 3, 2010

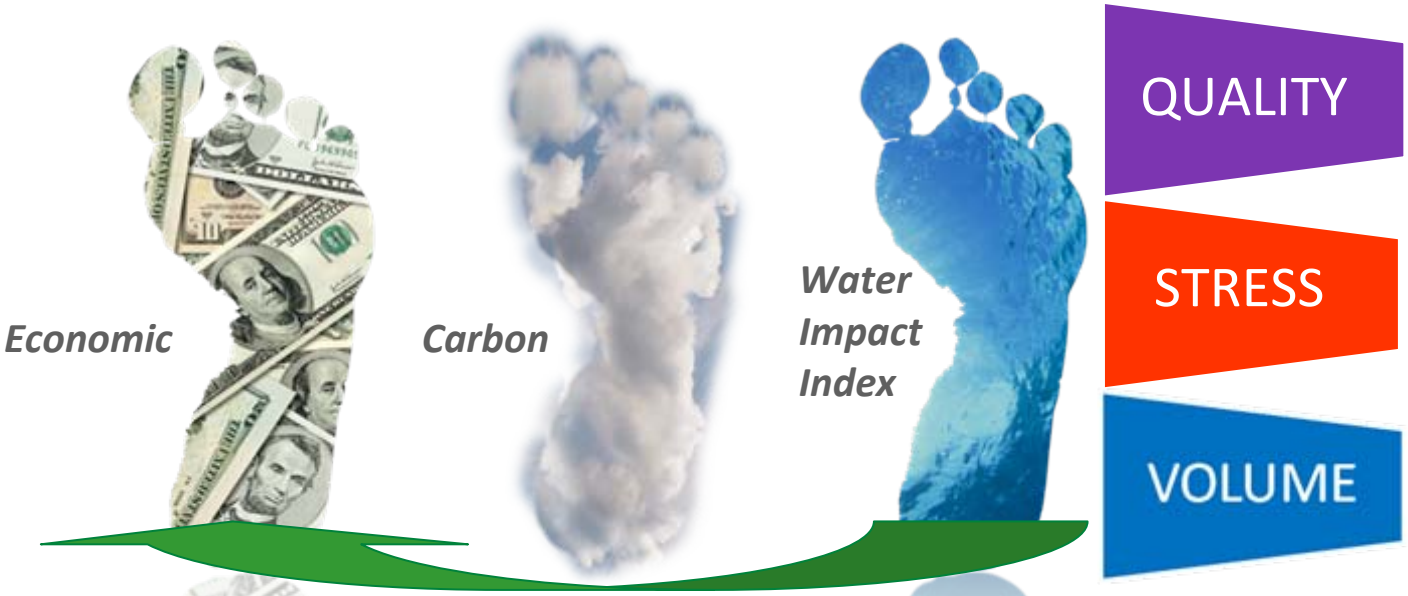
VEOLIA WATER

Great Lakes represent **20% of all freshwater resources**

Source: United Nations

Journal Sentinel

Two world firsts
New decision-making tools for sustainability

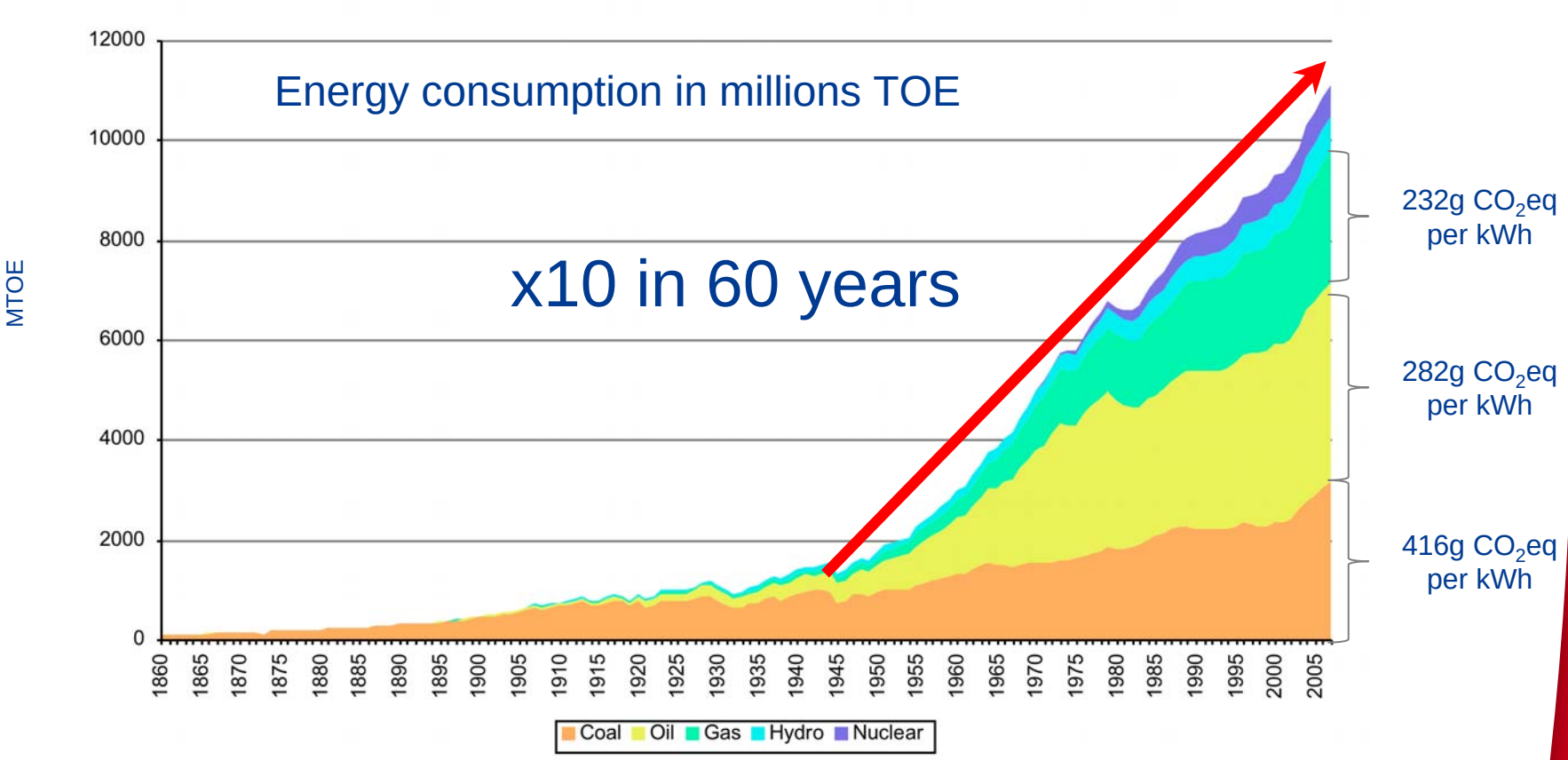


- **1. Simultaneous assessment** of the **water, carbon** and **economic impacts** to understand their interactions and support decision-making grounded in sustainability
- **2. Water Impact Index**, a more comprehensive water analysis
  - An assessment of the human footprint on water resources taking into account consumption, resource stress and quality

Carbon Footprint
why does it matter?

Carbon footprint: why does it matter?

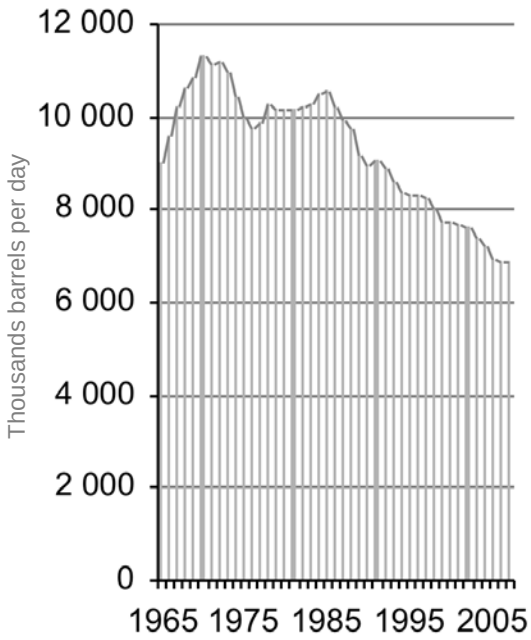
- Climate change, global warming, manmade or not…
- From a resources perspective, the end of the world as we know it…



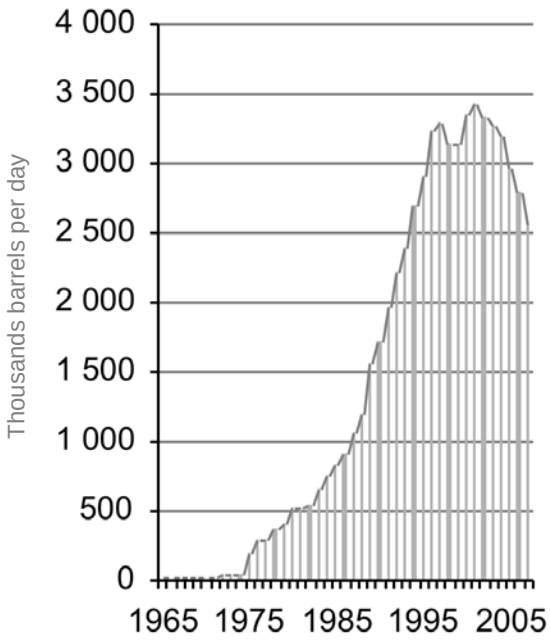
Source: Schilling & al + Observatoire énergie + AIE + BP Statistical review 2008

Carbon footprint: why does it matter?

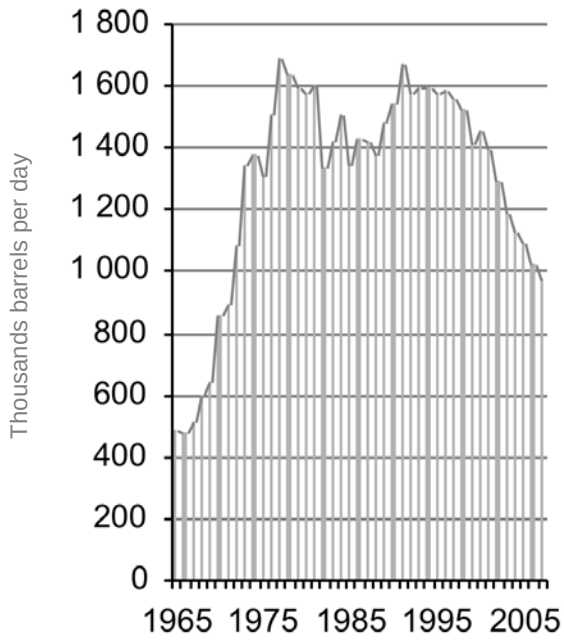
Daily production (USA)



Daily production (Norway)



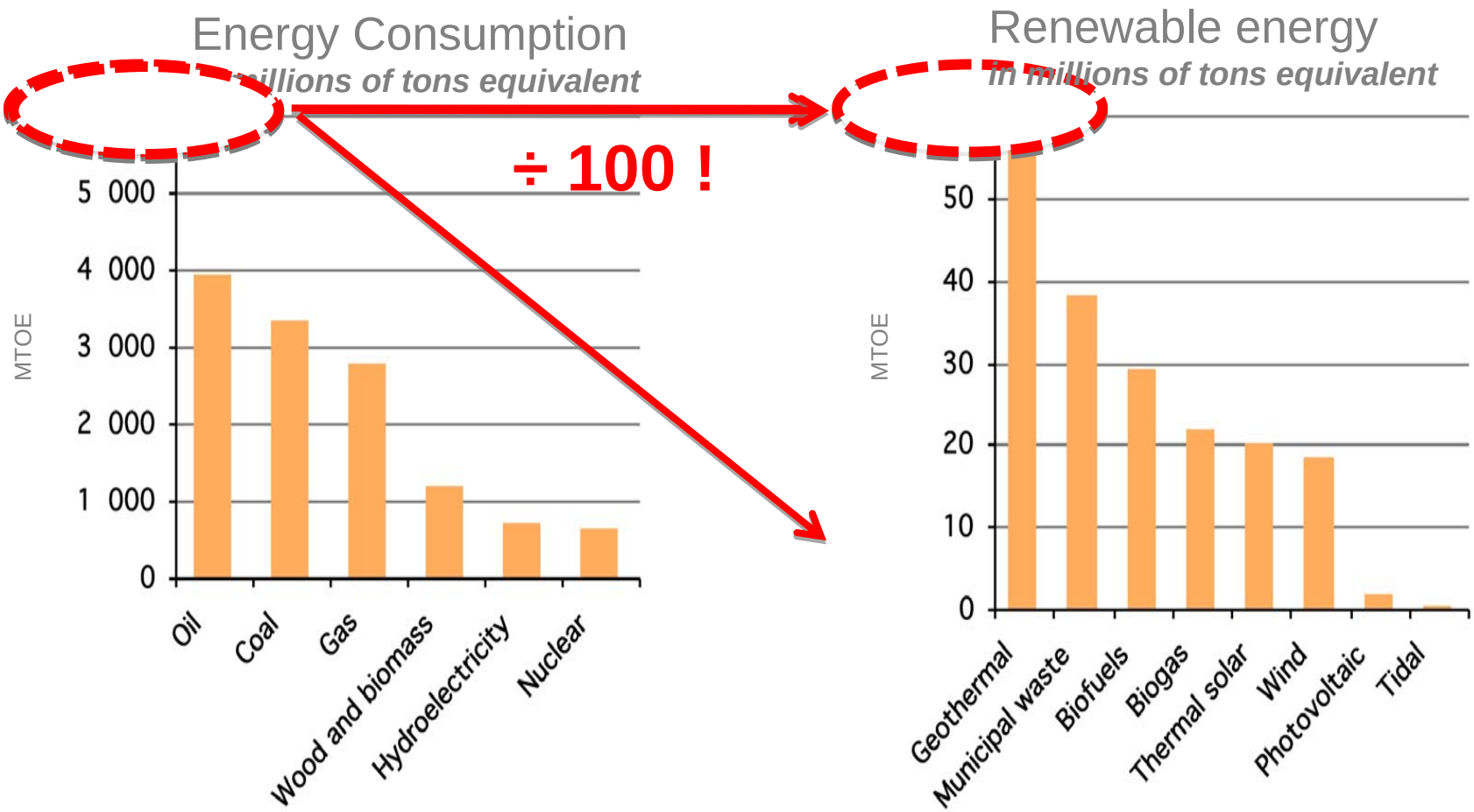
Daily production (Indonesia)



Source: BP Statistical Review 2009

- Many experts estimate **peak oil production** will be reached before **2015**
- <90 million barrels/day versus current 82 million barrels/day

Carbon footprint: why does it matter?



- **Gas and coal** are the only realistic short-term substitute to oil
- So, **more CO2 emissions are still to be expected**

Carbon footprint: why does it matter?

Kaya's equation:
Human impact on climate

$$CO_2 = \frac{CO_2}{TOE} \times \frac{TOE}{GDP} \times \frac{GDP}{POP} \times POP$$

CO2 emissions = **Carbon content of the energy supply** x **Energy efficiency of the economy** x **Wealth per capita** x **Population**

- CO_2 : CO_2 emissions from fossil fuels combustion
- TOE : Tons of Oil Equivalent (Energy supply)
- GDP : Gross Domestic Product
- POP : Population

Carbon footprint: why does it matter?

Kaya's equation:

$$CO_2 = \frac{CO_2}{TOE} \times \frac{TOE}{GDP} \times \frac{GDP}{POP} \times POP$$

CO2 emissions = **Carbon content of the energy supply** x **Energy efficiency of the economy** x **Wealth per capita** x **Population**

REQUIREMENT: Will be divided by 2 "some day," better if before 2050

COROLLARY: /8.4 by 2050: will it be possible?

OUR WISH x3 by 2050 ("only" 2% annual growth)

PROJECTION: X1.4 by 2050

Water Footprint™ why does it matter?

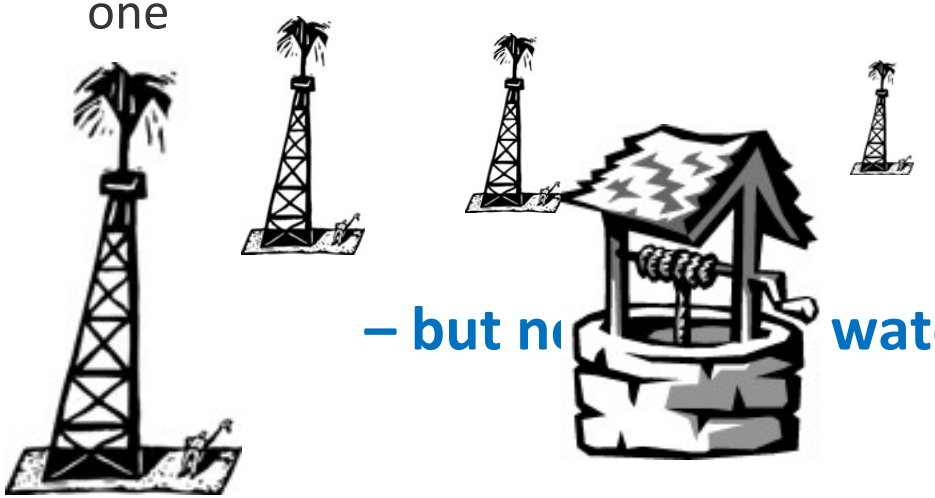
Water Footprint™: why does it matter?

- There is **no substitute to water – we need it for everything!**
- Unlike oil, **transporting water in large quantities is not a practical option**

  Oil $_{eq}$ = 8 tons/capita/year

  Water=2140 tons/capita/year

  - You can hop from one oil well to the next one



– but n water!

Water Footprint™: why does it matter?

Water can be “consumed” in two ways

1. Withdraw and return less

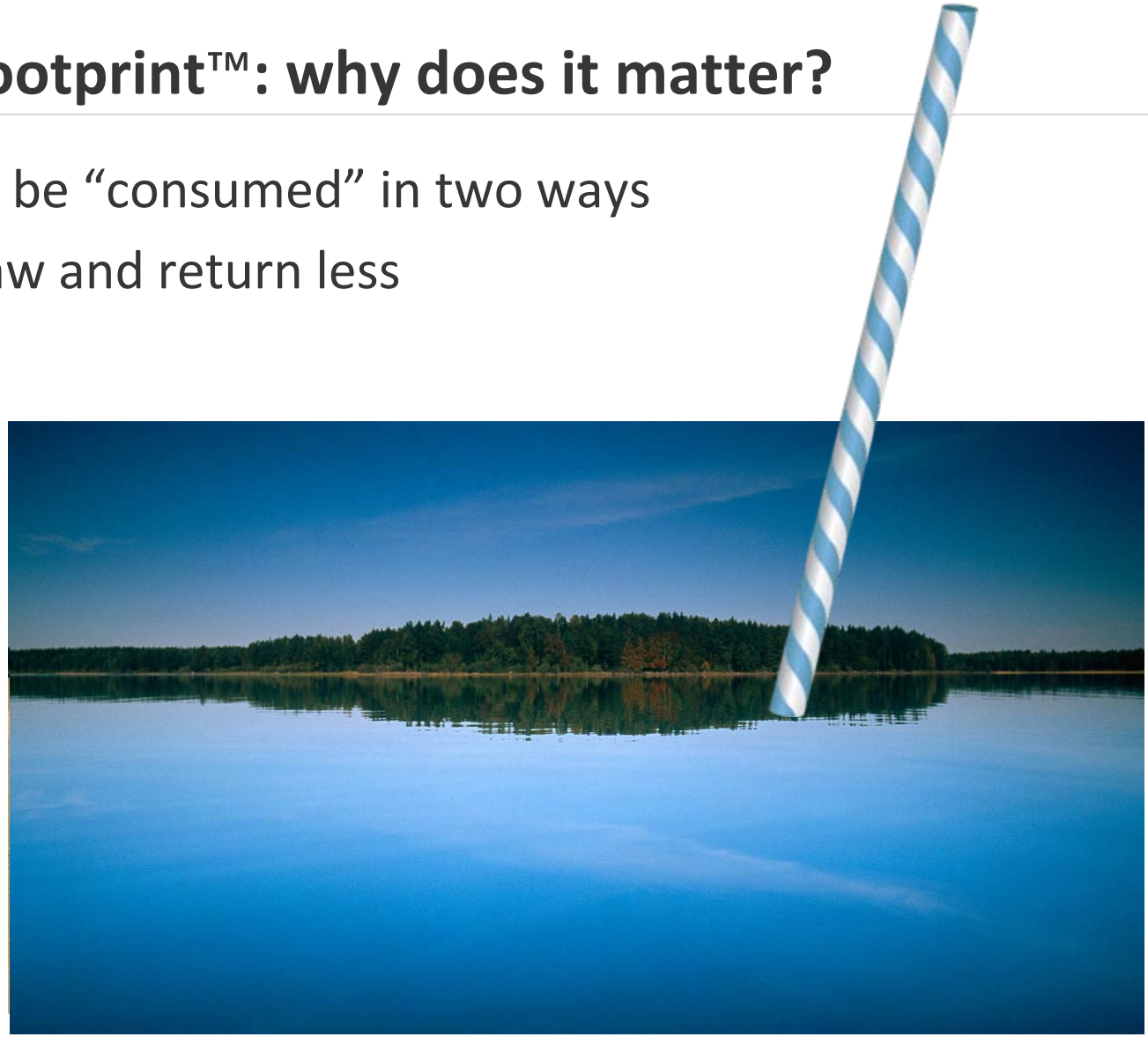


Photo from National Geographic

Water Footprint™: why does it matter?

Water can be “consumed” in two ways

1. Withdraw and return less
2. Pollute – a polluted resource is no resource!

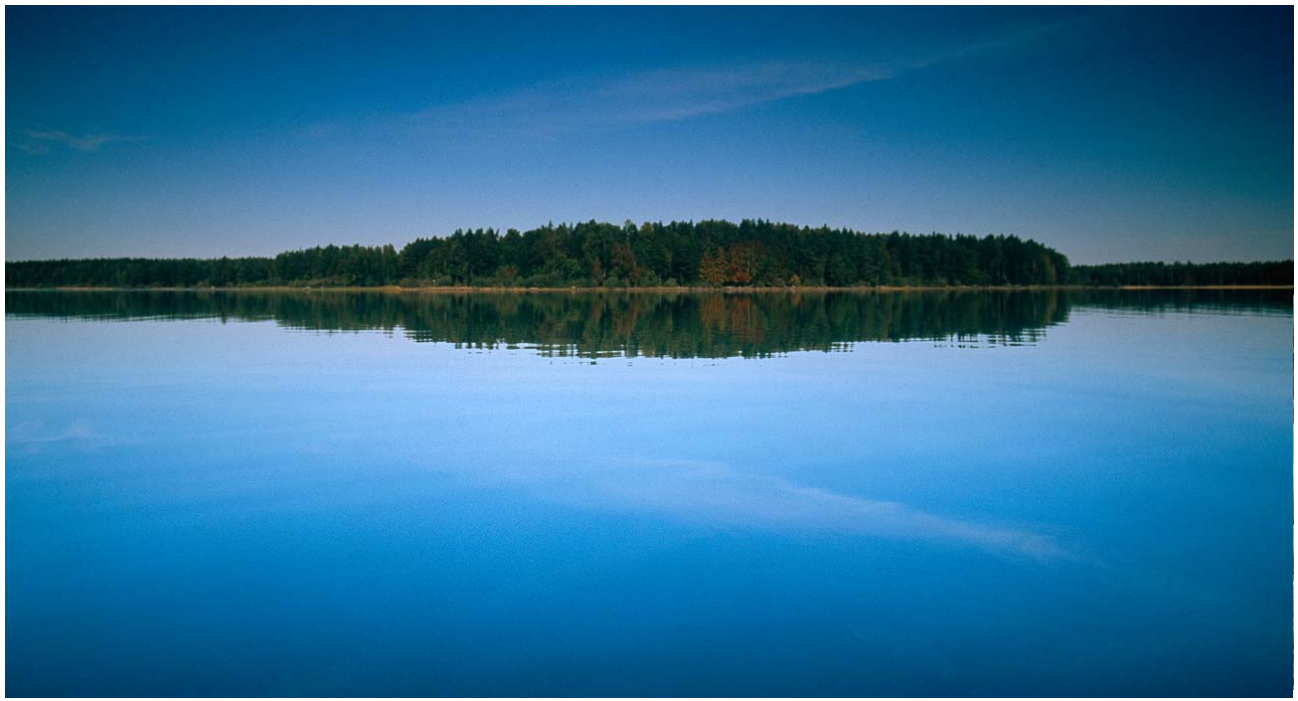
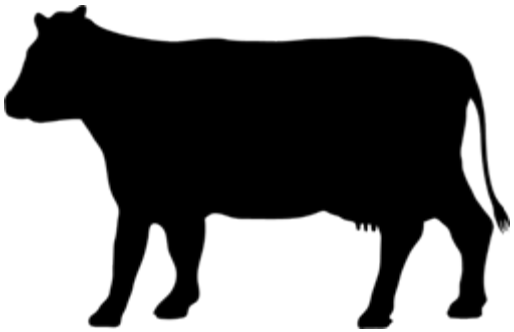


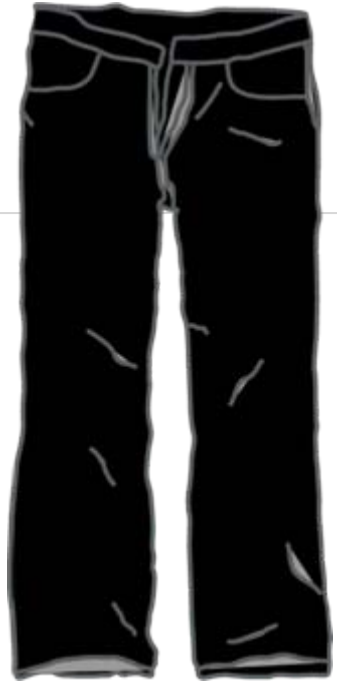
Photo from National Geographic

The “what” and “how” of Footprinting

Footprints based on volume



Beef (1 lb)
1,857
Gallons



Jeans
(1 pair)
2,900
Gallons

Milk (1 gal)
880
Gallons

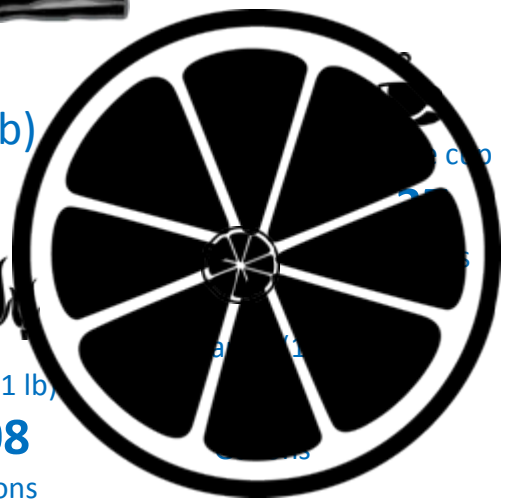
Pork (1 lb)
756
Gallons

1 Hamburger
634
Gallons

Chicken (1 lb)
469
Gallons

Orange (1 lb)
55
Gallons

Corn (1 lb)
108
Gallons

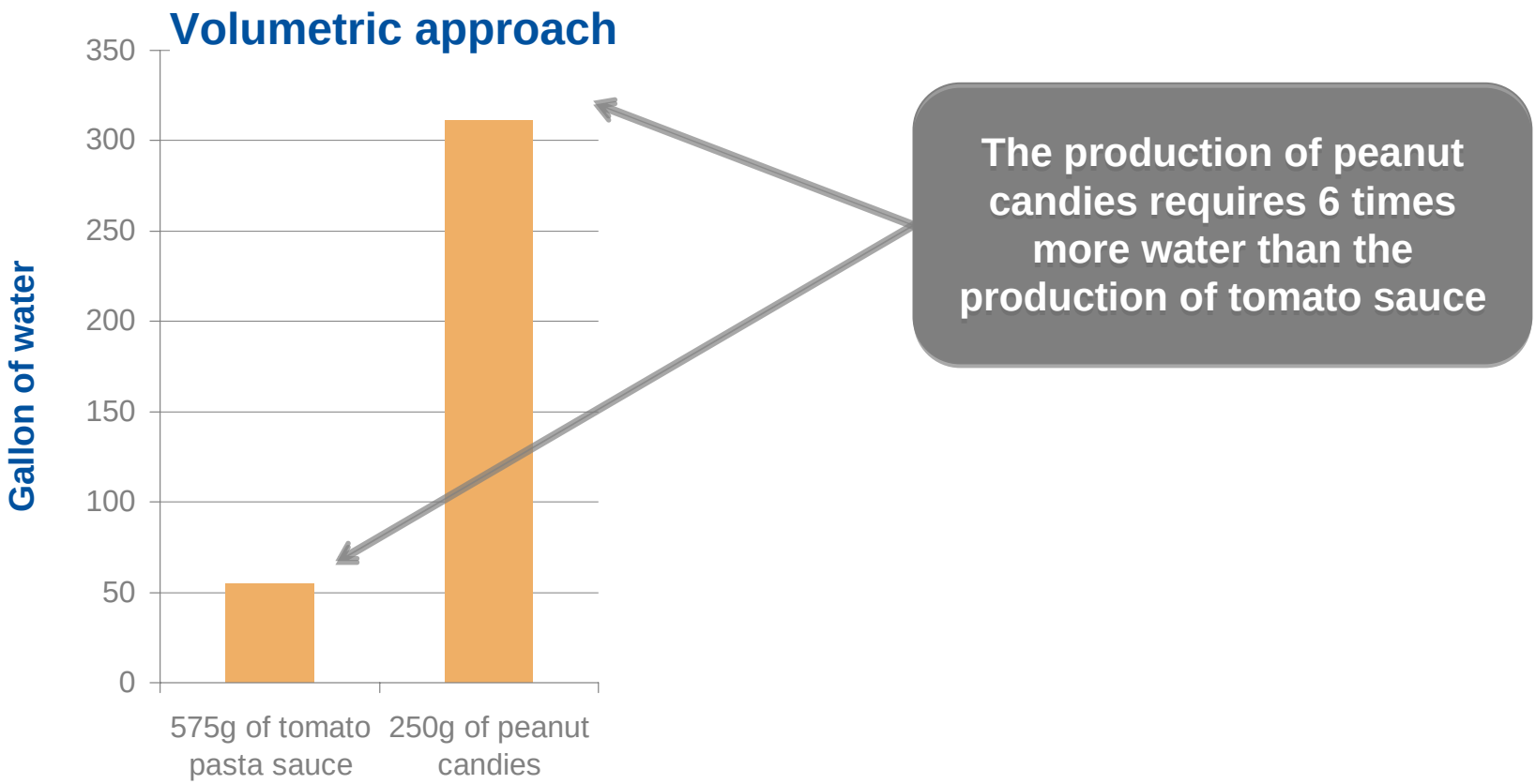


Volume is a very good indicator to raise awareness
but not sufficient to represent the impact on a water resource

Why go beyond a volumetric approach?

- Water Footprint™: tomato pasta sauce and peanut candies

What should I buy???....



Ridoutt, B.G., Pfister, S., 2010. A revised approach to water footprinting to make transparent the impacts of consumption and production on global freshwater scarcity. Global Environ, 20 (1), 113-120

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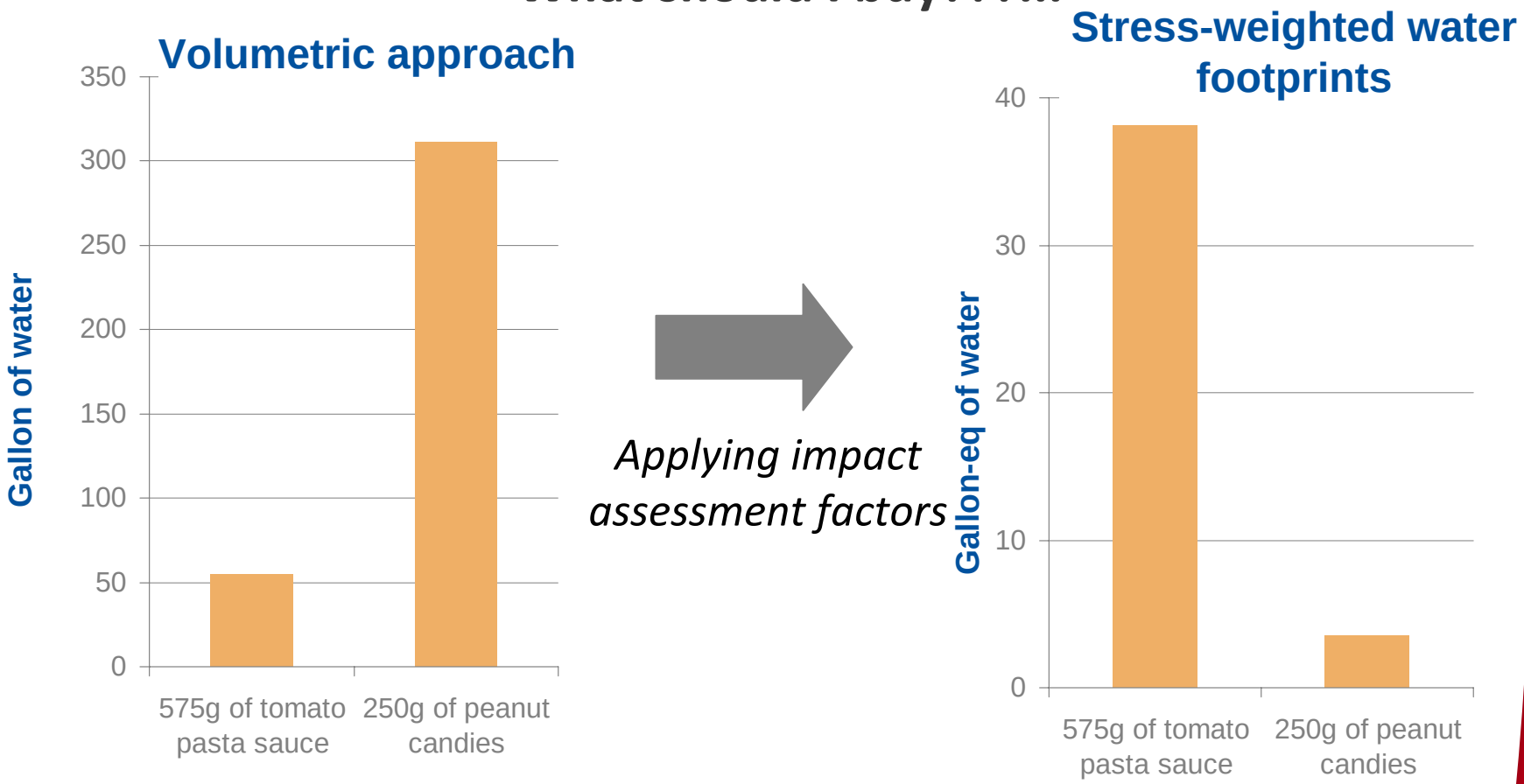

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Why go beyond a volumetric approach?

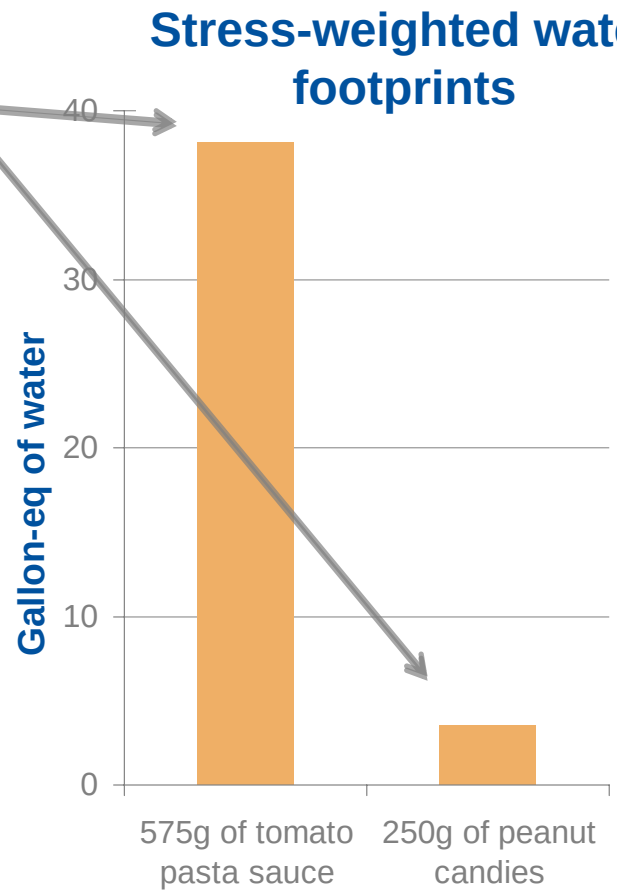
- Water Footprint™: tomato pasta sauce and peanut candies

Tomato sauce contributes 10 times more to freshwater depletion

Peanut production: rain fed agriculture

Tomatoes are produced in water stressed areas

Tomatoes require more fertilizers (water pollution)



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Why is a strictly volumetric approach not sufficient?

Only looking at volume can result in missing key water resource protection issues

Impact assessment factors should take into account specific local water issues:

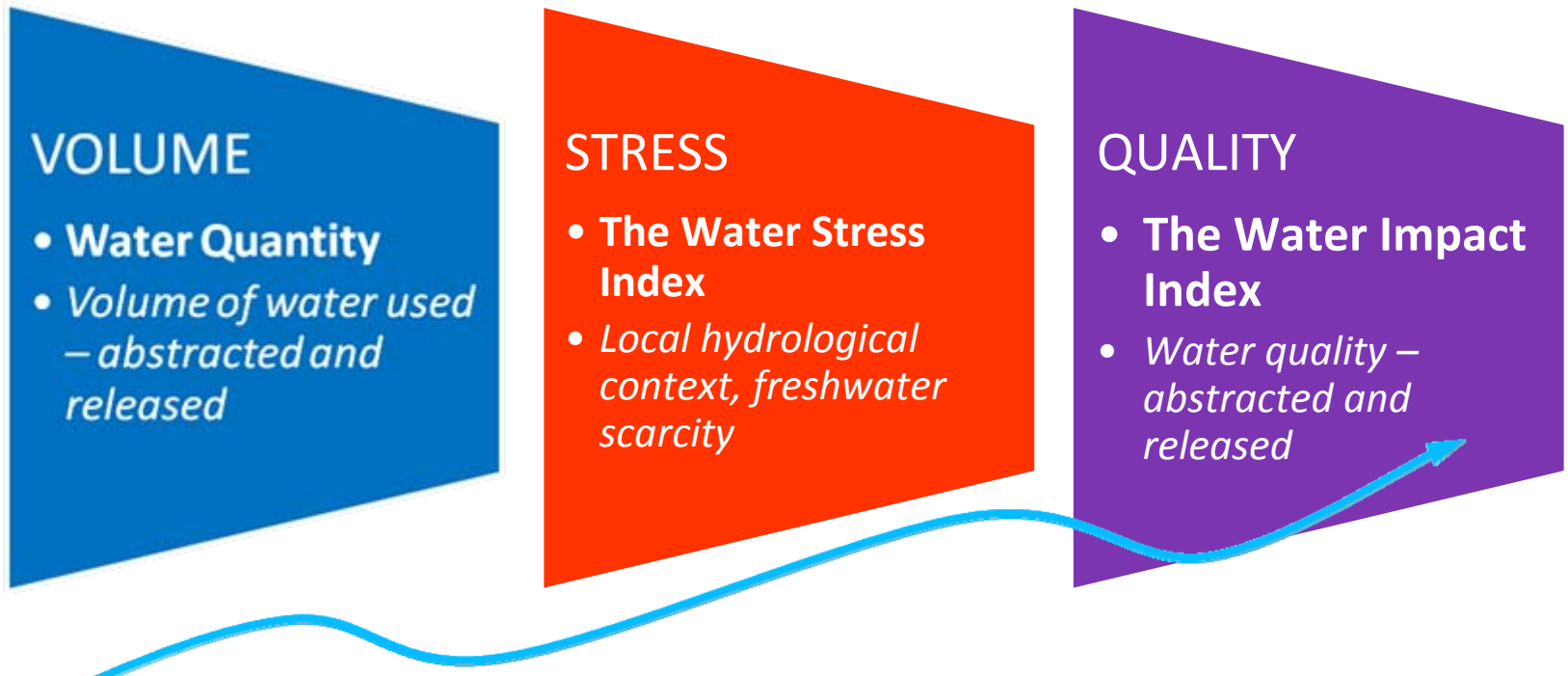
Applying simple assessment factors

A new metric for assessing water impacts – the Water Impact Index (WII)

The Water Impact Index accounts for…

… the **impact on water resources generated by a human activity**. It allows evaluating how other water users (both humans and ecosystems) could potentially be deprived of this resource…

…expressed in Gallon-WII-equivalent



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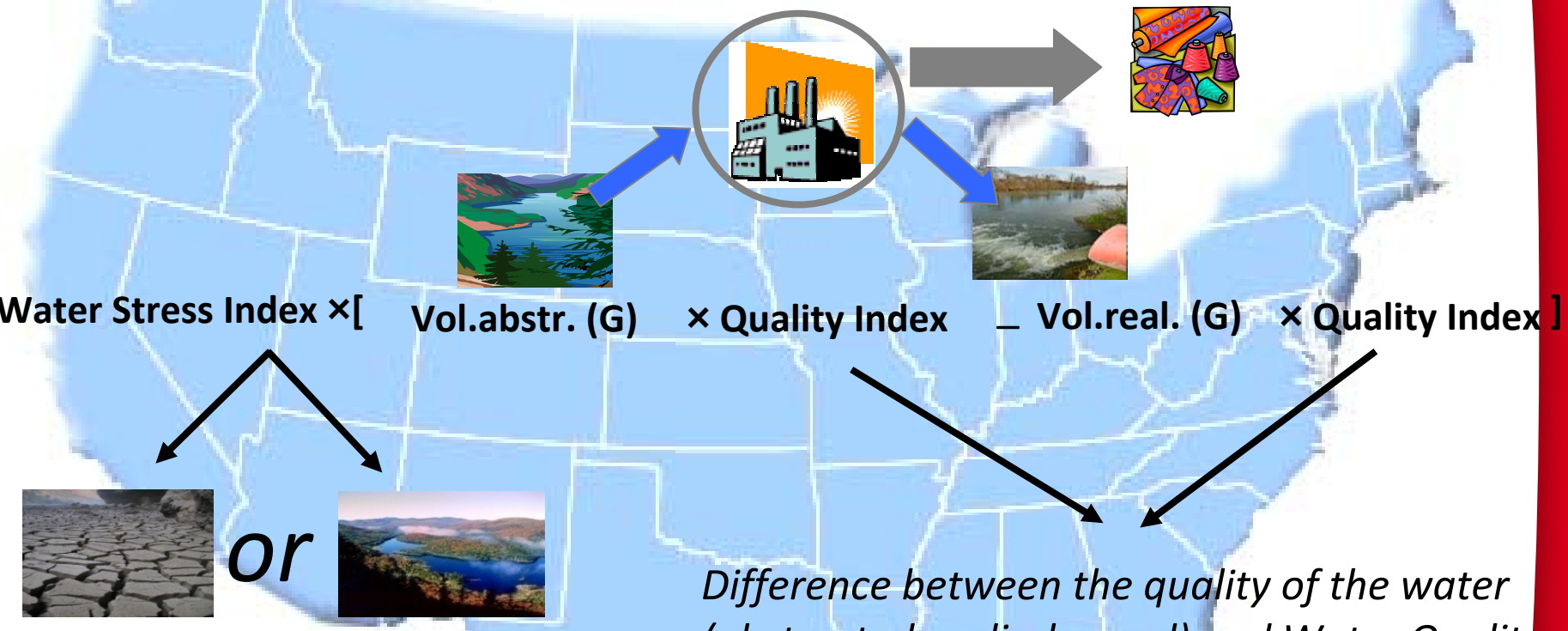
A new metric for assessing water impacts: methodology

- What is the Water Impact Index of a unit process?



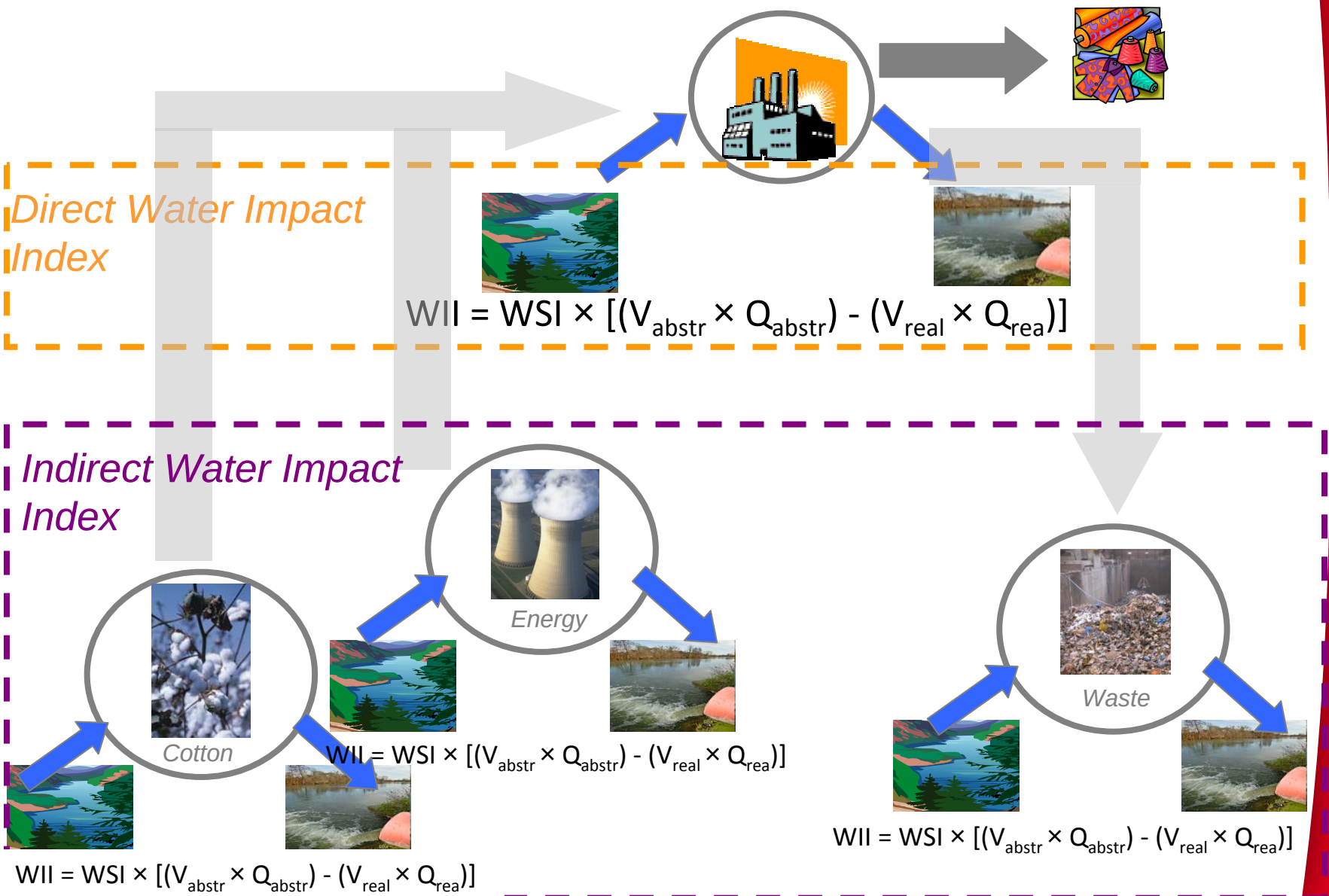
Water Stress Index ×[Vol.abstr. (G) × Quality Index _ Vol.real. (G) × Quality Index]

or

Difference between the quality of the water (abstracted or discharged) and Water Quality Standards for the water body

Calculated for the "most penalizing" pollutant

A new metric for assessing water impacts: methodology



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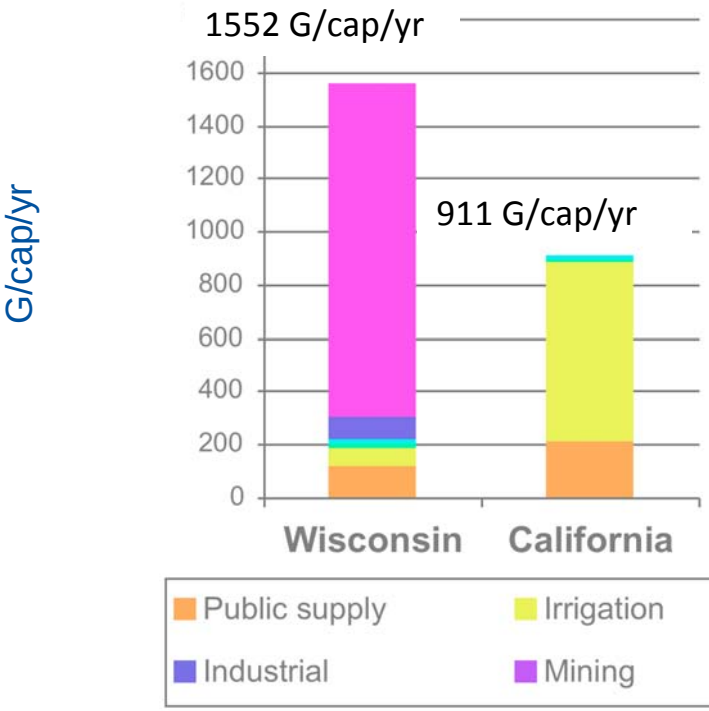
Footprint at a state level

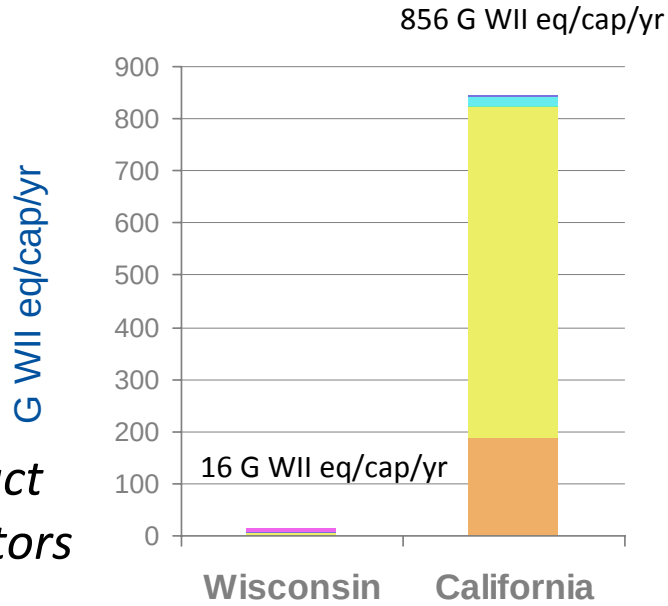
What is the difference among states?

Freshwater abstraction, by state *(2005)*



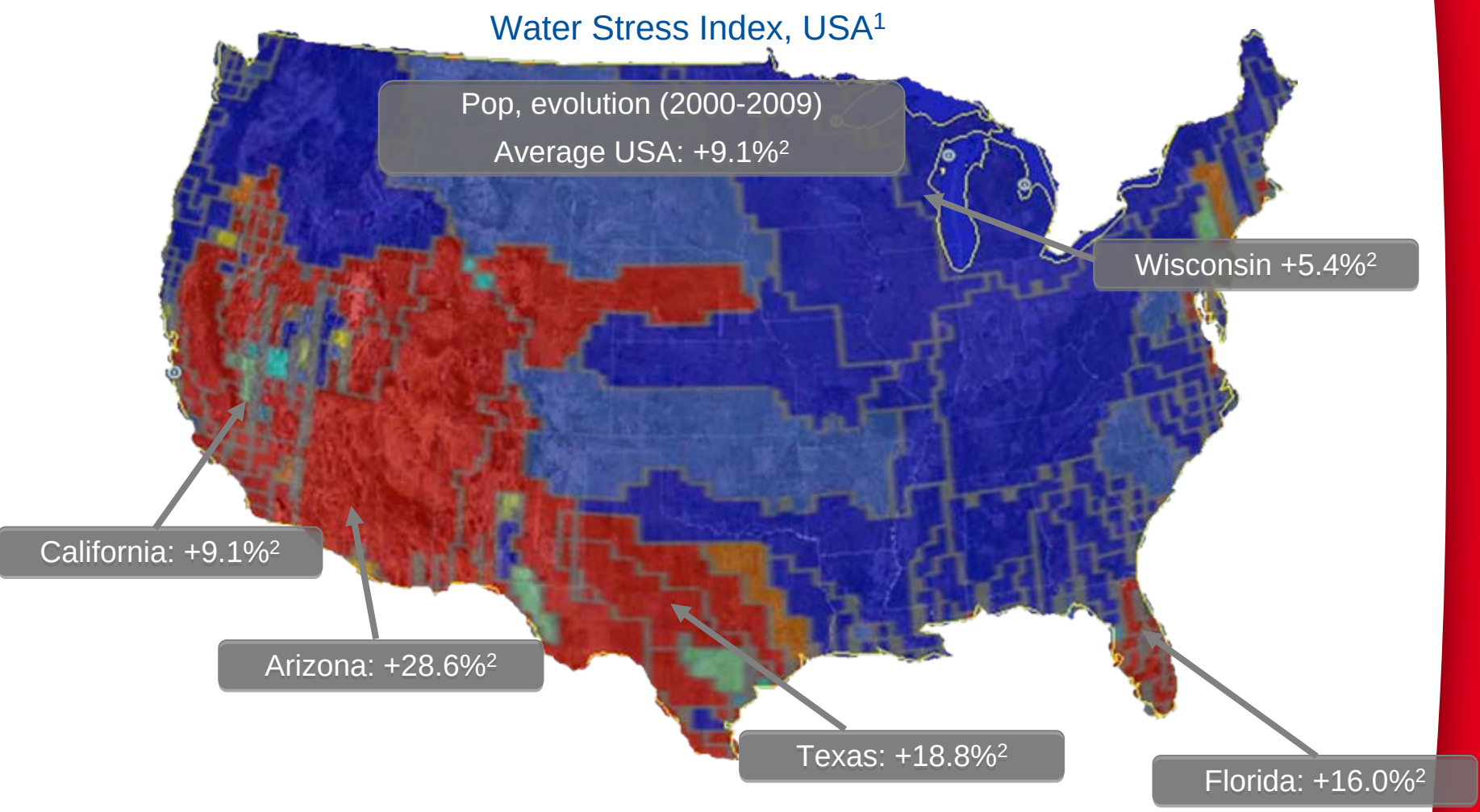
Applying impact assessment factors

Associated Water Impact Index



Water stress level makes a major difference!

A rapidly developing trend
EPA: 36 states facing water shortages



[1]S. Pfister, A. Koehler, and S. Hellweg, 2009 "Assessing the environmental impact of freshwater consumption in LCA," Environmental Science and Technology, no. 43, pp. 4098-4104 [2]U.S. Census Bureau, 2010

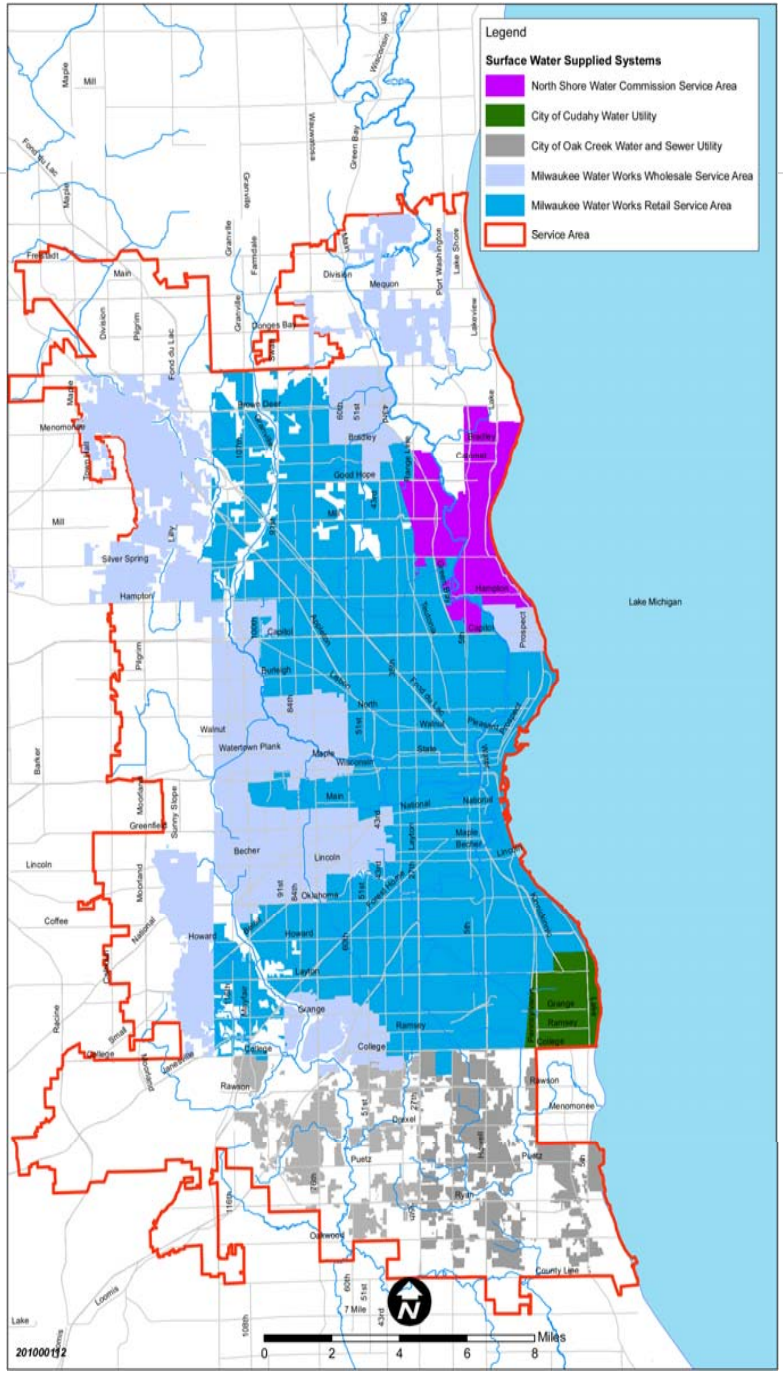
Case study:

Milwaukee's Water and Wastewater Systems

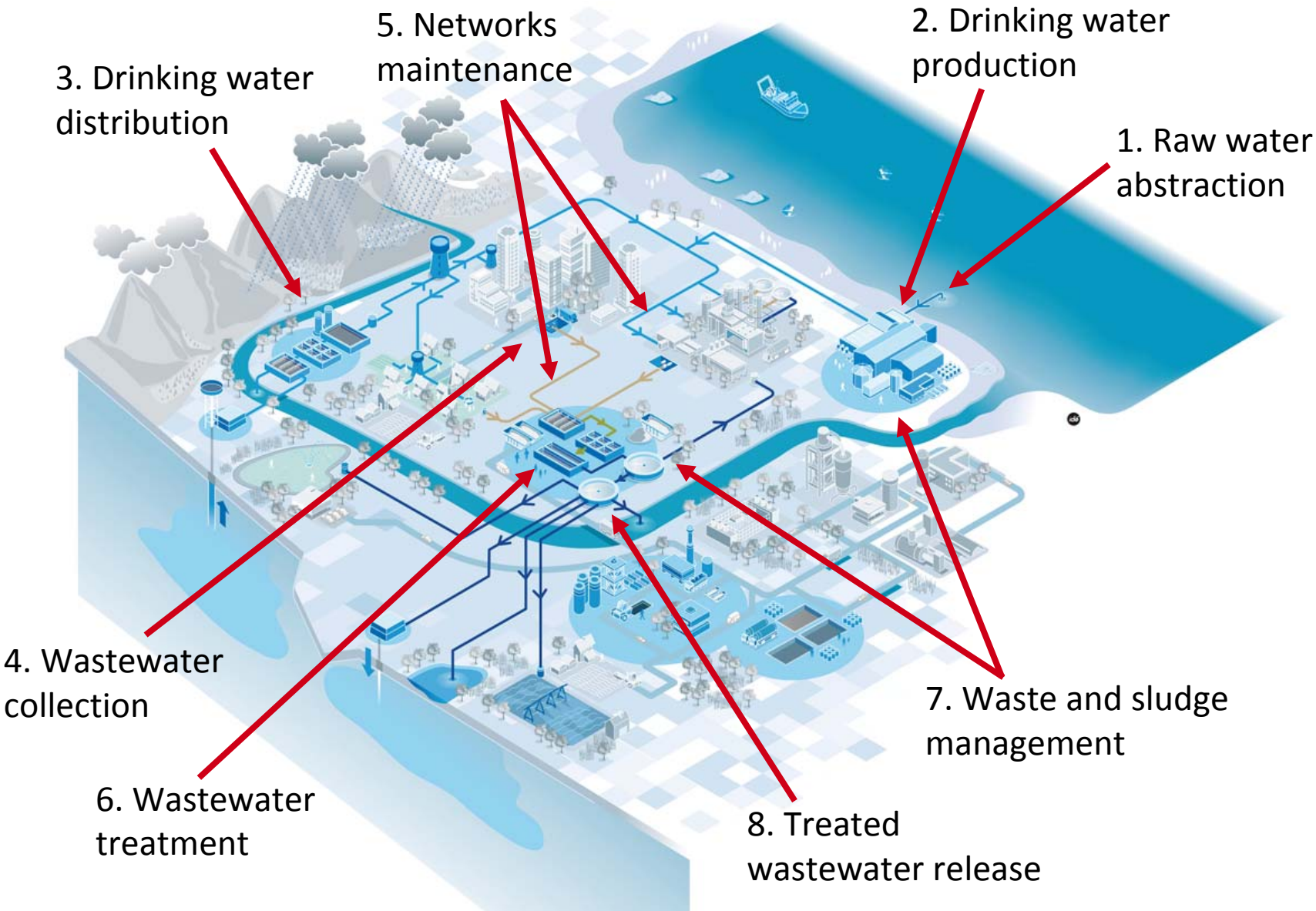
Geographical scope and acknowledgments

- Carbon Footprint and Water Impact Index calculations required a lot of data, and therefore a lot of time to collect on a matching Water & Waste Water scope!
- Thank you to all partners who supported this study.

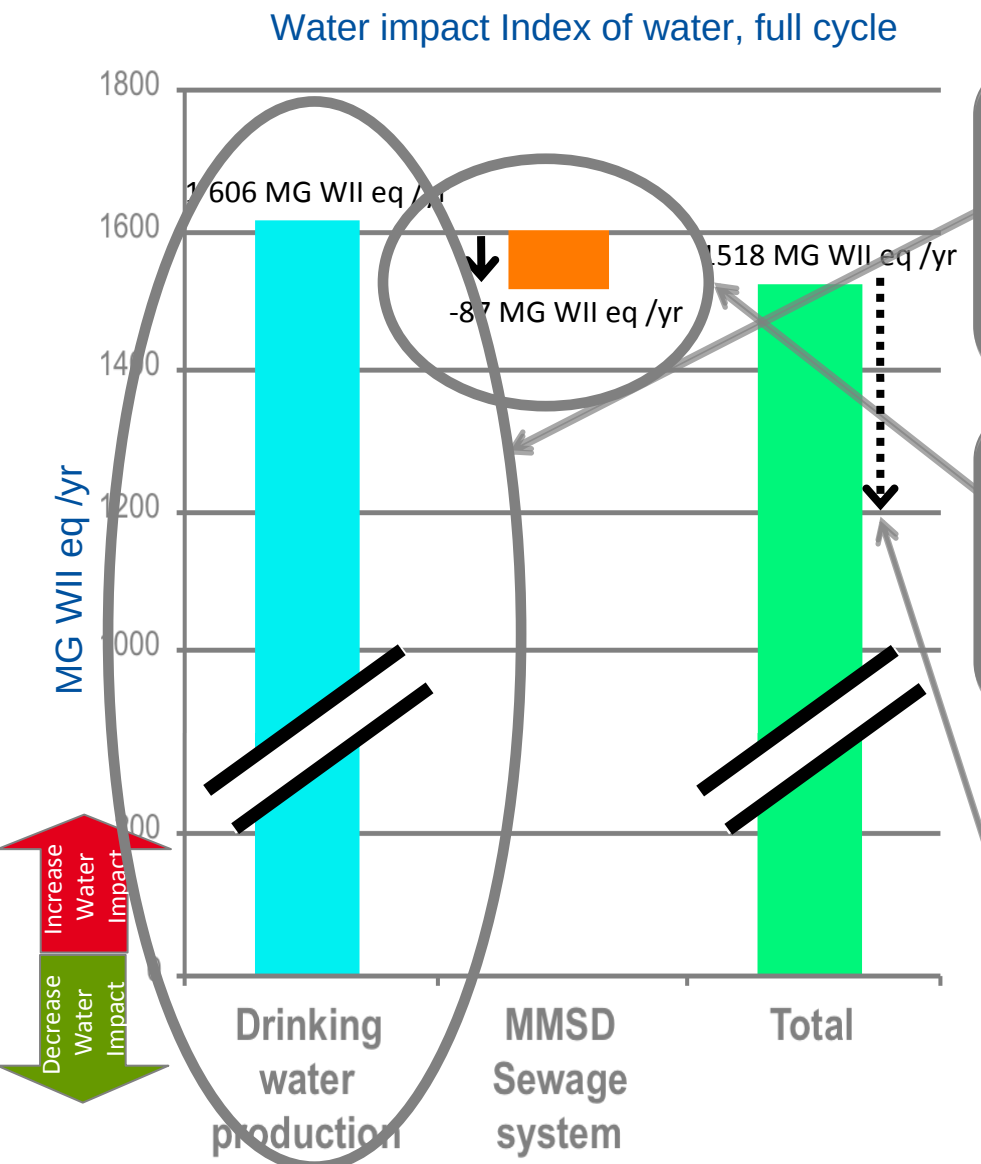
- **MMSD 100% population**
- **Water 93% population**



Description of the system under study: urban water cycle



Water Impact Index of drinking water and sewage system



Drinking water production is responsible of the Water Impact Index

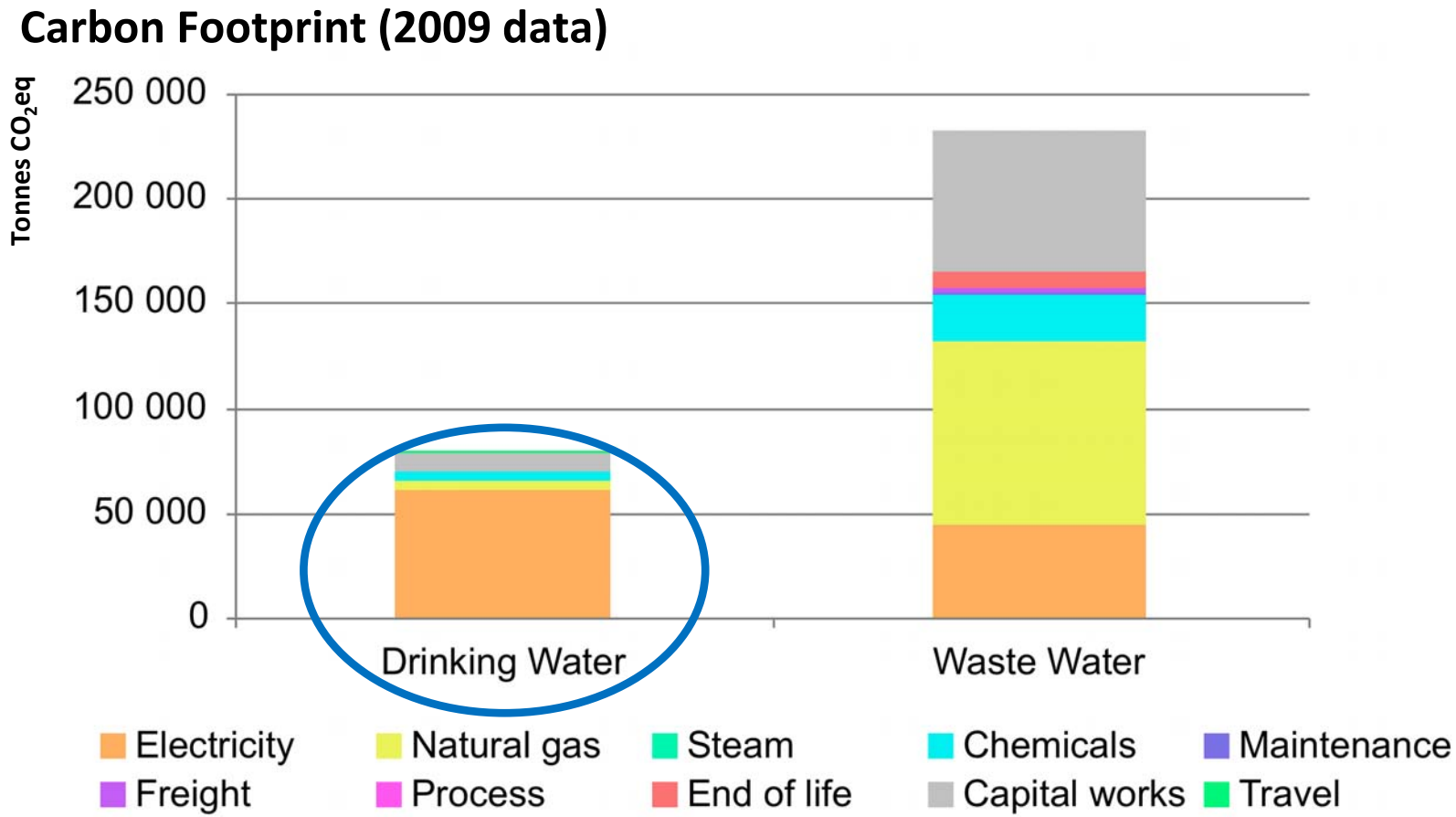
Water of very good quality is abstracted from its natural environment

MMSD sewage system allows to reduce the Water Impact Index

Water quality is improved and brought back closer to environmental requirements

The Water Impact Index should be as low as possible to protect our resource.

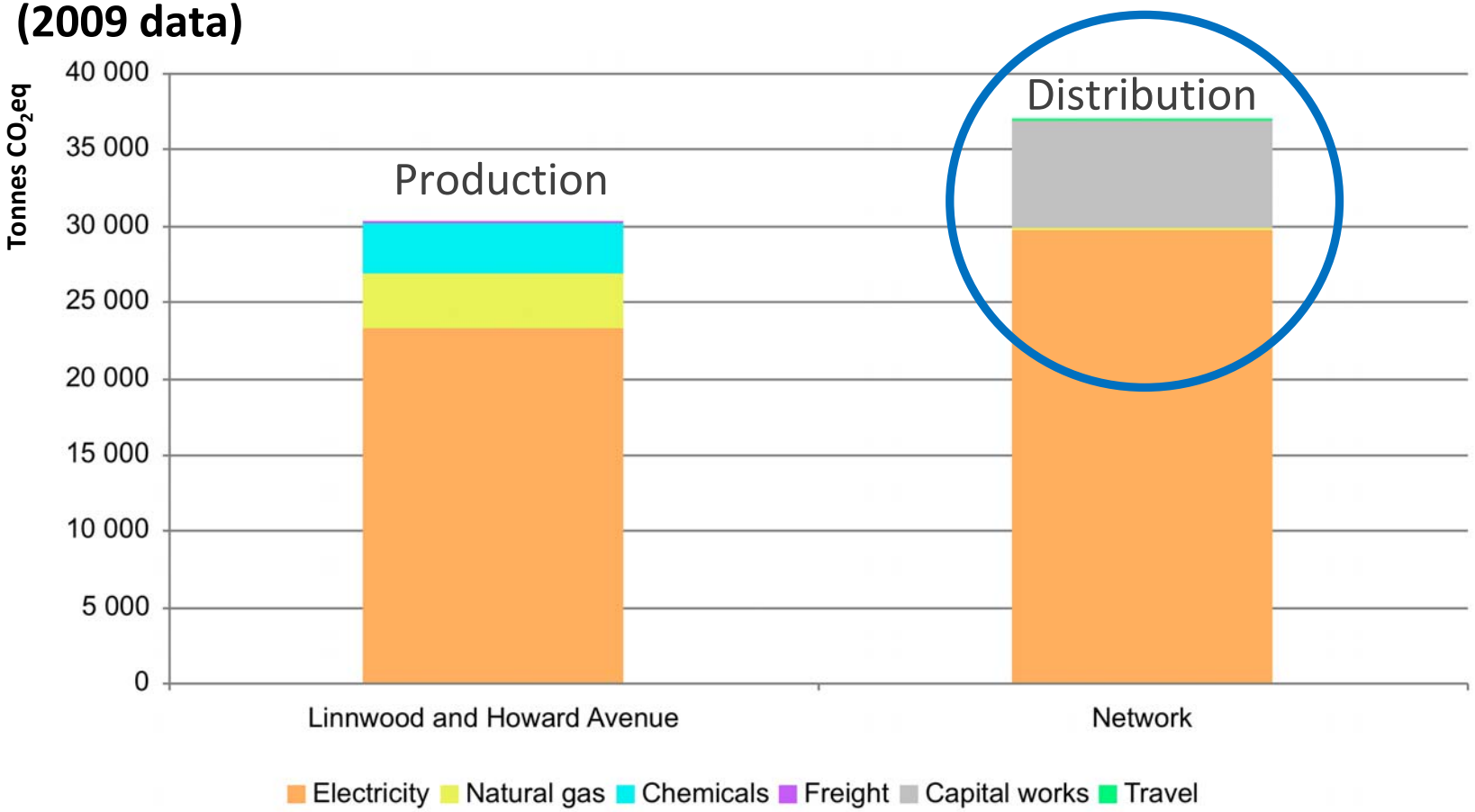
The Carbon Footprint of the whole water services is more than 310,000 tons CO_2eq



This represents about 15,500 people personal CFP

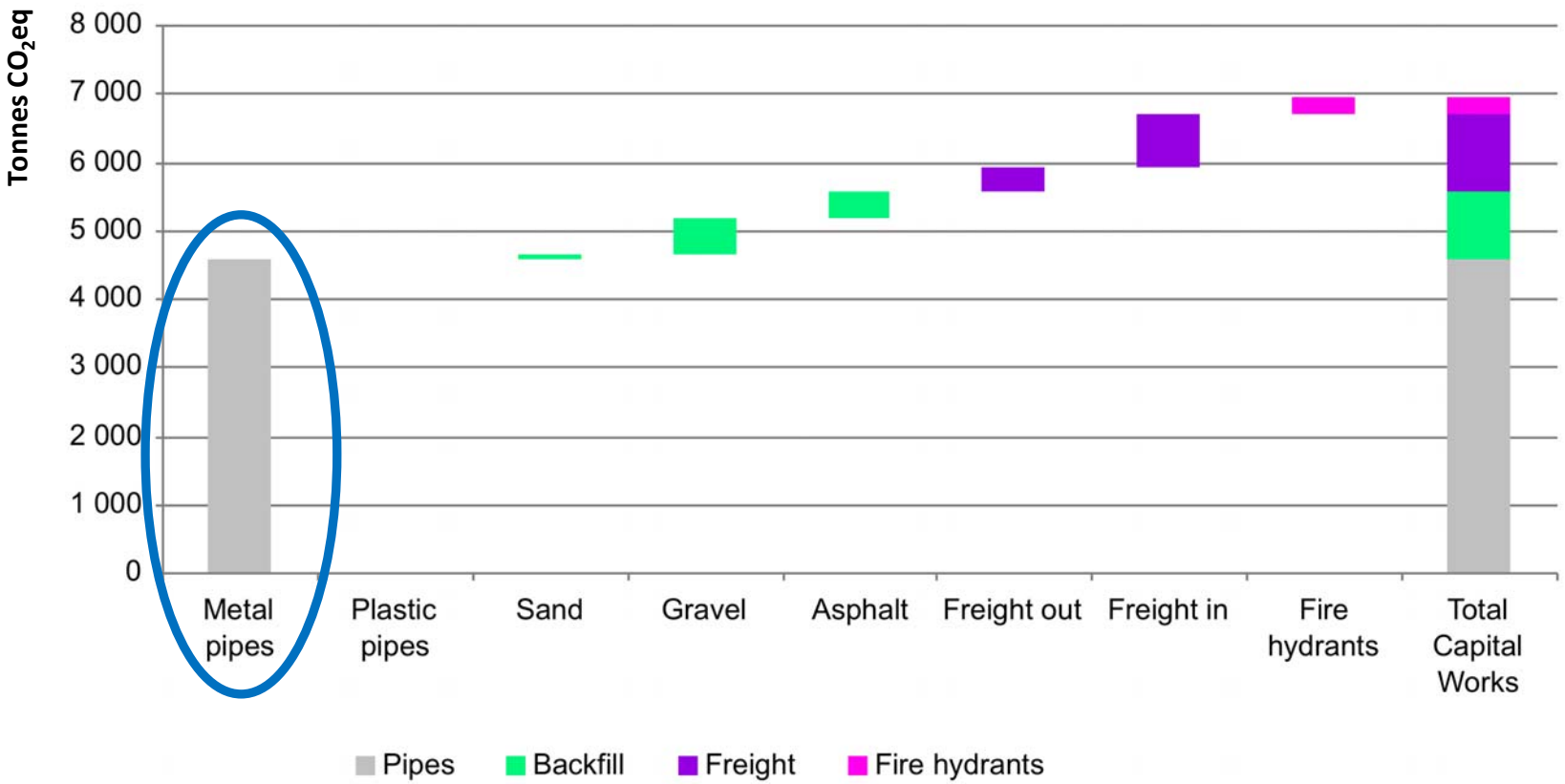
The network is the biggest contributer to MWW Carbon Footprint

Carbon Footprint of Milwaukee Water Works (2009 data)



Two third of the CFP of the capital works are from the pipes material

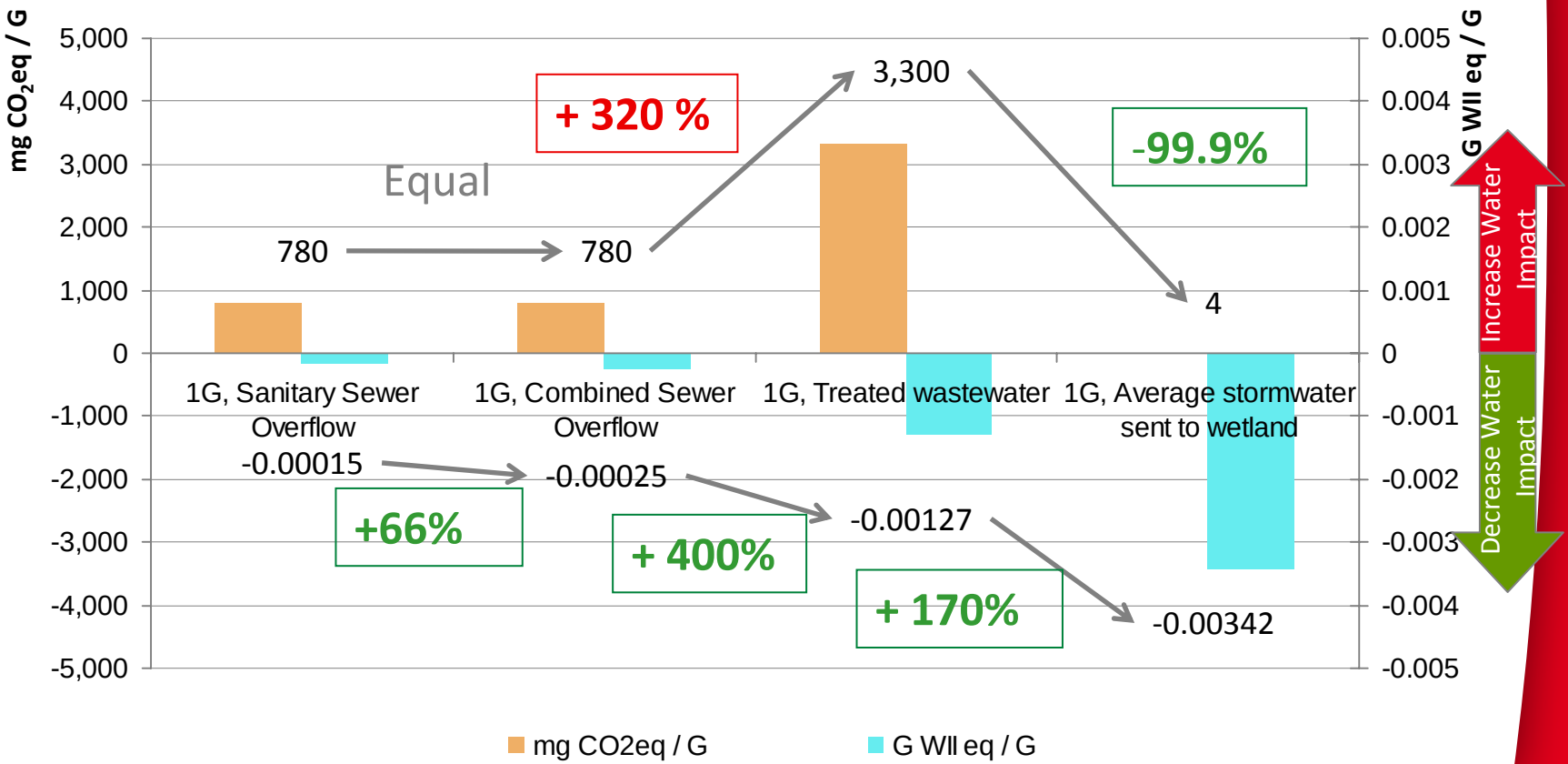
CFP split of the capital works on the network – Milwaukee Water Works (2009 data)



Focus on overflow

- Overflows have been reduced with grey infrastructures
  - Before Deep Tunnel System ~ 9 BG overflows /yr
  - Today ~1.24 BG overflows /yr
- What is the Water Impact Index of 1G overflow?

Carbon Footprint and Water Impact Index of overflow



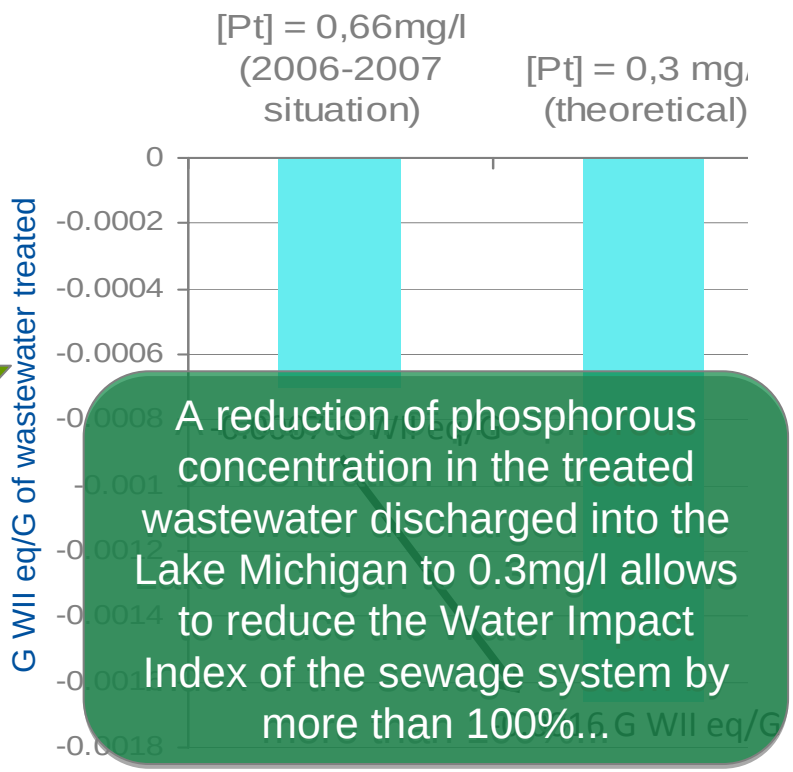
Effect of improving phosphorous removal?

- Current situation: concentration of phosphorous in water discharge: 0.66 mg/l (average 2006-2007)
- Potential improvement: concentration of phosphorous in water discharge: 0.3 mg/l (theoretical)

Increase Water Impact

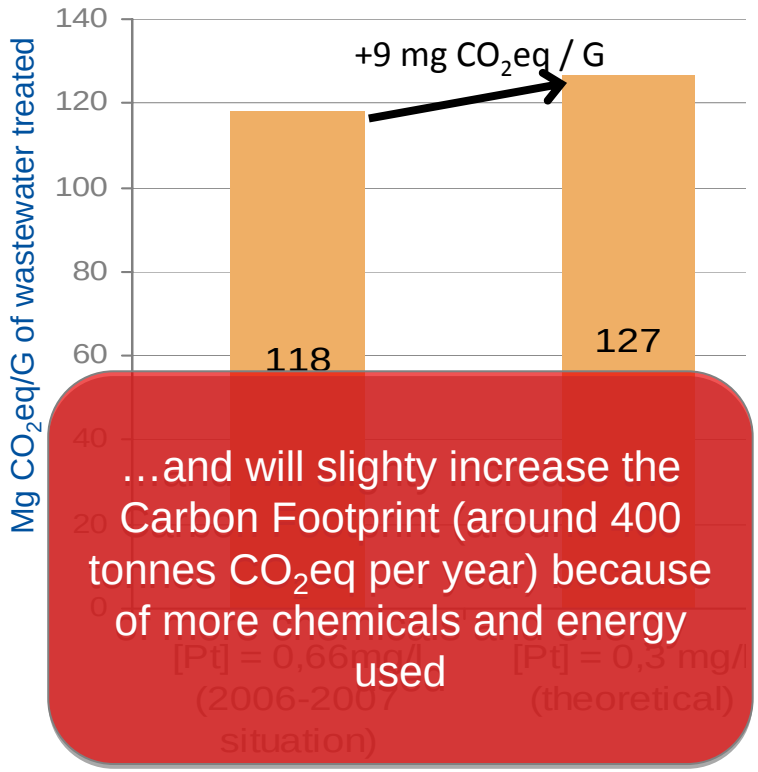
Decrease Water Impact

Estimation of Water Impact Index saving due to improvement of P removal



A reduction of phosphorous concentration in the treated wastewater discharged into the Lake Michigan to 0.3mg/l allows to reduce the Water Impact Index of the sewage system by more than 100%...

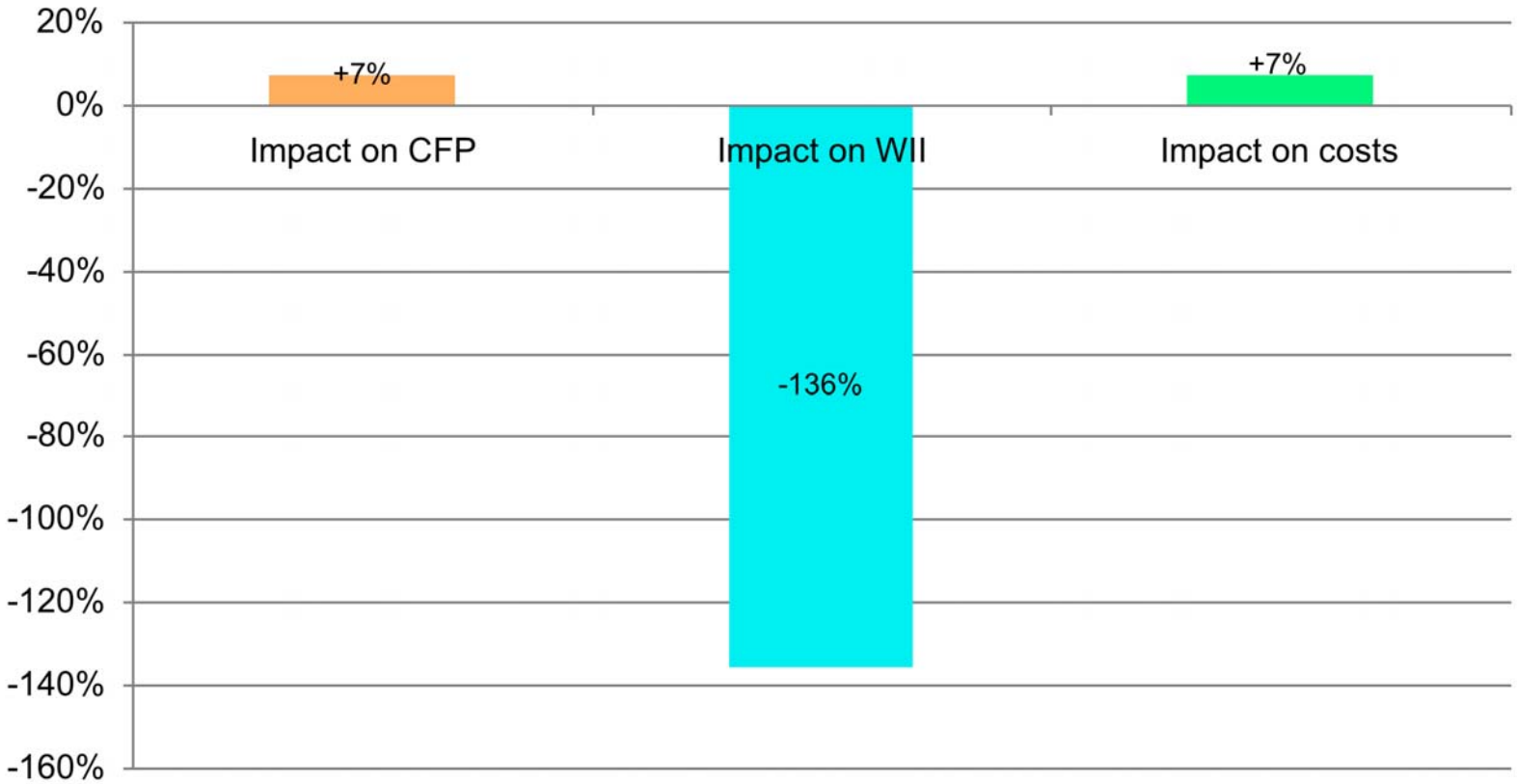
Estimation of Carbon Footprint increase due to improvement of P removal



…and will slighty increase the Carbon Footprint (around 400 tonnes CO_2eq per year) because of more chemicals and energy used

Improving phosphorous removal will have a cost both in term of $ and Carbon Footprint

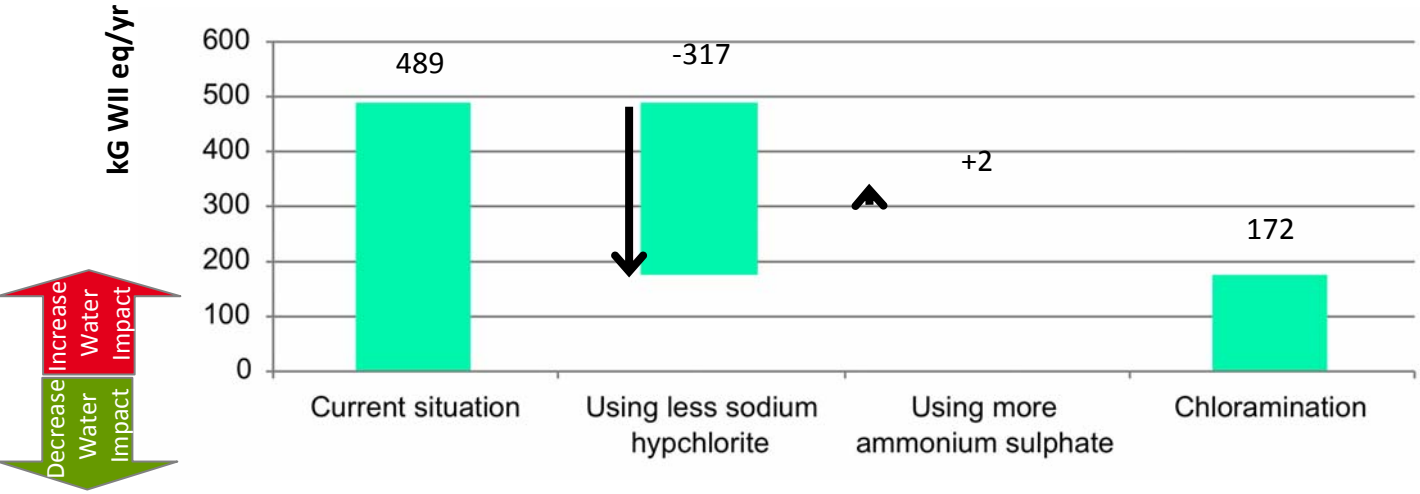
P removal project – Impacts on P removal figures



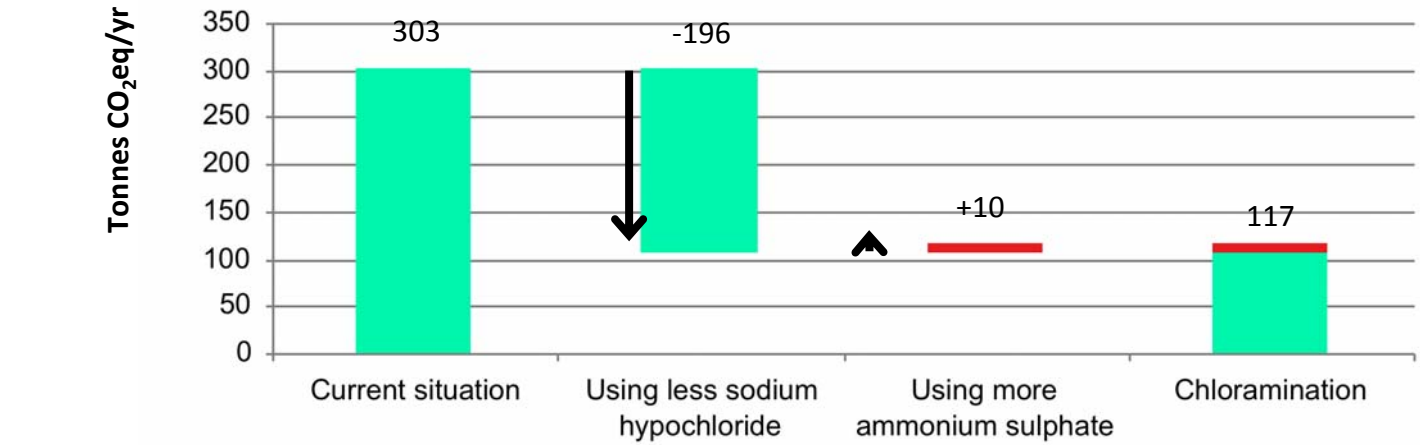
Potential future improvement: chloramination process

- Decrease of sodium hypochlorite consumption and increase of ammonium sulfate consumption (90 days/yr)

Water Impact Index saving due to Chloramination



Carbon Footprint saving due to Chloramination

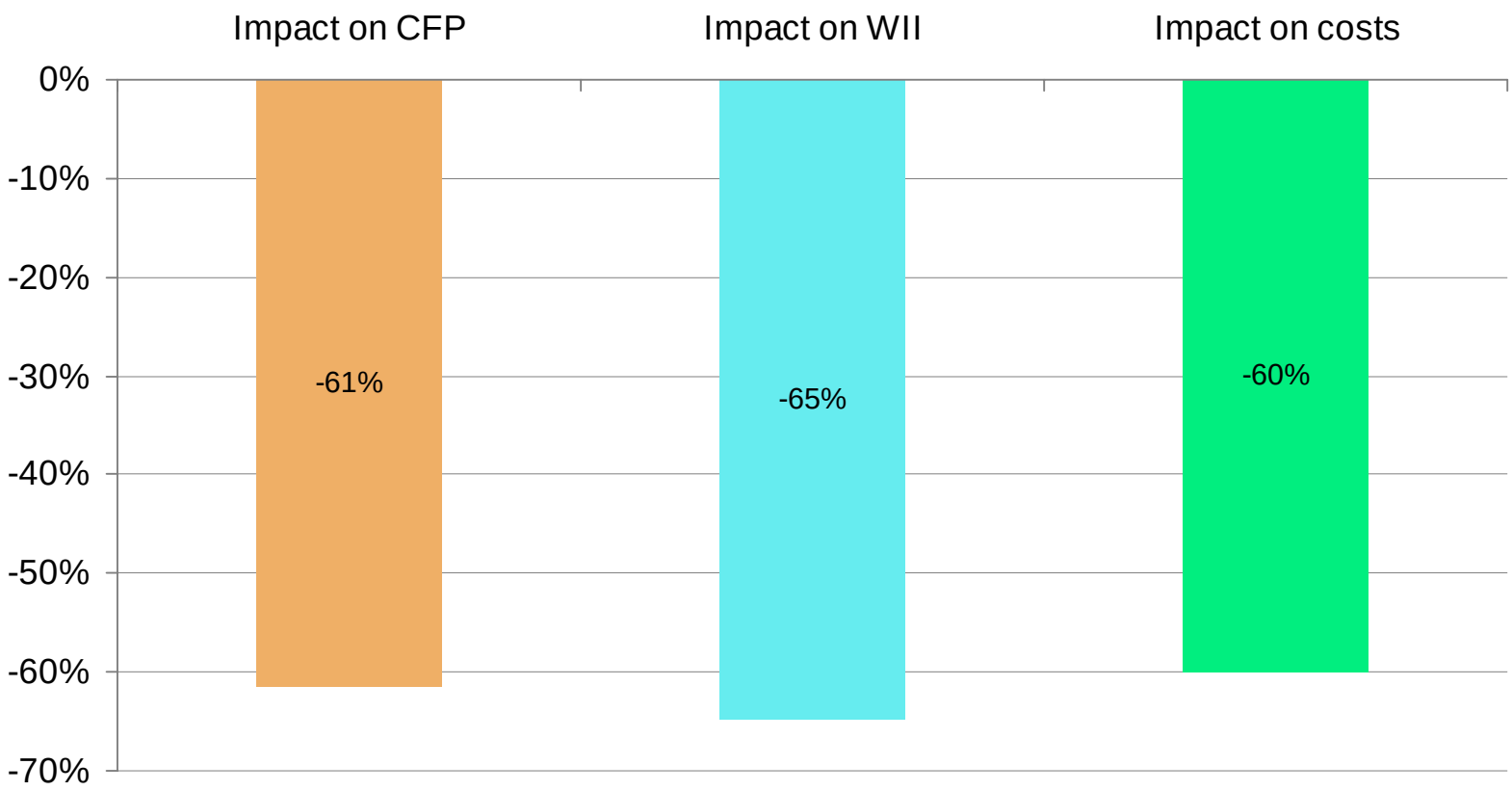


Chloramination would reduce the Water Impact Index of chemicals…

… and the Carbon Footprint of chemicals, while generating $ savings

The chloramination project is a « win-win-win » project

Chloramination project – Impacts on the disinfection figures

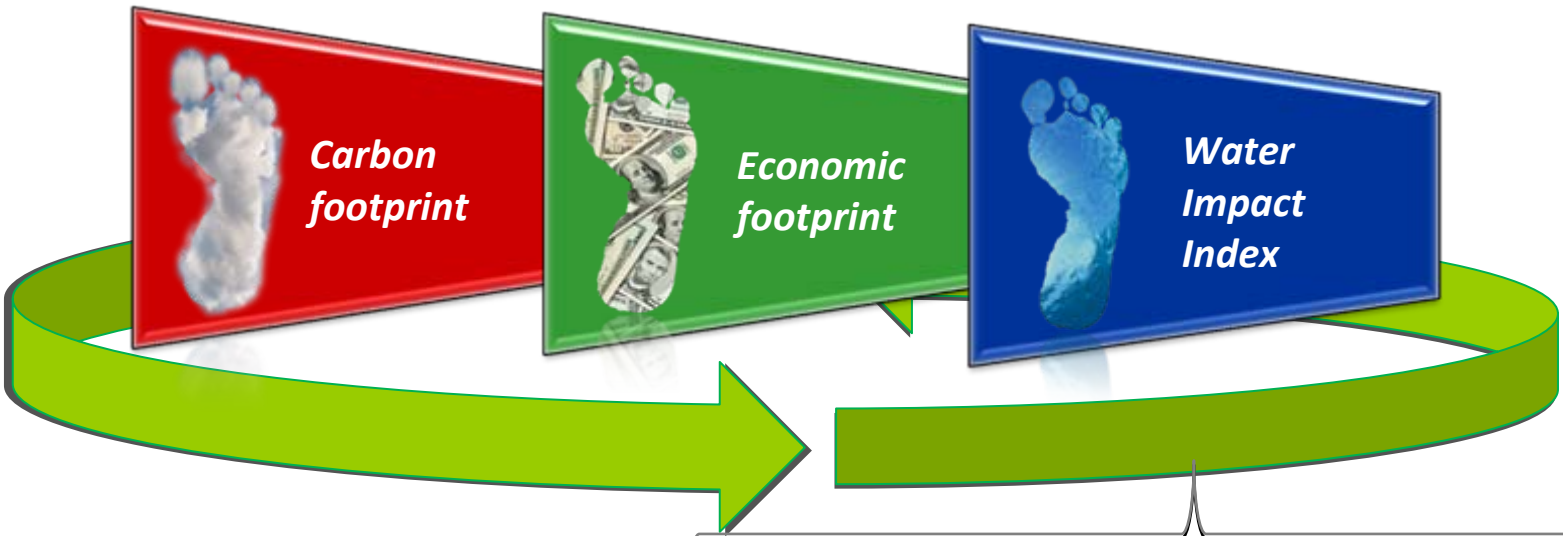


Conclusion

Conclusion: a comprehensive Footprint

A new model for assessing a combined Carbon-Water-Economic Footprint

A platform for awareness and making Sustainable Decisions



VOLUME

- Water Quantity

STRESS

- The Water Stress Index

QUALITY

- Quality added by the Water Impact Index