

Cities of the Future:

***Can We Reshape Urban Water and
Urban Design To Achieve
Long Term Water Security?***

**Zaragoza Forum
July 15, 2008**

**Paul Reiter
Executive Director, IWA**



**International
Water Association**

Our Evolution (*after Novotny*)

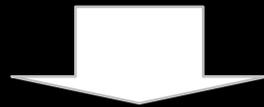
Opportunistic utilization of readily available water



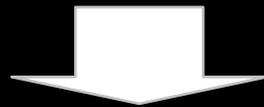
Engineered storage and conveyance



Addition of water treatment technologies



Non-point source pollution control



????????

- Opened the loop → → created linear supply and disposal systems
 - Context:
 - Water supply solving and leading problems
 - Disease, density and lack of reliable treatment
 - Sequence:
 - Provide reliable sources of water
 - To prevent odor and disease
 - Result:
 - Large scale import-export model
 - Distances extended as urban area grew

The Good News and the Bad News

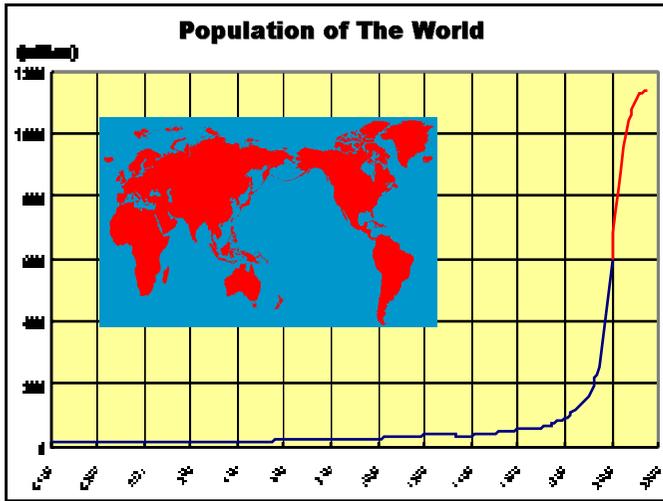
The Good News

- Upper income countries have revolutionized public health outcomes
- Also have made major progress in mitigation of environmental damage

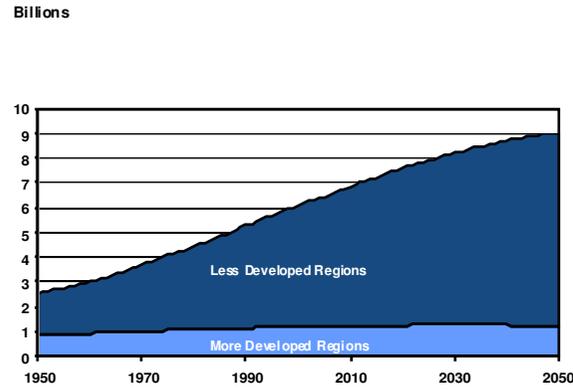
The Bad News

- Systems were built for narrow objectives with little resilience – not suited to the challenges ahead
- Extraordinarily resource intensive
- Unaffordable to 2/3 of the planet



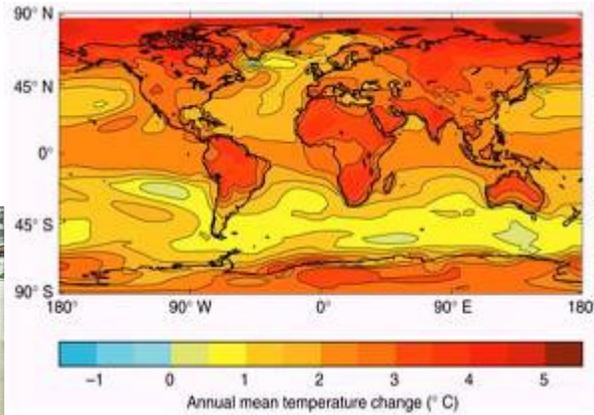
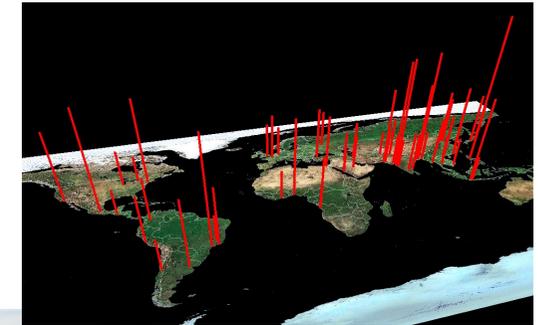
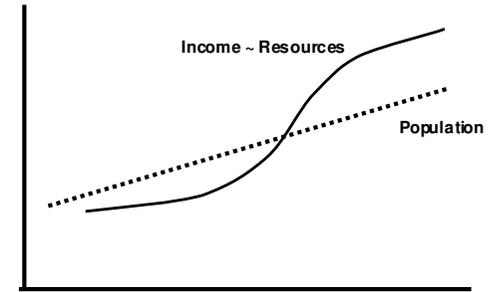


Growth in More, Less Developed Countries



Source: United Nations, *World Population Prospects: The 2004 Revision (medium scenario)*, 2005.

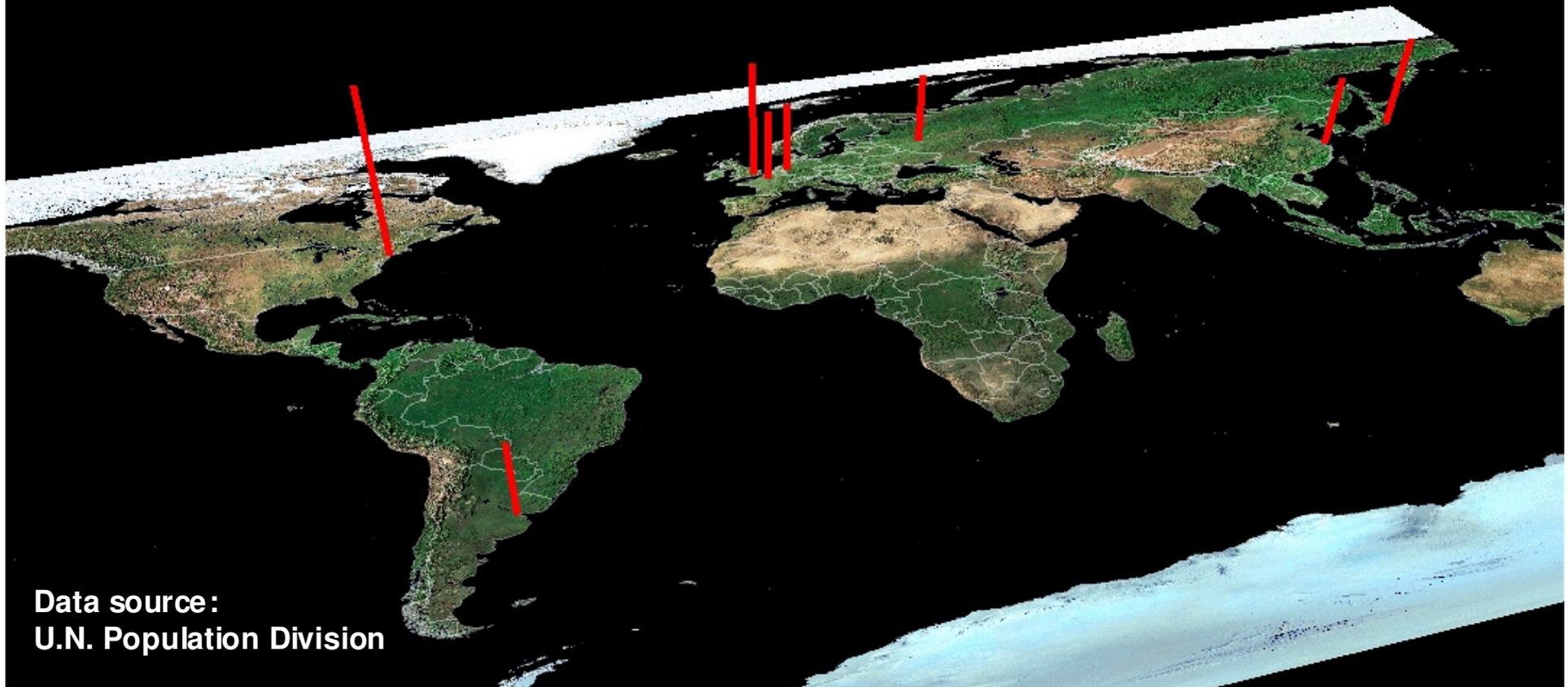
It's Not Just Population Growth



Development of World Cities

1950

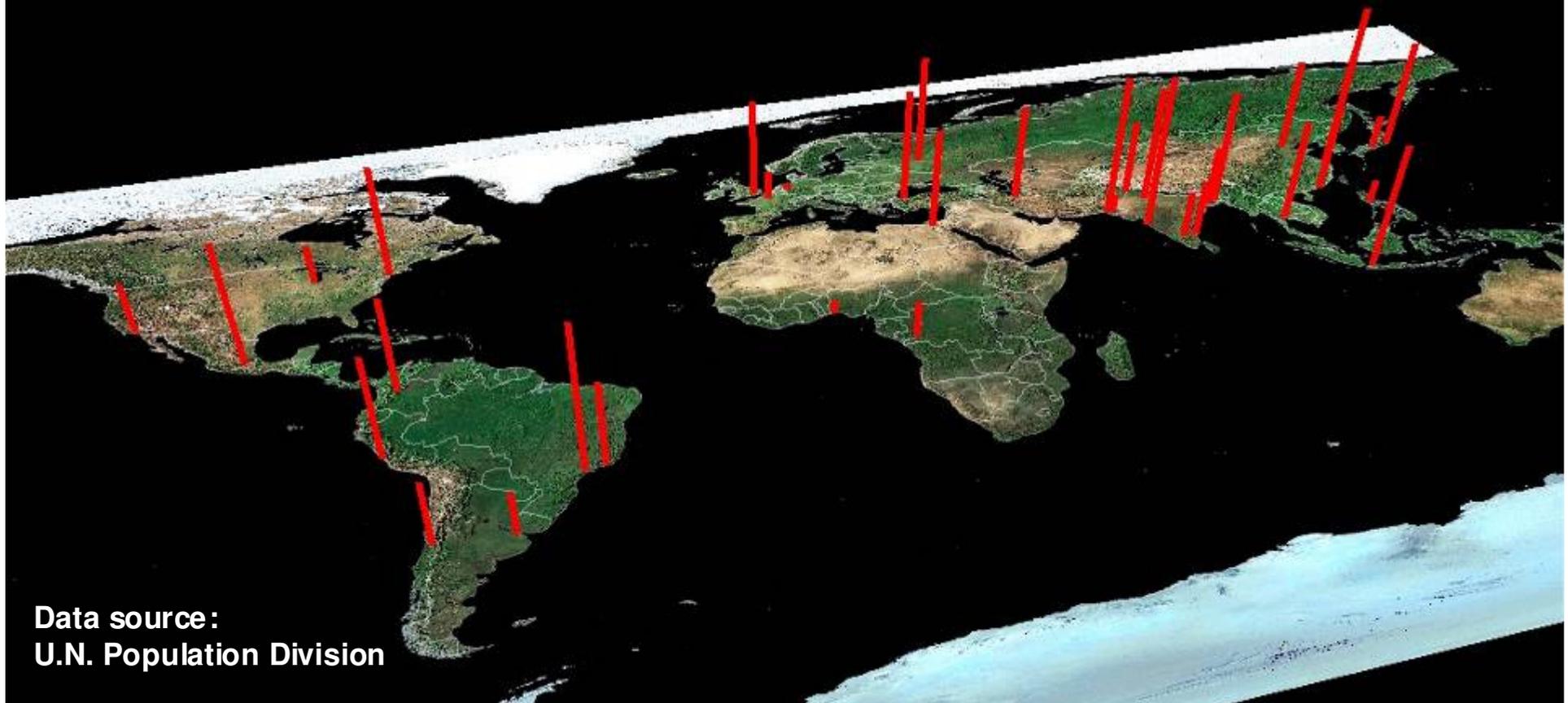
**World Cities exceeding
5 million residents**



Development of World Cities

2000

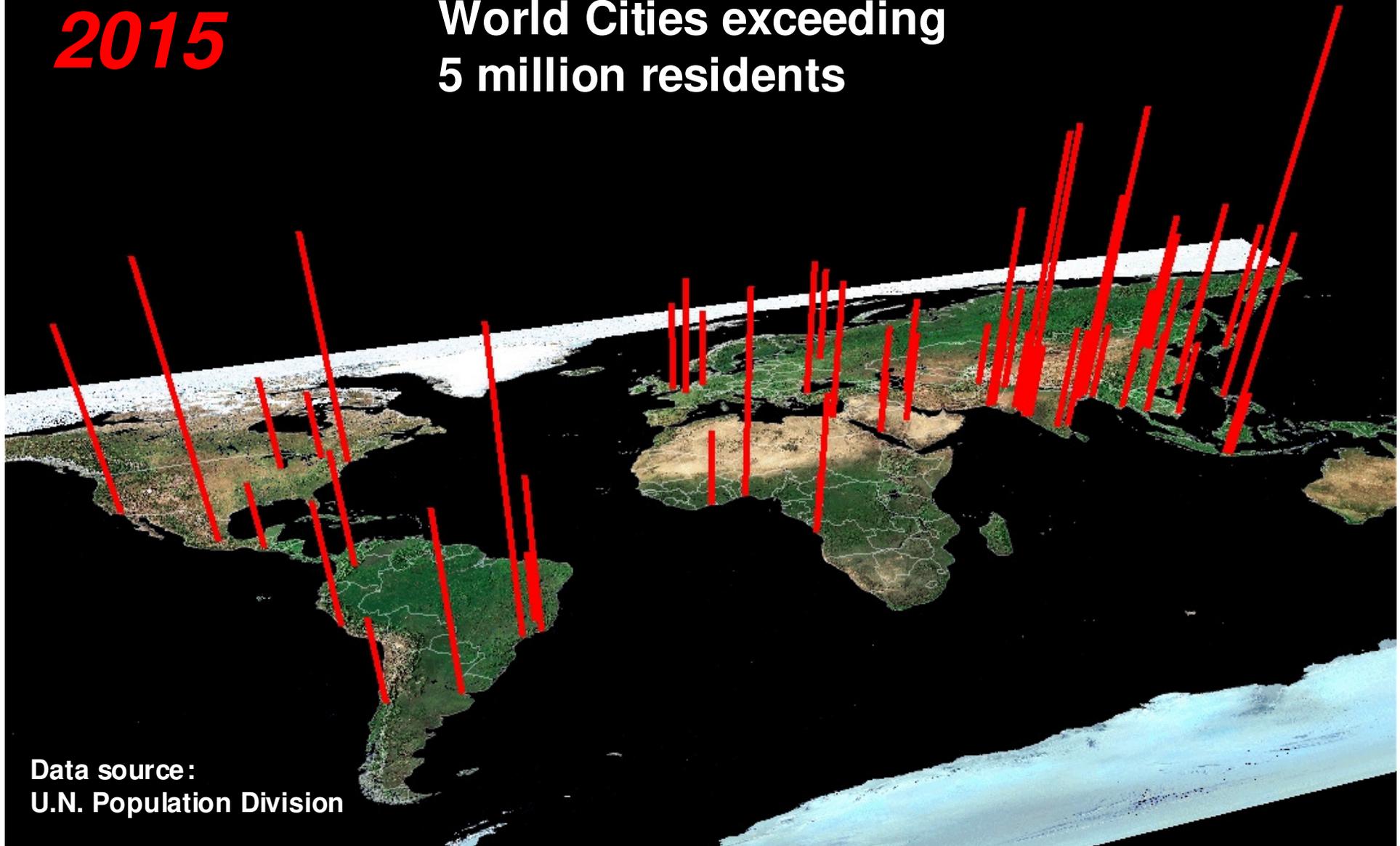
**World Cities exceeding
5 million residents**



Development of World Cities

2015

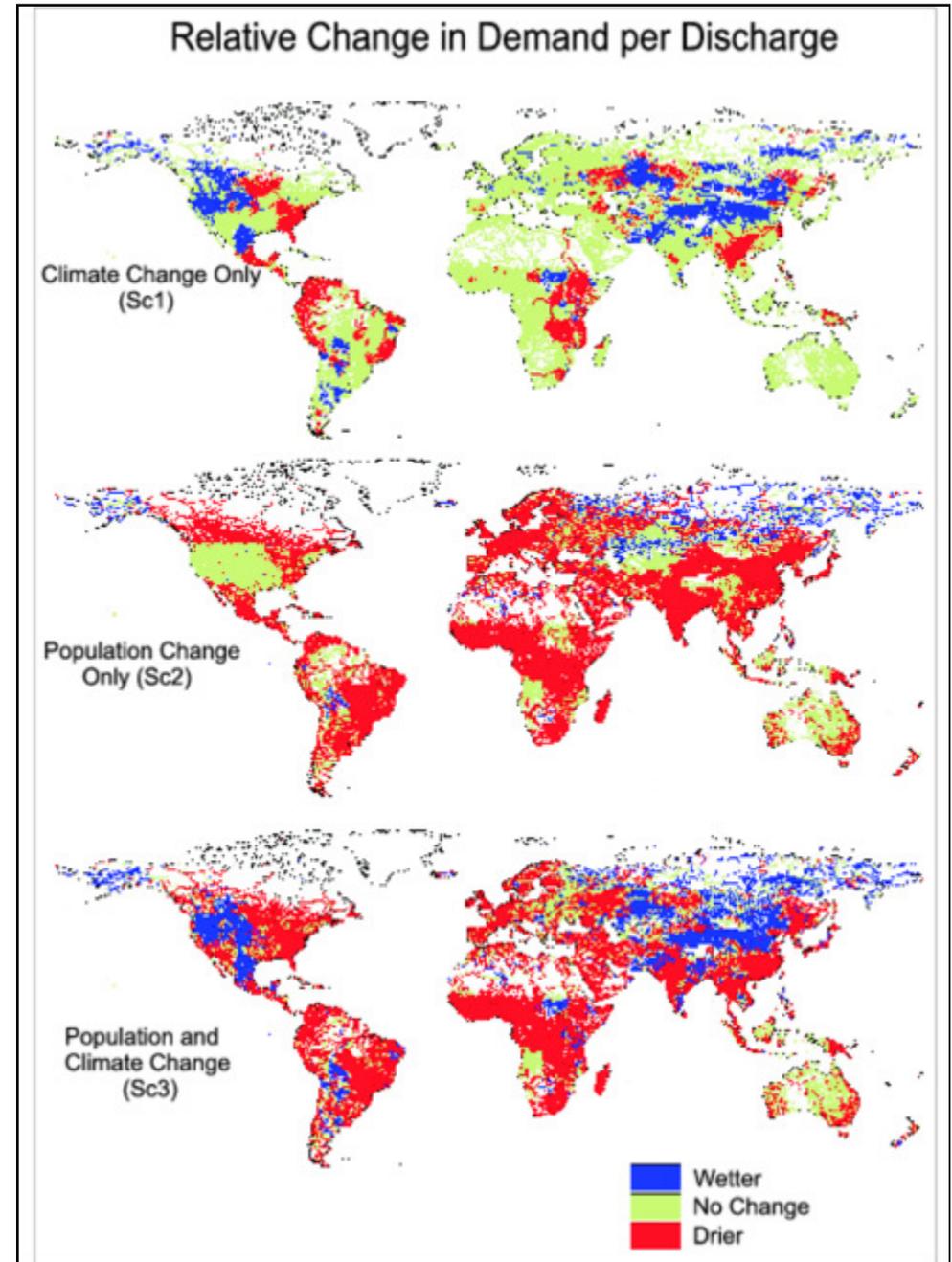
**World Cities exceeding
5 million residents**



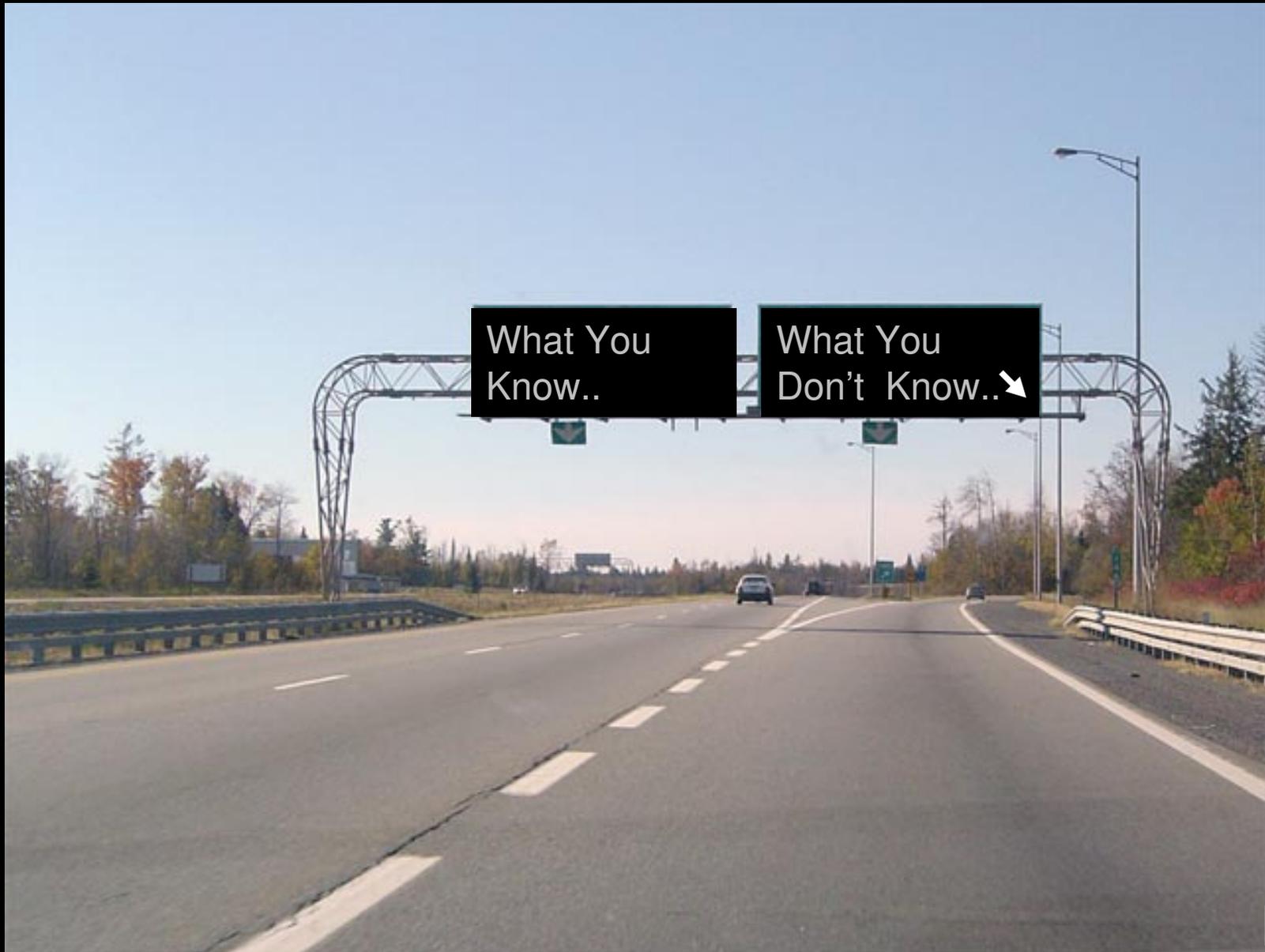
Data source:
U.N. Population Division

Water Stress Changes to 2025

- 80% of future stress from **population & development**, not **climate change**!
- Correct Priorities?
(E.g. 85% US global change research funding to climate and carbon)



Split in the Road





Desalination



Membrane Bio-Reactors

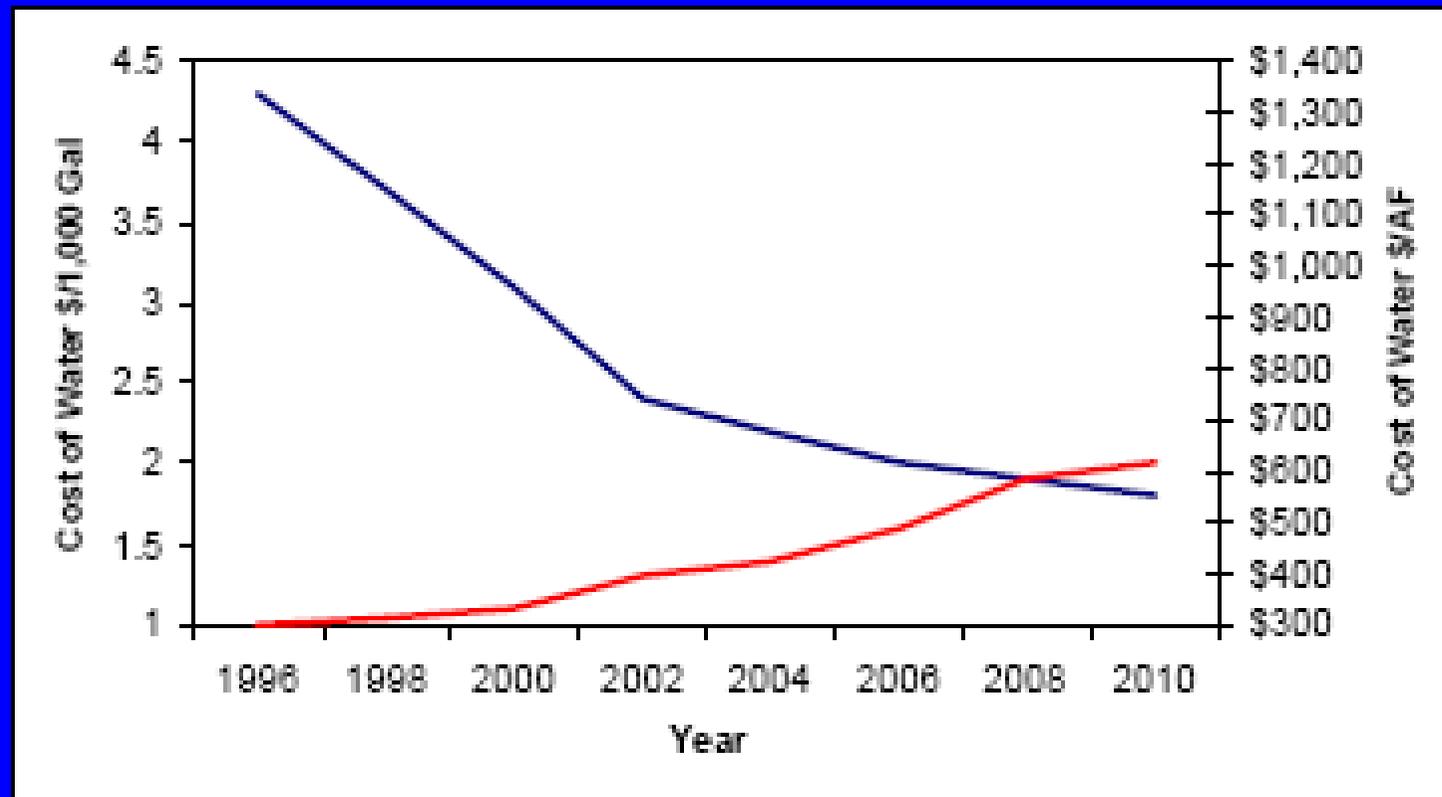


Biotechnology Frontiers

- ❑ Biofilm control
 - biomimicry?
- ❑ Phosphorus
 - controlling biomass
- ❑ Biocontrol
 - detection, enhancement, reduction
 - bioremediation
- ❑ Rapid pathogen detection



Membrane Desalination Becoming the Technology of Choice

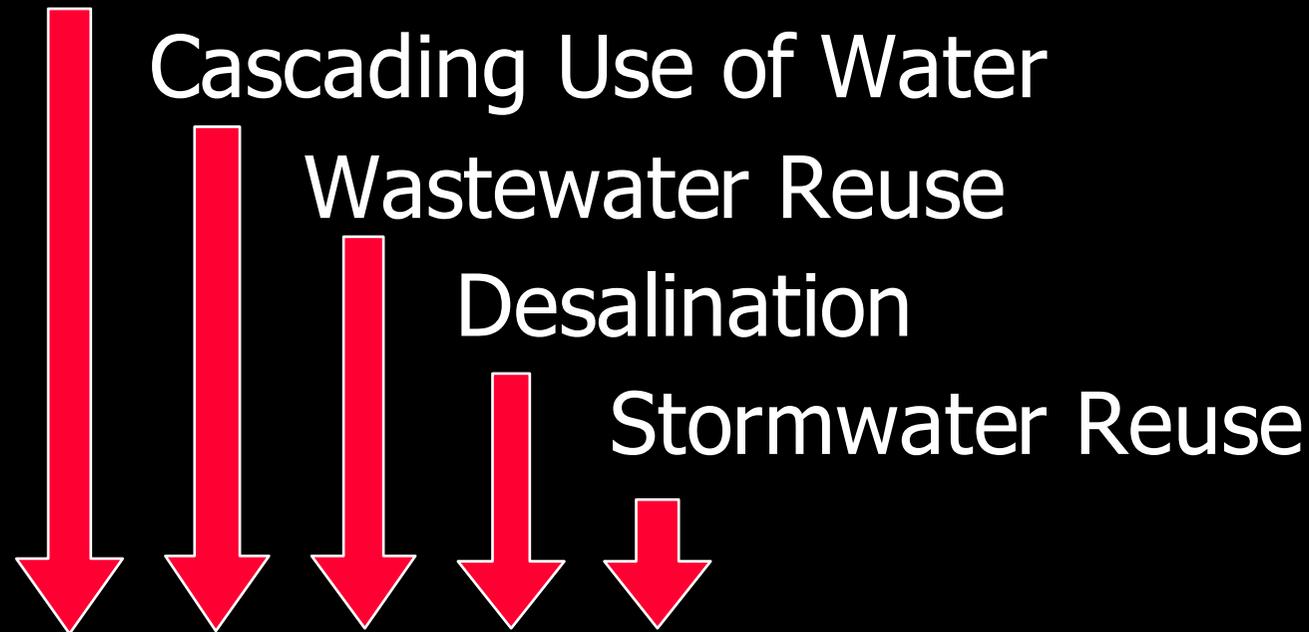


For more Info see:

<http://www.brazos.org>

Innovation in Water Production and Use: Doing More with Less

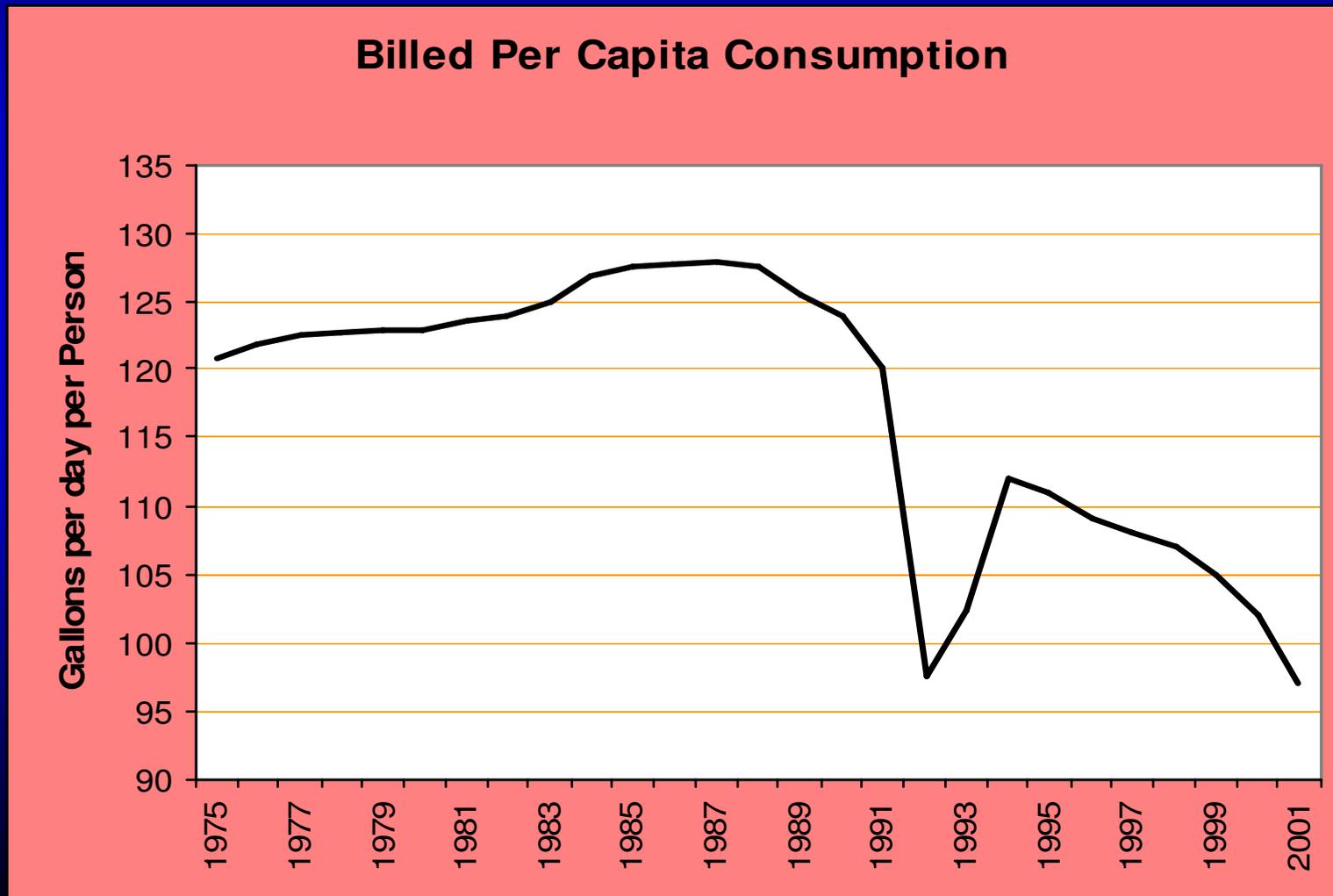
Efficiencies in Supply and Demand



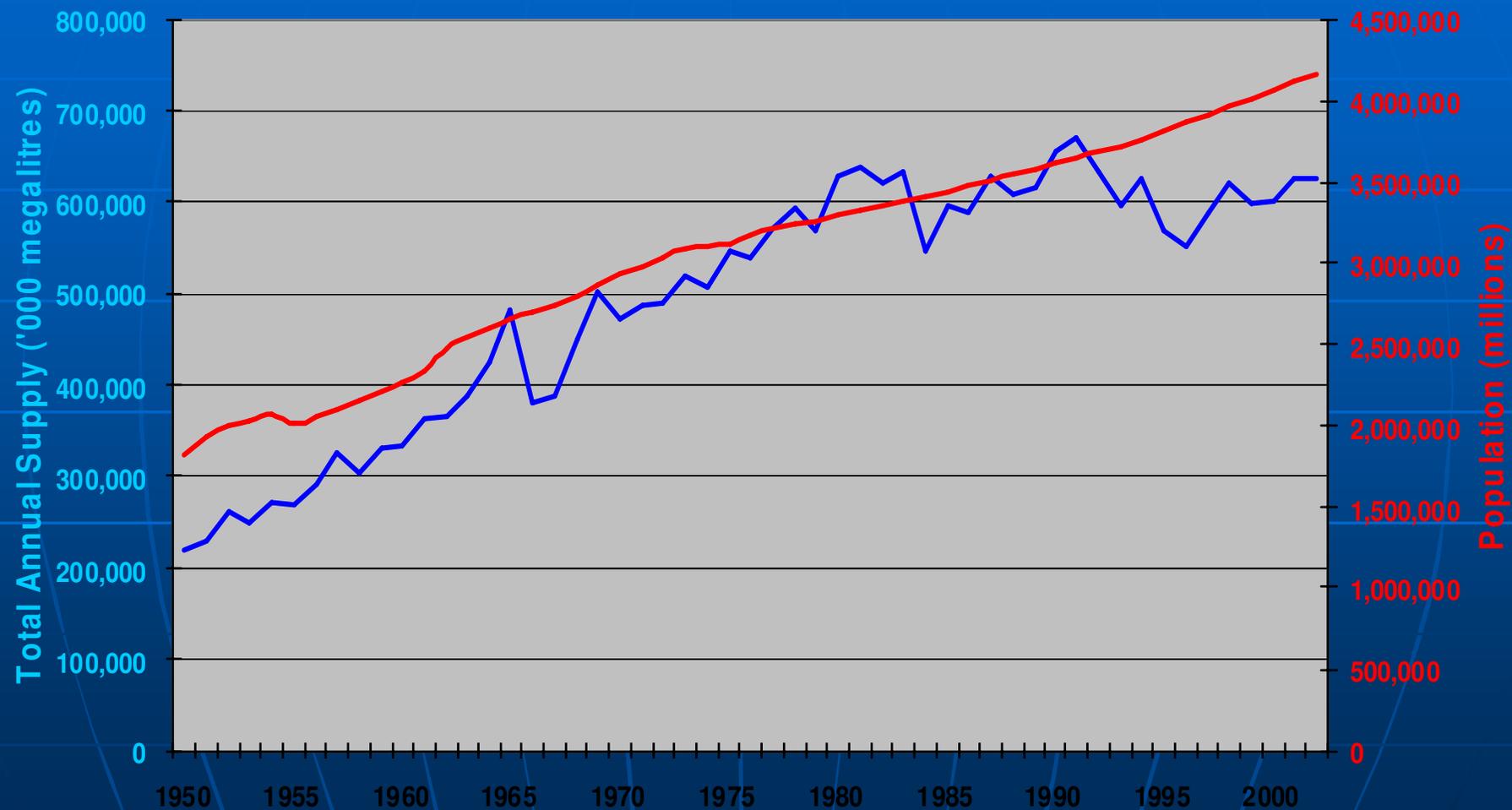
More water for people and the environment



Price and Conservation Impacts on Per-Capita Demand



Total Demand - since 1950



The magic circle

North: water-rich countries

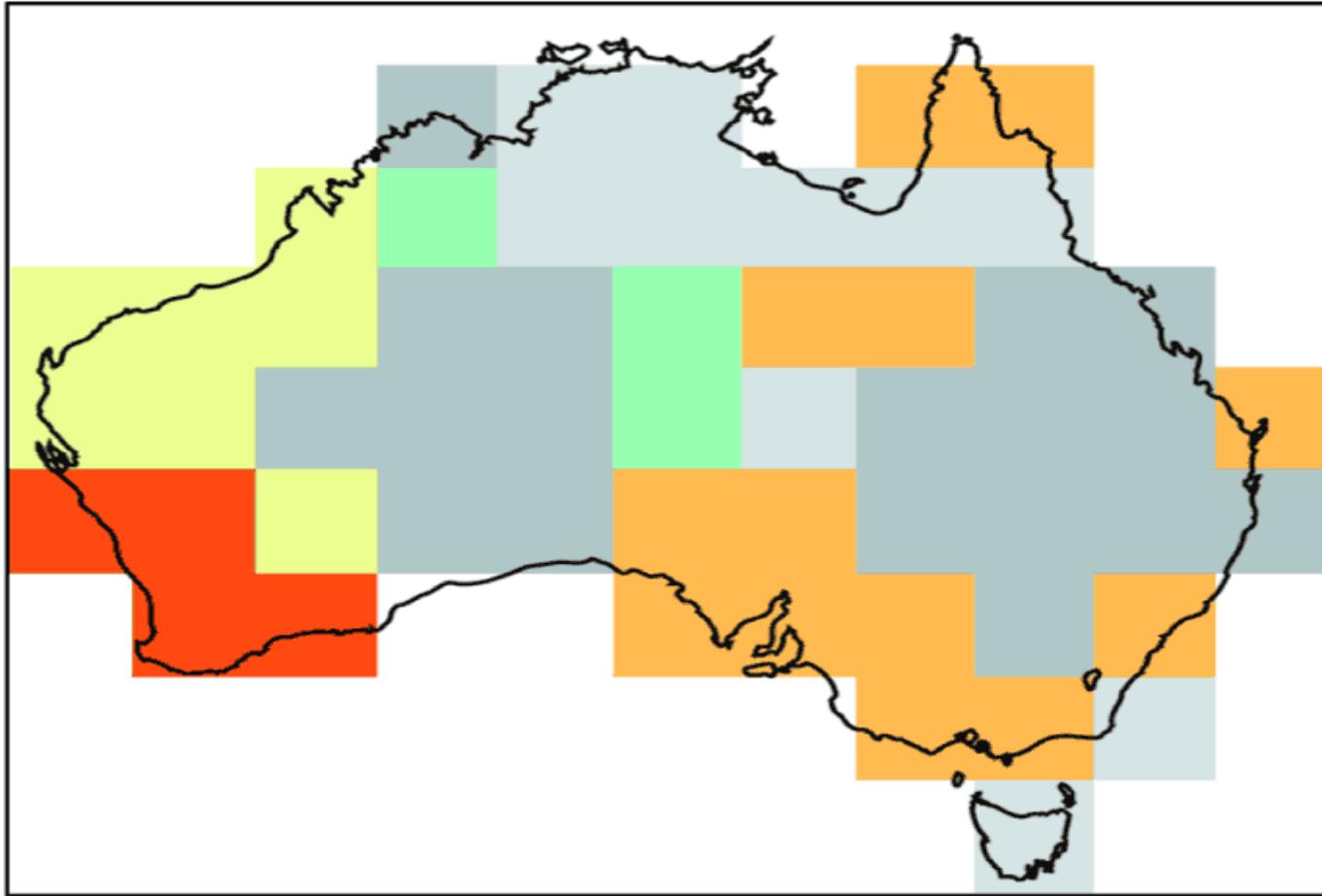
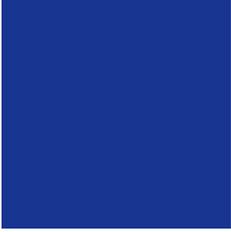
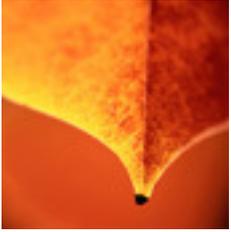
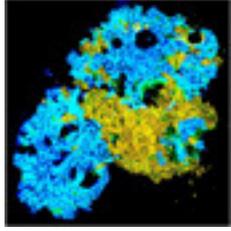
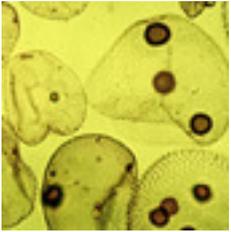
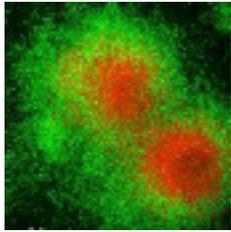
Center: nothing

Israel

South: oil-rich countries

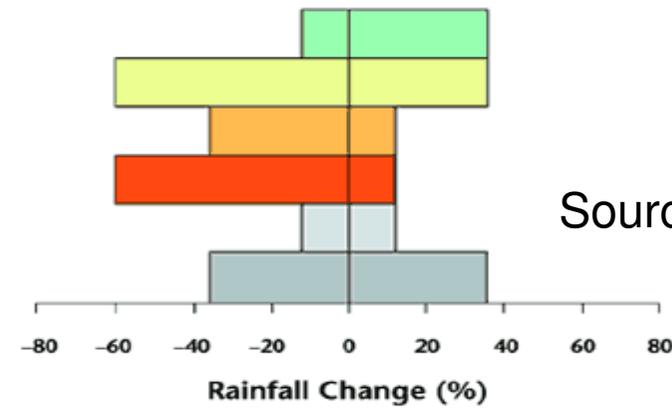
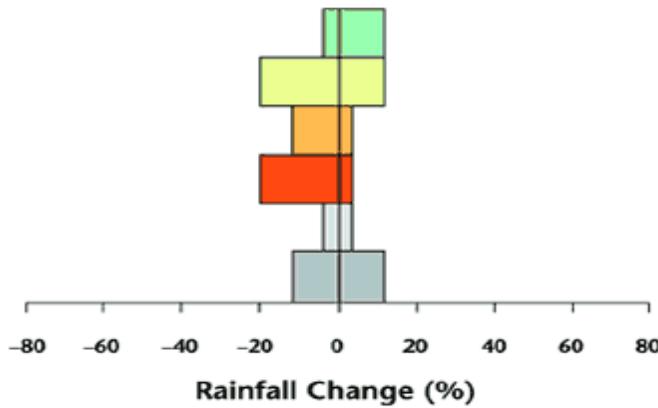






Drier 2030 Wetter

Drier 2070 Wetter



Source CSIRO





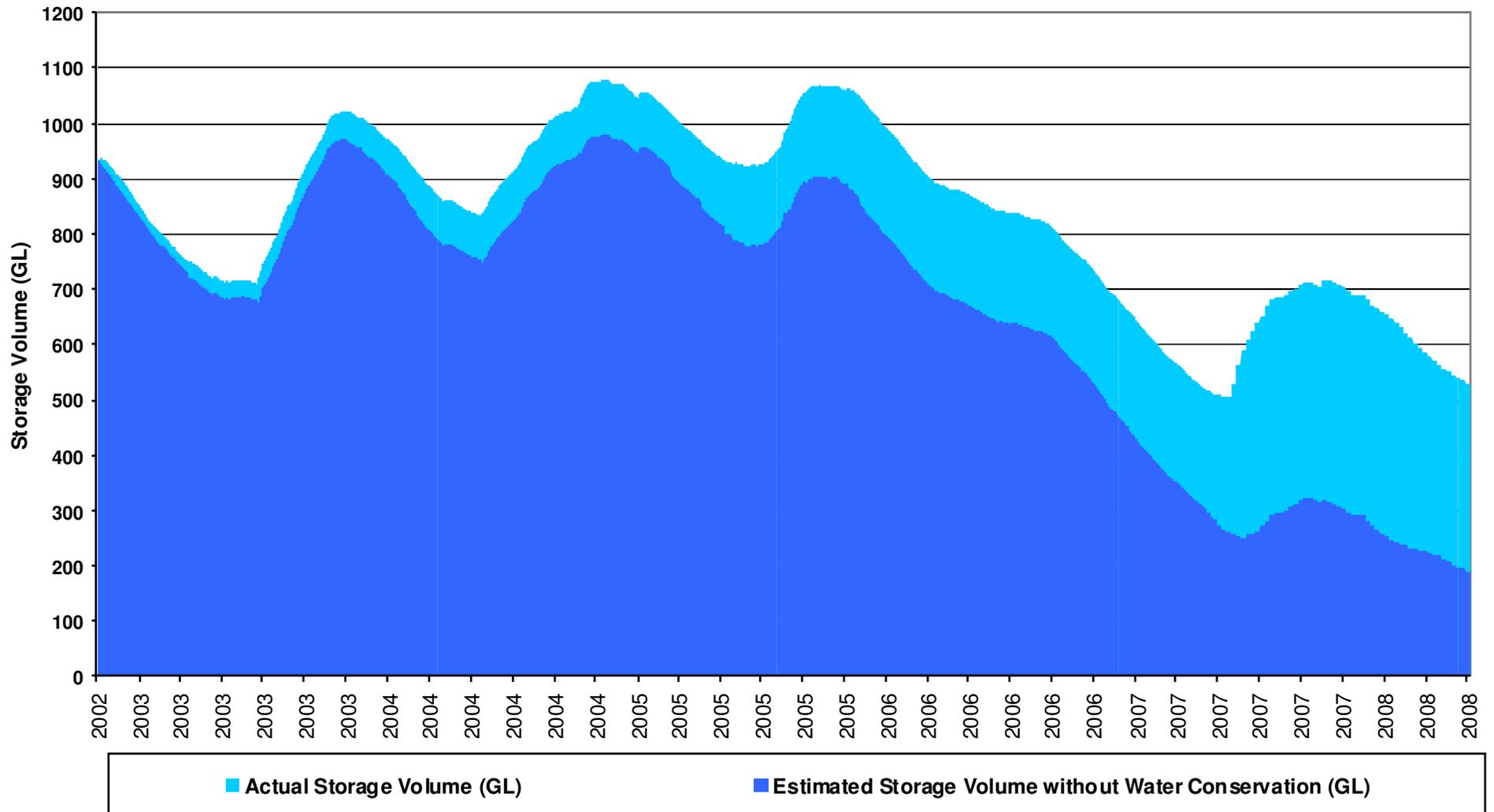
Projected urban water supply shortages by 2030

City	Projected Consumption 2030 GL/Y	Current <i>per Capita</i> Consumption (Unrestricted Usage) KL/Y	<i>Per Capita</i> Consumption required in 2030 with no increase in supply KL/Y	Reduction in <i>per capita</i> consumption %
Brisbane	255	210	103	51%
Gold Coast	99	147	78	47%
Melbourne	659	159	93	41%
Perth	313	171	102	41%
Sydney	884	174	80	54%

(1GL = 1billion litres)

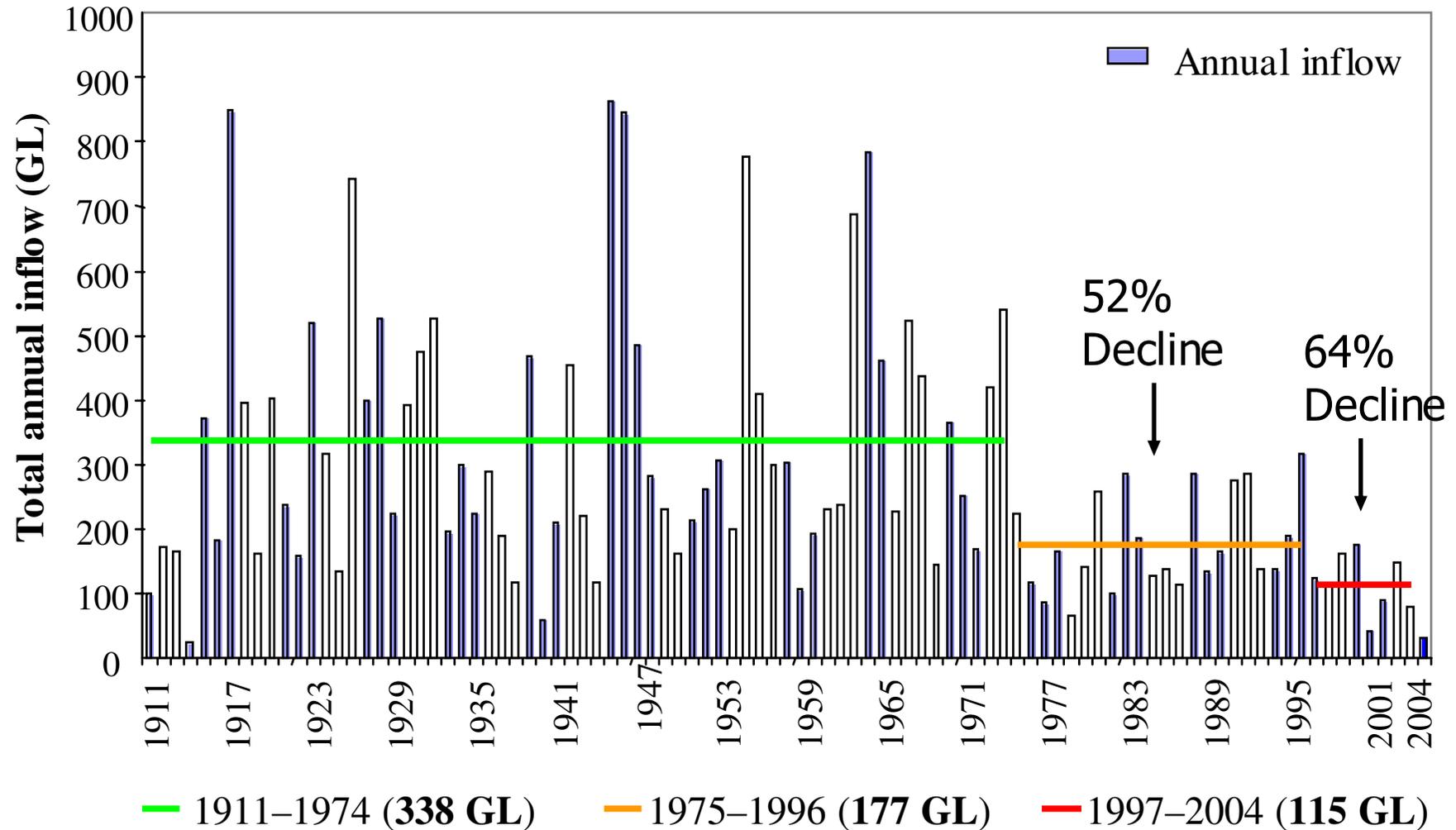
- These major cities must reduce *per capita* water consumption by at least 40% in the next 25 years unless they augment their water supply
- Total water supply shortfall by 2030 is ~800 GL/y

Melbourne Water Corporation Actual System Storage and Estimated System Storage (GL) Without Conservation: Dec 2002 - 2008



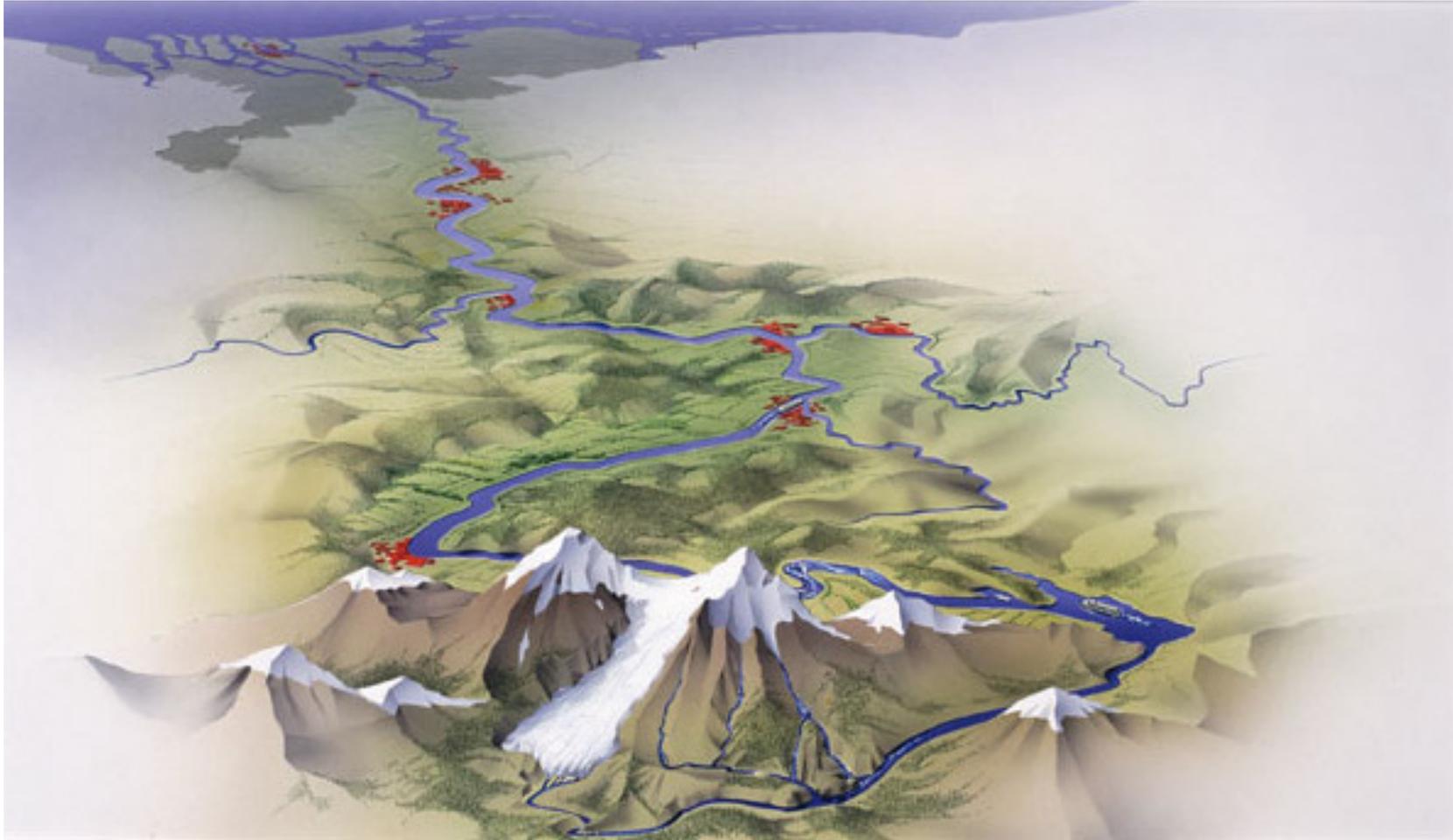


Annual inflows to Perth dams have declined markedly



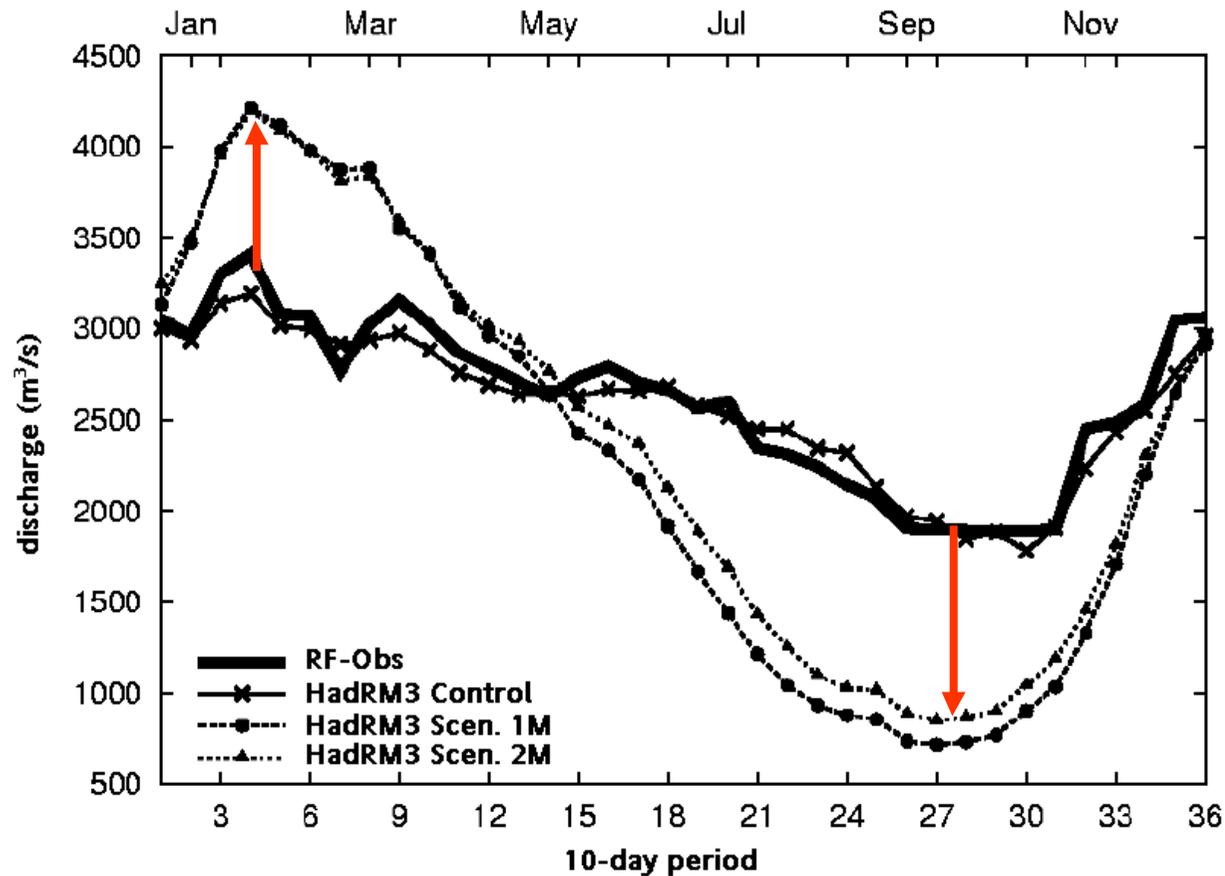
Source: WA Water Corporation.

Water supply to the Netherlands is heavily dependent upon the Rhine River (70%)





Possible impact of climate change on average discharge of the Rhine River (Lobith)



Buishand, T. A. and G. Lenderink (2004). *Estimation of future discharges of the river Rhine in the SWURVE project*, KNMI, De Bilt, Technical Report TR-273.



Impacts of climate change on the hydrological cycle (2): Increase of river floods and summer droughts



Meuse river, December 1993

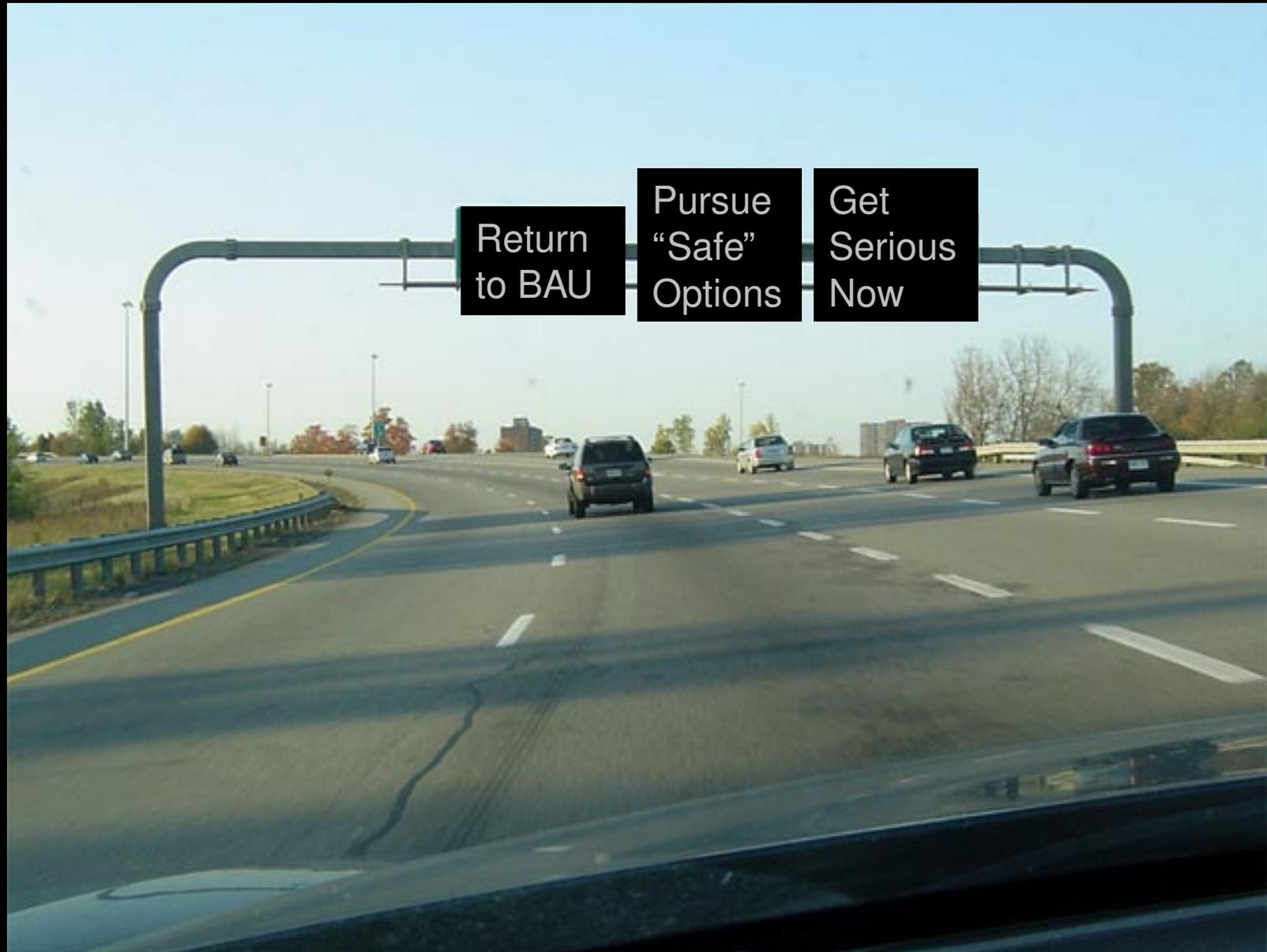


**Rhine river (secondary
channel in floodplain),
August 2003**

Colorado River Basin



Next Set of Choices



A Truly Different Way ...

- Guided by a systematic, empirically based rethink of how we construct the water systems supporting our cities
- Requires a rethink of how we build our cities and rarely seen joint city and water planning
- Requires a rethink of how cities relate to the larger scale environment (agriculture, energy, watershed services)



Water and Cities in the Future – Key Elements for Water Security

Ultimate Objectives

- Protection of human health
- Protection of ecological health
- Economic stability and enhancement
- Livability / quality of life

Water System Properties

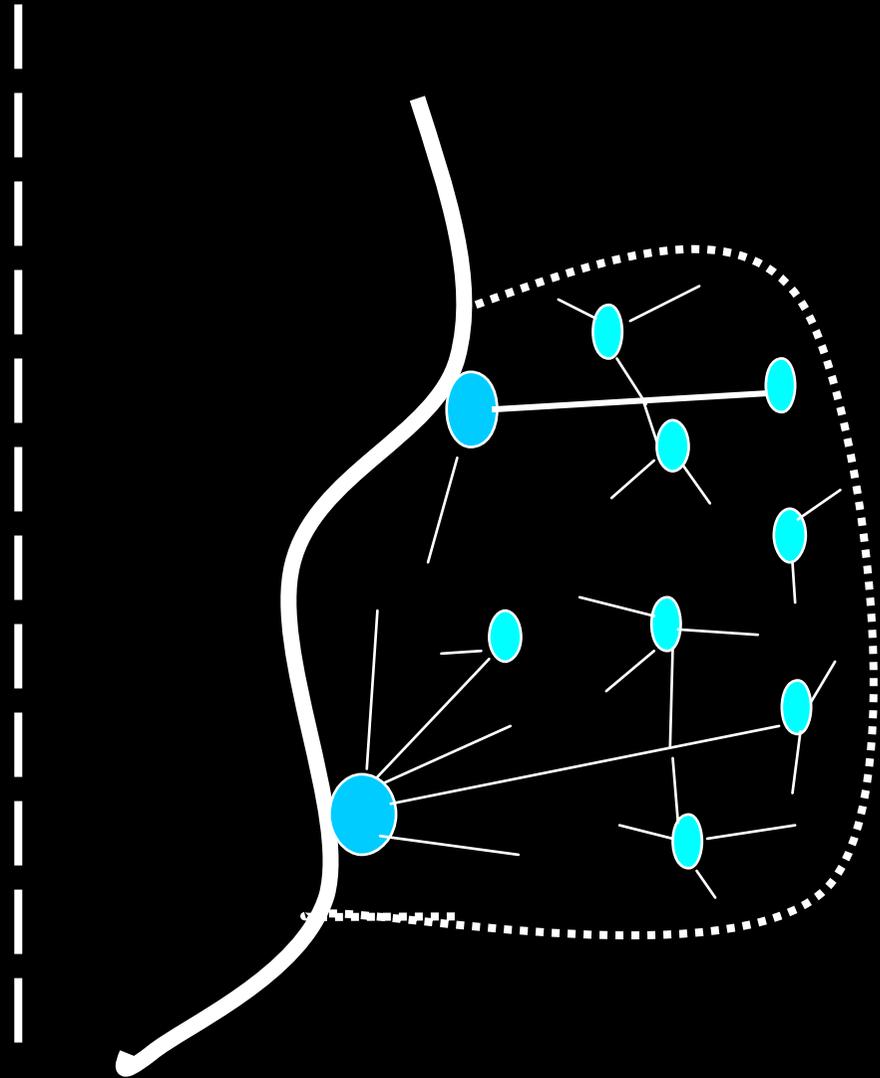
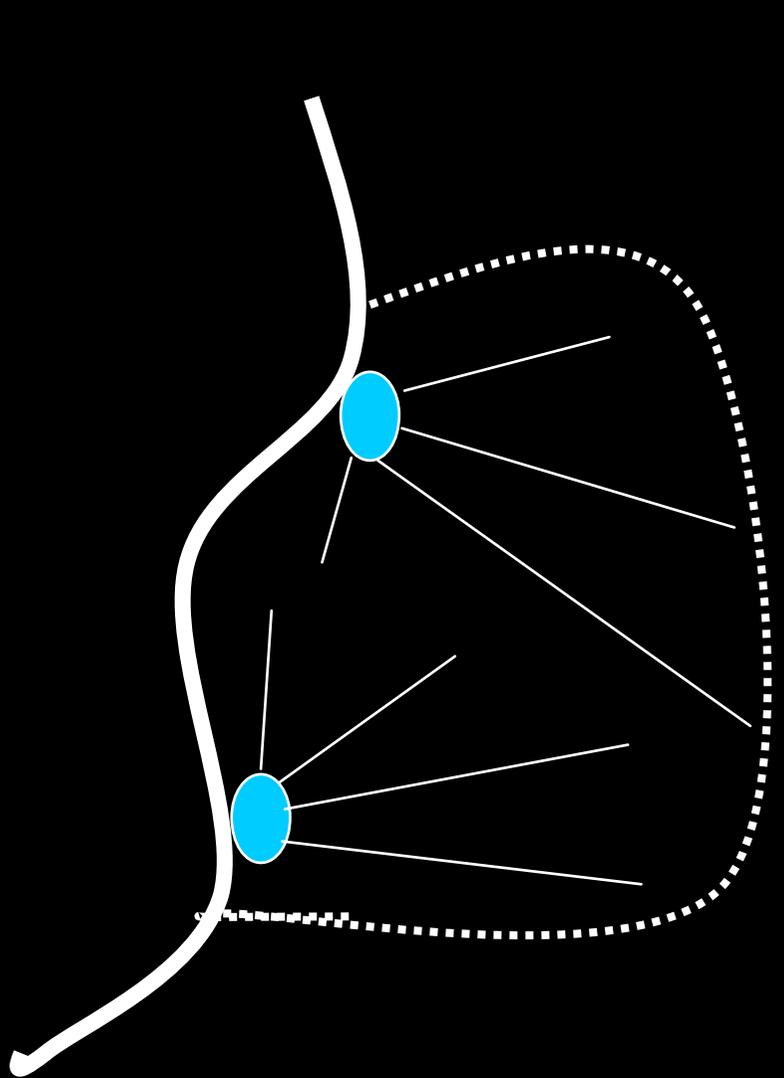
- Adaptable
- Resilient
- Diverse
- Efficient (resources and energy)
- Economical



Solution Set? – Likely elements

- Closing the loop → → rethink of basics
 - More efficient resource and energy outcomes
 - Different type of risks
- Fully integrating drinking water, wastewater, stormwater management
 - Big institutional challenges
- Further linking the city systems with larger scale environment
 - Agriculture, energy, watershed services
 - Resource benefits with energy costs

Centralized vs. Nodal System

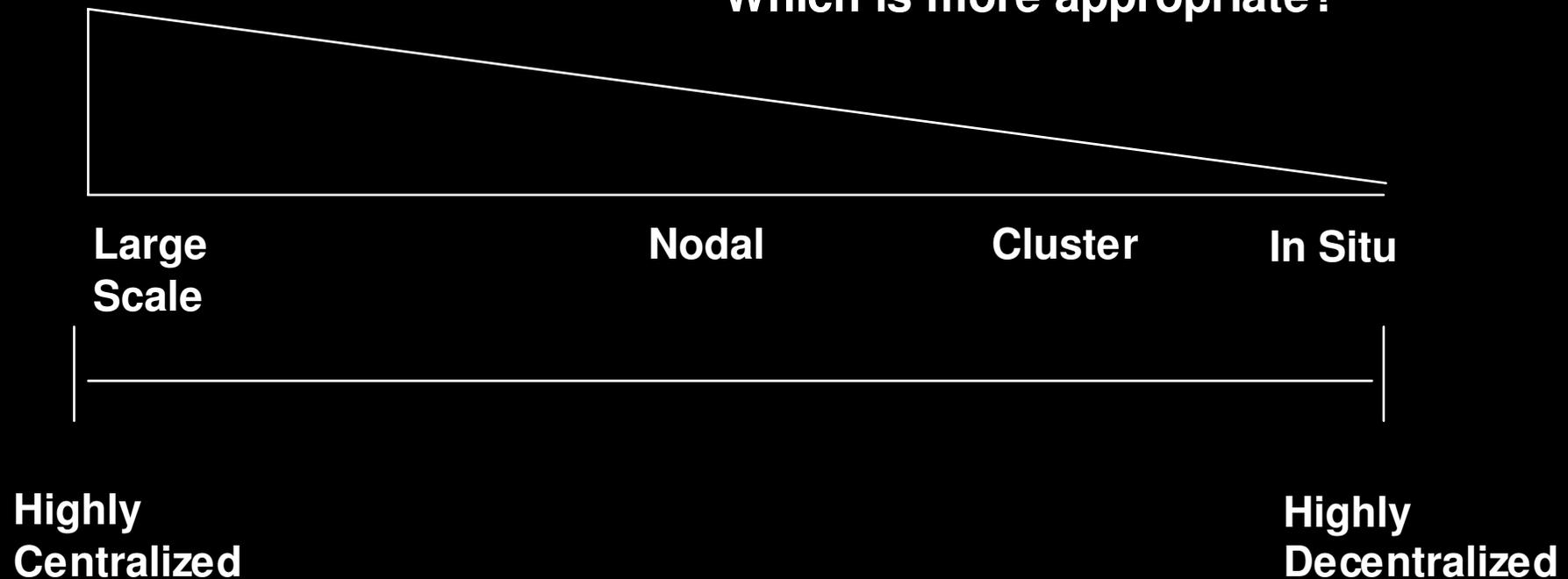


Optimizing Within A Continuum of Options

Which is more efficient?

Which is more sustainable?

Which is more appropriate?



FOUR NATIONAL TAPS



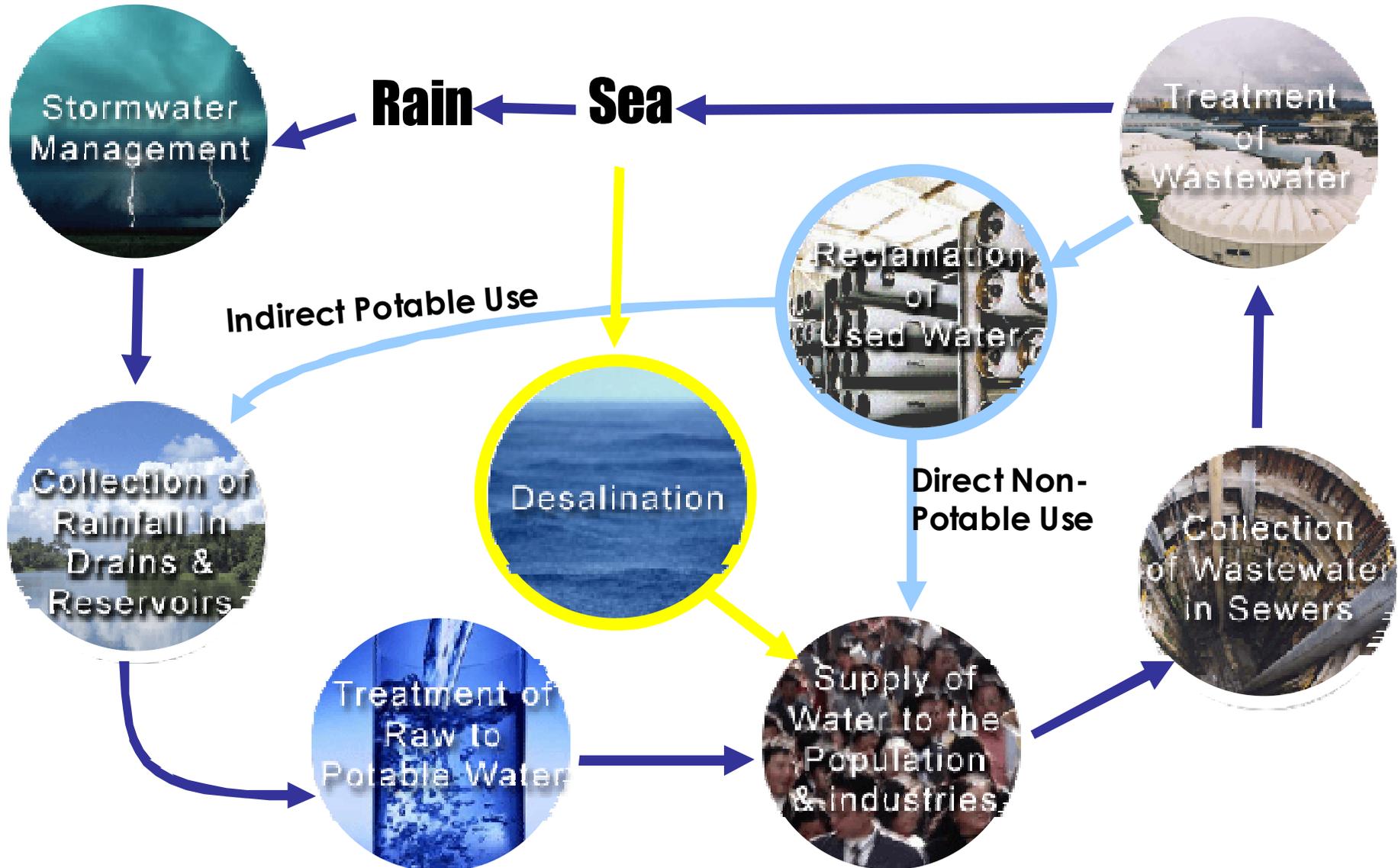
Water for All: Conserve, Value, Enjoy



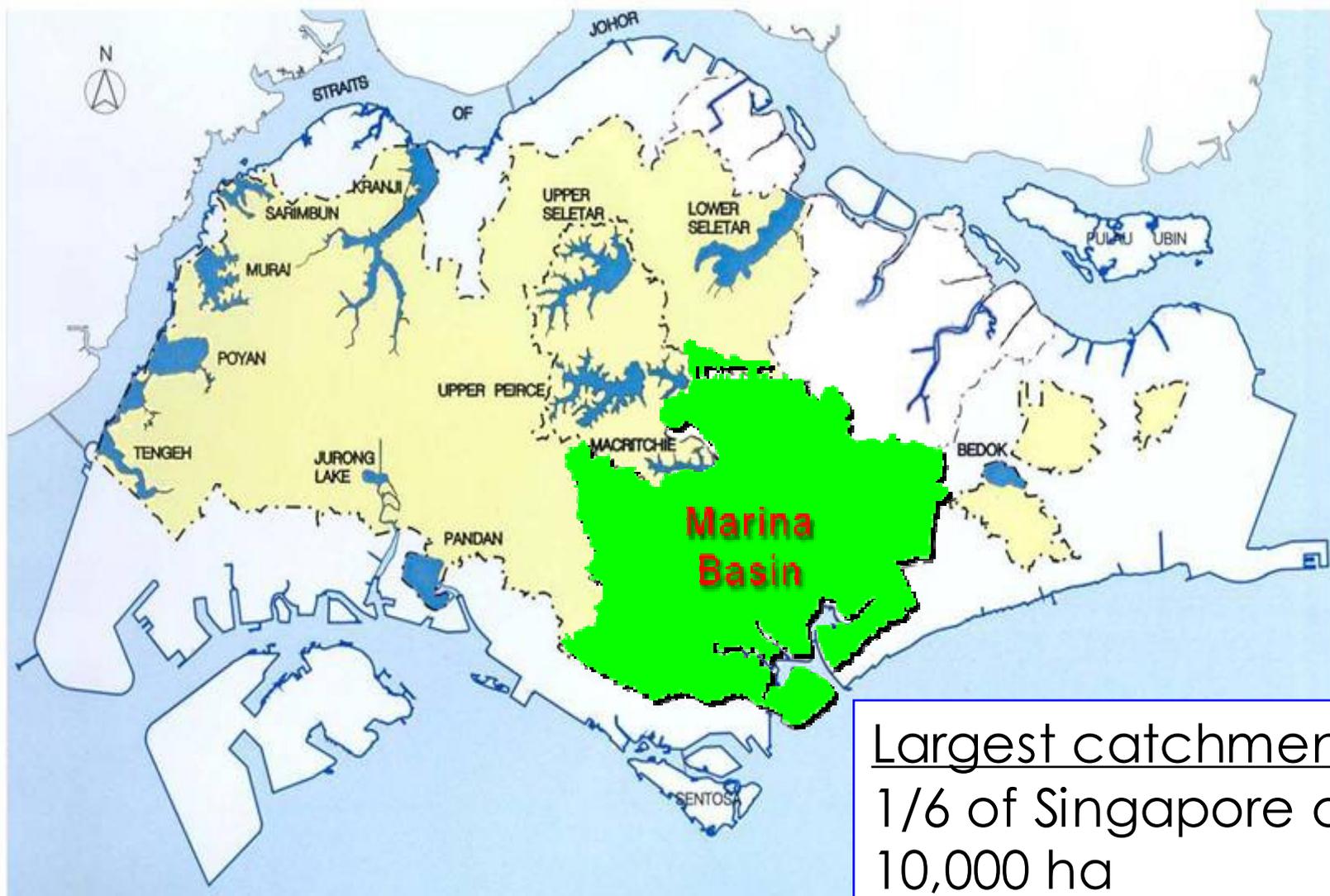
Integrating the Water Loop : Water for All

PUB manages the complete water cycle

From sourcing, collection, purification and supply of drinking water, to treatment of used water and turning it into NEWater, drainage of storm water



National Tap – Local Catchment



Largest catchment –
1/6 of Singapore or
10,000 ha

Sustainable water management

4 National Taps



- Local catchment
- Imported water (Johor)
- NEWater
- Desalinated water

“Water for All”

3P Approach



“Conserve Water”

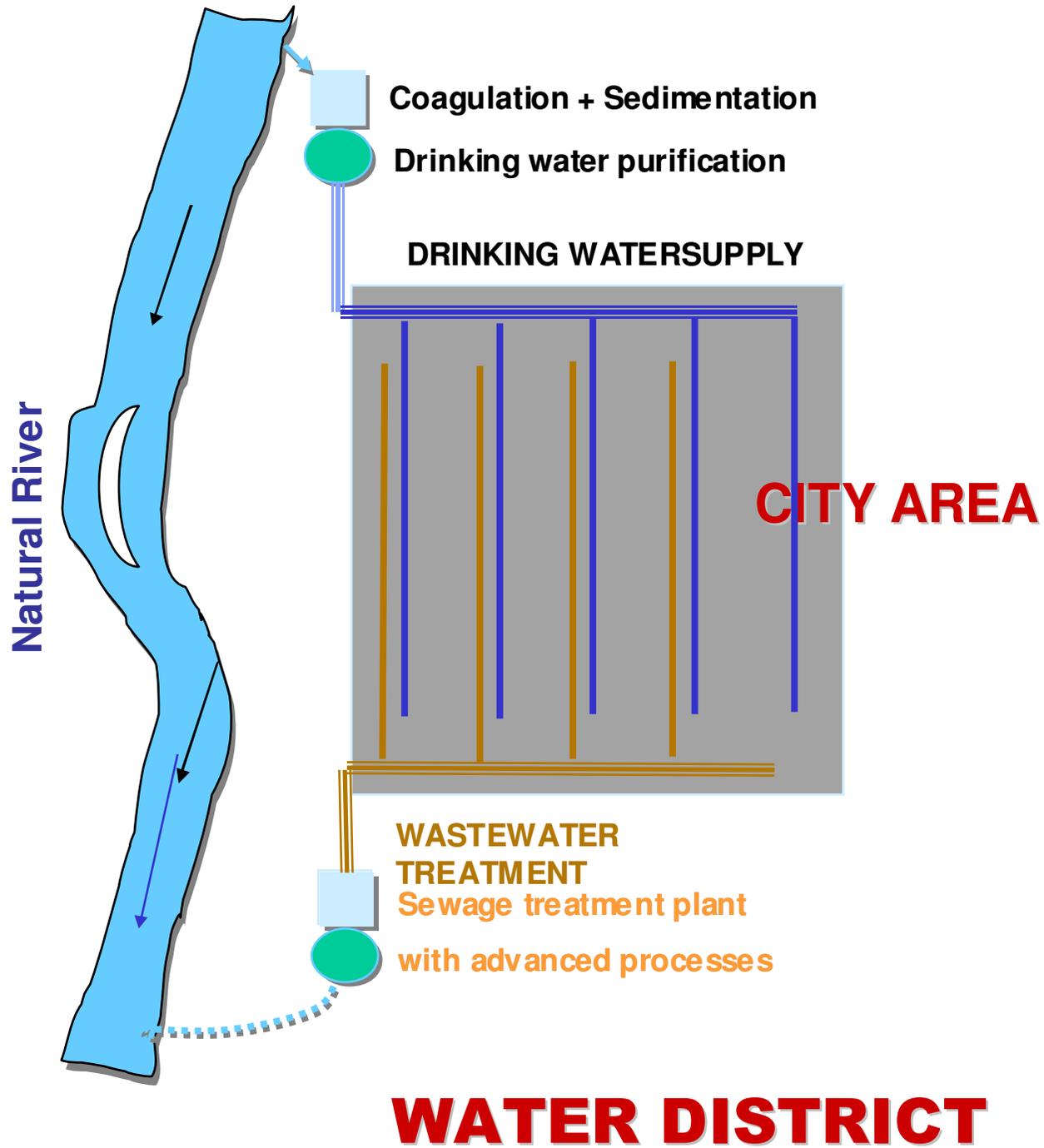
“Value Our Water”

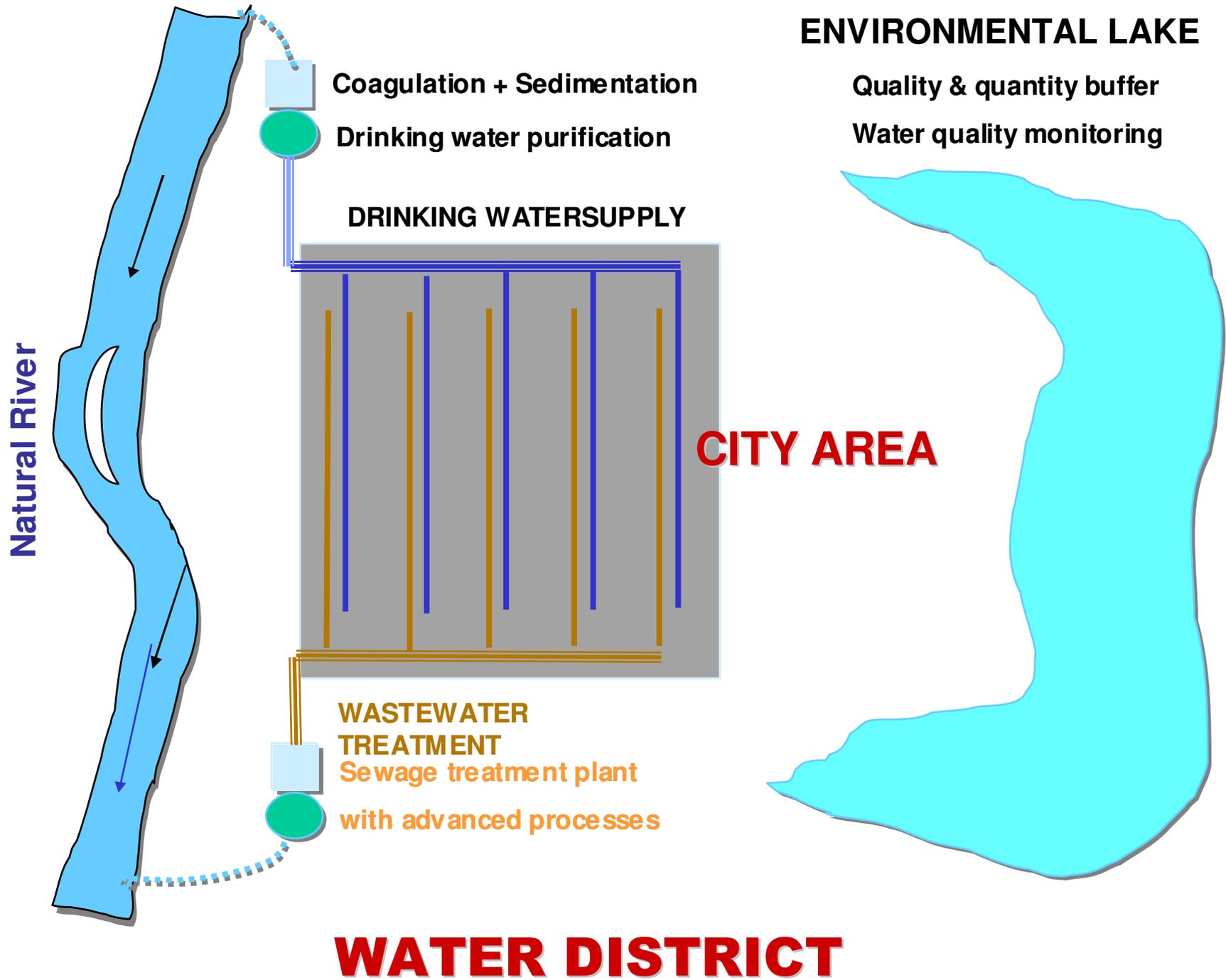
“Enjoy Our Waters”

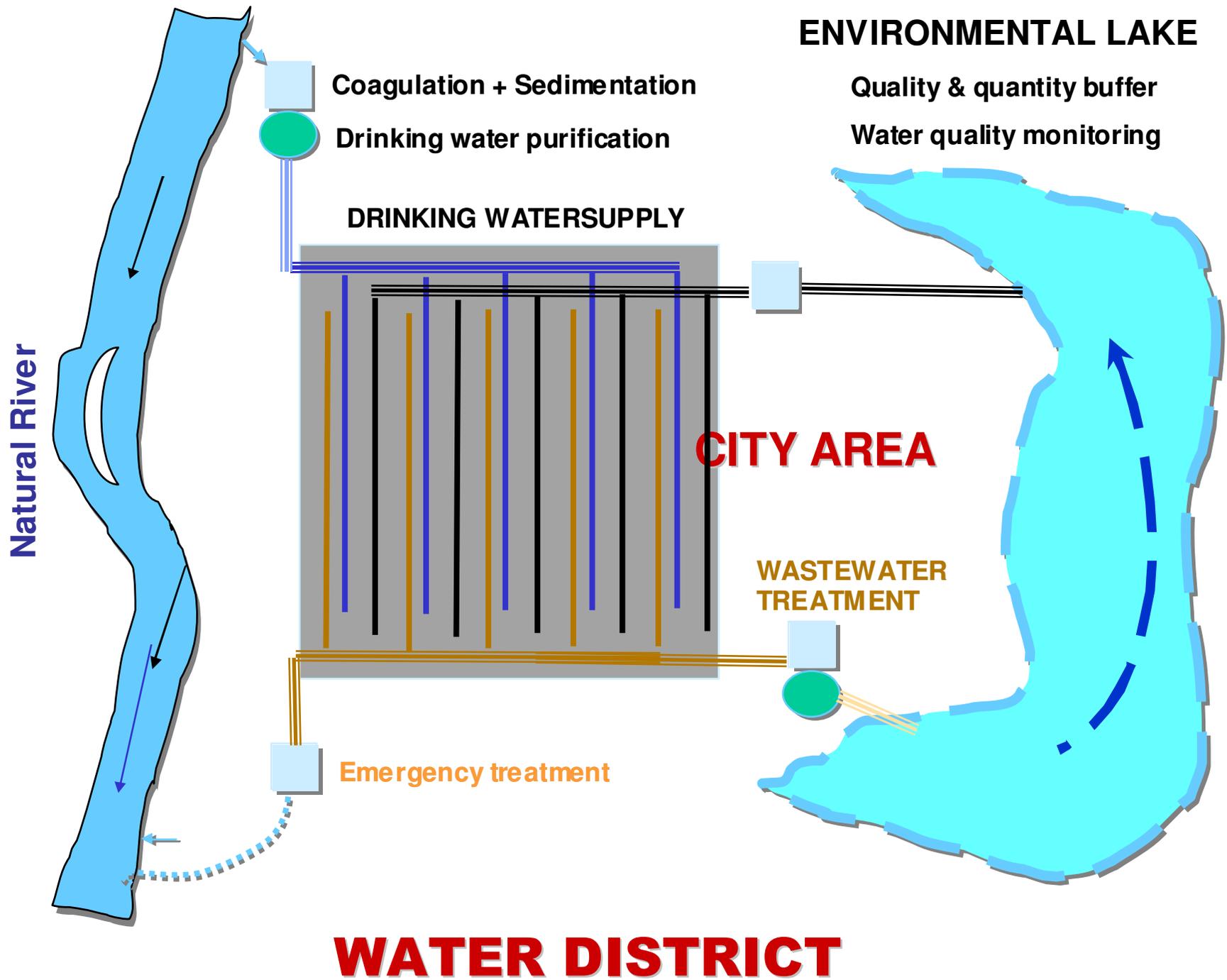
“Conserve, Value, Enjoy”

Water for All: Conserve, Value, Enjoy





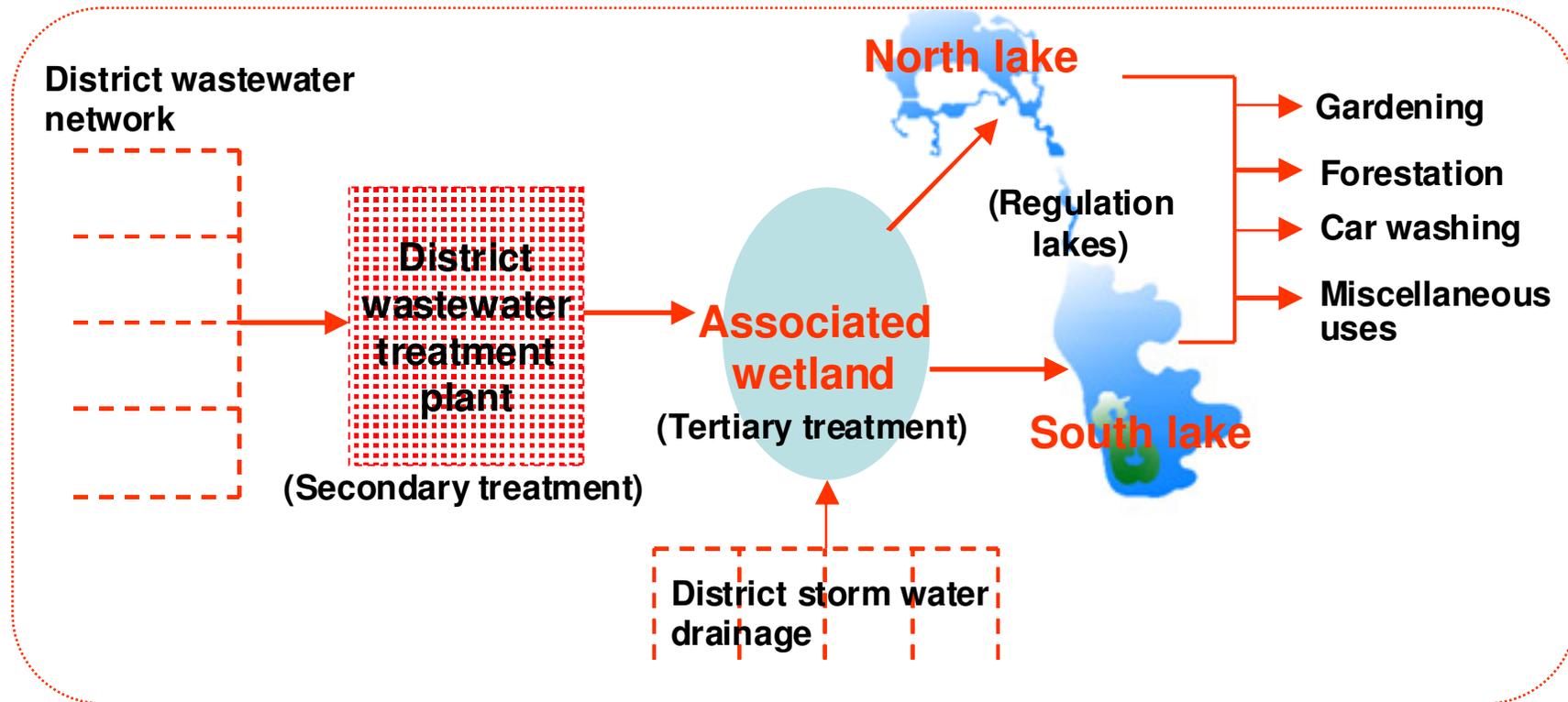






Case study 3: a newly developed district as an independent water district

● Configuration of an independent water district





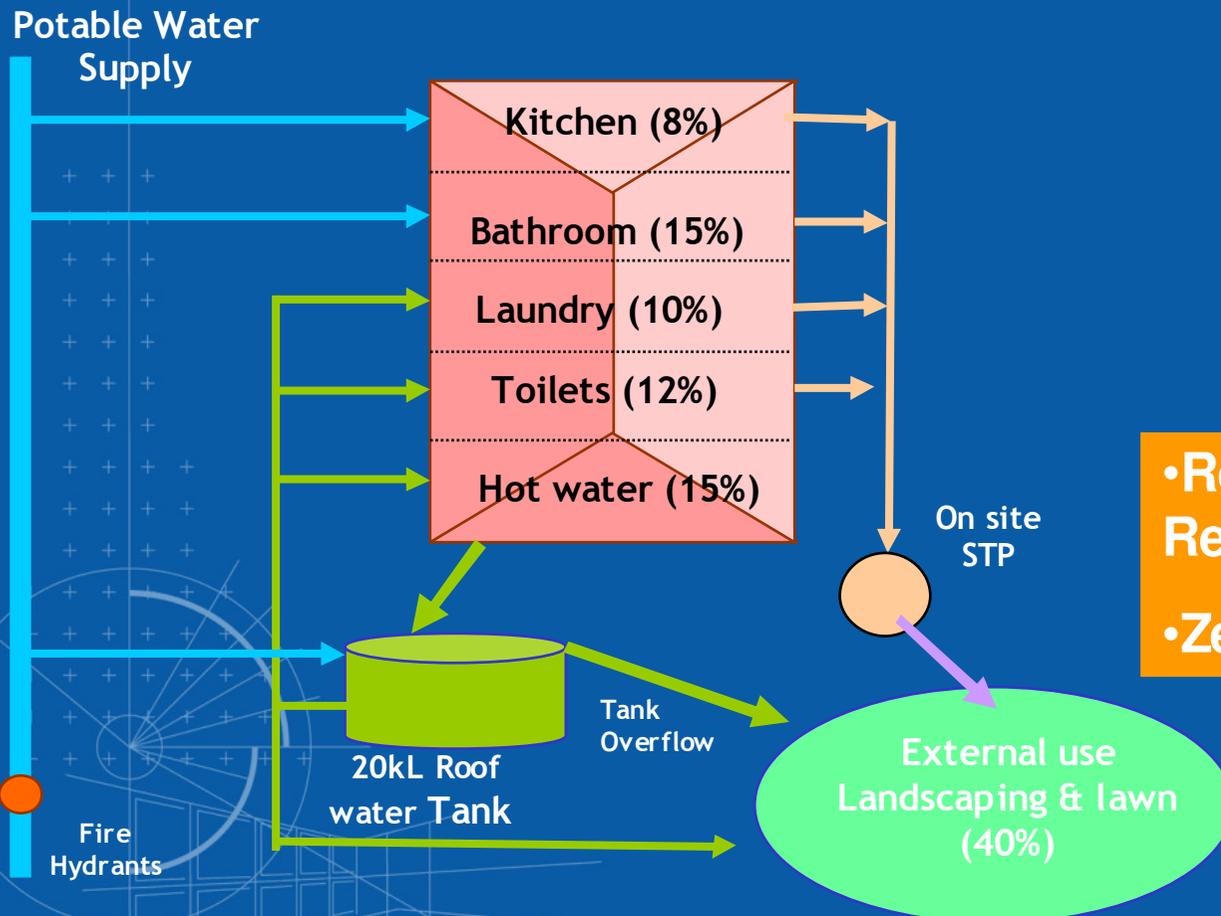
Shinjuku Area

Ochiai Sewage Treatment Plant





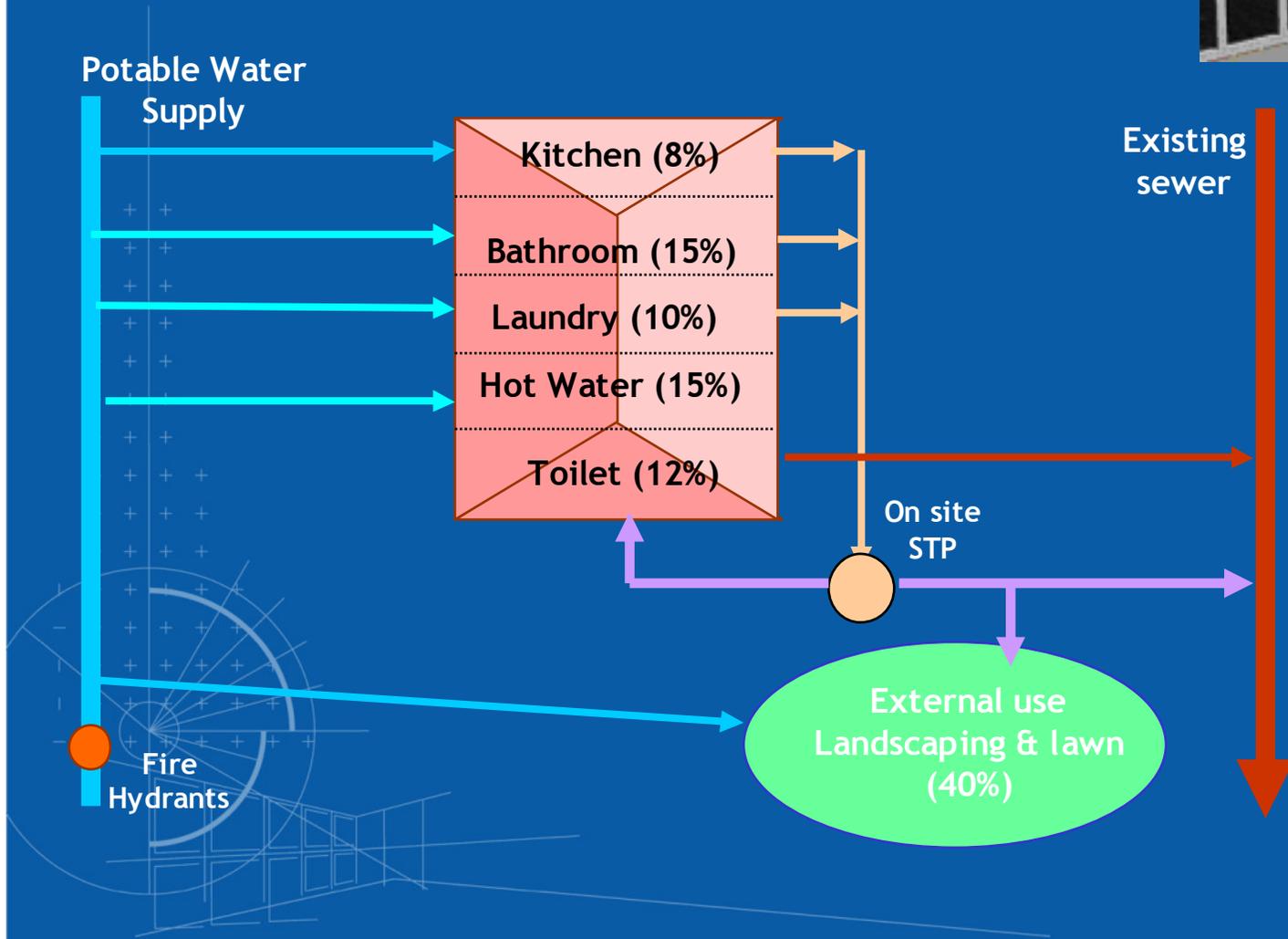
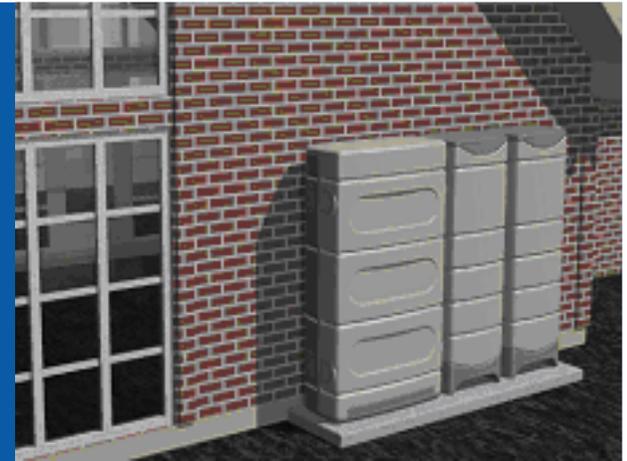
Concept Applicable at Household Level



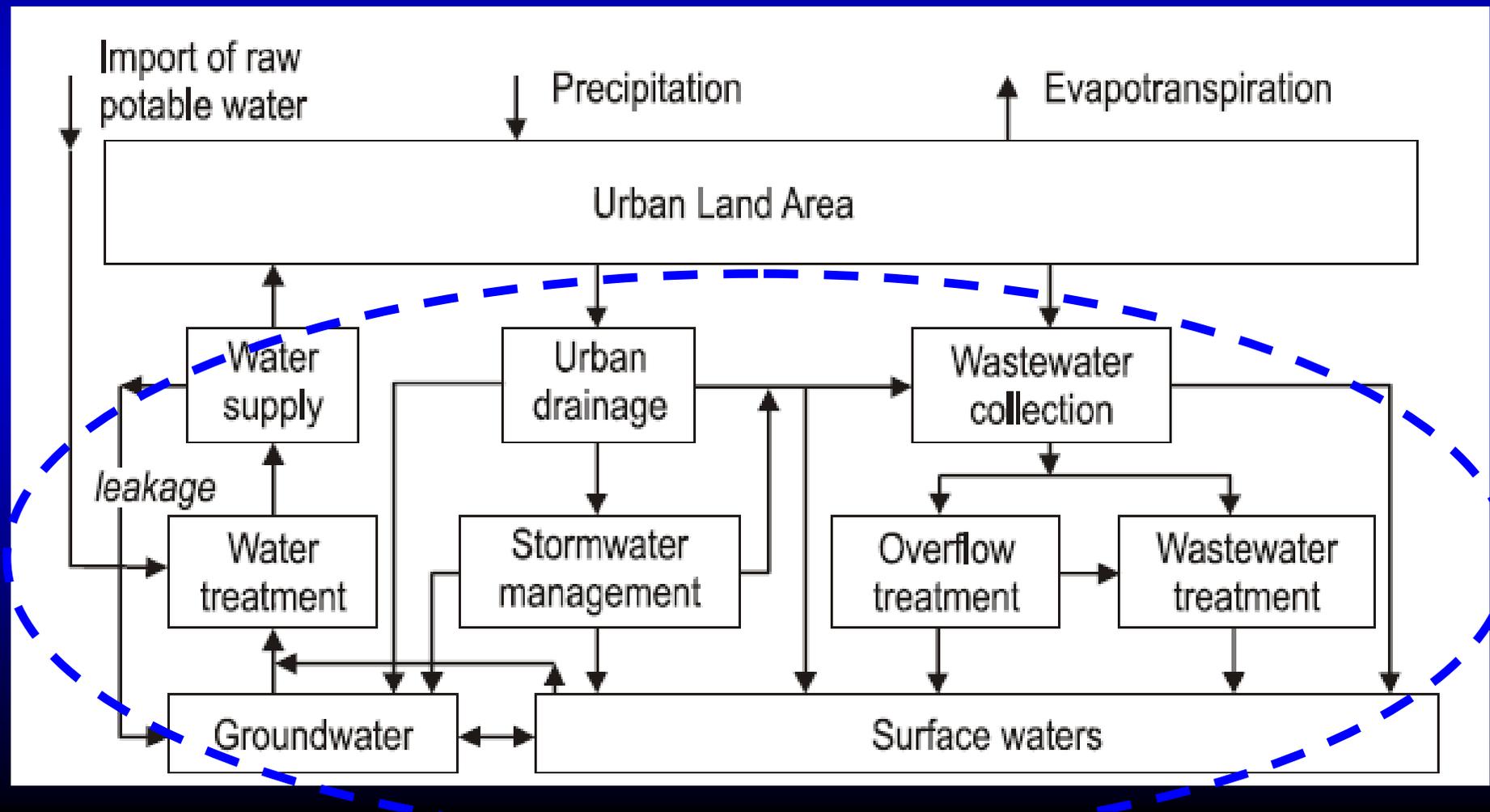
- Reduced water use from Reticulation by 60%
- Zero wastewater discharge



On-Site Solutions – Brownfield Sites



Addressing a Disintegrated Approach to Urban Water Mgt

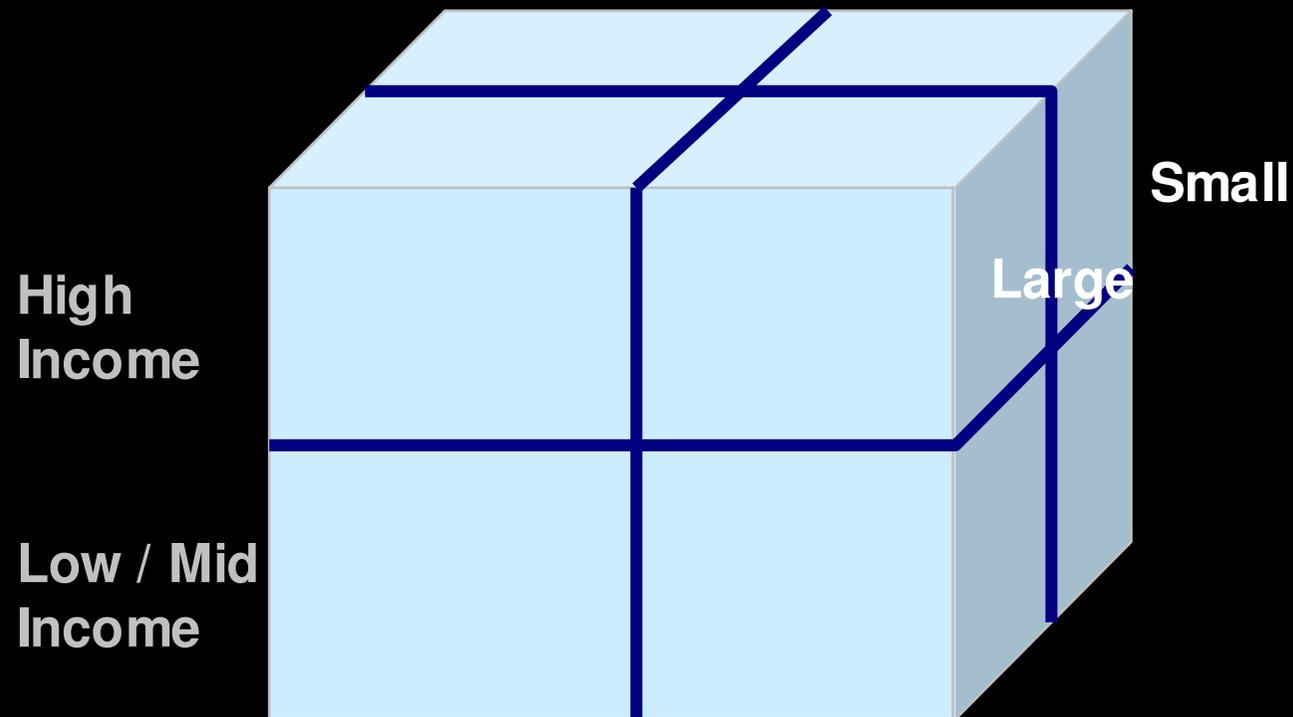


To step into a new way, major challenges lie ahead

- Institutional restructuring
- System / network modeling and potential redesign
- Taking advantage of breakthrough technologies
- Marrying city and water planning (currently unacquainted)
- Modifying exiting building/fire code rules
- Linking with energy at all levels
- Developing resilience for emergent pathogens and health impacts
- Fully internalize environmental needs
- Developing much closer relationship with community



The Application Space

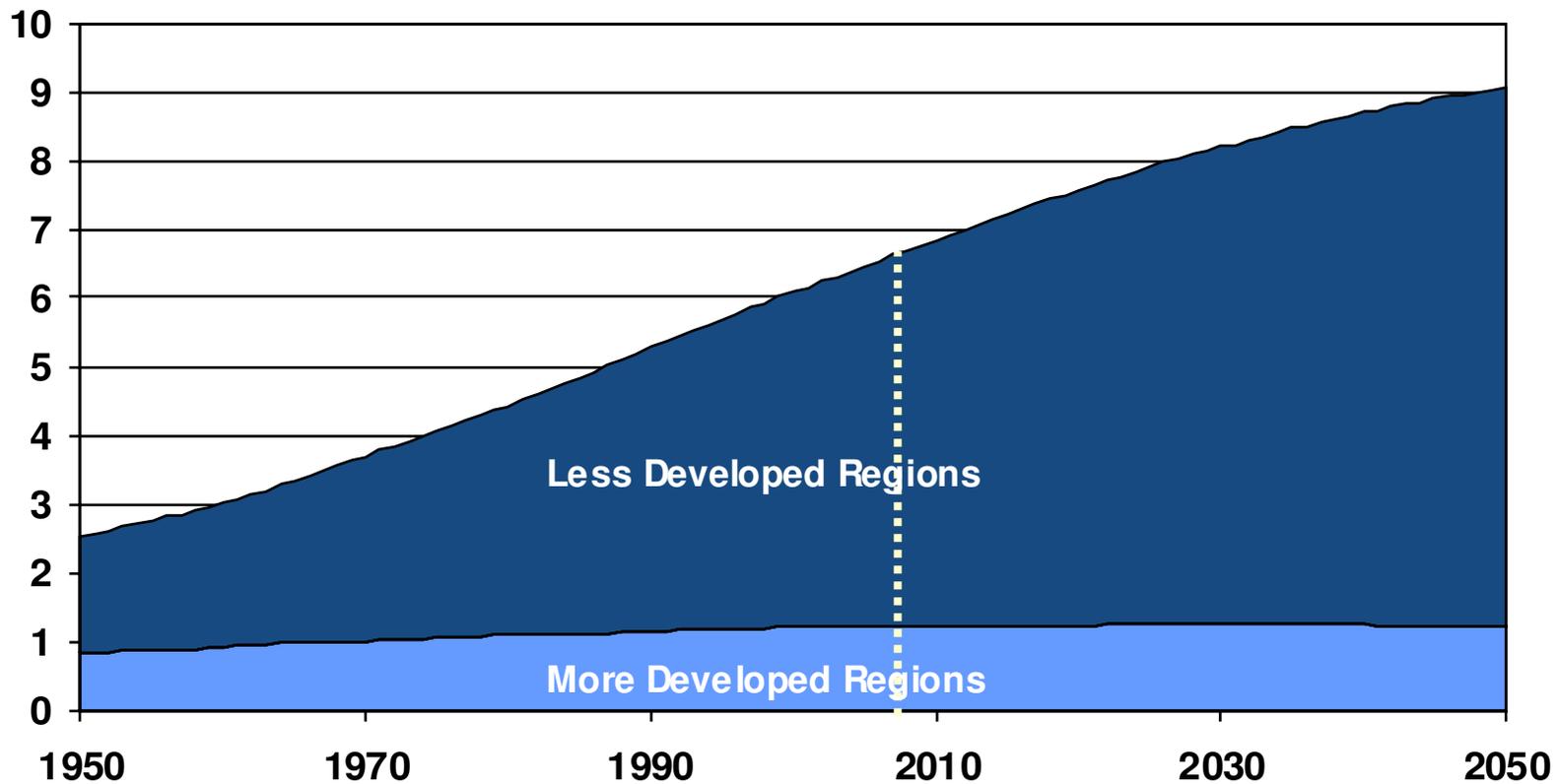


Already built:
Urban
remodelling

**Greenfield
(& brownfield):**
Starting from
scratch

Growth in More, Less Developed Countries

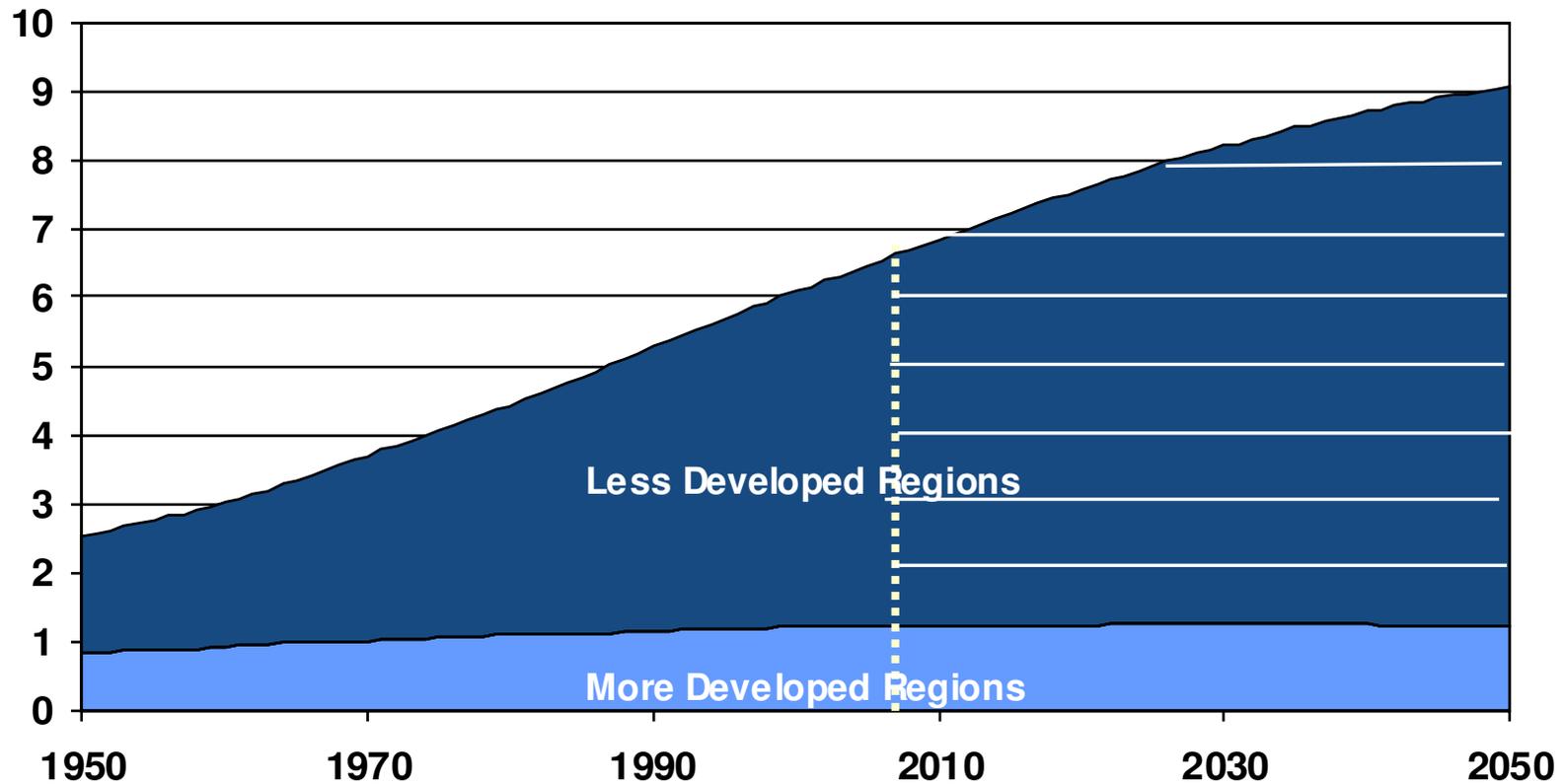
Billions



Source: United Nations, *World Population Prospects: The 2004 Revision* (medium scenario), 2005.

Growth in More, Less Developed Countries

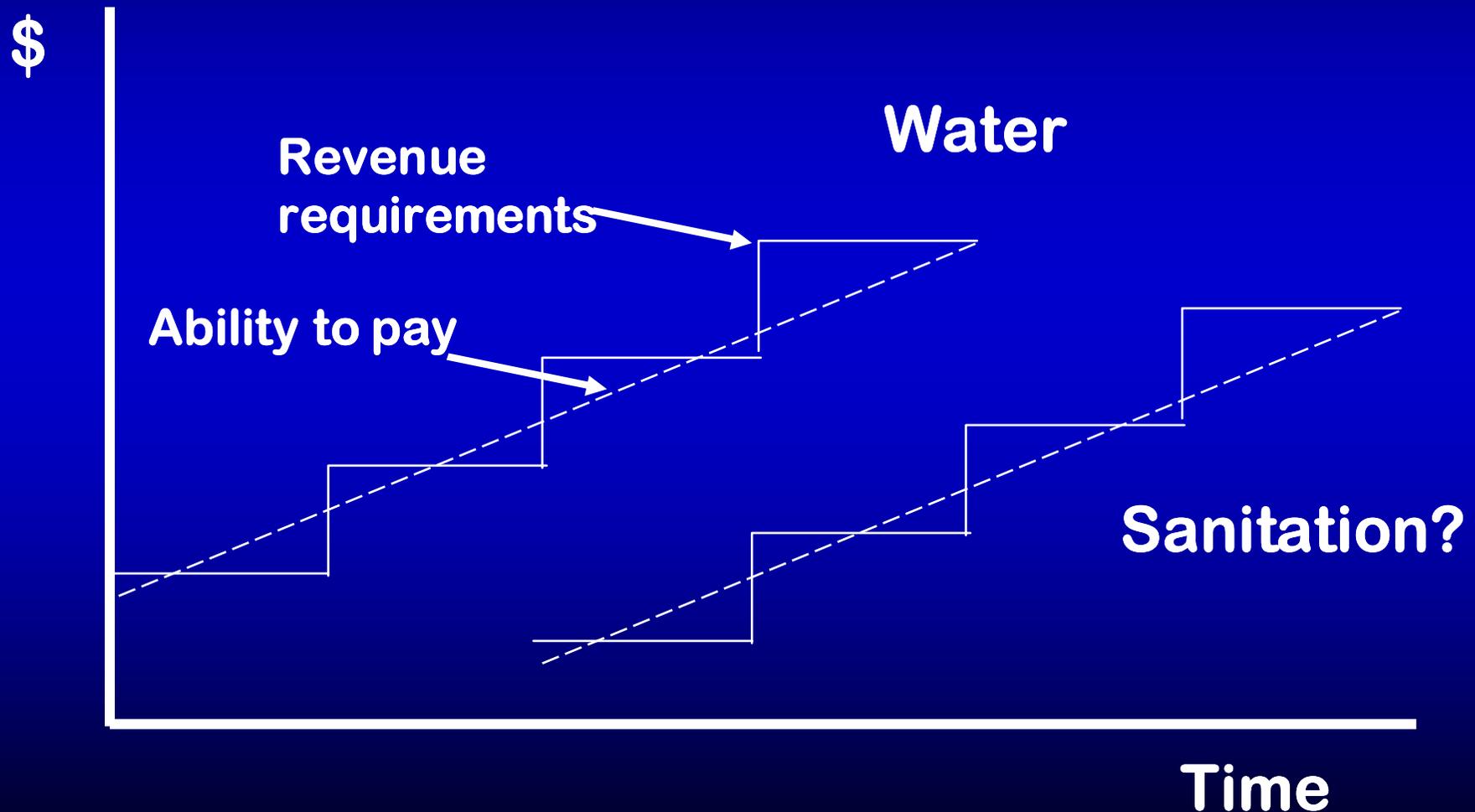
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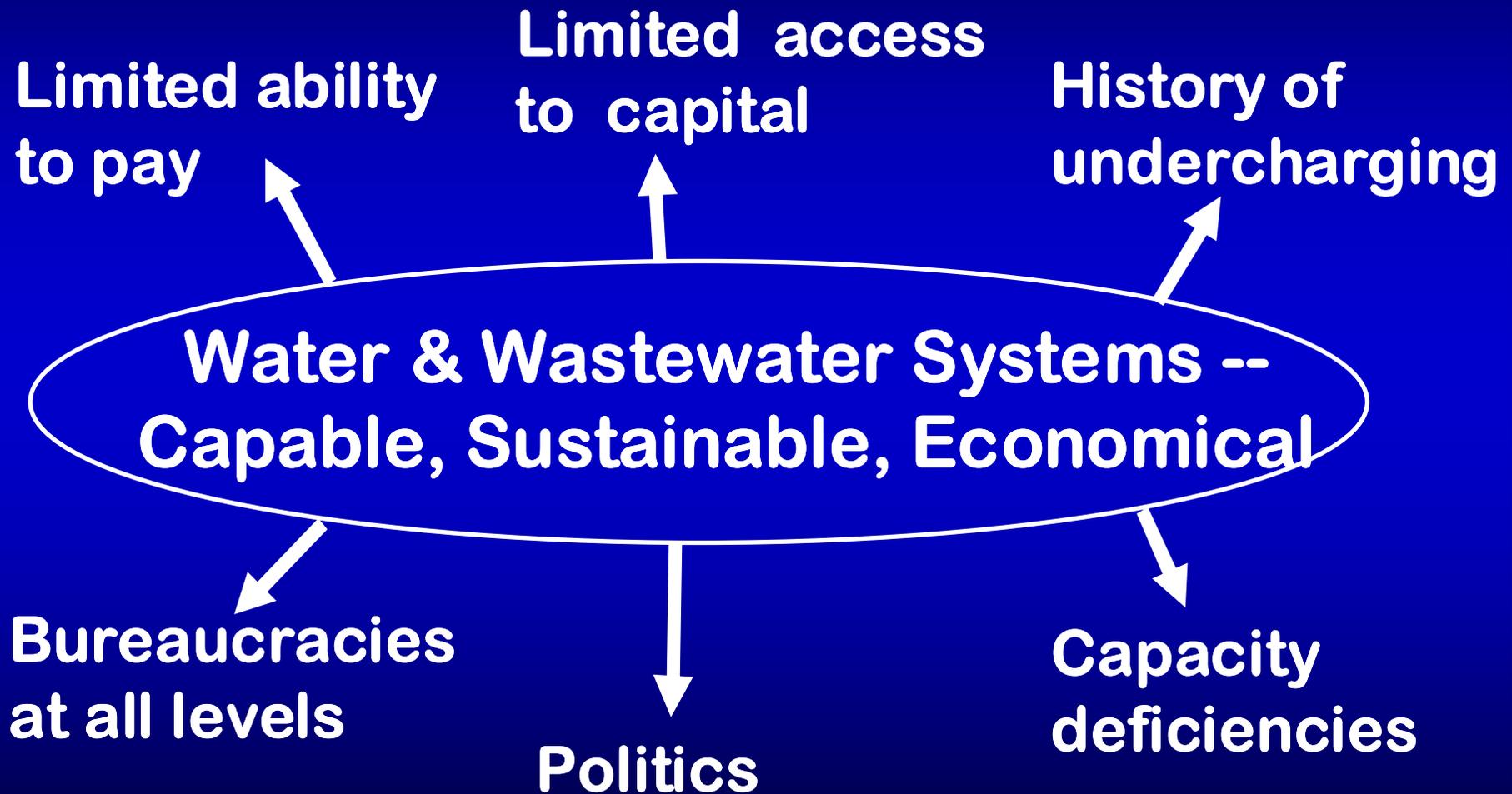


Strategic Stair Step Approach to System Build-Out?



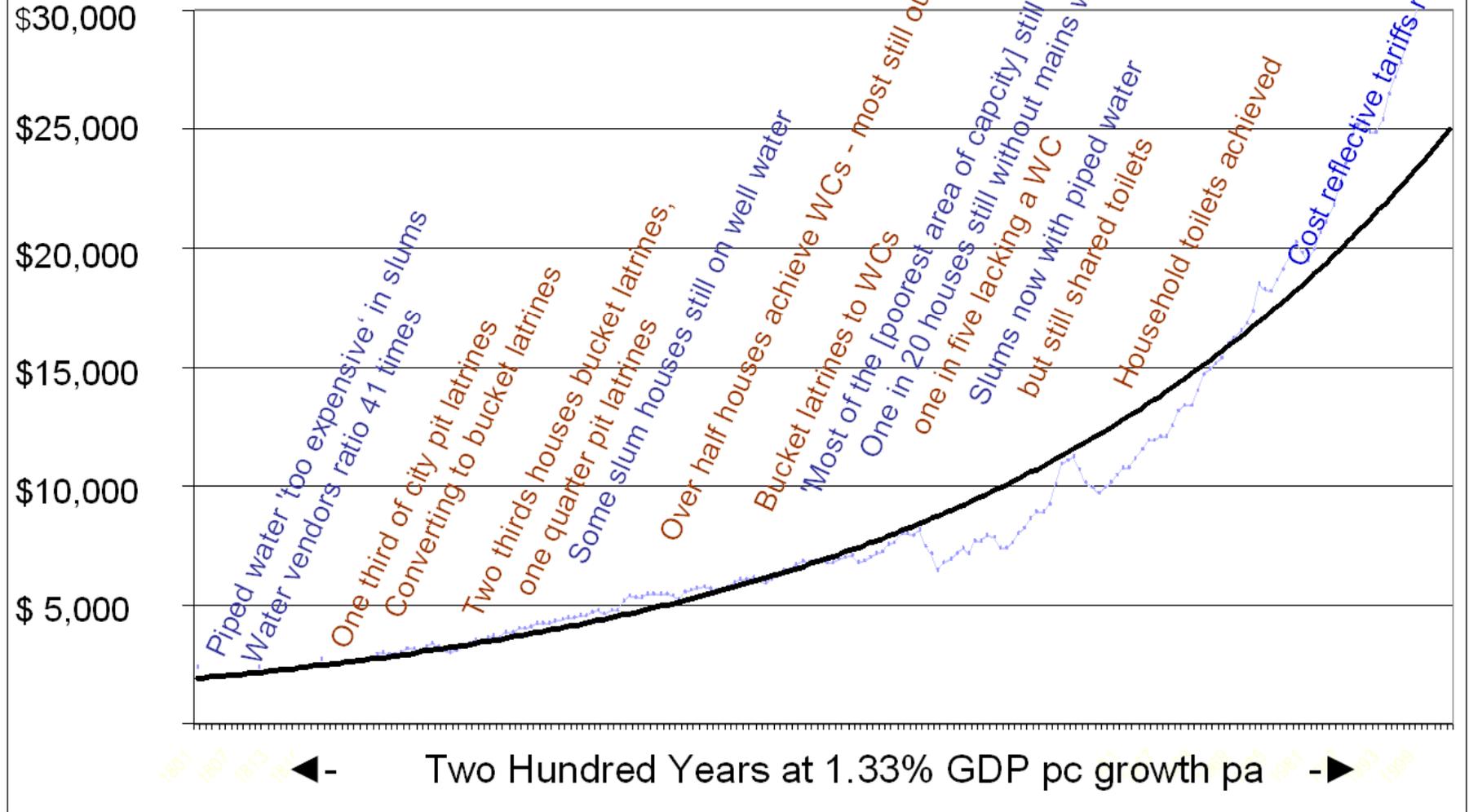


Key Challenges



Water & Sanitation and Economic Development 'A secondary city'

GDP pc 'real'



Water & Sanitation and Economic Development 'A secondary city'

GDP pc 'real'

\$30,000

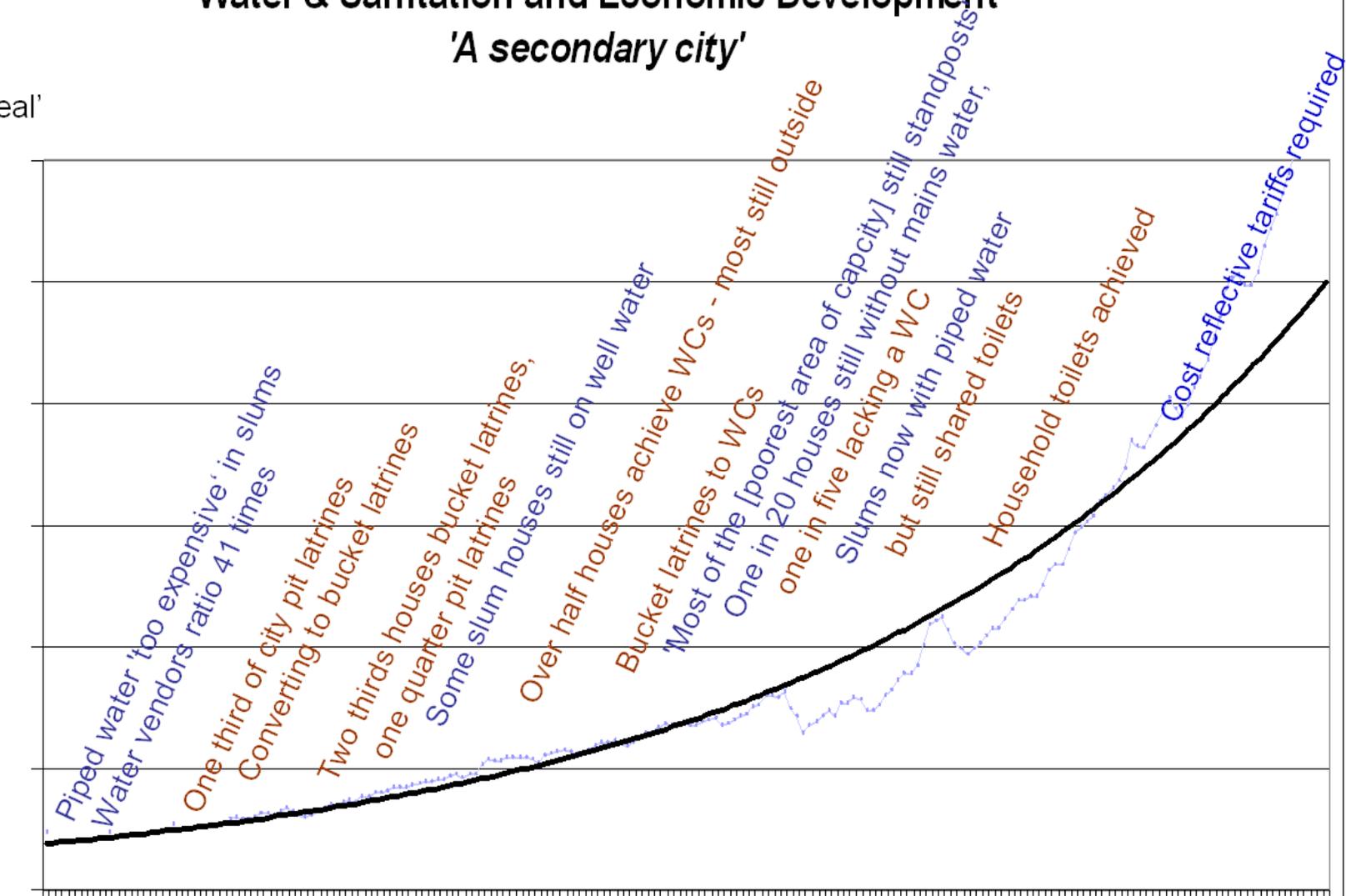
\$25,000

\$20,000

\$15,000

\$10,000

\$5,000



1801 1807 1813 1841

Two Hundred Years at 1.33% GDP pc growth pa

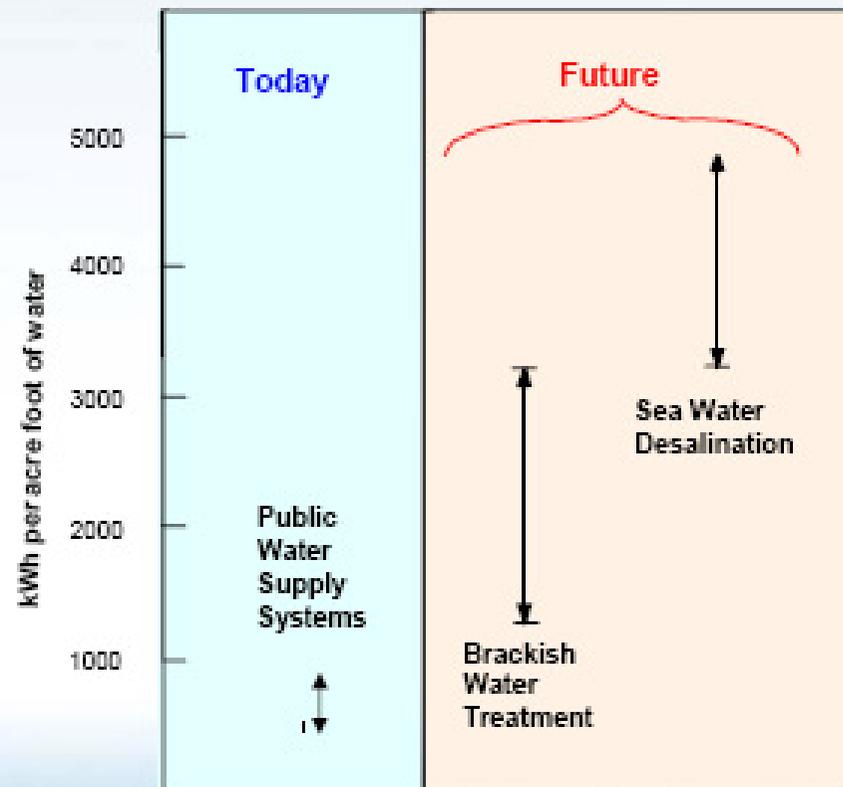
1900 1910 1920 1950 1980 1999

Future water supplies and treatment will be more energy intensive



- Readily accessible fresh water supplies are limited and have been fully allocated in some areas
 - Increased energy for pumping at deeper depths and longer conveyance
- New technologies to access and/or treat non-traditional water resources will require more energy per gallon of water
 - Impaired water, produced water, brackish water, and sea water

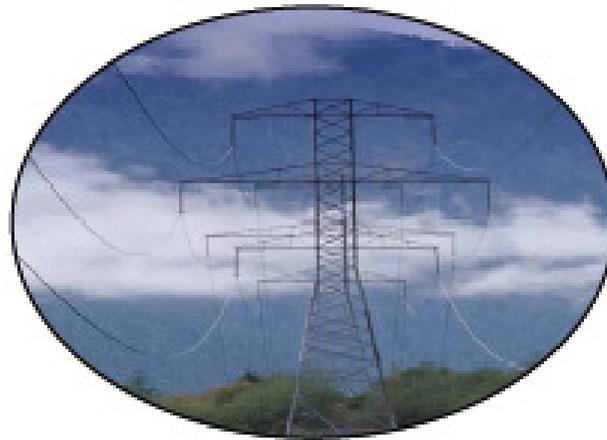
Power requirements for current and future water supply



Source: EPRI (2000), Water Desalination Task Force (2003)

Energy and Water are Inextricably Linked

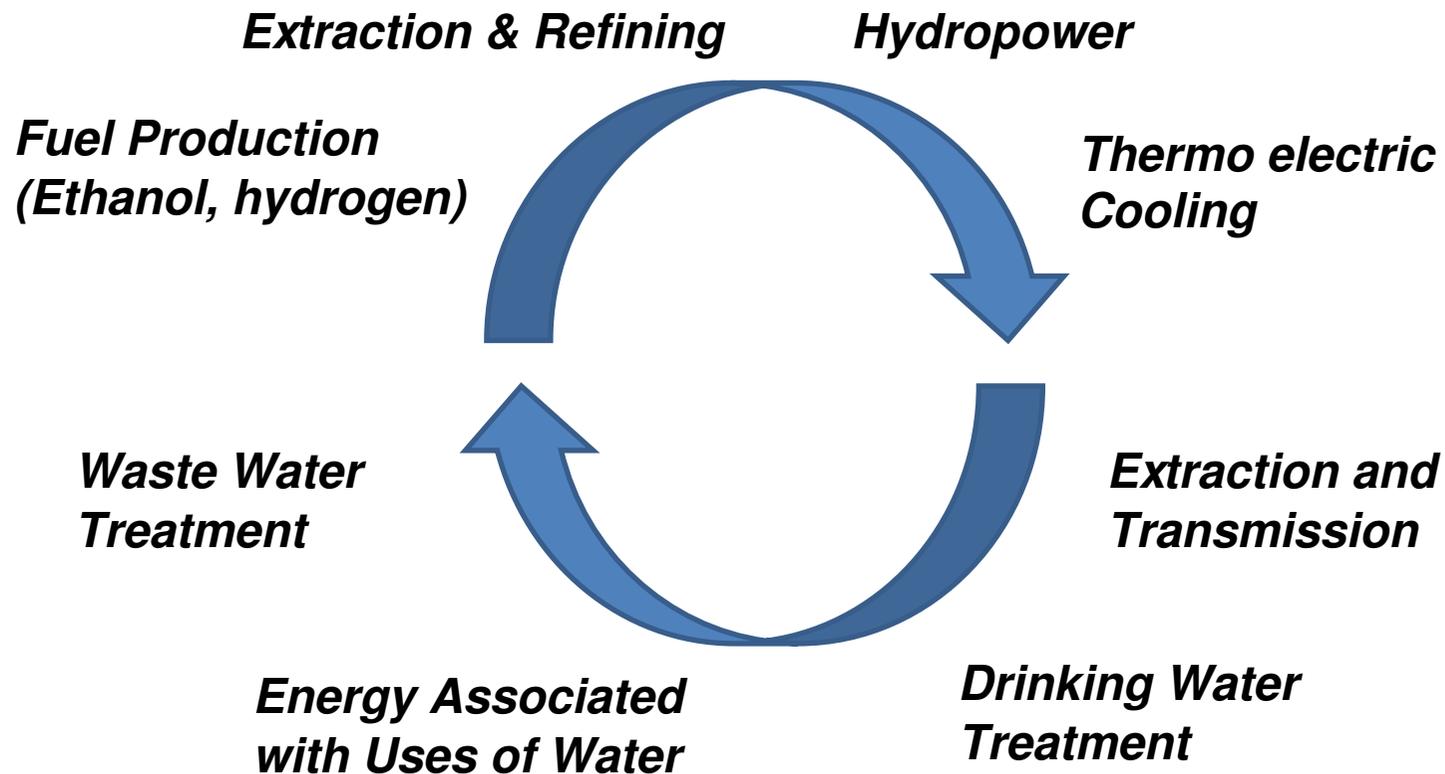
Energy production and generation require water



Water pumping, treatment, and distribution require energy

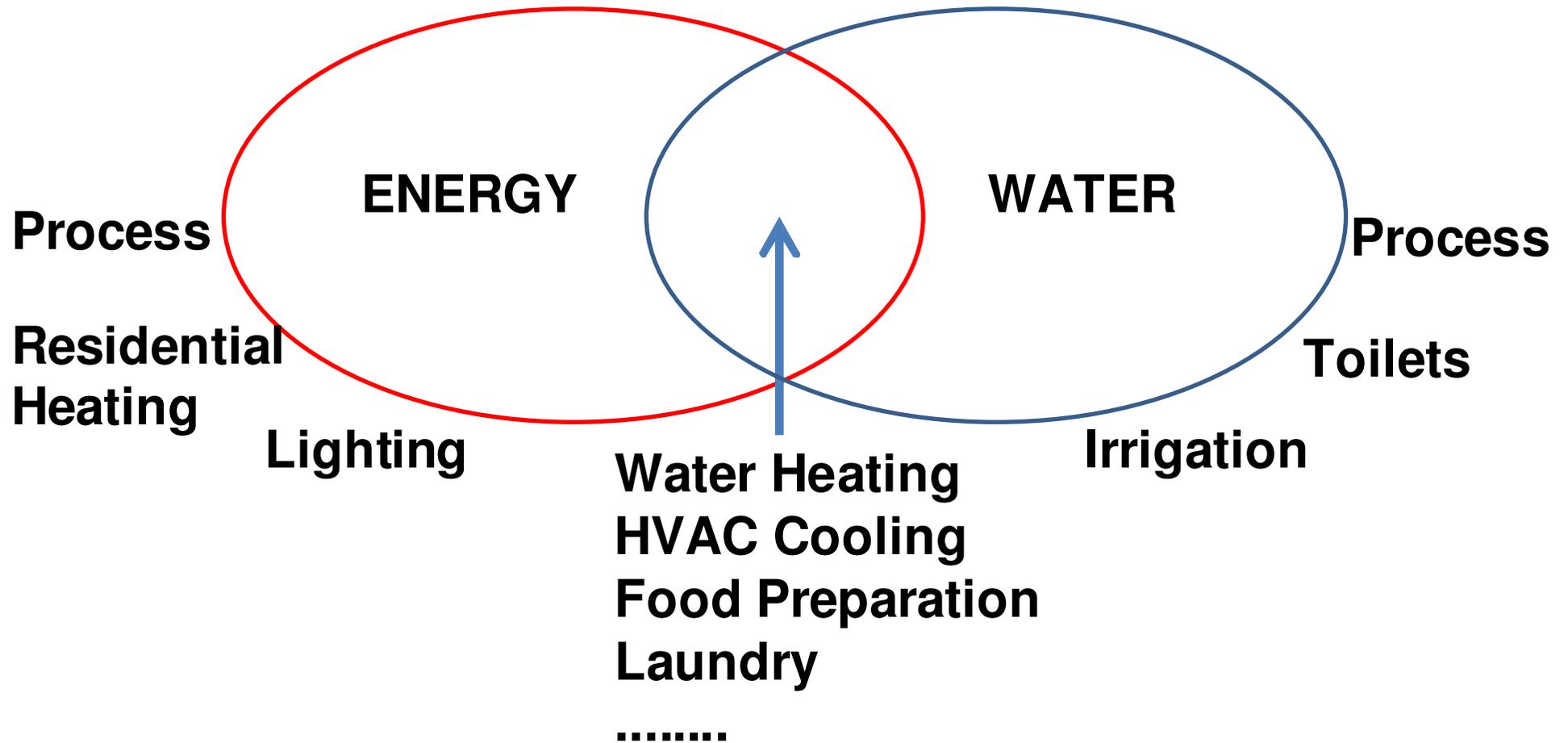
ENERGY AND WATER RELATIONSHIPS

WATER FOR ENERGY



ENERGY FOR WATER

Cross-Walk Between Energy and Water Efficiency Measures



IWA Cities of Future Program

- Building on successful CDM program
- Fully engage IWA's network plus those of others (including outside of water)
- Begin by recognizing obstacles to new thinking
- Develop an empirically based and systematic approach to new solutions



