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COPENHAGEN CENTRE ON ENERGY EFFICIENCY

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ELECTRICIDADE DE MOÇAMBIQUE, E.P.

Improving Energy Efficiency in Urban Water Supply Systems – Challenges, Options, and International Supports

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Outline

- Improving Energy Efficiency in Water Supply – Challenges
- Options
- International Supports

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Overview of global water withdrawal

- Global water use has increased by a factor of six over the past 100 years and continues to grow steadily at a rate of about 1% per year as a result of increasing population, economic development and shifting consumption patterns.
- 70% of the water withdrawal is for agriculture, especially irrigation, 15% is for energy sector, 5% for other industrial use, and 10% for domestic use.
- Hydroelectricity accounts for about 15% of global electricity production.
- There is an increasing risk of conflict between power generation, other water users and environmental considerations.
- Water, being dense, requires much energy to move it. Water transport and distribution are energy intensive processes. Reallocating water to different uses and places might increase the value per drop but increase the use of energy.
- Drinking water for municipal systems typically requires extensive treatment and once it becomes waste water it requires treating again before it can be discharged to the environment.

Challenges - uncertainties in water planning

- High uncertainties about future water demand, water resources from different sources, and their associated costs and side effects, especially in the context of urbanization, economic growth, and climate change
- Water resources are often shared by regionally and by different sectors and for different uses
- Energy and water policy making and administration is often done by different government authorities in isolation
- Water prices and energy prices are sometimes beyond the control of local municipalities
- Energy and water infrastructure facilities often involve large investment and once built, they have a use life of several decades or even longer.
- Energy production depends on water, while the urban water system - particularly inter-basin water transfer or desalination - requires a large amount of energy. Thus, water supply is closely connected to a city’s energy consumption.

Challenges - increasing complicity of urban water systems

- Urban water infrastructure is growing increasingly complex, driven by a number of factors including decreasing freshwater availability, increased allocation for environmental water flows, and increasing water demand caused by population growth.
- Waste water management is met with increasingly strict demands for effluent water quality and requirements for resource recovery, which in turn leads to an intensification of waste water treatment.
- Climate change affects water availability in many places, but also requires cities to adapt to new storm water regimes.
- Most cities handle three major water flows and a myriad of minor flows in between compartments of the cities.
- The major flows are rainfall, water supply and industrial/household waste water. These vary dramatically between geographic location.
- With increasing expectations on water quality and exploitation of unconventional water resources, the energy requirement of urban water systems may increase and subsequently raise greenhouse gas emissions.

Challenges - isolated policy making and project planning

- Energy and water policies are disjointed, with many federal, state, and local decision makers but few mechanisms to coordinate action.
- This lack of integrated planning, management, and regulation has already had an impact in the power sector.
- Water allocation modelling does not adequately address scale and time in energy modelling from planning to operation.
- Water supply planning generally uses a fairly broad spatial scale (river basin) and a fairly coarse time scale (months or weeks).
- Energy operational models generally run on a more refined time scale (minutes or hours) that are not necessarily concerned with the spatial component or supply limitations evidenced with the underlying hydrologic systems.
- In most countries, water and energy is administrated by different government agencies; the policy making, planning, and investment of energy projects and supply system and those on water supply and wastewater treatment often take place in isolation, without thinking about the.

Options for additional water supply

- Rainfall and waste water adequately cover for the water demand in many cities, but intermittency and poor quality have historically limited its use, although this is changing due to increased focus on decentralised rainwater harvesting and waste water reclamation.
- Besides the major urban water flows, cities also have access to water resources available as groundwater, surface water (rivers or lakes), and seawater.
- Additional water resources can be available via three options: intensified treatment, increased production from a known resource, or increasing imports from resources available further away.

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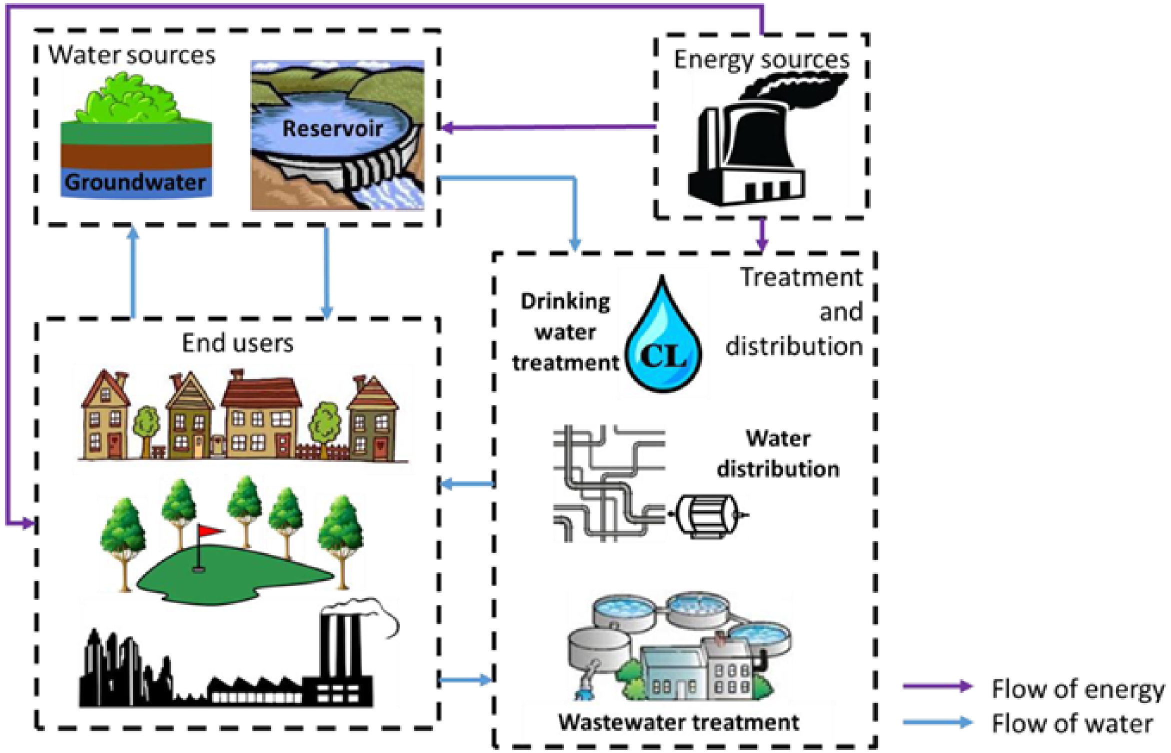
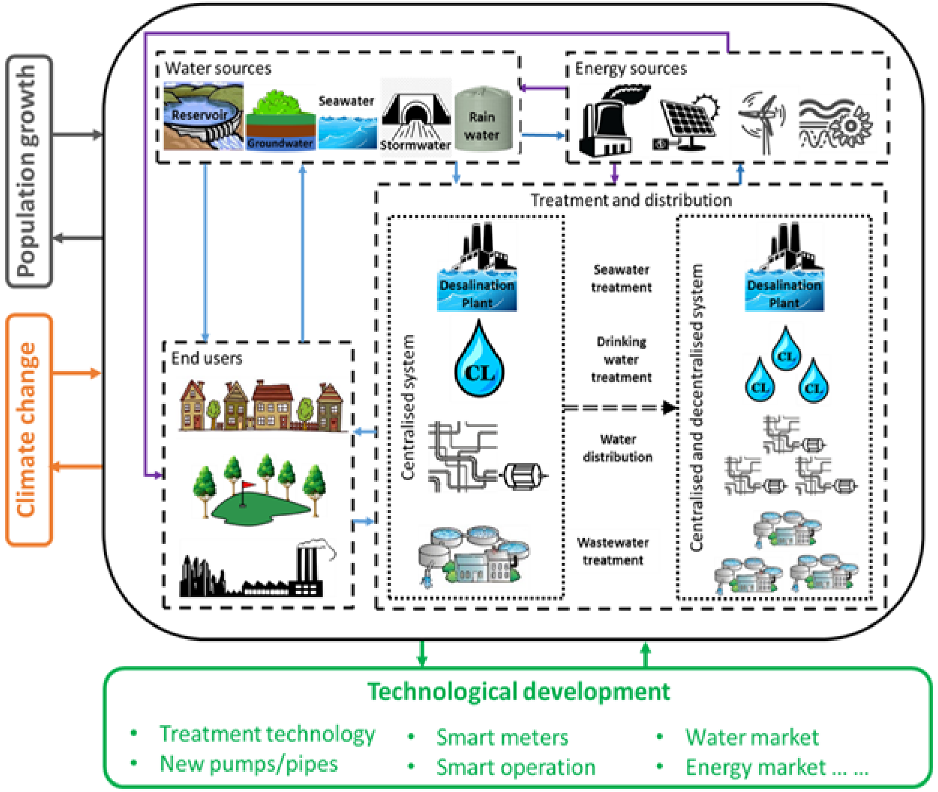
Water–energy nexus in the traditional UWSSs and consideration of long-term drivers



Water–energy nexus in traditional UWSSs.

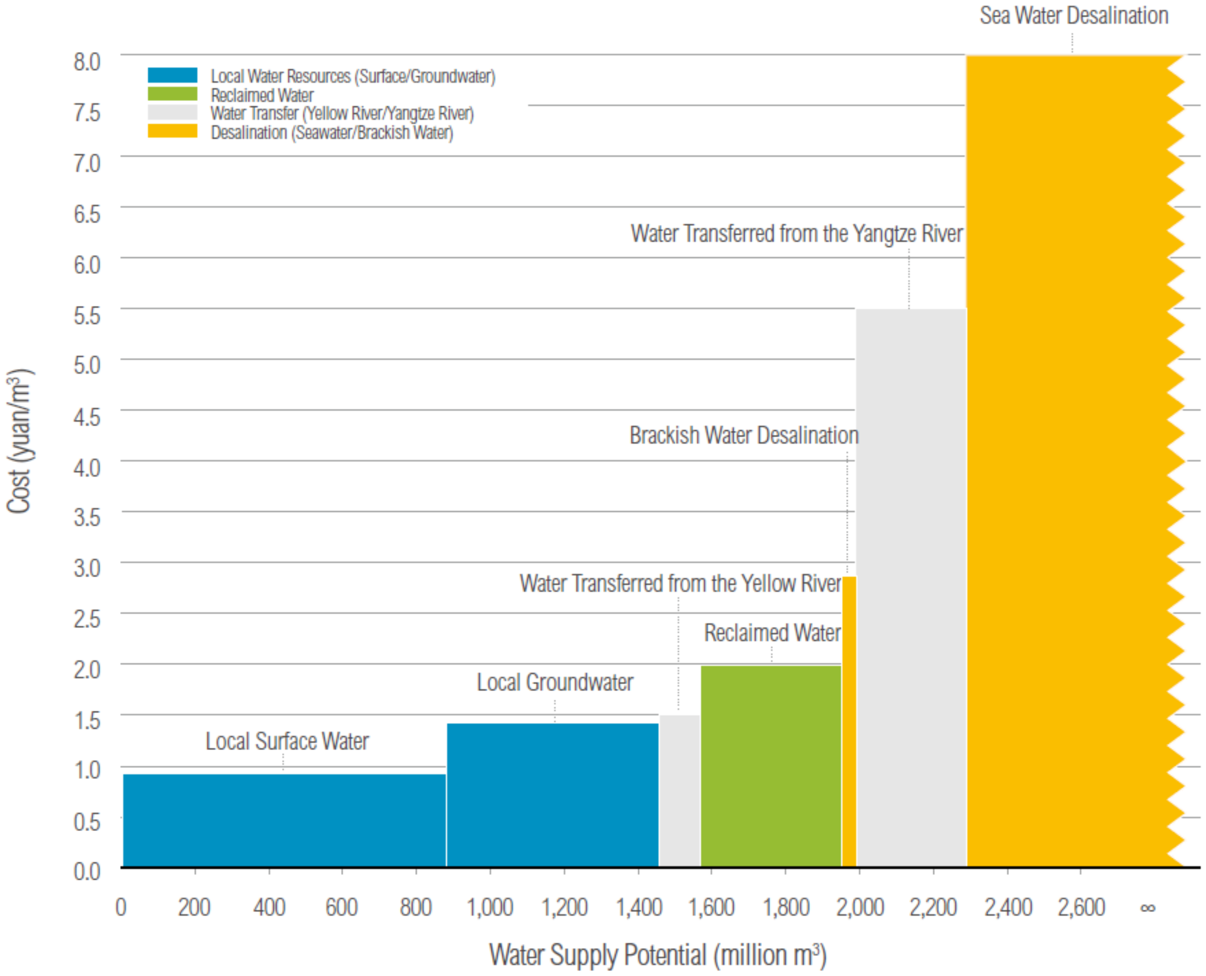


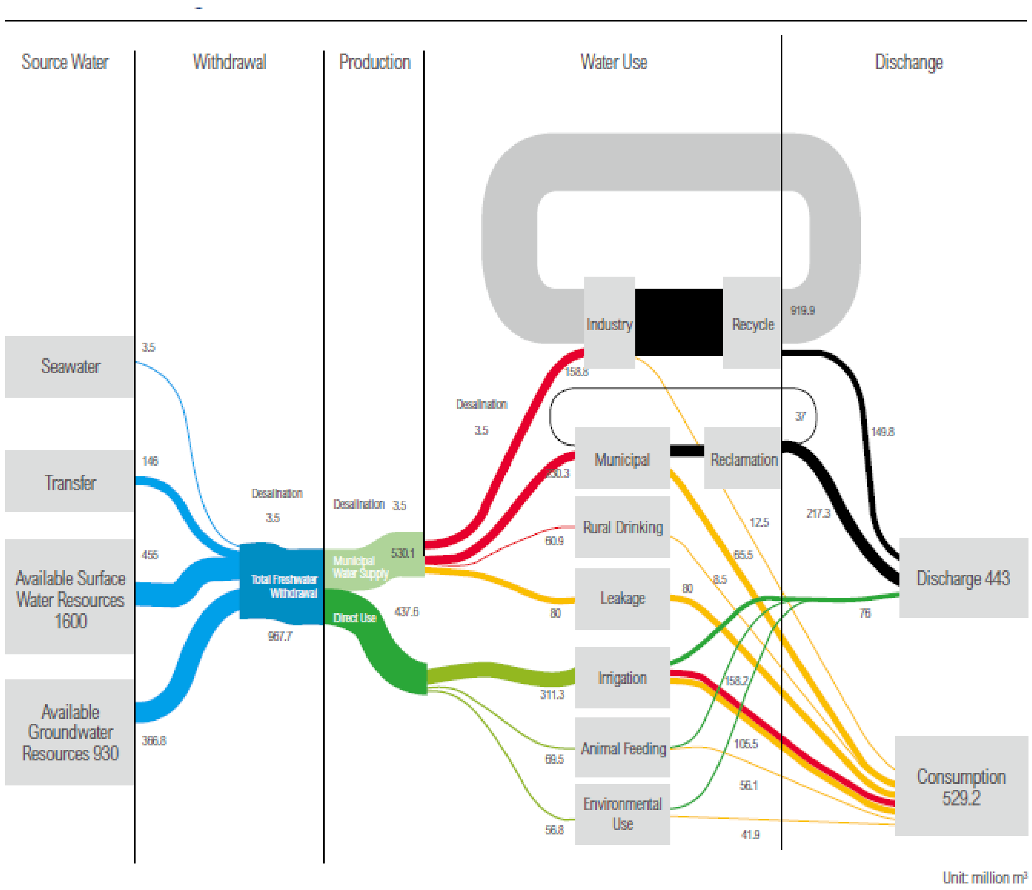
Changed water–energy nexus in UWSSs due to long-term drivers

Note: Purple arrows show the flow of energy and blue arrows show the flow of water.

Source: "The changing nature of the water–energy nexus in urban water supply systems: a critical review of changes and responses"

Assessing local water resources and costs, including energy use





Source: WRI, 2017. Water Energy Nexus in Urban Water Source Selection: A Case Study from Qingdao.

Risk assessment for different water resources

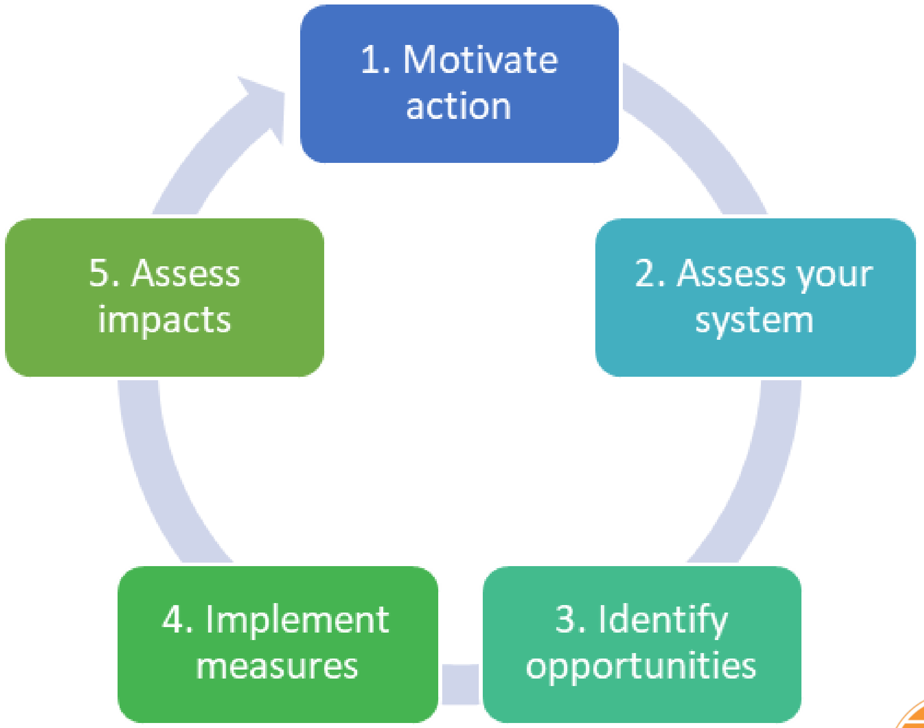
INDICATOR	LOCAL SURFACE WATER (RESER- VOIR)	LOCAL GROUNDWATER	WATER DIVERSION	SEAWATER DESALINA- TION	RECLAIMED WATER	RAINWATER
Water Quality	Medium	Medium	Medium	Low	Low-Medium	High
Water Source Guarantee Rate	Medium	Medium	Medium	Low	Low	High
Impact on Land Use	High	Low	High	Low	Low	Low
Investment	High	Low	High	High	Medium	Low
Energy Consumption	Low	Medium	High	High	Medium-High	Medium
Environmental Impact	High	Medium	High	Low	Low	Low
Population Resettlement	High	Low	Medium	Low	Low	Low
Public Acceptance	Low	Low	Medium	High	High	Medium
Vulnerability to Climate Change	High	High	High	Low	Low	High

Example of the WRI 2017 Study on the Chinese City of Qingdao

How to realise the opportunities?

- Adopting a Nexus approach will enhance the understanding of the complex and dynamic interrelationships between energy, water, and food, and facilitate more sustainable management of these resources.
- Integrated policy making, resource planning, and investment project designing, to maximize benefits both in terms of energy and water, instead of improving performance on one front at the price of the other.
- Acting now, instead of waiting.

5-step roadmap for low-carbon urban water utility



Partnerships at different levels

- UN-Water 2030 Strategy
- UN Water-National systems to support drinking water and sanitation-global status report 2019
- UN Water: 2014 World Water Development Report is on Energy and Water.
- The UN declared 2003 the International Year of Freshwater, and designated the period 2005–2015 the UN Decade of Water.
- UN-Water is coordinating the SDG 6 Global Acceleration Framework which unifies the international community's support to countries for SDG 6. The UN Water relies on five accelerators to deliver results at speed and scale: **data and information**, **financing, governance, innovation, and capacity development.**
- Globally, over US$ 10 billion was disbursed in development assistance1 for water and sanitation in 2017, provided by external support agencies (ESAs) such as bilateral donors, multilateral development banks, non-government organizations and private foundations.
- These disbursements consisted of US$ 6.9 billion in official development assistance (ODAs), US$ 3.0 billion in non-concessional loans/credits and over US$ 500 million in other funds.

World Bank - 5-year Thirsty Energy imitative

- The interdependencies of water and energy must be better understood and translated into policies and plans
- In January 2014 the World Bank launched the Thirsty Energy initiative, the aim of which is to help countries address their water and energy challenges by:
  – Identifying synergies and quantifying trade-offs between energy development and water use
  – Piloting cross-sectoral planning to ensure sustainability of energy and water investments
  – Designing assessment tools and management frameworks to help governments coordinate decision-making and to mainstream water requirements into energy planning.

The initiative carried 3 case studies in South Africa, China, and Morocco

Findings:

- water-energy nexus is context specific, and solutions can’t be generalized.
- Win-win solutions are possible.
- Infrastructure investments made today are critical.

Tools and guidance

- GIZ **The Water and Wastewater Companies for Climate Mitigation (WaCCliM) project:** WaCCliM is pioneering GHG reductions in the water sector in **Mexico, Thailand, Peru and Jordan**.
- The programme offers utilities a roadmap to achieve energy and carbon neutrality. Utilities from more than **20 cities worldwide** have used ECAM in the pilot phase of WaCCliM.
- Energy Performance and Carbon Emissions Assessment and Monitoring (ECAM) Tool
- WaCClim 2020, Linking Water and Climate - Towards a Carbon Neutral and Climate Resilient Water Sector.
- World Bank, 2013. "Thirty Energy", Water Paper 78923.
- OECD (2017), *The Land-Water-Energy Nexus: Biophysical and Economic Consequences*, OECD Publishing, Paris, https://doi.org/10.1787/9789264279360-en
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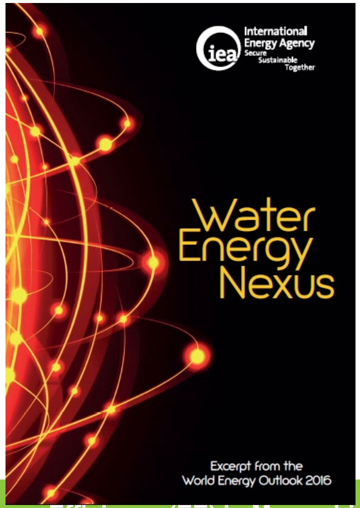
WATER PARTNERSHIP PROGRAM



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Thanks for your attention!
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