

REAL ACADEMIA CANARIA DE CIENCIAS

“El Papel del Agua Para Producir Energia en Canarias”

*Campus Anchieta
Universidad de La Laguna*

El Nexo Energia-Agua En Nuestro Planeta

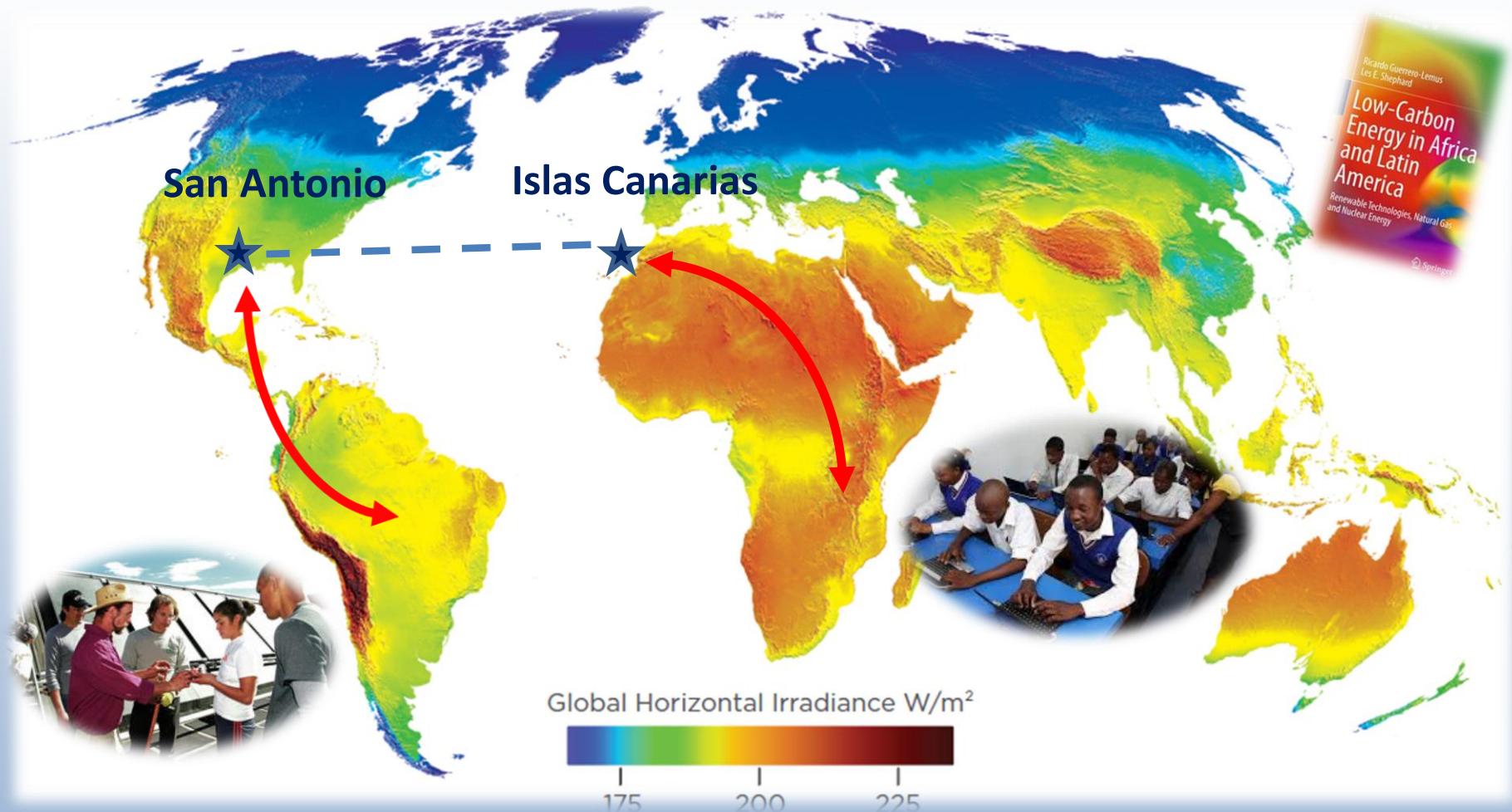
Les Shephard
Vice President Emeritus
Sandia National Laboratory



**Feliz Dia De La Tierra
April 22, 2019**

Conectando El Mundo Para Un Futuro Más Sostenible

Puertas De Entrada A Las Regiones De Necesidad



Ahora Enfocado En E



Las Naciones Emergentes

Water Stress Is A Global Issue

“Ratio of Water Withdrawal to Supply”

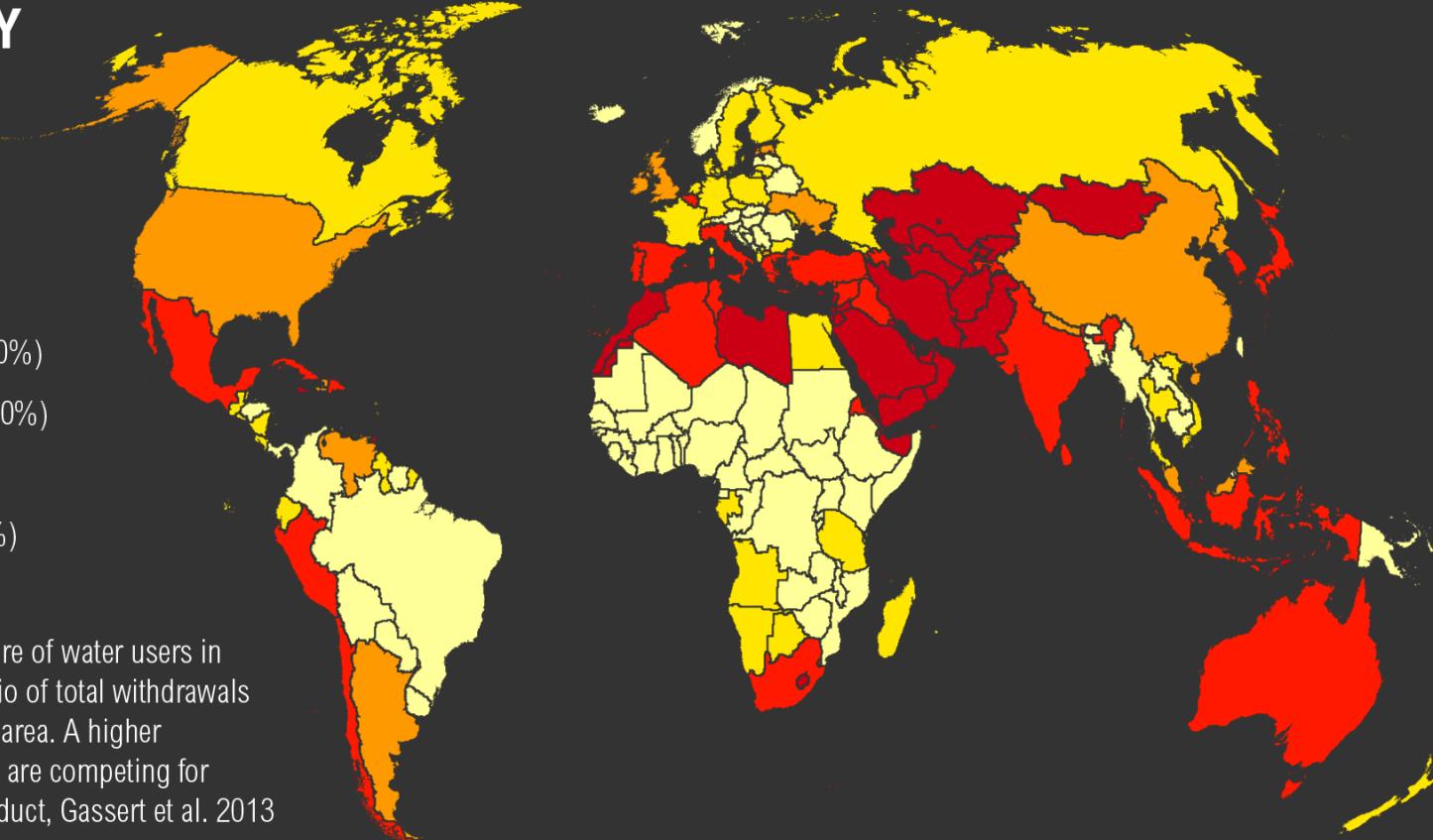
(El Estrés Hídrico Es Un Problema Global)

WATER STRESS BY COUNTRY

ratio of withdrawals to supply

- Low stress (< 10%)
- Low to medium stress (10-20%)
- Medium to high stress (20-40%)
- High stress (40-80%)
- Extremely high stress (> 80%)

This map shows the average exposure of water users in each country to water stress, the ratio of total withdrawals to total renewable supply in a given area. A higher percentage means more water users are competing for limited supplies. Source: WRI Aqueduct, Gassert et al. 2013



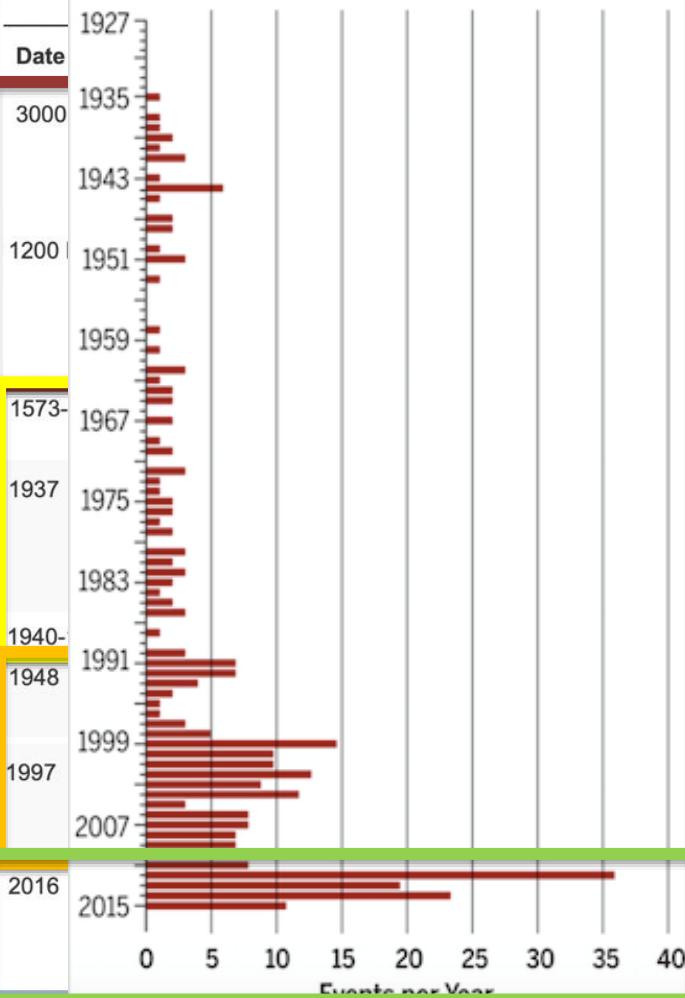
Water Conflicts Have Been Around Since the Beginning

Pacific Institute Study (2019)

(Los Conflictos Por El Agua Han Existido Desde El Principio)

Water Conflict Events per Year, 1927–2015

Data from the Water Conflict Chronology List 2015.



All Dates All Regions All Conflict Types 655 Conflicts

But In Texas, We Have Always Known:
Whiskey is for Drinking AND Water is for Fighting!!!

Western Europe In 1573 at the beginning of the eighty years war against Spain, the Dutch flood the land to break the siege of Spanish troops on the town Alkmaar. Dutch Water Line 2002

(Pero en Texas Siempre los Hemos Sabido:
El Whisky es Para Beber y el Agua Para Luchar!!!)

cut off that supply in retribution for criticisms by Singapore of policy in Malaysia.

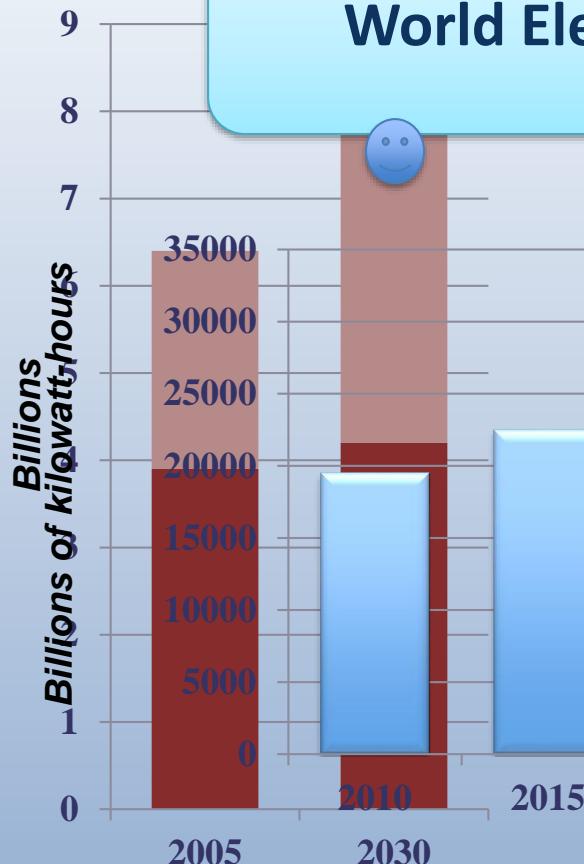
North America U.S. authorities discover that Iranian hackers have successfully infiltrated the control system of a small dam in New York State. Due to work being performed on the dam, the hackers are unable to alter dam operations, however the event exposes the risks of cyberattacks on U.S. infrastructure. Berger 2016

Energy – Water Nexus

A Global Context

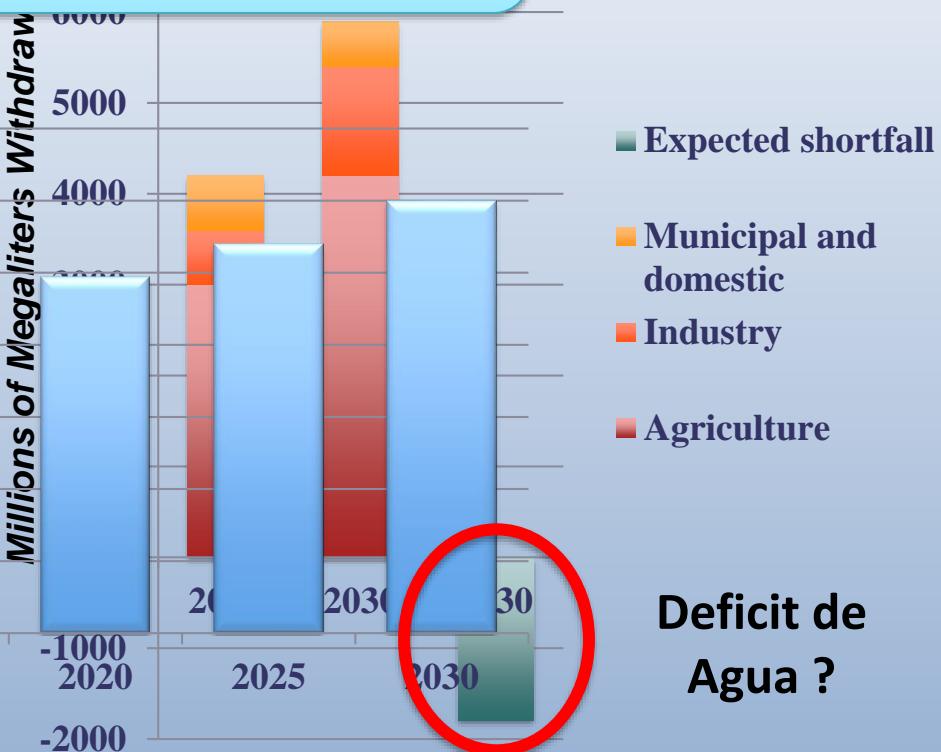
World Population

- Population living under severe water stress
- Global population

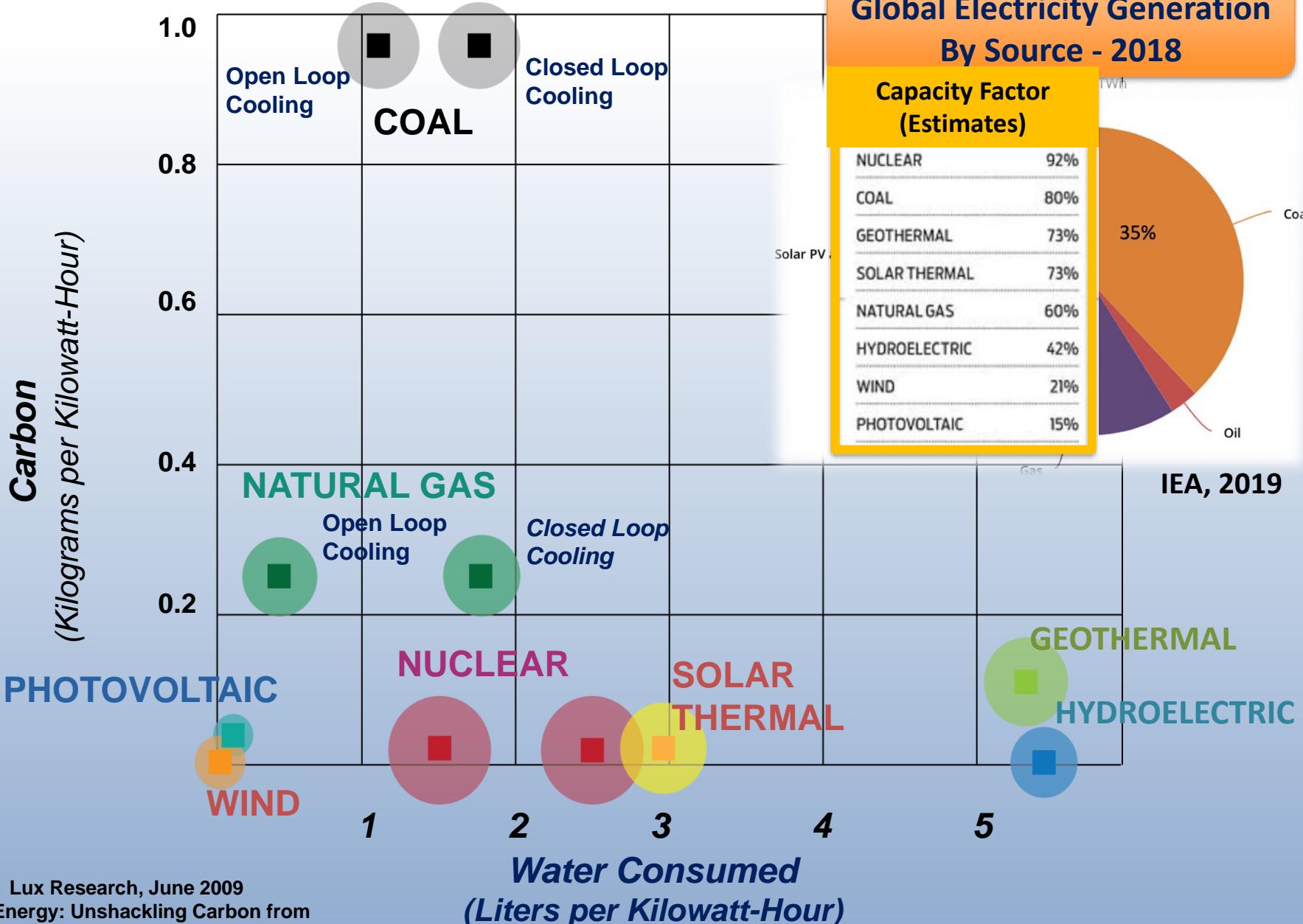


World Electricity Demand

Future Freshwater



The Energy – Water – Carbon “Trifecta”

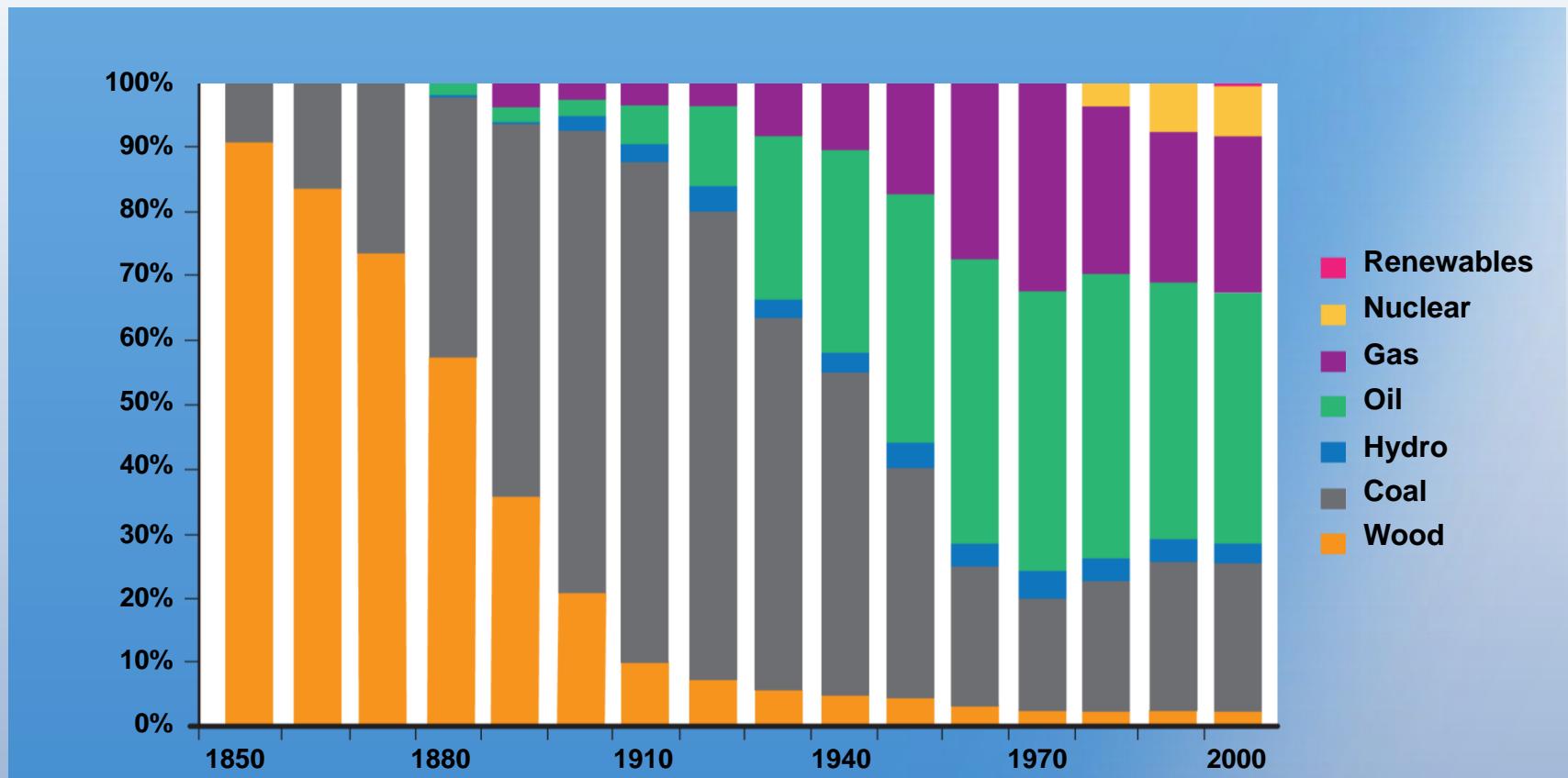


Source: Lux Research, June 2009

Global Energy: Unshackling Carbon from Water

Two Major Global Energy Transitions Have Occurred

Major Energy Transitions



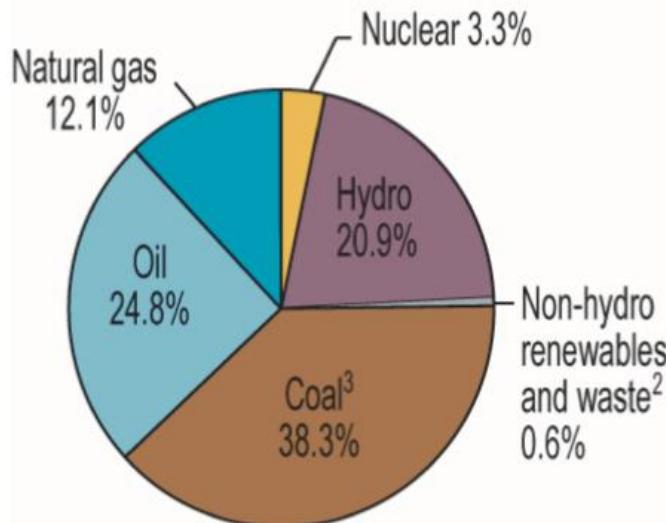
Our Challenge Is To Accelerate the Third!!

Global Electricity Production by Fuel Type

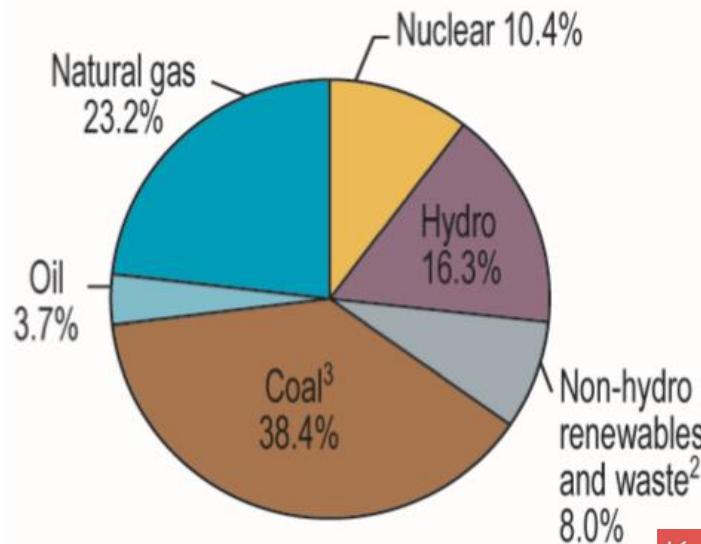
The World Has Changed!!

1973 and 2016 source shares of electricity generation¹

1973



2016



6 131 TWh

24 973 TWh

Key world energy statistics

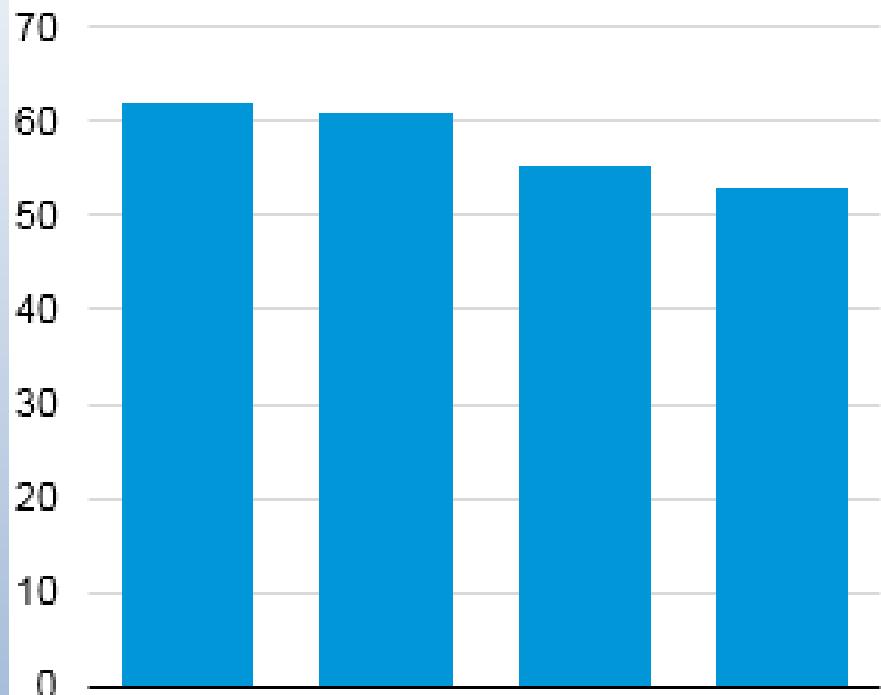
Also available on smartphones and tablets



But Has It Changed Fast Enough????

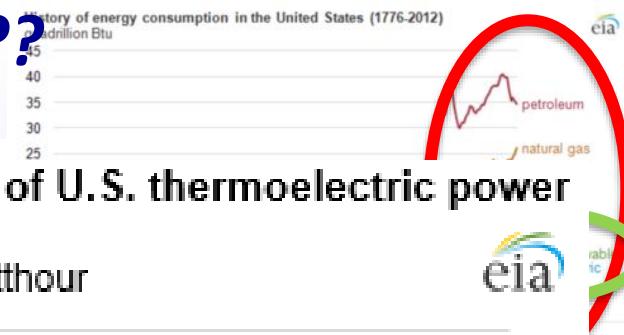
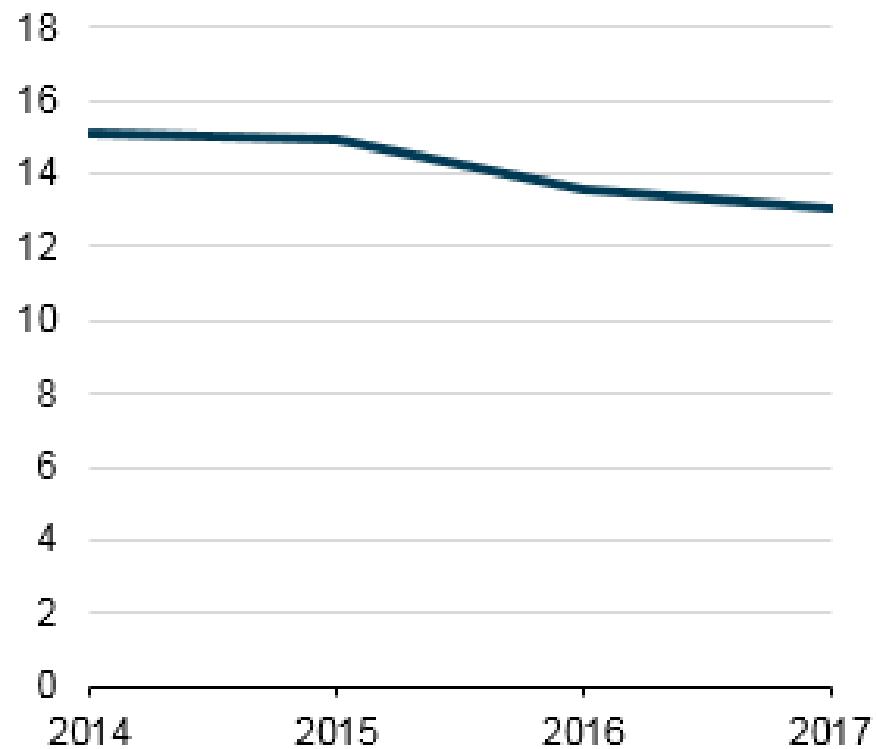
Cómo Est醤 Estados Unidos? *Suficientemente Rapido???*

Total water withdrawals by U.S.
thermoelectric power plants
trillion gallons



Source: Short-Term Energy Outlook, January 2018.

Water intensity of U.S. thermoelectric power plants
gallons per kilowatthour



Impacts of the “Nexus” Are Very Real Across The Globe

Sou
Nu

Drought

Twenty-four
riencing the
power plants

The 2012 Indian Blackout Affected 600 Million People and Was Triggered Partly by Drought

- 1) Increased power demand from irrigation
- 2) Decreased power generation at dams

The New York Times

2nd Day of Power Failures Cripples Wide Swath of India



Adnan Abidi/Reuters

Passengers waited Tuesday for train service to be restored in New Delhi. More Photos »

By JIM YARDLEY and GARDINER HARRIS
Published: July 31, 2012 | 429 Comments

Michael E. Webber, Ph.D.
Energy Water Nexus
June 10, 2013

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Significant Power Curtailment From Drought

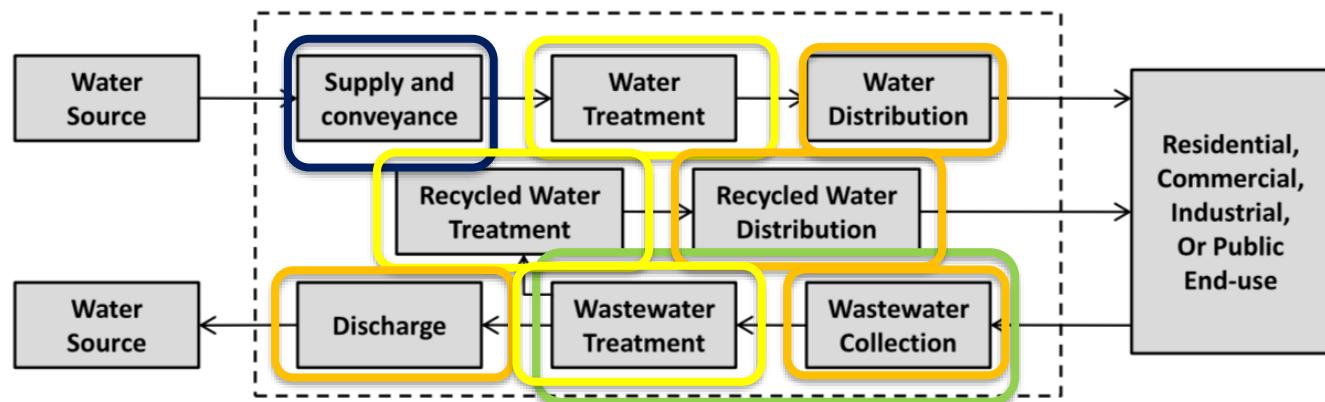
days

Fukushima

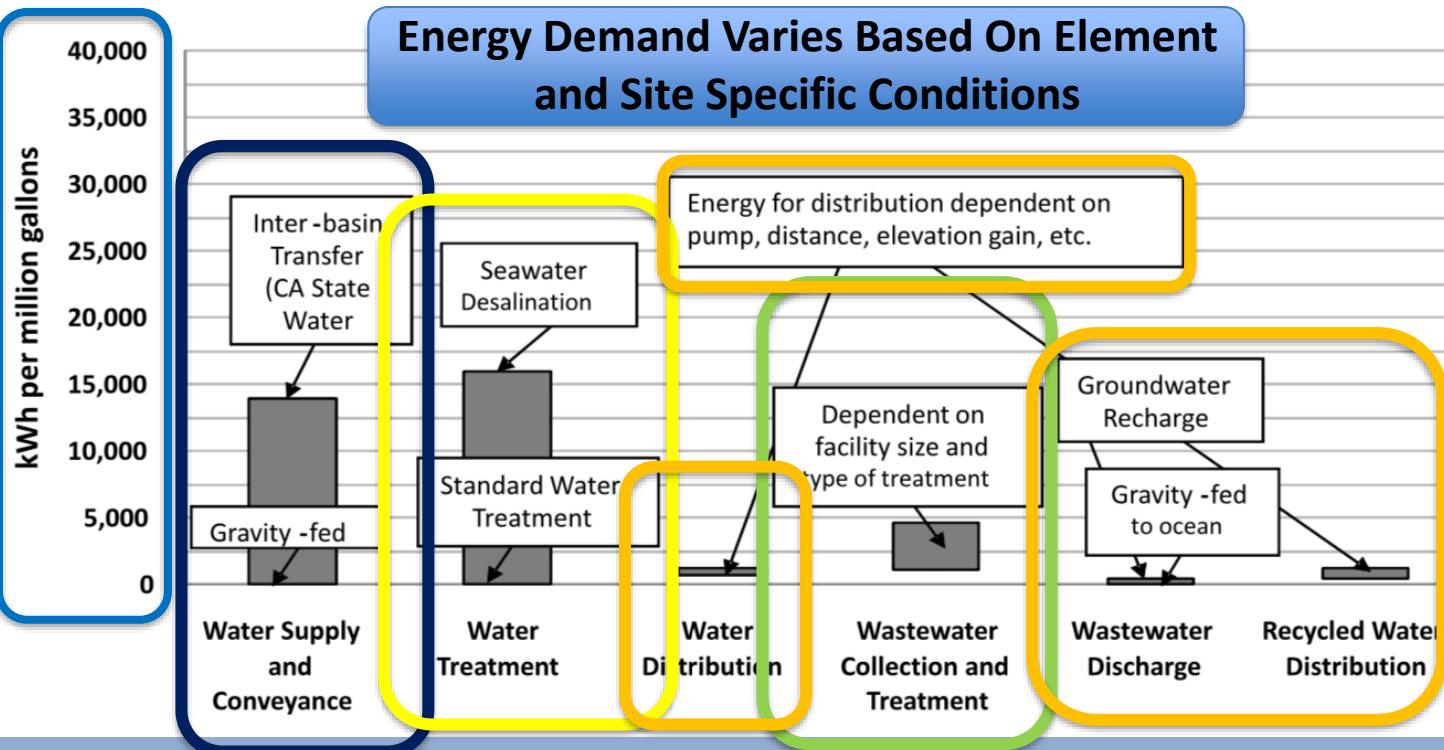
A Non-Traditional Tragic Link Between Water and Energy



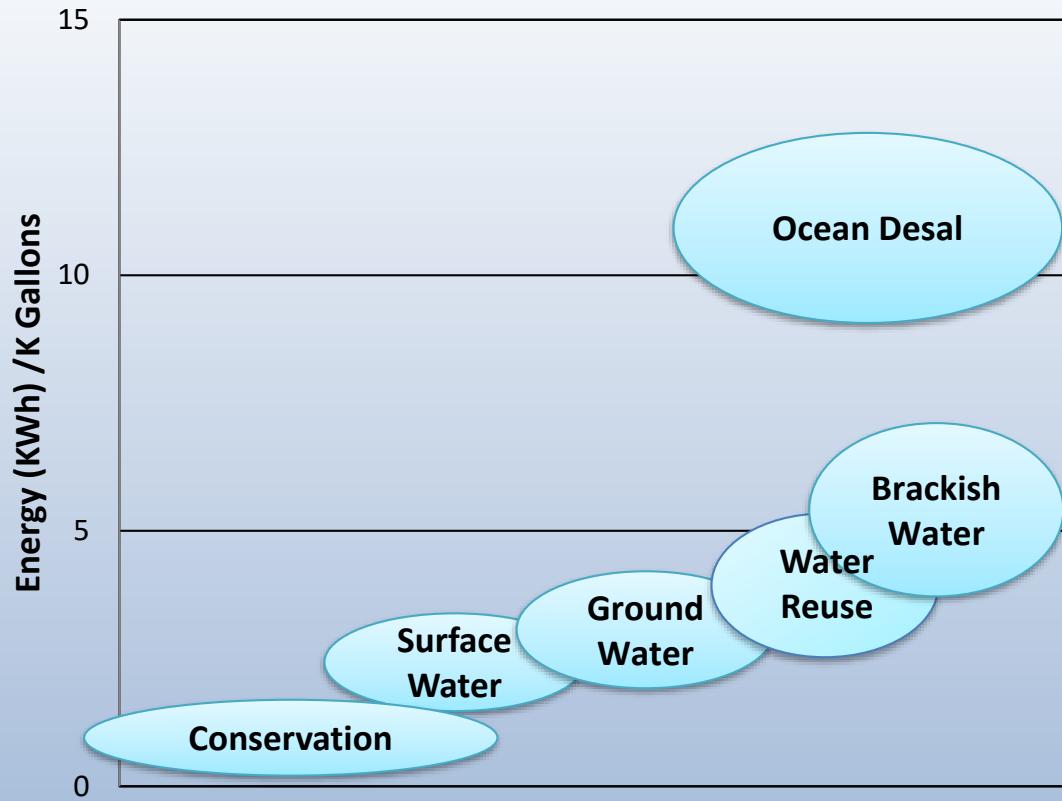
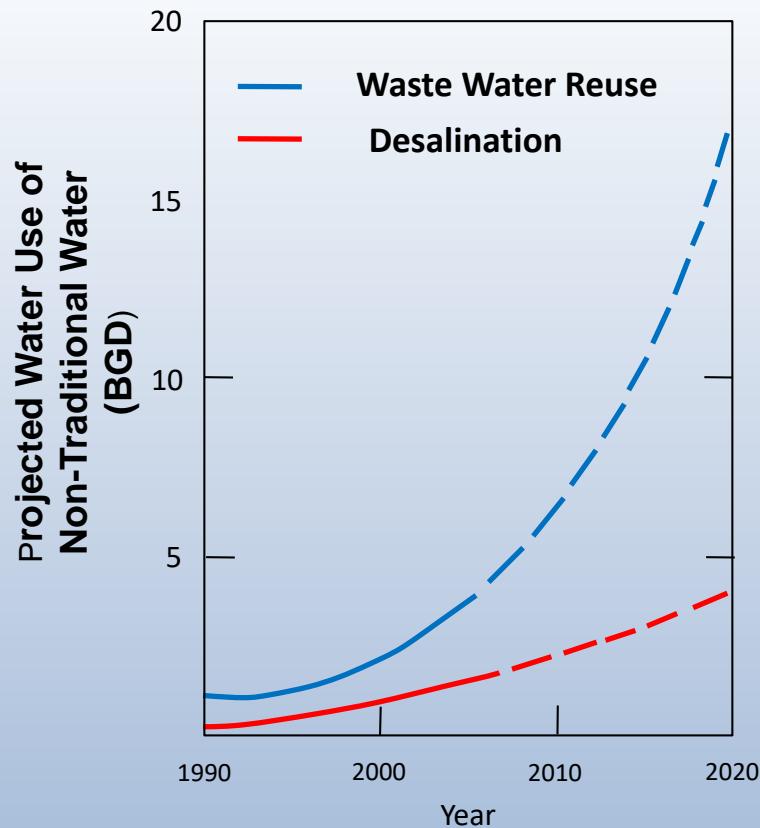
Energy Is Needed In Every Element of the Water Sector



Energy Demand Varies Based On Element and Site Specific Conditions



Growing Demand for Non-Traditional Water Resources



- Desal increasing ~ 10% per year; Waste water reuse ~ 15% per year
AND Accelerating!!

Conservation/Efficiency is Critical --- AND Cheap!

Global Use of Desalination and Water Reuse

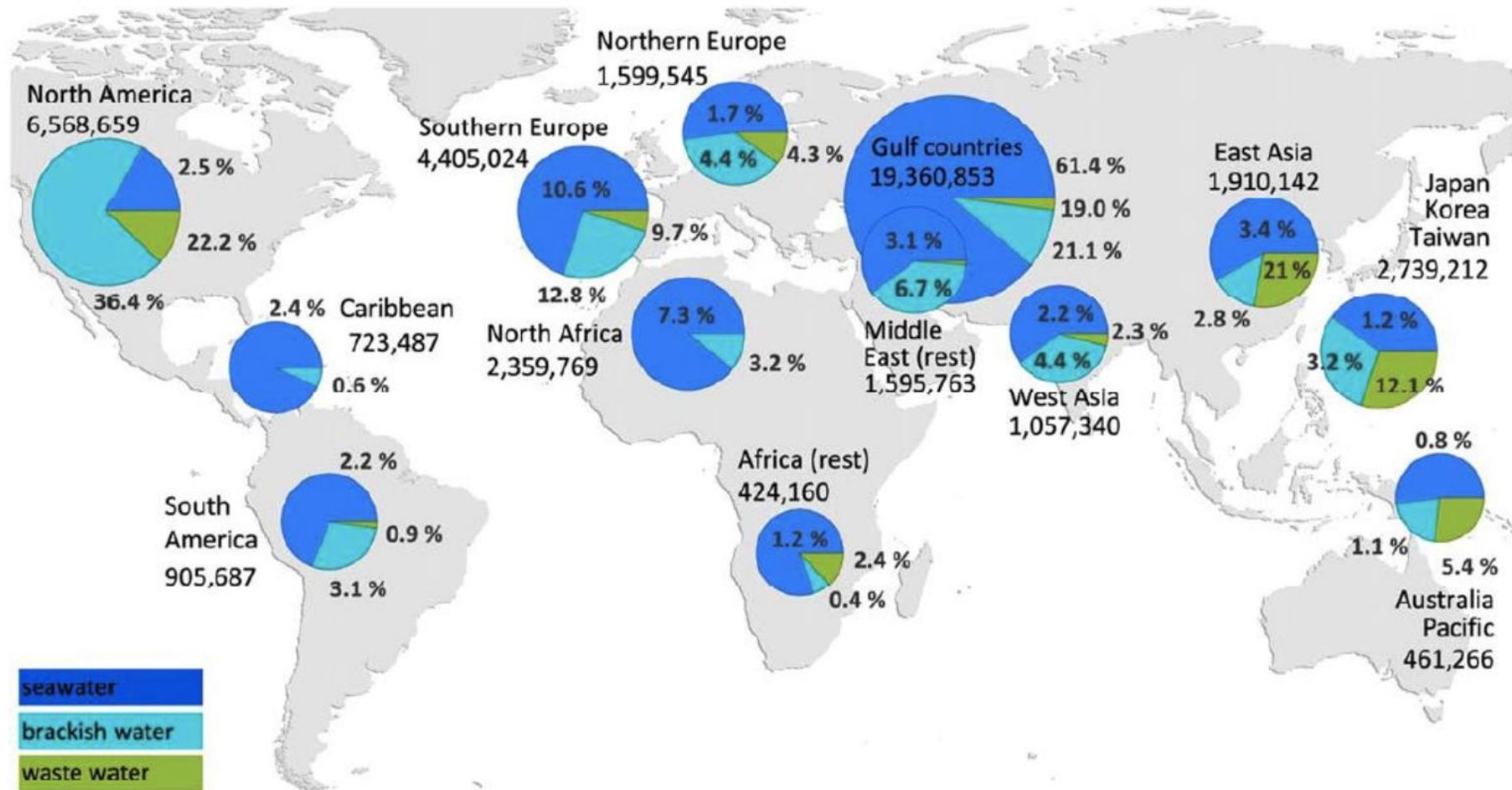
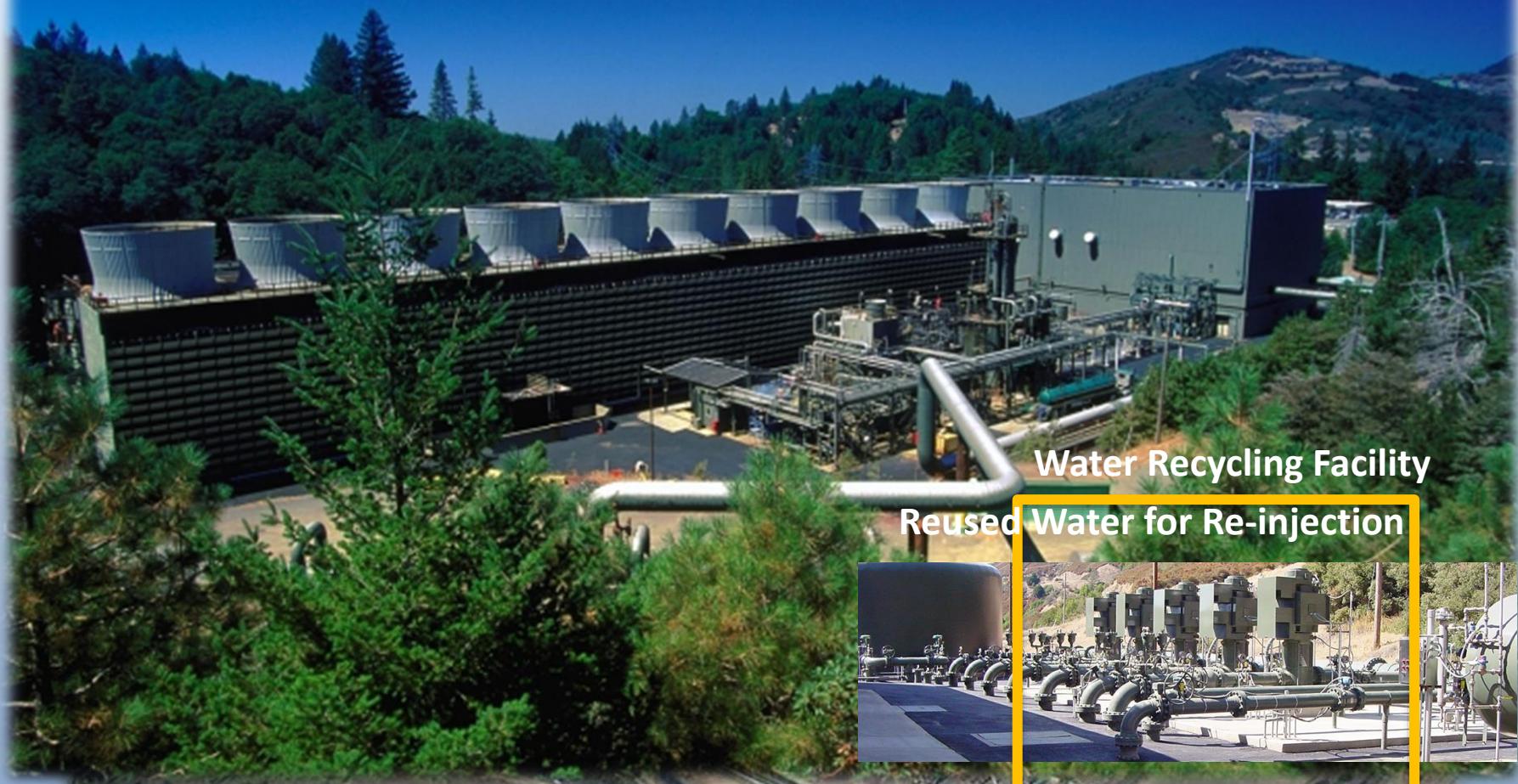


Fig. 3. Global distribution of desalination capacities worldwide (Lattemann et al., 2010).

Reused Water – Increasing in Value

“Driving Our Energy Future”

The Geysers (900 MW)
22 K ac ft Annually (~ 27 M m³)



Hydraulic Fracturing – Transformative and Water Intensive

Driving A Global LNG Natural Gas Market

300 000 Fractured Wells Drilled Since 2000 In USA



Hydraulic Fracturing Is Not New
BUT Horizontal Drilling With “Fracing” IS!

Hydraulic Fracturing – Transformative and Water Intensive

Water Management Is A Significant Challenge!!



Three Main Water Types

Flowback and

Produced Water

What are the possible impacts of surface spills on or near well pads of

flowback and produced water on drinking water resources?

- **Fracturing Fluid – Largely Freshwater: Nominal 2 to 5**

Million Gallons ($\sim 7\text{ K to }19\text{ K m}^3$) Per Well

Wastewater Treatment

and/or Reuse

What are the possible impacts of inadequate treatment of hydraulic

fracturing wastewater, including untreated

- **Flowback Water – Largely Drilling/Fracturing Fluid and Some Formation Water Mixed With Oil and Gas –**

• **Waste Water Treatment Strategies and Disposal That May**

• **Very Short Life of Well**

Largely In Situ Formation Water ($\sim 90\%$)

• **Water Reuse is Still an Intended Option – But NOT**

Fully Viable Yet

Creando Un Mundo Más Sostenible



Con Amigos Que Sostienen En Familia

Creando Un Mundo Más Sostenible



Ven A Rodar Con Nosotros!