



Water, Energy and Food- Towards operationalization

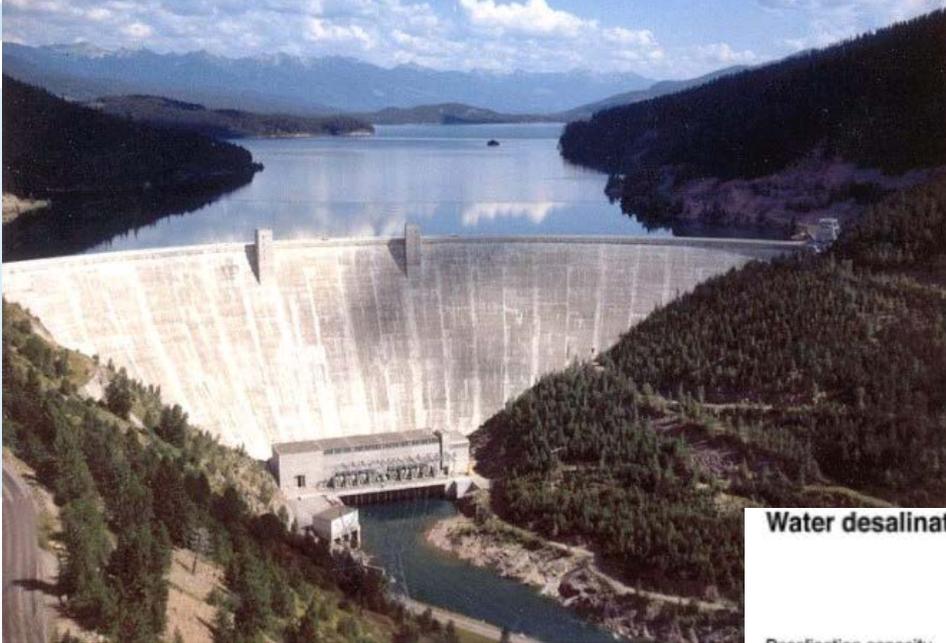
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Pietermaritzburg*

Introduction

- Up to 2 billion more people by 2050
- Need to produce 70 percent more food
- For access to energy to be universal energy generation needs to double
- With increasing energy and food demands WATER demands are expected to rise by 55 percent
- Up to 40 percent of the worlds population will live in severe water stressed regions

Predominant response to focus on supply



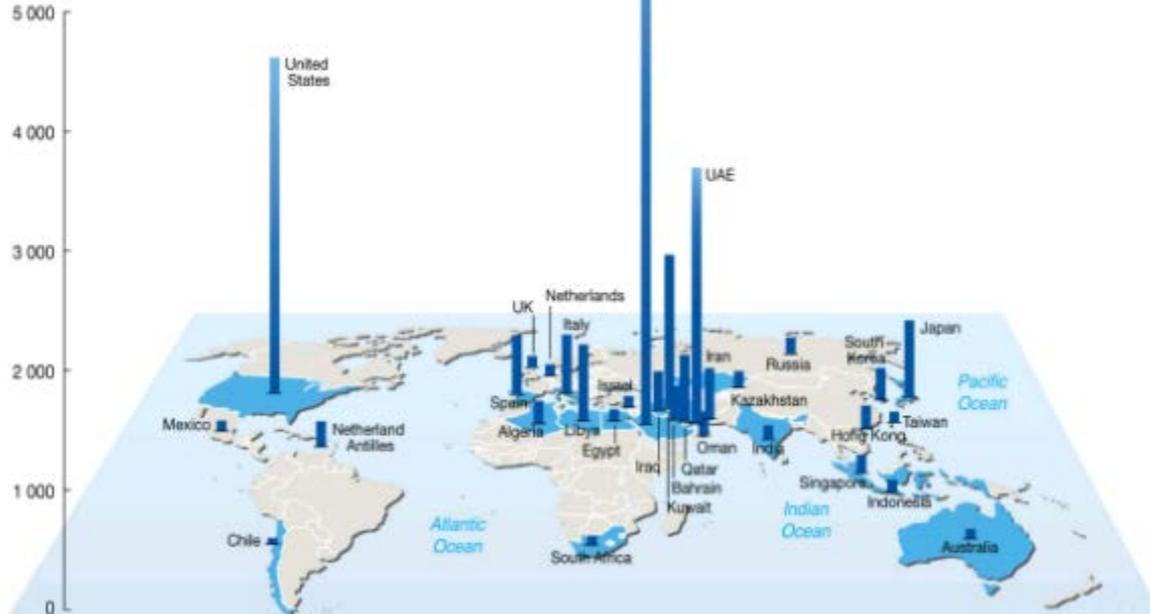
**Additional 600 km³ reservoir storage (by 2050)
US\$ 10 billion??**

**50 times increase in desalination capacity (by 2050)
US\$ 20 billion??**



Water desalination

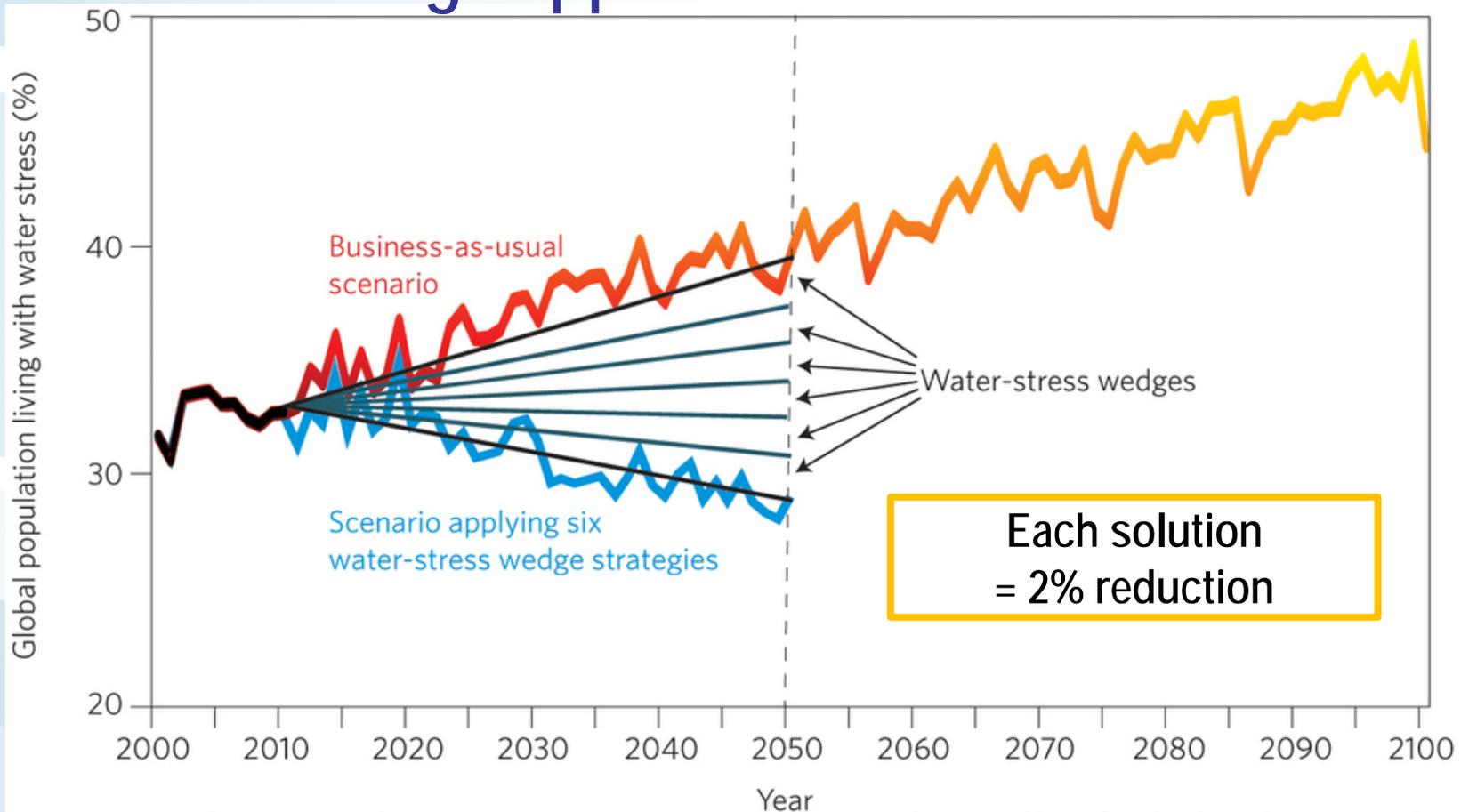
Desalination capacity
Thousand of cubic metres per day



Note: only countries with more than 70 000 cubic metres per day are shown.

Sources: Pacific Institute, The World's Water, 2009.

Wedge approach to water stress



We present six strategies, or water-stress wedges, that collectively lead to a reduction in the population affected by water stress by 2050, despite an increasing population.

- Water productivity – crop per drop
- Irrigation efficiency – decrease losses
- Water use intensity – industry and domestic
- Population

- Reservoir storage

- Desalination

Soft path vs. Hard path

Wada et al. (2014), Nature Geoscience

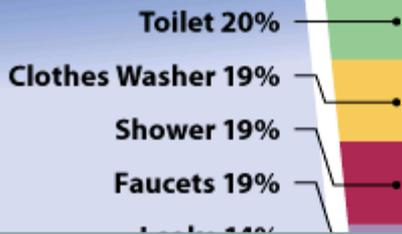
More Crop Per Drop

Improvement in water productivity at 0.5% per year (20% by 2050)

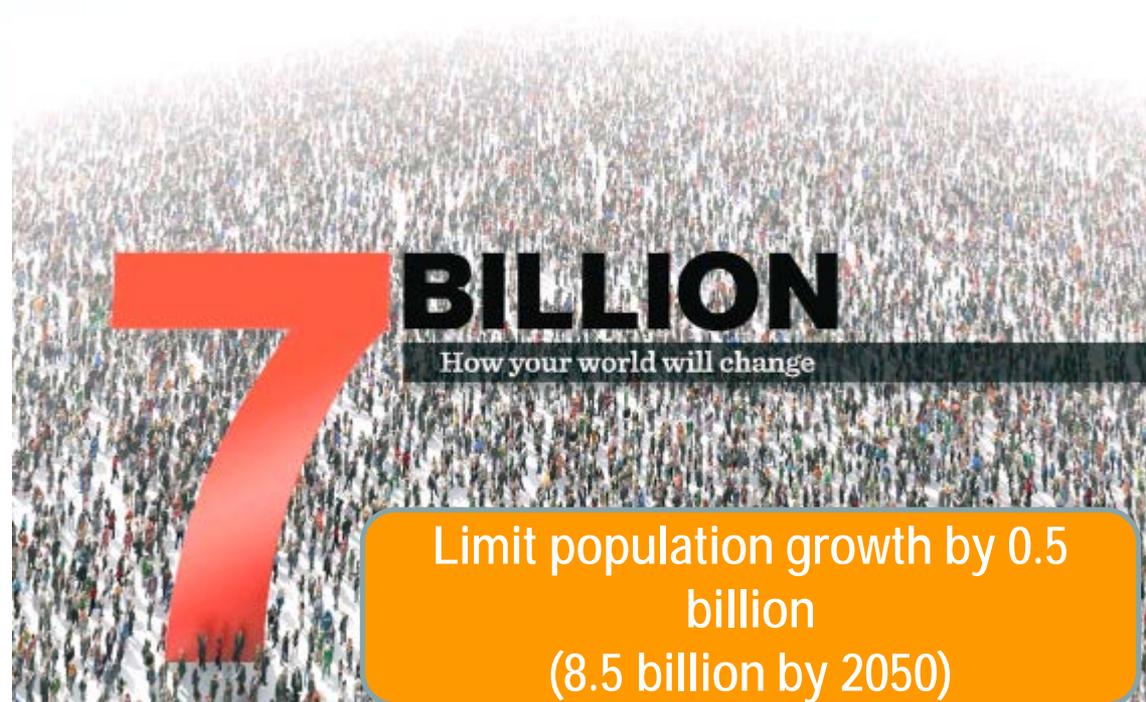


Efficiency increase by 1% per year (40% by 2050)

Average Indoor Household Water Use



Improvement of 0.5% per year (20% by total)



Limit population growth by 0.5 billion (8.5 billion by 2050)

A new approach is required to operationalize investments and planning at a regional scale

- To capture synergies and trade-offs among food, energy, water and ecosystems
- Identifies cross-sectoral solutions responding to various alternative futures
- ***Integrated Solutions for Water, Energy and Land*** is a new project funded by the Global Environment Facility which sets out to do this

NEXUS THINKING

ENERGY FOOD WATER

Food/Land Use System

- Preparing land
- Growing crops
- Raising livestock
- Harvesting produce
- Drying, processing
- Storing food products
- Transport, distribution
- Preparing food

Biomass, crop residues, biofuel feedstocks, land

Fertilizer, irrigation, fuel, processing, transportation

Irrigation, food processing, sanitation, health risk

Runoff, pollution, storage, purification, flood protection

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Energy System

- Extracting resources
- Harnessing hydro, wind, solar, biomass energy
- Generating and transmitting electricity
- Production, refinement and distribution of transport fuels
- Storing, buffering

Hydropower, power plant cooling, extraction, (bio)fuels

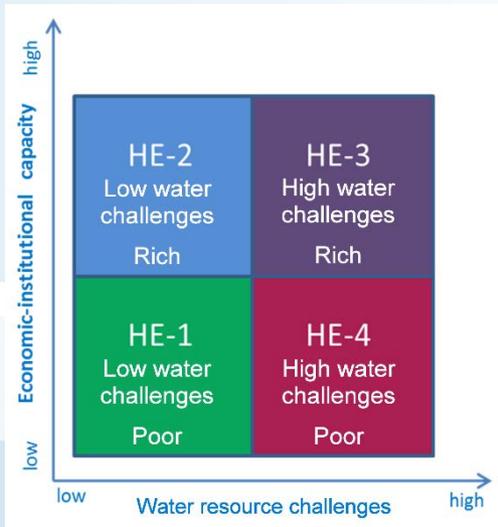
Water pumping, delivery, water treatment, energy for desalination

Water System

- Manage renewable surface- and groundwater resources
- Distribute water supply for human consumption
- Collect sewage
- Treat wastewater to protect human and ecological health
- Transfer between basins
- Desalination

Multiple scenarios

Developing narratives of the future



SSP1: The world is moving toward sustainability

SSP characteristics

- Improved resource use efficiency
- More stringent environmental regulations
- Rapid technological change is directed toward environmentally friendly processes
- Management of global commons improves.

Implications for Manufacturing Water Use:

- Manufacturing industries with efficient water use and low environmental impacts are favored.
- Enhanced treatment, reuse of water, and water-saving technologies;
- Widespread application of water-saving technologies in industry



With global and regional stakeholders co-design scenarios that identify cross sectoral, transboundary issues and priorities for solutions to promote ownership. Use these to drive Integrated Assessment models (MESSAGE, GLOBIOM, COMWAT)

Regional Basin Case Studies

Indus



Area: 1.100.000 km²

Countries: Pakistan, India, China, Afghanistan

Population: 257 Mio. people

Projection 2050 (SSP1-5): 370-440 Mio. people

Main land cover: [%]

Cropland: 30 Irrigated cropland: 24

Forest: 0.4

GDP per cap. [US\$]: 700 (Afghanistan) - 7600 (China)

Main challenges:

Climate Change	glacier melting flood & drought risk
Water security	water scarcity agricultural pollution
Energy security	potential of hydropower energy access
Food security	irrigation groundwater exploitation
Socioeconomic	population growth urbanization economic growth
Ecosystems	loss of biodiversity

Zambezi



Area: 1.332.000 km²

Countries: Zambia, Angola, Zimbabwe, Mozambique, Malawi, Tanzania, Botswana, Namibia

Population: 38 mio. people

Projection 2050 (SSP1-5): 70-95 Mio. people

Main land cover: [%]

Cropland: 20 Irrigated cropland: 0.1

Forest: 4

GDP per cap. [US\$]: 950 (Zimbabwe) - 5400 (Angola)

Main challenges:

Climate Change	flood & drought risk
Water security	water infrastructure water scarcity urban, industrial pollution
Energy security	potential of hydropower energy access
Food security	potential of irrigation soil degradation
Socioeconomic	population growth urbanization economic growth
Ecosystems	loss of biodiversity

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- (PS Citizen science, see Geo-wiki!)