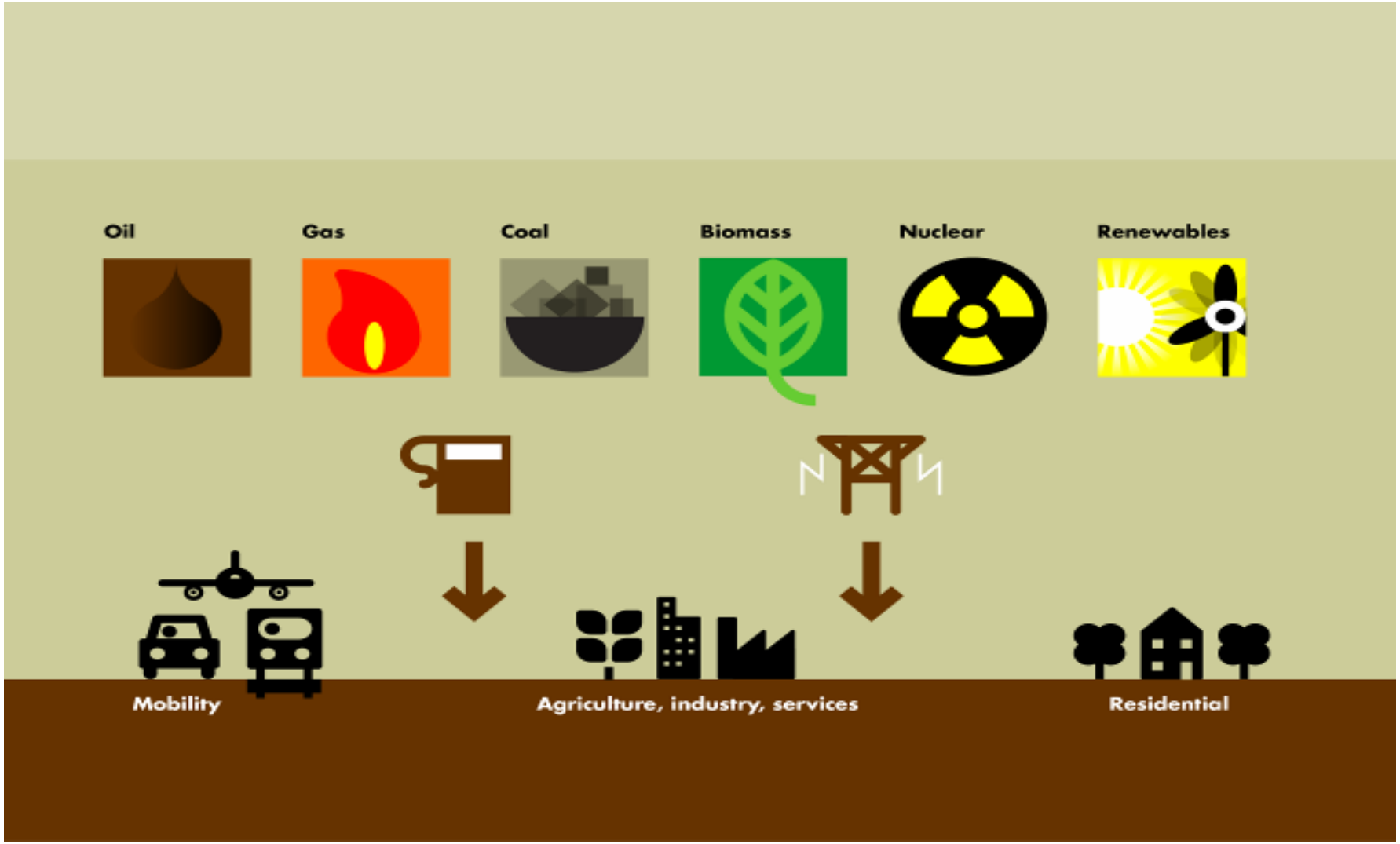
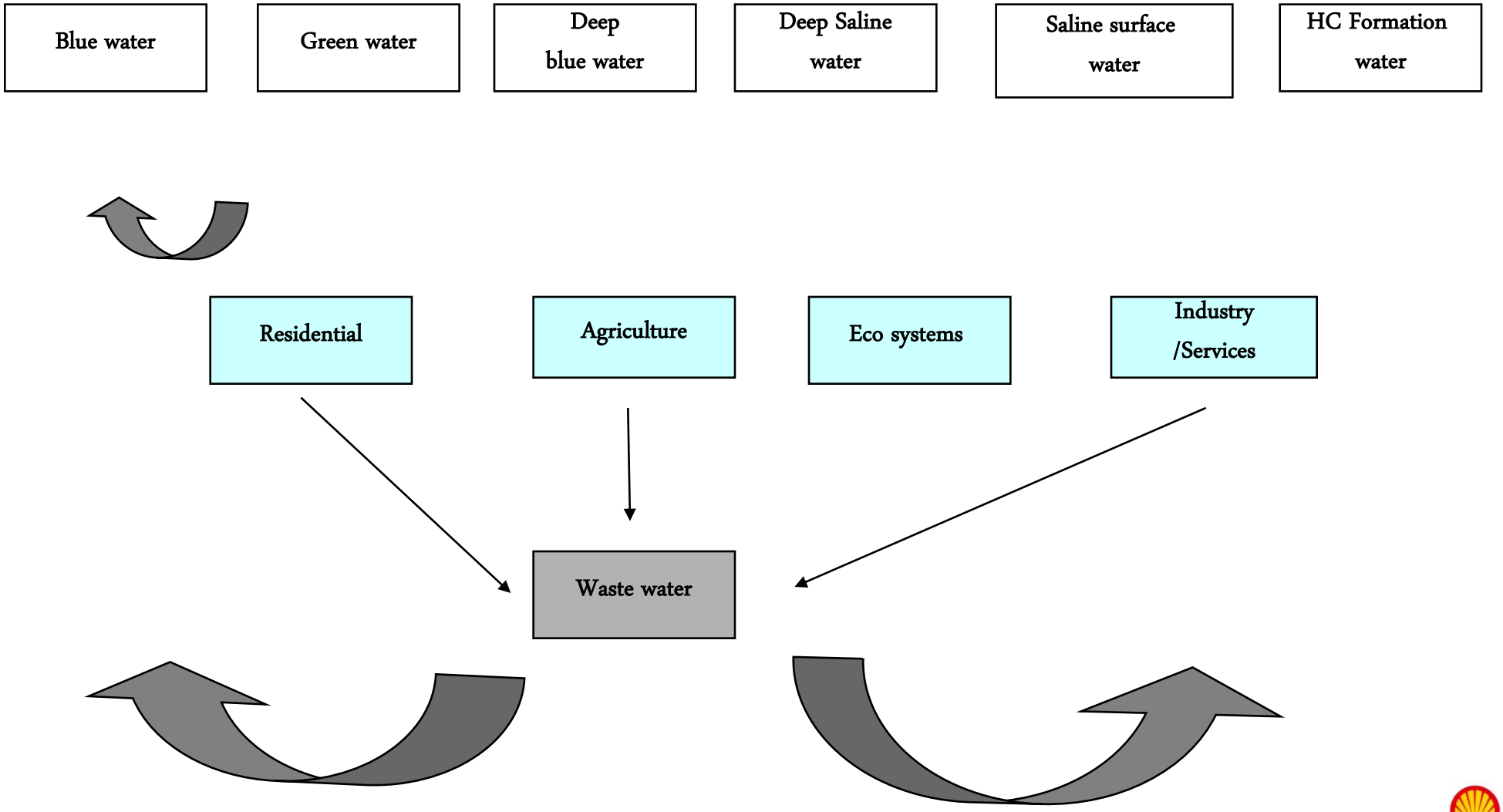
The Energy System today sets the context for the future



The Water System today sets the context for the future



The "Three Hard truths" form our long term view...

- **Surging energy demand** - The global demand for energy and and water is growing, both in the developed and developing world.

- **Supply will struggle to keep pace** - Supplies of "easy oil" - accessible, conventional oil and gas –and easy water (clean fresh water) cannot keep up with the growth in demand.

- **Environmental stresses are increasing** - More energy means more CO_2 emitted at a time when climate change looms as a critical global issue

The world in 2050

9 billion people

2.5 billion more than today

4-5 times richer

With most extra wealth coming from developing countries

Double the energy

Using twice as much energy as now

Twice as efficient

Using half the energy as now to produce each dollar of wealth

6-10 times more energy

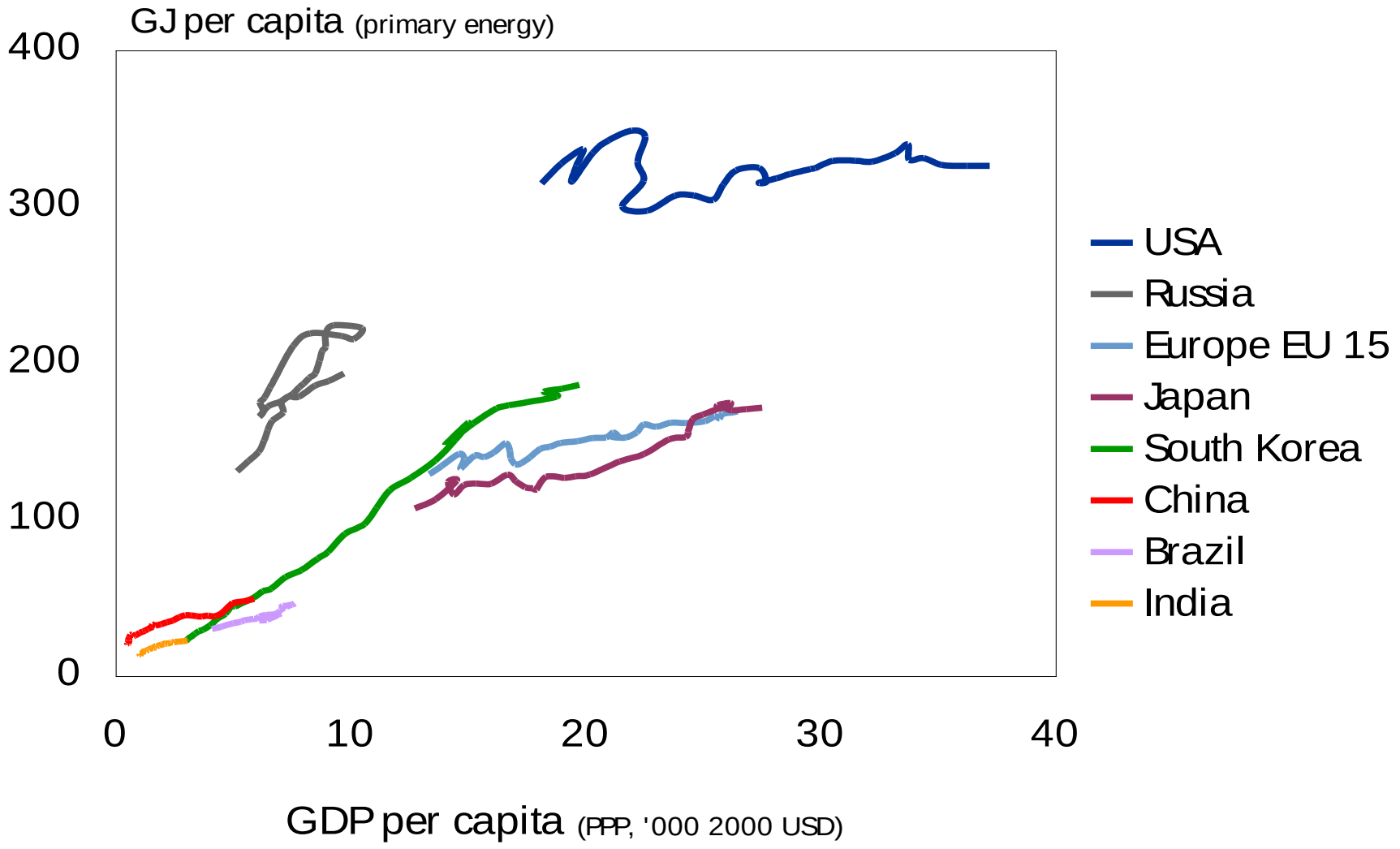
from renewable sources

World population is to rise 40% over the next 50 years

A People-Centred Map of the World

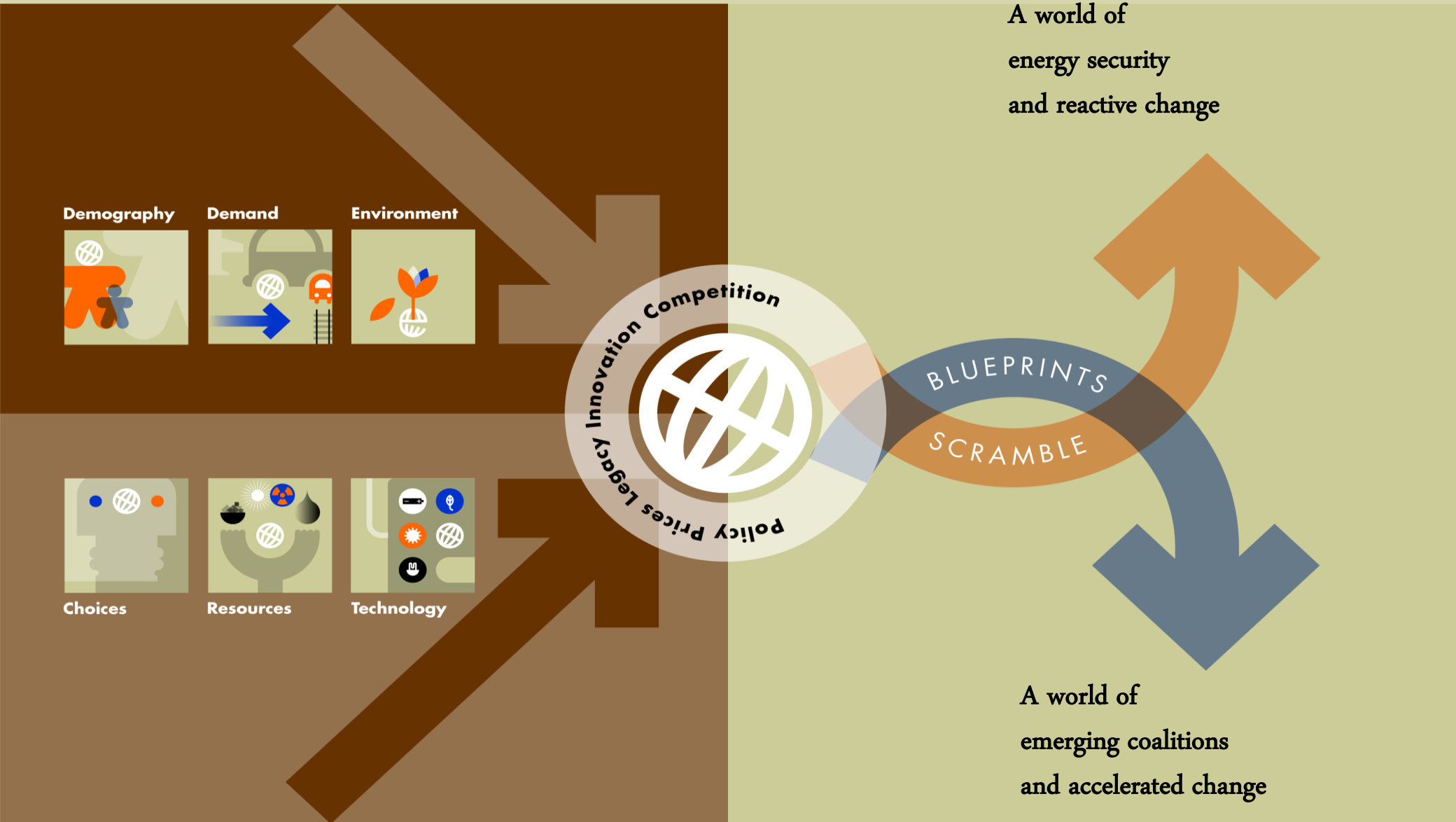
Source : Derived from population data from United Nations

Emerging economies are climbing the energy ladder



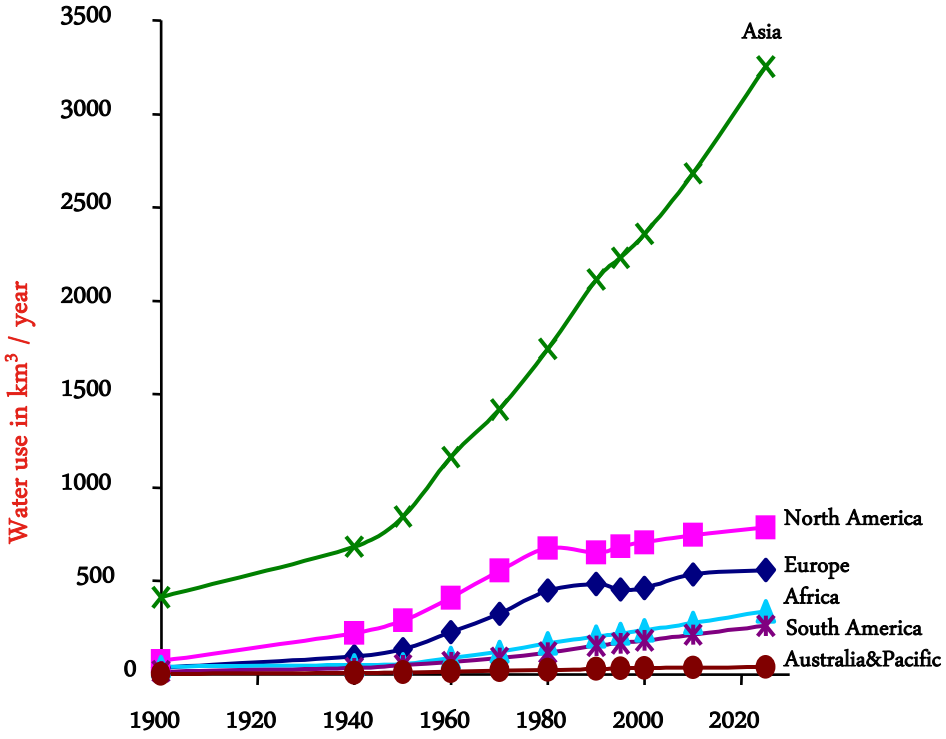
Source: Shell International BV, Oxford Economics and Energy Balances of OECD and Non-OECD Countries ©OECD/IEA 2006

Shell energy scenarios help us to imagine alternative futures

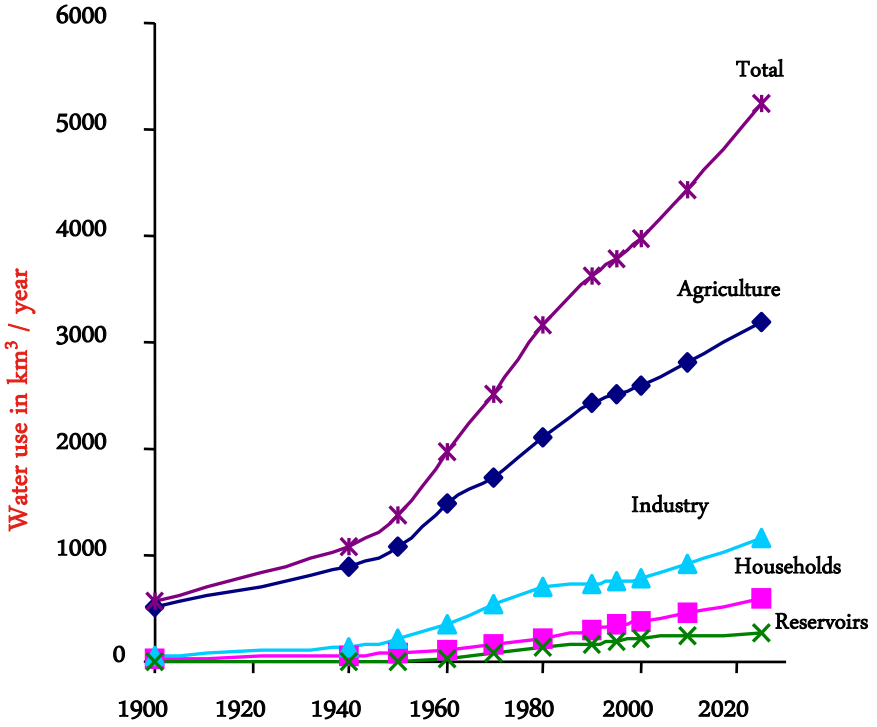


Global demand for water, like energy, is intensifying

Global water use by region

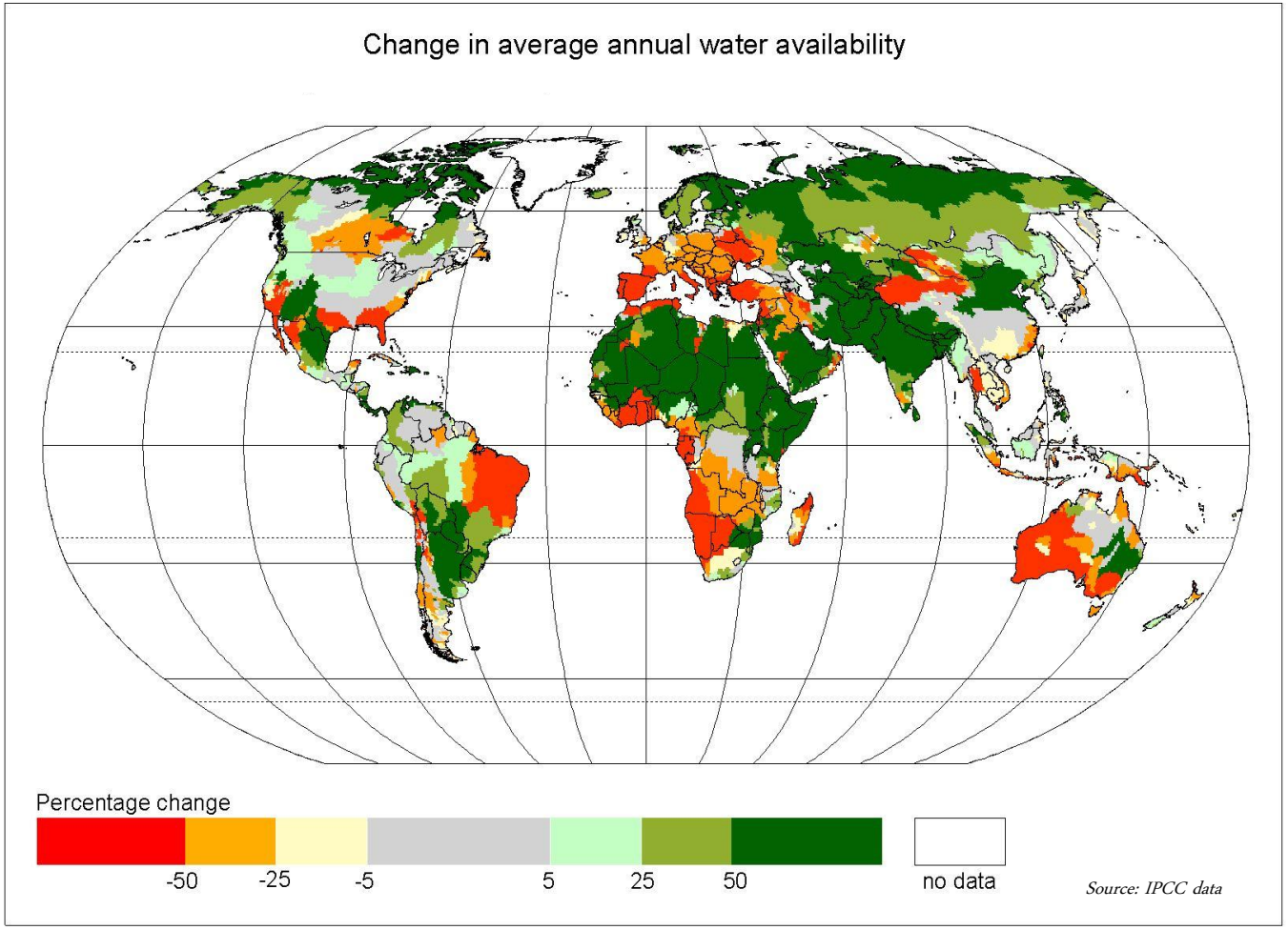


Global water use by sector



Fuelled by global population growth, increasing standards of living in developing countries and rapid industrialisation in China & India

Climate Change will impact water availability



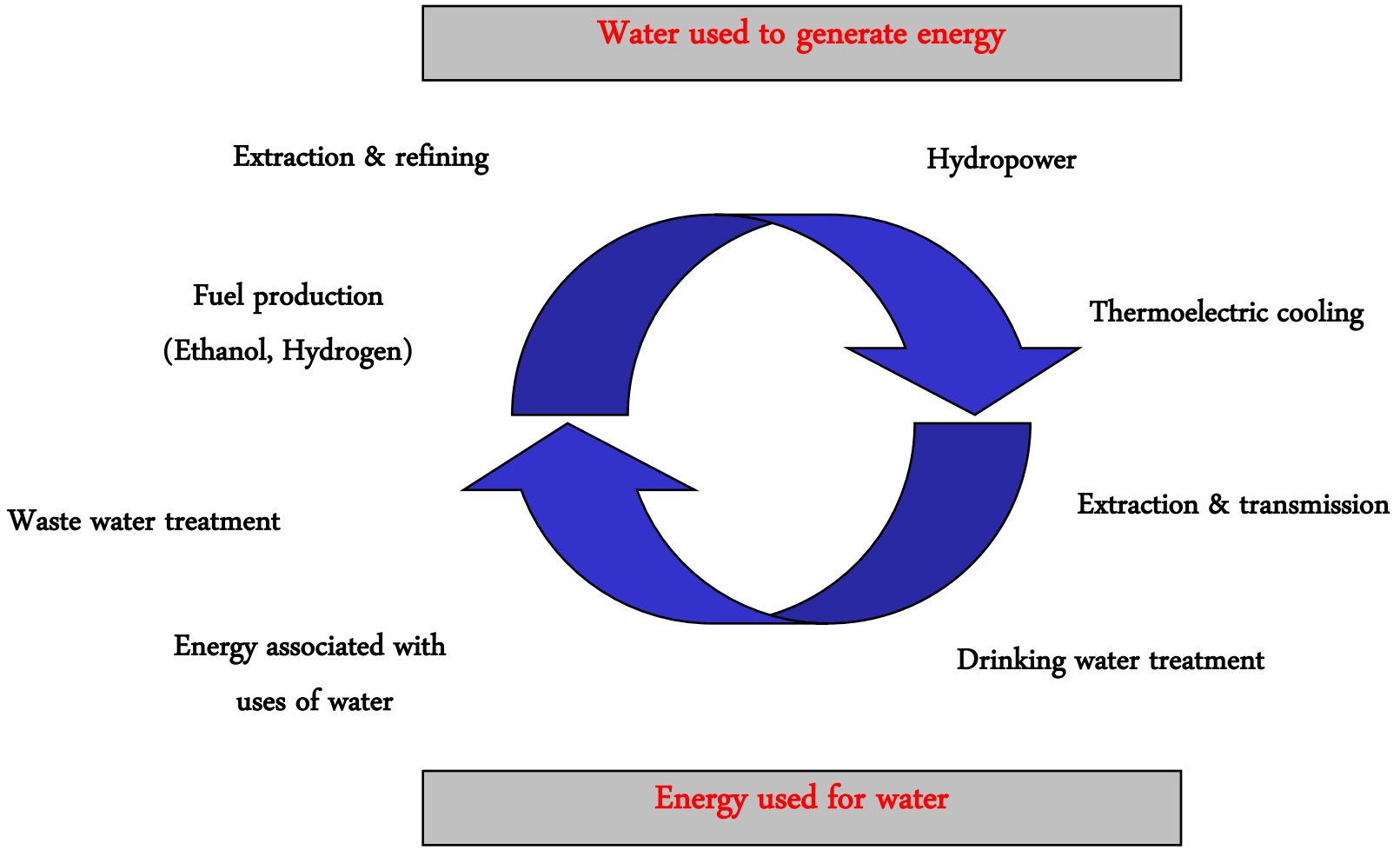
Countries that will be impacted most include

- US
- Canada
- Brazil
- EU countries
- ME countries
- Nigeria
- Gabon
- China
- Australia

By 2025, two thirds of the world's population will live in conditions of "water stress" adding significant pressure to the water available for industry (22% global water use)

The energy industry is becoming one of the largest consuming industrial sectors of fresh water globally

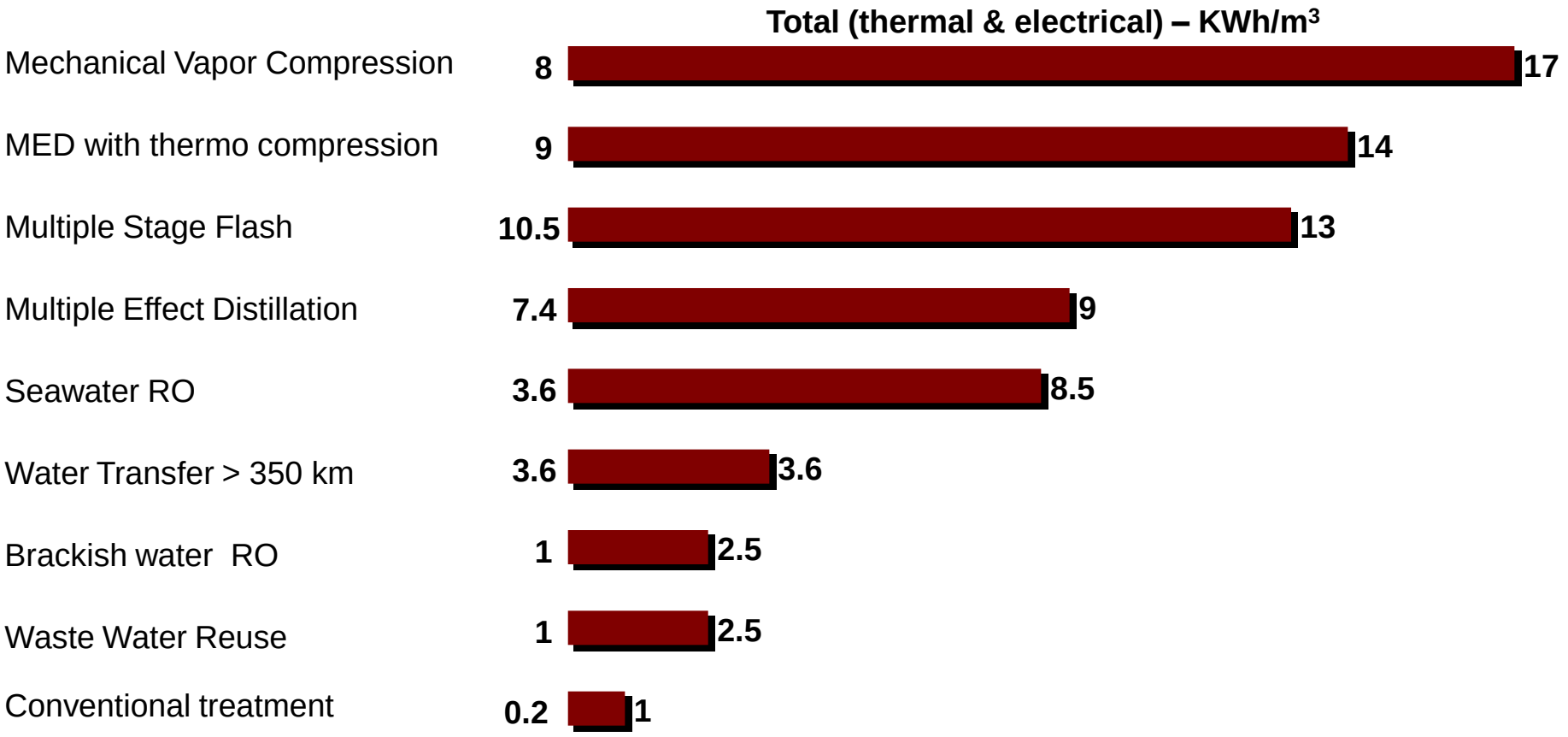
Business environment



Water is used for energy generation and energy is consumed in water extraction, distribution, treatment and desalination

The water sector is becoming increasingly a significant energy consumer

Specific Energy Consumption for Different Water Sources



Water is used for energy generation and energy is consumed in water extraction, distribution, treatment and desalination

Water footprint Primary Energy Carriers

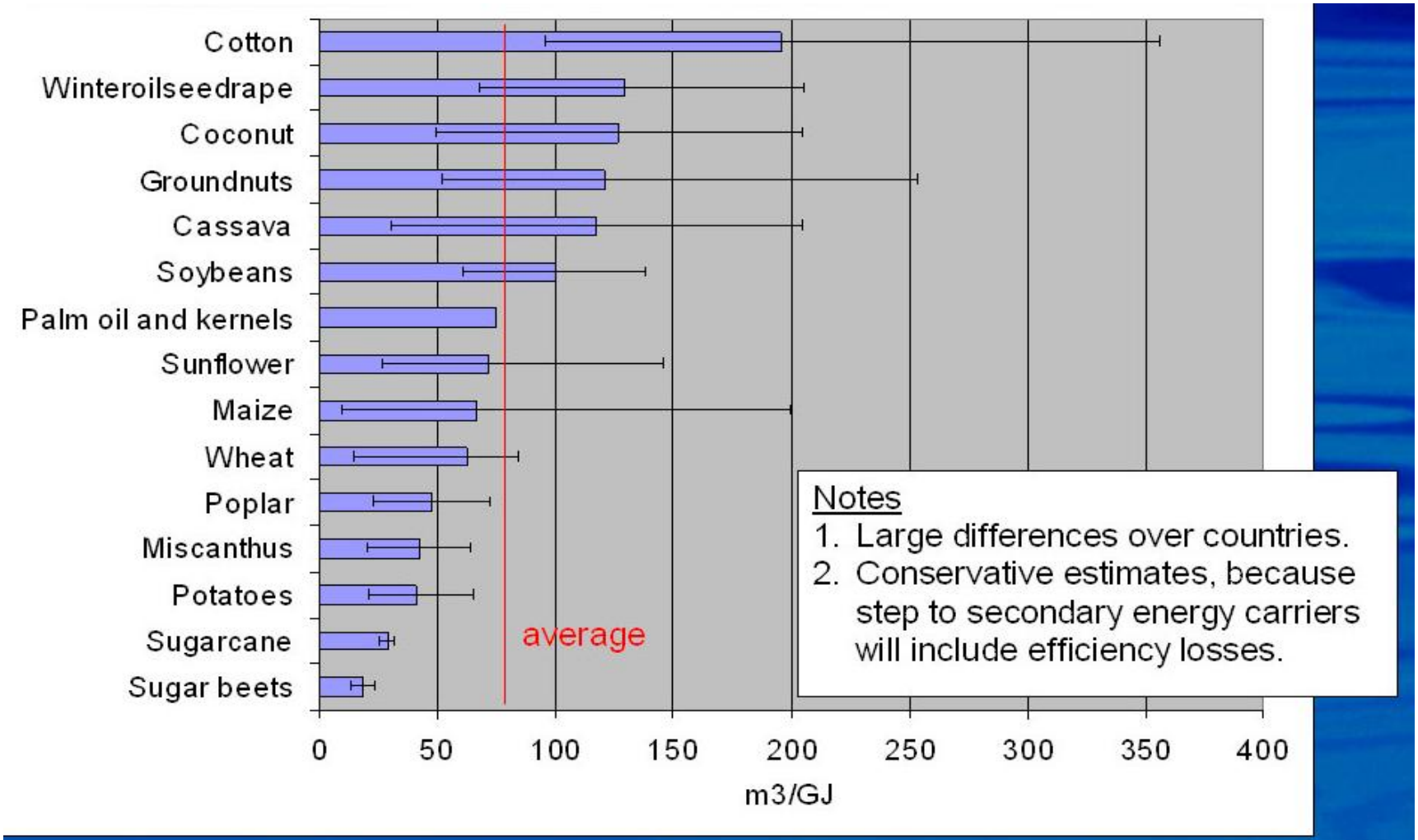
Primary energy Carrier	Average water footprint (m3/GJ)
Wind Energy	0.00
Solar Thermal	0.27
Crude Oil	
Conventional	0.006
Water flooding	0.6
Thermal Recovery	0.05
Unconventional	
Oil sands (mine)	0.1
Oil Sands (up grader)	0.026
Natural Gas	0.006
Hydro Power	22
Biomass	70 (range 250-250)

Water footprint: Volume of freshwater used for the production of that product at the place it is actually produced

Source: Water footprint of Bio-energy and other primary energy carriers UNESCO-IHE Gerbens-Leenes, Hoekstra van der Meer, March 2008

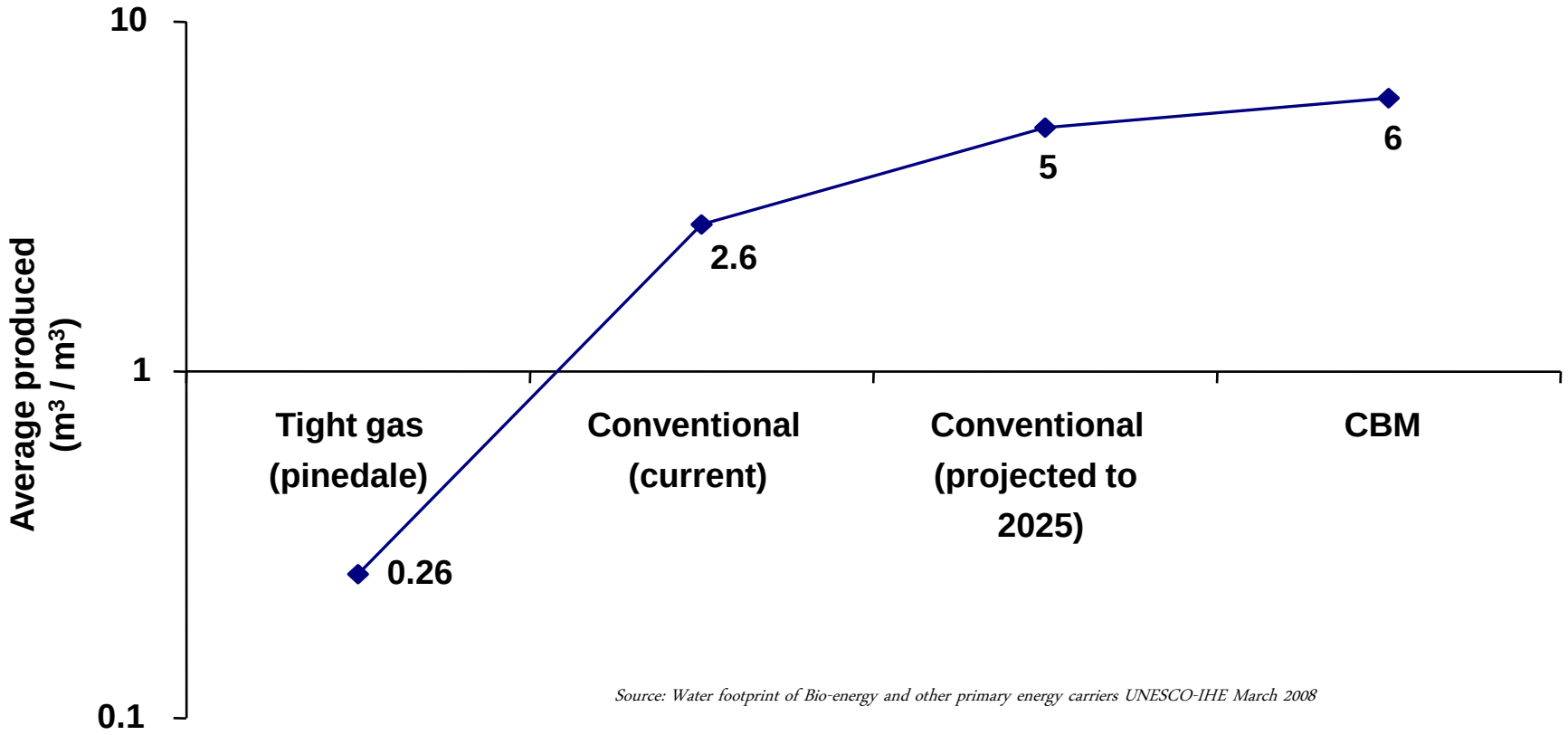
1 BOE = 6.12 GJ = 5.68 BTU = 1.7 MWh

Water footprint of Bio energy



[Gerbens-Leenes, Hoekstra & Van der Meer, 2008]

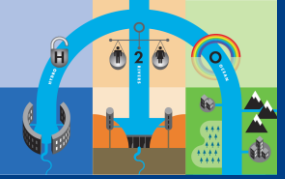
Average volume of water produced by primary energy carriers



Source: Water footprint of Bio-energy and other primary energy carriers UNESCO-IHE March 2008

CBM projects have a significant water footprint at 6bbls of water/BOE gas

Key challenges are land access & re-use solutions of this produced water



Gives rise to Three Parallel Challenges...

Scenario	Hydro	Rivers	Ocean
Water Challenge	Efficiency (more drops for less and more value per drop)	Security (quantity and quality for all)	Interconnectivity (taking the whole system into account)
Business Challenge	Innovation	Social license to operate	Business role in water governance

Water treatment selection - Menu Driven

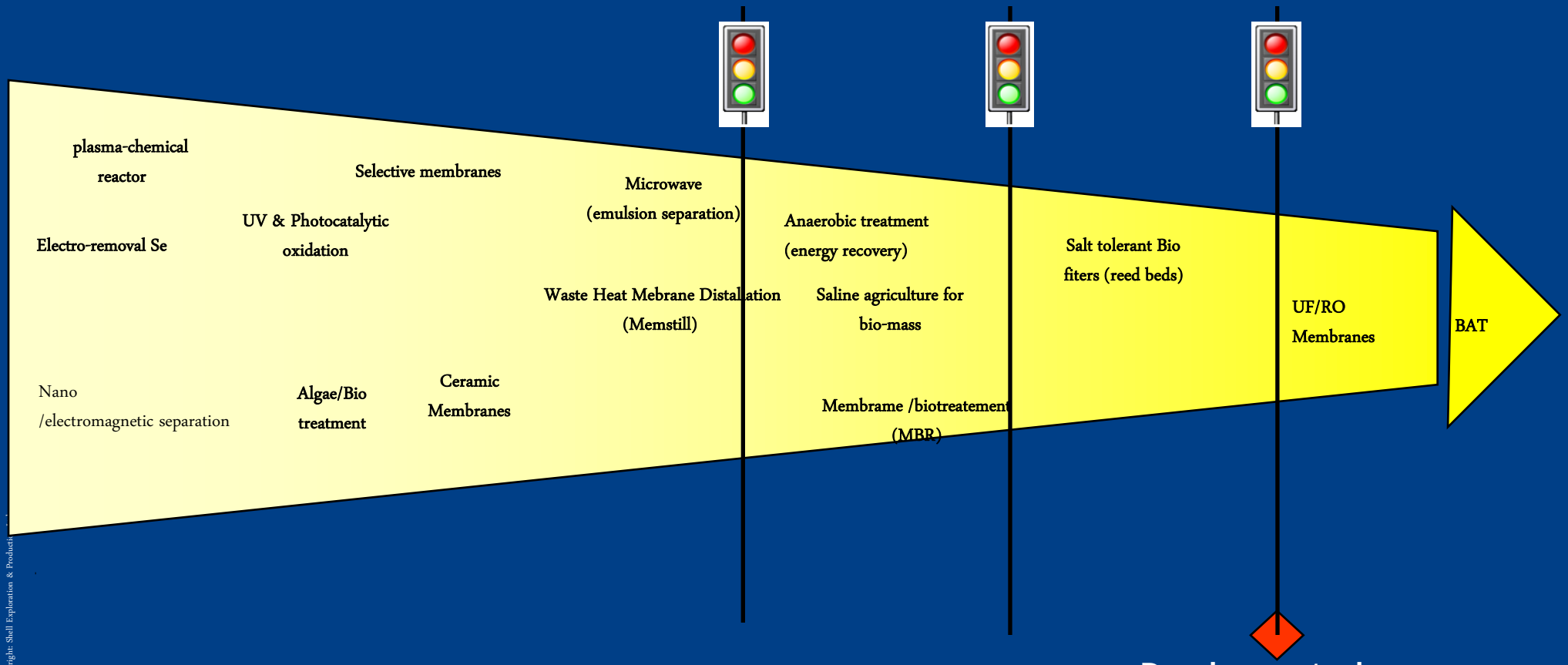
Step 1: Water Source
Blue water
Ground Water
Saline Water
Waste Water

Step 2: Characteristics relevant for use or discharge
Salinity: up to 1500 ppm 1500-15,000 ppm over 15,000 ppm
Divalent cations (SO4, Mg, Ca)
Solids and fines
Hydrocarbons: disperse/dissolve
Biological/bacterial activity
Scaling, corrosion risk
Organic species
Note: Specification depends on intended end-use of the treated water stream:e.g oil production, steam, agriculture, beautification etc

Step 3: Select Water Treatment
Nano Filtration for removal of SO4, Mg, Ca Reverse Osmosis for desalination
Solids removal by settling/ filtration/ membrane
Hydrocarbons removal by settling /cyclonic/centrifuge/flotation/ chemical/absorbent/extraction
De-aeration
Active Carbon Filter
Ultra filtration
Post treatment remineralisation
Reed beds, bio-treater

Water technology funnel

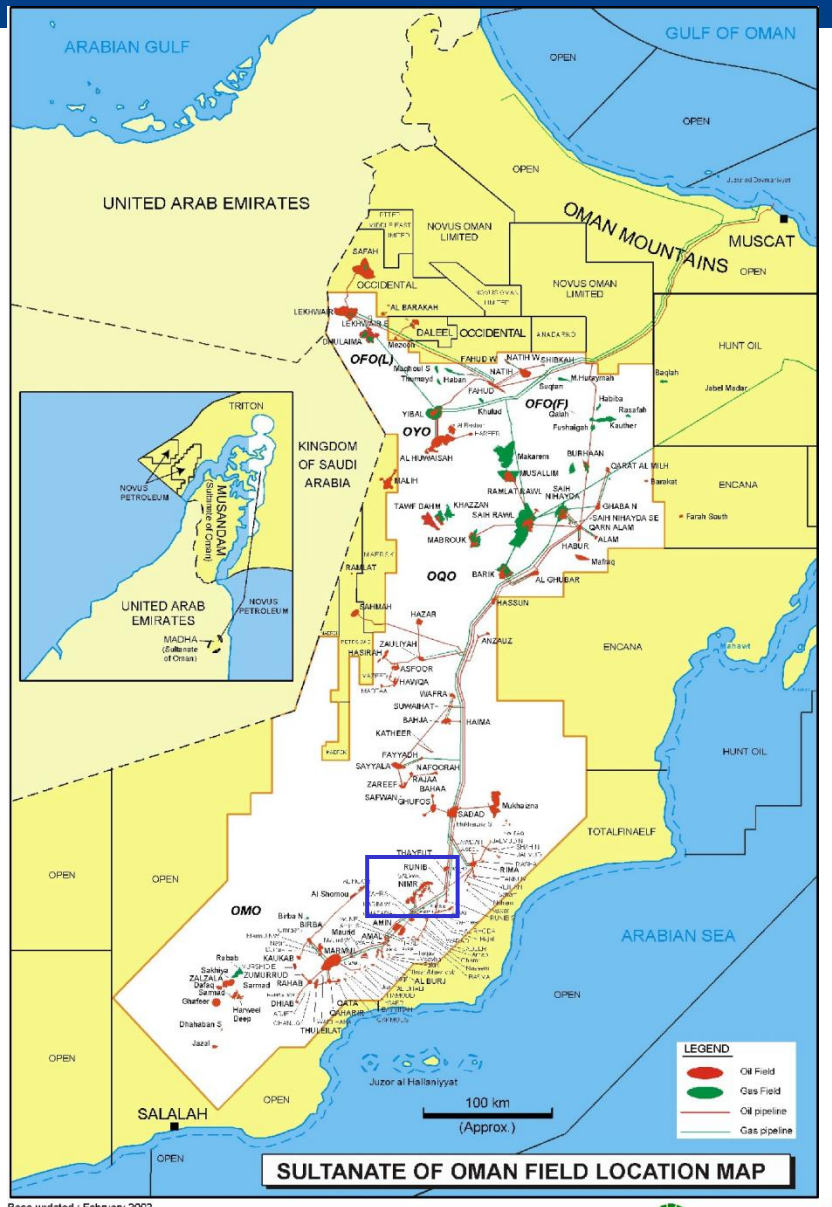
Shell Exploration & Production



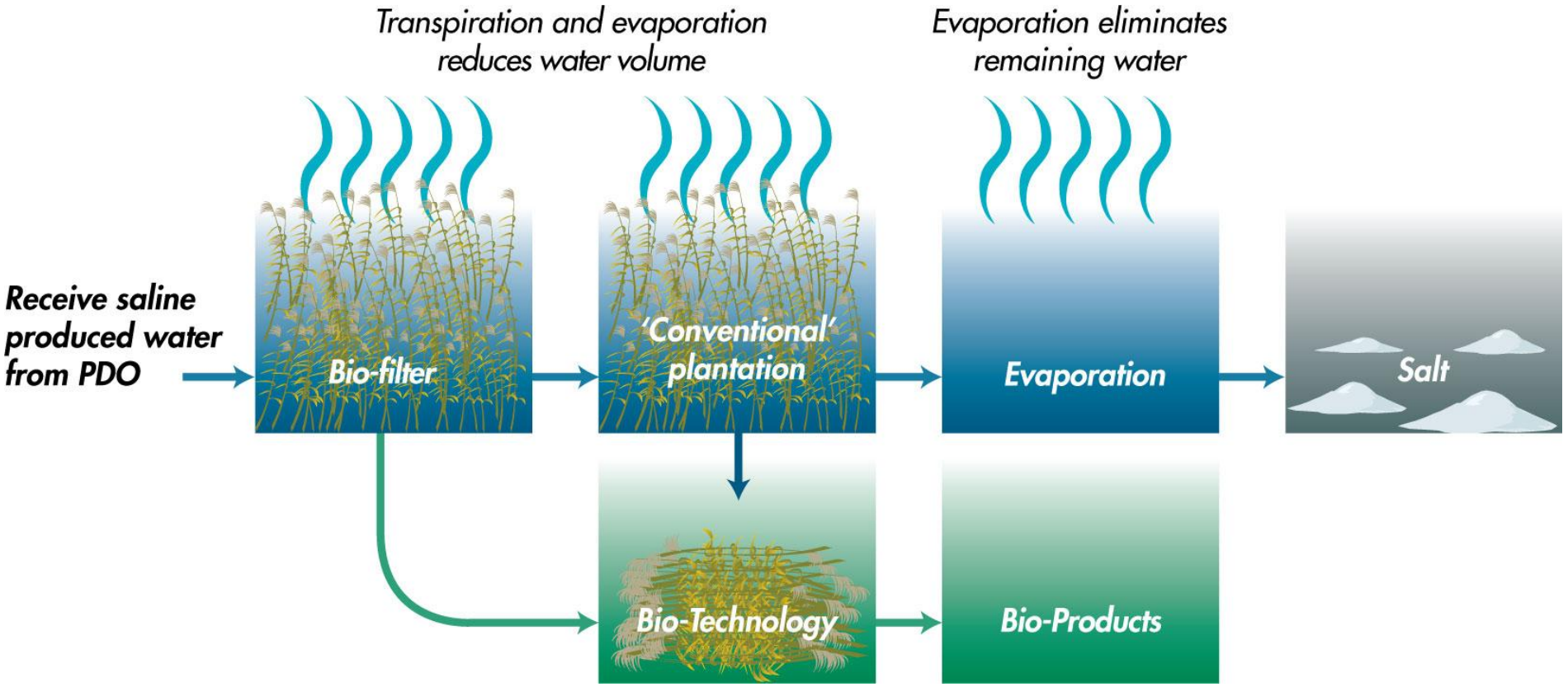
The Case for Change

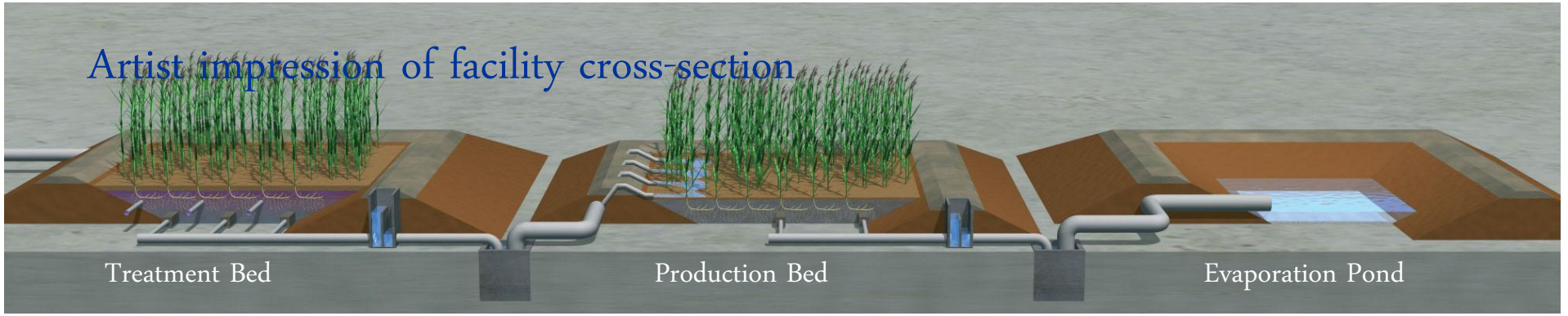
Currently in Nimr operations, more than 20 barrels of water are produced for every barrel of oil. This produced water is then disposed of via Deep Well Disposal (DWD). The dilemma faced by PDO is that, from 2009 onwards water disposal rate is expected to reach capacity constraints, which will result in oil deferment.

In Nimr, 250,000 m3 of water is produced each day, to dispose of this volume requires six pumping stations, each having two or three wells. The continued use of DWD is unsustainable because of the prohibitive and increasing cost, the high gas usage and the growing inaccessibility of low-pressure aquifers - in the face of ever increasing water production. Replacing DWD in Nimr could reduce operating and capital expenditures and over 30 years, liberate 150 Bcf gas for other uses.

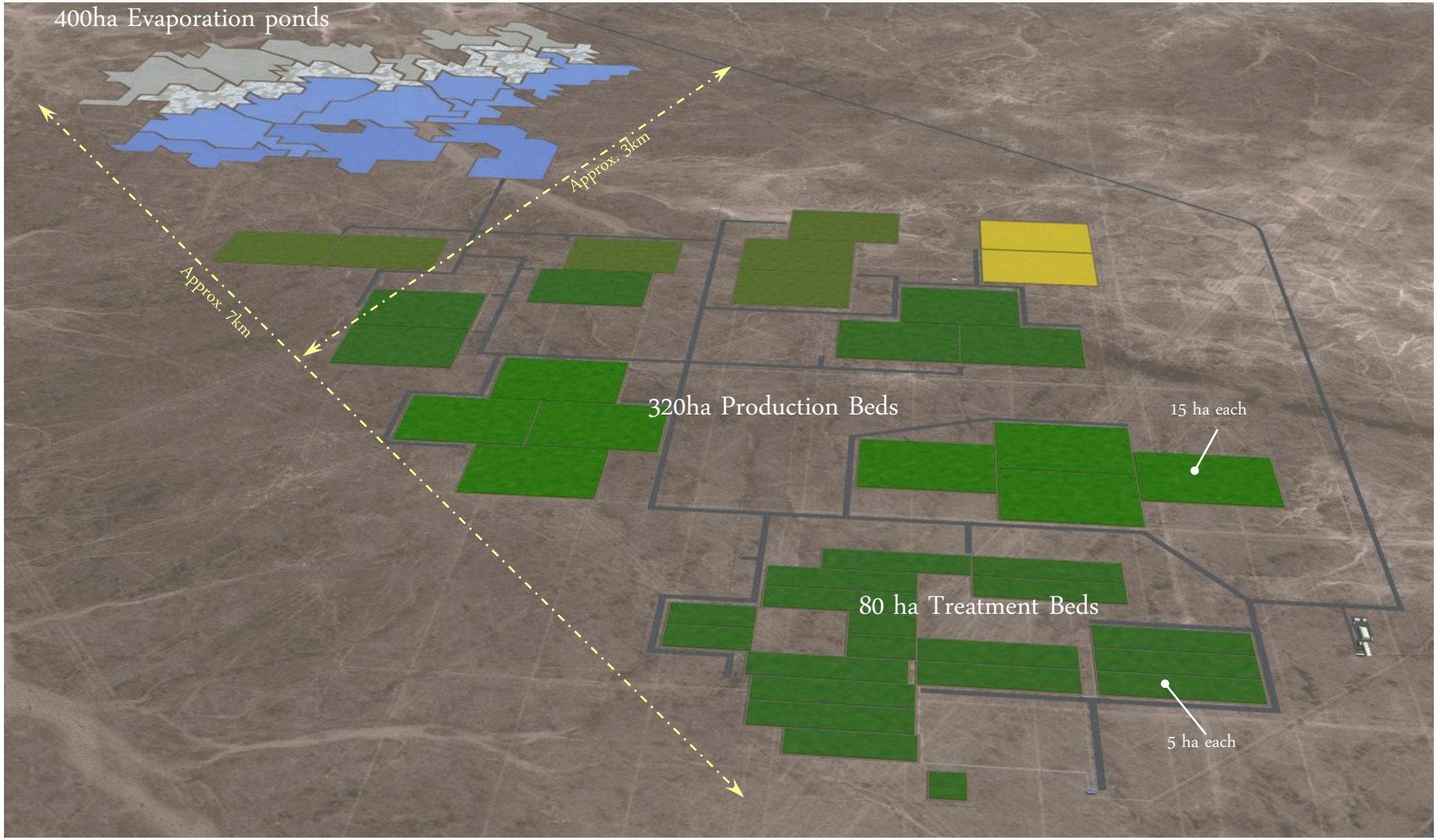


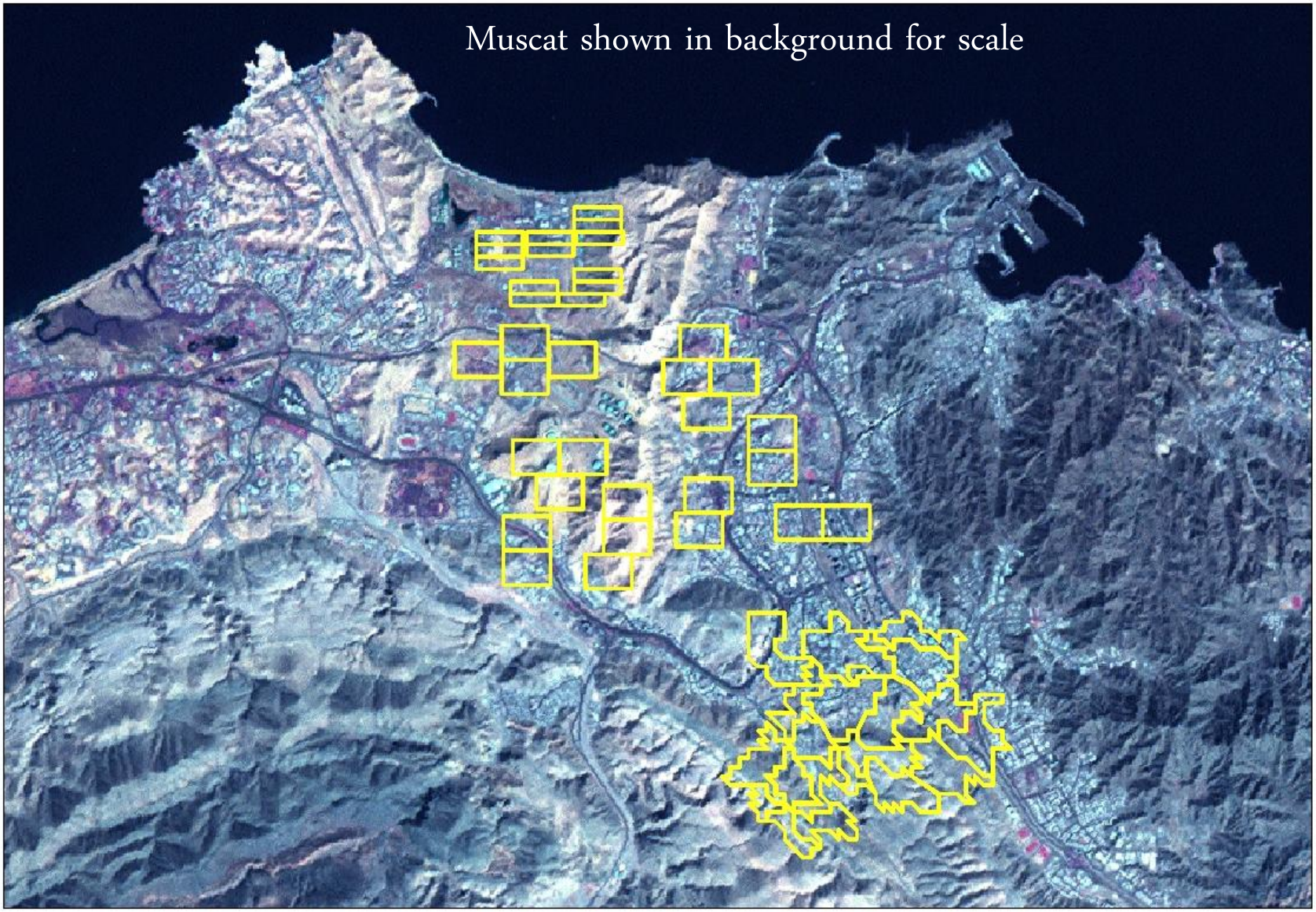
Overview schematic





- PDO production water flows into Treatment Beds through buried perforated pipes, through the root zone of reed plants, and out through perforated drainage pipes in the base of the beds.
- Naturally occurring soil bacteria already present in the soil will degrade the hydrocarbons in the water in the time it takes the water to flow through the beds.
- Treated water is applied to the production beds via surface irrigation. Here a crop of reed plants is grown.
- Initially, the crop will be mulched and left in the field. Later, the crop may be harvested for a commercial but non-food chain use.
- Remaining water is evaporated in evaporation ponds, leaving salt. Salt may be buried at the end of facility life, but may also be harvested and sold if its composition is suitable.


400ha Evaporation ponds
Approx. 3km
Approx. 7km
320ha Production Beds
15 ha each
80 ha Treatment Beds
5 ha each


Muscat shown in background for scale

Shell Values the Great Diversity of its People

Thank you