



The Water-Energy Nexus: Planning for a Sustainable Future

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The Water-Energy Nexus: Planning for a Sustainable Future

- **A Quick Outline:**
 - The Water Environment Federation: **Driving Innovation**
 - **Water and Energy Nexus**
 - Water and energy interconnection and interdependence
 - Water use in energy production
 - Energy use in water systems:
 - **Challenges facing the water-energy nexus**
 - **Concluding remarks**



Water Environment Federation: Programs and Initiatives



Water Environment Federation

- Founded in 1928 as a “not-for-profit” technical and educational organization for water professionals
 - Water Environment Federation (WEF)
 - Water Environment Research Foundation (WERF)
- Membership: 36,000 members in 75 MA’s in the US and around the globe.





**We are the
“water quality people”**



Driving Innovation

LIFT

Leaders Innovation Forum for Technology

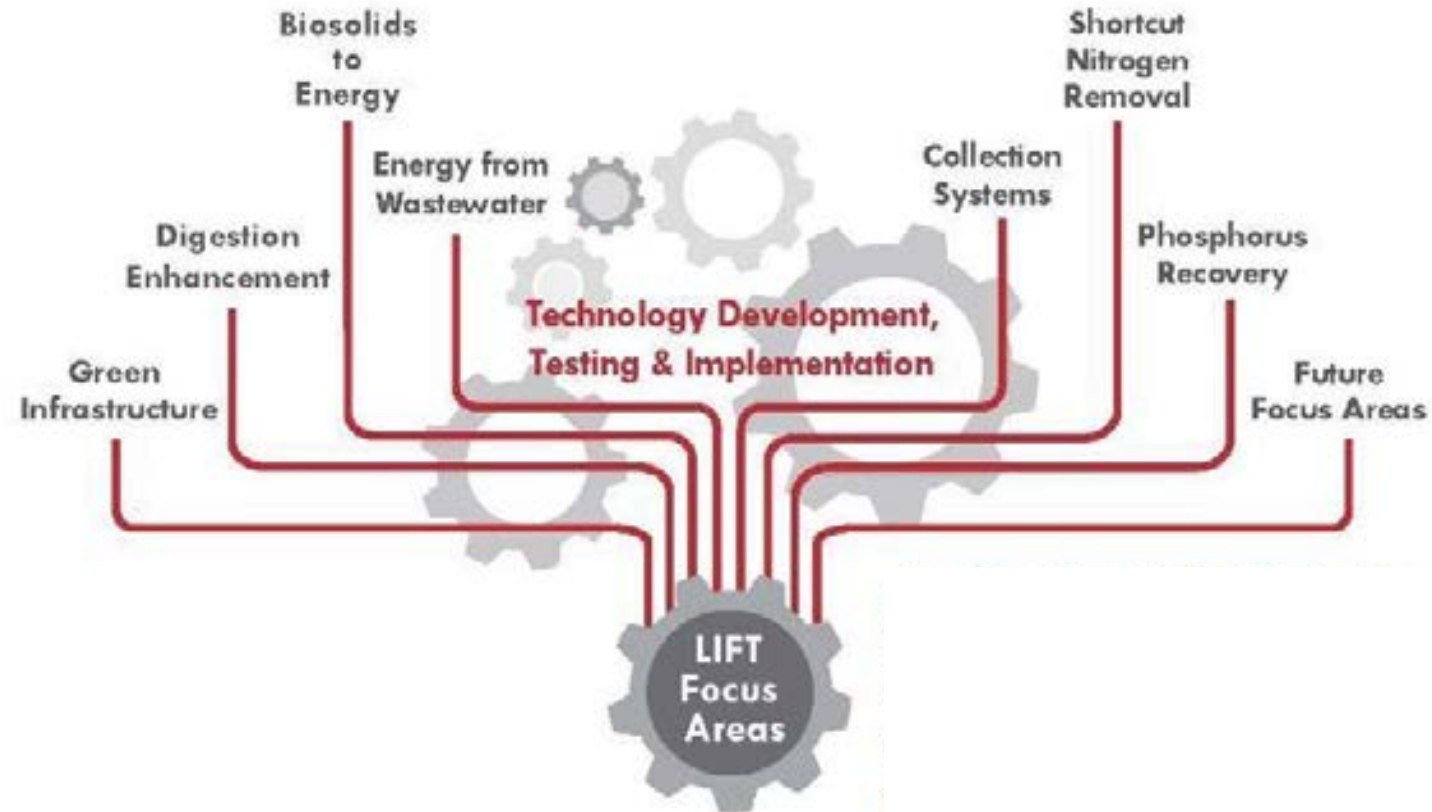
A WEF/WERF
initiative to
accelerate
innovation
into practice



Driving Innovation

LIFT

Leaders Innovation Forum for Technology



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LIFT

Leaders Innovation Forum for Technology

WEF LIFT Focus Areas:

- **Water and Energy**
- **Nutrient Management**
- **Infrastructure Resilience to Climate Change**
- **Water Conservation and Reuse**
- **Stormwater Management**

Driving Innovation

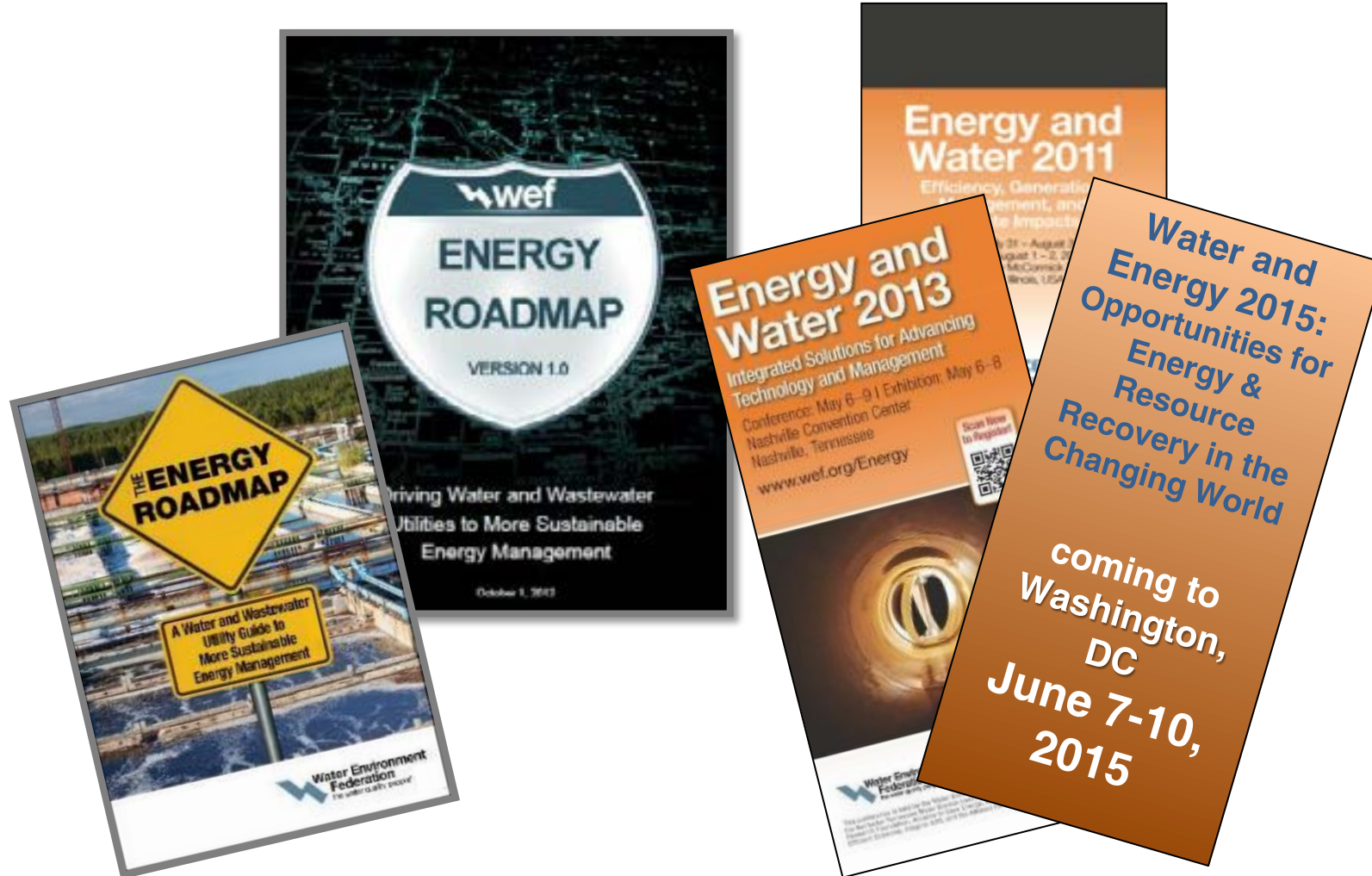
Resource and Energy Recovery

*WEF believes that wastewater treatment plants are **NOT** waste disposal facilities, but rather water resource and energy recovery facilities that produce clean water, **recover nutrients**, and reduce dependence upon fossil fuels through the production and use of **renewable energy**.*



Driving Innovation

Resources and Energy Recovery




Driving Innovation

Nutrient Resource Recovery

2013 Conference Program

WEF/IWA
Nutrient Removal and Recovery
Trends in Resource Recovery and Use

Conference: July 28 – 31 | Exhibition: July 29 – 30
Sheraton Vancouver Wall Centre Hotel
Vancouver, British Columbia, Canada



Water Environment Federation
the water quality people®

IWA
INTERNATIONAL WATER ASSOCIATION


BCWWA
BRITISH COLUMBIA WATER AND WASTE ASSOCIATION

WERF
WATER ENVIRONMENT RESEARCH FOUNDATION

This conference is organized jointly by the Water Environment Federation and the International Water Association and is held in cooperation with the British Columbia Water & Waste Association and the Water Environment Research Foundation.

Nutrient Recovery And Management
Inside and Outside the Fence

Conference: January 9–12 | Exhibition: January 10–11
Hilton Miami Downtown | Miami, Florida, USA



2011

Water Environment Federation
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INTERNATIONAL WATER ASSOCIATION

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Conference Program

Driving Innovation






weftec[®] 2014

the water quality event[™]

New Orleans, Louisiana

- 
- 20,385 attended
 - 1,027 companies exhibited
 - 303,075 total net square feet used

INNOVATE

SEPTEMBER 2014



LIFT

WE&T
water engineering and technology

world
water
the water quality people

The Water-Energy Nexus



The Water-Energy Nexus!

- Nexus: A relationship or connection between people and things. (Webster's Dictionary)
- **The Water-Energy Nexus:** *Water and energy are interdependent resources, each with a cost to the other. Energy production has impacts on water resources and water quality. Likewise, the production, distribution, collection, and treatment of water/wastewater consume a great deal of energy.*
- Understanding the water-energy nexus then requires an understanding of the many connections and interactions between the two vital natural resources.
- So how are Water and Energy connected?

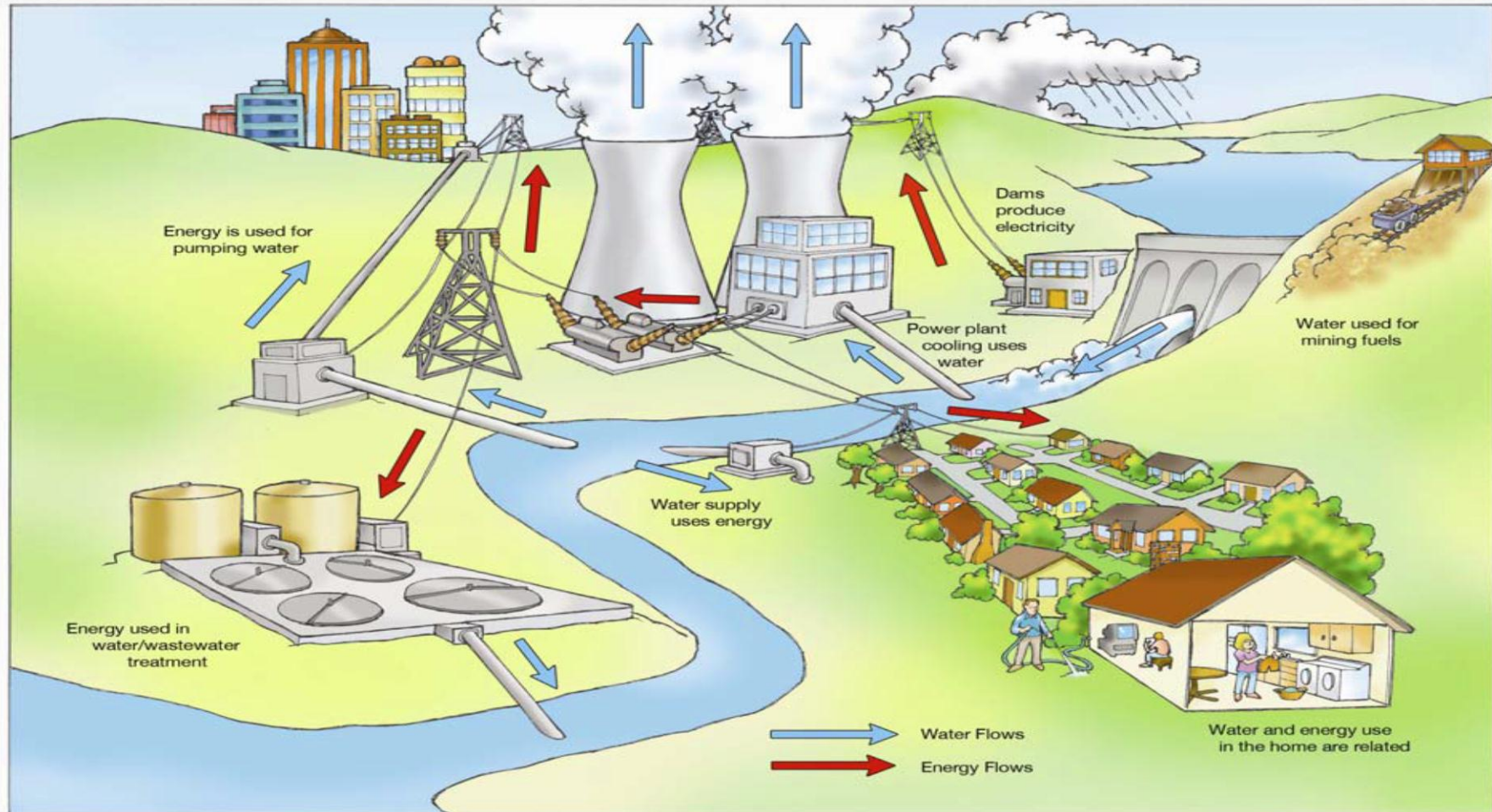


Water Use in Energy Production

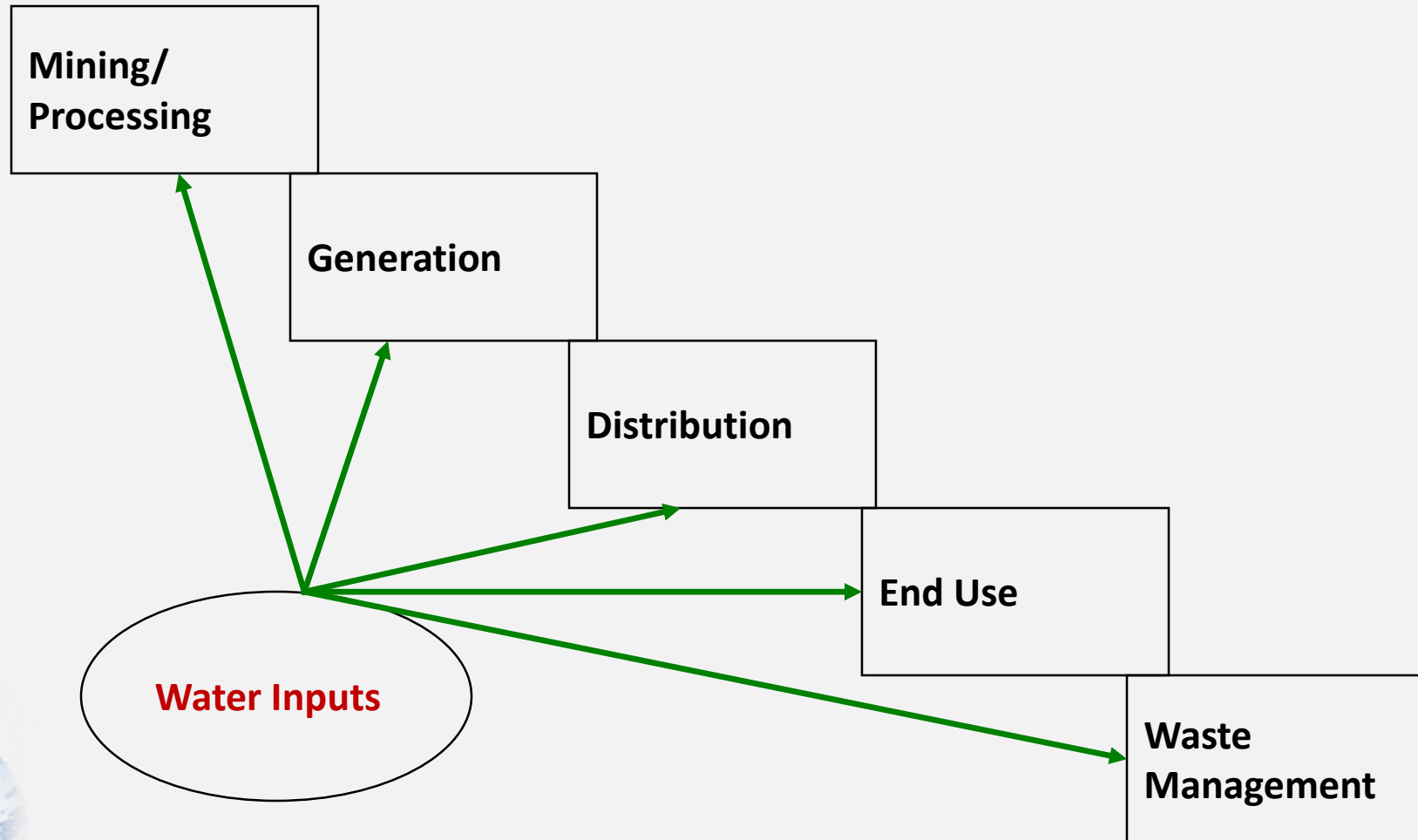
- Hydroelectric power production
- Mining, extraction, and processing of fuels
- Transportation, storage and handling
- Thermoelectric systems (steam generation and cooling demands)
- Environmental control systems
- Etc.



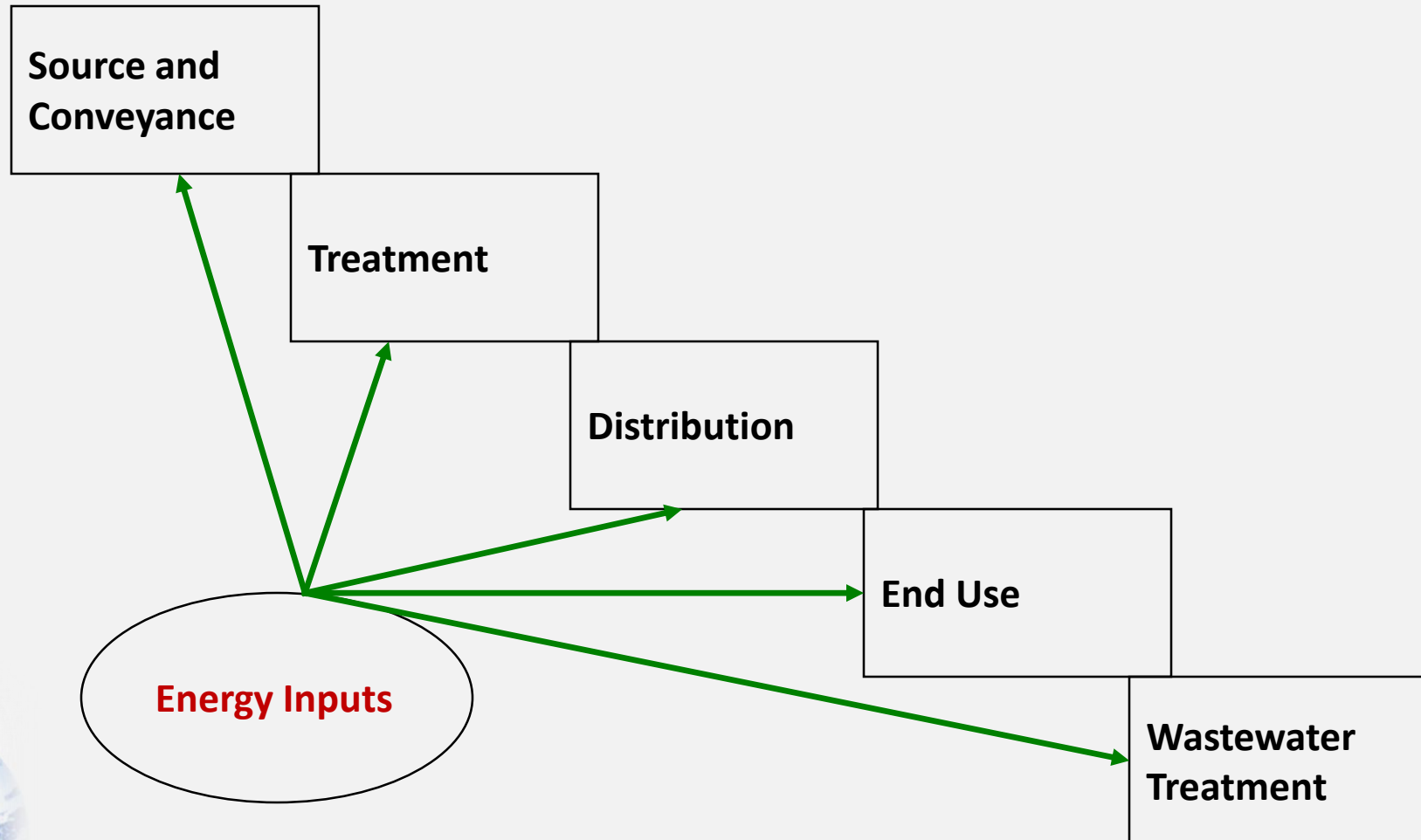
How Are Water and Energy Connected?



Energy Systems Require Water

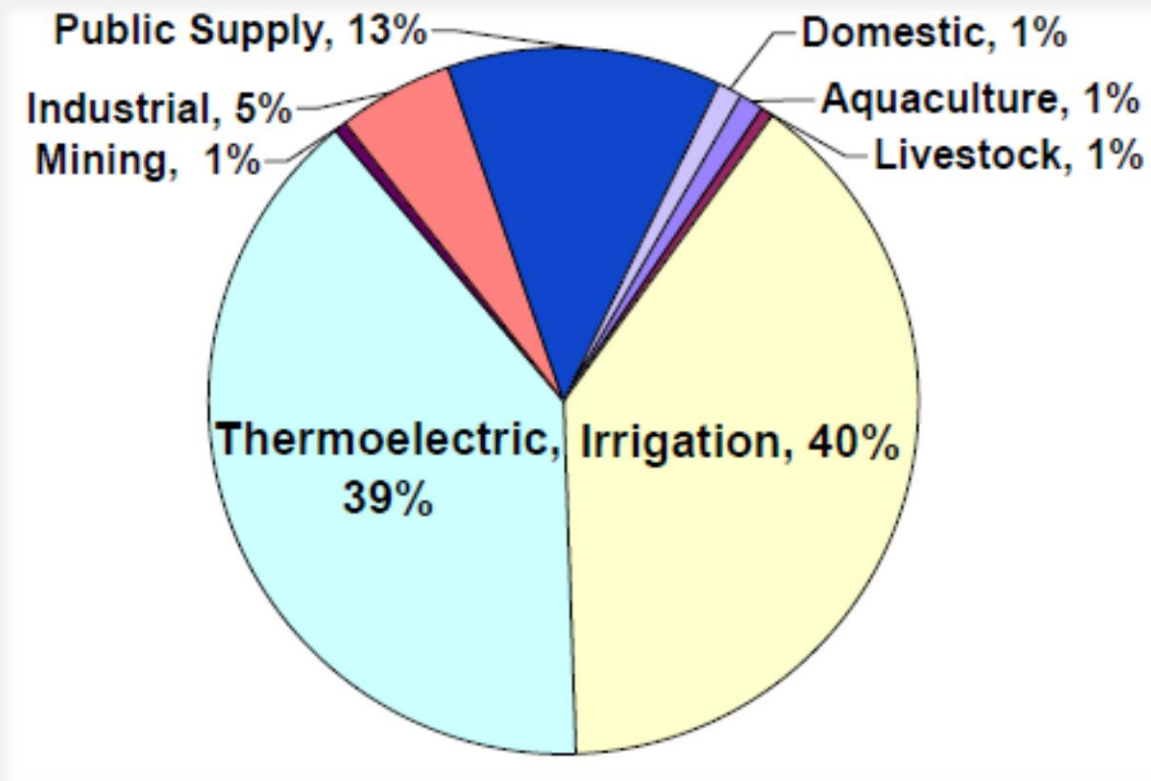


Water Systems Require Energy



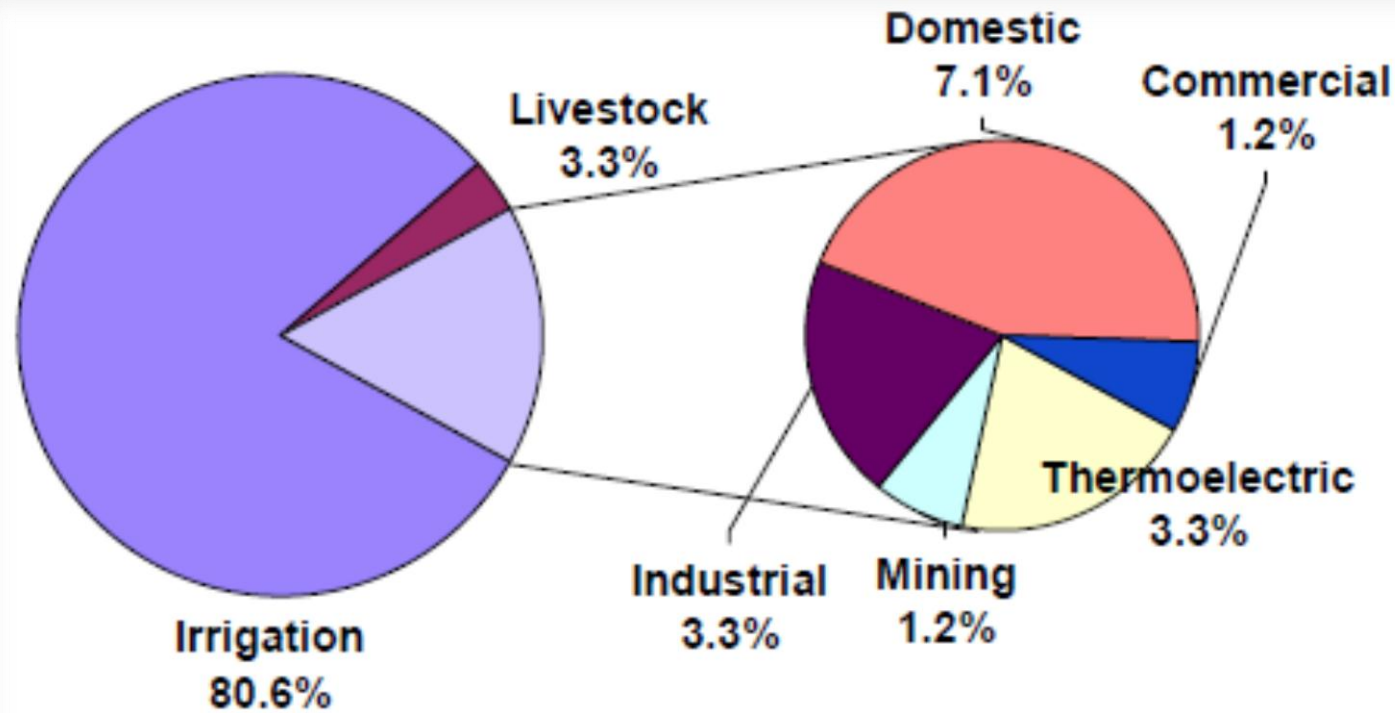
Water **Use** and Consumption in the U.S.

Total Water Use = 1.3 b m³/d (2005)



Water Use and Consumption in the U.S.

Total Water Consumption = 390 m³/d (1995)

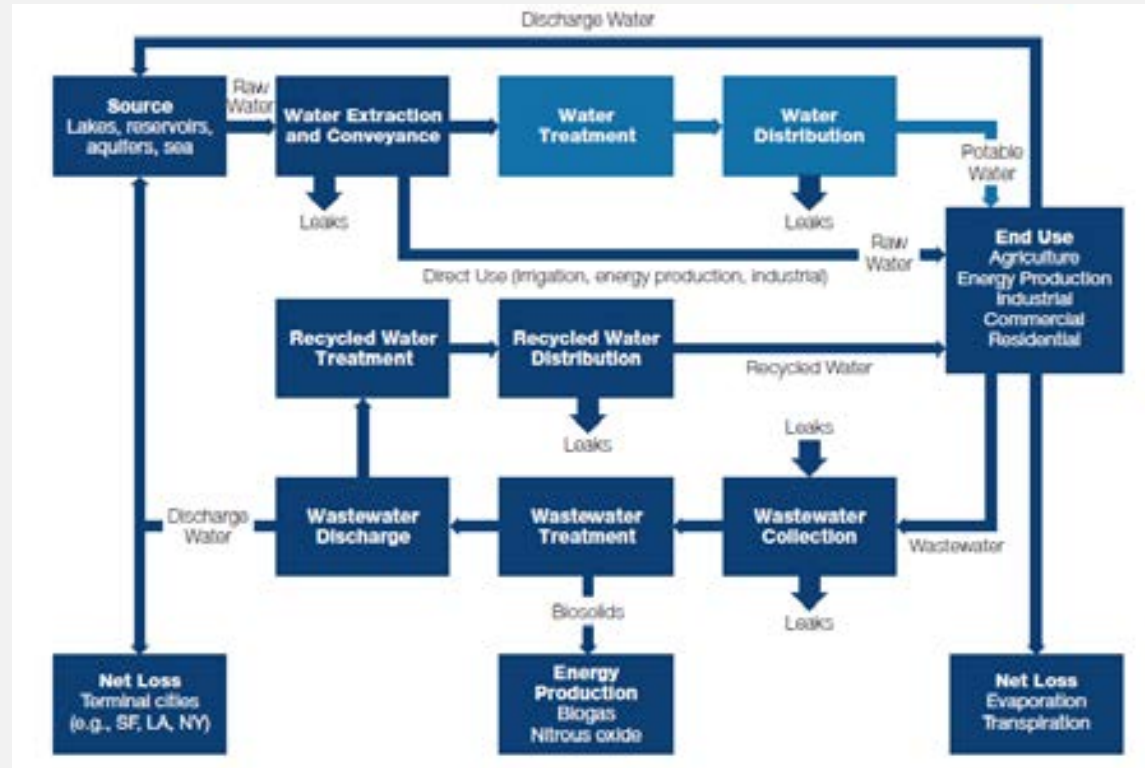


Energy Uses in Water Systems

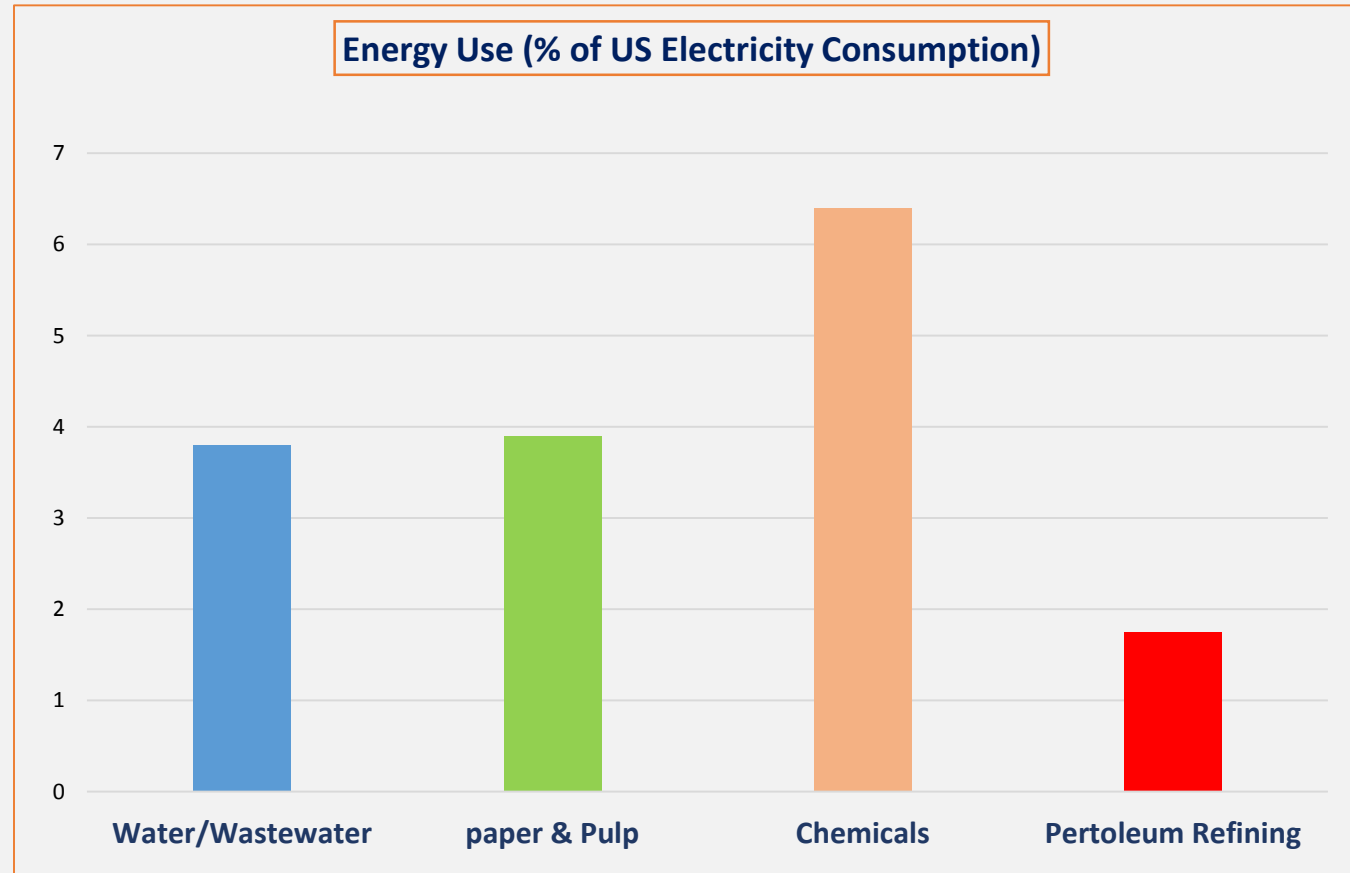
- Water resources development, extraction and conveyance
- Agriculture and food production
- Industrial and commercial sectors
- Water treatment and distribution
- Wastewater collection, pumping, treatment and recycling
- Other uses!



Energy Uses in Water and Wastewater Treatment



Energy Uses in Water and Wastewater Treatment



Electric Power Use in CA, GWh

Segment of the water use cycle	CEC 2005	CEC 2006	Other Studies
Supply	10,742	10,371	10,786
Conveyance			
Water Treatment			312
Water Distribution			1,000
Wastewater Treatment	2,012	2,012	2,012
Total Water Sector Electricity Use	12,754	10,382	18,282
% of Total Statewide Electricity Requirements	5.1 %	4.9 %	7.7 %

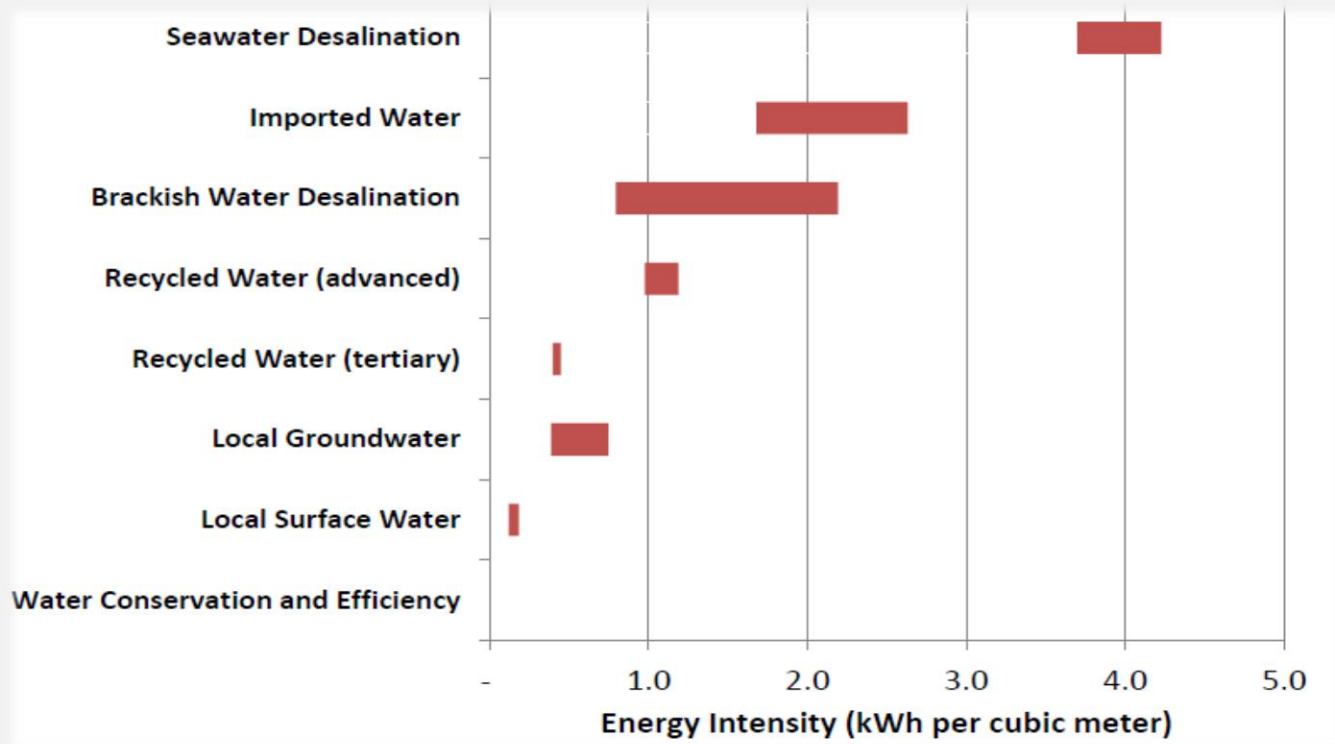


Energy Use for Different Water Supplies in CA

Functional Component	Primary Energy Drivers	Energy Use (Prior Studies)	Observed Energy Use (kWh/m ³)		
			Northern California	Southern California	State-wide
Surface Water	Pumping		0.040 – 0.320		0.040 – 0.320
Groundwater	Pumping	0.142 – 0.600	0.450 – 0.770	0.375 – 0.675	0.240 – 0.770
Brackish Desalination	Treatment	0.328 – 1.380		0.375 – 0.480	0.375 – 0.480
Recycled Water	Treatment	0.080 – 0.317	0.280 – 0.575	0.300 – 0.900	0.280 – 0.900
Seawater Desalination	RO	3.646			3.646



Energy Uses in Water Supply and Conveyance



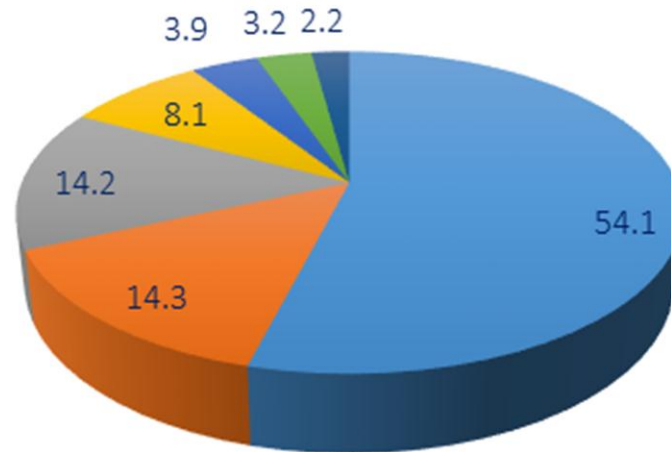
Energy Uses in Wastewater Treatment

Treatment Plant Capacity (m ³ /d)	Unit Electricity Consumption (kWh/m ³)			
	Trickling Filters	Activated Sludge	Advanced WW Treatment	Adv. WW Treatment w/ Nitrification
4,000	0.479	0.591	0.686	0.780
20,000	0.258	0.362	0.416	0.509
38,000	0.225	0.318	0.372	0.473
76,000	0.198	0.294	0.344	0.443
190,000	0.182	0.278	0.321	0.423
380,000	0.177	0.272	0.314	0.414



Energy Use in Wastewater Treatment Systems

Typical Energy Use at A.S. Plants



- Aeration
- Anaerobic Digestion
- Sludge Dewatering
- Other Uses
- Wastewater Pumping
- Lights & Building
- Clarifiers

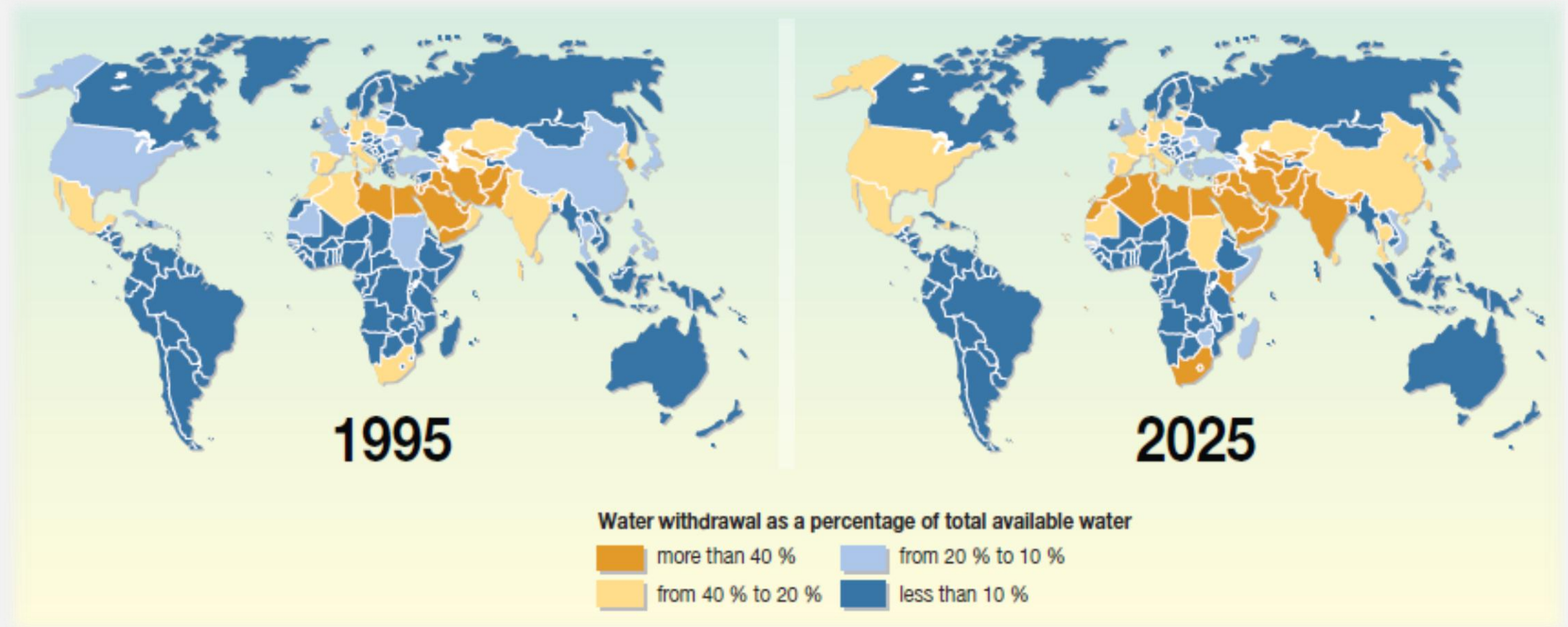


Challenges Facing the Global Energy-Water Nexus

- Limited understanding of the energy-water nexus (interactions, interconnections and dependencies) by policy/decision makers
- Impending drastic changes in the availability of water and energy resources world-wide
- Global climate change and implications for both water and energy resources
- Lack of incorporation of the energy-water nexus issues in economic and socioeconomic policies – nearly everywhere

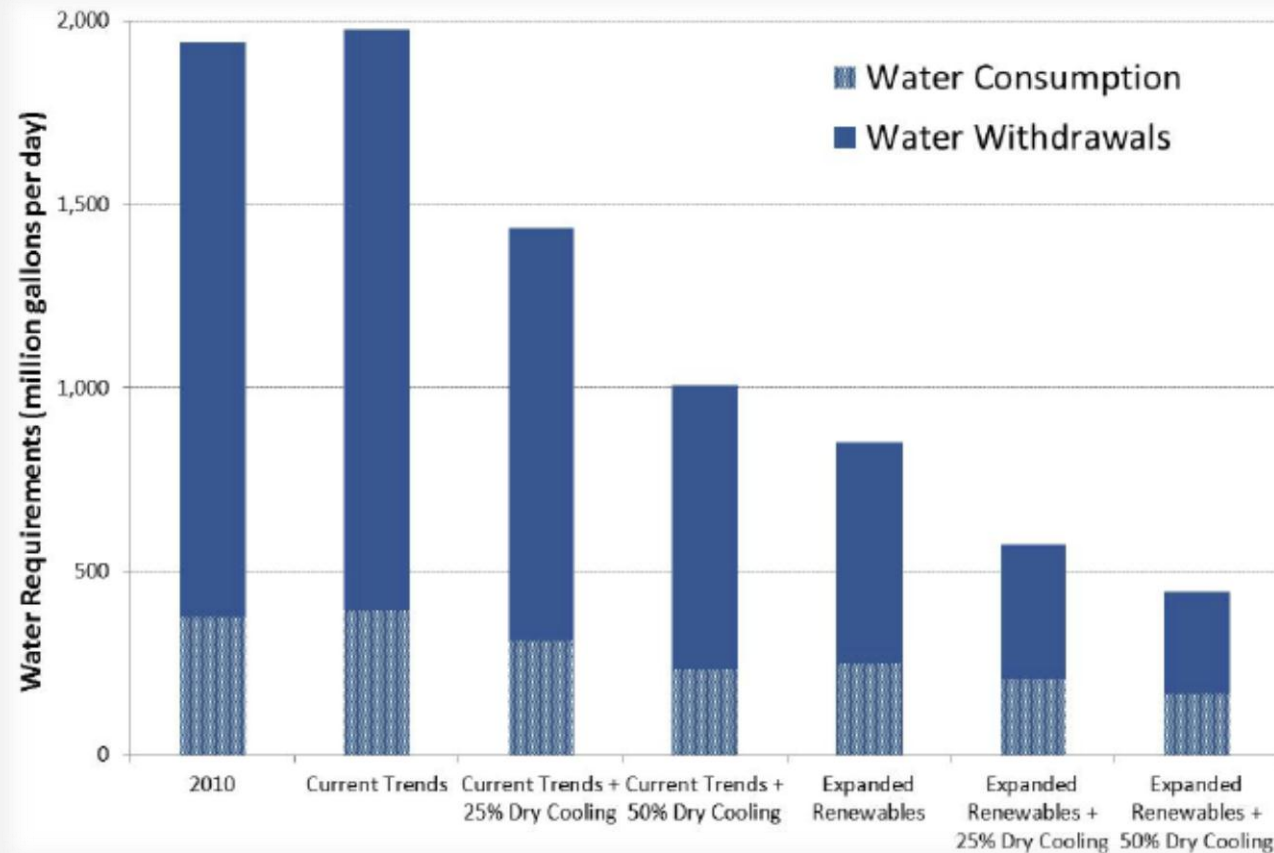


Global Water Withdrawals (1995-2025)



Source: UN Environmental Program

Water Use Choices in Energy Production



Energy-Water Nexus: Choices for Sustainable Future

- Water use and energy use are closely linked and interdependent.
- Sustainable water and energy use requires integrated planning and management.
- Under "business-as-usual" approach, water/energy resources challenges are likely to intensify world-wide.
- Climate change will have possibly severe implications for water and energy resources thus requiring new approaches for adaptability.
- Energy-water management will require continuous adoption of energy-efficiency improvements including cooling systems and use of renewable energy sources.



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Thank You for Listening

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