WATER-ENERGY NEXUS UNDER WATER AND ENERGY SCARCITY

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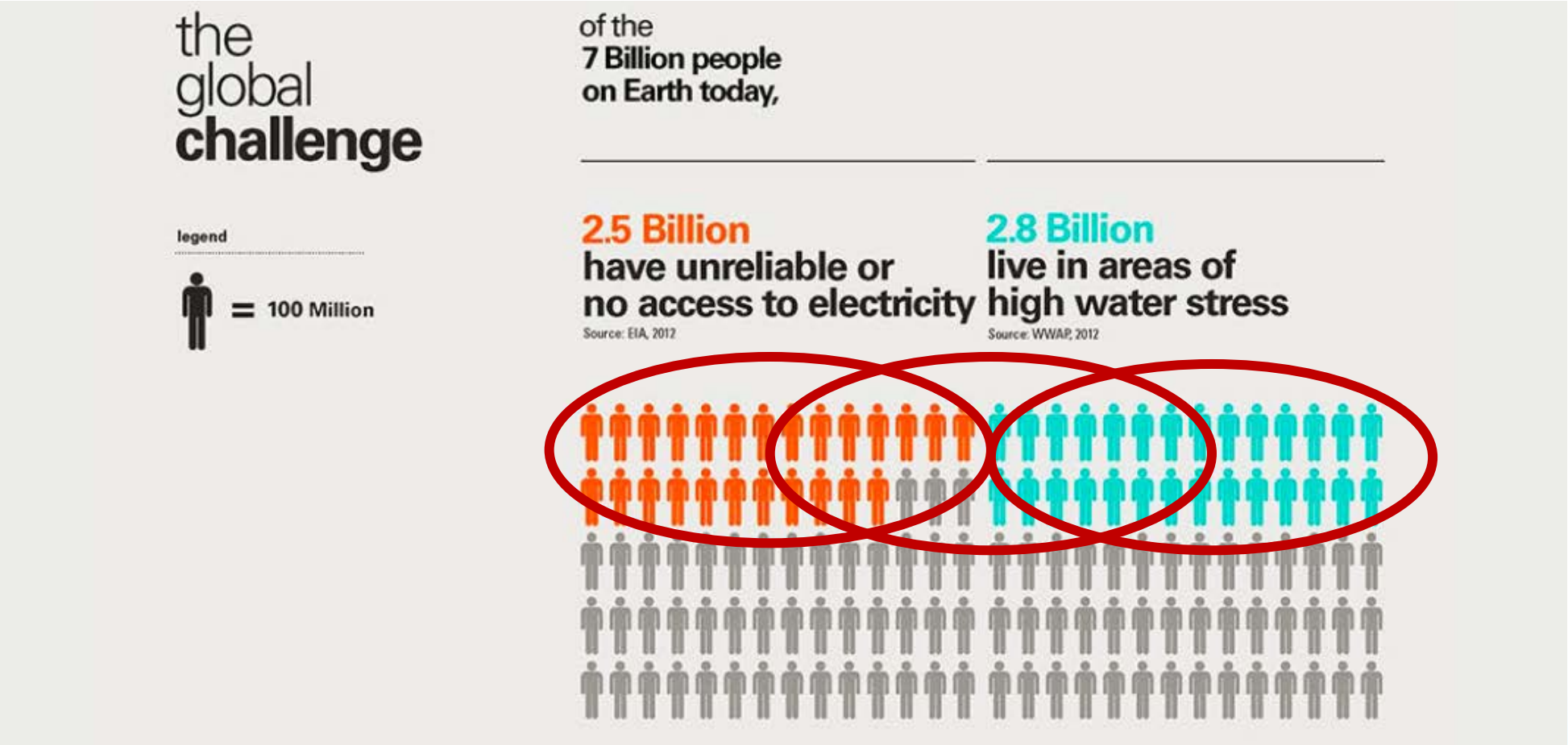
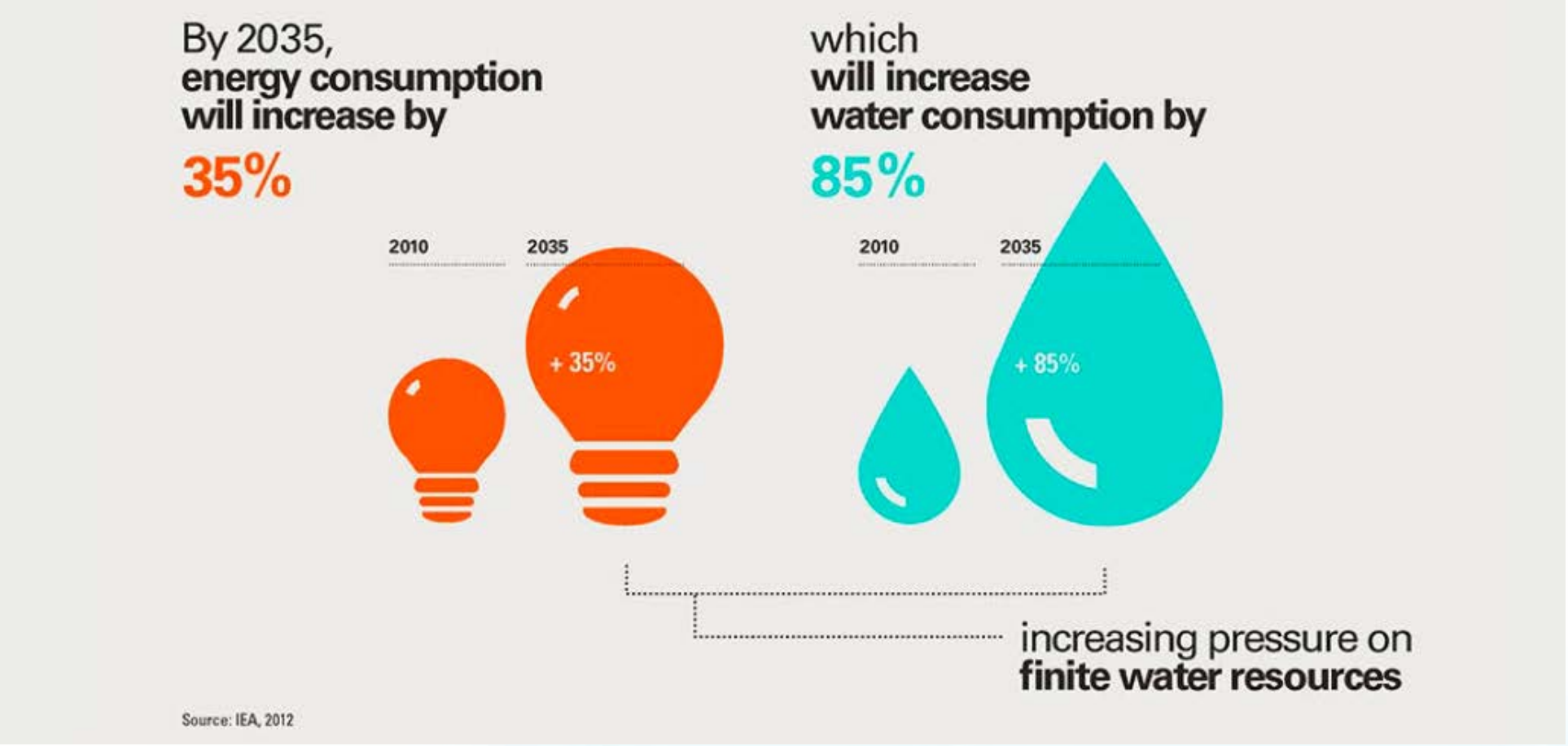
THE WATER AND ENERGY WORLD WE HAVE



THE WATER AND ENERGY WORLD WE WILL FACE



THE WATER AND ENERGY WORLD WE NEED

SDG 6 ensuring availability and sustainable management of water and sanitation for all.

SDG 7 ensuring access to affordable, reliable, sustainable and modern energy for all.

2030 Sustainable Development Agenda

NEED TO THINK BEYOND CONVENTIONAL APPROACHES

Where the ENERGY is scarce

Water- and energy-scarce countries and communities need to consider combinations of alternative – **unconventional water and energy resources** – to narrow the water and energy demand-supply gap.

Where the WATER is scarce

ENERGY FROM USED WATERS

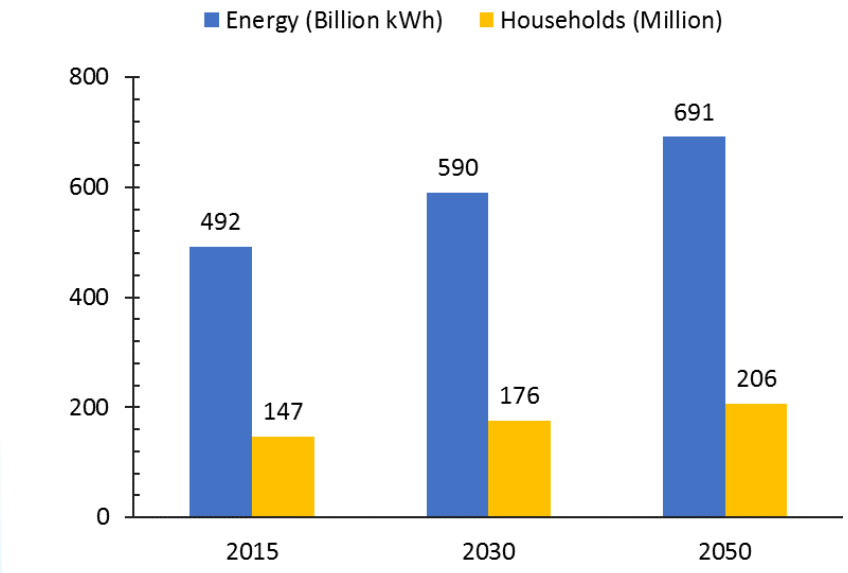
- **Municipal wastewater**
- **Agricultural drainage water**

ENERGY EMBEDDED IN MUNICIPAL WASTEWATER

- Wastewater contains more energy than its is needed for the wastewater treatment process; in some cases, up to 3 times.
- Many wastewater treatment plants utilize biogas for heating the wastewater treatment reactors and generating electricity.
- In current practices, the energy potential of wastewater is yet to be fully exploited.
- Wastewater potential as an **energy** resource stands at 492 billion kWh

147 million households

550 million people



Qadir et al. (Unpublished data)

BIOMASS AND BIOENERGY FROM SALINE WATER

- Russian olive (*Elaeagnus angustifolia* L.)
- 5-year-old tree plantations on salt-affected wasteland
  - Wood production: 25.5 t/ha
  - Stem wood energy: 118 MJ/tree
  - Branch wood energy: 94 MJ/tree
  - Bio-fuel capacity: 487,623 MJ/ha
  - 1 MJ = 0.28 kilowatt/hour
  - I ha plantation can meet the energy needs of 72 people

Lamers and Khamzina (2008)

BIOMASS AND BIOENERGY FROM SALINE WATER

- Euphrates poplar (*Populus euphratica* Oliv.)
- 5-year-old tree plantations on salt-affected wasteland
  - Wood production: 32.0 t/ha
  - Stem wood energy: 117 MJ/tree
  - Branch wood energy: 145 MJ/tree
  - Bio-fuel capacity: 601,036 MJ/ha
  - 1 MJ = 0.28 kilowatt/hour
  - I ha plantation can meet the energy needs of 89 people

Lamers and Khamzina (2008)

DECENTRALIZED AND ENERGY NEUTRAL SYSTEMS

- Solar and wind energy systems
- Micro-hydro turbines
- Fog water collection systems

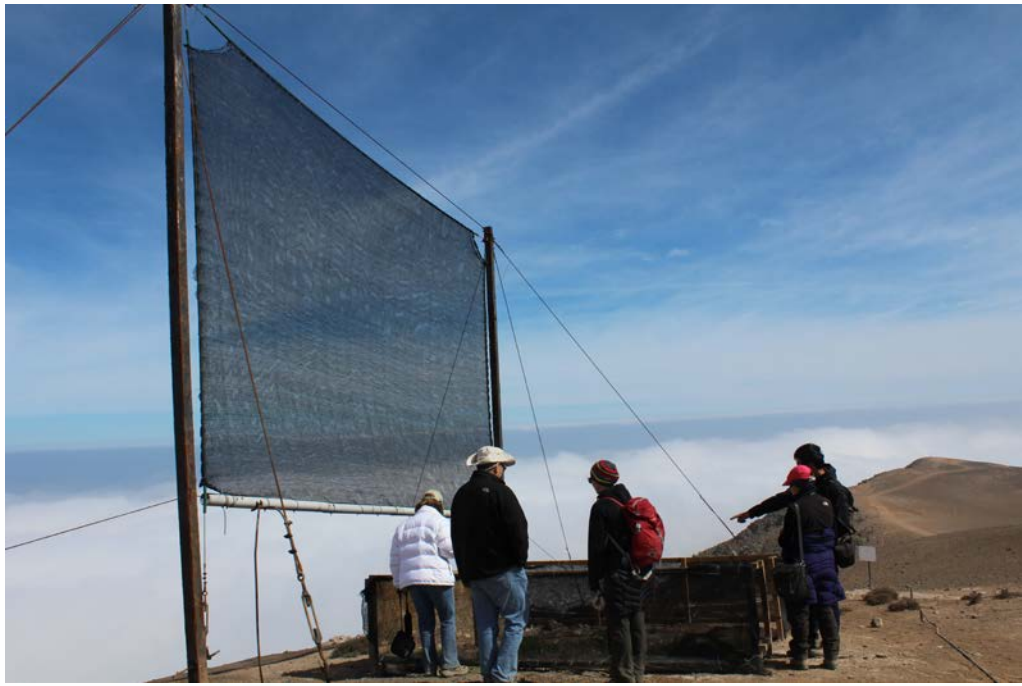
SOLAR AND WIND ENERGY

MICRO HYDRO-TURBINES FOR DECENTRALIZED ENERGY

- Electricity by hydropower needs a source of running water and a difference in water level.
- Saline drainage networks can be used for operating micro hydro-turbines.
- Their efficiency depends on the blade design, and turbine size and speed.
- Micro hydro-turbines are a means of decentralized energy production.
- Potential for remote, off-grid areas with poor communities.

ENERGY NEUTRAL WATER COLLECTION SYSTEMS

- Fog water collection systems in dry areas around the world where fog events and intensity are conducive for fog collection systems
- Community based systems
- Fog water collection is an environmentally friendly intervention that does not rely on energy consumption; i.e. fog water harvesting is a green technology.
- Examples from Eritrea, Morocco, Namibia, South Africa, and Ethiopia.



CONCLUSIONS AND TRADEOFF

- Energy from used waters and decentralized and energy neutral systems can enhance water- and energy-scarce communities resilience to adapt to climate change and risks.
- Financial mechanisms for low-income communities based on initial subsidies or soft loans for off-grid energy production systems, bioenergy production, and fog collection systems.
- Capacity needs assessment and need-specific capacity development.
- Stakeholders involvement and their support.

THANK YOU