Balancing rural-urban water and resource needs

Wageningen Institute of Environment & Climate Research

March 10 2014, Huub Rijnaarts

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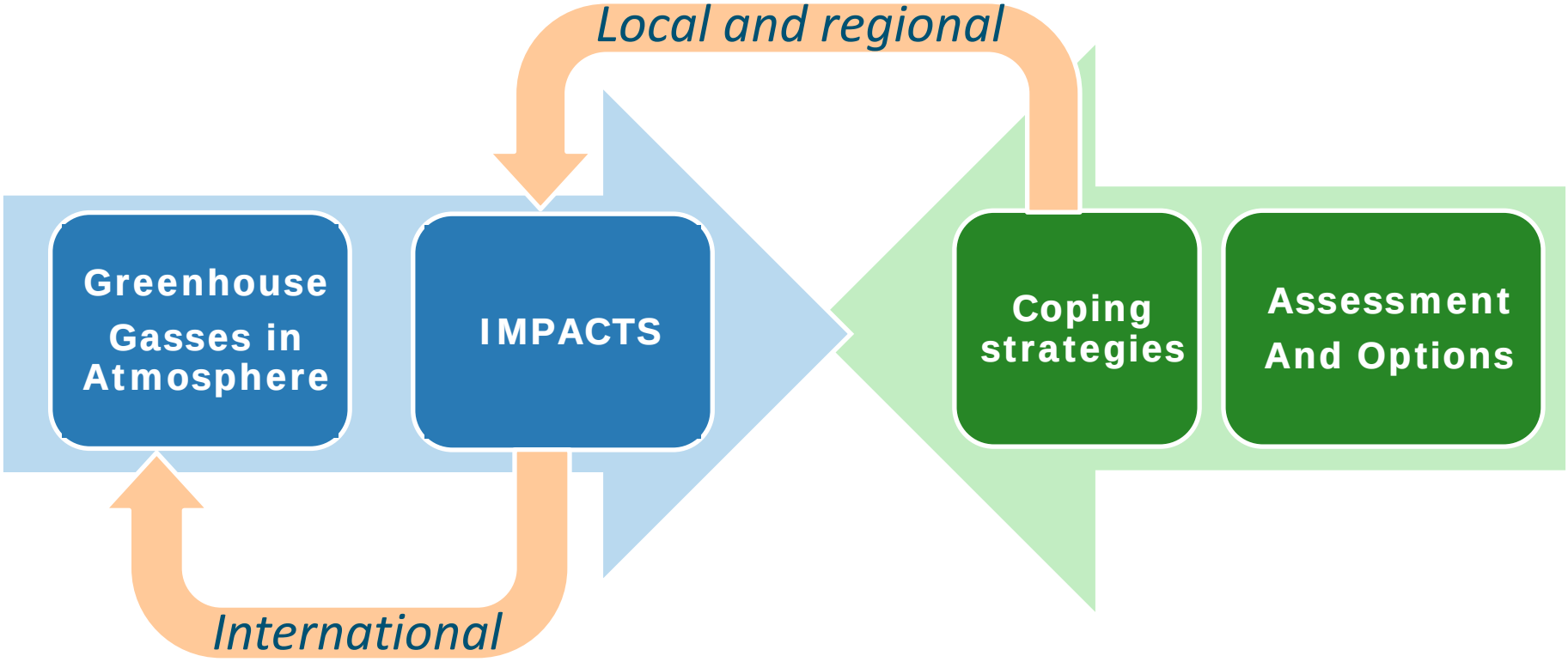
Population growth

Projected growth: from nearly 7 billion people today to more than 9 billion in 2050

Climate Change

Adaptation: coping to the impacts



Mitigation: reducing emissions

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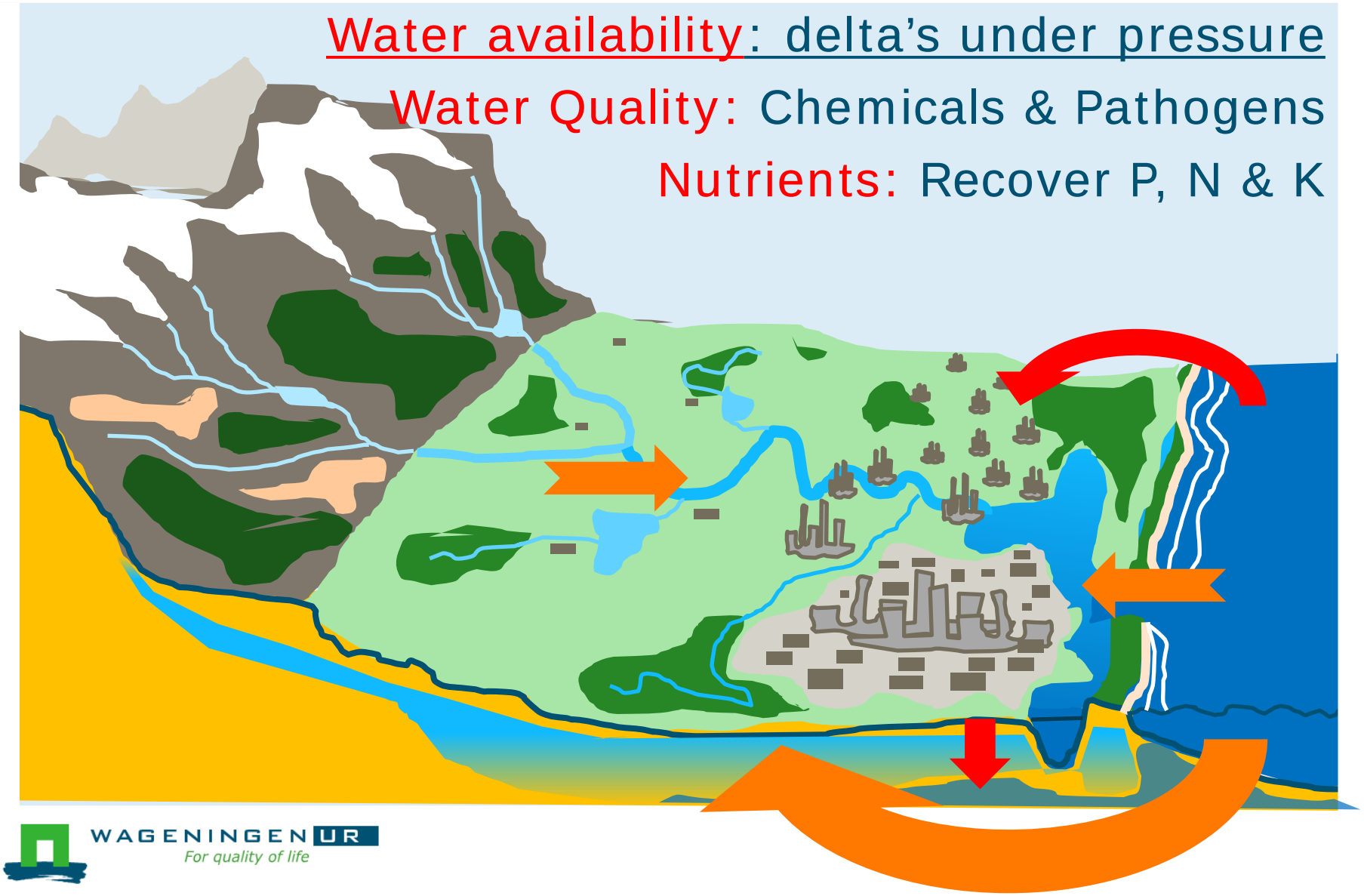
Prof. Rik Leemans, 2014: Elaborated

70% of world population will live in delta's



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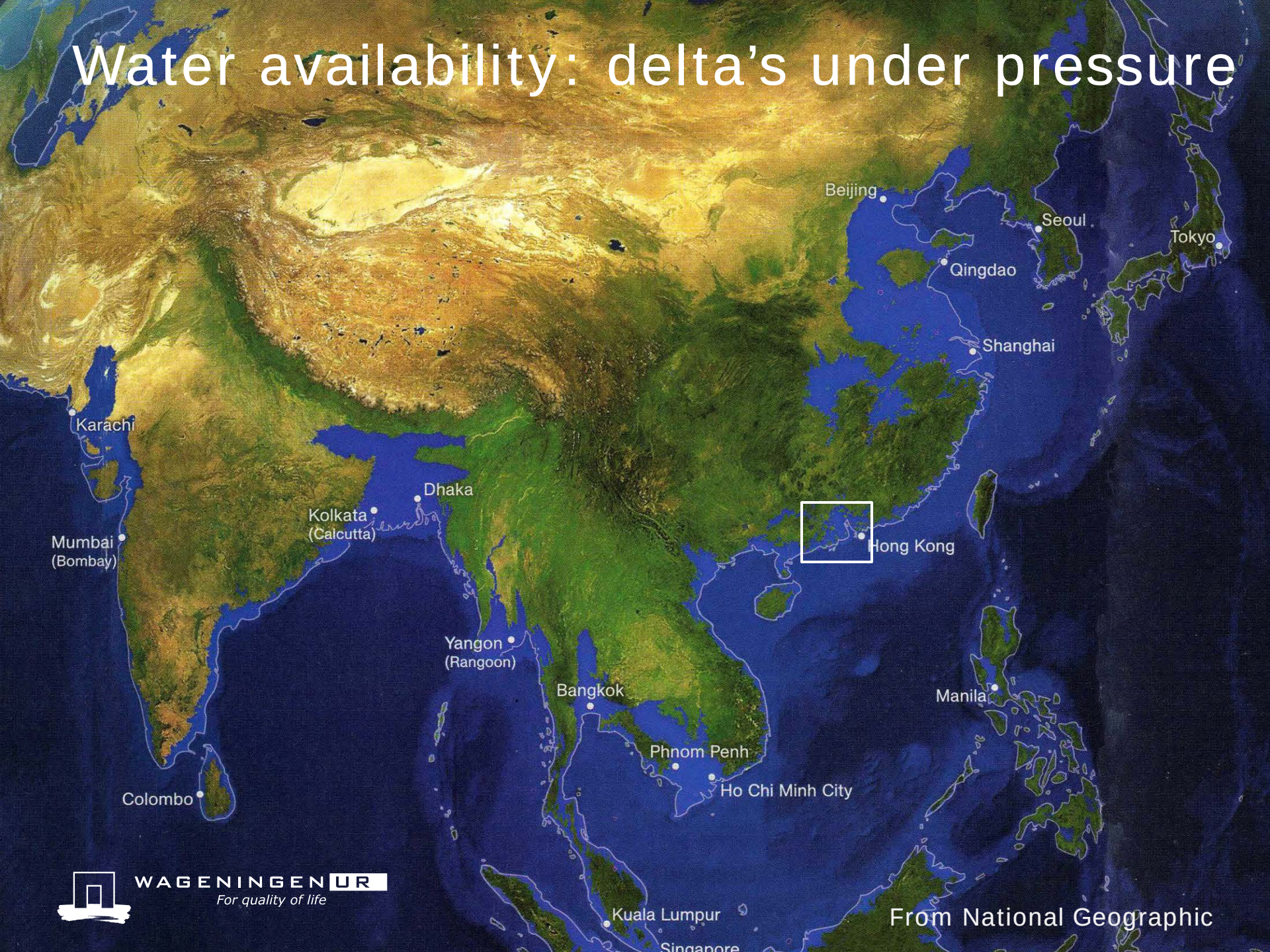
Water availability: delta's under pressure



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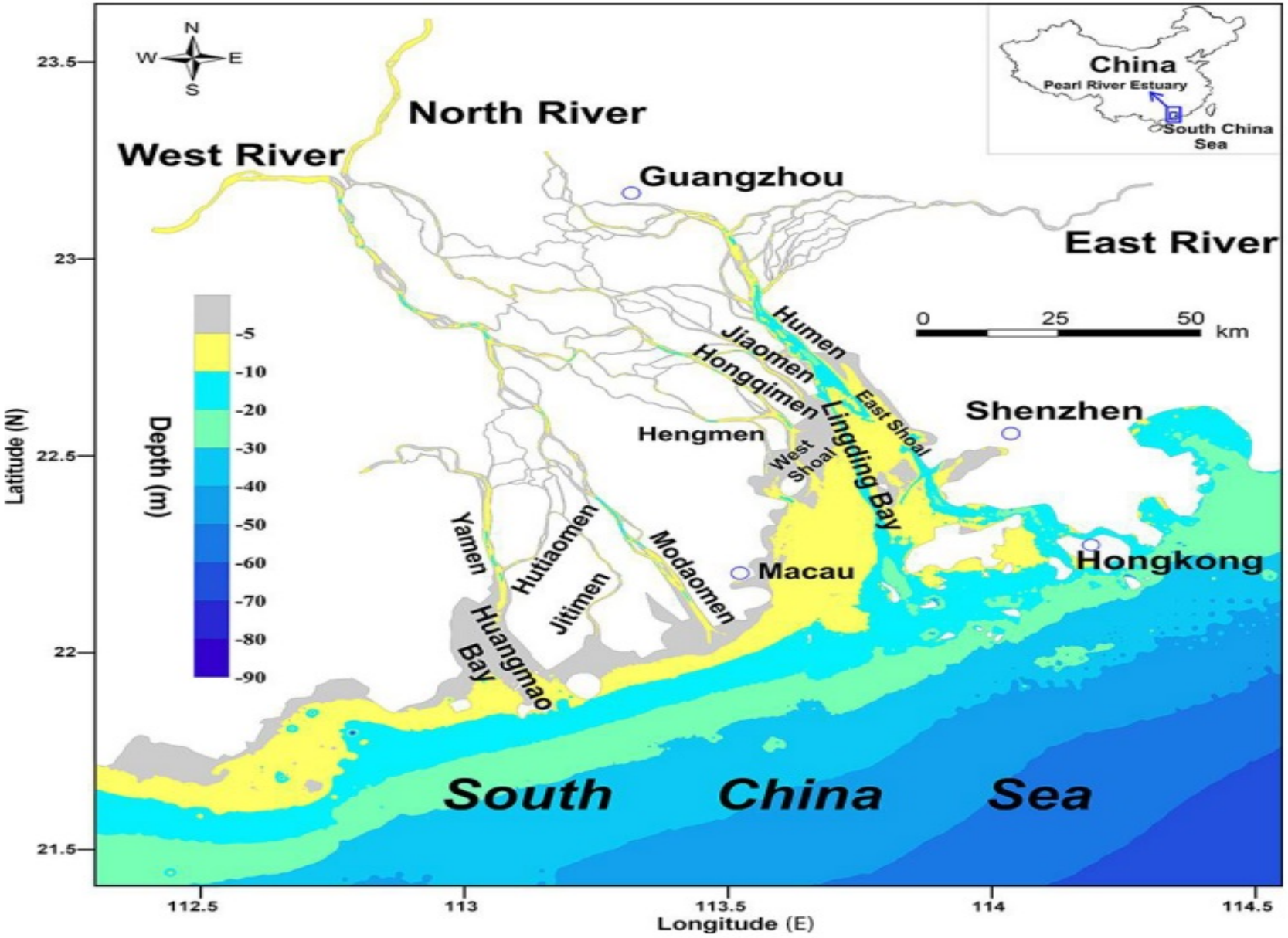
From National Geographic



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Hoiting and Zang, 2014

What about Europe?

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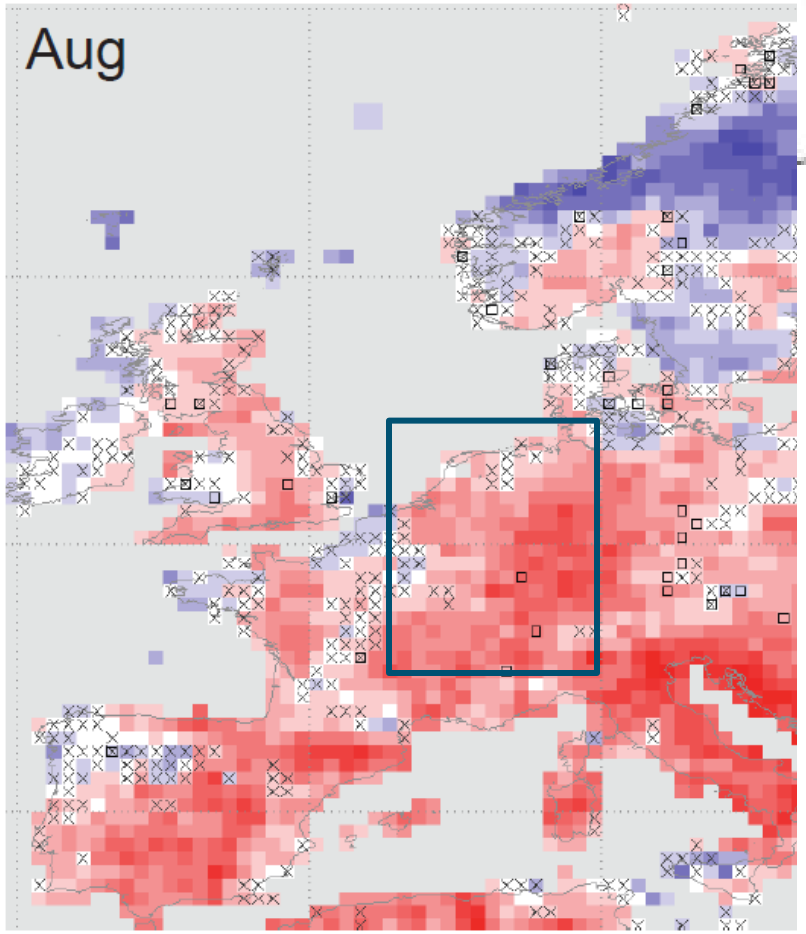
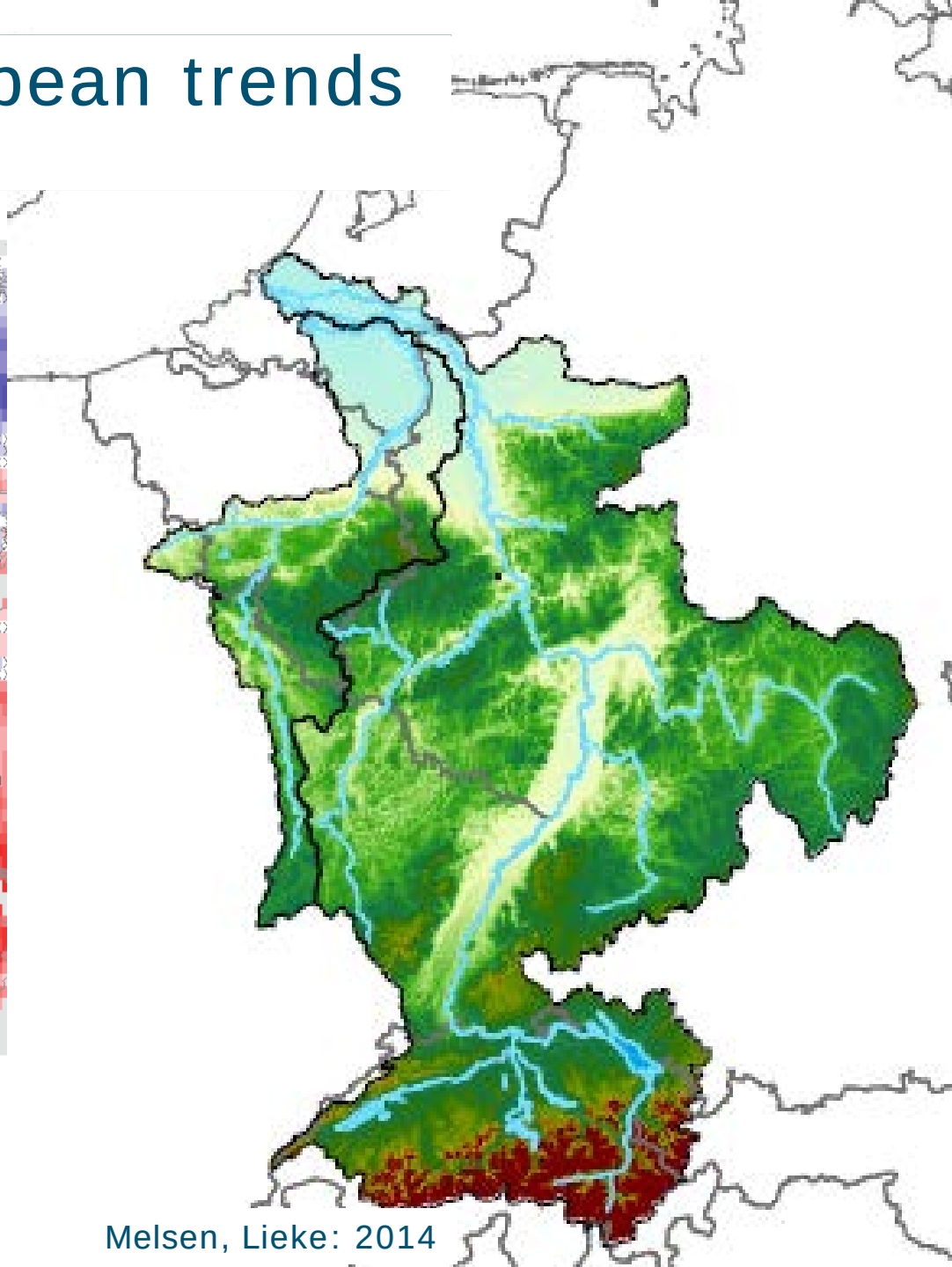
From National Geographic

Drought: pan-European trends



Dr. Stahl et al.; van Lanen, H.A: 2012



Melsen, Lieke: 2014

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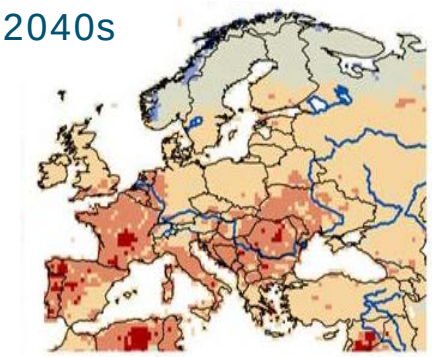
Vulnerability Electricity Supply to Climate Change

Change in low river flows

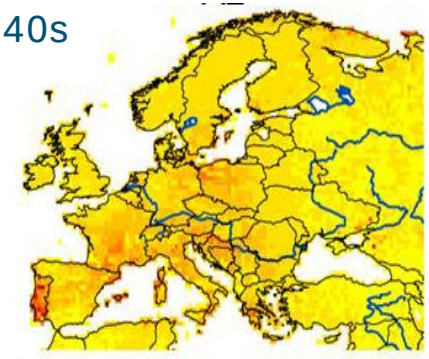
Change water temperatures

Changes in usable capacity of thermoelectric power plants

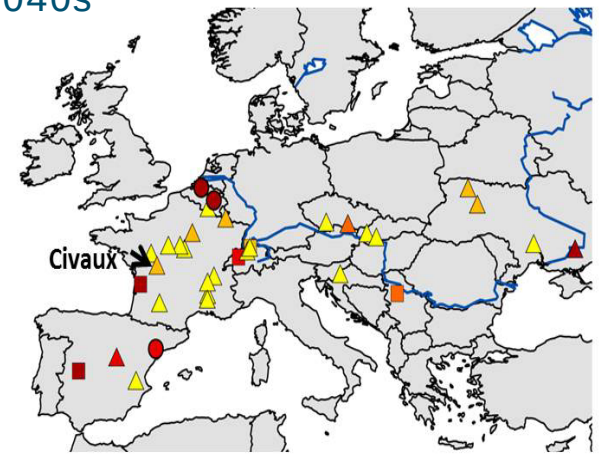
2040s



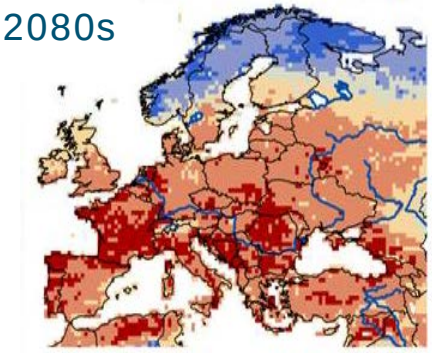
2040s



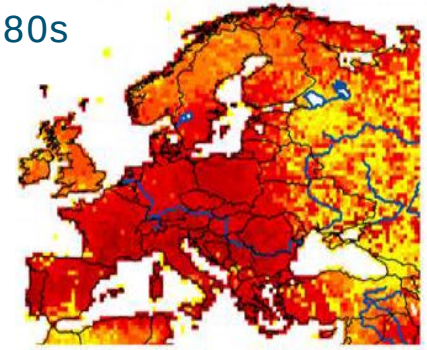
2040s



2080s



2080s



change (%) < -50 -50 to -25 -25 to 0 0 to +25 +25 to +50 > +50

change (°C) 0.5 to 1.0 1.2 to 1.4 1.6 to 1.8 2.0 to 2.5 > 3.0

change (%) -10 to -5 < -20 -5 to -1 -20 to -10 -1 to 0

once through, fresh water

combination (once-through with supplementary cooling tower)

recirculating with cooling tower(s)

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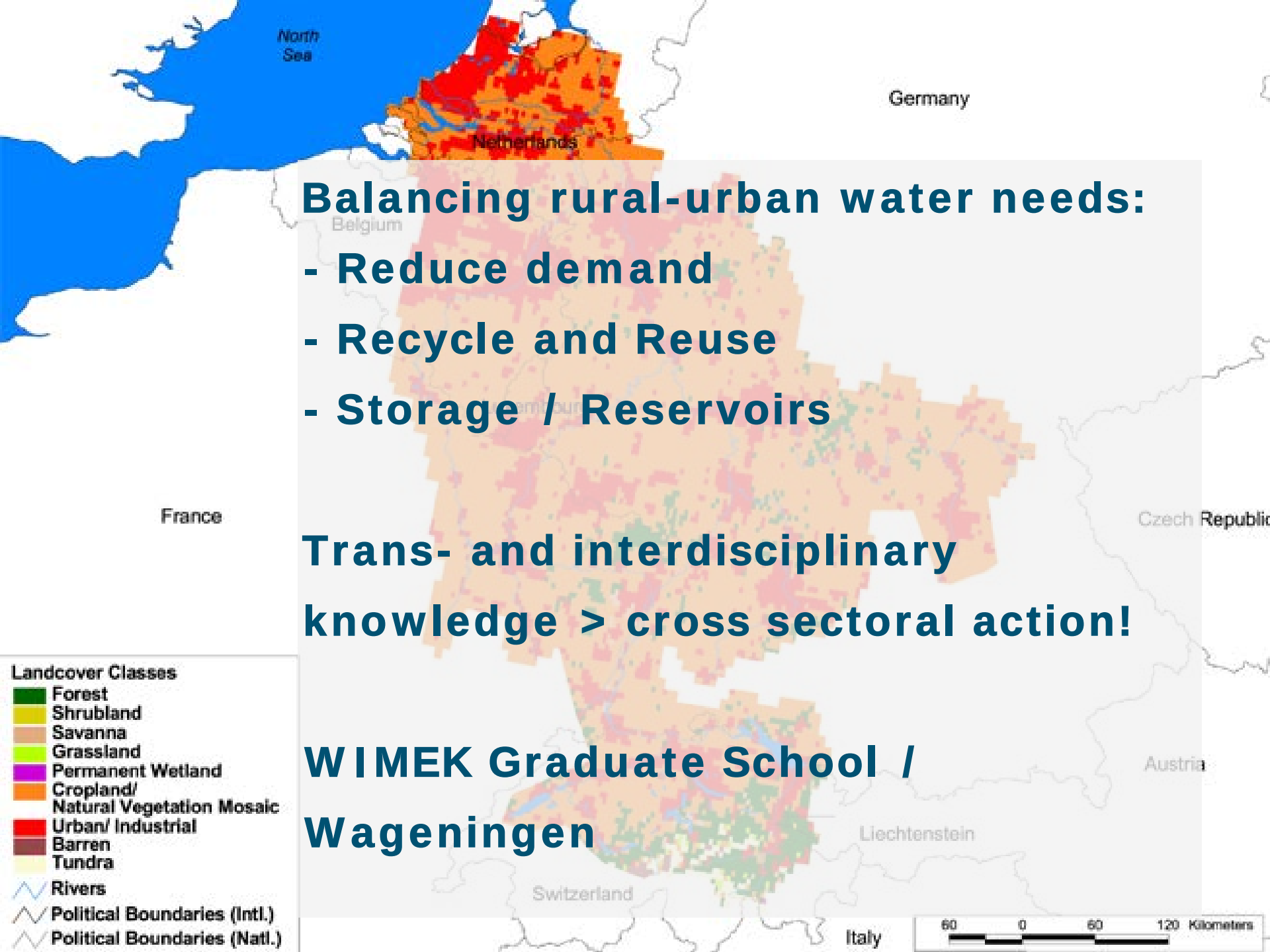
Dr. Van Vliet, M et al. 2012, Nature Climate Change



Balancing rural-urban water needs:

- Reduce demand

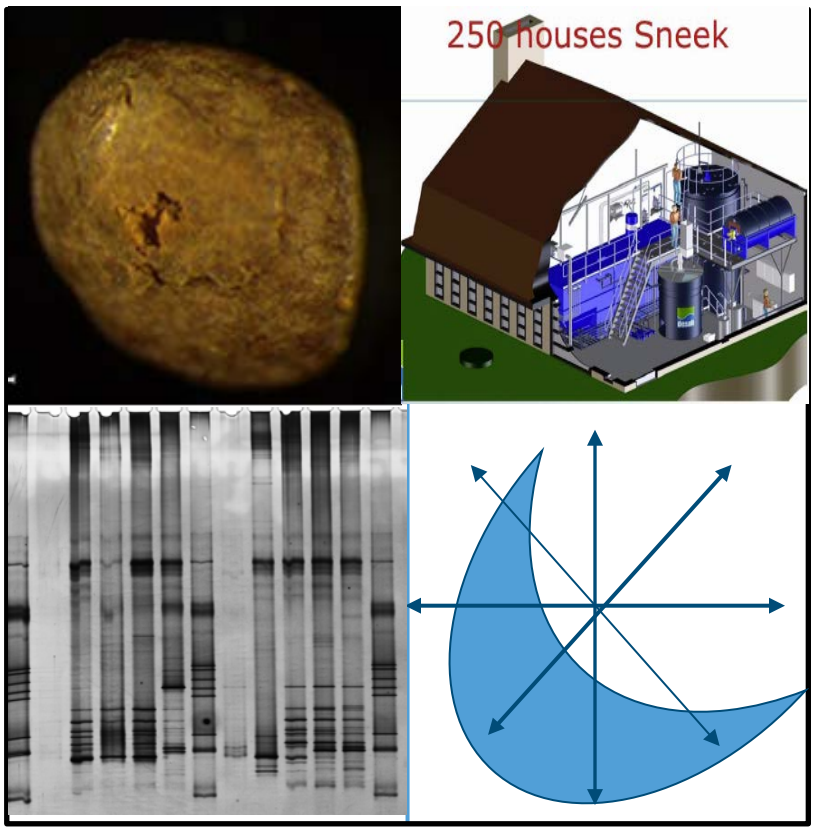
- Recycle and Reuse

- Storage / Reservoirs

Trans- and interdisciplinary knowledge > cross sectoral action!

WIMEK Graduate School / Wageningen

Strategies to Solutions
Inter and Trans Disciplinary Approach



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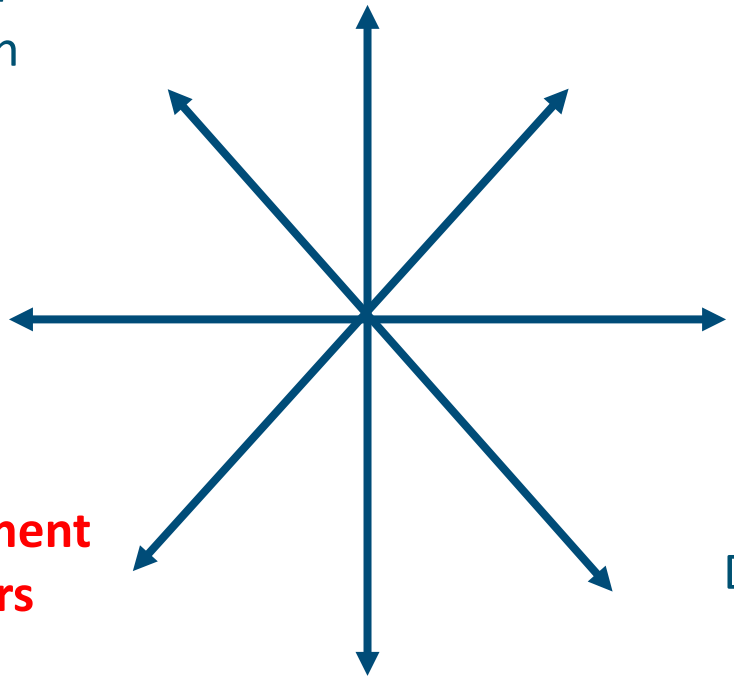
Martin Kropff: 2014; Elaborated

Interdisciplinary collaboration

Trans Disciplinarity
4 Dimensions Infrastructure Managament



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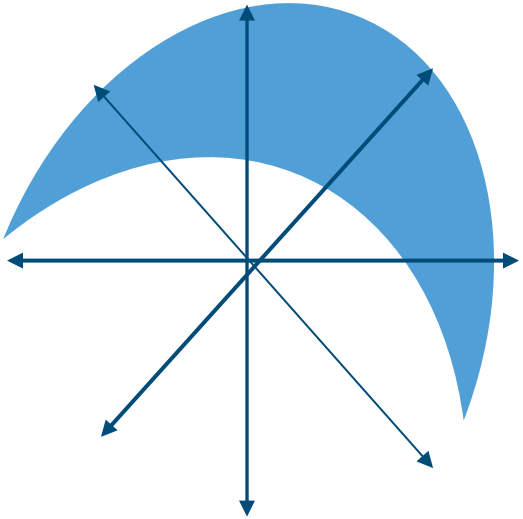
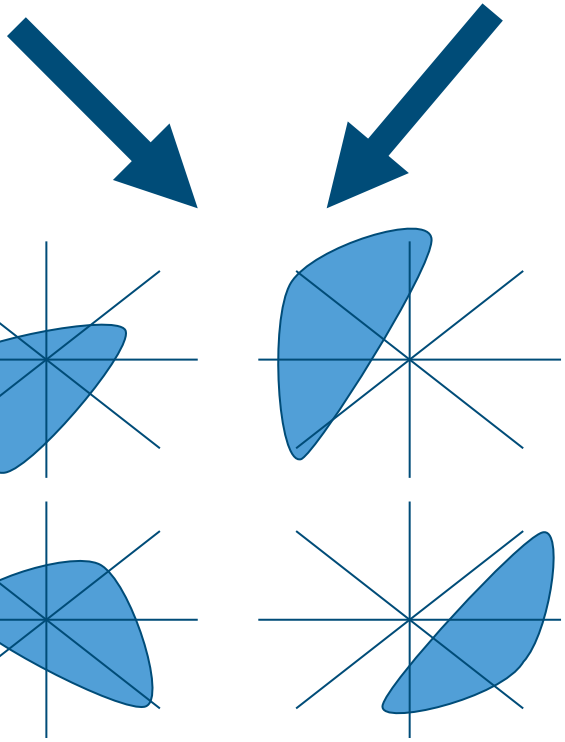
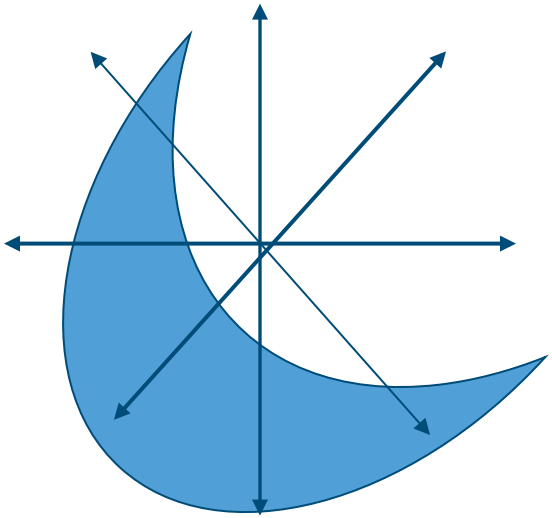
Van Vliet, B.J.M. et al. 2014



centralised systems



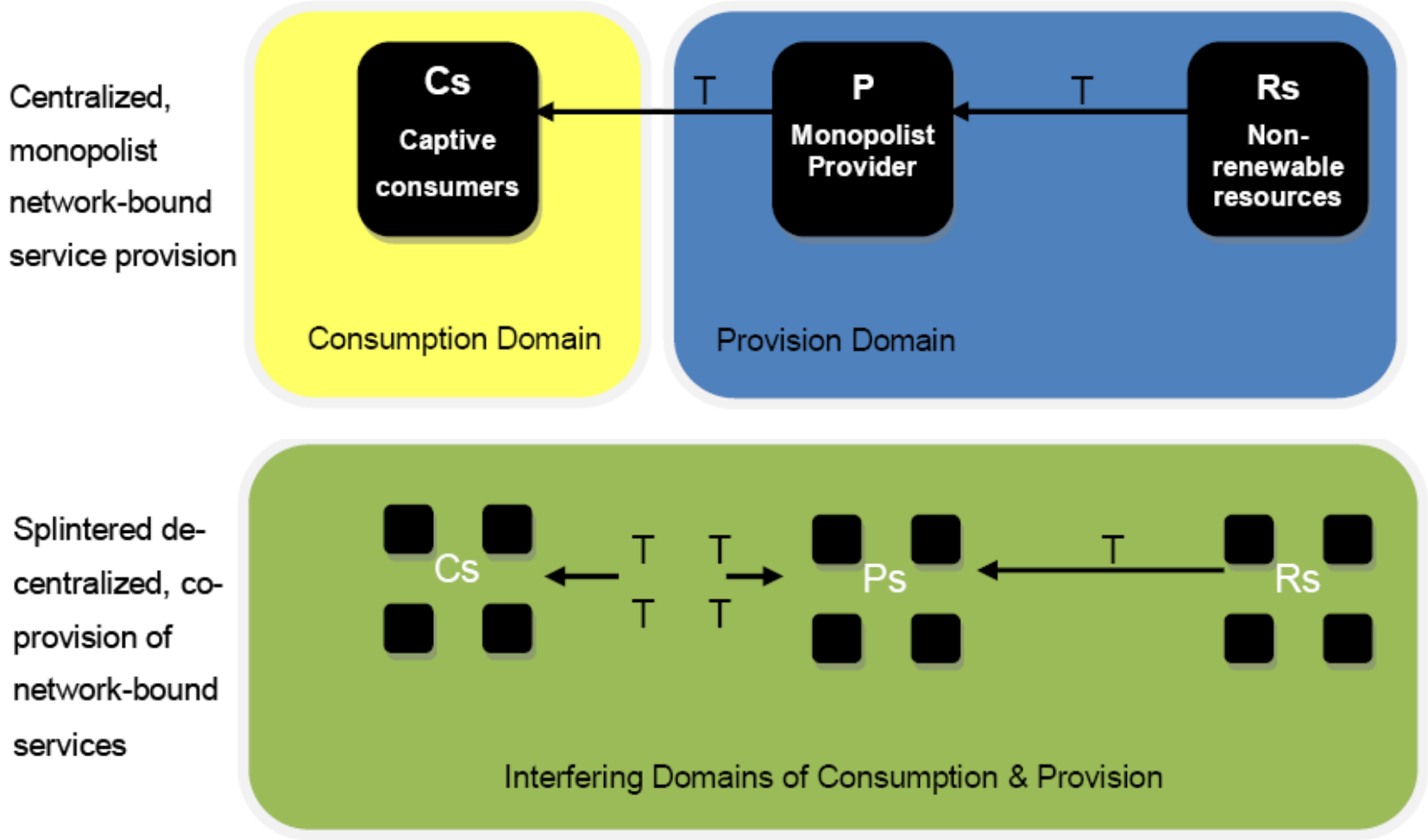


de-centralised systems

modernized mixtures

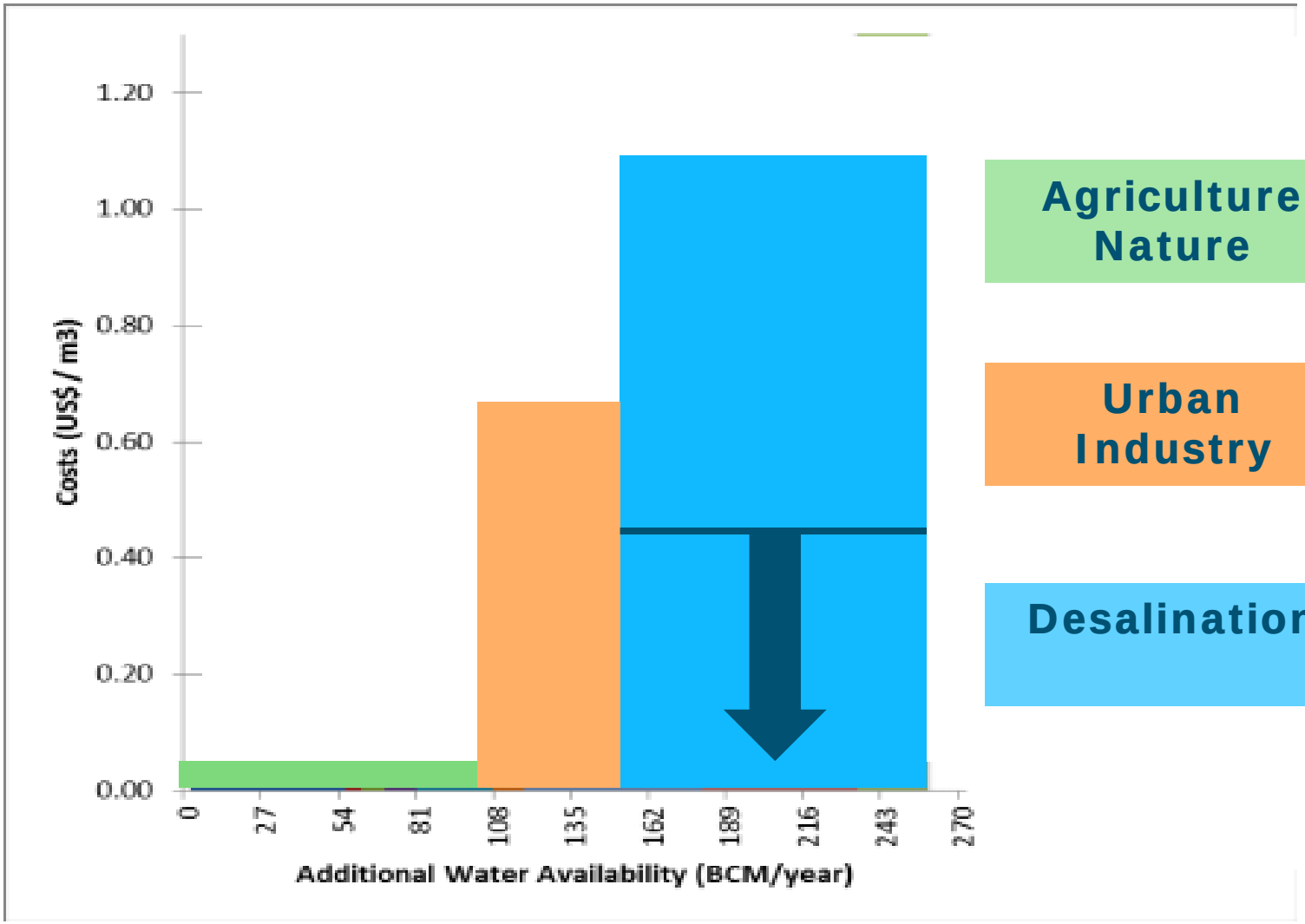
Van Vliet, B.J.M. et al. 2014

Splintering : Resources, Providers, Technologies, Consumer roles



See also: Van Vliet, B.J.M. et al. (2012), JEPP

Unit costs ($/m^3) of measures to make water available



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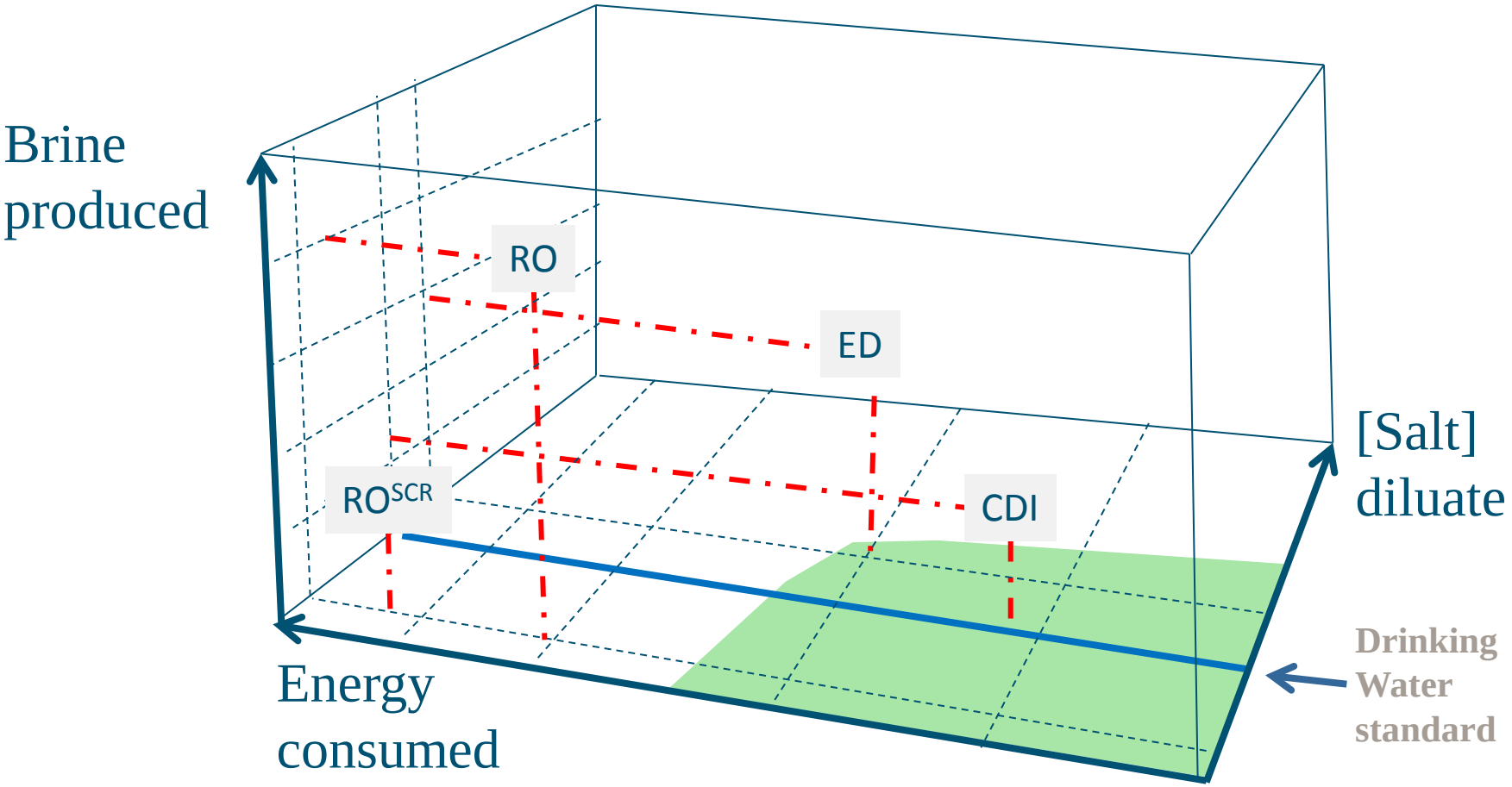
Petra Hellegers, 2014; elaborated

Sustainable Desalination

low energy technology, brackish water=resource



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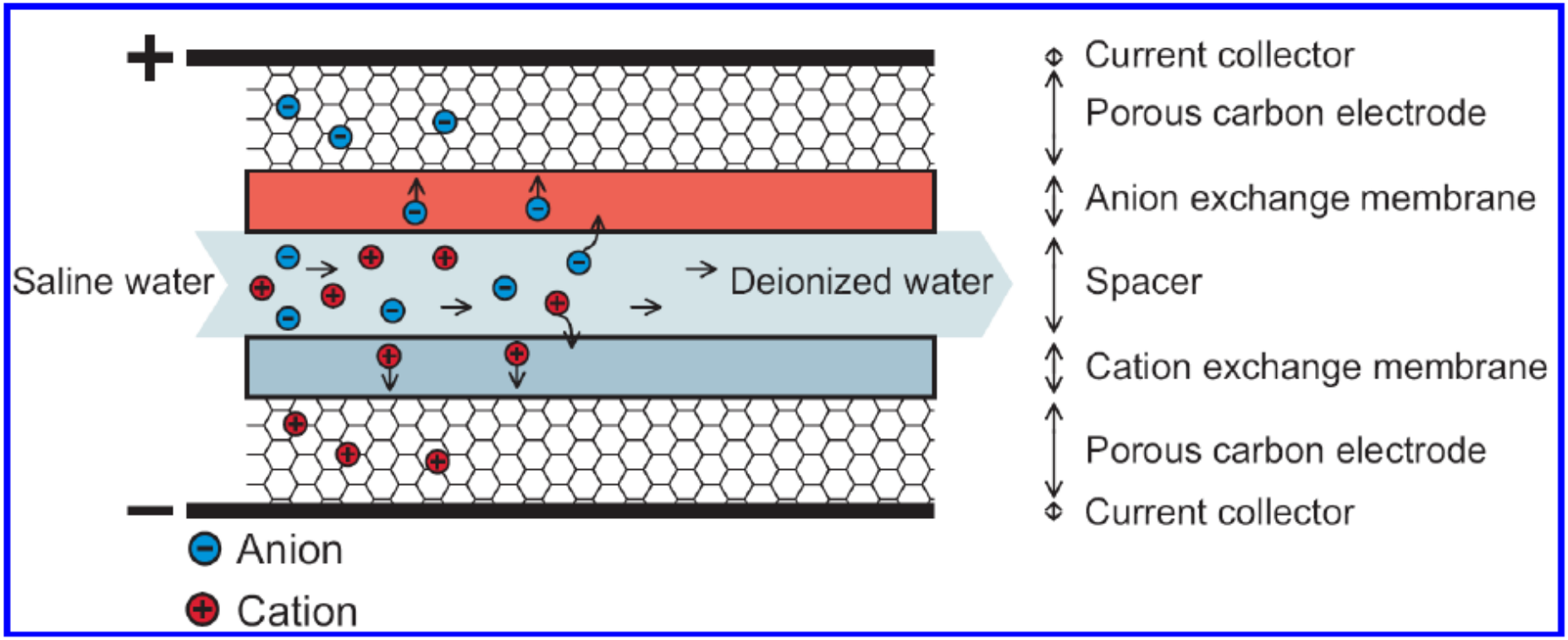
Desalination with a Minimum of Energy



wetsus

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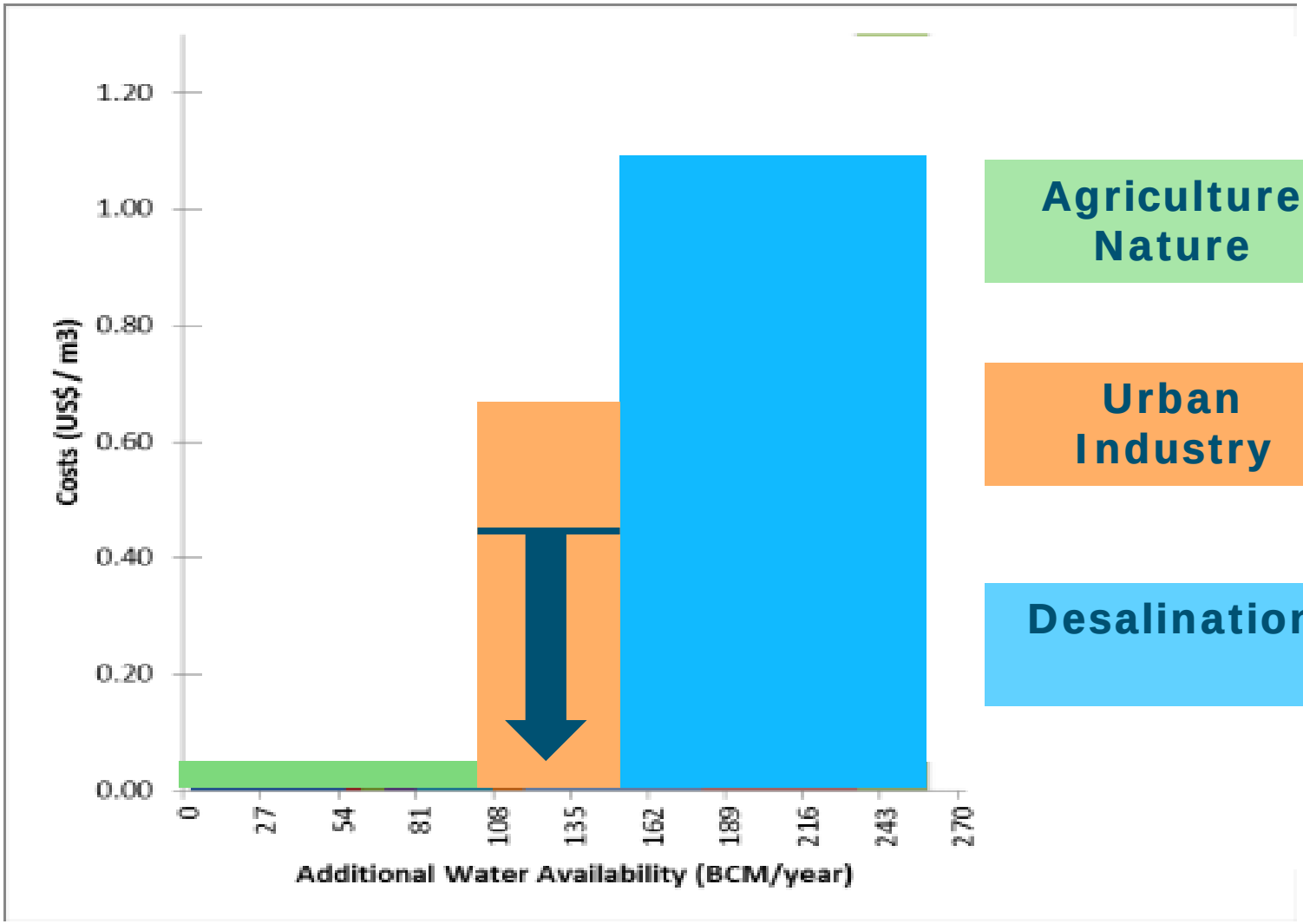
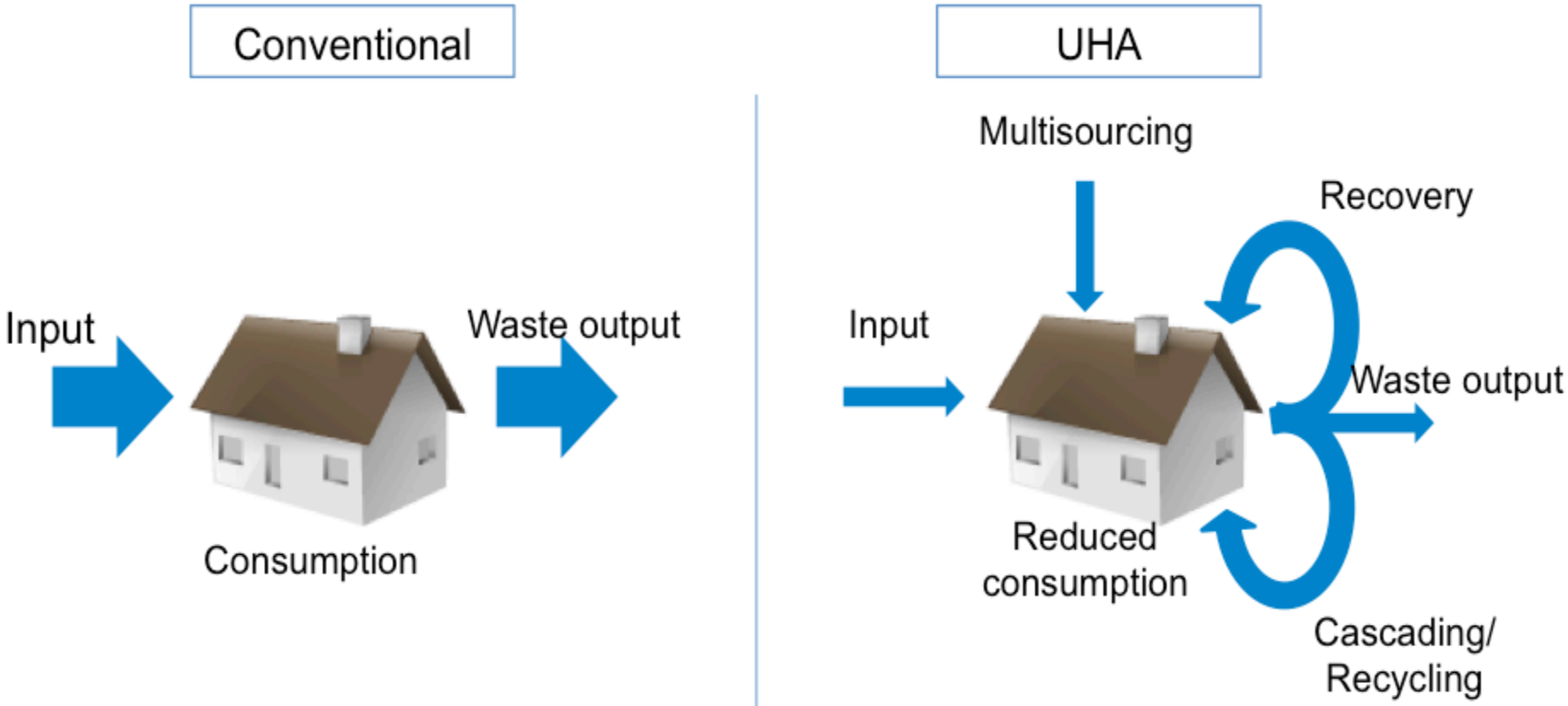
Unit costs ($/m^3) of measures to make water available

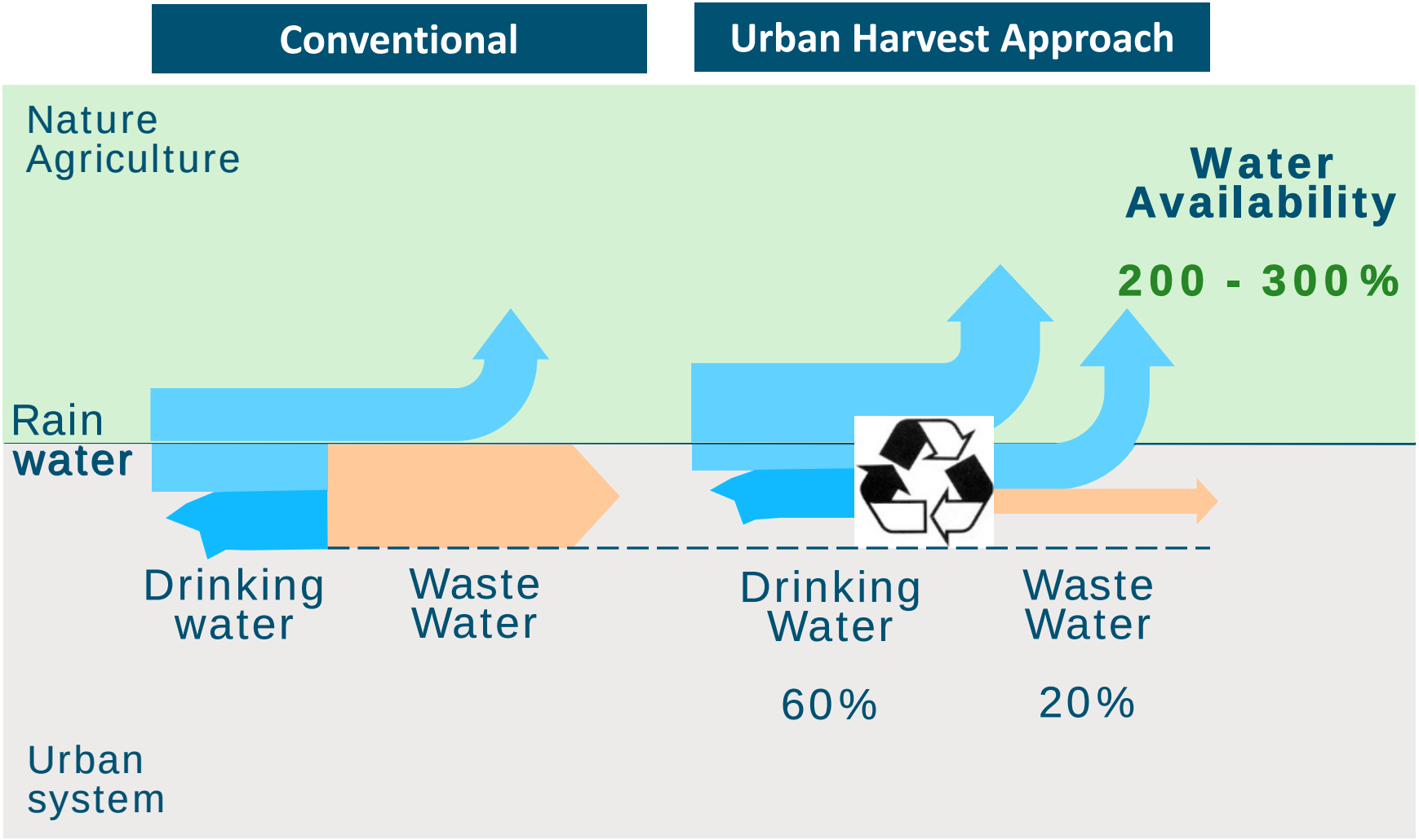


UHA – Shifting to a circular metabolism



Agudelo, et al.: 2011

Prognosis (semi-)arid area



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Agudelo, et al.: 2011, 2012
Bozileva, et al.: 2014

Securing food by securing water

New Sanitation Installed in Buildings

Amsterdam Metropolitan Solutions

AMSTERDAM INSTITUTE FOR
ADVANCED METROPOLITAN SOLUTIONS

Wageningen UR,

TU Delft, MIT

Amsterdam Smart City,

City of Boston,

CISCO, ESA, IBM,

KPN, Shell, TNO,

Waag Society, WaterNet,

and other partners.....

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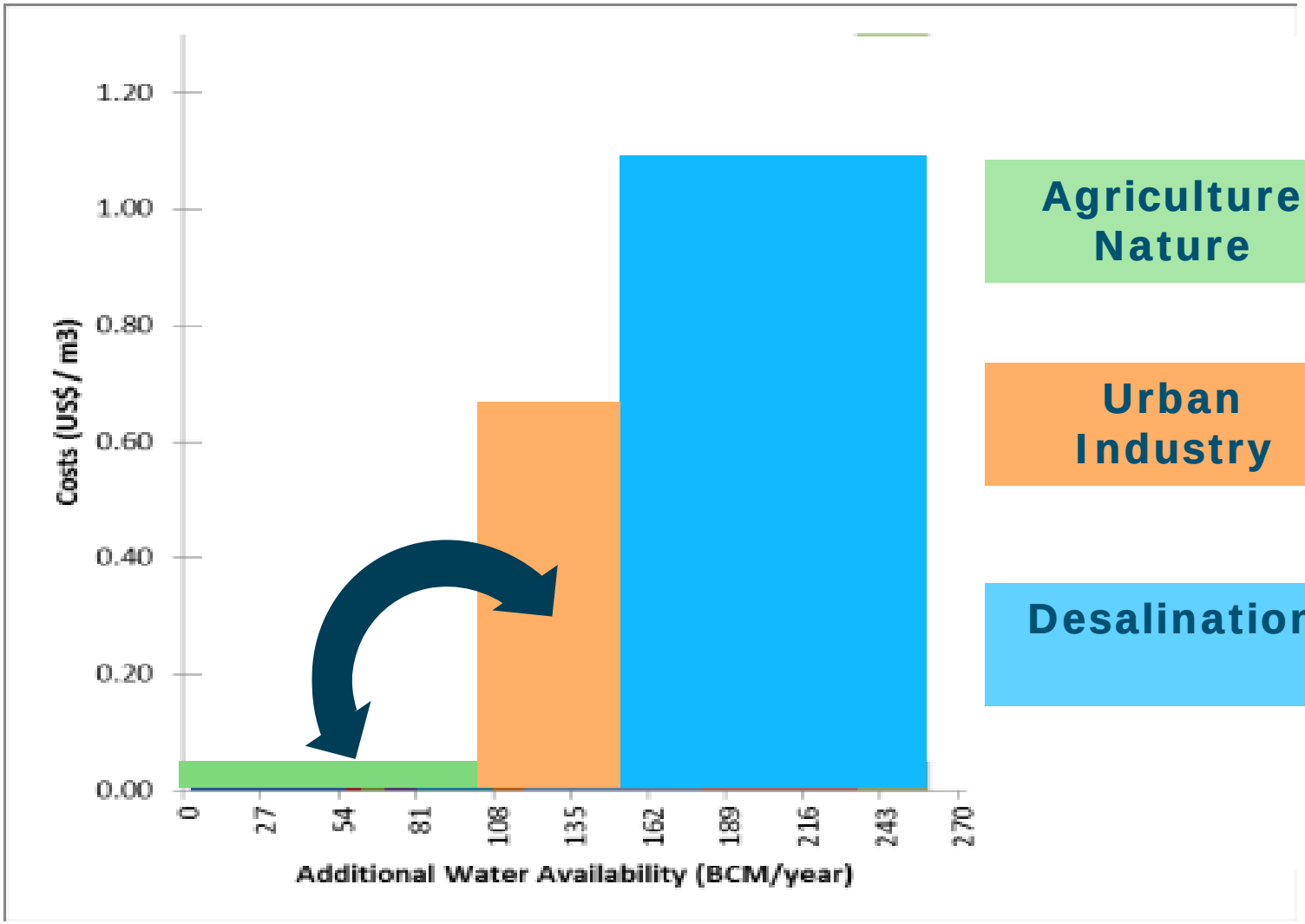
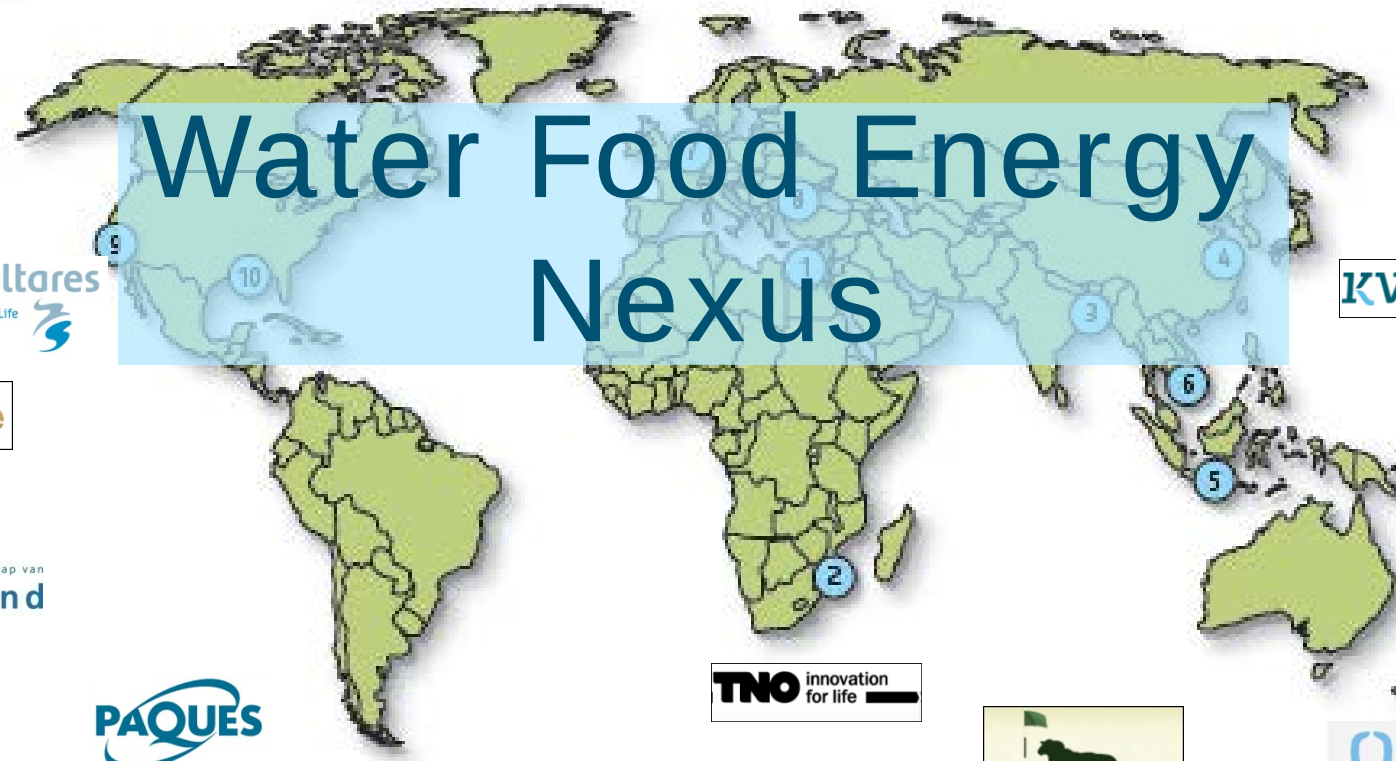
Unit costs ($/m^3) of measures to make water available



Water Food Energy Nexus



Shell
Royal HaskoningDHV
Enhancing Society Together
Witteveen + Bos
Voltea
FUGRO
DOW
Pentair Water
ALTERRA WAGENINGEN UR
PRIVA
nijhuis WATER TECHNOLOGY
Deltares
Enabling Delta Life
KWR Watercycle Research Institute
Plant-e
wln water | onderzoek | advies
Hoogheemraadschap van Rijnland
stowa
PAQUES
TNO innovation for life
oaseo drinkwater
MAGNETO SPECIAL ANODES B.V.
Eijkelkamp Agrisearch Equipment
a Royal Eijkelkamp Company
HOLLANDSCHE GREENKEEPING MAATSCHAPPIJ
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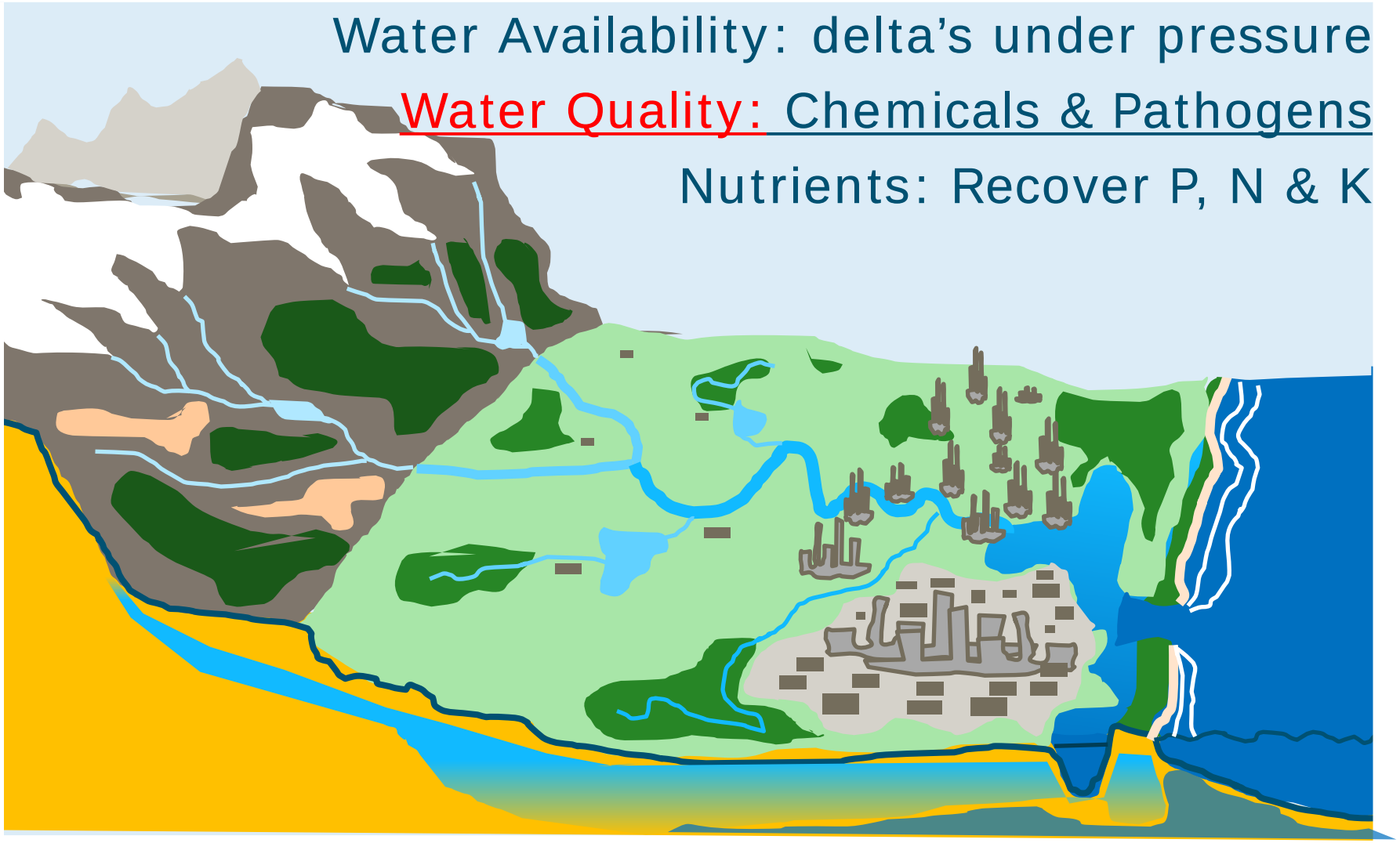
UNIVERSITEIT TWENTE.
VU VRIJE UNIVERSITEIT AMSTERDAM
TU Delft

70% of world population will live in delta's



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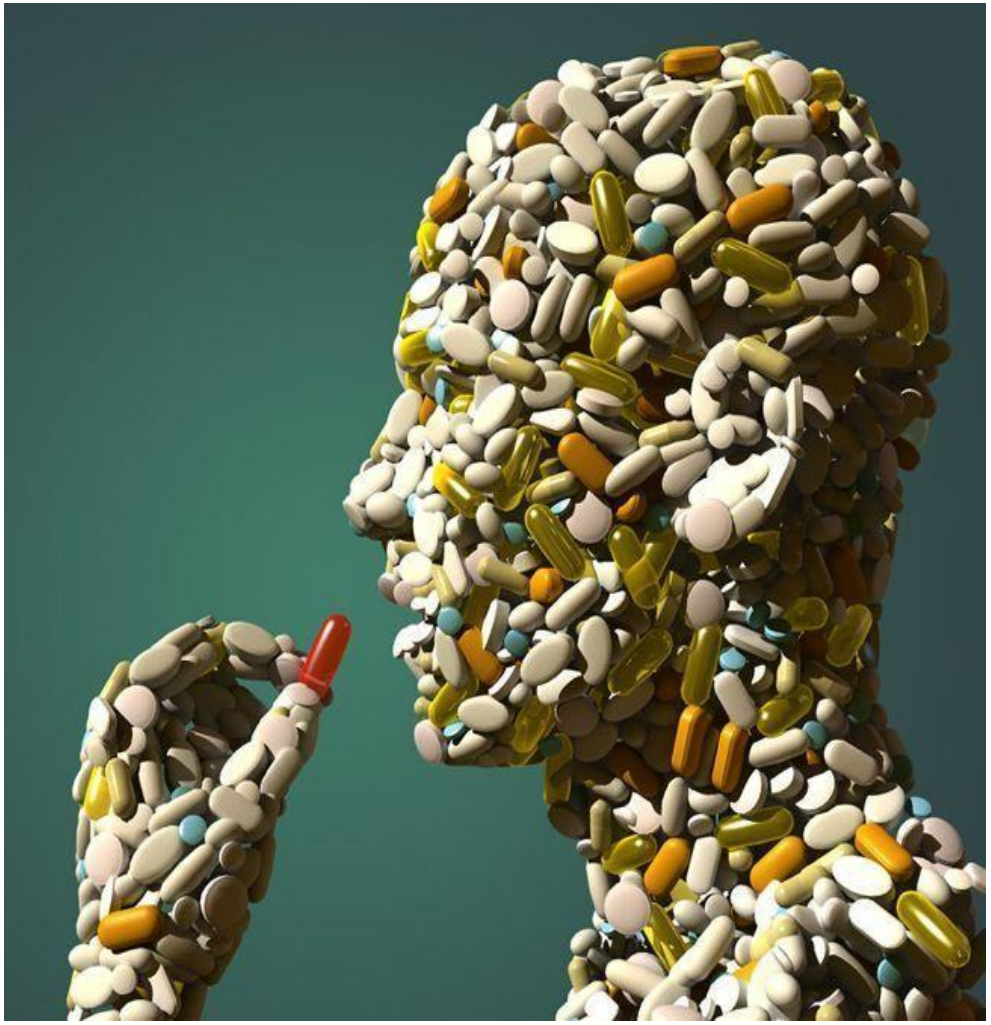
Micropollutants in the environment e.g. Pharmaceuticals



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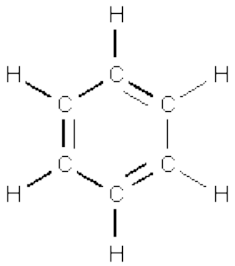
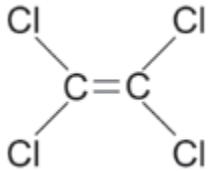
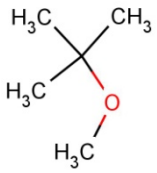
Microorganisms: our greatest friends



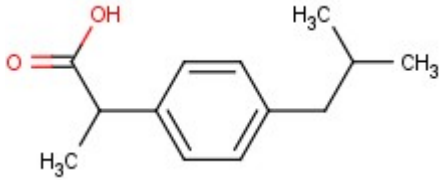
Benzene



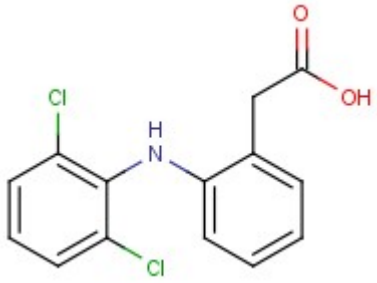
PCE



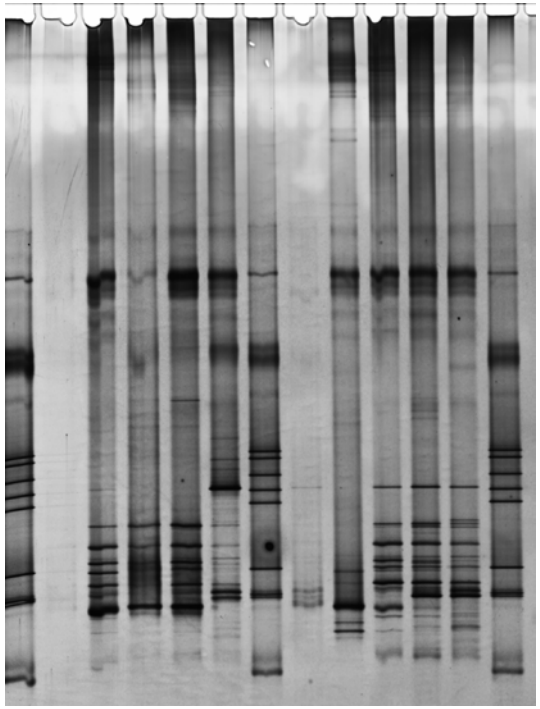
MTBE

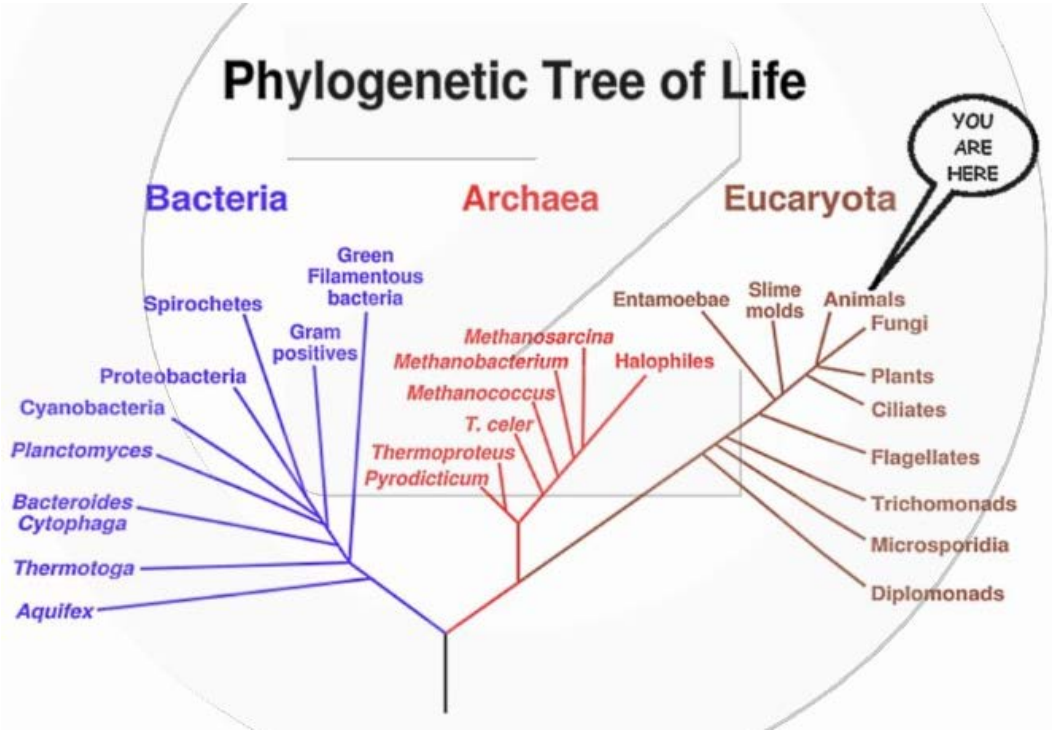


ibuprofen



diclofenac





Sutton, E. et al.: 2014

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Microorganisms
Help to degrade pharmaceuticals in water





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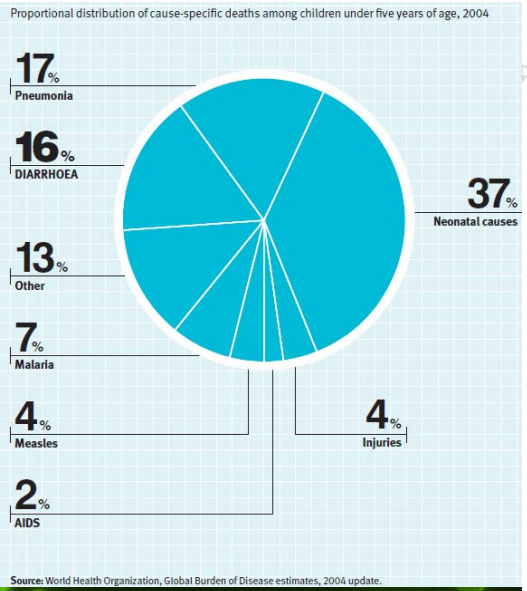
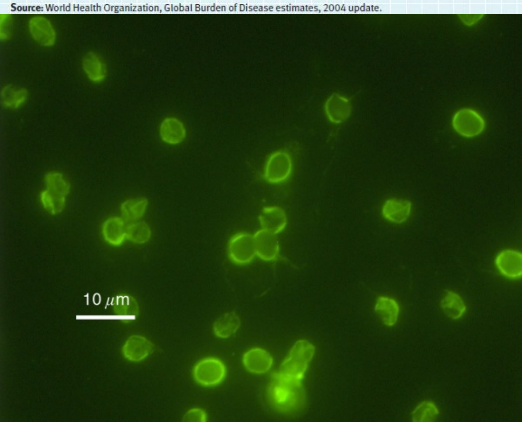
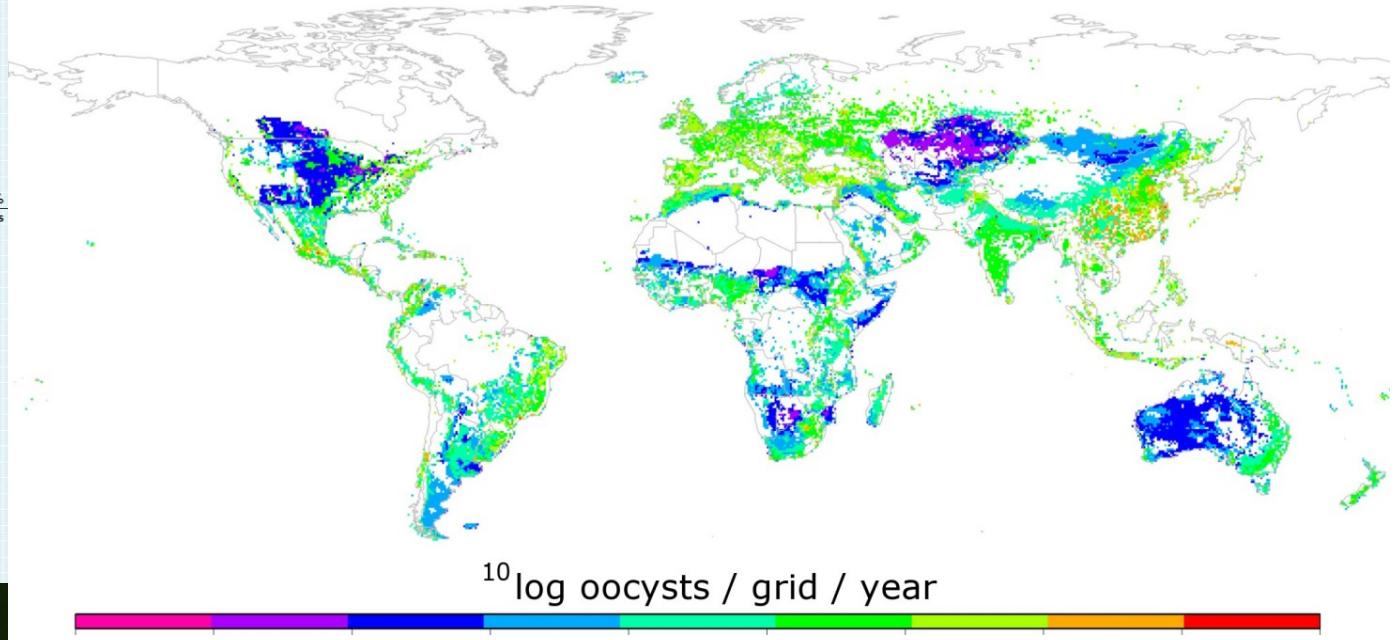
Dr. AAM Langenhoff et al.: 2014

Among microorganisms also some crooks!







- Diarrhoea
- *Cryptosporidium*
- Emissions: humans/livestock

(UNICEF/WHO 2009, Hofstra et al. 2013)

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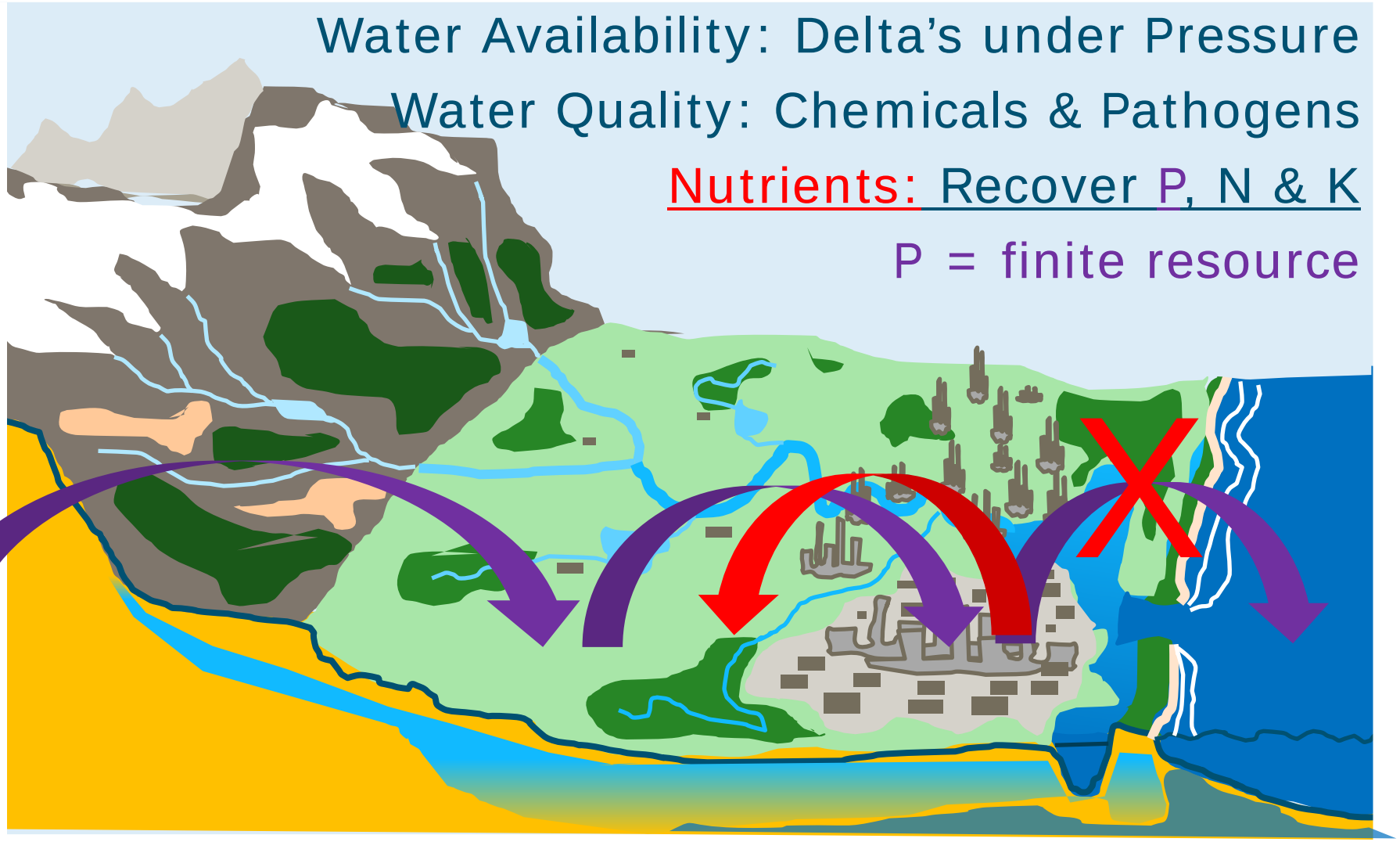
70% of world population will live in delta's



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Twitter: @kimovandijk

Global by-products and wastes P flows

Sources	Quantity Mt P / year
Animal manures	20 – 30
Sewage sludge	3 – 5
Other streams	3 – 28
Total	26 - 63

60-80 %

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Oenema et al. 2013

5 R's of Sustainable P management

Recycle & Reuse P from Waste

Reduce P losses, P-rich (top)soils; **Reduce P inputs,** process innovation; **Redefine systems**, processes & diets

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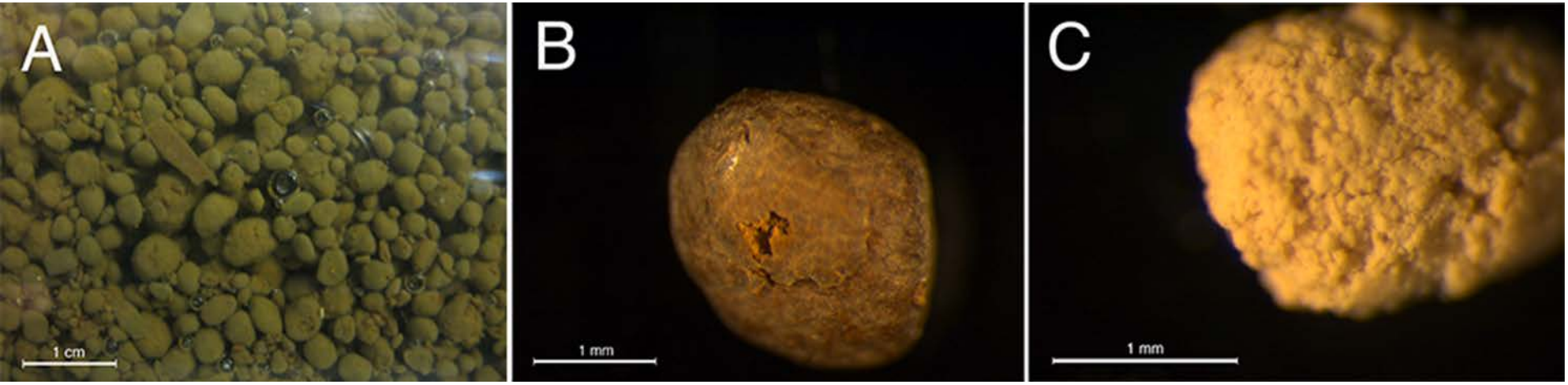
Simultaneous Anaerobic Digestion & Ca-phosphate precipitation



Calcium phosphate granules from anaerobic digested human (and livestock) waste streams

Taina H. Tervahauta, Renata D. van der Weijden, Roberta L. Flemming, Luc´ıa Hern´andez Leal, Grietje Zeeman,,Cees J. N. Buisman (submitted) Calcium phosphate precipitation in anaerobic treatment of black water: a new approach to phosphorus recovery. Water Research 48 (2 014) 632-642

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We Need To

Close Water and Resource Cycles

Keep these Clean and Healthy

Work Trans Disciplinary

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Research Institute Wimek

Wageningen Graduate Schools