THE ImpEE PROJECT

IMPROVING ENGINEERING EDUCATION

Water

The Cambridge-MIT Institute

UNIVERSITY OF CAMBRIDGE

The Blue Planet?

Total volume of water on Earth (100%) = 1,386,000,000 km^3

Total freshwater (2.5%) = 35,029,000 km^3

Available freshwater = 200,000 km^3

Hydrological Cycle

Residence time in the atmosphere is approximately 1 week

Transpiration
takes a few hours

72,000 km³/yr (12%)

Atmospheric water
0.035% of the Earth's fresh water

119,000 km³/yr (20%)

458,000 km³/yr (80%)

60% of molecules falling as rain are re-evaporated in 1-2 days

505,000 km³/yr (88%)

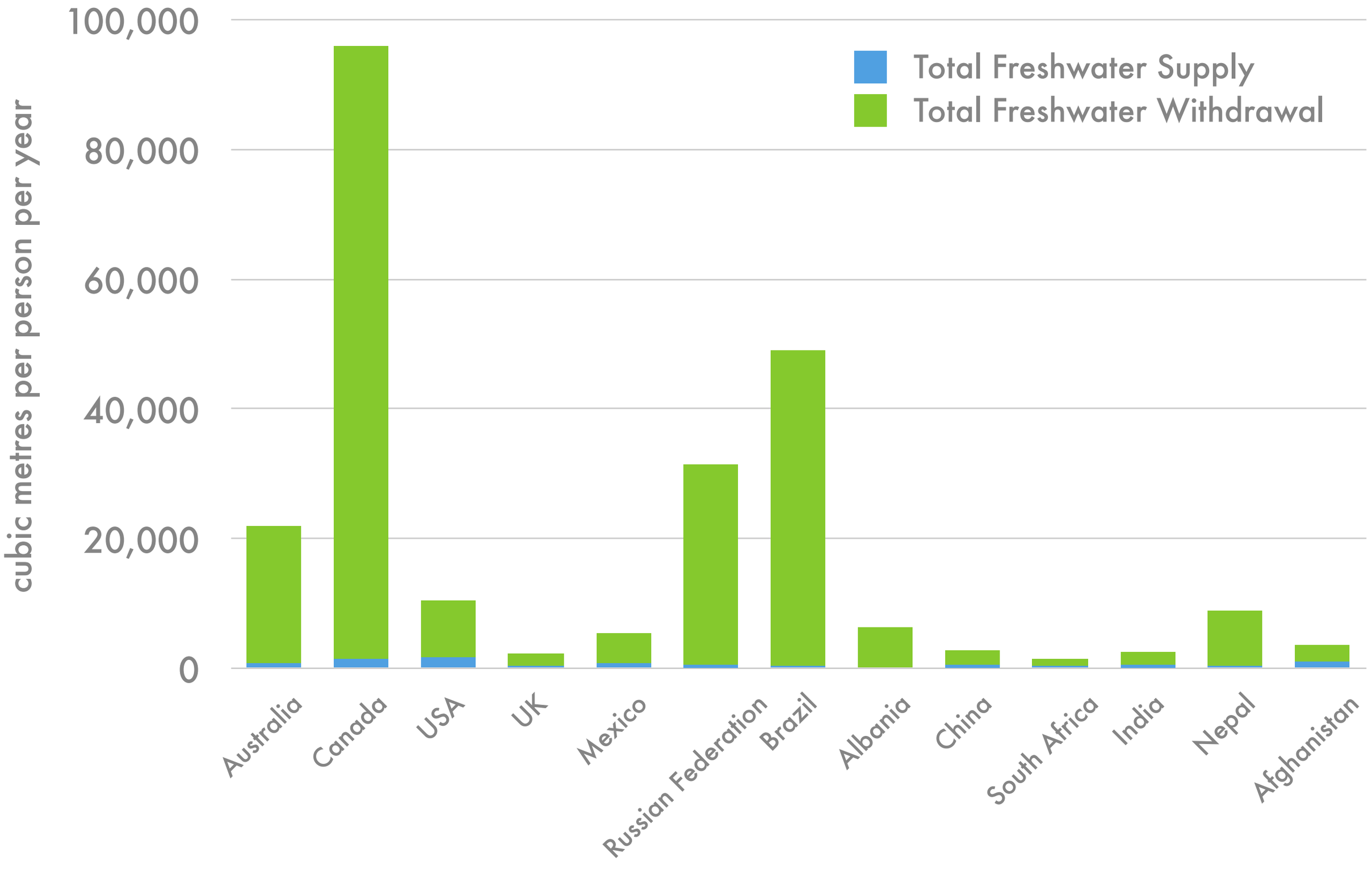
Residence time of lakes approximately 10 years

Available - 47,000 km³/yr (8%)

Residence time of groundwater may be thousands of years

Residence time of oceans approximately 100 years

Water Supply

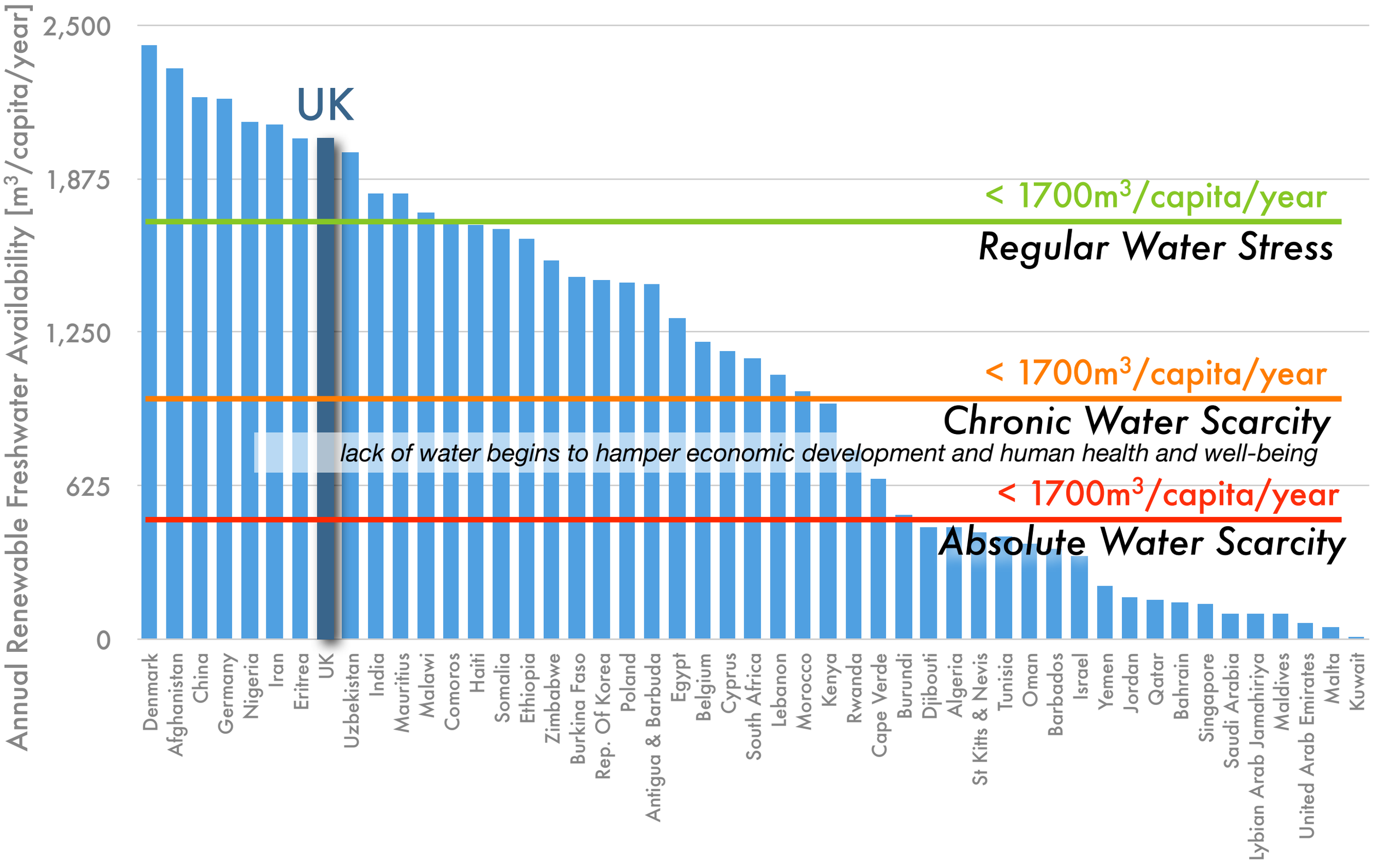


The role of engineers

"The engineers that help realise these water supply opportunities will be this century's most valued peace keepers"

Andrew Mylius

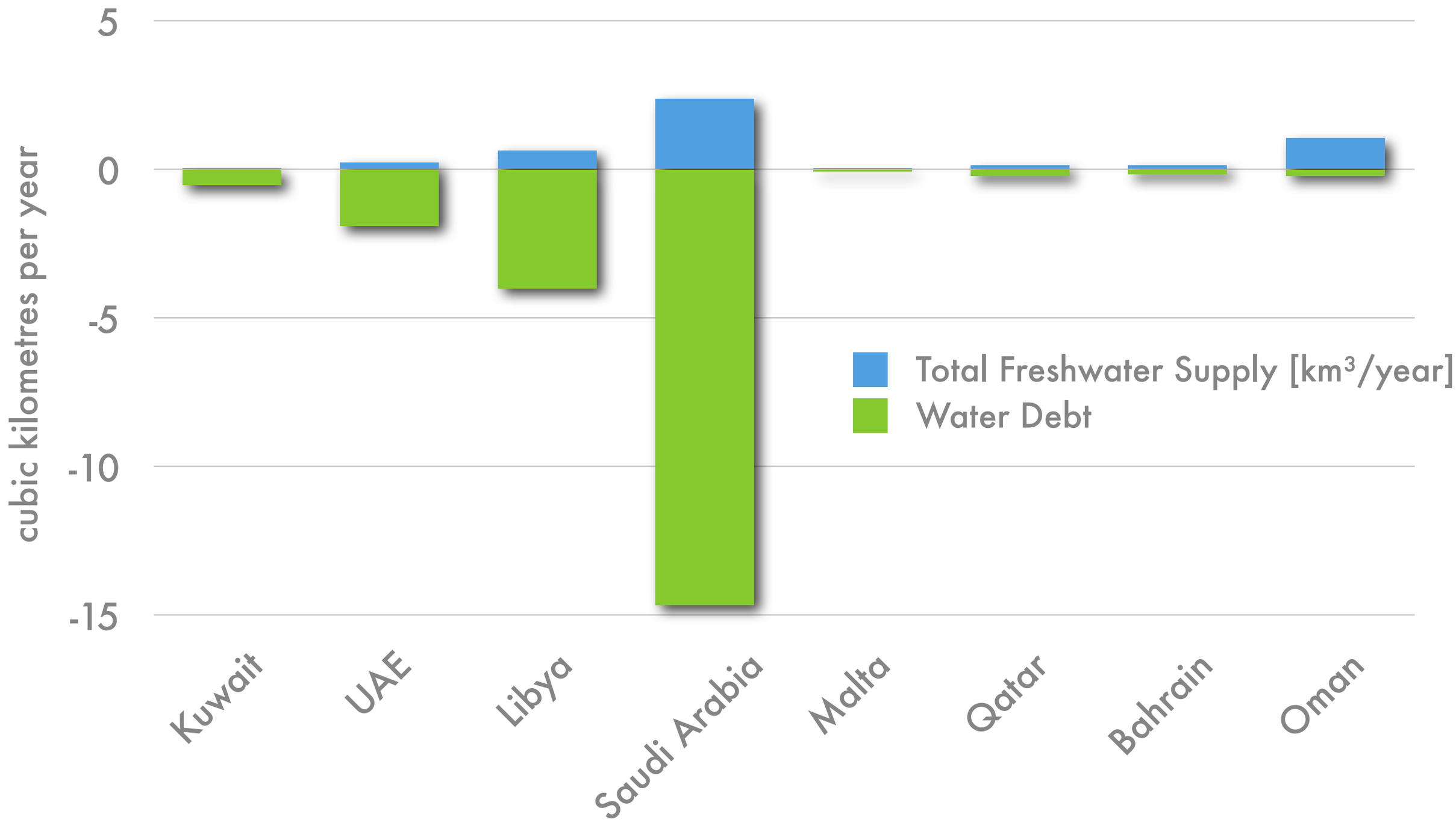
Water Scarcity



Water debt

- If the amount of ground water withdrawn exceeds natural inflow, there is a water debt
- In such cases, water should be considered as a non-renewable resource that is being mined.

Water debt


5
0
-5
-10
-15
cubic kilometres per year
Total Freshwater Supply [km³/year]
Water Debt
Kuwait
UAE
Libya
Saudi Arabia
Malta
Qatar
Bahrain
Oman

Desalination

- Seawater contains about 3.5% salt
- One cubic meter of sea water contains around 40kg of salt
- To produce ‘freshwater’ the salt content must be reduced to less than 0.05%

Desalination

Sea water pumped through at a pressure of approximately 7,000 bar

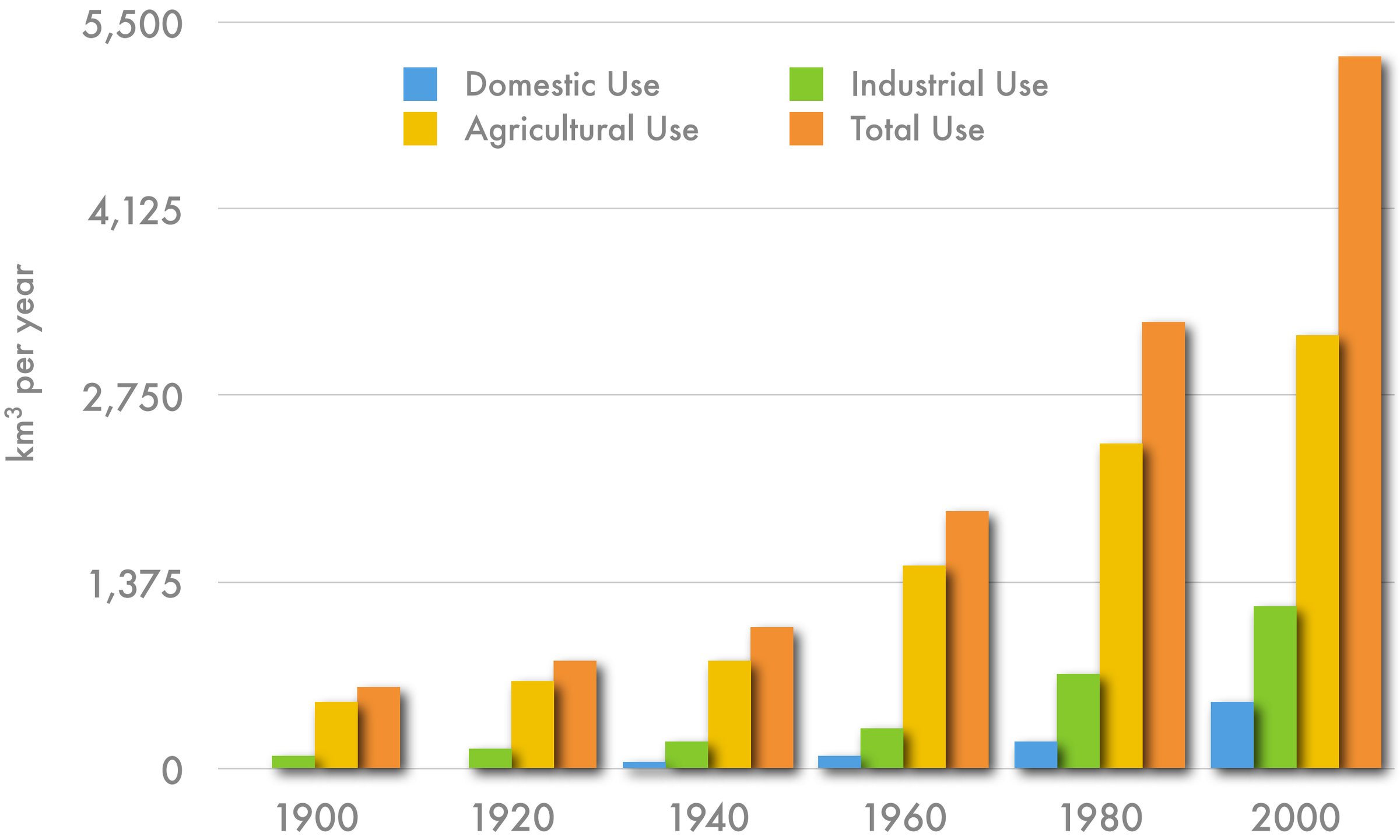
1.8 units of seawater

Membrane filter

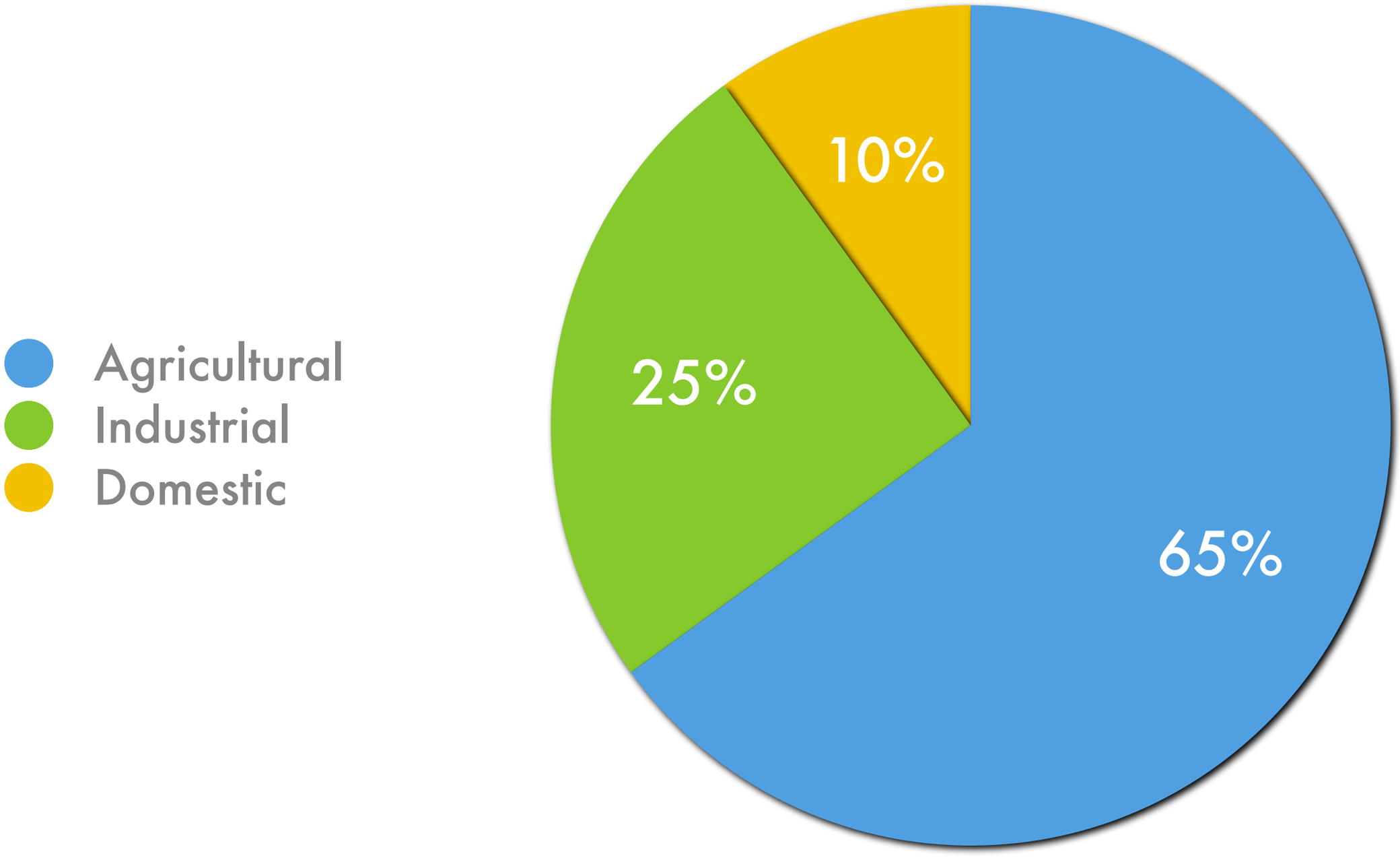
1 unit freshwater

0.8 units wastewater

Increasing Global Use

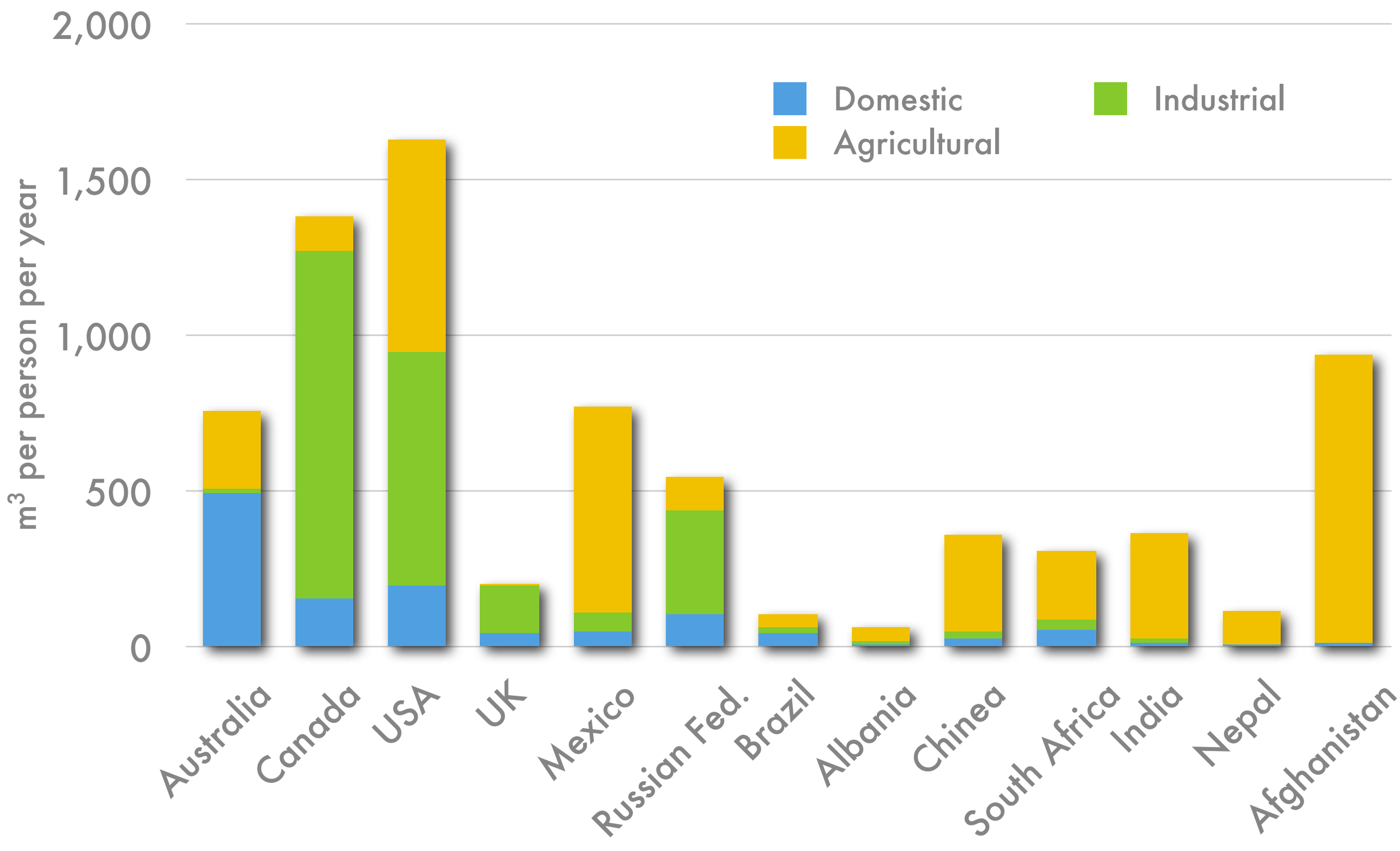


Global Freshwater Use

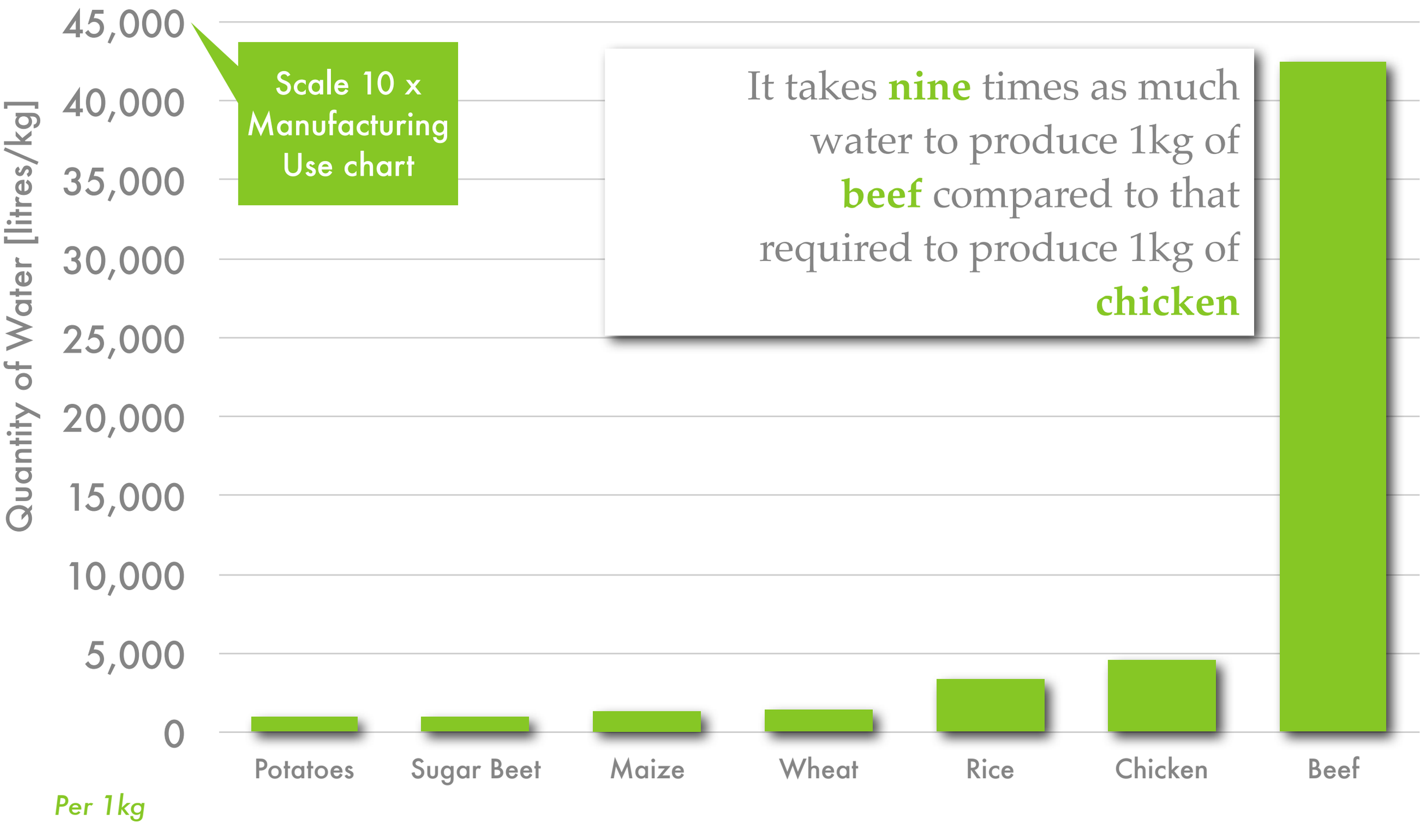


Data from 1992

Water Use

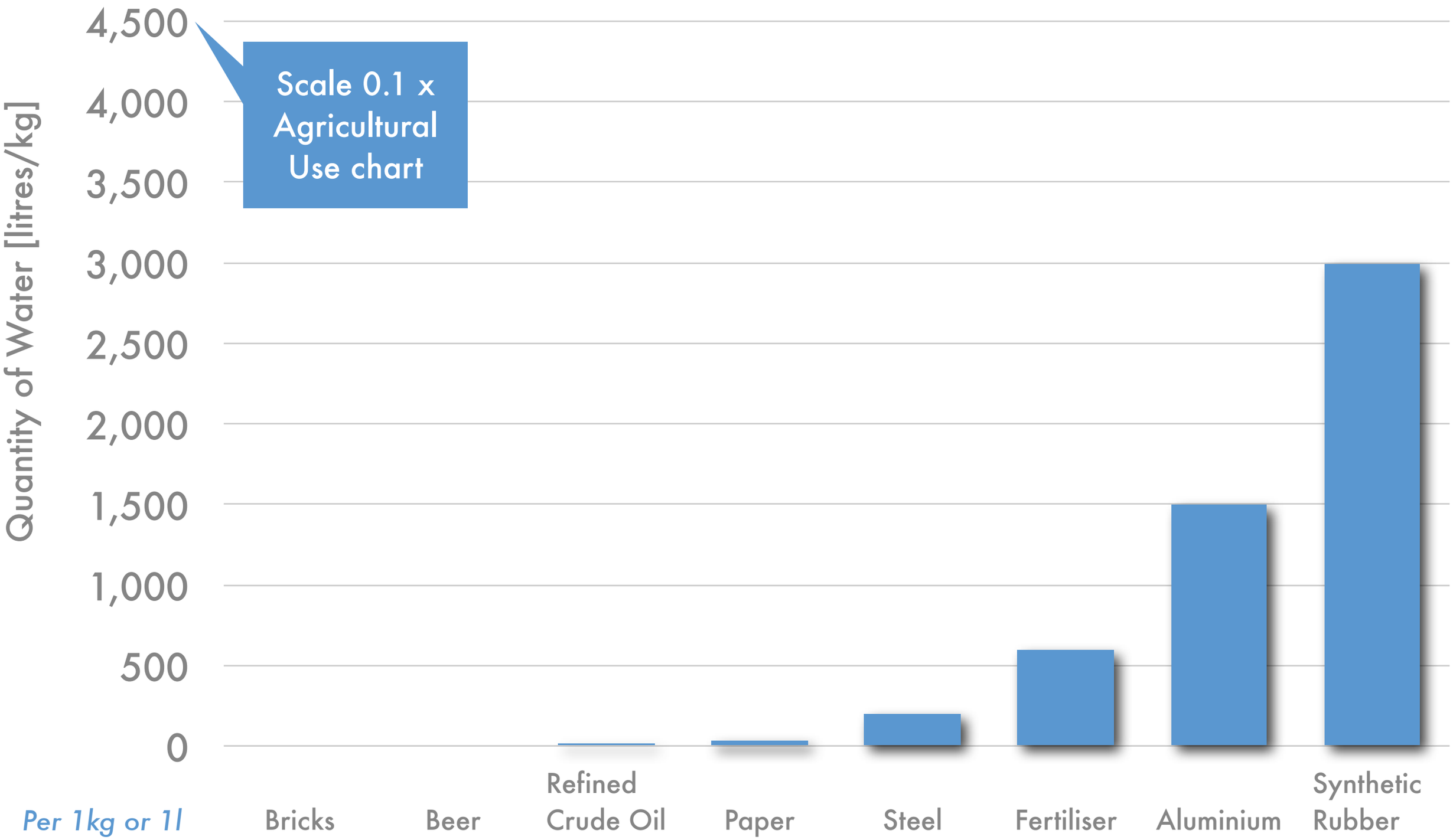

2,000
1,500
1,000
500
0
m3 per person per year
Domestic
Industrial
Agricultural
Australia
Canada
USA
UK
Mexico
Russian Fed.
Brazil
Albania
Chinea
South Africa
India
Nepal
Afghanistan

Agriculture



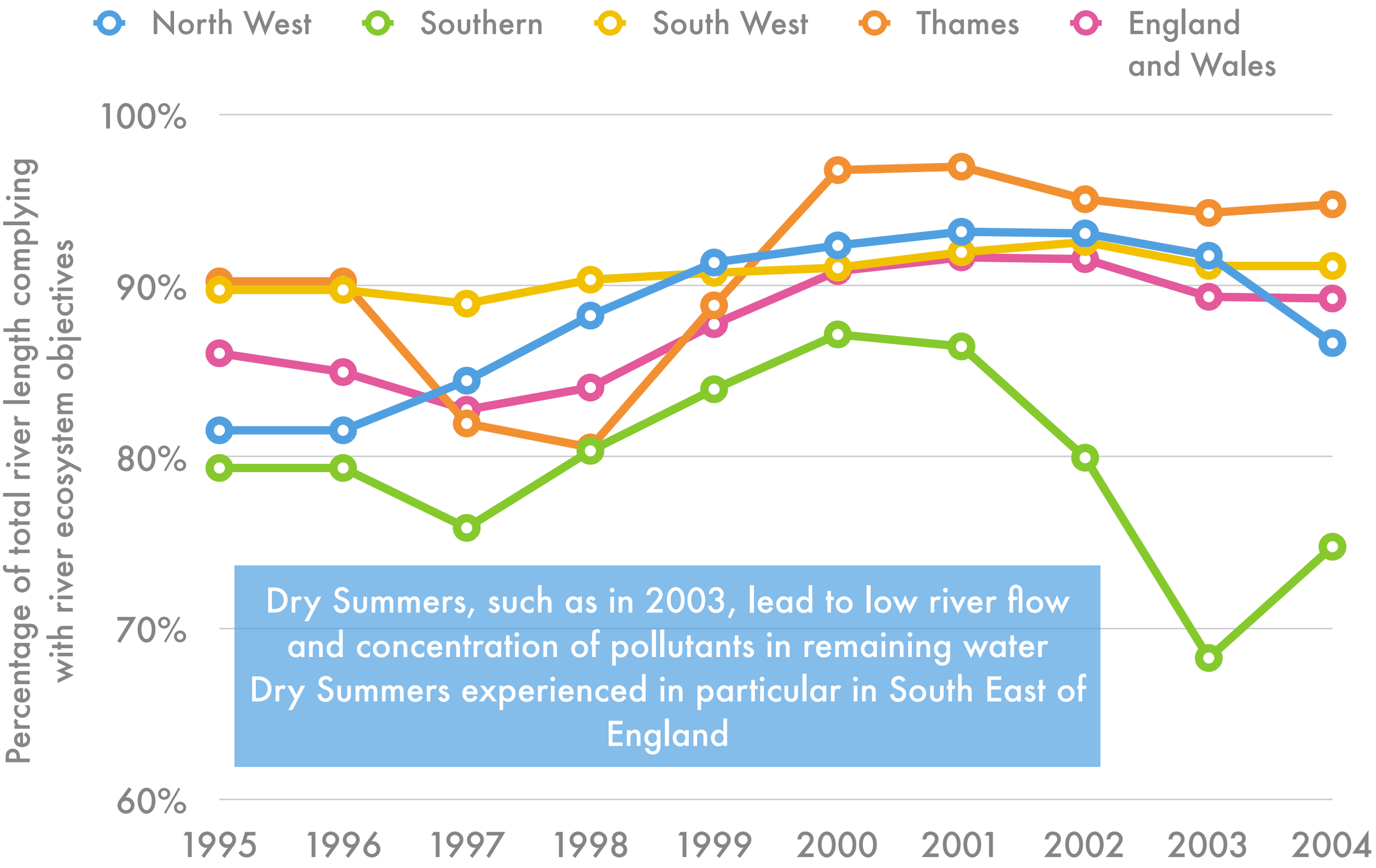
Per 1kg

Manufacturing

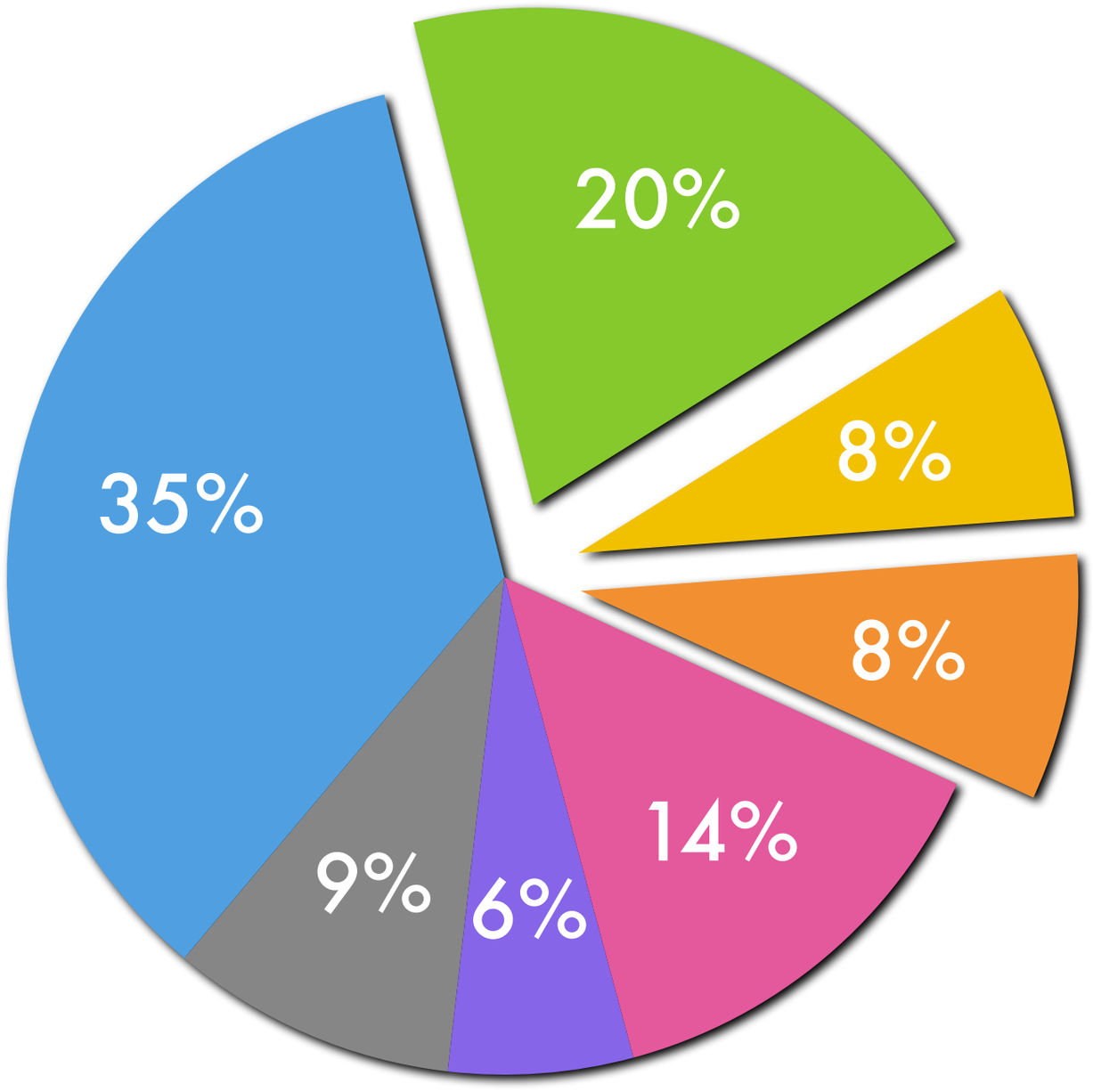


State of Rivers

State of UK Rivers



UK domestic water use

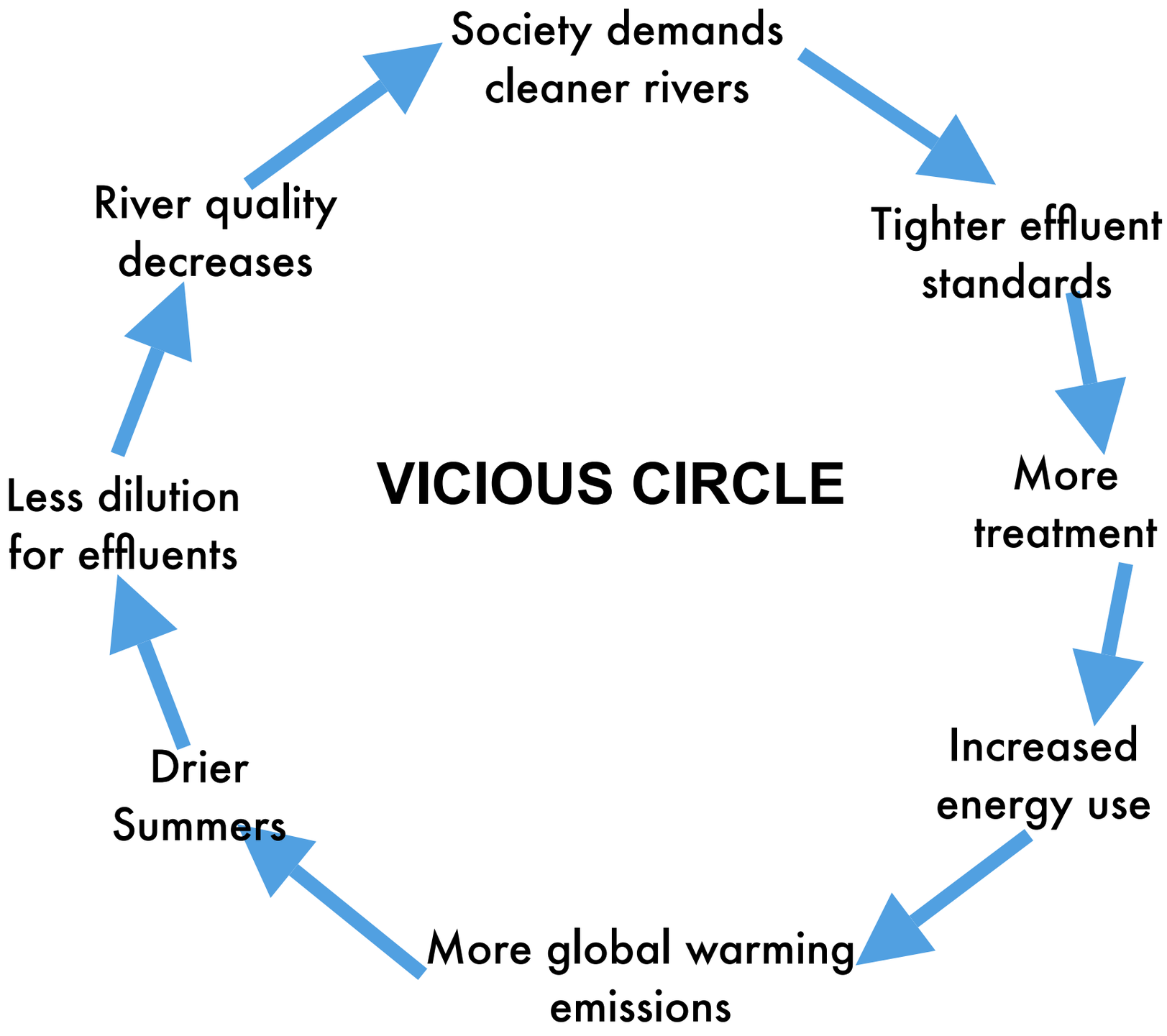


- WC Flushing
- Bath / Shower
- Dishwasher
- Drinking
- Washing Machine
- Outside
- Miscellaneous

Potable quality water required only for those applications **indicated** – approximately one third of total domestic use

Energy costs of stricter water treatment legislation

- Water Industry and Global Water
- The Paradox of treating all water to a fully potable standard



Flooding

Recent Developments

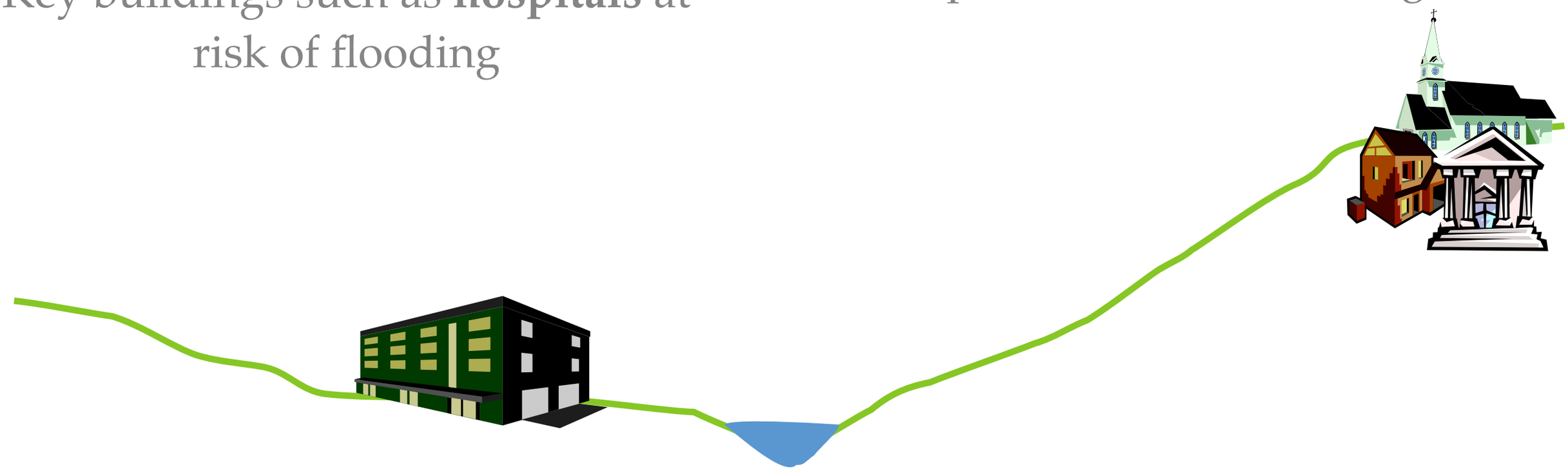
Expansion onto flood plain

Key buildings such as **hospitals** at risk of flooding

Early Settlements

Built on high ground above rivers

Key buildings such as churches protected from flooding



Population growth and increasing urbanisation, coupled with paving over of more land leads to less surface water infiltration, higher peak flow after storms and increased frequency and severity of flood events

Dublin Principles

Principle No. 1: Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.

Principle No. 2:Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

Principle No. 3: Women play a central part in the provision, management and safeguarding of water.

Principle No. 4: Water has an economic value in all its competing uses and should be recognised as an economic good.

Hydropolitics

Control of Water Resources: Water supplies or access to water at the root of tensions

Military Tool: Water resources, or water systems themselves, used by a nation or state as a weapon during military action

Political Tool: Water resources, or water systems themselves, used by a nation, state or non-state actors for a political goal

Terrorism: Water resources, or water systems, as targets or tools of violence or coercion by non-state actor

Military Target: Water resource systems as targets of military actions by nations or states

Development Disputes: Water resources or systems as source of contention in the context of social and economic development

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