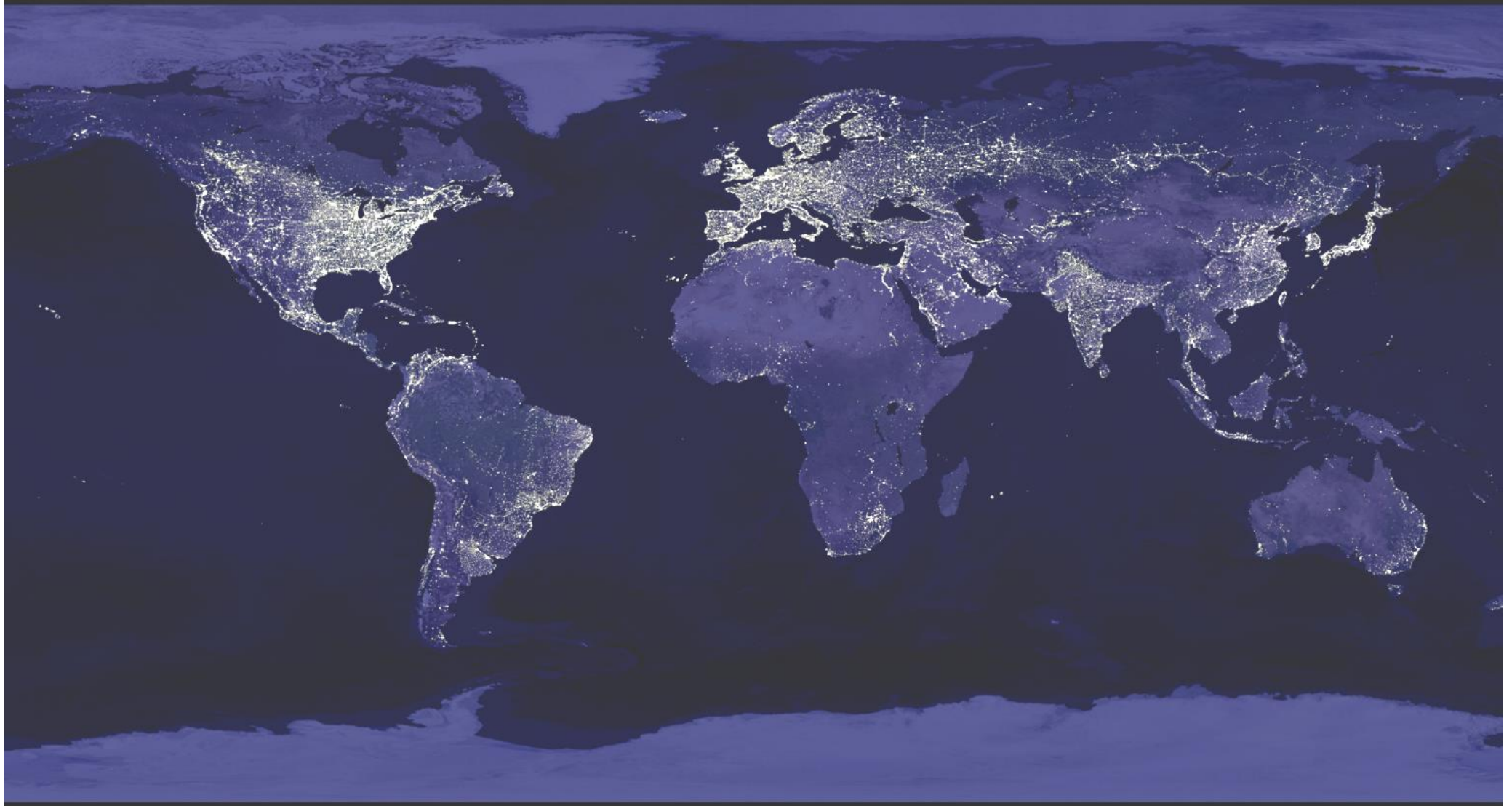
# DOING MORE WITH LESS:
## *THE JOURNEY AHEAD*

**Paul Reiter**
**ReiterIWS – Reiter International Water Solutions**

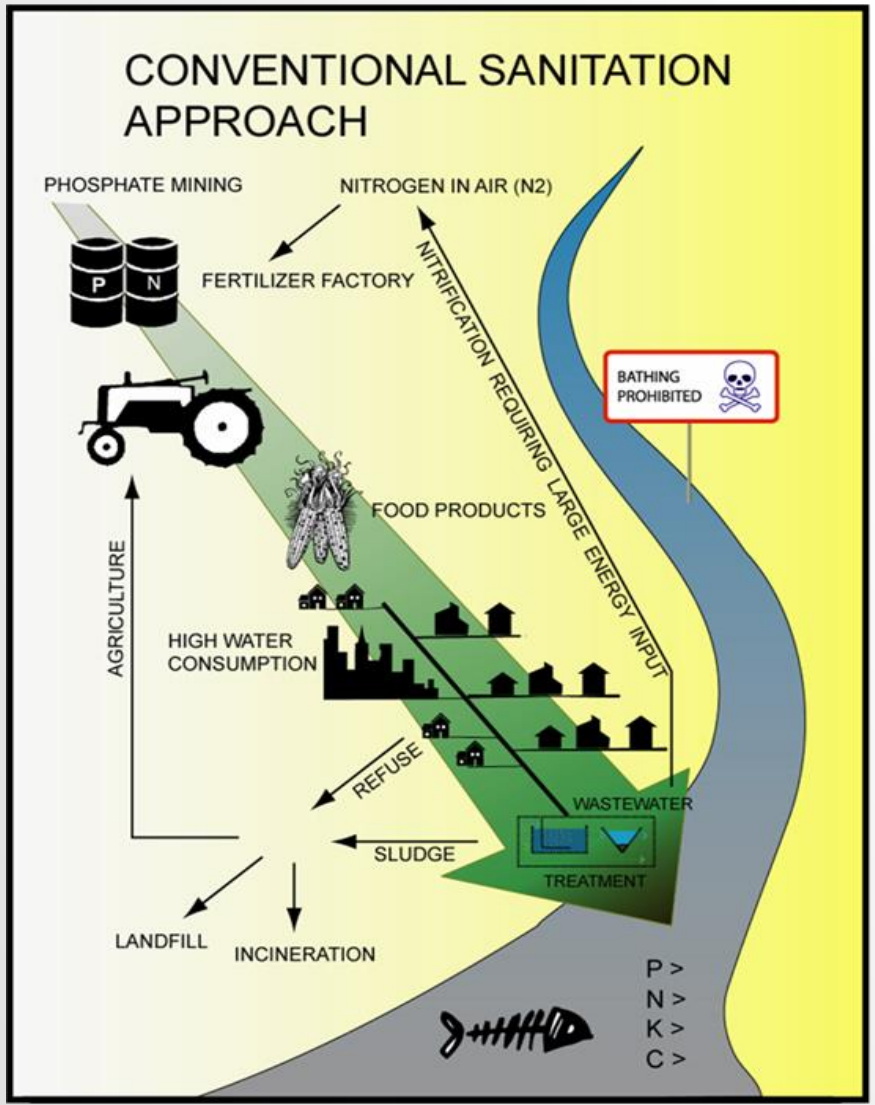
**Towards Water in a Circular Economy (aka…..), Xian China**
**September 12, 2018**

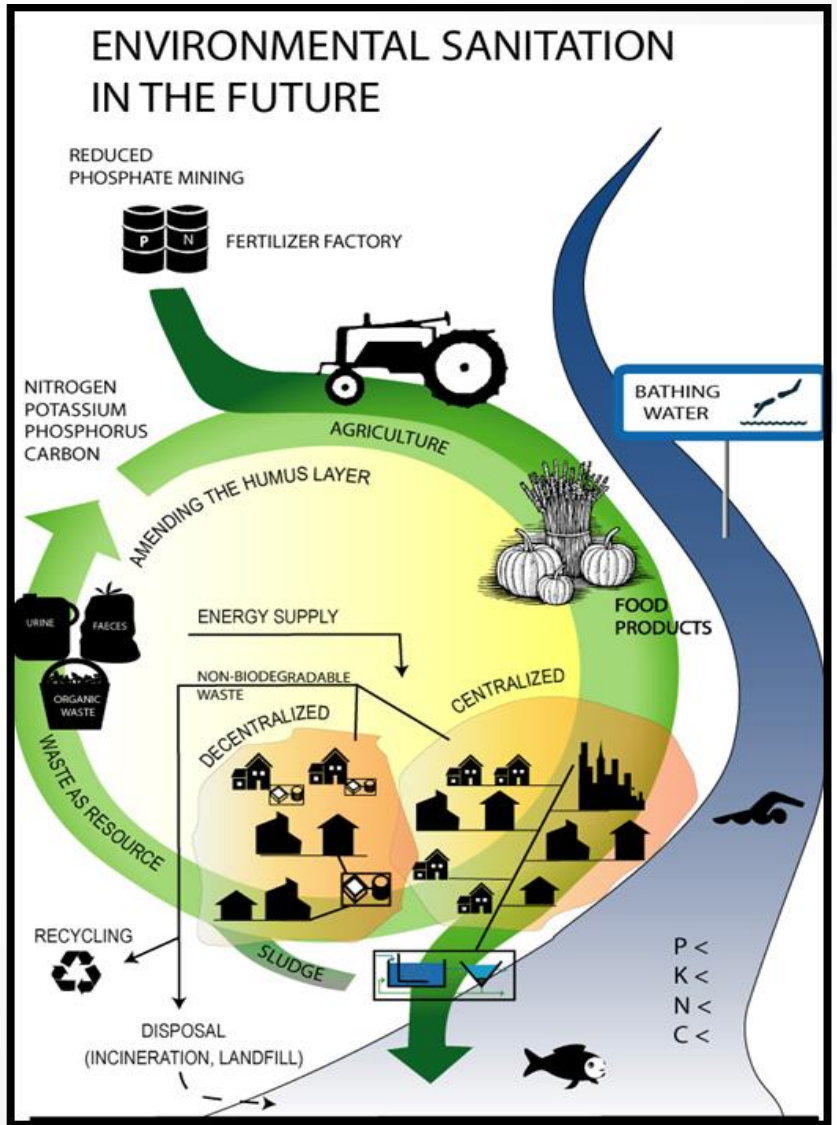
# The Earth From Above At Night



# WE ARE ON A CONTINUING JOURNEY …

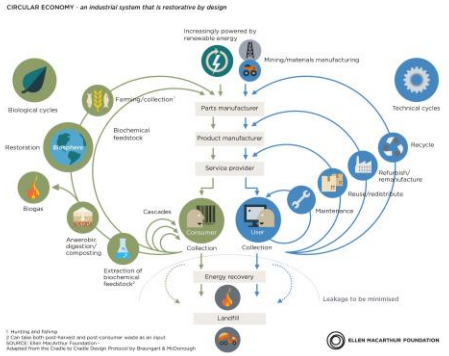
## To Where? From "Linear Systems" Towards "Closed Loop" Systems



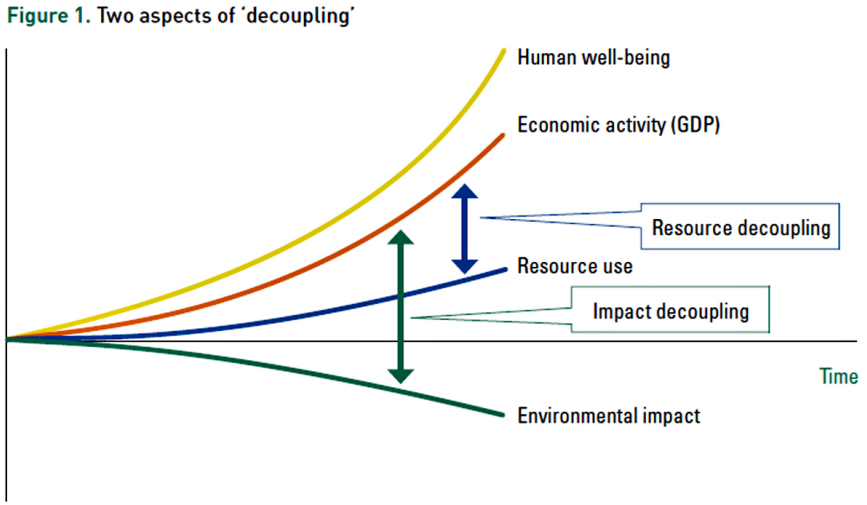
# HOW DO WE DESCRIBE THIS JOURNEY?

Towards a circular economy




A path to efficient and effective resource utilization and reuse


Decoupling growth in GDP from growth in resource use and environmental degradation

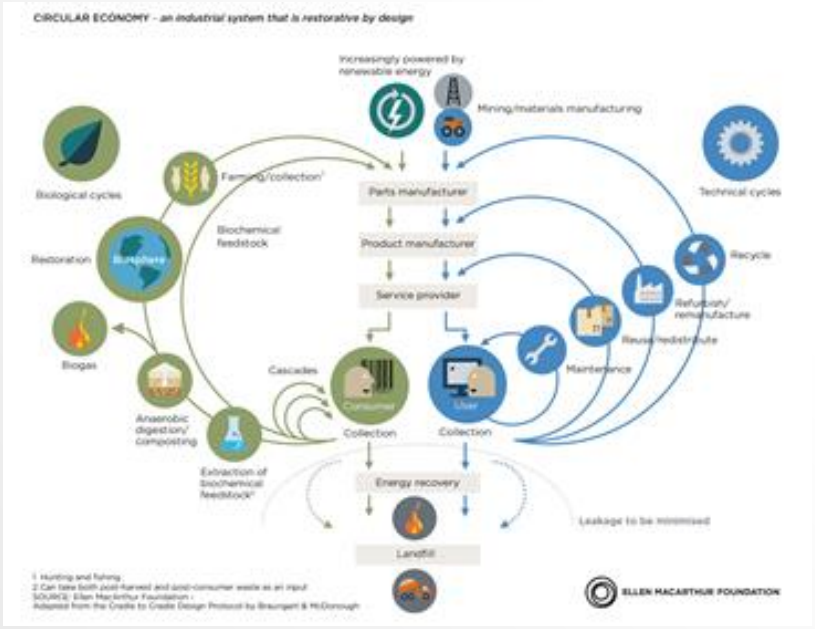


# HOW ABOUT THE TERM: "DOING MORE WITH LESS" ?

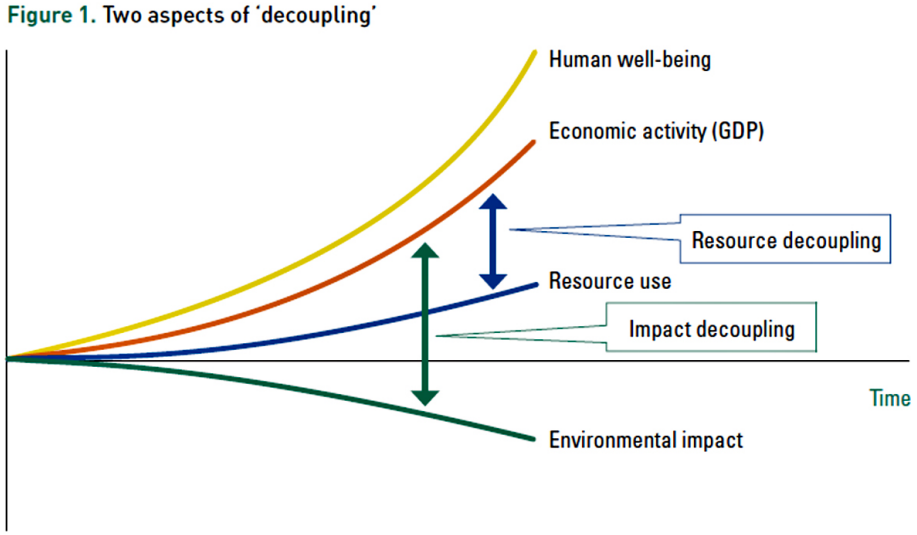
## *FEWER RESOURCES, LESS POLLUTION AND LESS MONEY*

### In a system or city

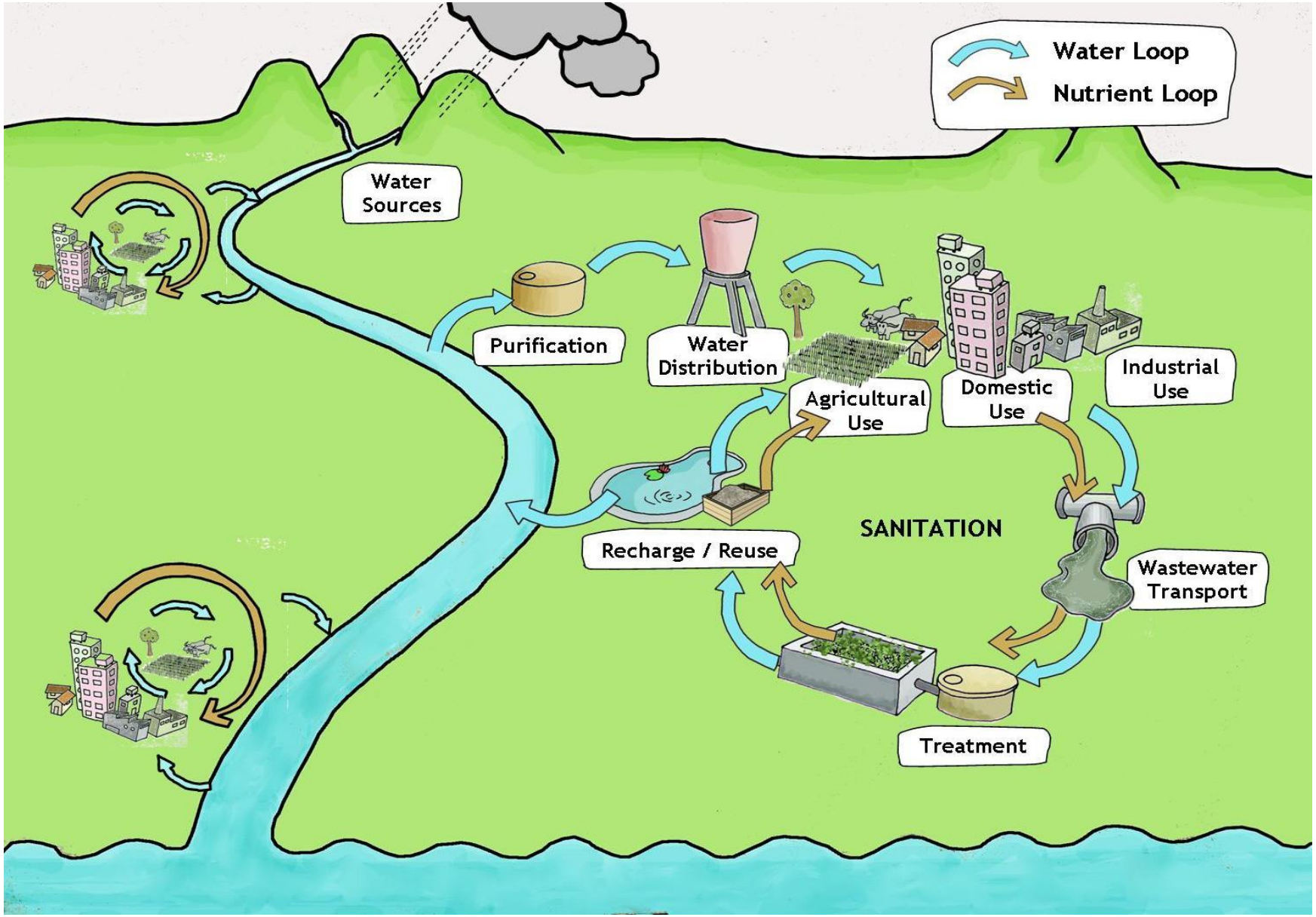

### In a system of systems




### In a national economy




from: Decoupling Natural Resource Use and Environmental Impacts from Economic Growth
2011 UNEP International Resource Panel Report

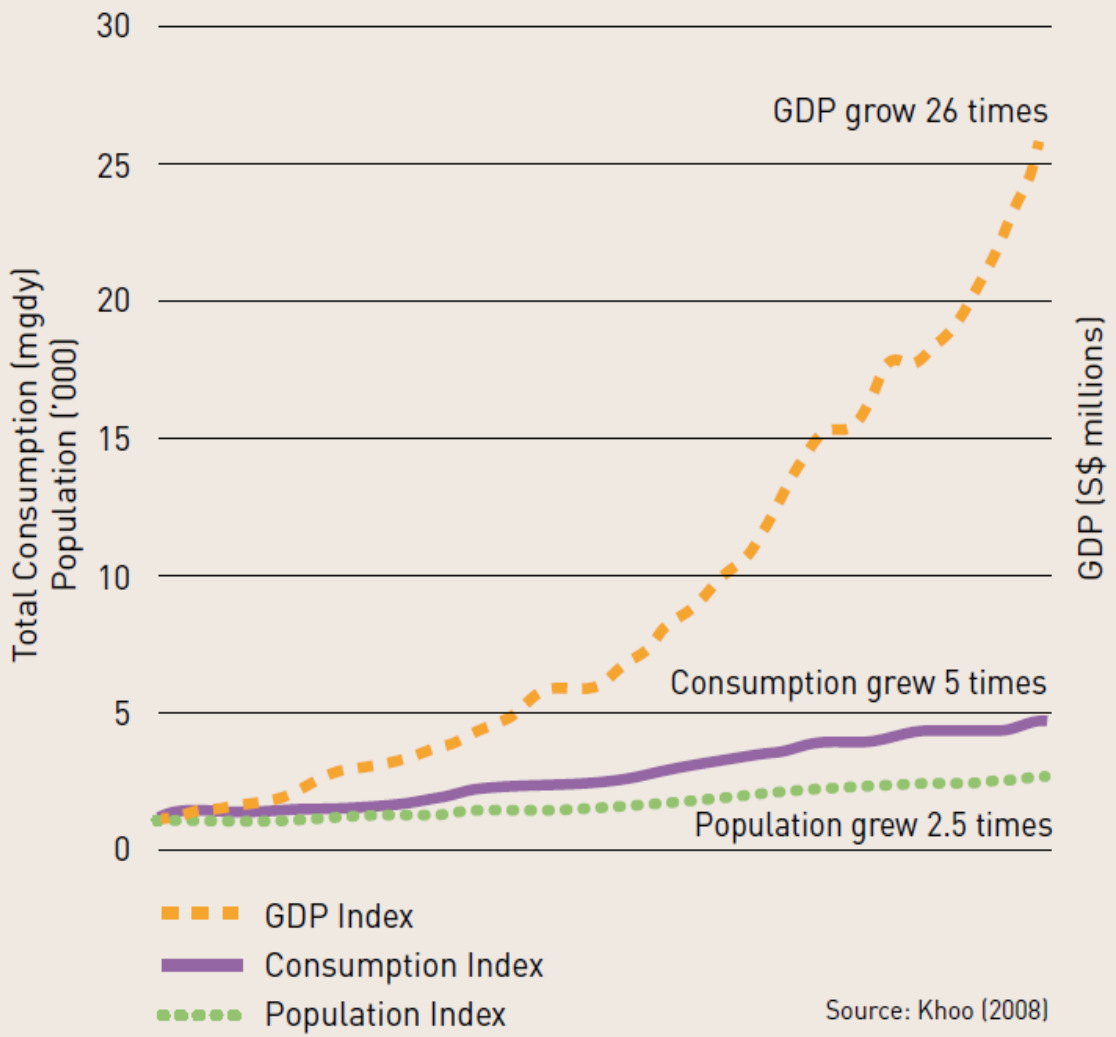


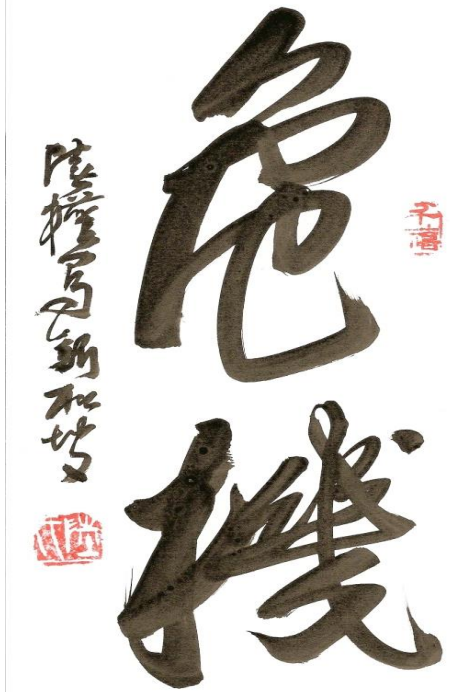

Courtesy of SSWM

# DOING MORE WITH LESS: Singapore as Case Study (1)

Figure 2.5

**Singapore GDP, population and total water consumption, 1965–2007 (index, 1965 =1)**





**CRISIS**

**=**

**DANGER + OPPORTUNITY**

# WHAT IS THE IMPERATIVE FOR "DOING MORE WITH LESS" ?

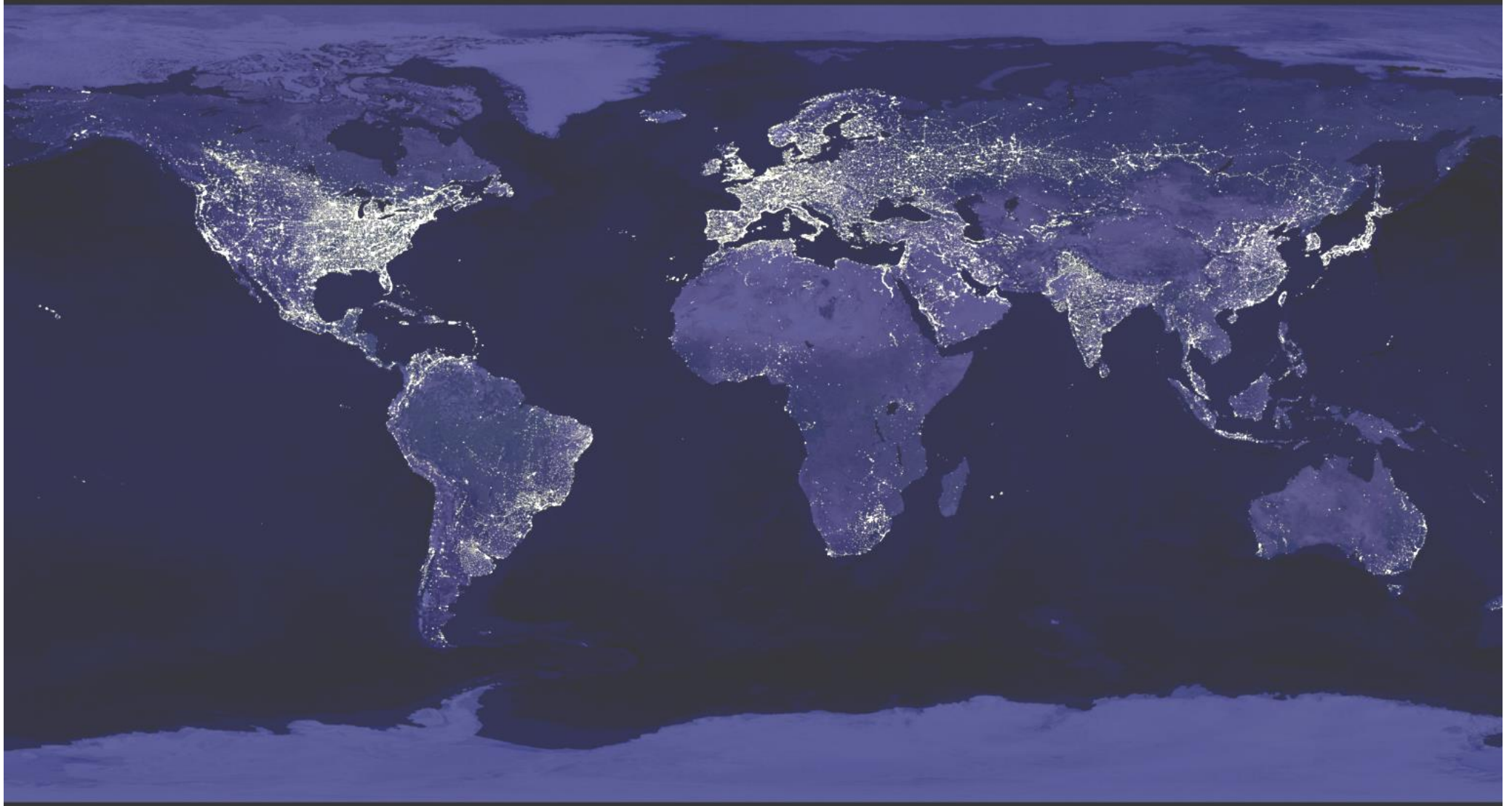
## PUSH FACTORS

- **Resource scarcity** driven by:
  - Population growth, more wealth and global demand
- **Climate change and uncertainty**
- **Regulations** requiring more a more sustainable approach to natural resources and pollution
- **A growing sense of responsibity and social discipline** by government, industry and people

## PULL FACTORS

- **Rapid evolution in knowledge and technologies**
- Now able to look at **waste as a feedstock to valuable products**
- **Reduced uncertainty** related to the potential for destabilizing changes in resource prices

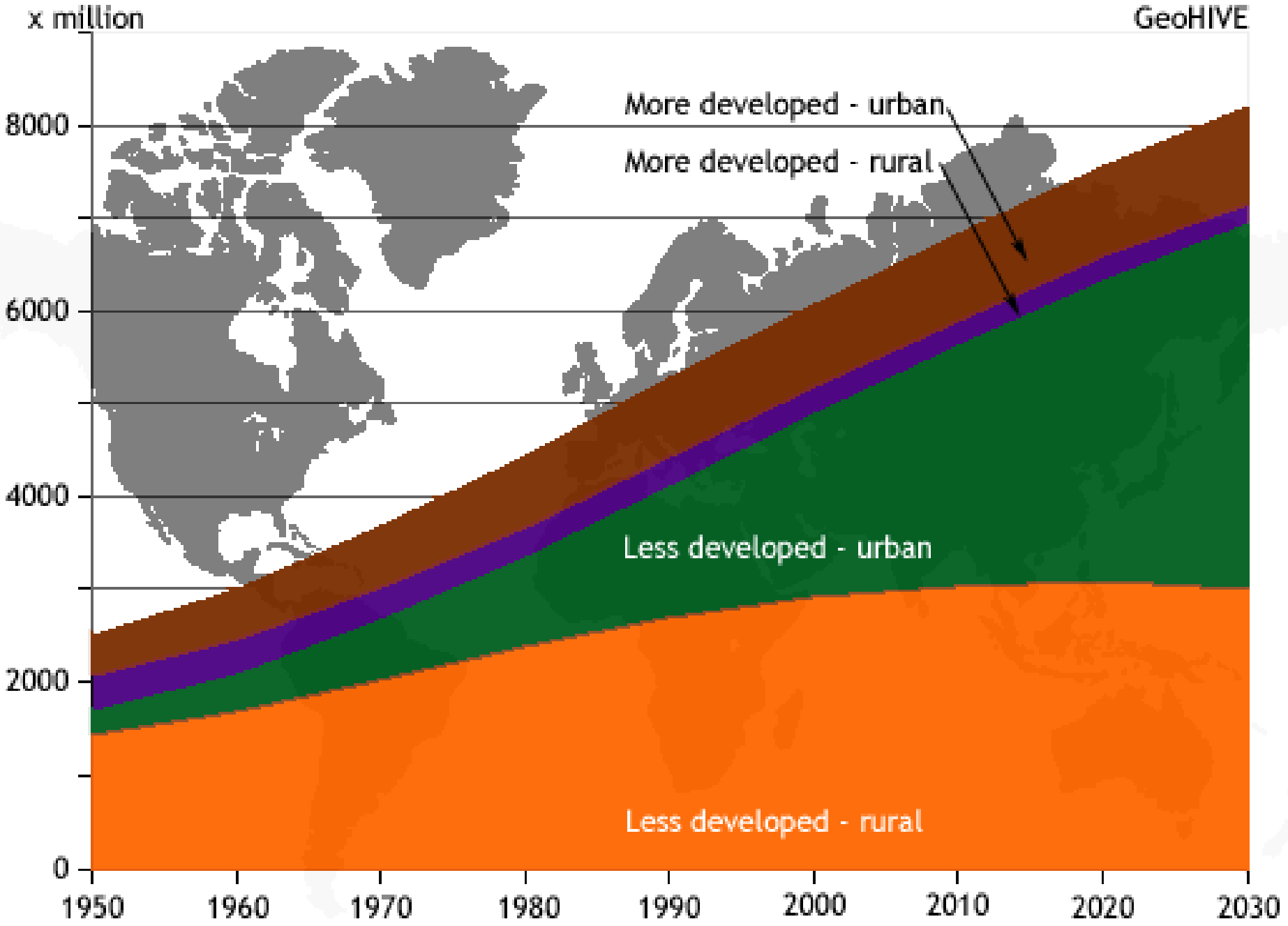
# The Earth From Above At Night



# The Urban Arithmetic for 2050

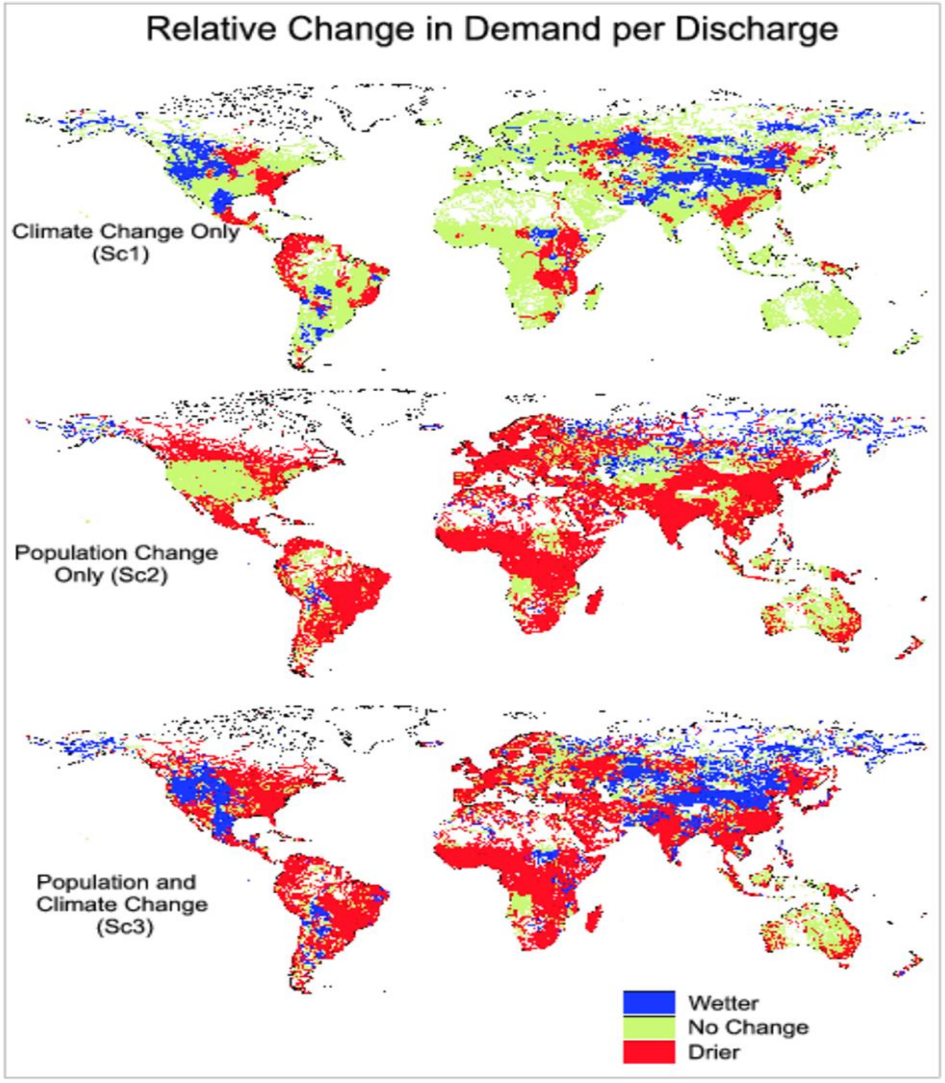
- 155,000 persons per day
- 90% in developing countries
- ~90% in urban areas

- ~800,000 per week in urban settings
- X 52 weeks per year
- X 40 years




Urban/rural population for less and more developed regions

# WE MUST FUNDAMENTALLY CHANGE OUR APPROACH TO WATER MANAGEMENT TO AVOID WATER STRESS

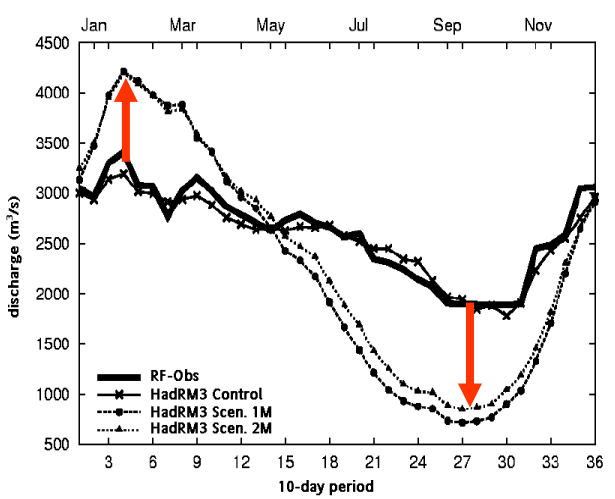



- Finite Natural Resources
- Population Growth
- Increased Living Standard
- Urbanization
- Climate Change
- Persistence of the Linear System

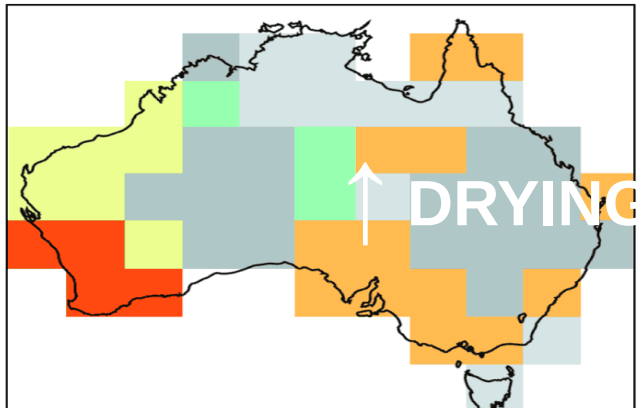
✓ Nearly Half of Human Population Will Experience Water Stress by 2025

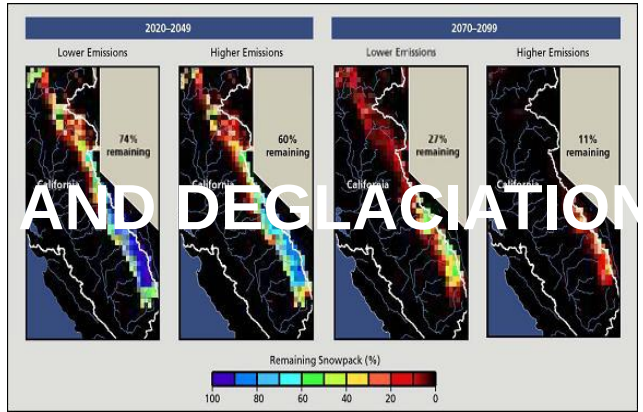
✓ Asia is 40% Water Short by 2030

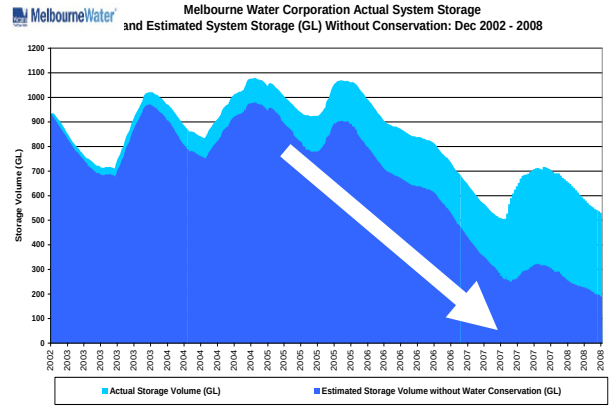

ERATIC EVENTS


Jan
Mar
May
Jul
Sep
Nov
4500
4000
3500
3000
2500
2000
1500
1000
500
discharge (m³/s)
RF-Obs
HadRM3 Control
HadRM3 Scen. 1M
HadRM3 Scen. 2M
3
6
9
12
15
18
21
24
27
30
33
36
10-day period


CYCLONIC INTENSITY & FREQUENCY


DRYING AND DEGLACIATION


2020–2049
2070–2099
Lower Emissions
Higher Emissions
Lower Emissions
Higher Emissions
74% remaining
60% remaining
27% remaining
11% remaining
California
Remaining Snowpack (%)
100
80
60
40
20
0


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

# Resource Recovery Elements

- Reusing Wastewater / WS
  - Rehabilitate (to fit for purpose standards) and reuse
- **Energy Production / WW**
  - Generate energy from the treatment process
  - Recover waste heat from TP and networks
  - Generate other raw materials from WW
- Energy Conservation / WS & WW
  - Use less energy in producing DW & WW
  - Use less energy in customer end uses
- Nutrient Recovery / WW
  - Recover phosphate from wastewater

# DOING *MORE WITH LESS* RELATED TO WATER

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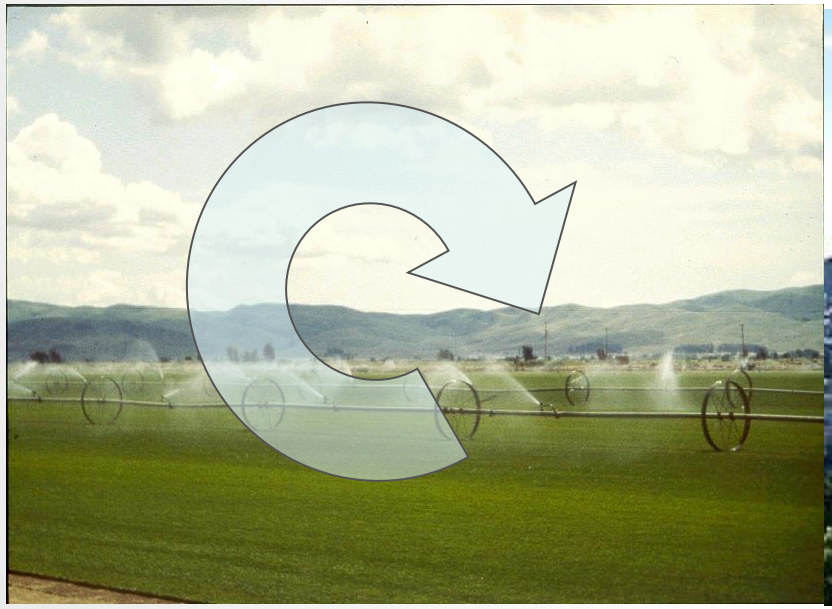


# DOING *MORE WITH LESS* RELATED TO URBAN WATER

# WE SHOULD BE IN THE MIDST OF ONE OF THE MOST SIGNIFICANT TRANSITIONS IN THE HISTORY OF THE WATER PROFESSION

REITER & DAIGGER

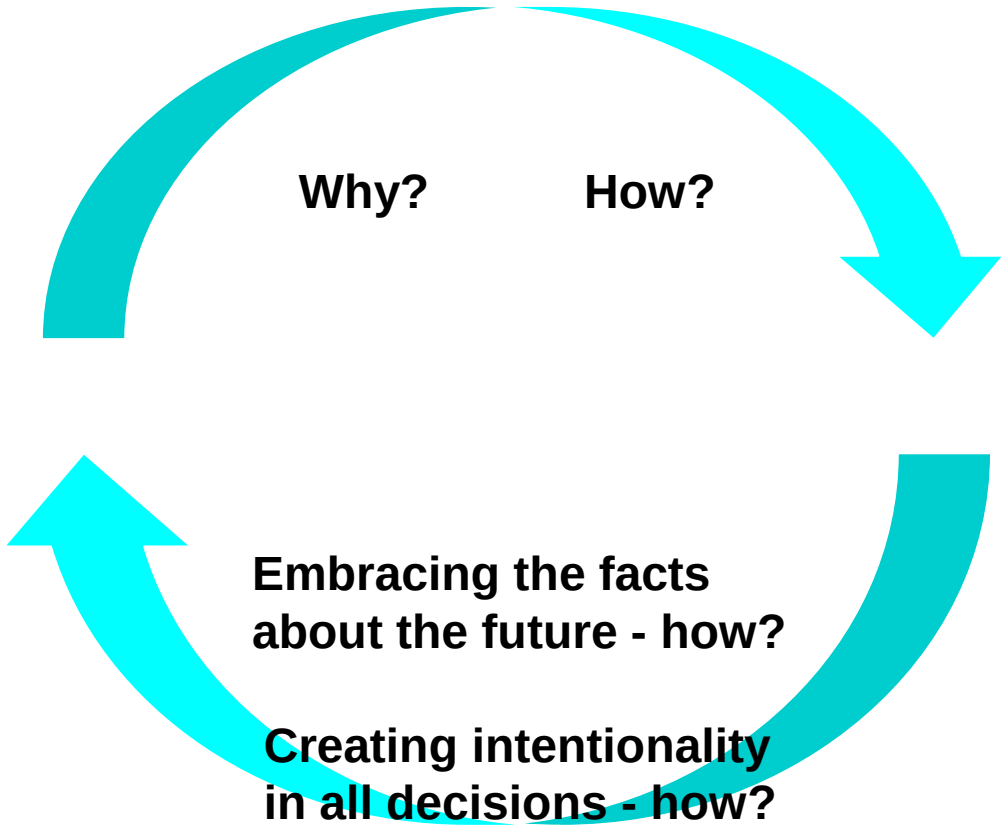
| Item | Past | Future |
|---|---|---|
| Sources and Return flow | Linear – Use once; distant DW sources; compliance mentality for effluents | Semi-closed loop with large fraction of source water (fit for purpose) through reuse |
| System Objective Function | Drinking Water–Safe, reliable, economical<br>Used Water – Meets effluent standards<br>Storm water – Safely evacuated via pipes | High quality, reliable, economical<br>Ability to reuse water, fit for purpose stds<br>Routine recovery of nutrients and waste heat<br>Storm water as aesthetic and water resource |
| System Optimization Framework | Disjointed by facility - Most efficient outcome (effectiveness, cost) calculated in a static framework | Multiple objective, system-level optimization (effectiveness, net energy, environment, aesthetics, l.c. cost) in a dynamic framework |
| System Components | Conceptually and/or physically separate systems for drinking water, used water and storm water | Integrated, multipurpose systems |
| System Configuration of Treatment Facilities | Centralized treatment | Hybrid (centralized and distributed) systems |
| Institutions | Single purpose utilities | Integrated, water-cycle utilities |
| Financing | Volume based | Service based |
| The Water System inside the Urban System | Water system “plumbing” an after-thought in the planning process | Water system development Integrated with City’s strategic, spatial and land use planning |

# Motivating Change Vital to Survival

## Reimagining Our Future

+

Show-casing the possibilities




Show-casing the risks of inaction

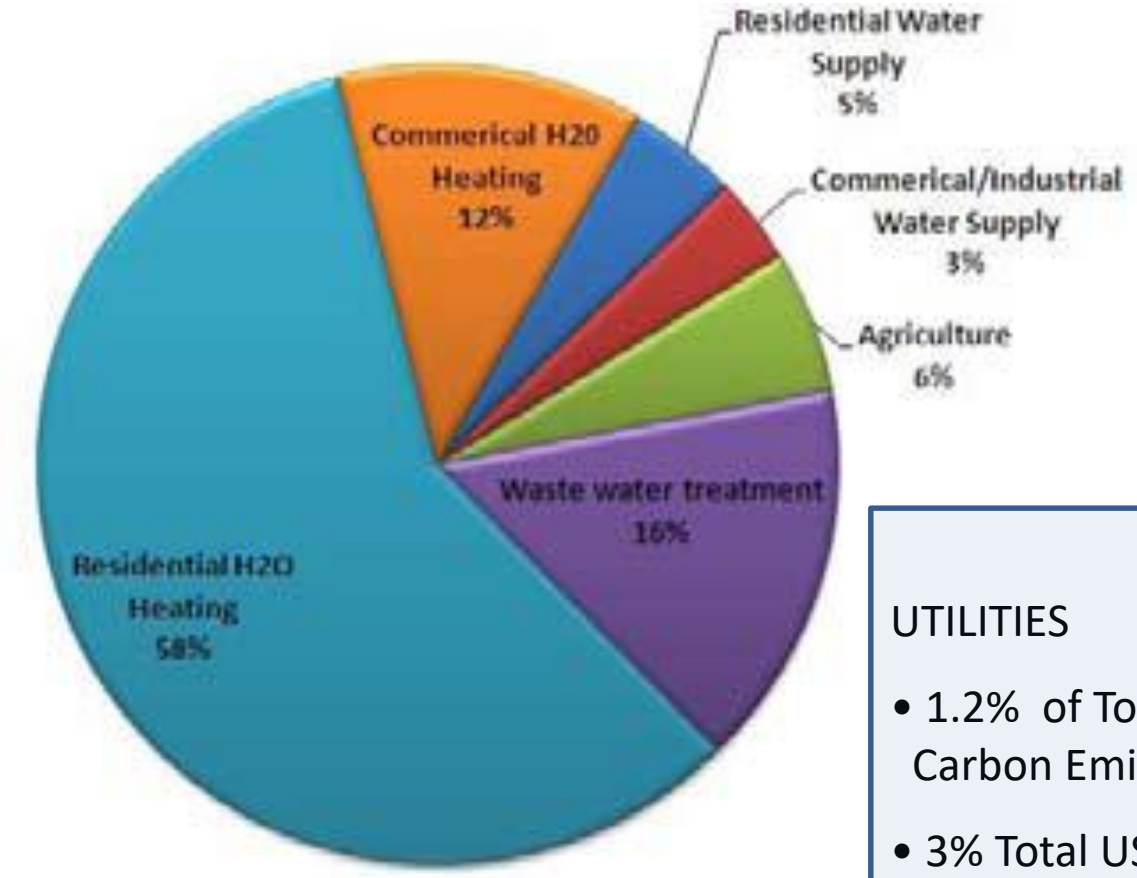
−

## Defeating Habitual Comfort Zones in the Context of Future Conditions

# US Water-Related Carbon Emissions

IN TOTAL

- 5.2% of Total US Carbon Emissions
- 13% Total US Electricity Use
- Equivalencies
  - 40 Million Homes
  - 53 Million Vehicles




National Water-Related Carbon Emissions
(290 million metric tons)

River Network, 2009

UTILITIES

- 1.2% of Total US Carbon Emissions
- 3% Total US Electricity Use

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# SINGAPORE:  FOUR NATIONAL TAPS

Imported water
(Johor)

NEWater

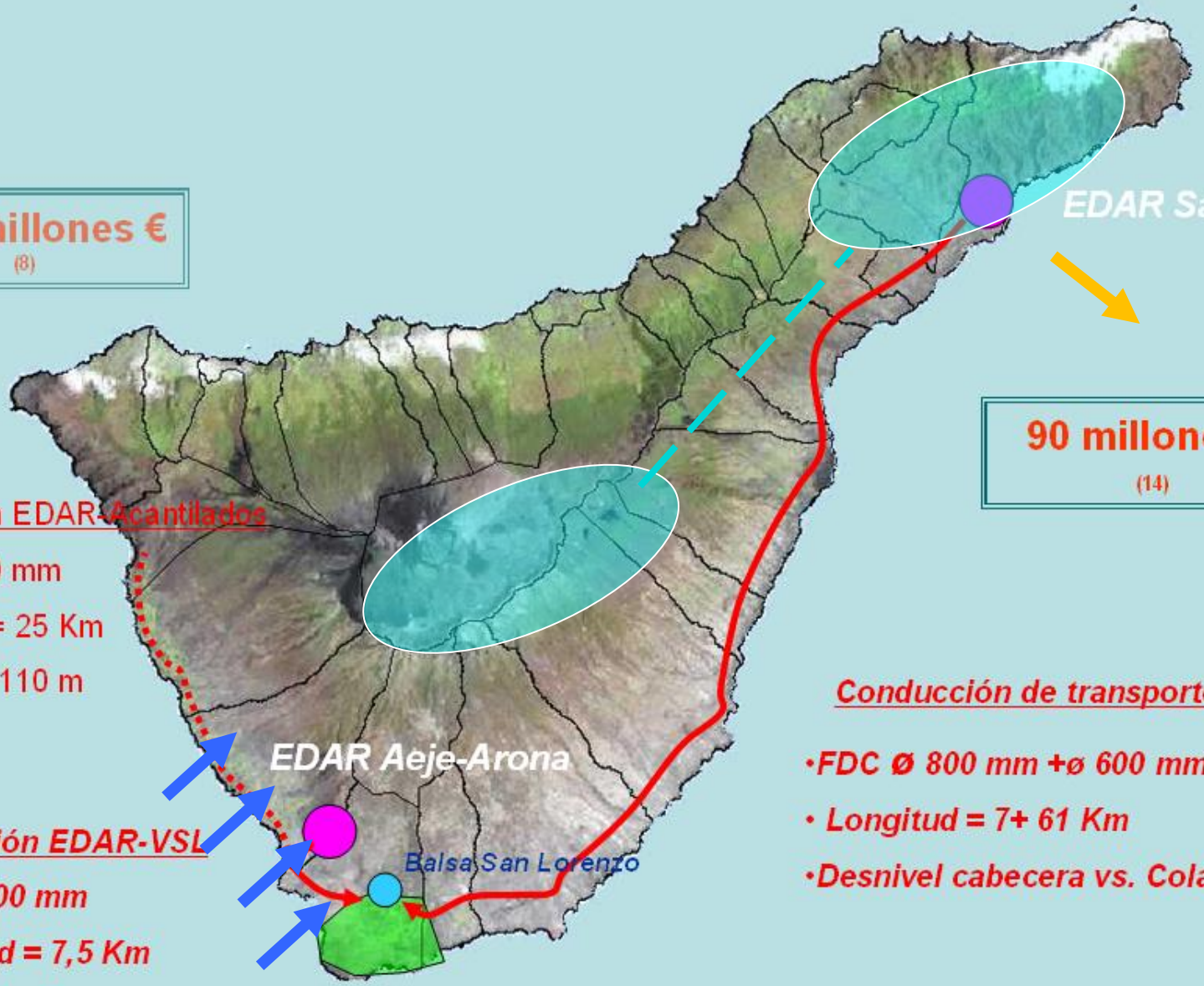
Local
catchment
water

Desalinated
water

Singapore's
Water Supply


ISRAEL
Administered by UNDOF
Golan Heights
(Rabbah)
Amman
(Tel Aviv)
West Bank
(Jerusalem)
Gaza Strip
Israel
Jordan
© 2007 Europa Technologies
Image © 2007 TerraMetrics
Google
Pointer 31°50'38.04" N 34°56'15.13" E elev 369 m Streaming 100%
Eye alt 398.70 km

# Esquema general del Sistema de Reutilización Insular

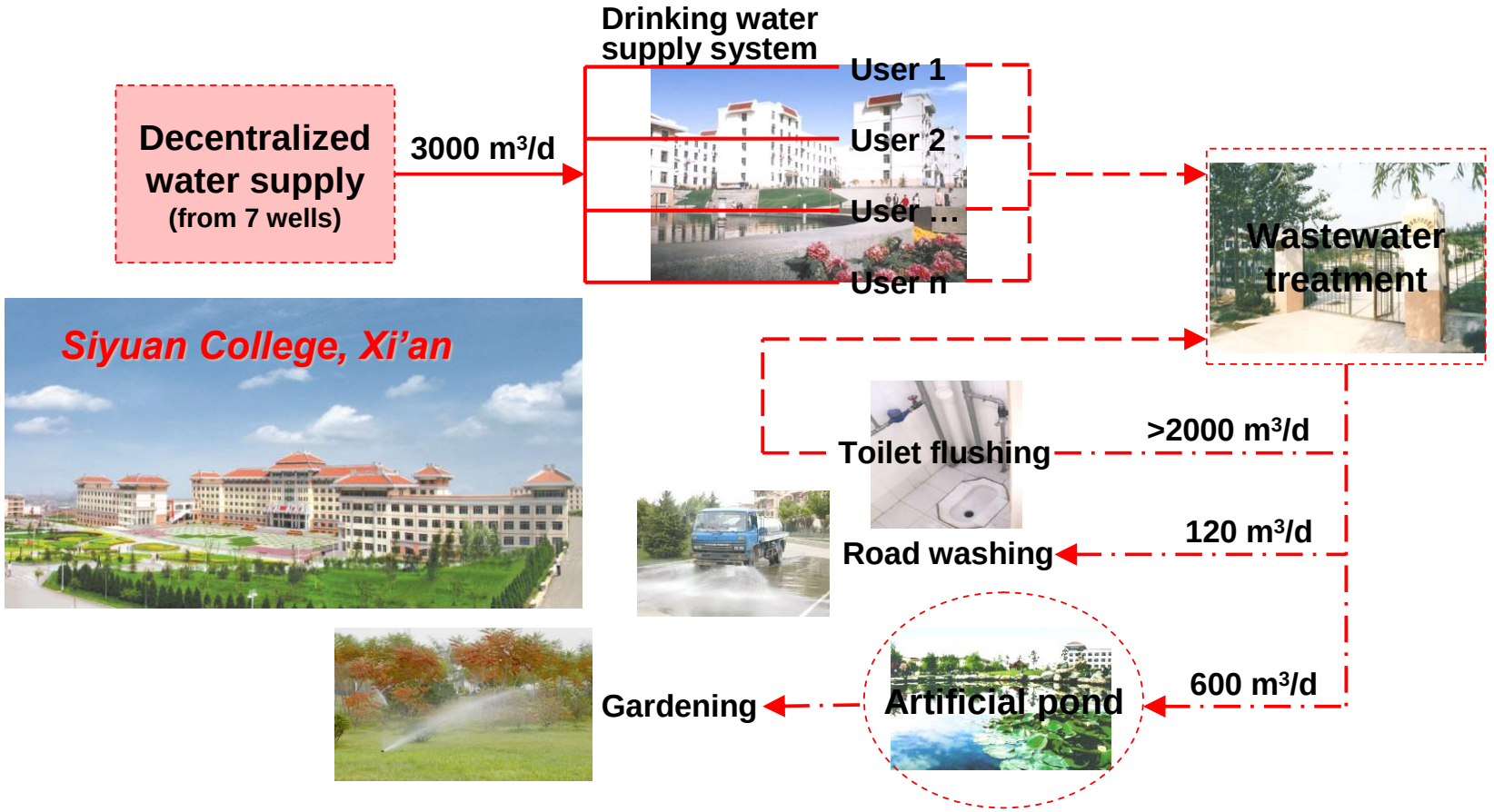



BALTEN
BALSAS DE TENERIFE

# Semicentralized Supply and Treatment System Qingdao

# Case study 1: A college with zero discharge of wastewater

- **System composition**




Integrated water treatment and reuse
-less water use
-net energy generation
-heat recovery
District heating supplied entirely by waste heat
-no purchased energy for heating
-
Storm water capture treatment and reuse
-no polluted discharges
-local detention
-reuse
OPPORTUNITY
Close to triple zero impacts with favourable market economics
Aerial to South East

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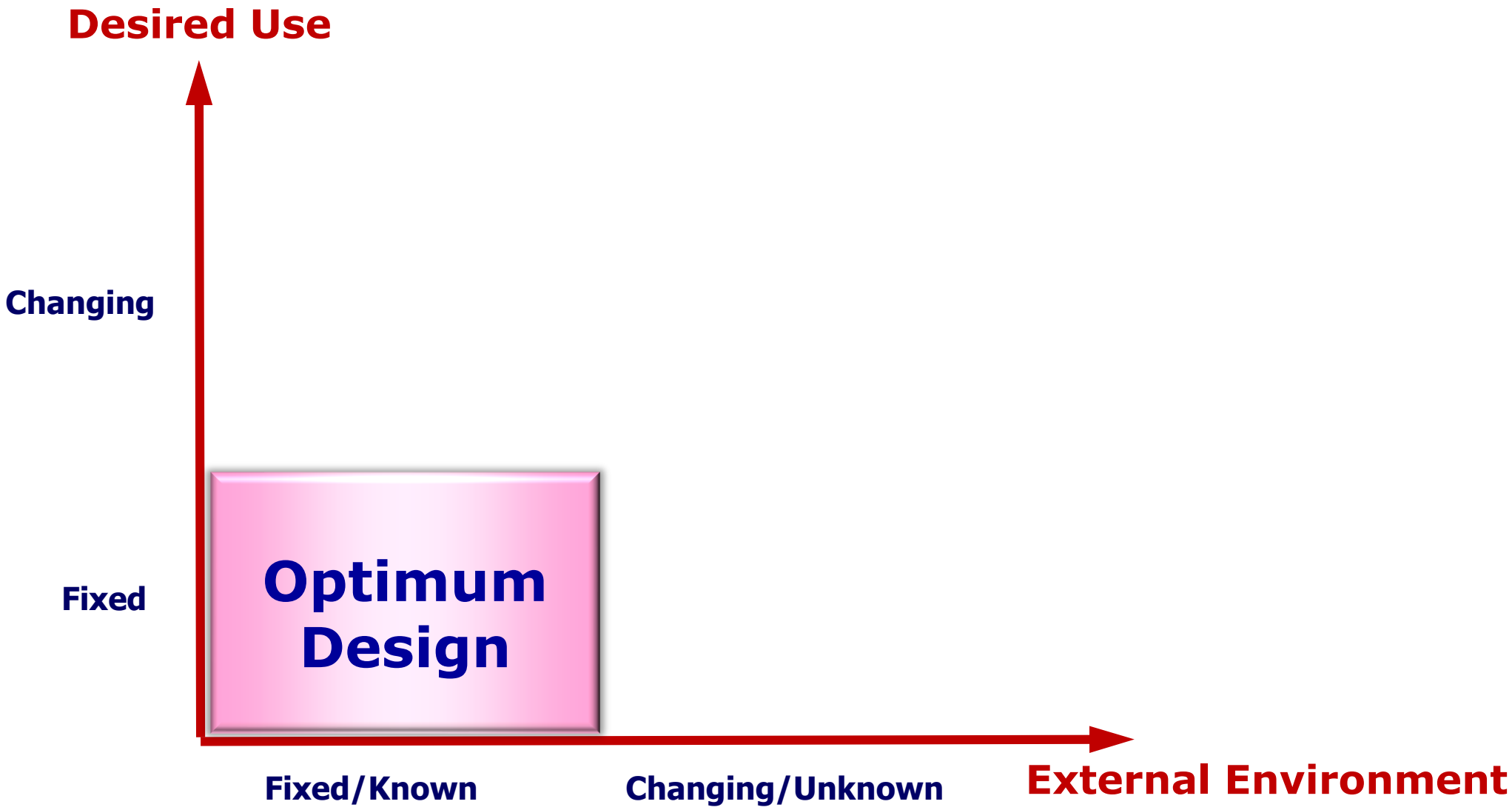
# Optimization Thinking : Static vs Dynamic in Two Dimensions



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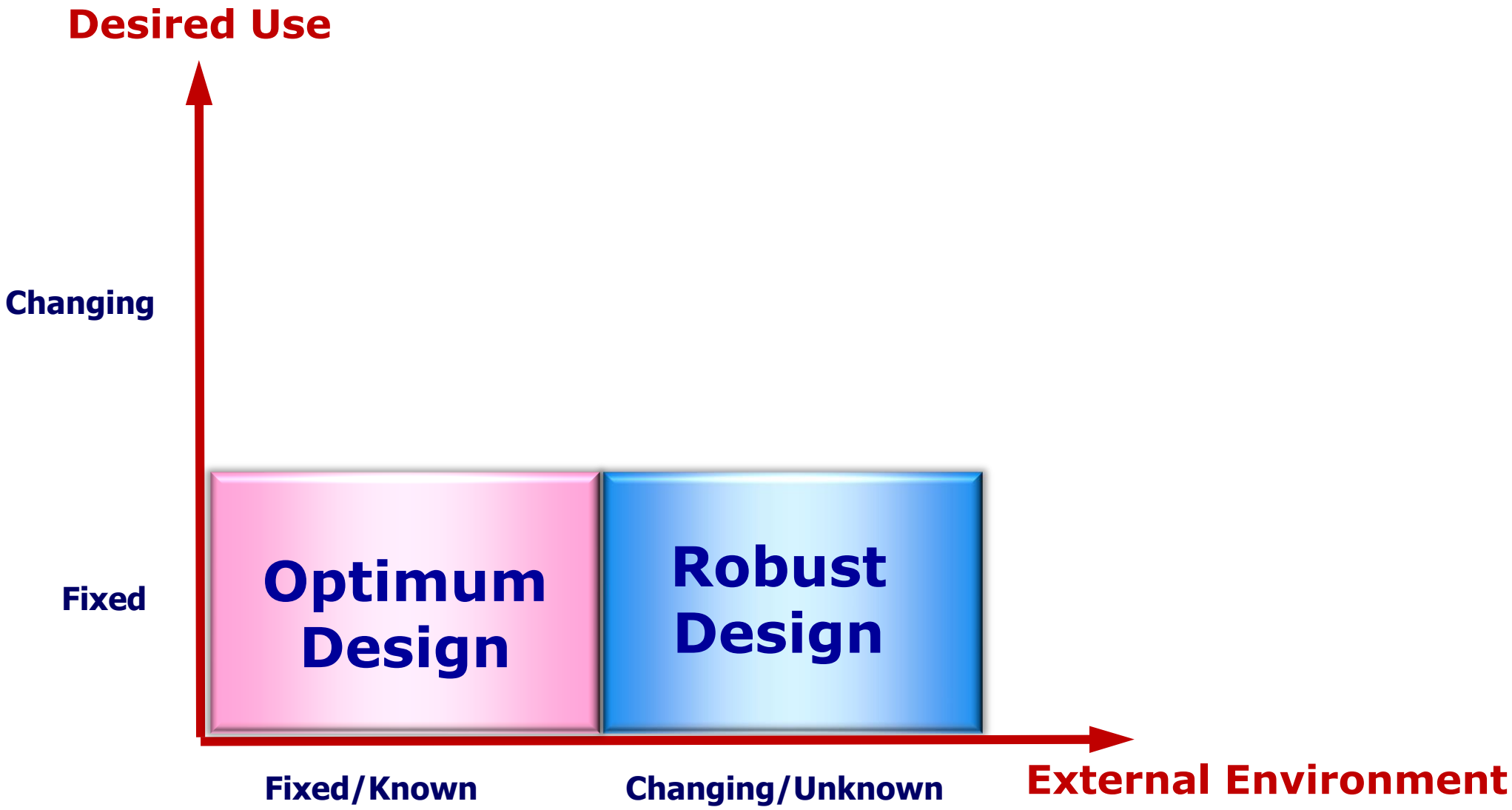
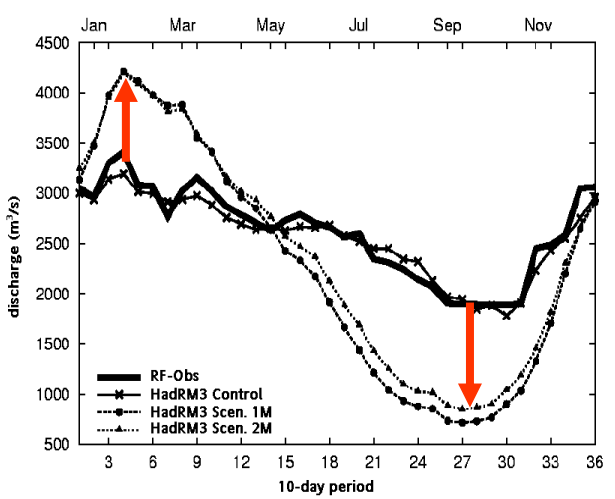
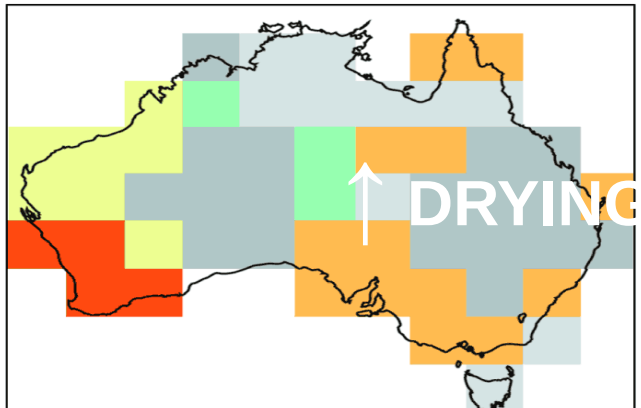



ERATIC EVENTS


Jan
Mar
May
Jul
Sep
Nov
4500
4000
3500
3000
2500
2000
1500
1000
500
discharge (m³/s)
RF-Obs
HadRM3 Control
HadRM3 Scen. 1M
HadRM3 Scen. 2M
3
6
9
12
15
18
21
24
27
30
33
36
10-day period


CYCLONIC INTENSITY & FREQUENCY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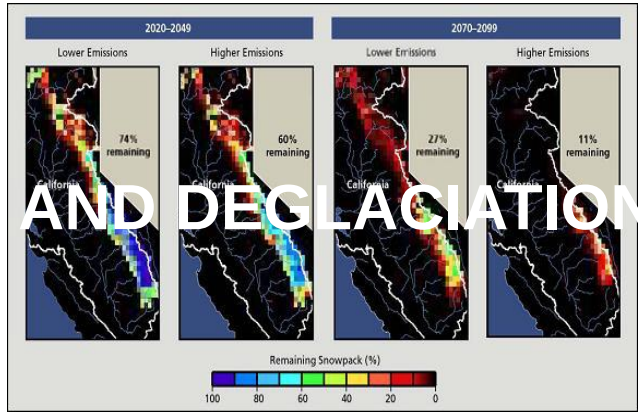
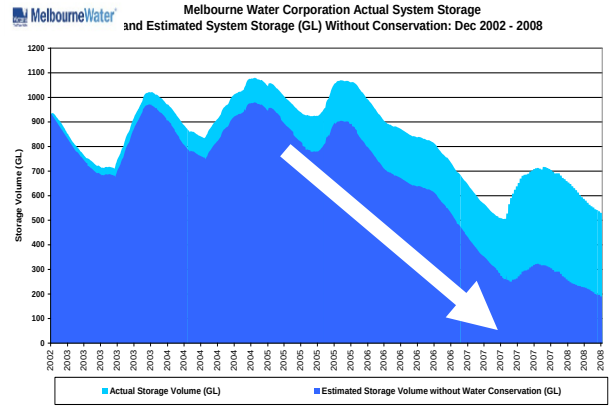

2020–2049
2070–2099
Lower Emissions
Higher Emissions
Lower Emissions
Higher Emissions
74% remaining
60% remaining
27% remaining
11% remaining
California
Remaining Snowpack (%)
100
80
60
40
20
0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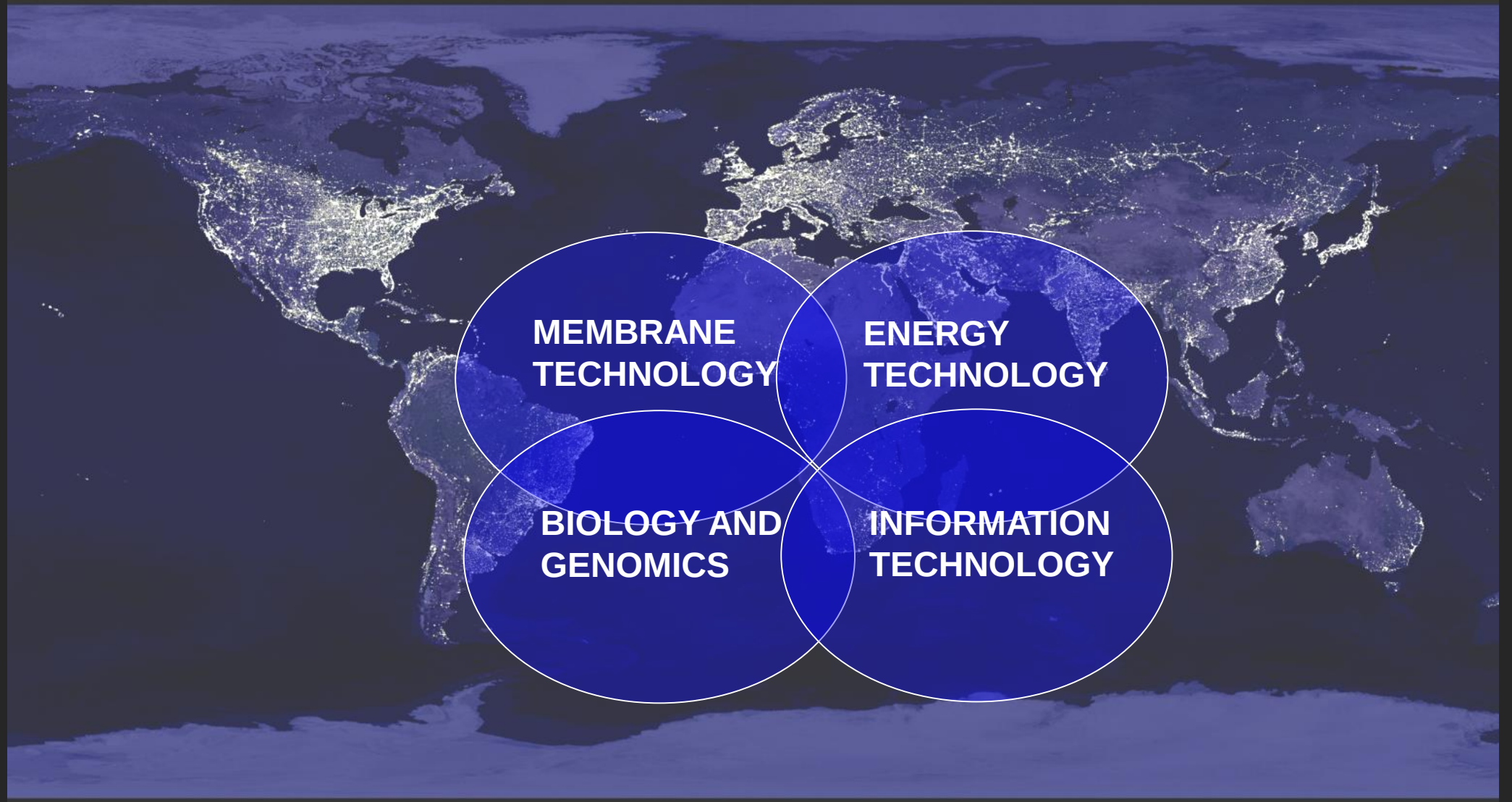
# Hot, Flat and Crowded but with a Revolution in the Making ?



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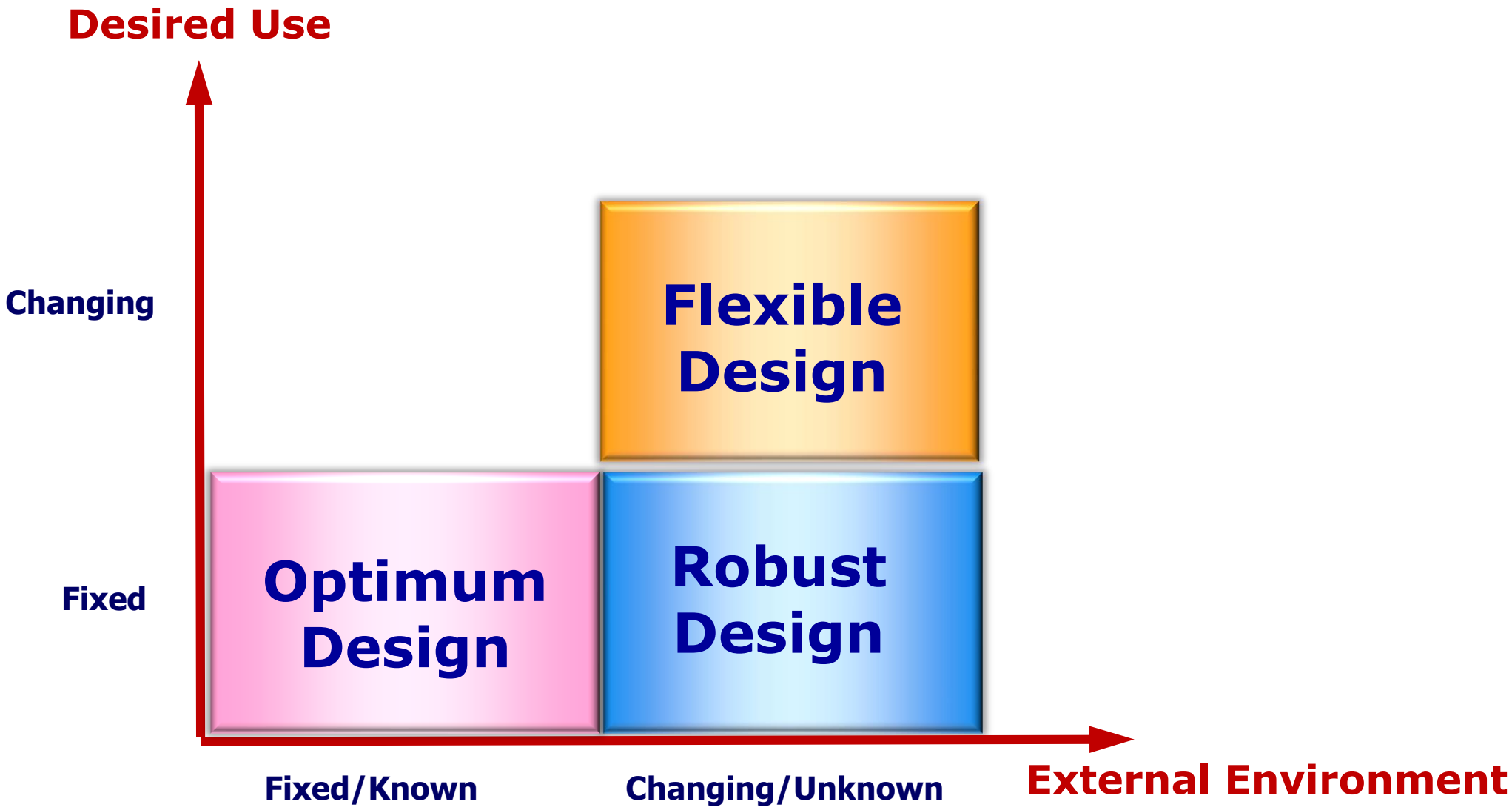
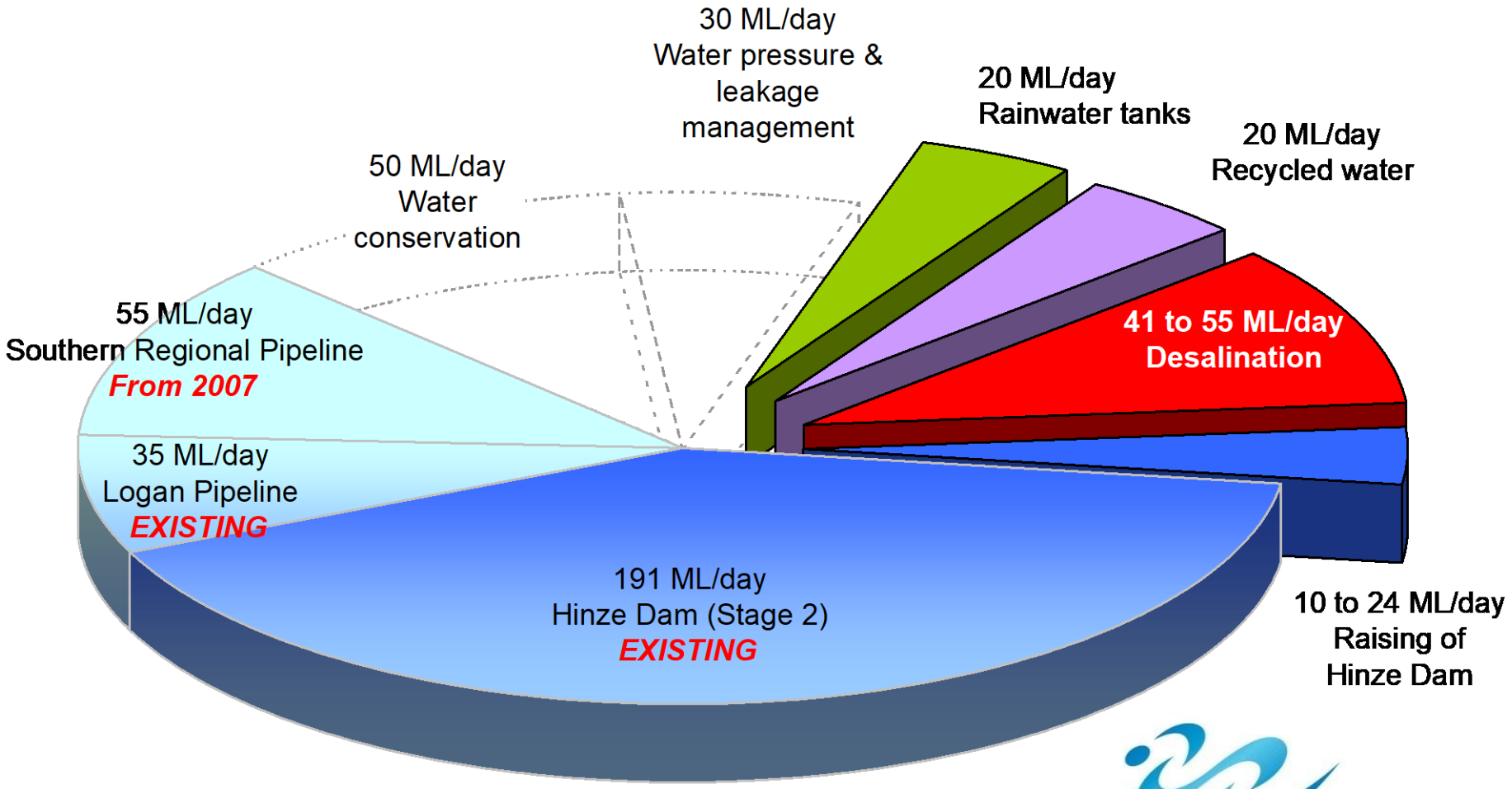


# The Preferred GCWF Strategy




GoldCoastWater

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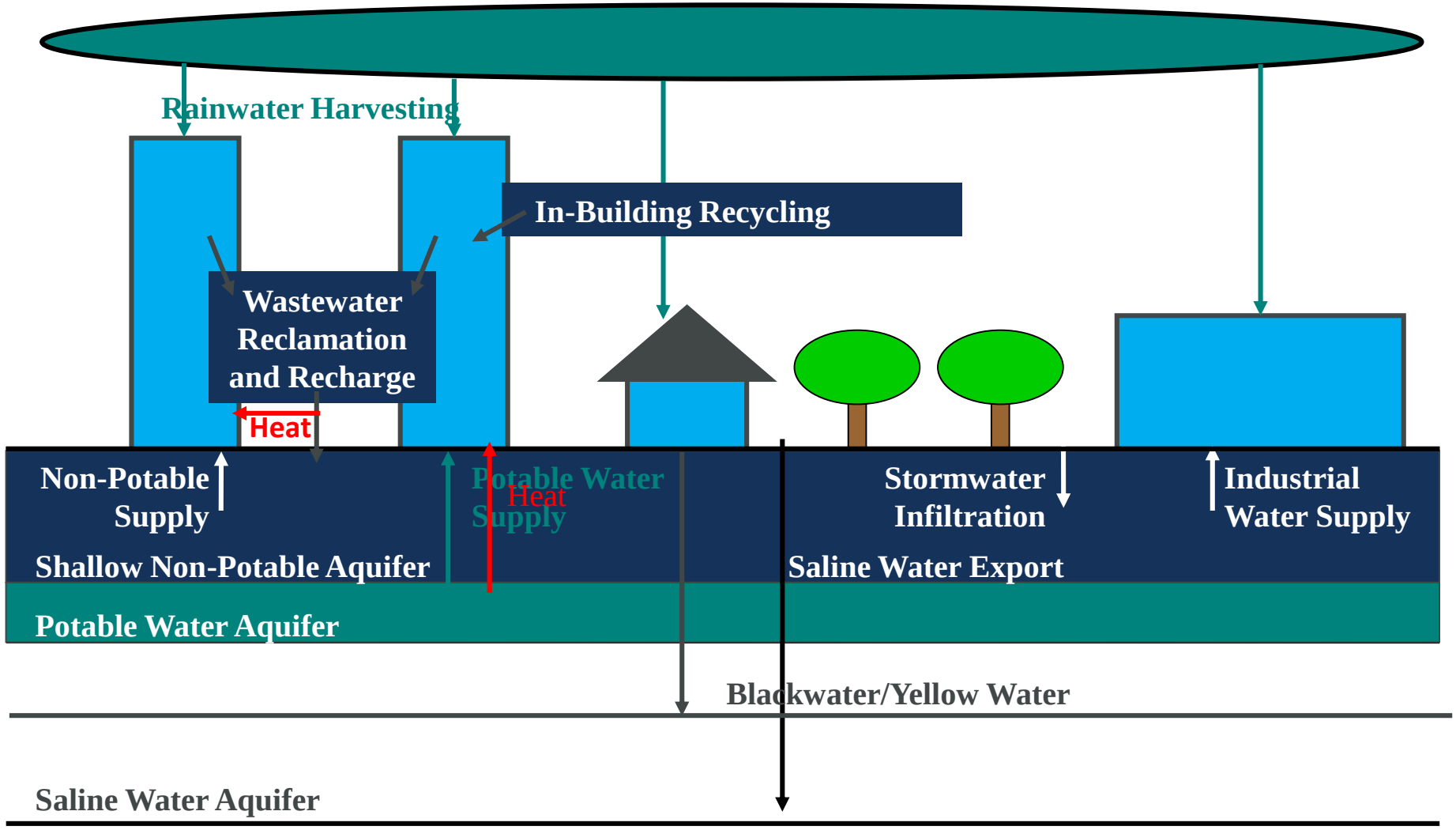
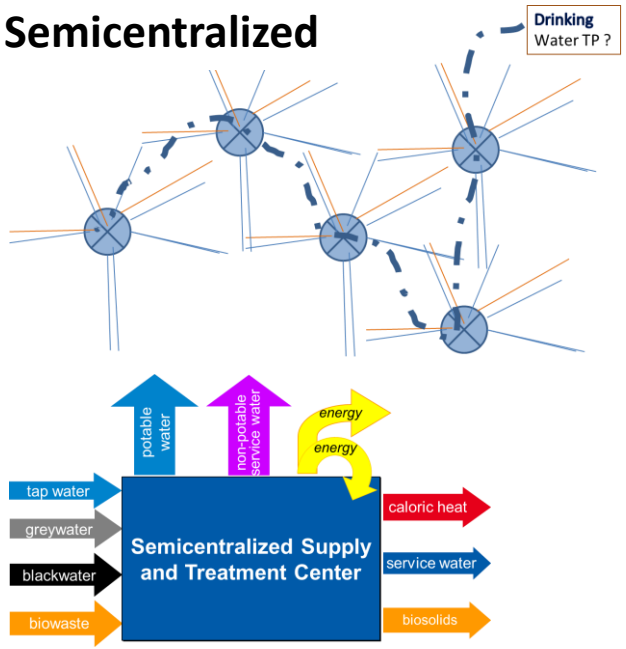
# LET'S LOOK AT AN EXAMPLE OF AN INTEGRATED SYSTEM THAT INCORPORATES MOST TOOLS

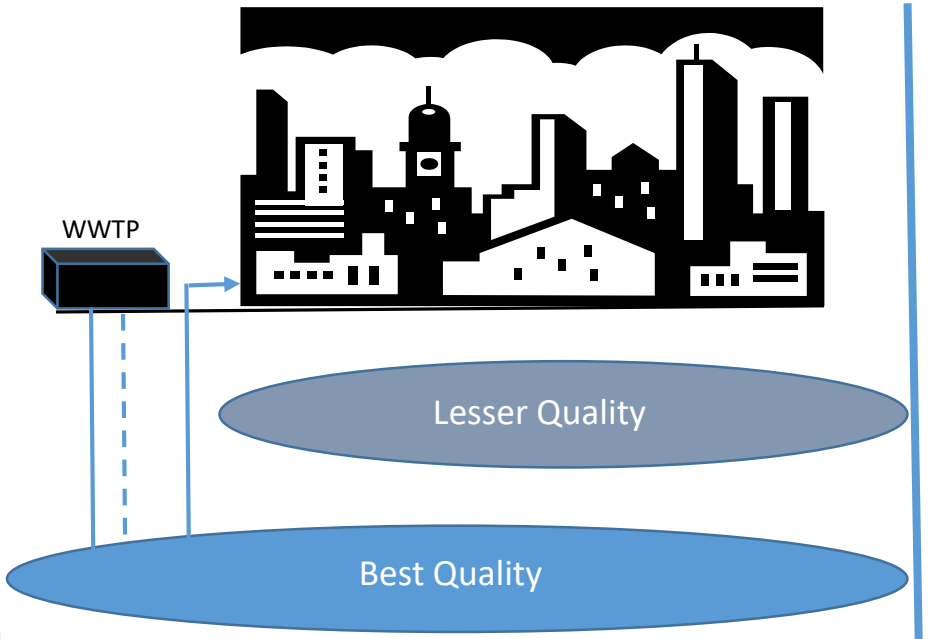



Courtesy of G Daigger

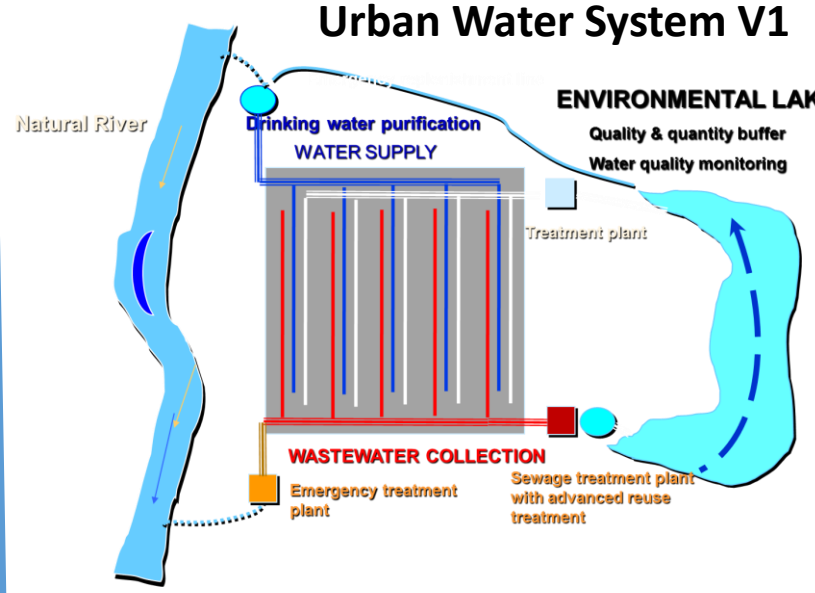
# Options for Achieving the Full Range of Objectives are Circumstantially Driven

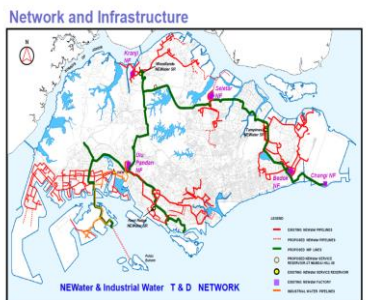
## Semicentralized

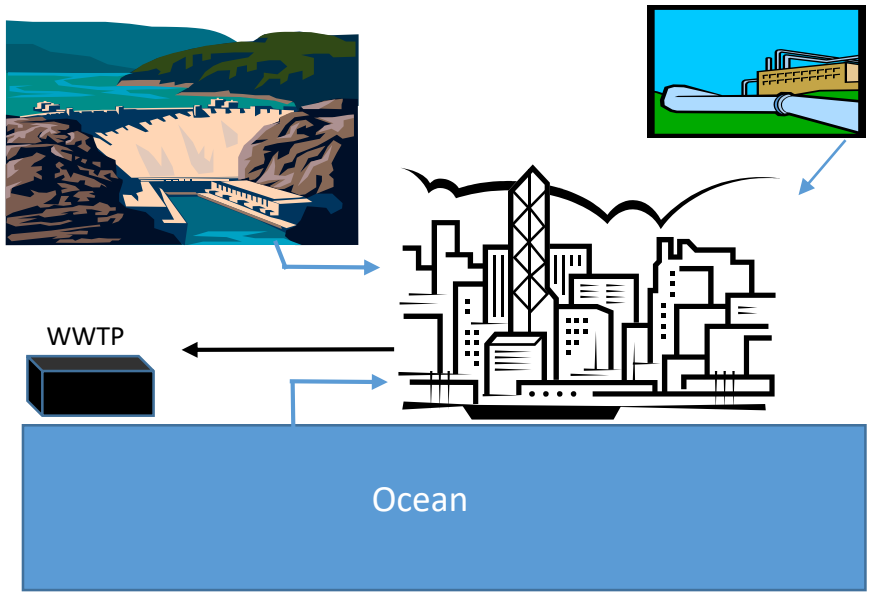


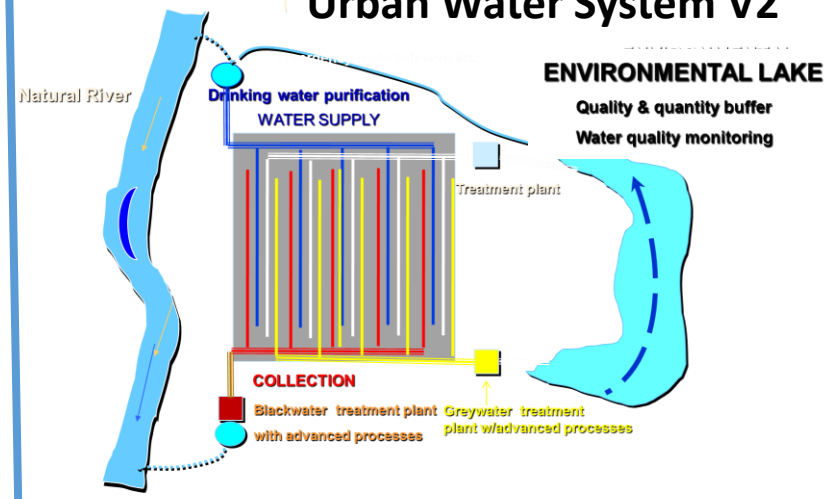

## Urban Water System V1




## Urban Water System V2



# WE SHOULD BE IN THE MIDST OF ONE OF THE MOST SIGNIFICANT TRANSITIONS IN THE HISTORY OF THE WATER PROFESSION

REITER & DAIGGER

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# Cities of the Future

## building strategies to advance urban water security

International Water Association

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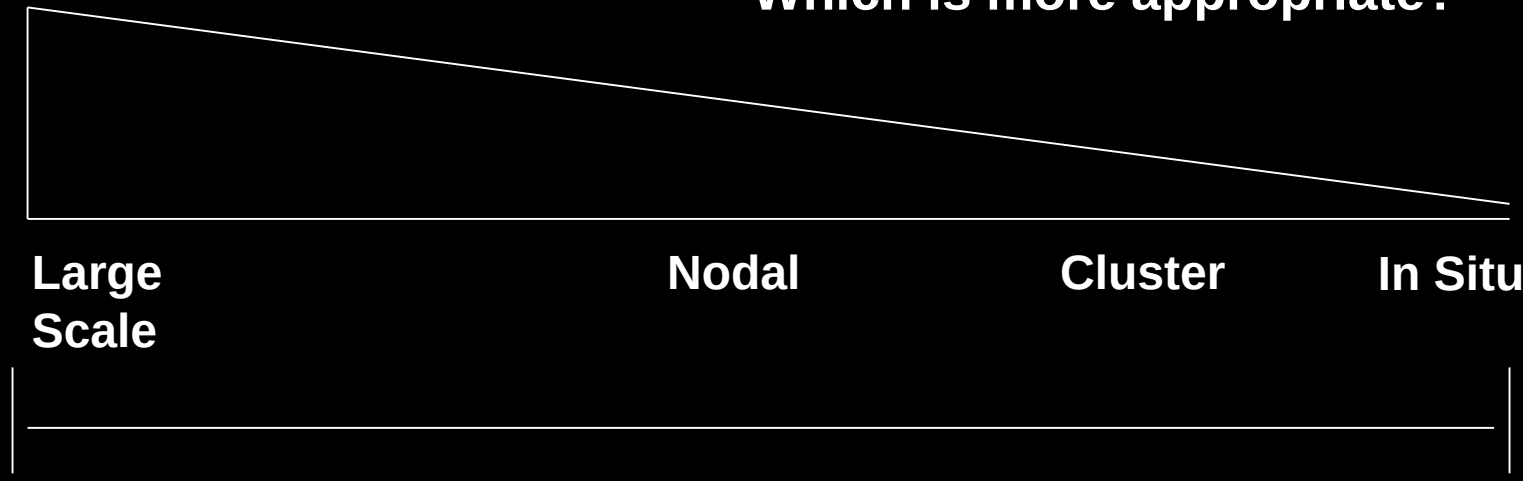
### How Will Cities of the Future Need to Evolve to Meet These Emerging

# Optimizing Within A Continuum of Options

Which is more efficient?

Which is more sustainable?

Which is more appropriate?




Highly Centralized

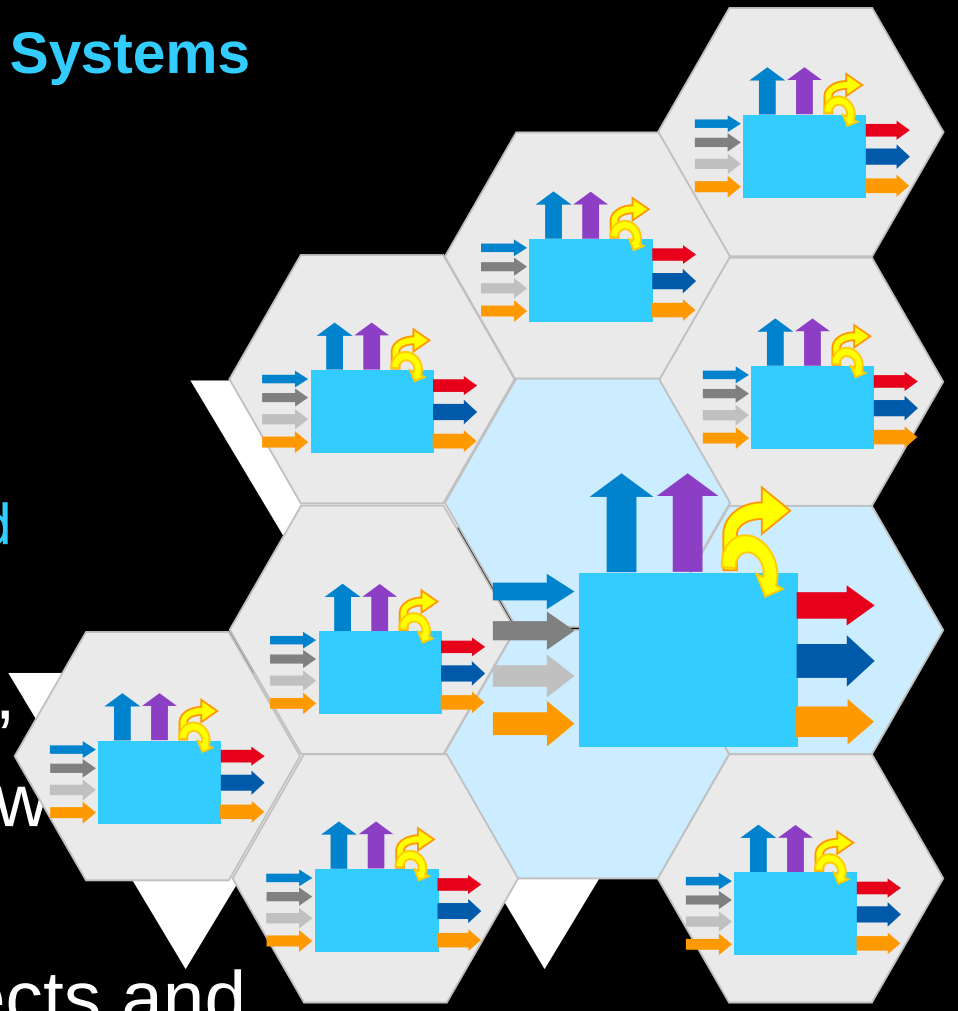
Highly Decentralized

# Semicentralized Supply and Treatment Unit

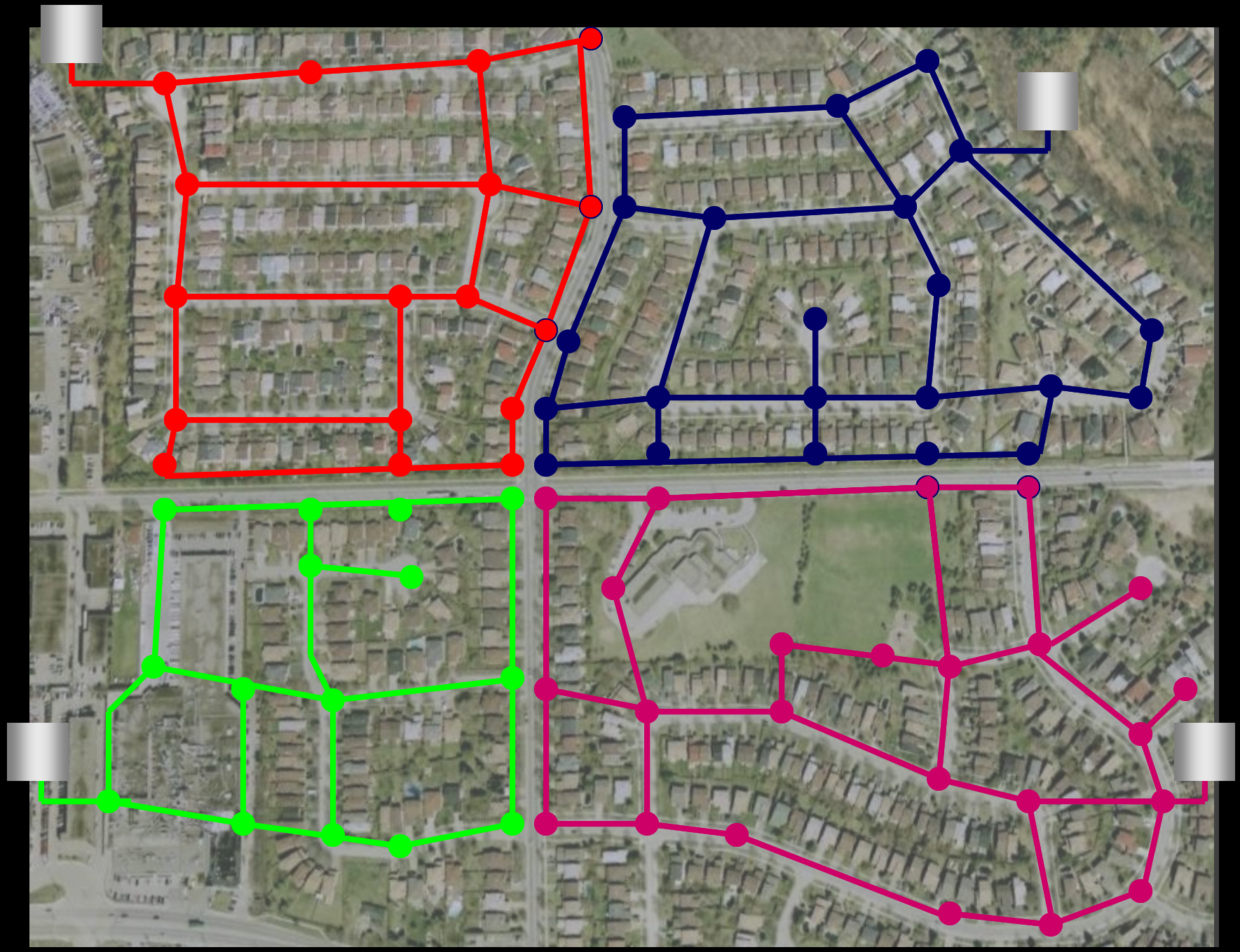
# Integrated treatment on district level

- **Integrated Semicentralized Systems therefore**
  - focus on smaller,
  - more compact units

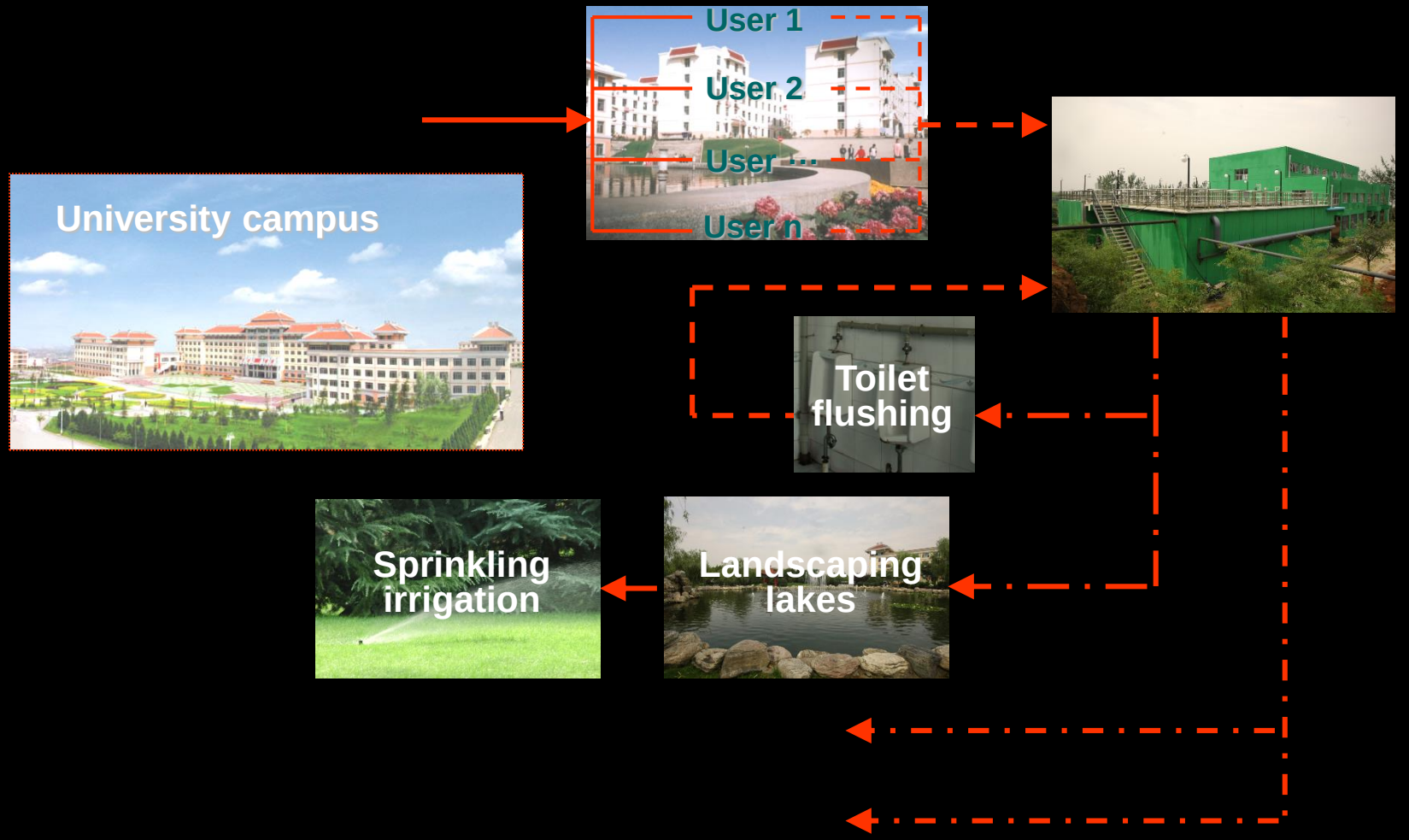
- **Each district has its own** “Semicentralized” Supply and Treatment Unit
  - integrated approach,
  - focusing material flow management,
  - utilizing synergy effects and re-use potentials



TU D

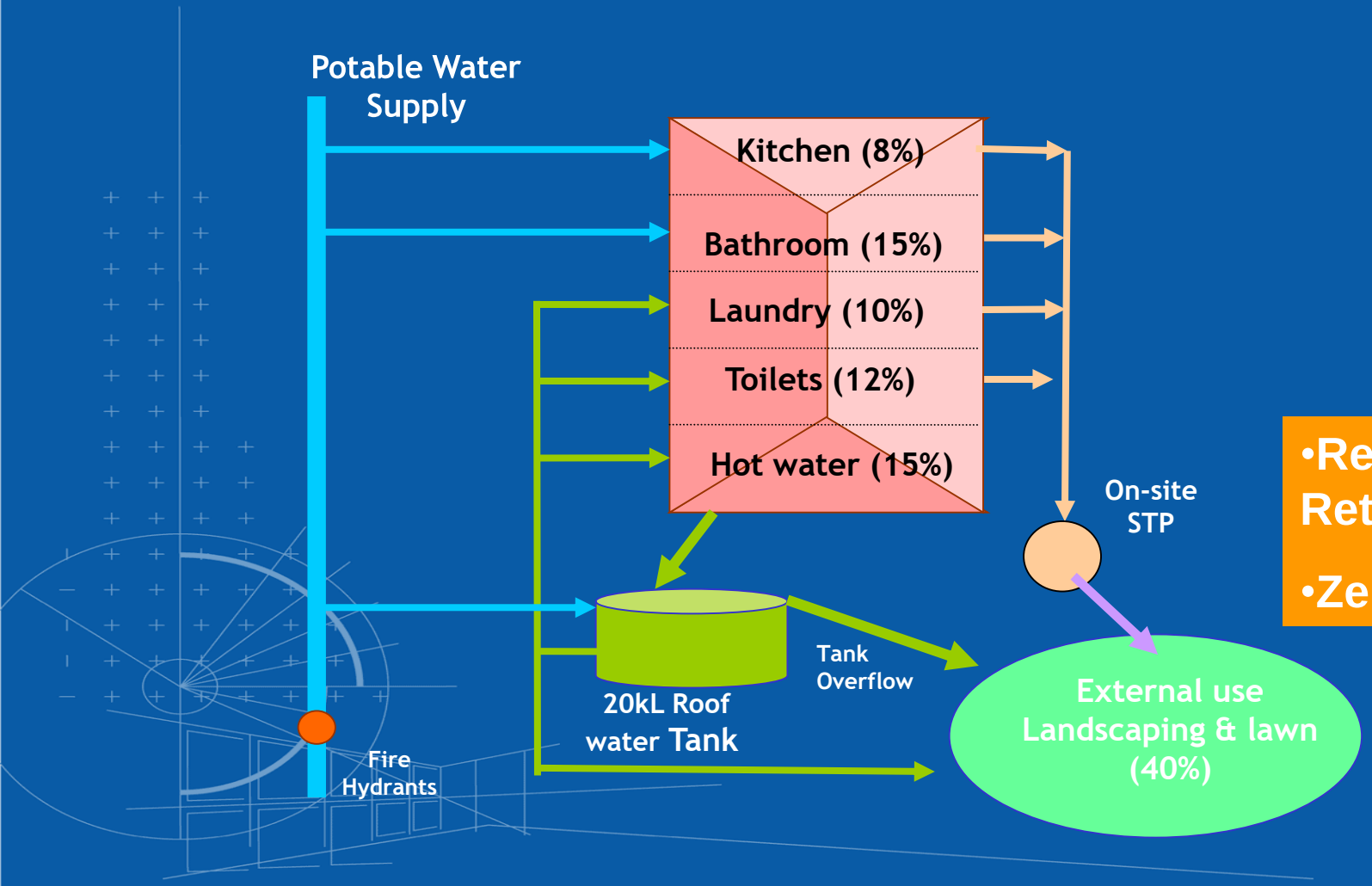


- System outline



# Environmental lakes system

# Concept Applicable at Household Level



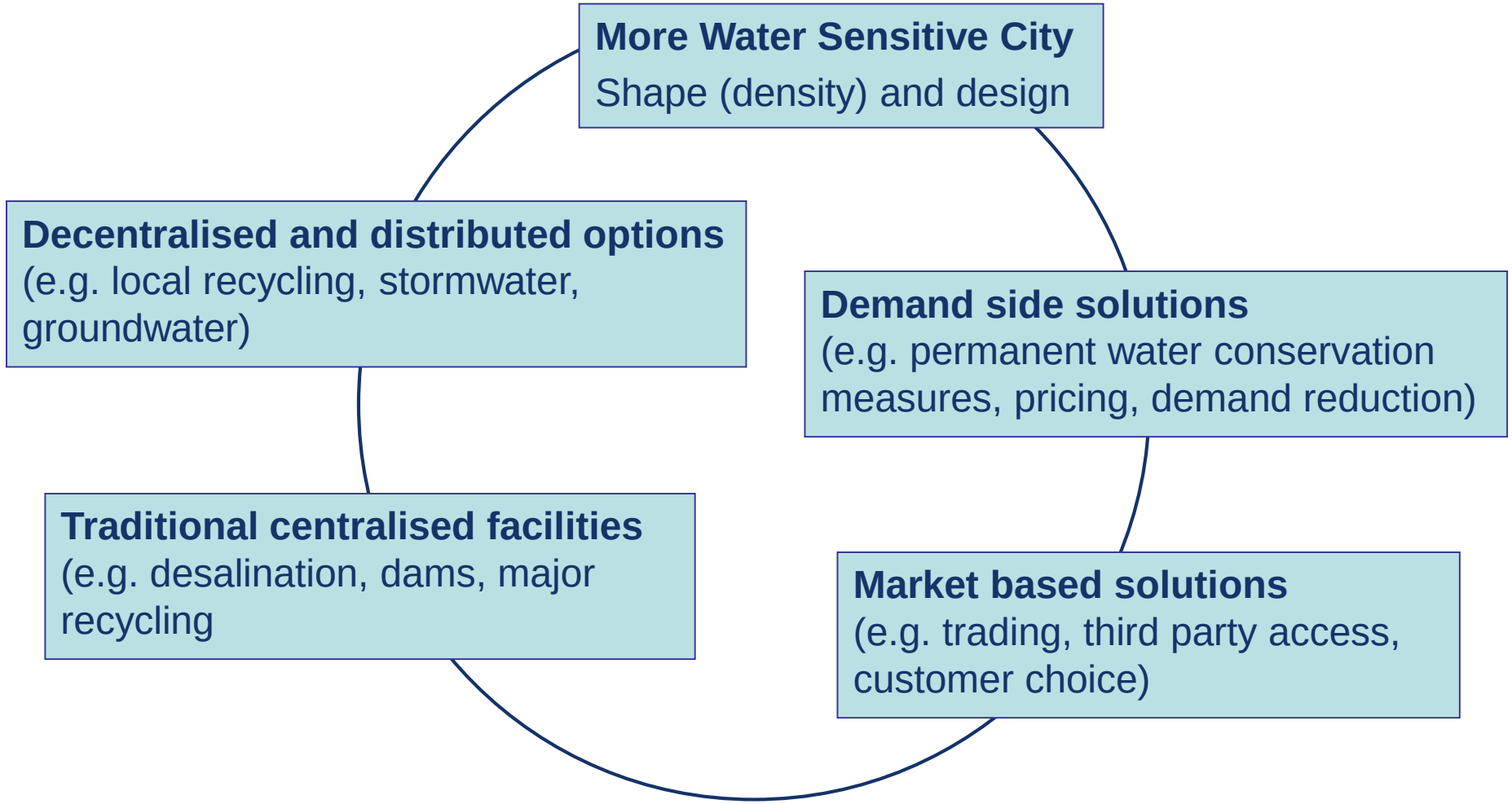

The Gap House

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

# Recent Schemes With Significant Closed Loop Configurations

| Scheme | % Reduction in potable water consumption | % Reduction in discharges to Waterways |
|---|---|---|
| Pimpama – Coomera | 80% | >70% |
| Rouse Hill | 50% | >90% |
| Homebush Bay- Olympic Village | 67% | 100% |
| Mawson lakes | 50% | >80% |

# Integrating strategies for meeting future needs – NOT MUTUALLY EXCLUSIVE




- The five strategic components are interdependent – need to be integrated
  - No silver bullet, different solutions for different conditions

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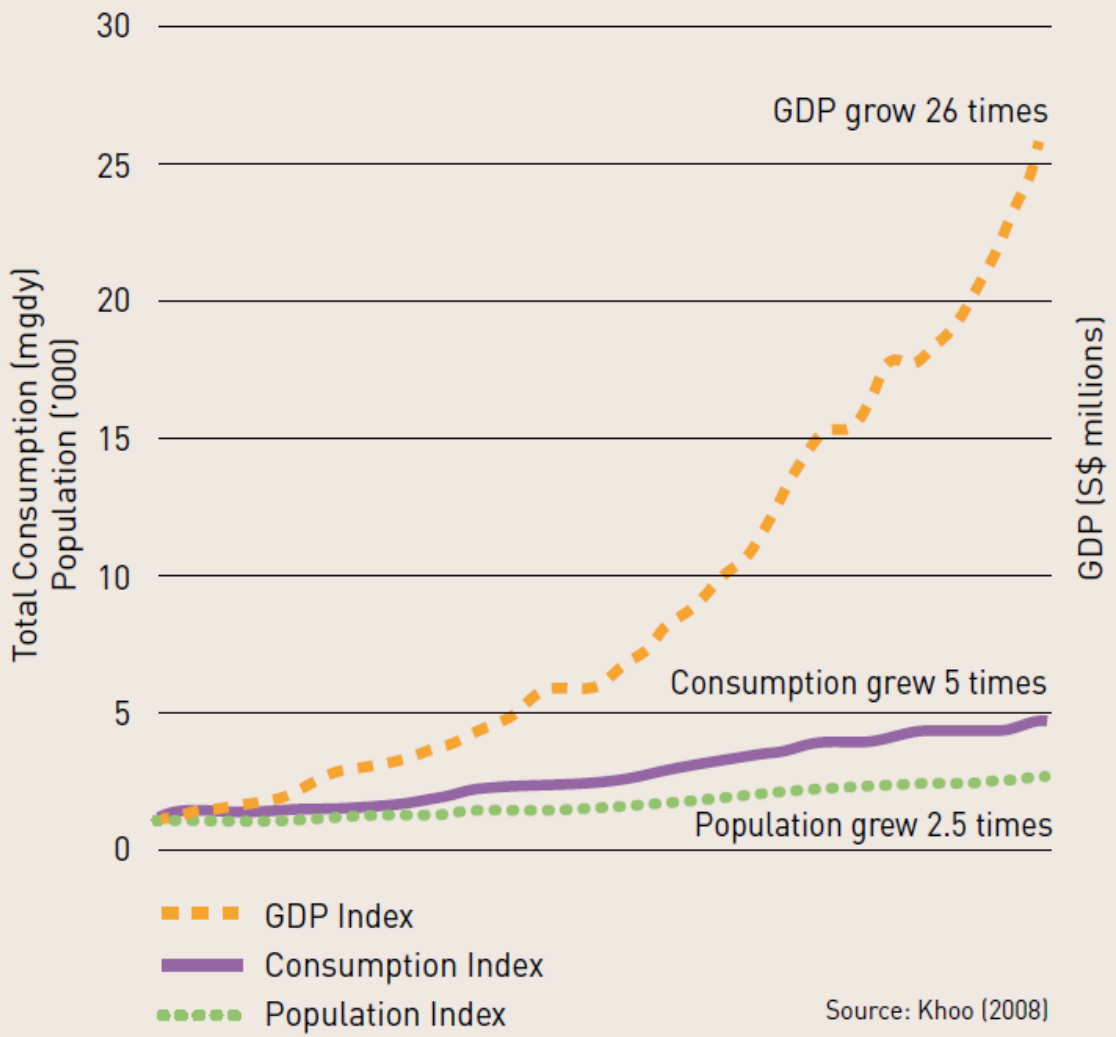
# DOING MORE WITH LESS: Singapore as Case Study (1)

Figure 2.5

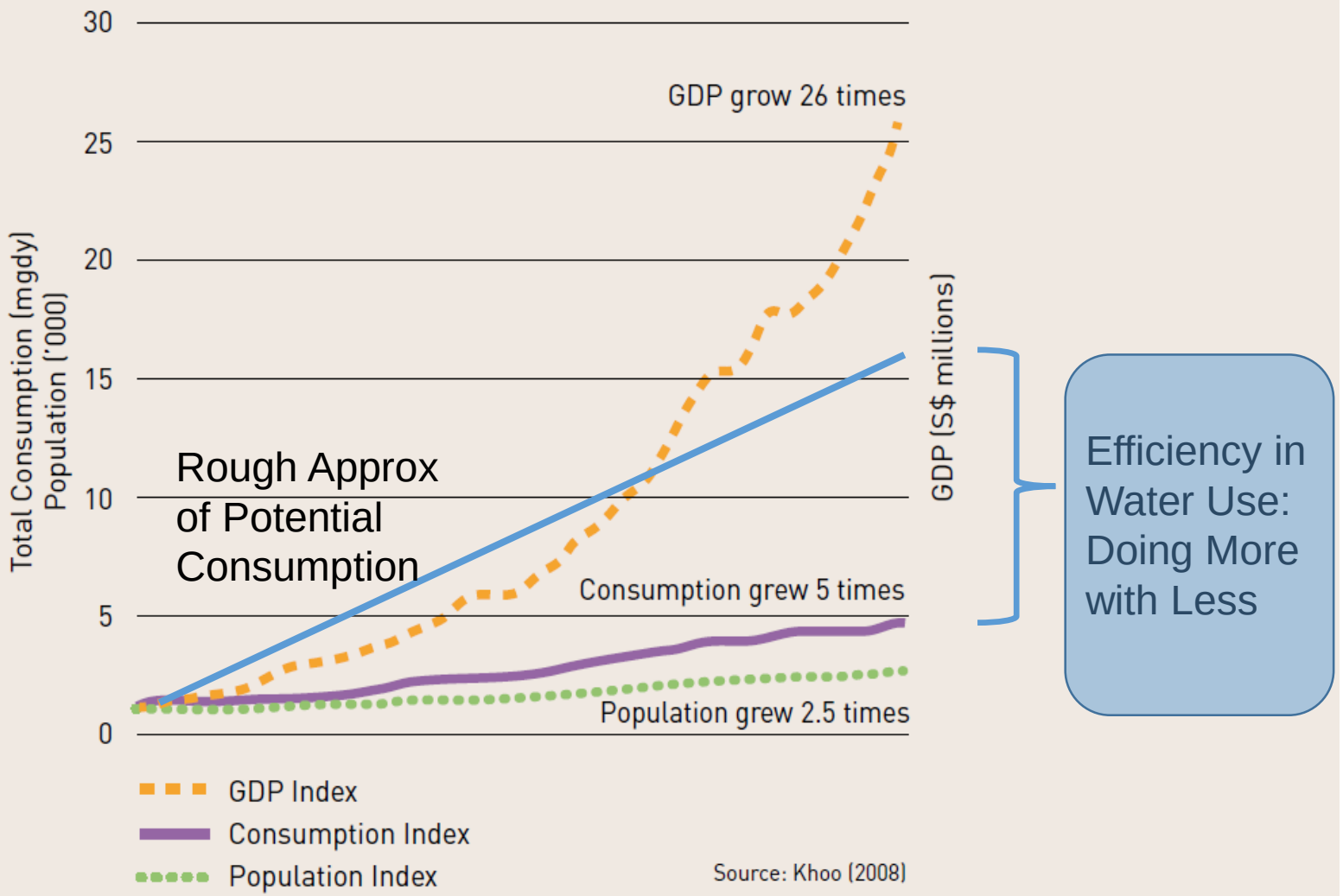
**Singapore GDP, population and total water consumption, 1965–2007 (index, 1965 =1)**



# DOING MORE WITH LESS: Singapore as Case Study (2)

Figure 2.5

**Singapore GDP, population and total water consumption, 1965–2007 (index, 1965 =1)**



# SINGAPORE:  FOUR NATIONAL TAPS

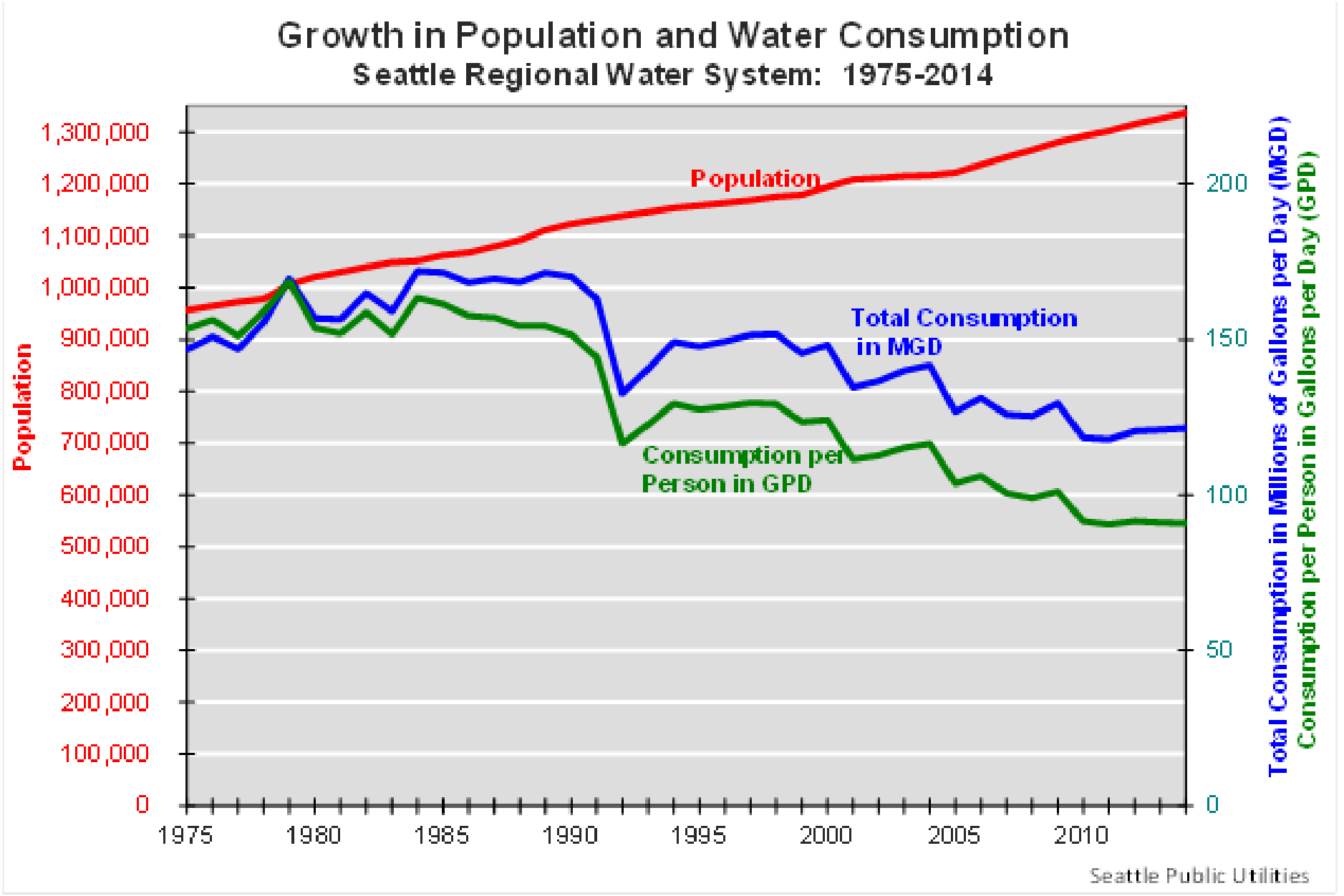
Imported water
(Johor)

NEWater

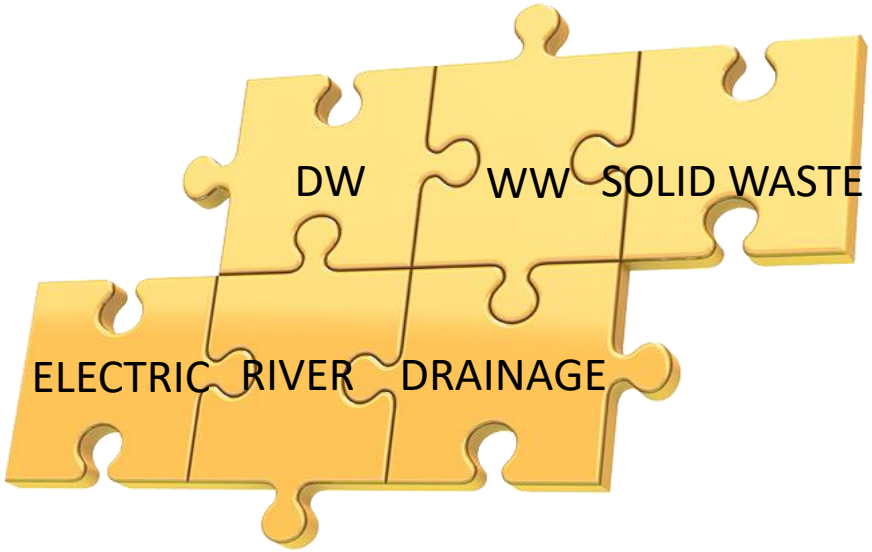
Local
catchment
water

Desalinated
water

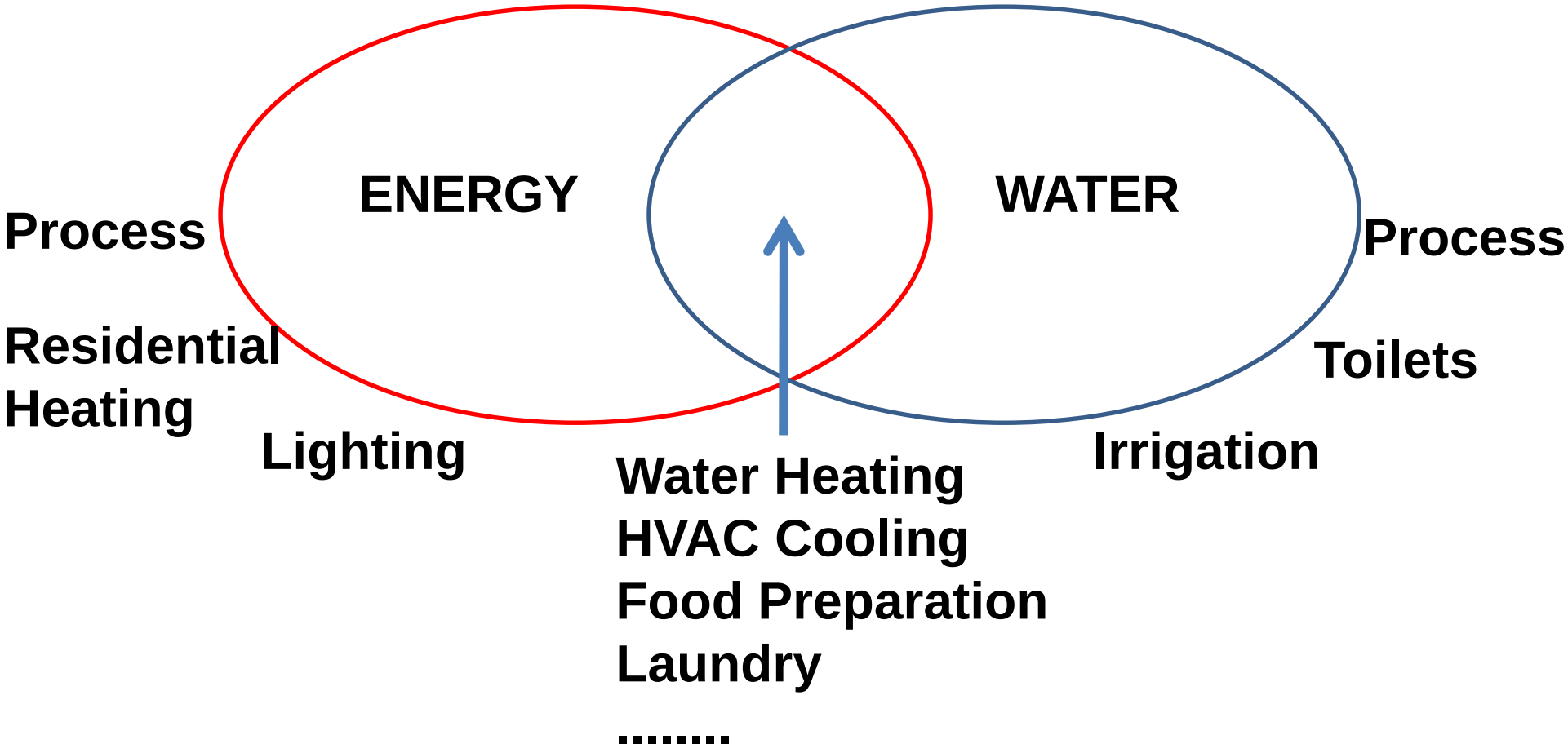
Singapore's
Water Supply


Growth in Population and Water Consumption
Seattle Regional Water System: 1975-2014
Population
1,300,000
1,200,000
1,100,000
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Population
Total Consumption
in MGD
Consumption per
Person in GPD
200
150
100
50
0
Total Consumption in Millions of Gallons per Day (MGD)
Consumption per Person in Gallons per Day (GPD)
1975
1980
1985
1990
1995
2000
2005
2010
Seattle Public Utilities

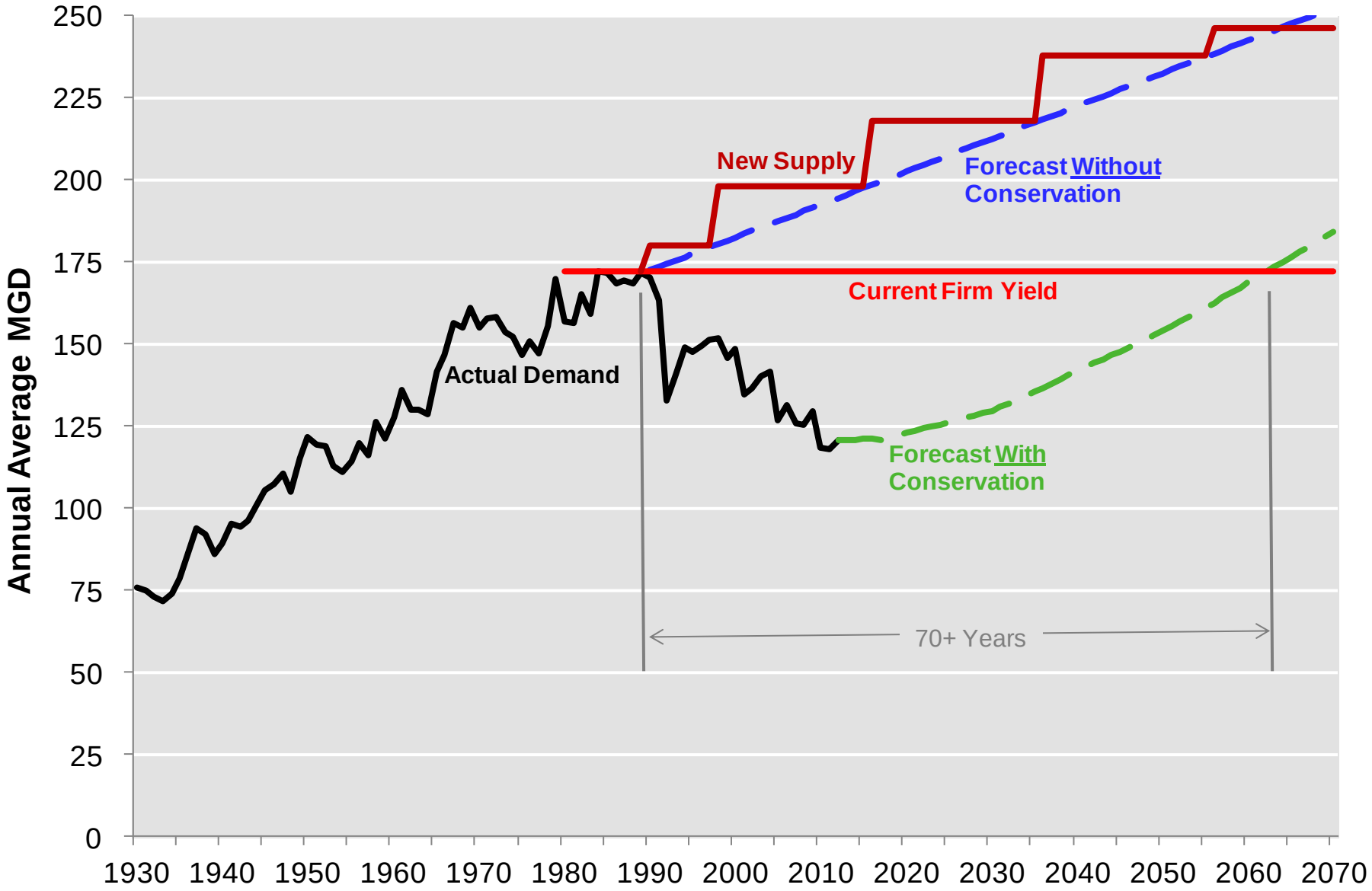
# Creation Seattle Public Utilities




# Cross-Walk Between Energy and Water Efficiency Measures

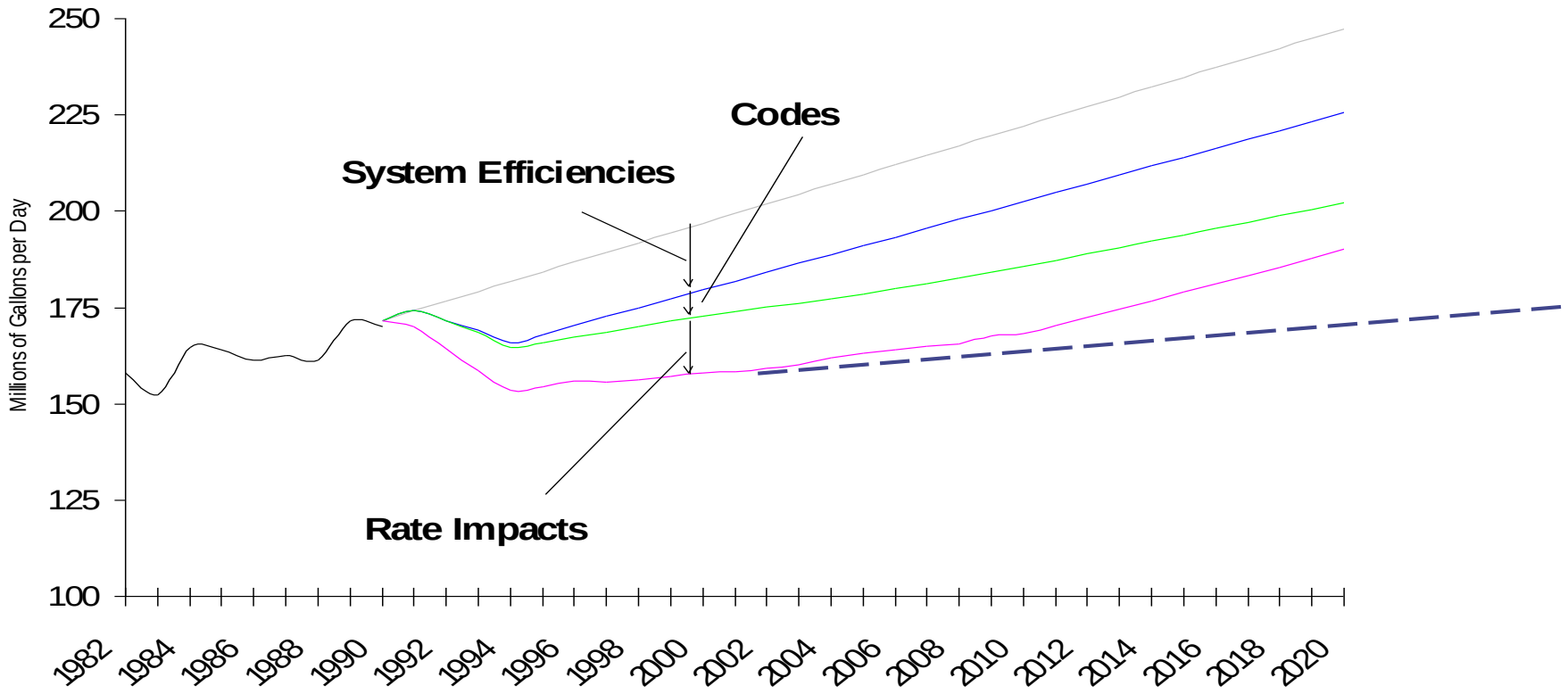


# Conservation Vs. New Supply



# Seattle Public Utilities, USA

## Key Components of Conservation



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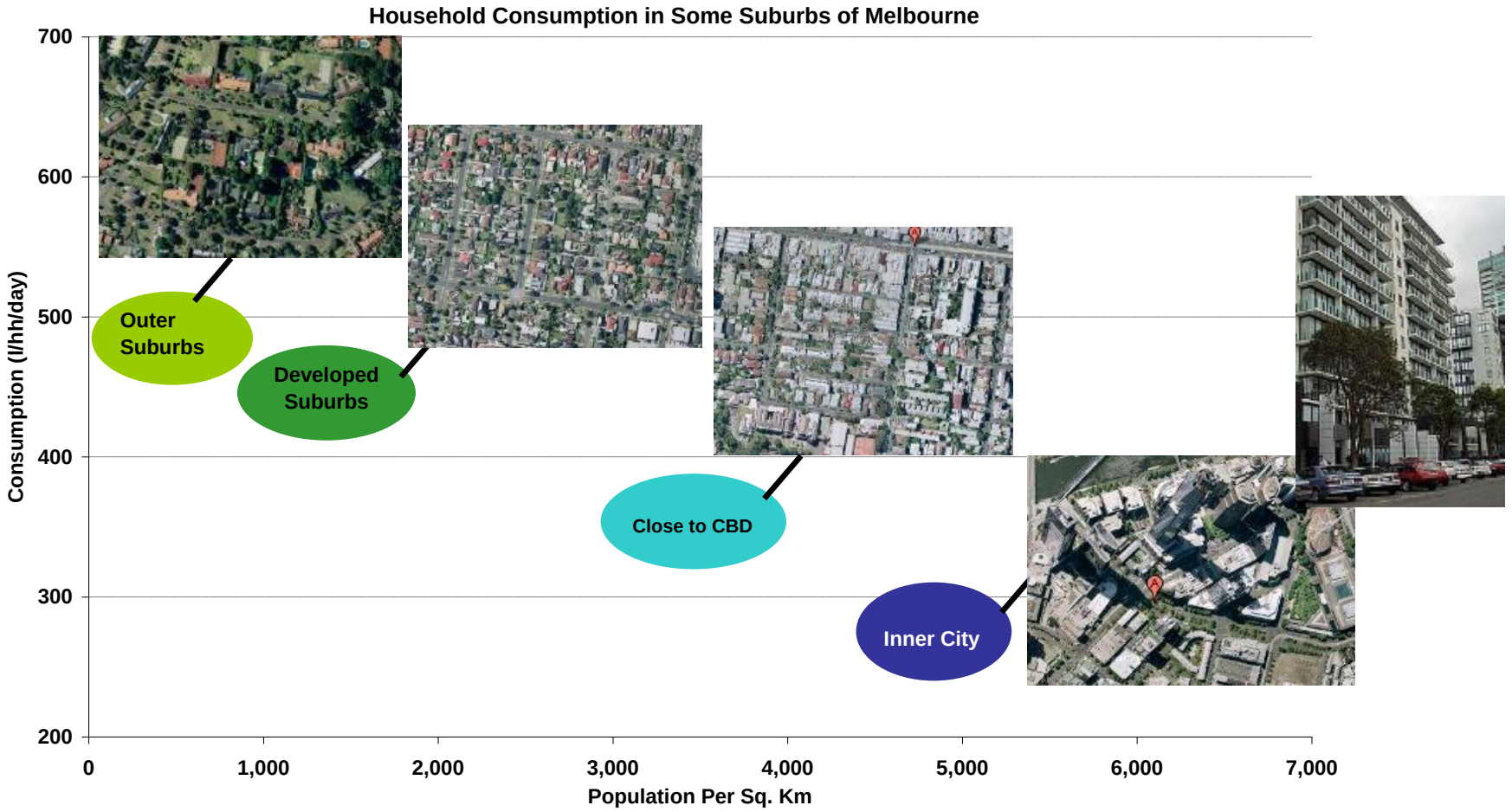
### How Will Cities of the Future Need to Evolve to Meet These Emerging

# Changing City Shape and Form

- Aim to reduce per capita consumption of water
- Sustainability objectives linked to energy, access and liveability objectives



# INTEGRATION OF "GREEN INFRASTRUCTURE" WITH "GREY"

# Integrated Wastewater and Solid Waste Treatment


Des Moines Wastewater Treatment Plant, Des Moines, IA, USA

Hauled organic wastes account for 40% of the feed to the anaerobic digesters. Revenue from tipping fees, selling biogas. Savings on electricity.

Courtesy of Dave Parry, CDM

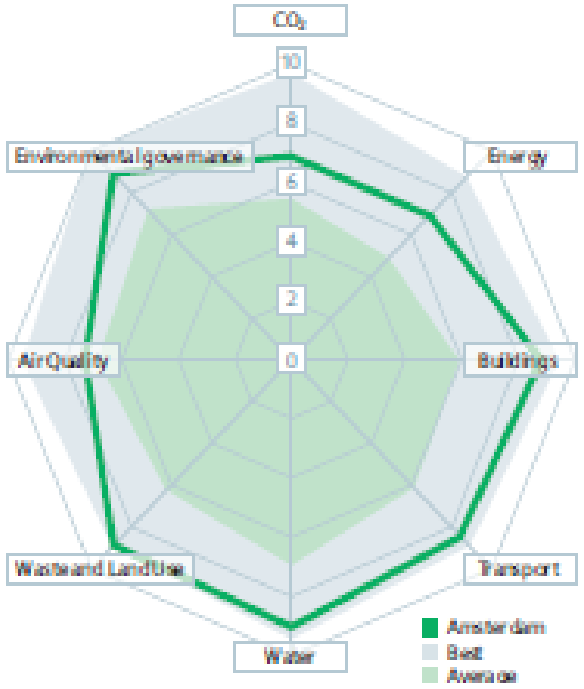
# Amsterdam

# Amsterdam Case: Result

## Sustainable Energy Production from Biogas and Waste

- Co-production of bio-gas and heat through jointly run public authorities

- Heat is linked to one of Europe's most energy efficient district heating networks in the City of Amsterdam

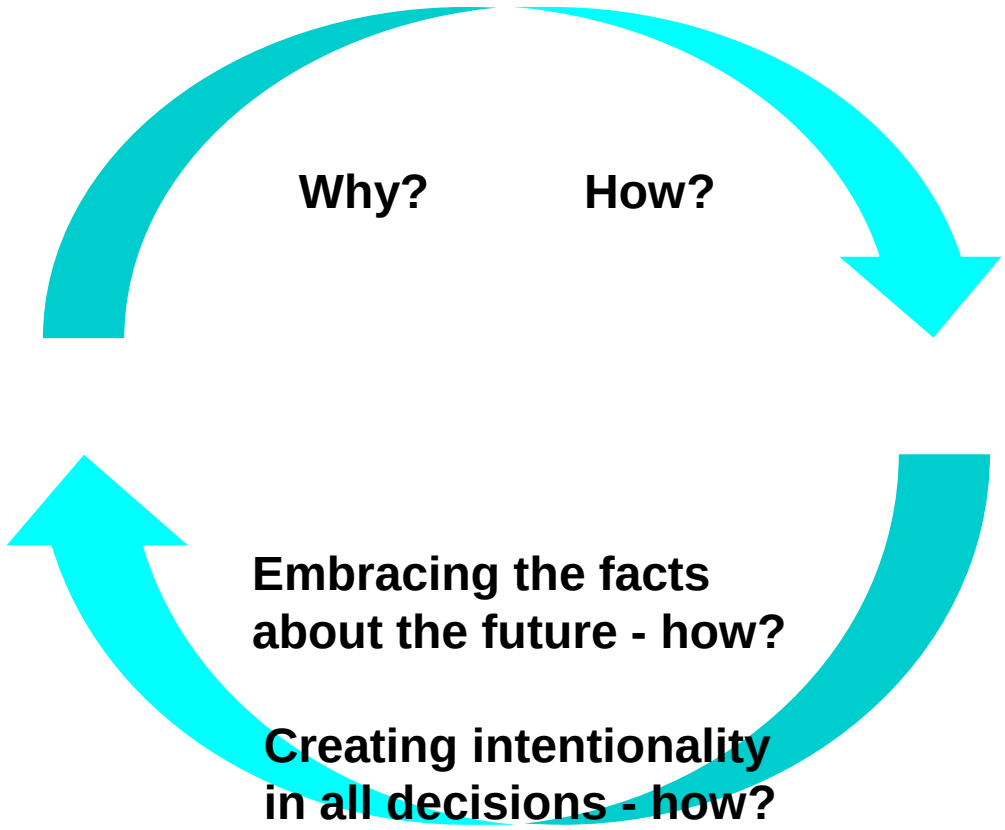


# Motivating Change Vital to Survival

## Reimagining Our Future

+

Show-casing the possibilities

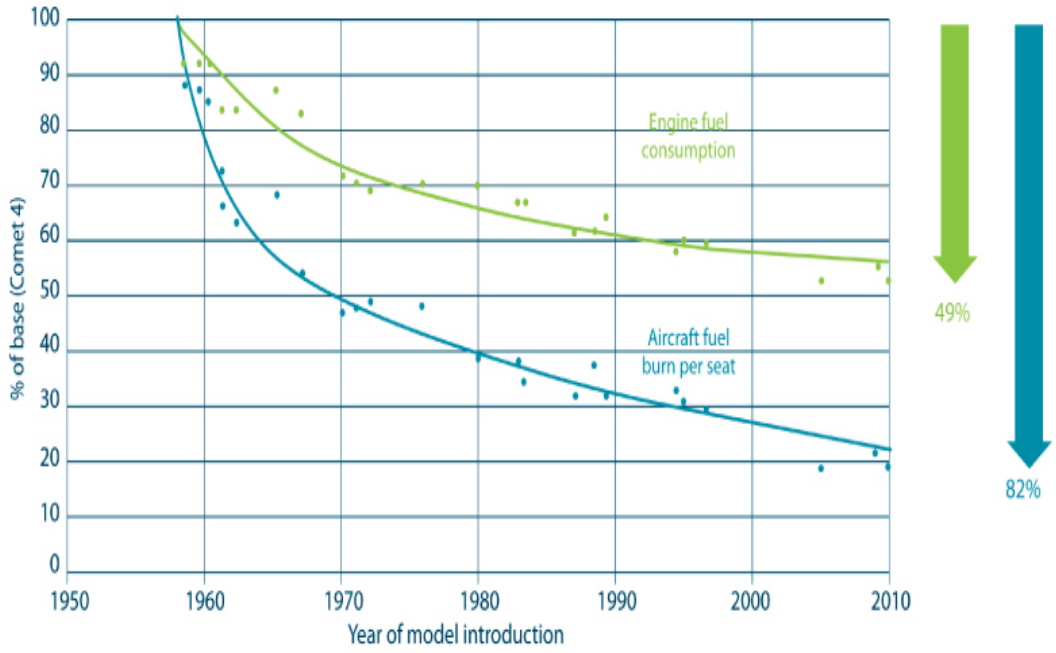



Show-casing the risks of inaction

−

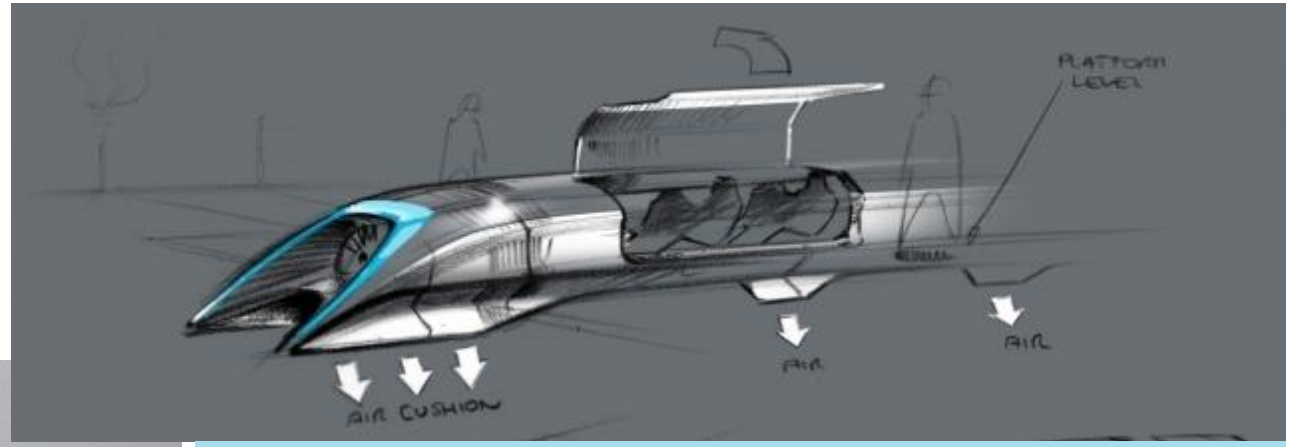
## Defeating Habitual Comfort Zones in the Context of Future Conditions

## Fuel efficiency gains since the modern jet age




courtesy of Air Transport Action Group


© Reuters

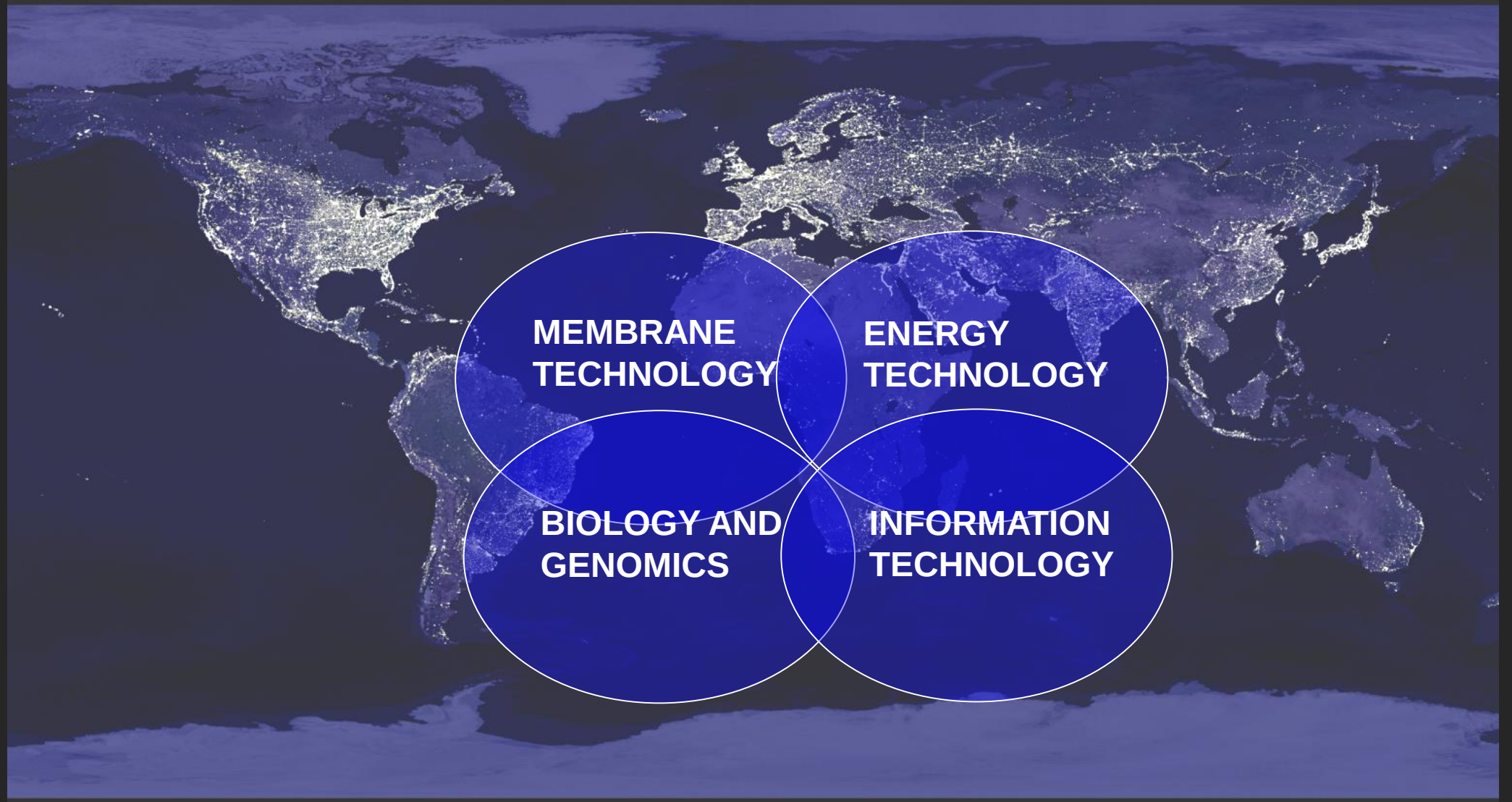





© EPA

Solar Home Community, California

# Hot, Flat and Crowded but with a Revolution in the Making ?

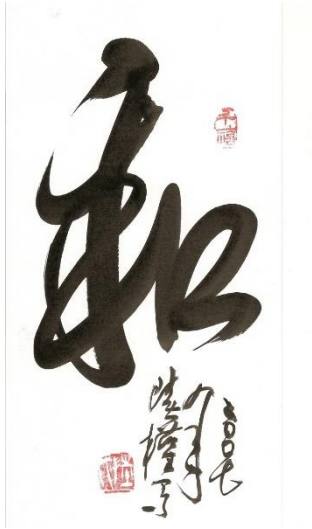


**RESPONSIBILITY,**

**DUTY**

# DOING *MORE WITH LESS* RELATED TO MULTIPLE SECTORS

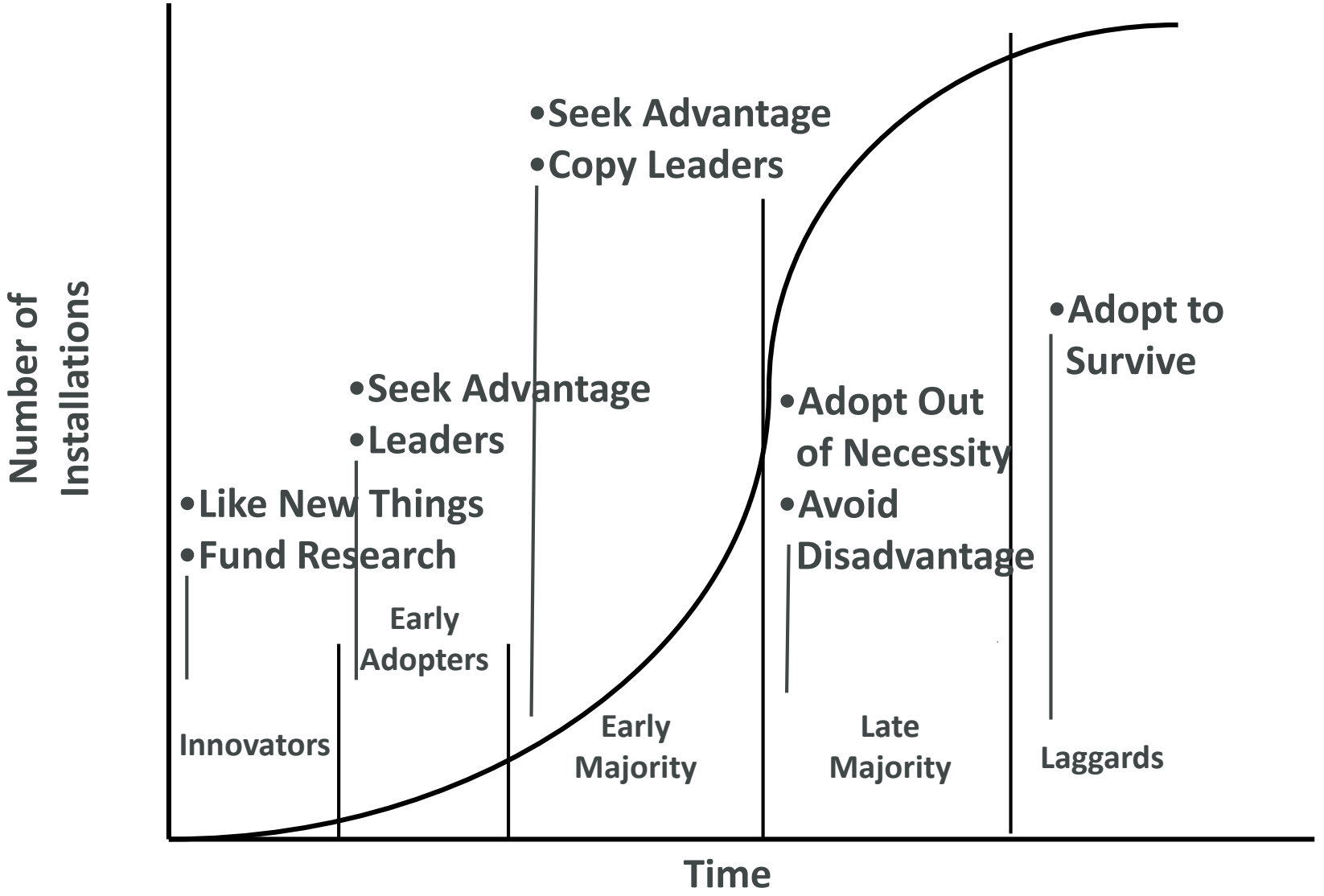
**PERSEVERANCE**



**HARMONY**

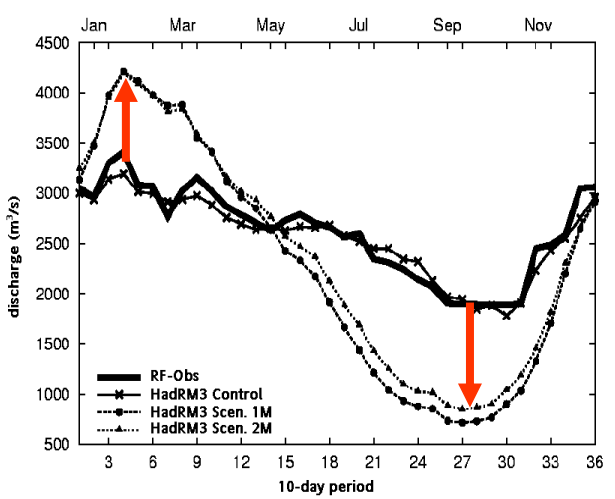
# Thank You

# ADOPTION OF INNOVATIONS FOLLOWS CLASSIC "S" CURVE*

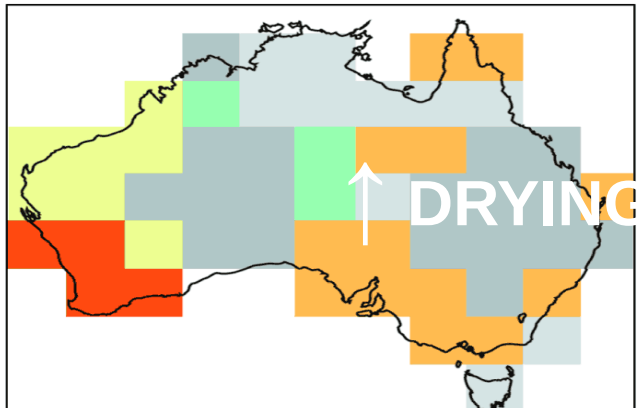


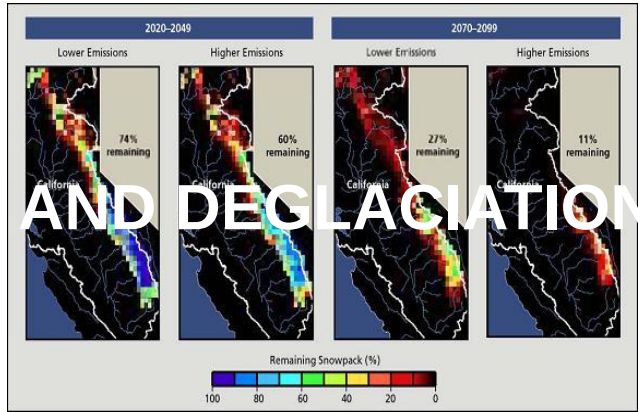

* Rogers, E. M., *Diffusion of Innovations*, Free Press, NY, 2003..

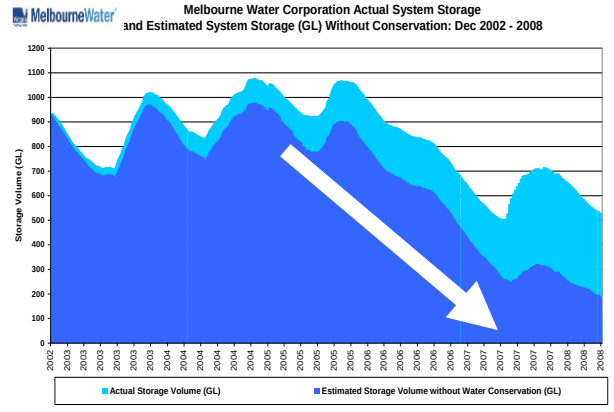

ERATIC EVENTS


Jan
Mar
May
Jul
Sep
Nov
4500
4000
3500
3000
2500
2000
1500
1000
500
discharge (m³/s)
RF-Obs
HadRM3 Control
HadRM3 Scen. 1M
HadRM3 Scen. 2M
3
6
9
12
15
18
21
24
27
30
33
36
10-day period

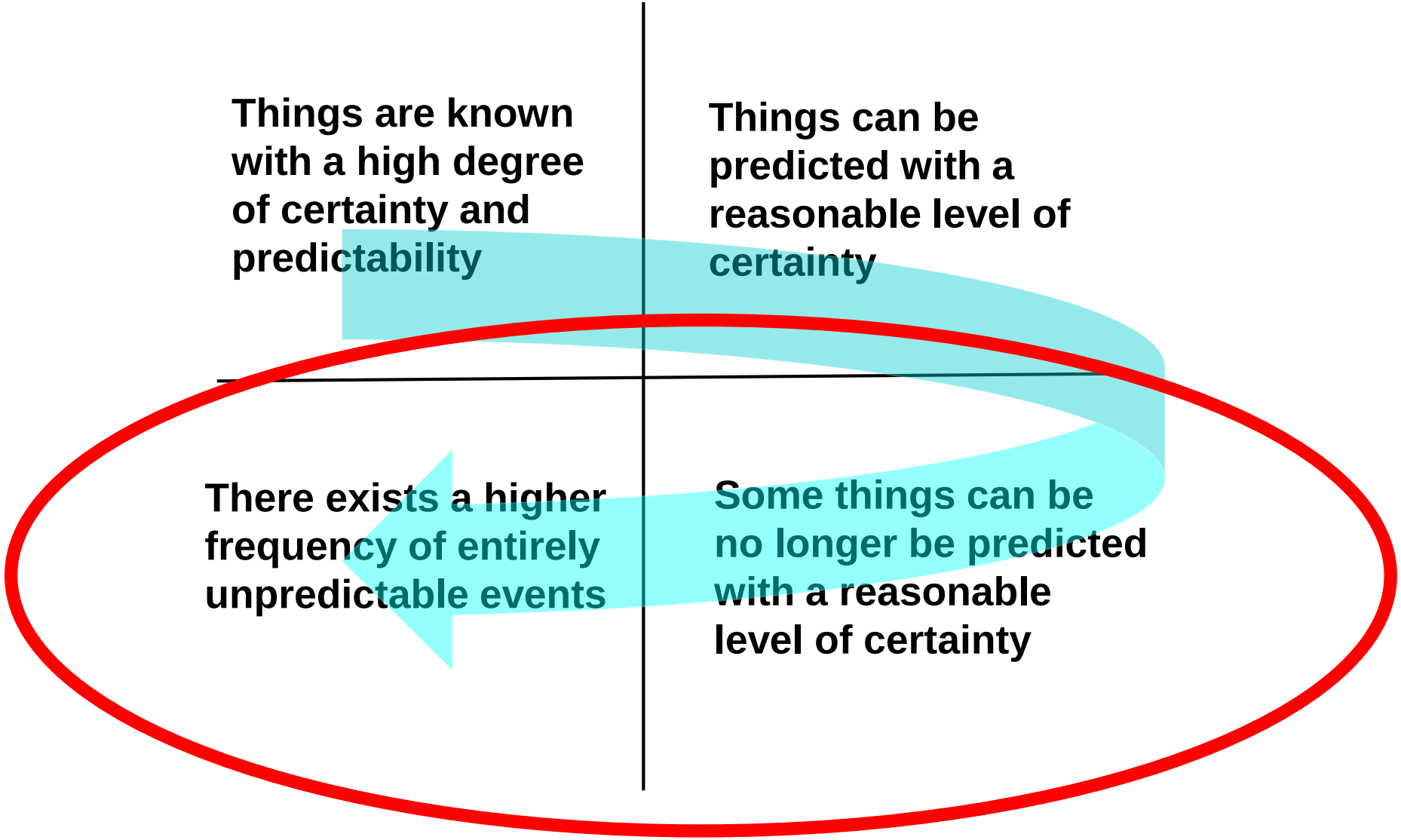

CYCLONIC INTENSITY & FREQUENCY

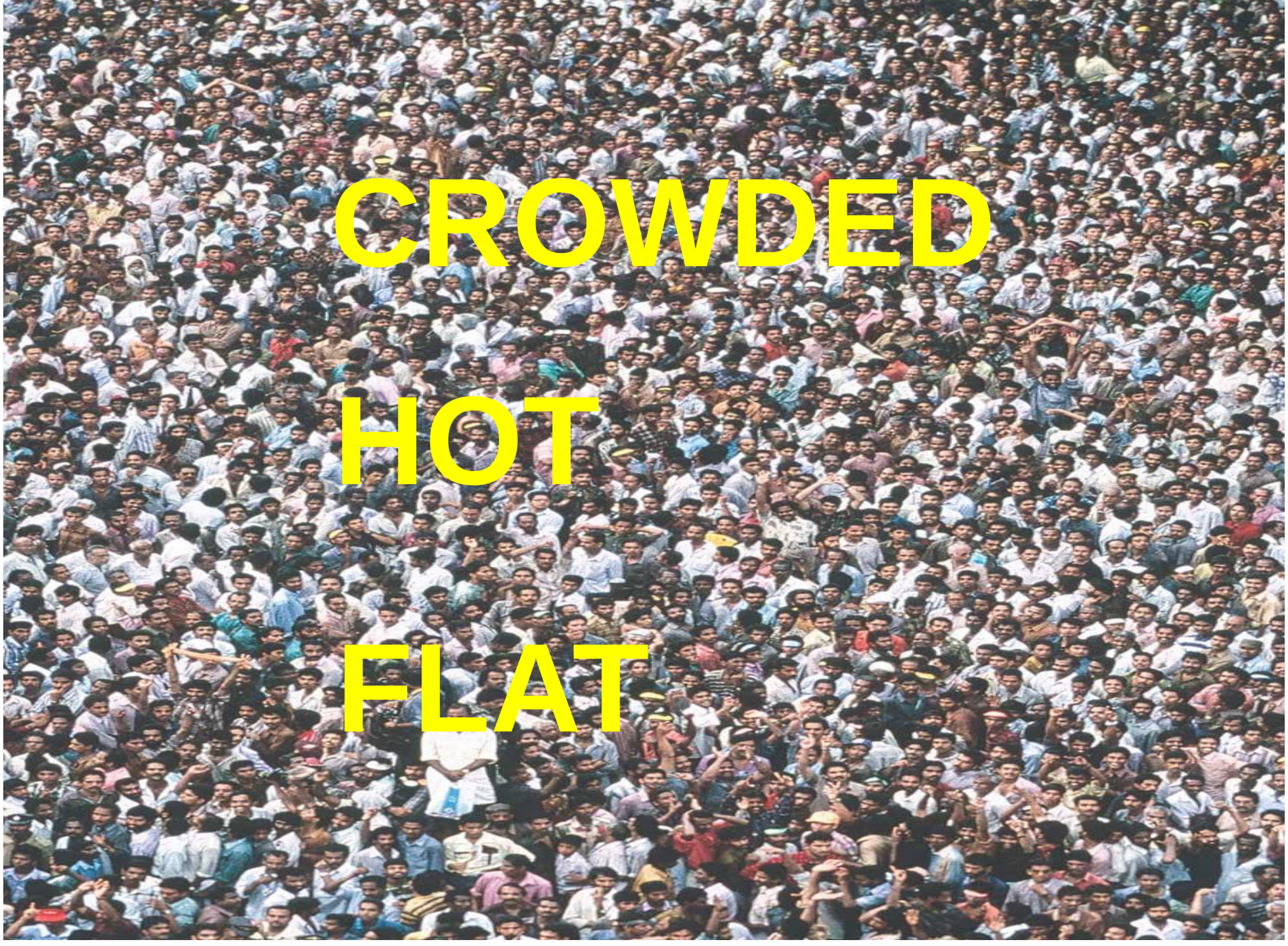

DRYING AND DEGLACIATION


2020–2049
2070–2099
Lower Emissions
Higher Emissions
Lower Emissions
Higher Emissions
74% remaining
60% remaining
27% remaining
11% remaining
California
Remaining Snowpack (%)
100
80
60
40
20
0

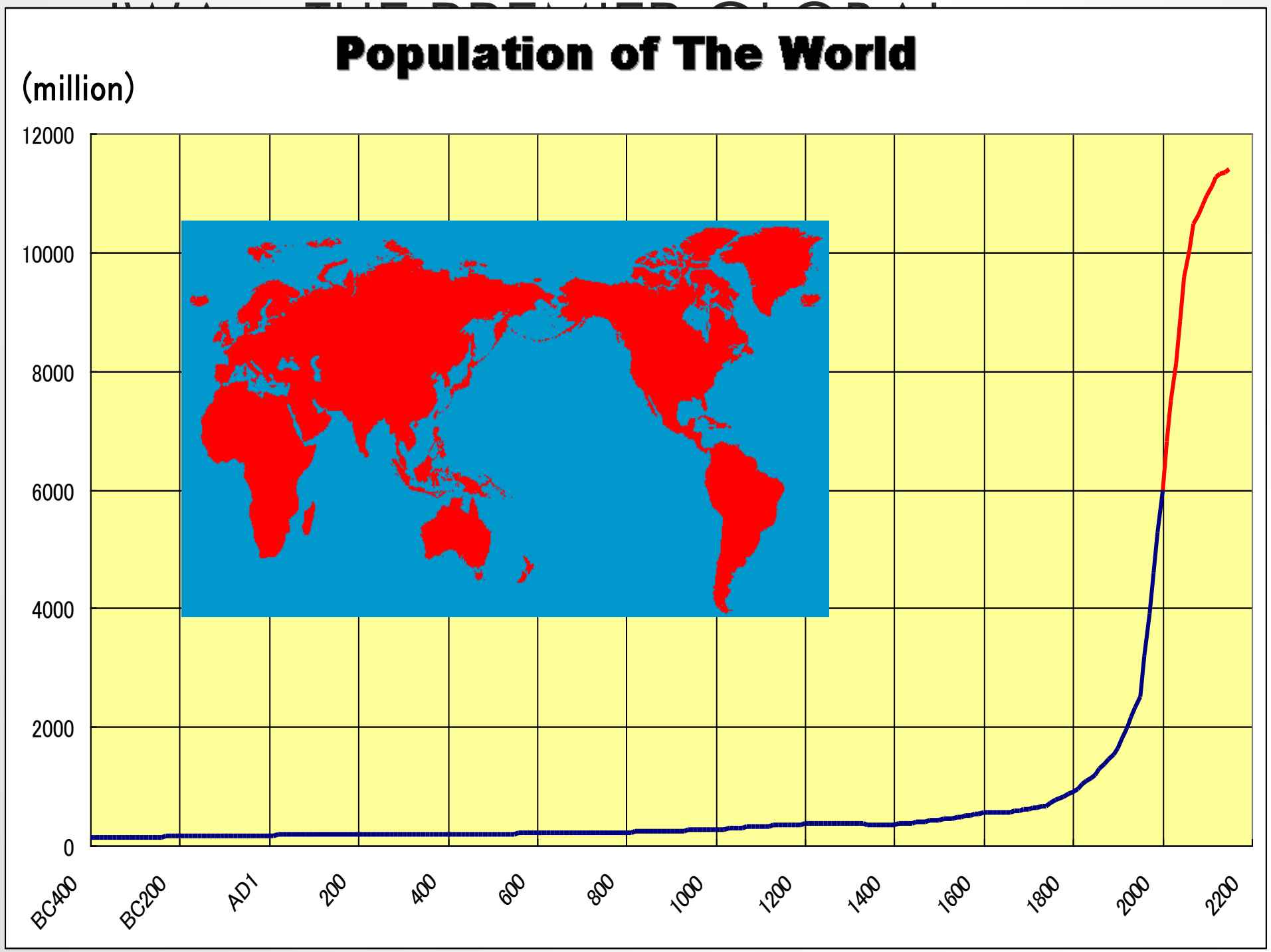

MelbourneWater
Melbourne Water Corporation Actual System Storage
and Estimated System Storage (GL) Without Conservation: Dec 2002 - 2008
Storage Volume (GL)
Actual Storage Volume (GL)
Estimated Storage Volume without Water Conservation (GL)

# An Increasingly Uncertain Future for All Involved in Urban Water

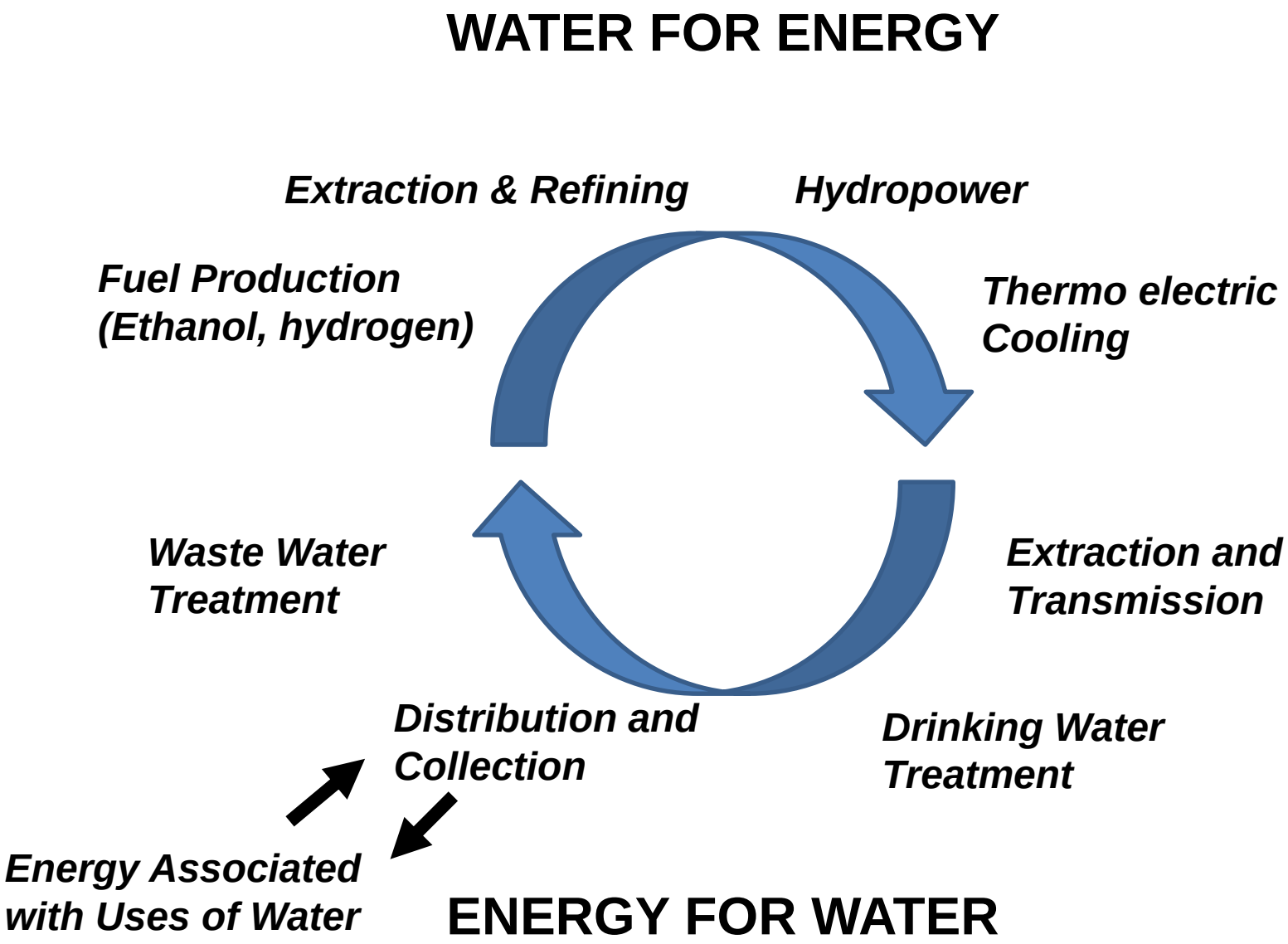



CROWDED
HOT
FLAT

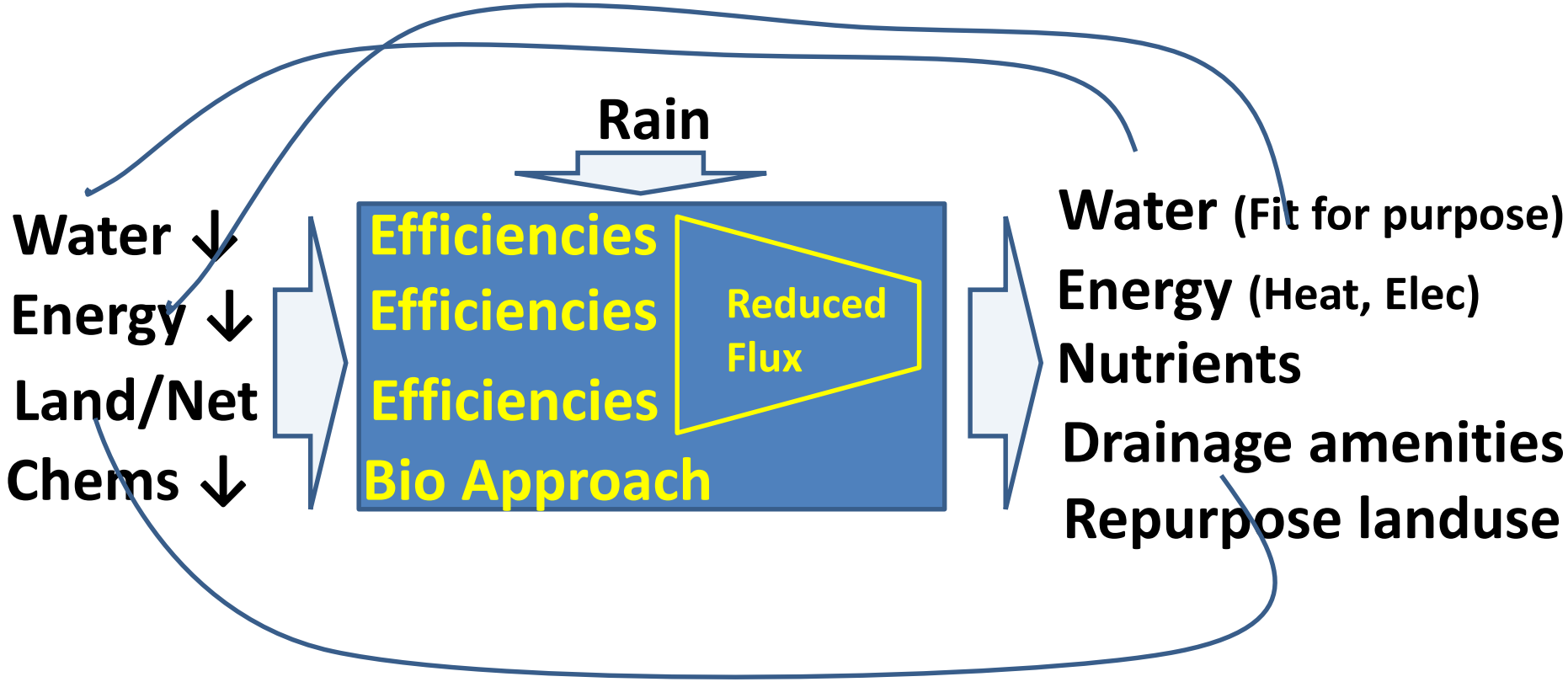
# Population of The World



# Water Uses Energy, Energy Uses Water



# The Changing Paradigm of Water & Energy in Cities



Solid Waste Plant

Power Plant

CITY A ----BEFORE

Waste Water TP

Drinking Water TP

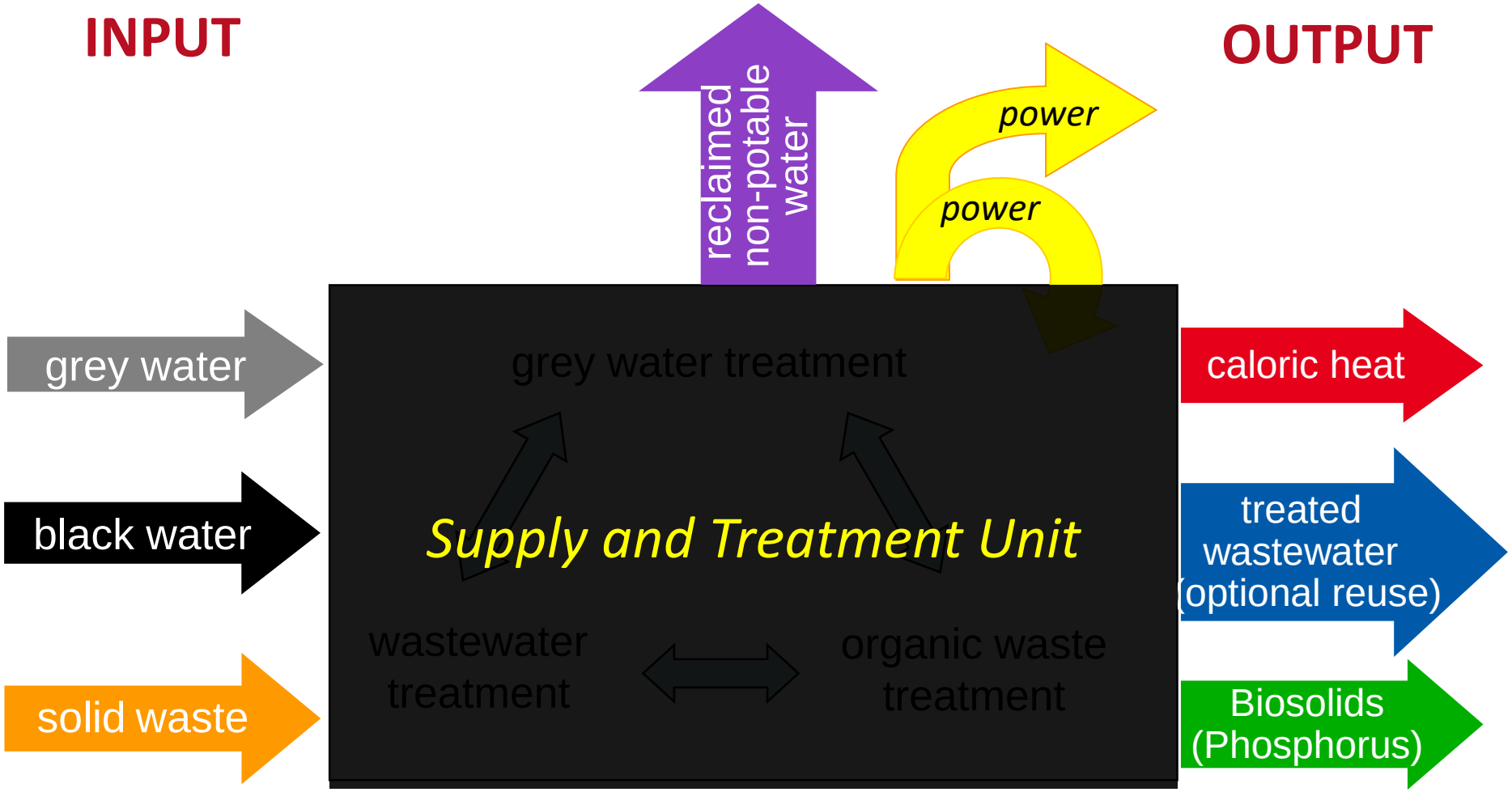
New Waste Water TP (Mostly solids)

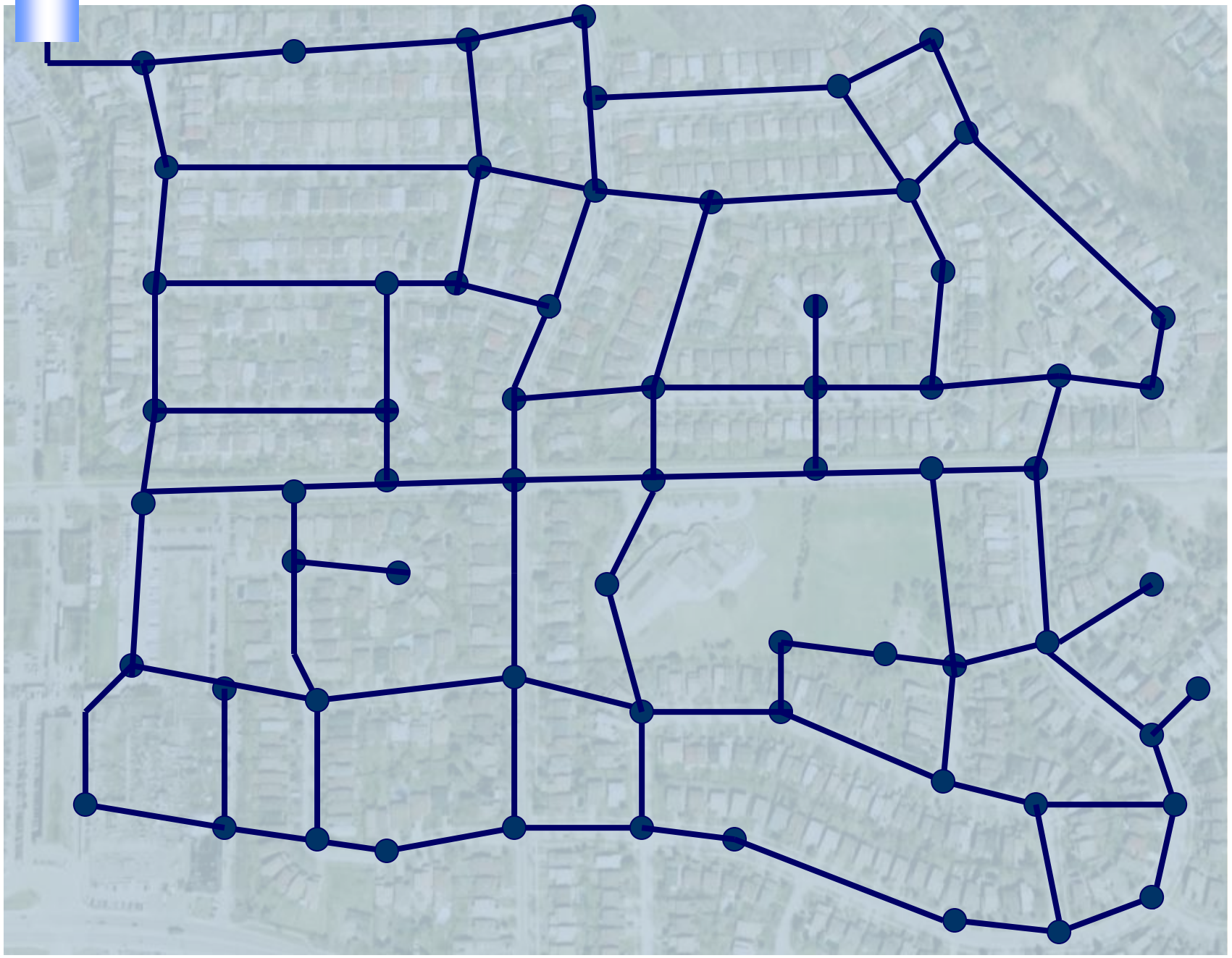
New Power Plant

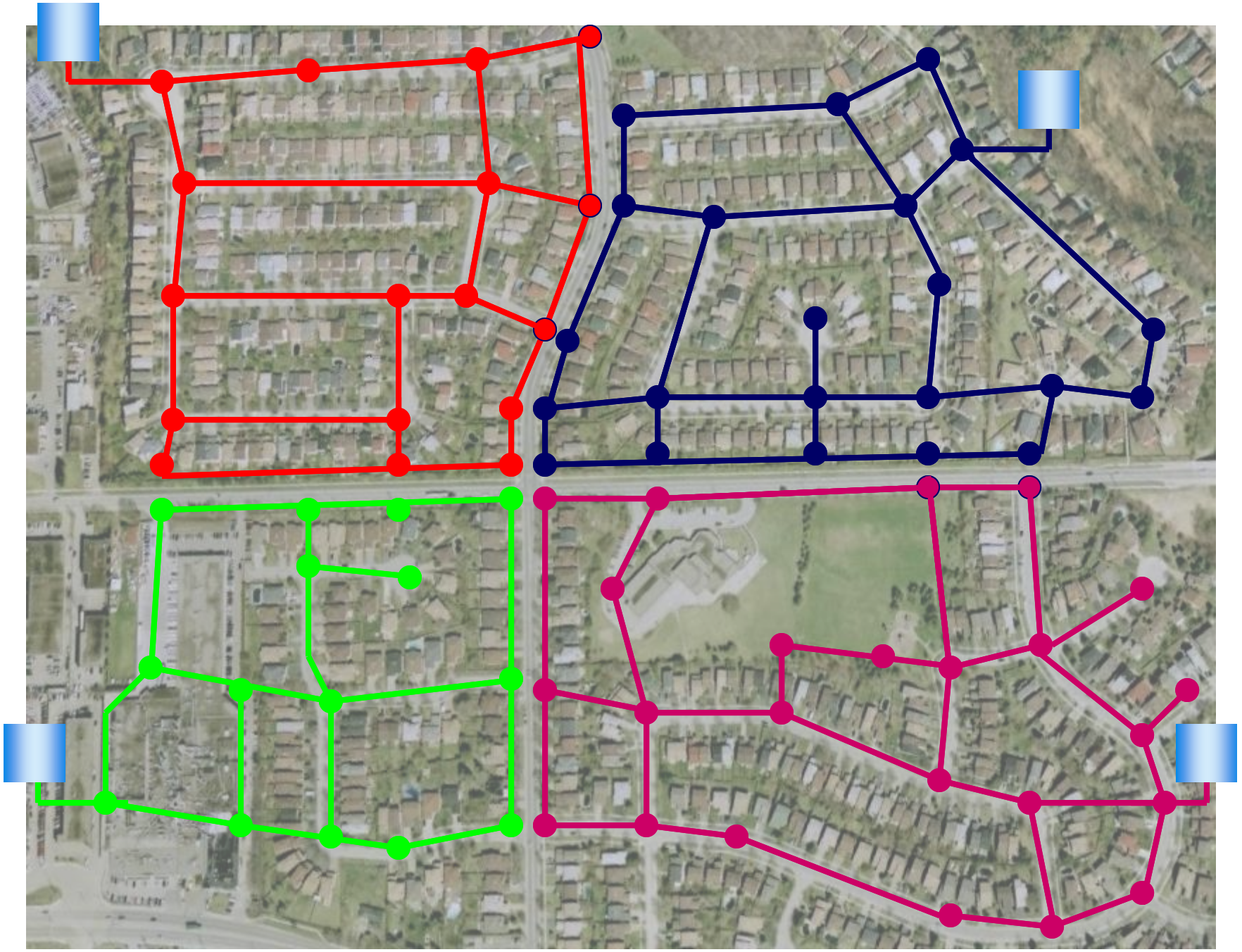
Solid Waste Non-Petruiciables

CITY A ----AFTER

# Semicentralized Supply and Treatment Unit







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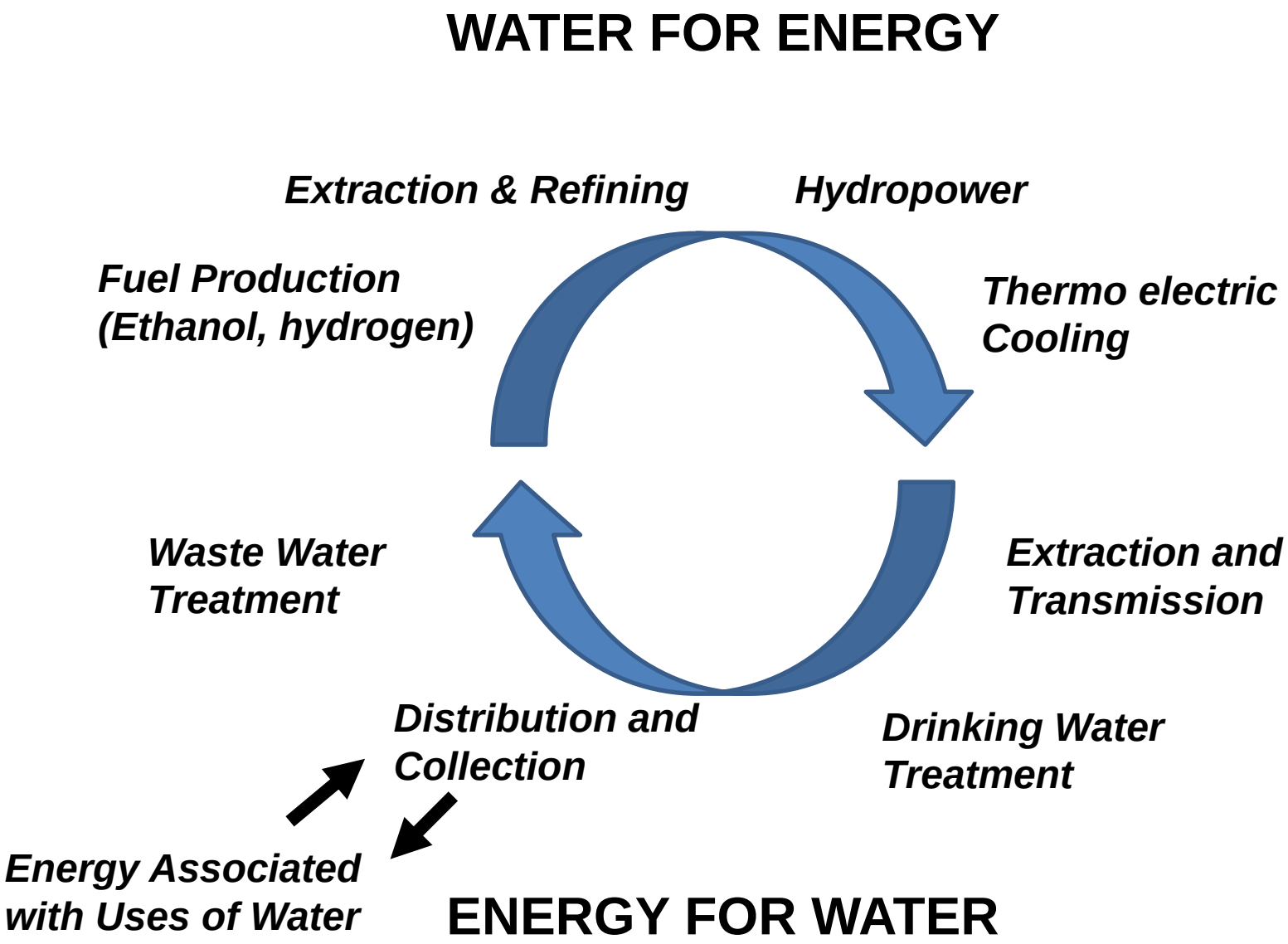

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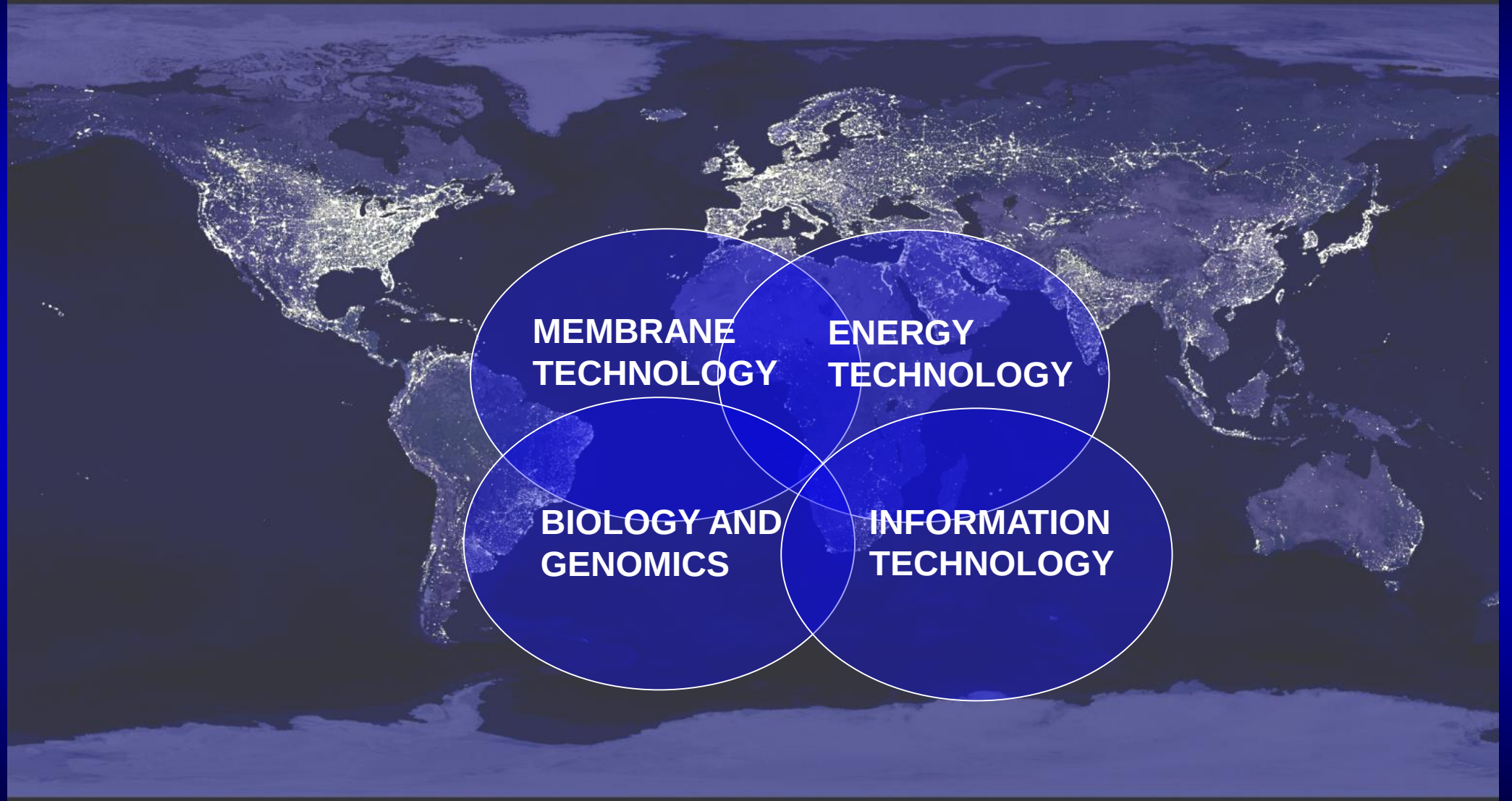

# Decision Making in an Uncertain World