



Seawater Desalination: Arizona's Next Bucket?

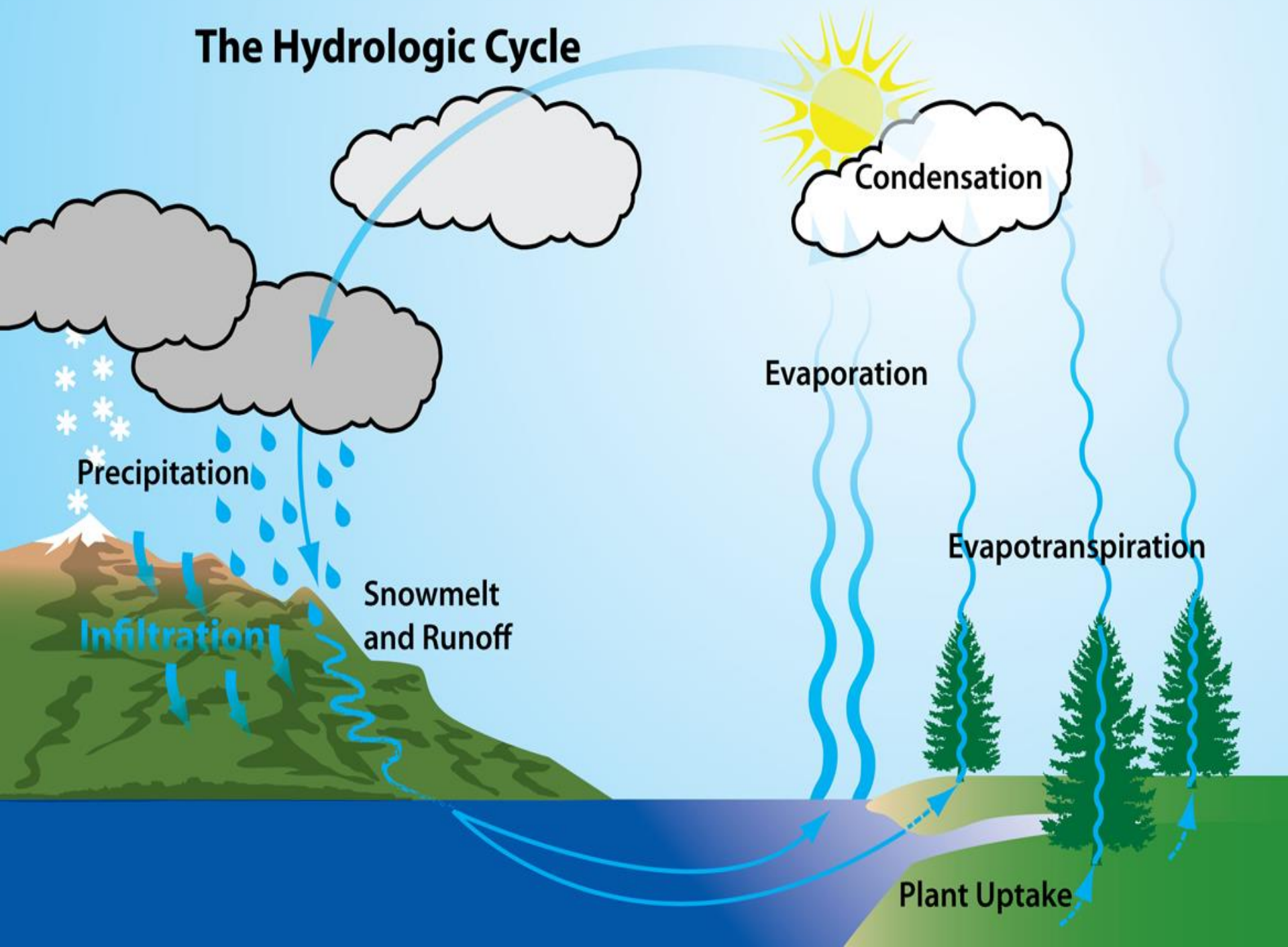
MARC CAMPBELL
OCTOBER 29, 2015

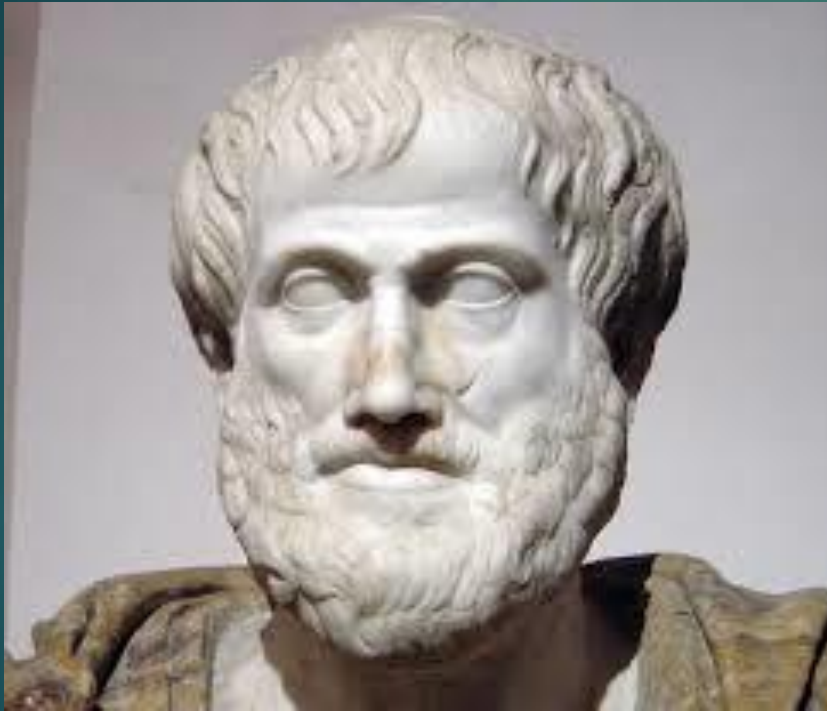


“If we could produce fresh water from salt water at a low cost, that would indeed be a great service to humanity, and would dwarf any other scientific accomplishment.”

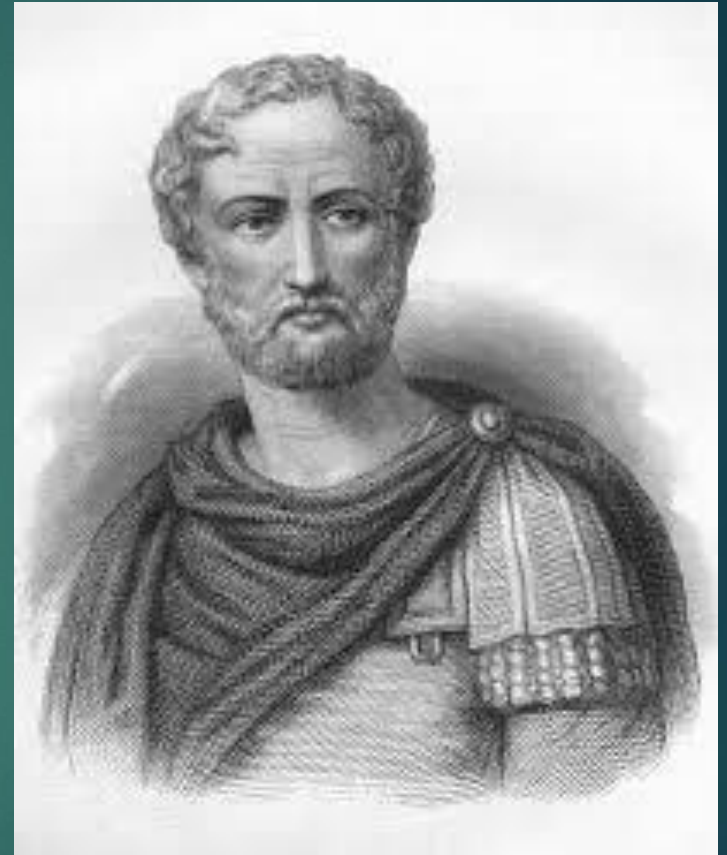
President John F. Kennedy,
1962

The Hydrologic Cycle





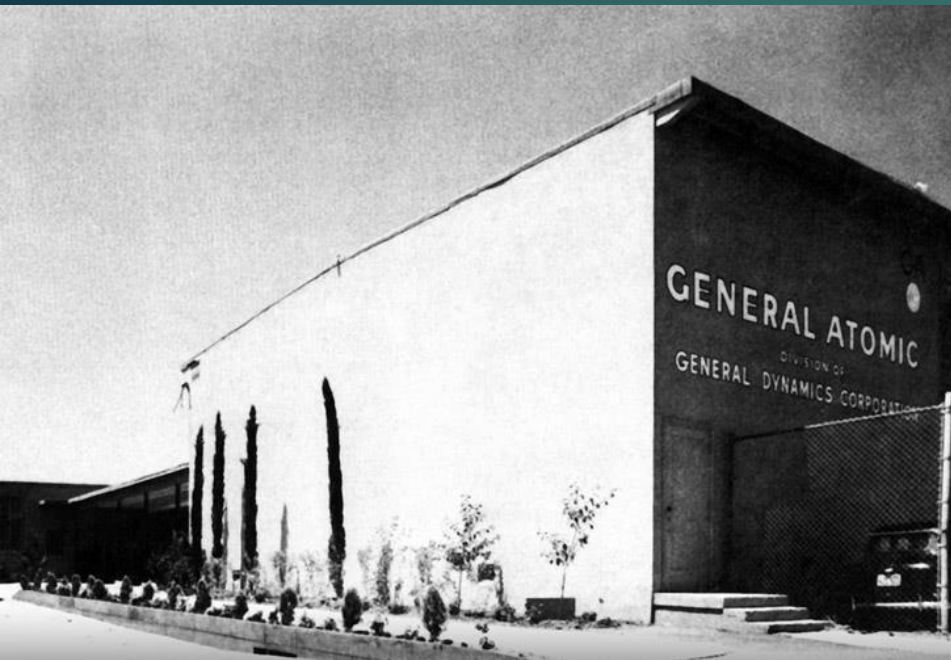
Aristotle



Pliny the Elder

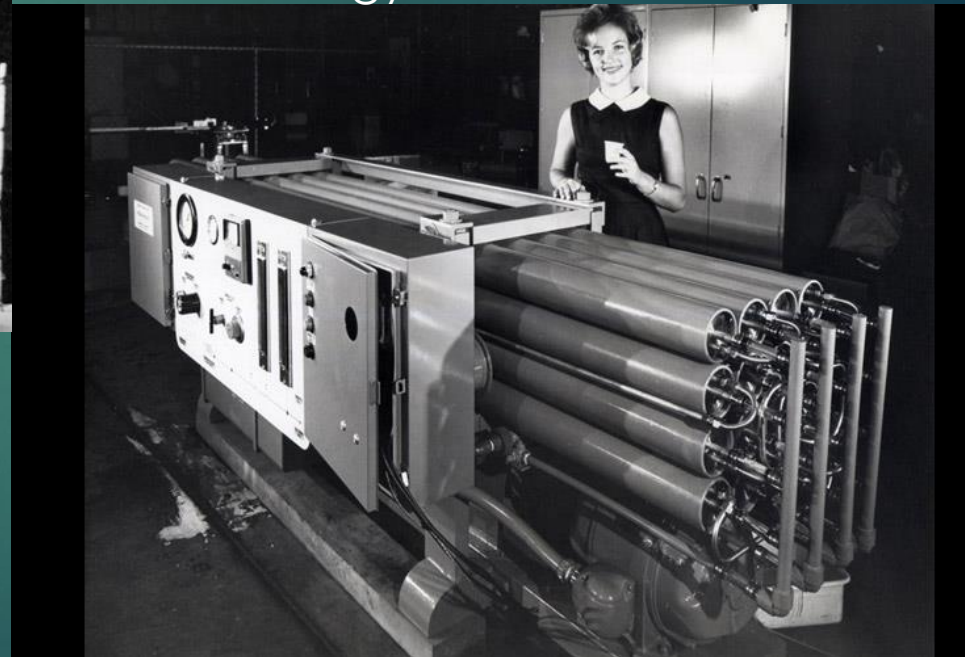
Modern Advance of Desalination

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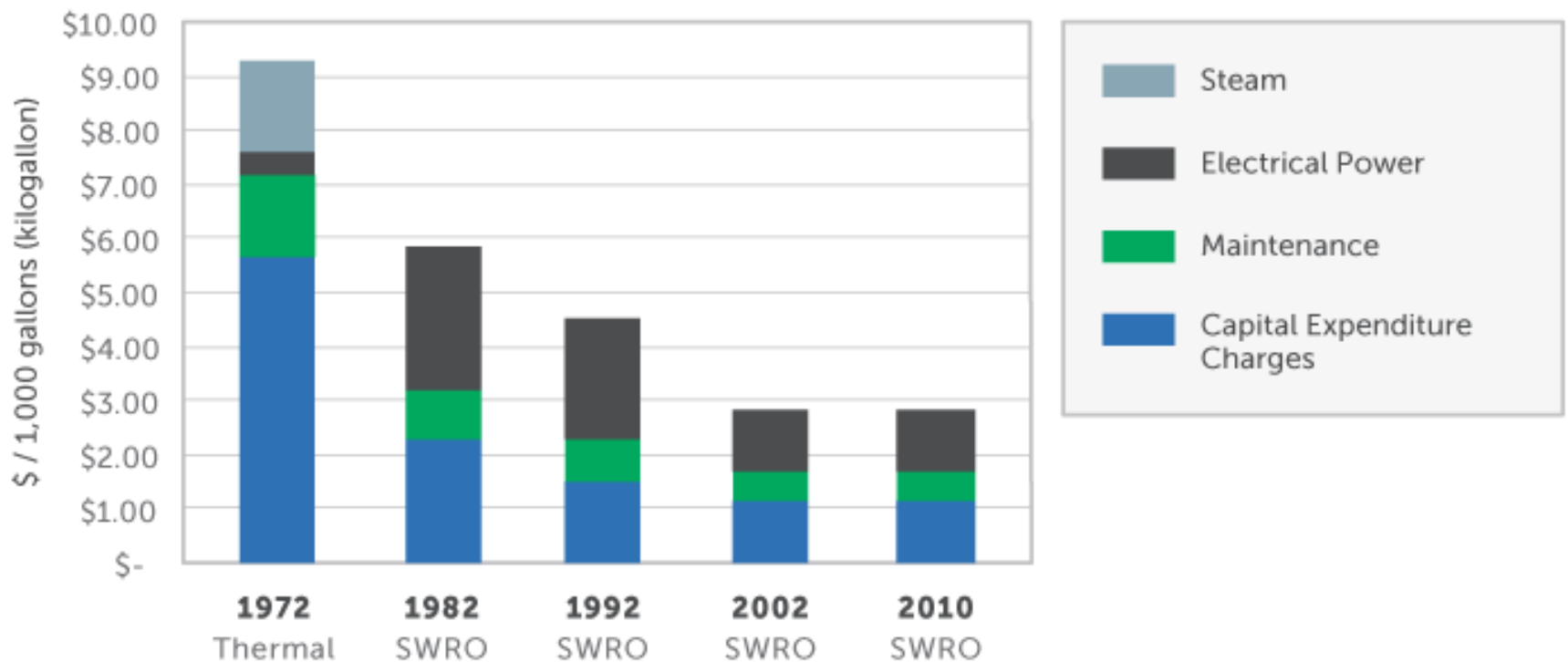
July 1955—General Dynamics creates their General Atomic Division for research and development in the peaceful use of atomic energy.

May 1962—The Department of the Interior's Office of Saline Water sponsors research at GA on reverse osmosis for saline water conversion.



Declining Cost of Desalination

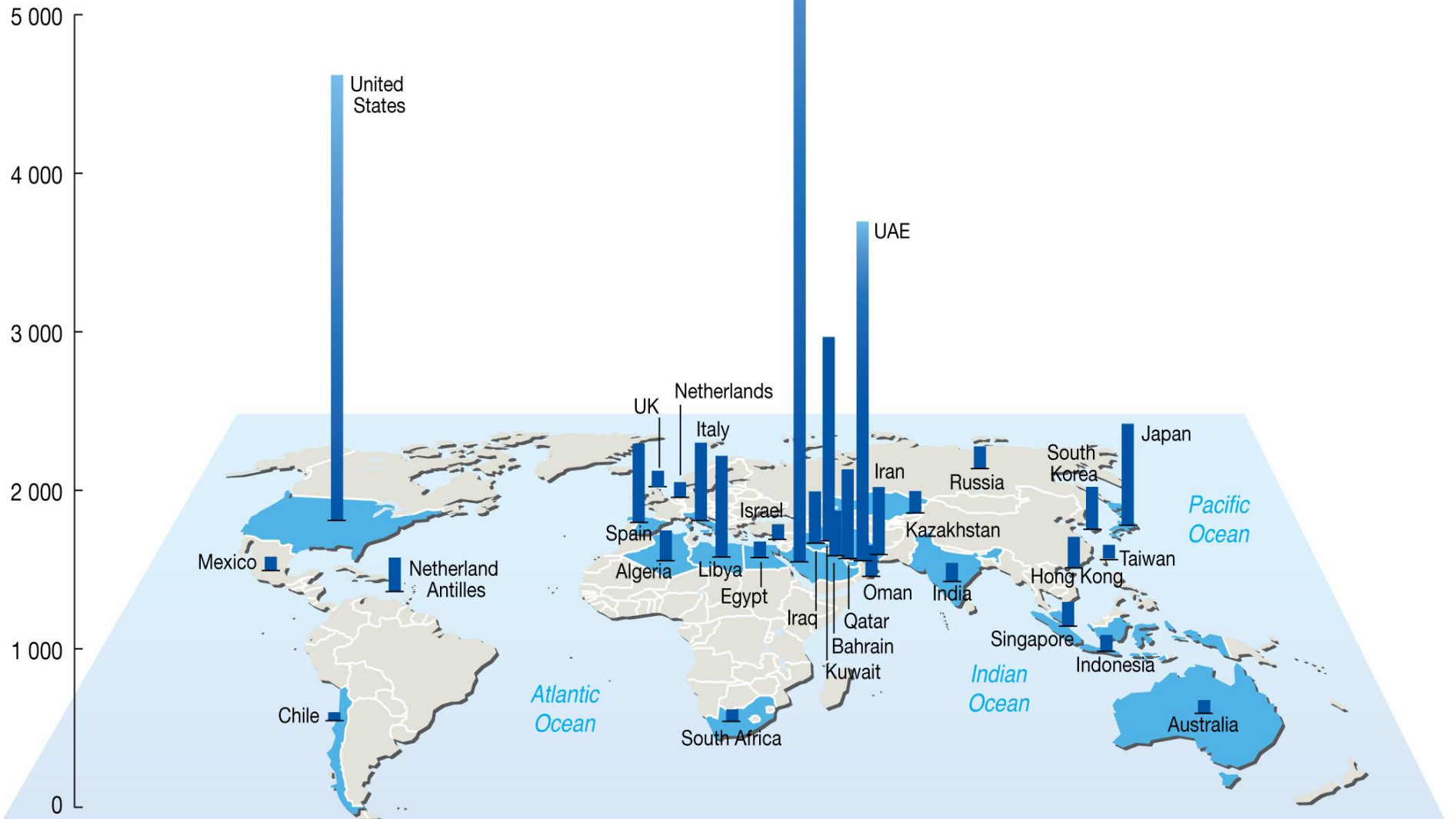
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Water desalination

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.

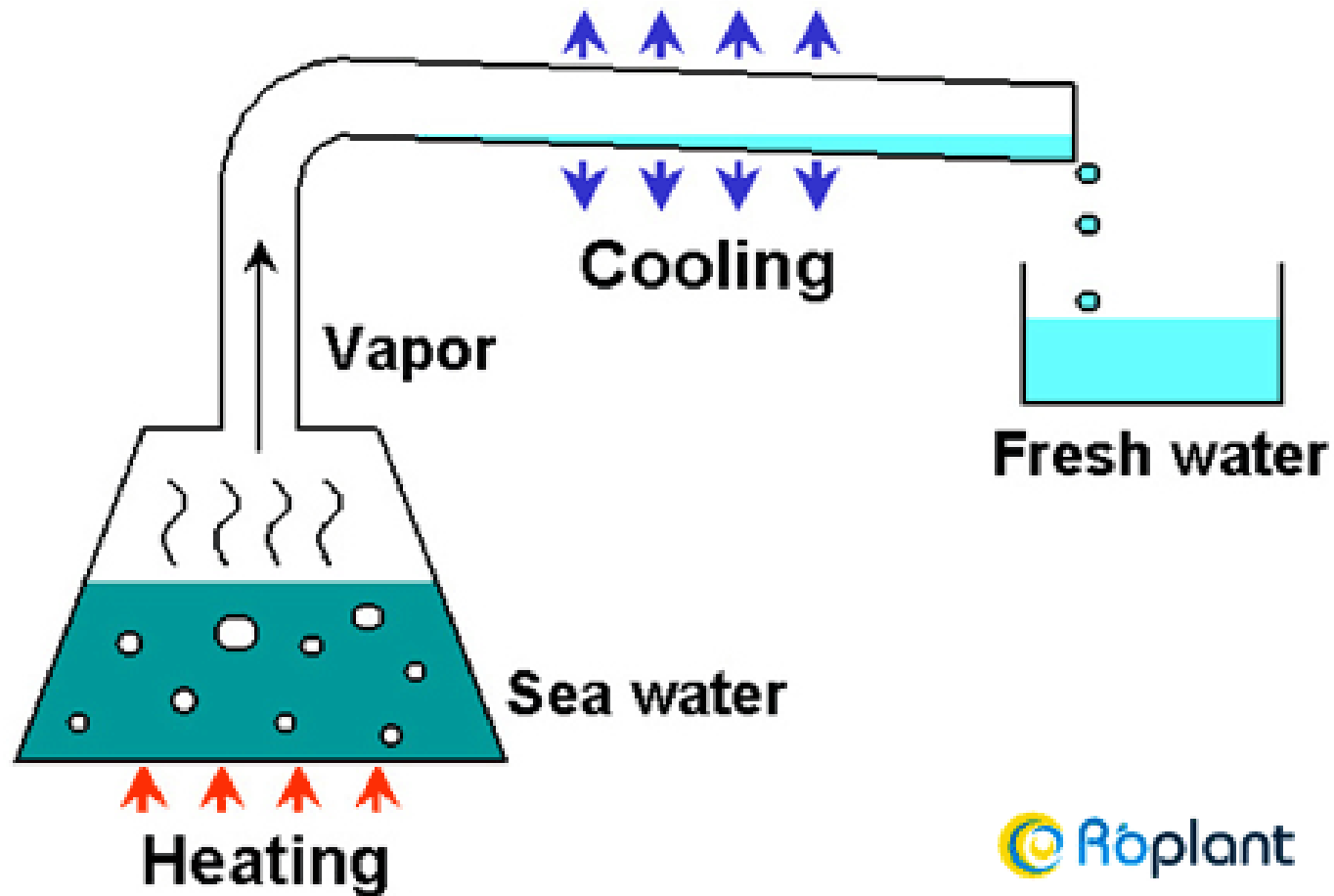
U.S. Desalination

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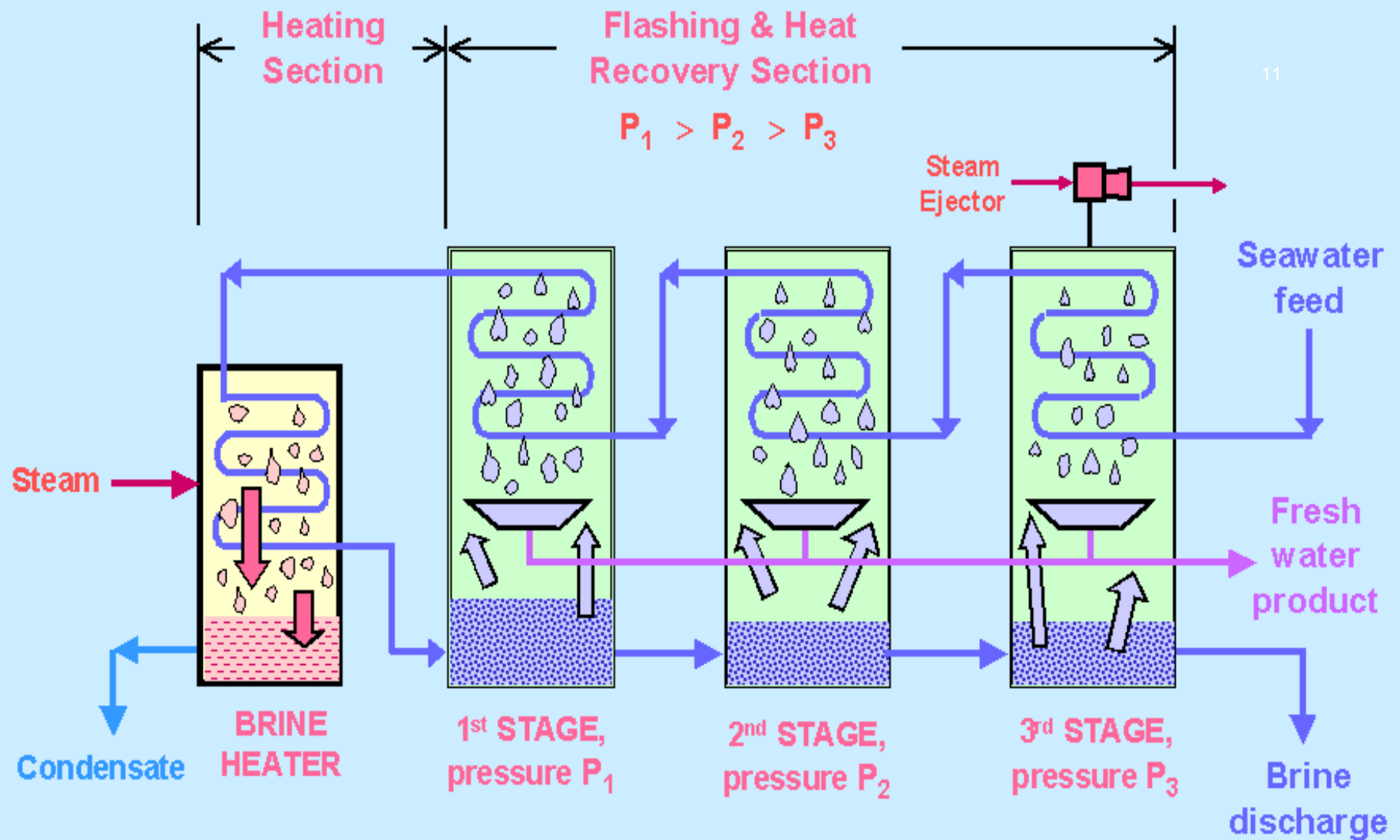


Predominant Desalination Processes

- ▶ Thermal Distillation
 - Multi-effect distillation and multi-stage flash evaporation
 - Vapor Compression
- ▶ Membrane
 - Reverse Osmosis



<Thermal Desalination Principle>

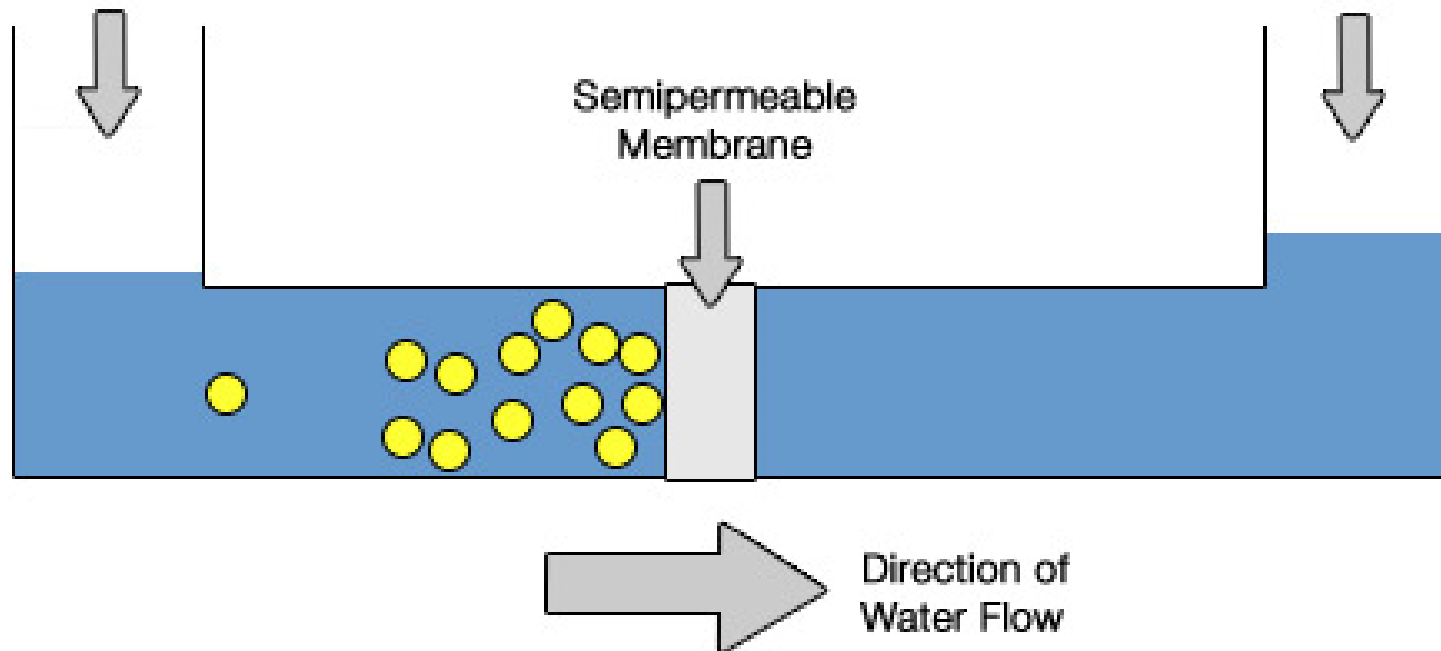


MULTI-STAGE FLASH DISTILLATION (MSF)

Reverse Osmosis

Applied Pressure

Pure Water



Emerging Technologies

- ▶ Forward Osmosis
- ▶ Semi-batch Reverse Osmosis
- ▶ Solar Desalination
- ▶ Flow-through Electrode Capacitive Desalination
- ▶ Membrane Solutions
 - Perforated Graphene
 - Bacteria Resistant

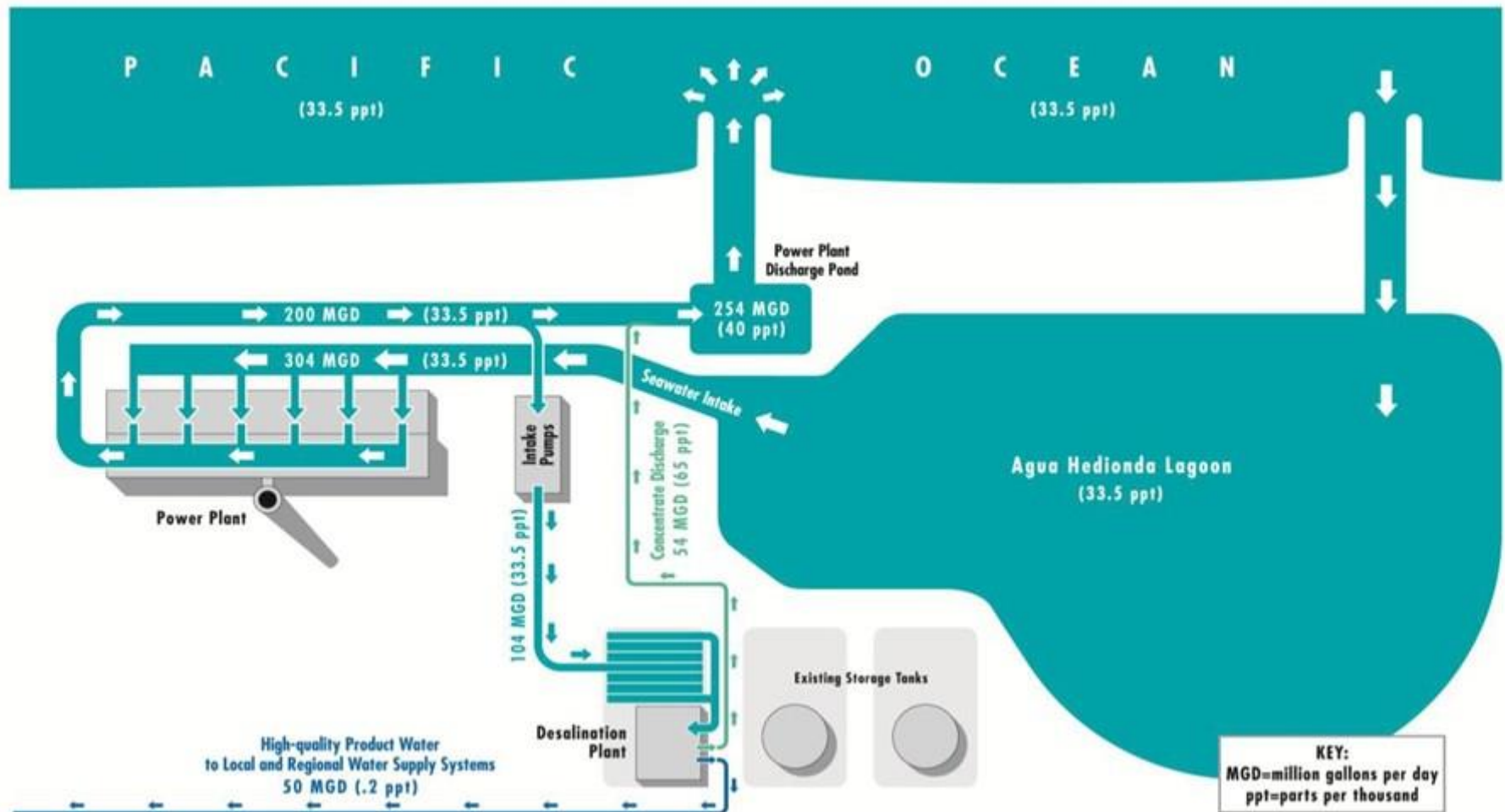
Carlsbad Plant

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Water Intake and Production

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Opportunities for Arizona

- ▶ Develop drought-proof water supply
- ▶ Continued economic development
- ▶ Regional partnerships

Arizona's Desalination Options

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- ▶ Partner with California
 - Invest in coastal desalination plants
 - Exchange supplies for CA Colorado River water
- ▶ Partner with Mexico
 - Invest in desalination plant on Sea of Cortez/Pacific Ocean
 - Exchange supplies for portion of Mexico's Colorado River water or Yuma/CA ag water
 - Develop direct delivery to southern Arizona



CalDesal

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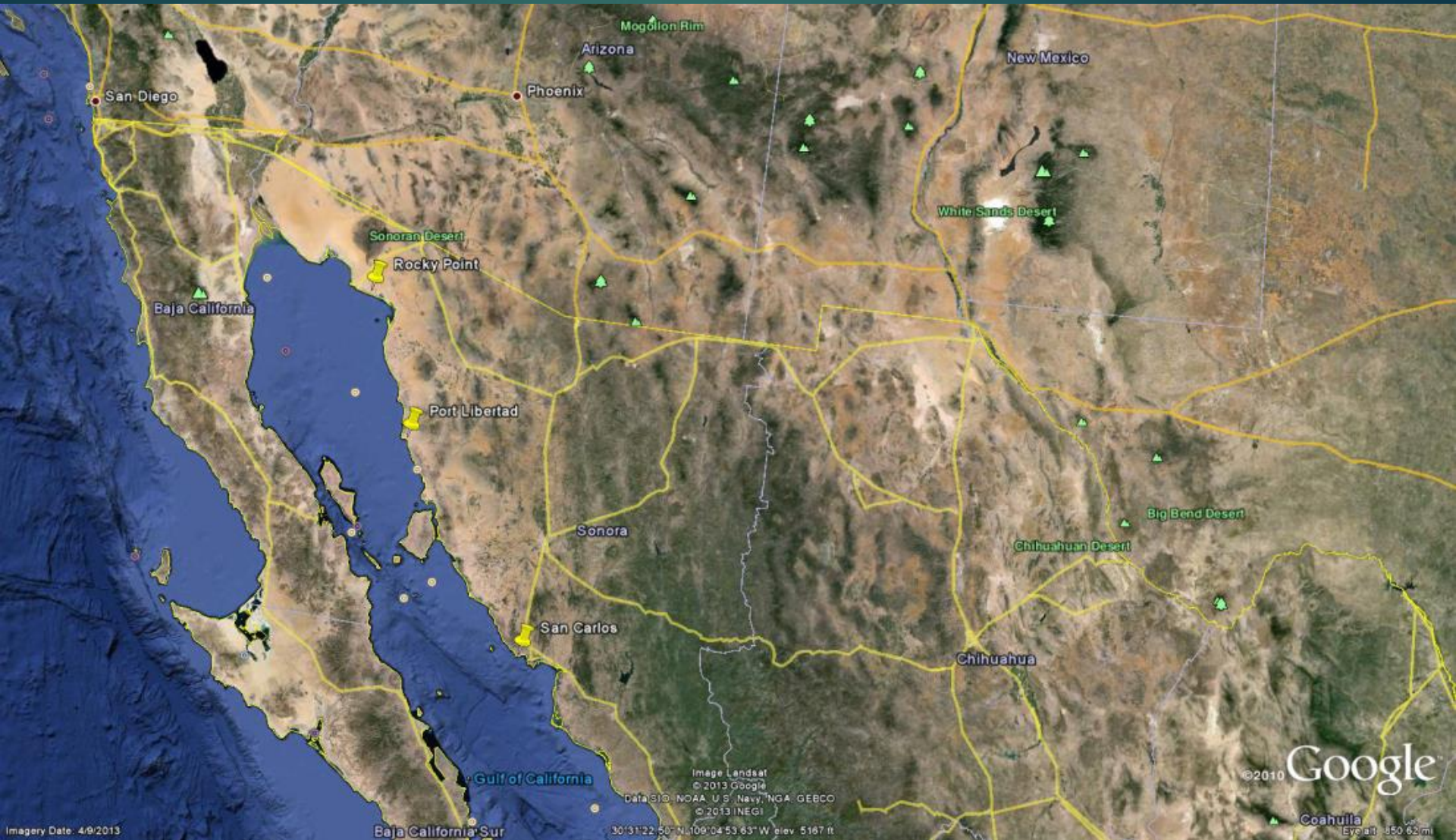
Alameda County Water
City of Oceanside
Delta Diablo Sanitation
Laguna Beach Water
Orange County Water
SDCWA
City of San Clemente
Moulton Niguel Water
Southern Nevada W.A.
Vallecitos Water
Zone 7 Water
AECOM
Avista Technologies
Carollo Engineers
DYK, Inc.
Malcolm Pirnie
Kiewit

California American Water
City of Santa Barbara
Eastern Municipal Water
Mesa Water District
Park Water Company
San Gabriel Co. Water
San Juan Capistrano
South Coast Water
Sweetwater Authority
Water Replenishment Dist
Acciona Agua Corp
AMTA
Bay Planning Coalition
CDM, Inc.
Energy Recovery, Inc.
HDR Engineering
Poseidon Water

California Domestic Water Co.
Contra Costa Water District
Irvine Ranch Water District
MWD
Municipal Dist. of Orange Co.
Santa Margarita Water District
Laguna Beach Co. Water
South Orange Co. Wastewater
Upper San Gabriel Valley
West Basin Municipal District
ACWA
American Membrane Technology
Black & Veatch
Dudek
ESA
IDE Americas
United Water

Binational Desalination

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Previous Studies

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- ▶ 6 studies in Sonora since 1999
 - From Puerto Peñasco to Guaymas
- ▶ 2 most recent occurred in 2008-2009, focused on Puerto Peñasco
 - Study for future municipal supplies
 - Funded by USTDA (\$369,000)
 - HDR conceptual study for Sonoran and Arizona
 - Funded by CAP and SRP



Puerto Peñasco HDR Study

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- ▶ Deliver water to Arizona through Imperial Dam
- ▶ Create opportunities for various Colorado River users
- ▶ 2 scenarios
 - AZ-Sonora
 - Regional (MX, AZ, CA, NV)
- ▶ 170 miles conveyance
- ▶ 180 elevation gain



Puerto Peñasco HDR Study

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Two scenarios and two alternatives for transmission:

1. AZ-Sonora (107 mgd)
 - ▶ 120,000 AF/Yr
 - ▶ 170 miles of pipeline (78-inch)
 - ▶ 4 pumping plants 6,000 hp
 - ▶ Energy requirements – 50MW
2. Regional (1,070 mgd)
 - ▶ 1.2 MAF/Yr
 - ▶ 143 miles of open canal
 - ▶ 25 miles of double pipeline (180-inch)
 - ▶ 5 pumping plants 15,000 hp
 - ▶ Energy requirements – 500MW

Where We Are Now

- ▶ Declaration of Cooperation between Sonora and AZ at Arizona-Mexico Commission Plenary June 2014
 - Cross-border investigation of desalination potential
- ▶ Conversation moved to federal level as part of U.S.-Mexico CO River discussions
- ▶ Monitoring outcome of Rosarito desal plant
- ▶ Hope to drive feasibility analysis back to state level with support of other interested parties

Environmental Considerations

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Questions?

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San Carlos, Mexico