The Joint Crisis in Water and Energy

Conference call briefing with
the **Water Innovations Alliance** and **Scientific American**
November 30, 2010
—John Rennie, former editor in chief, Scientific American

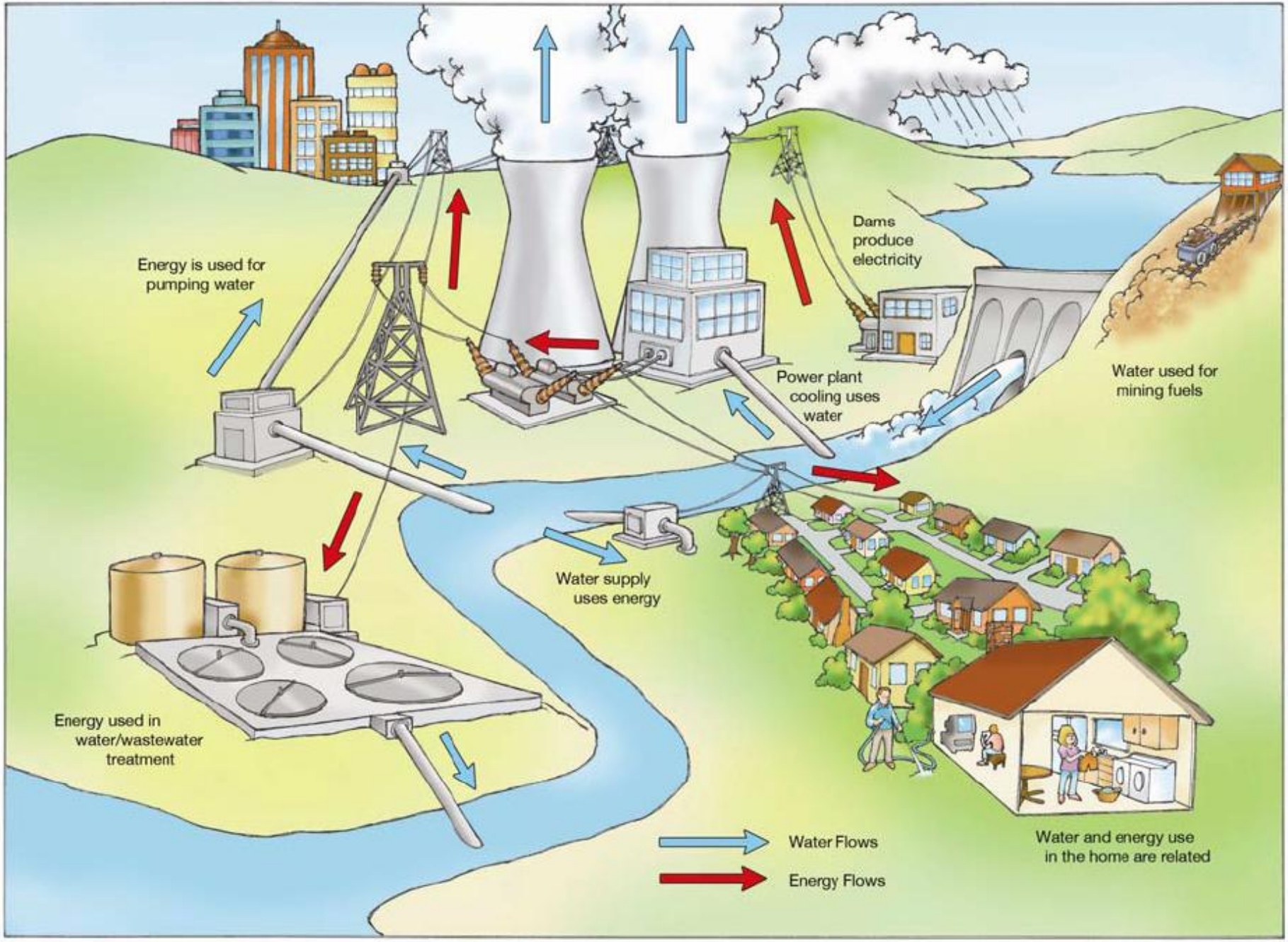
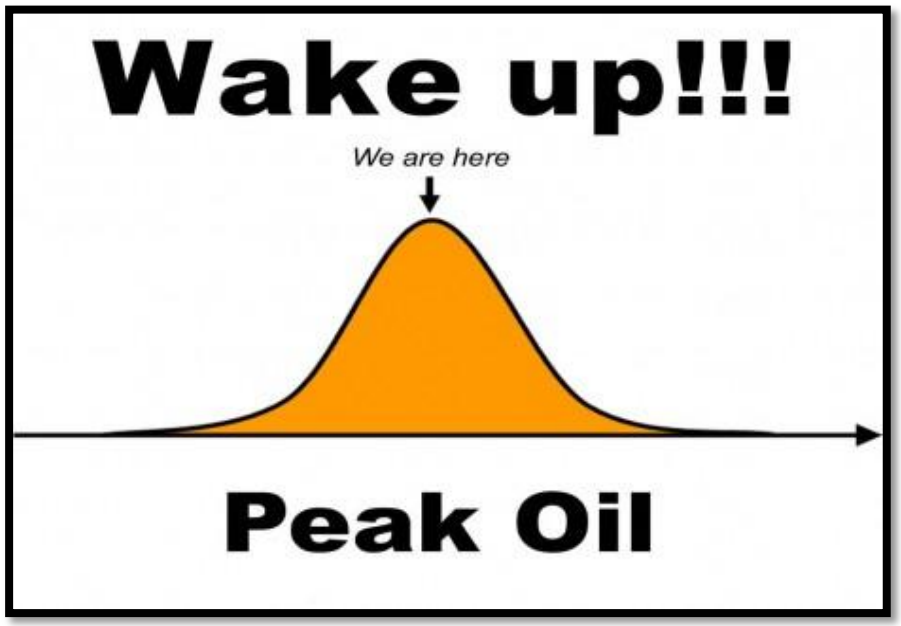


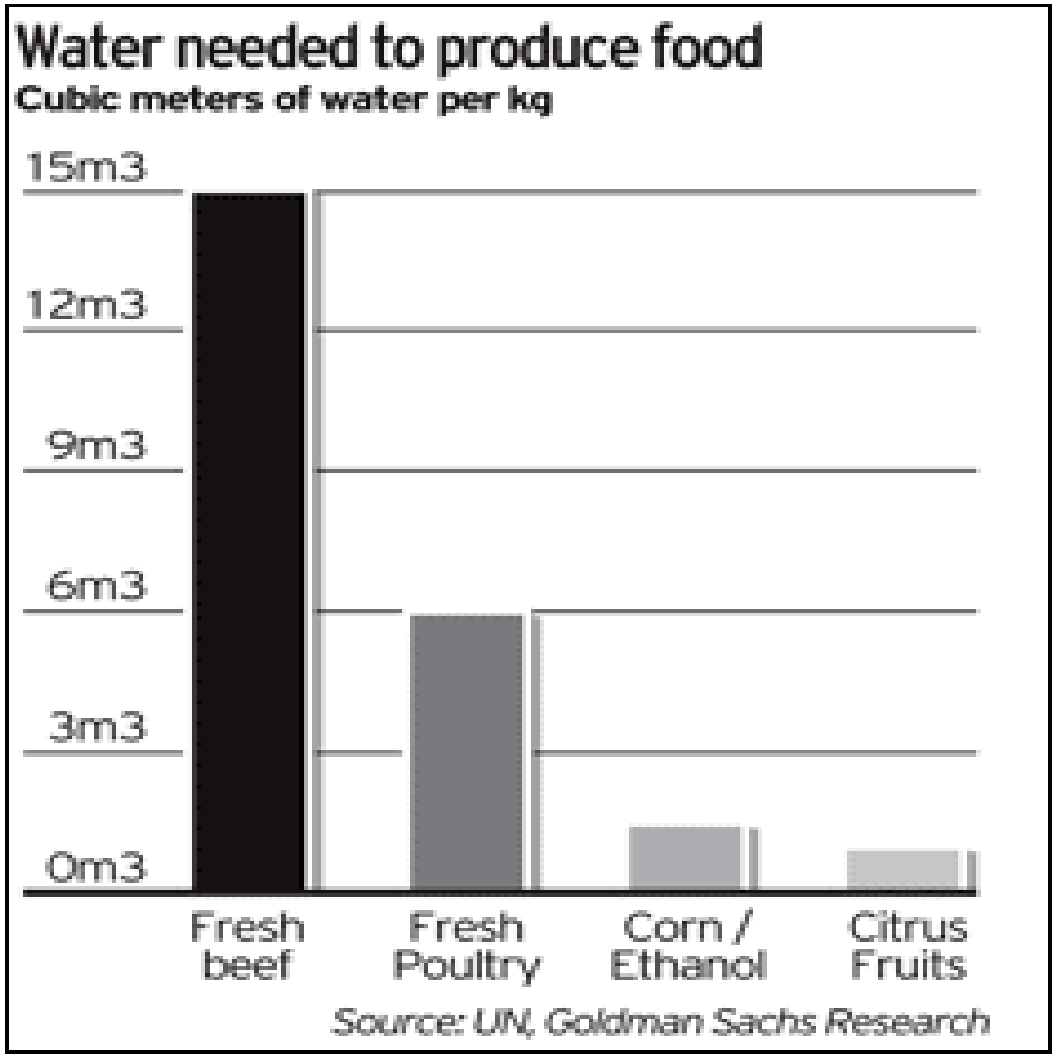
Figure I-1. Examples of Interrelationships Between Water and Energy

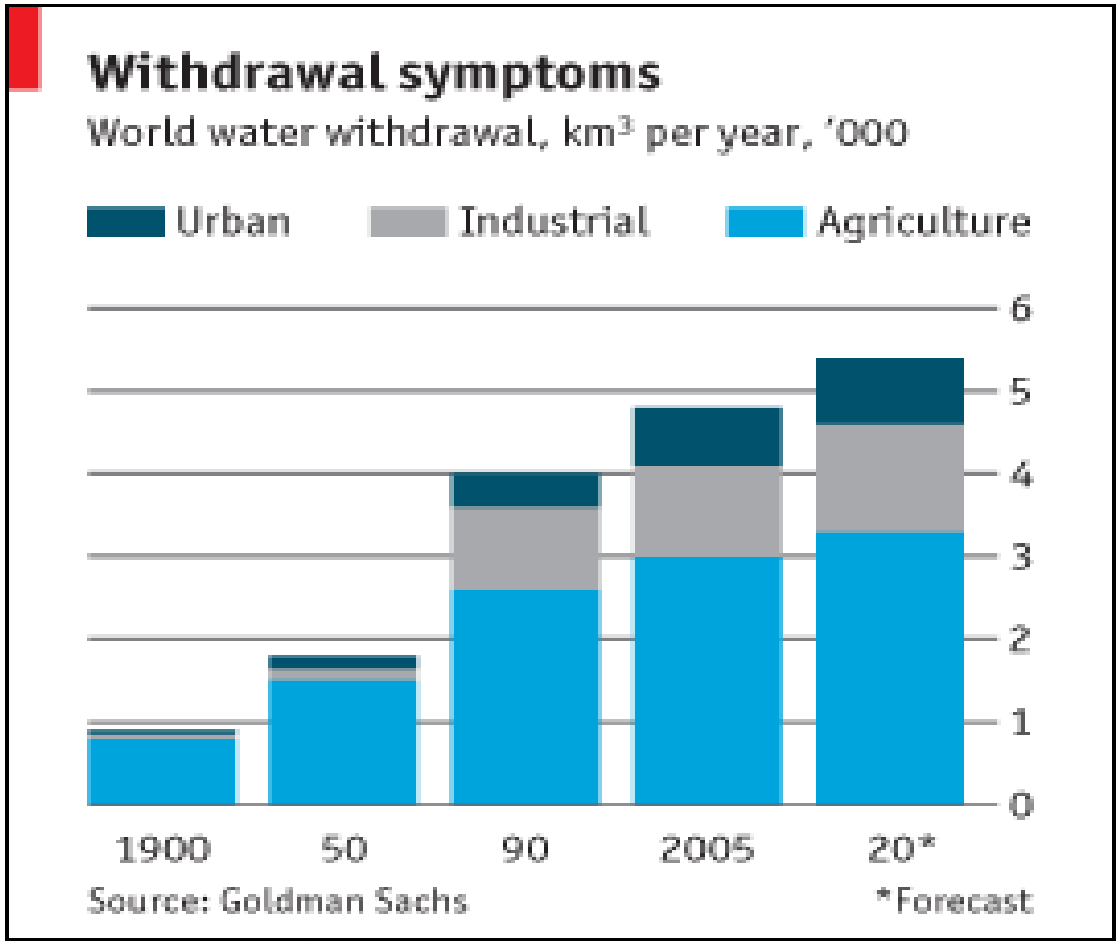

Wake up!!!
We are here
Peak Oil

The minimum water each person requires for drinking, hygiene and growing food. The volume is equivalent to two fifths of an Olympic-size swimming pool.

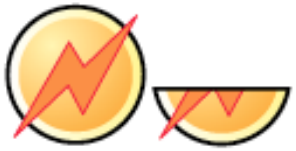
11 cubic meters

The amount of water it takes to produce a pair of denim jeans. This quantity equals the capacity of a standard-size tank truck.


Water needed to produce food
Cubic meters of water per kg
15m3
12m3
9m3
6m3
3m3
0m3
Fresh beef
Fresh Poultry
Corn / Ethanol
Citrus Fruits
Source: UN, Goldman Sachs Research


Withdrawal symptoms
World water withdrawal, km³ per year, '000
Urban
Industrial
Agriculture
6
5
4
3
2
1
0
1900
50
90
2005
20*
Source: Goldman Sachs
*Forecast

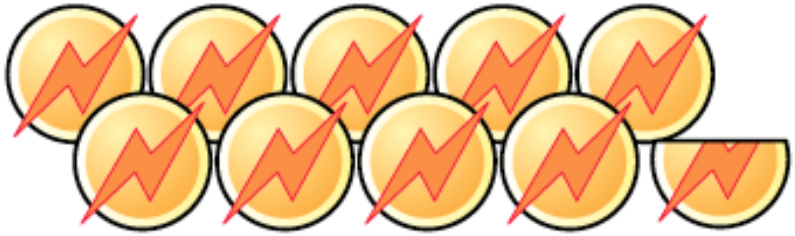
Energy Required to Deliver One Million Gallons of Clean Water from …



Lake or river 1,400 kilowatt-hours

Groundwater 1,800

Wastewater 2,350–3,300



Seawater 9,780–16,500

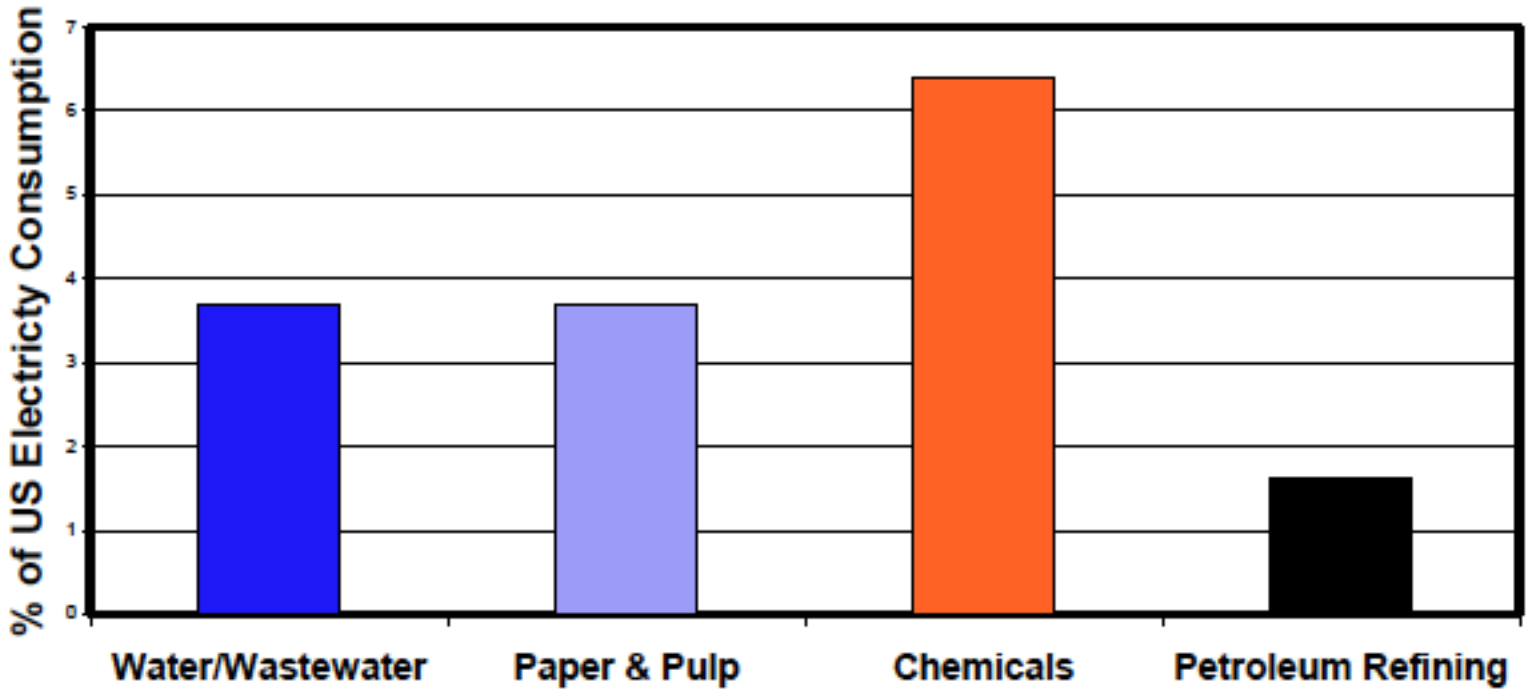
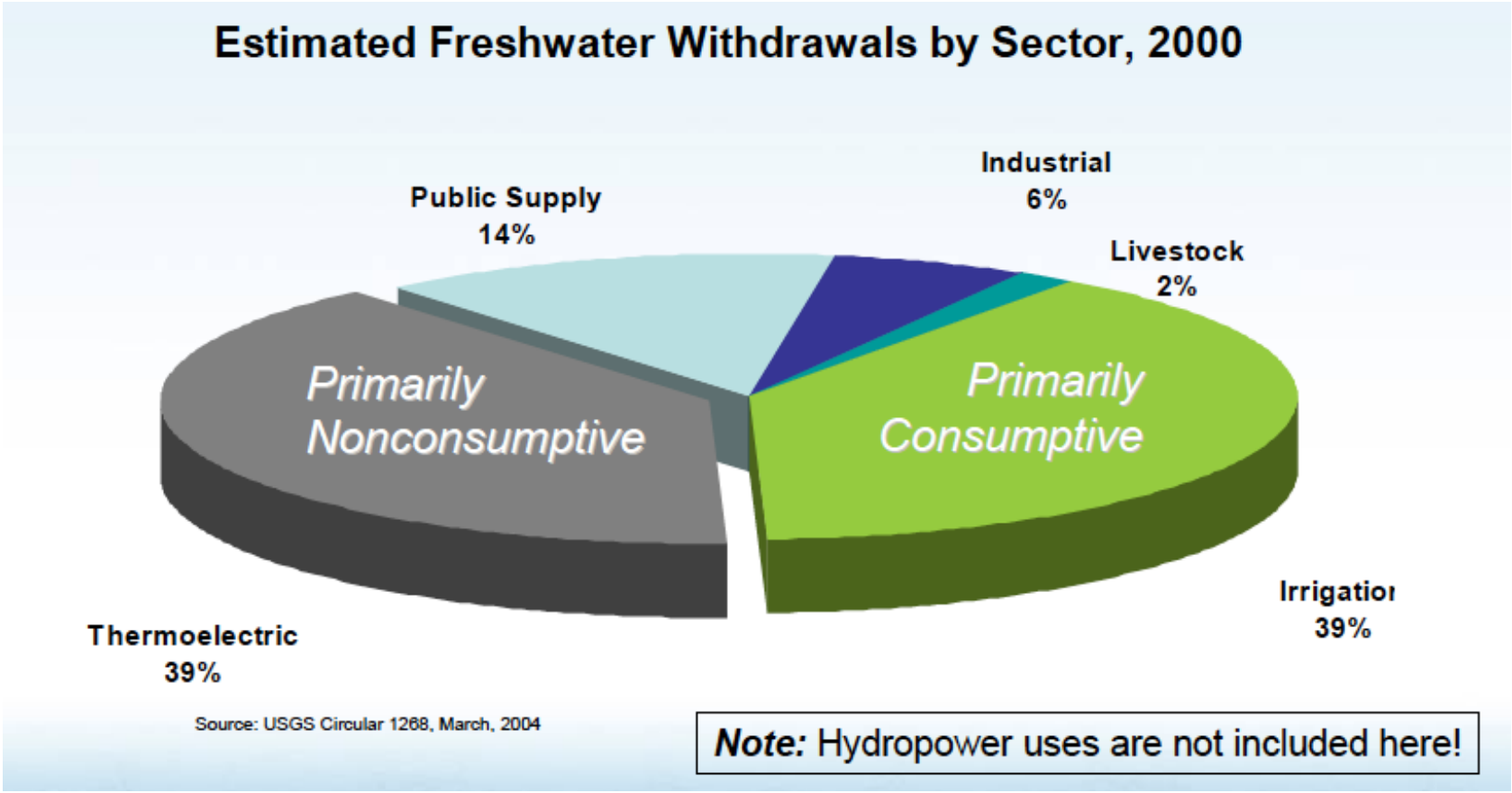


Figure III-1. Percent of U.S. Electricity Consumption by Sector (EPRI, 2002b; EIA, 1998)



Note: Thermoelectric **consumption** is about 3.3% of freshwater total.

Water Required to Generate One Megawatt-hour of Electricity Using …

Gas/steam combined cycle 7,400–20,000 gallons

Coal and oil 21,000–50,000

Nuclear 25,000–60,000

Data are for plants that draw and dump water; plants with cooling towers use less.

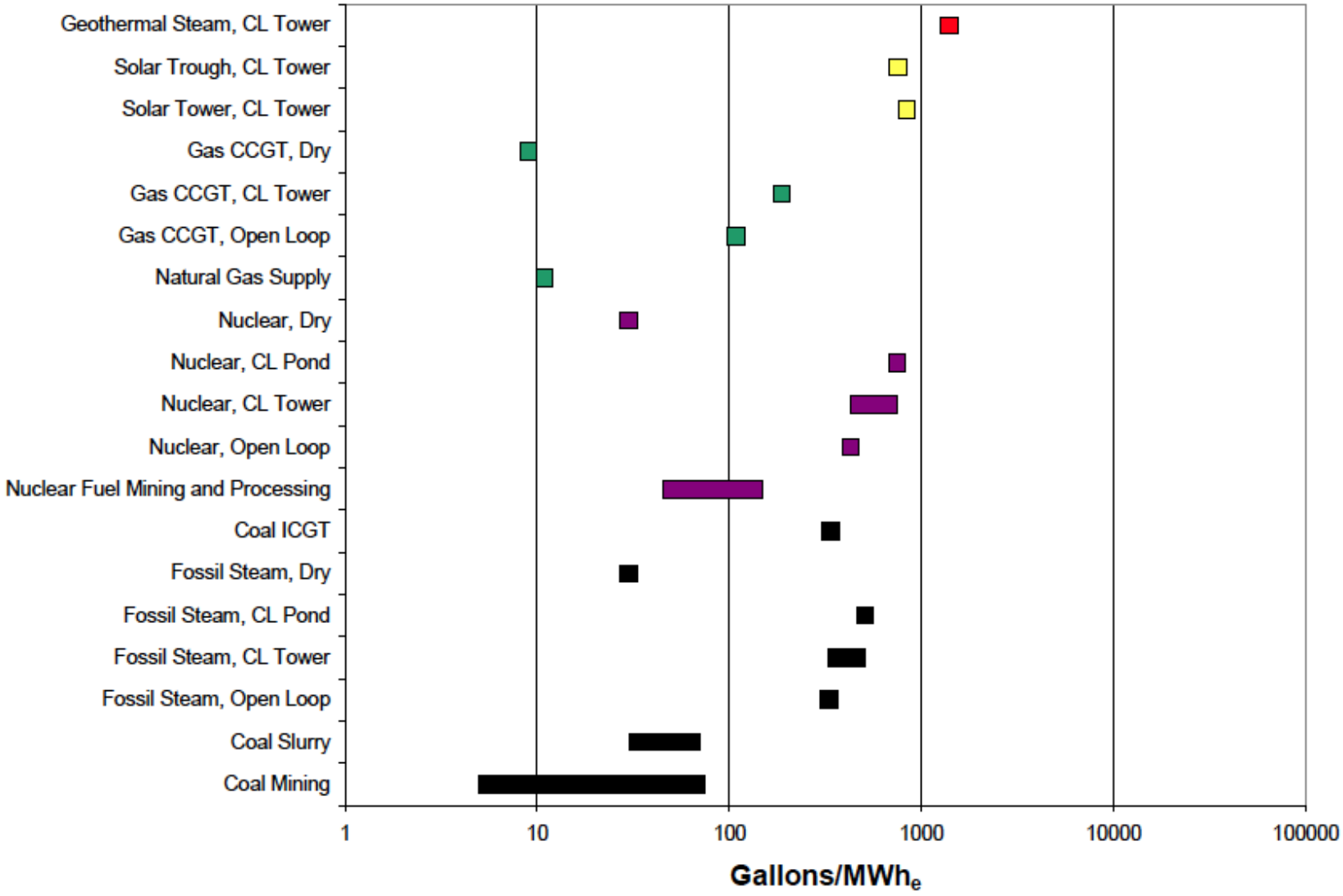


Figure V-2. Water Consumption for Power Generation

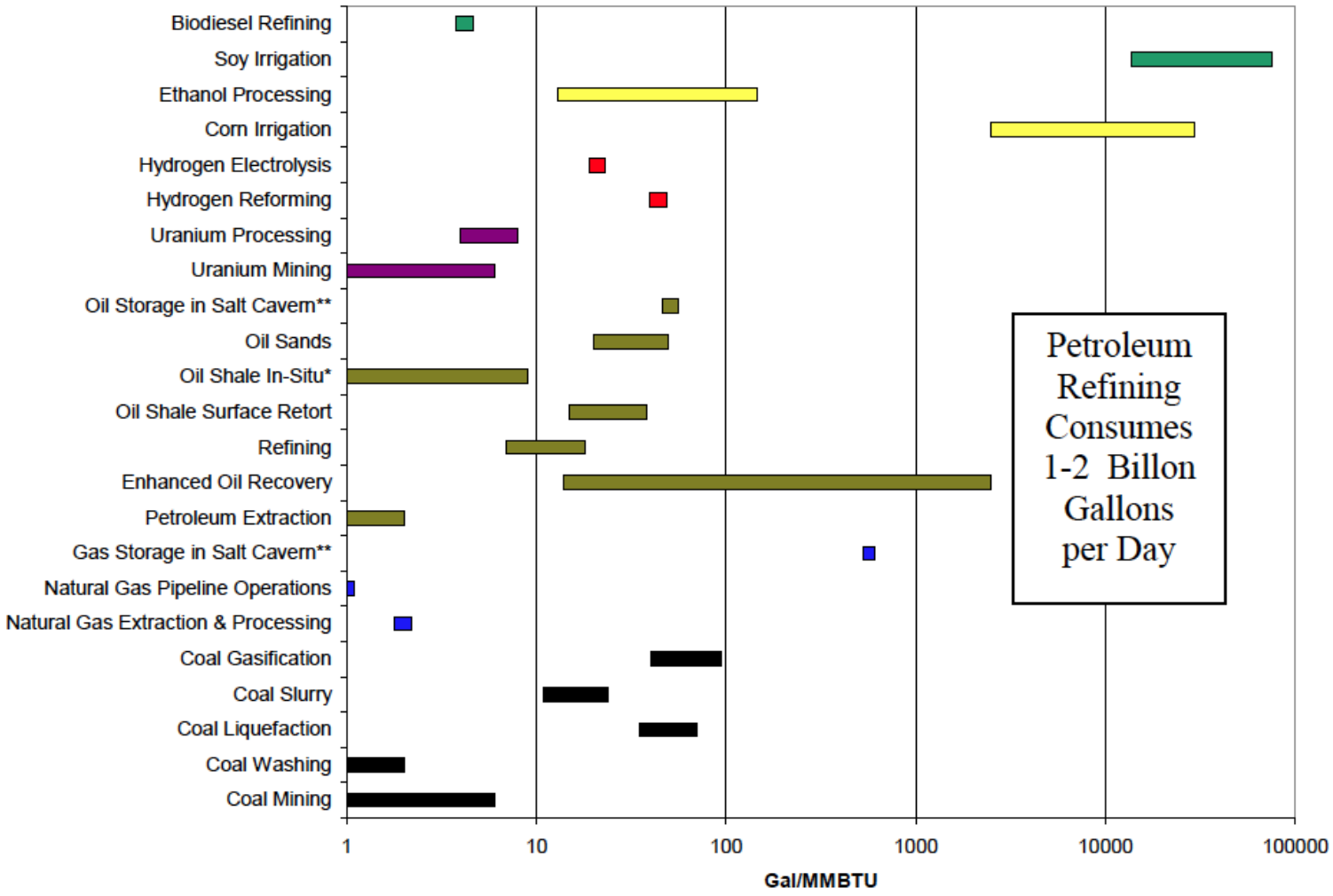


Figure V-4. Water Consumption Per-Unit-Energy and Current Water Use for Fuel Extraction and Processing

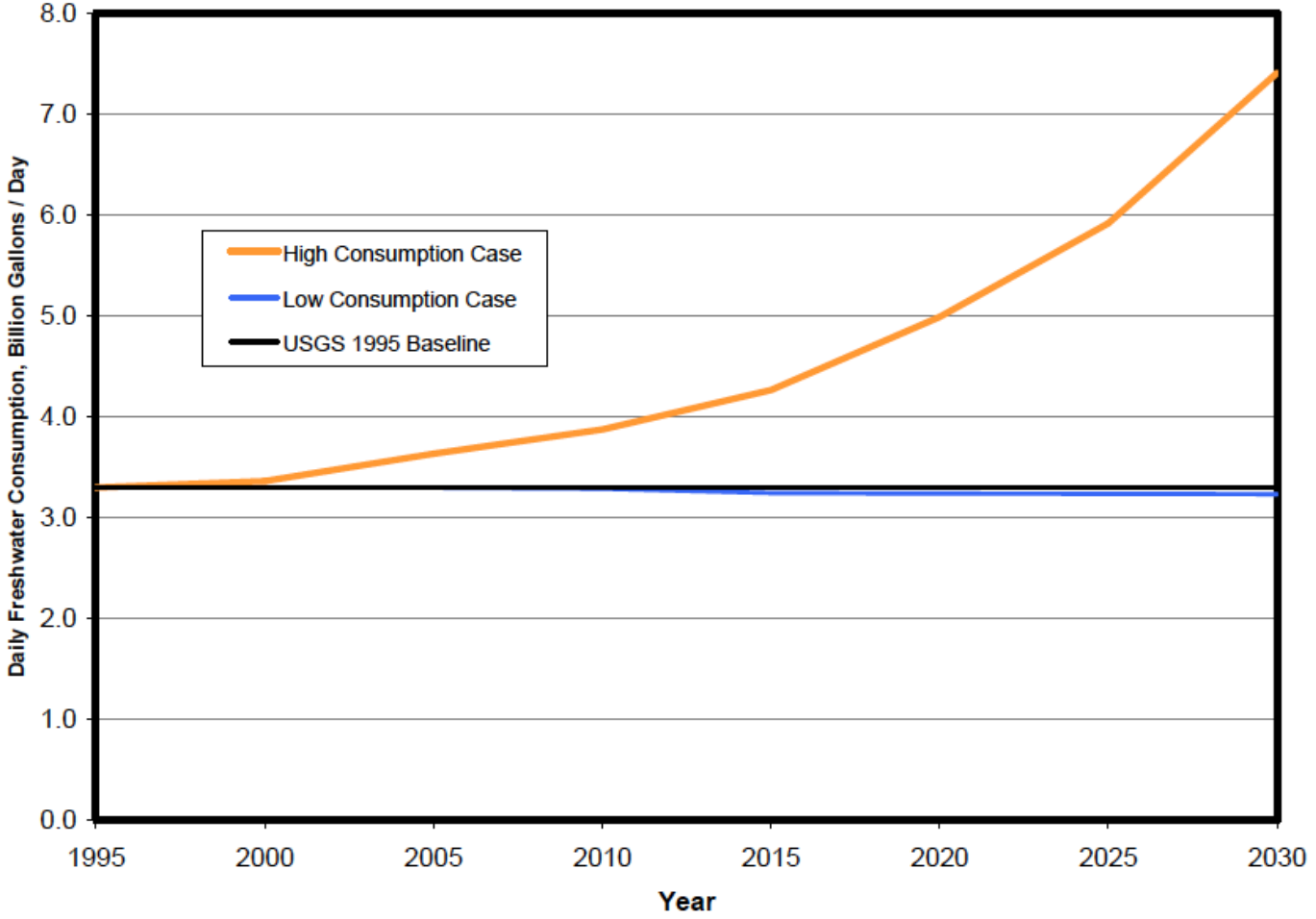


Figure IV-7. Range of Projected Freshwater Consumption for Thermoelectric Power Generation (revised from Hoffmann et al., 2004)

Electricity demand is expected to increase by as much as 50% over the next 25 years.

Consumption of water for electrical energy production could more than double by 2030, from 3.3 billion gals./day to 7.3 billion gals./day.

Consumption of water for electricity production would then equal **all U.S. domestic water consumption in 1995.**

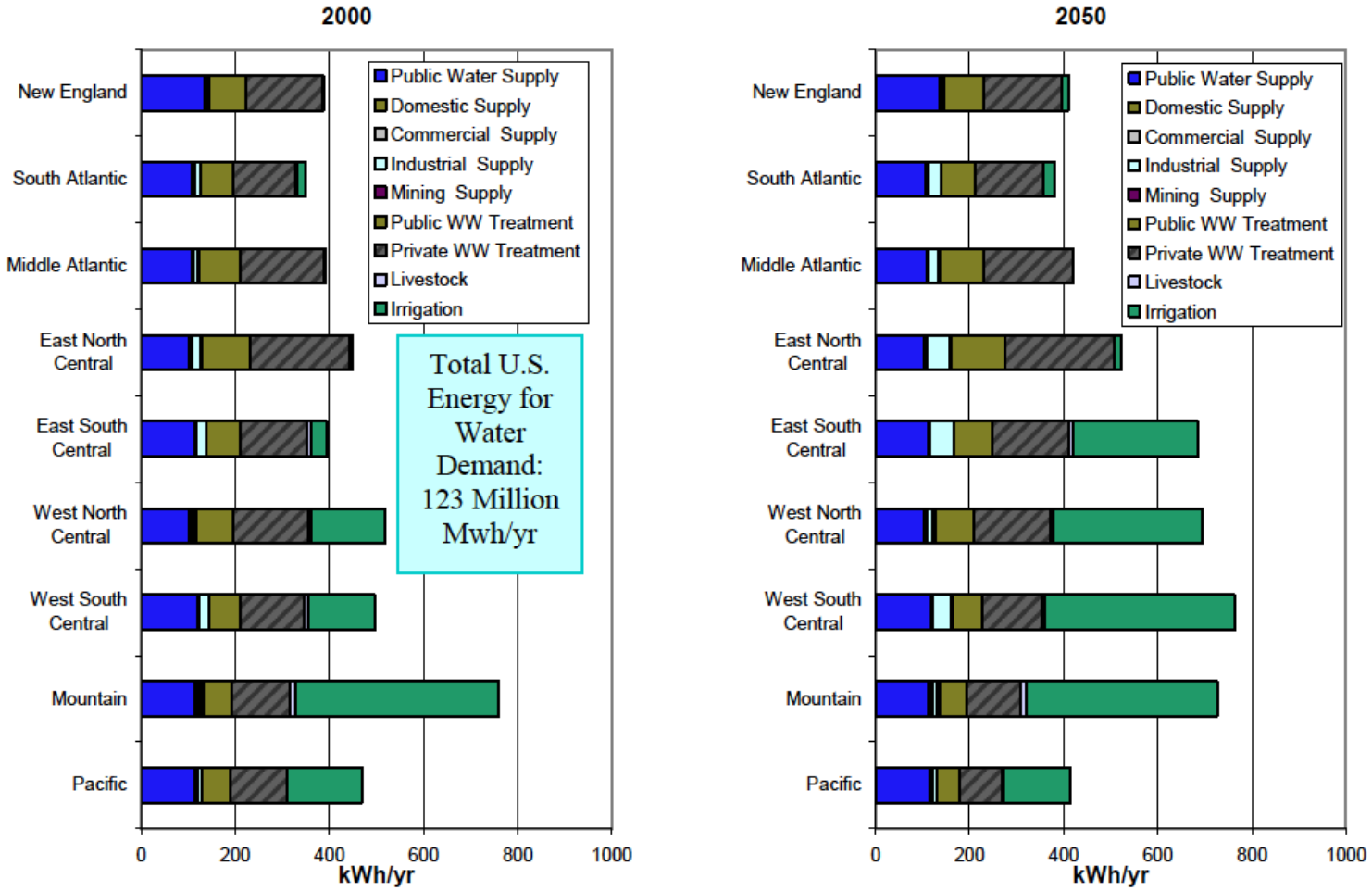


Figure III-2. Per Capita Energy Use for Water Supply and Wastewater Treatment in 2000 and Projected for 2050 (EPRI, 2002b).

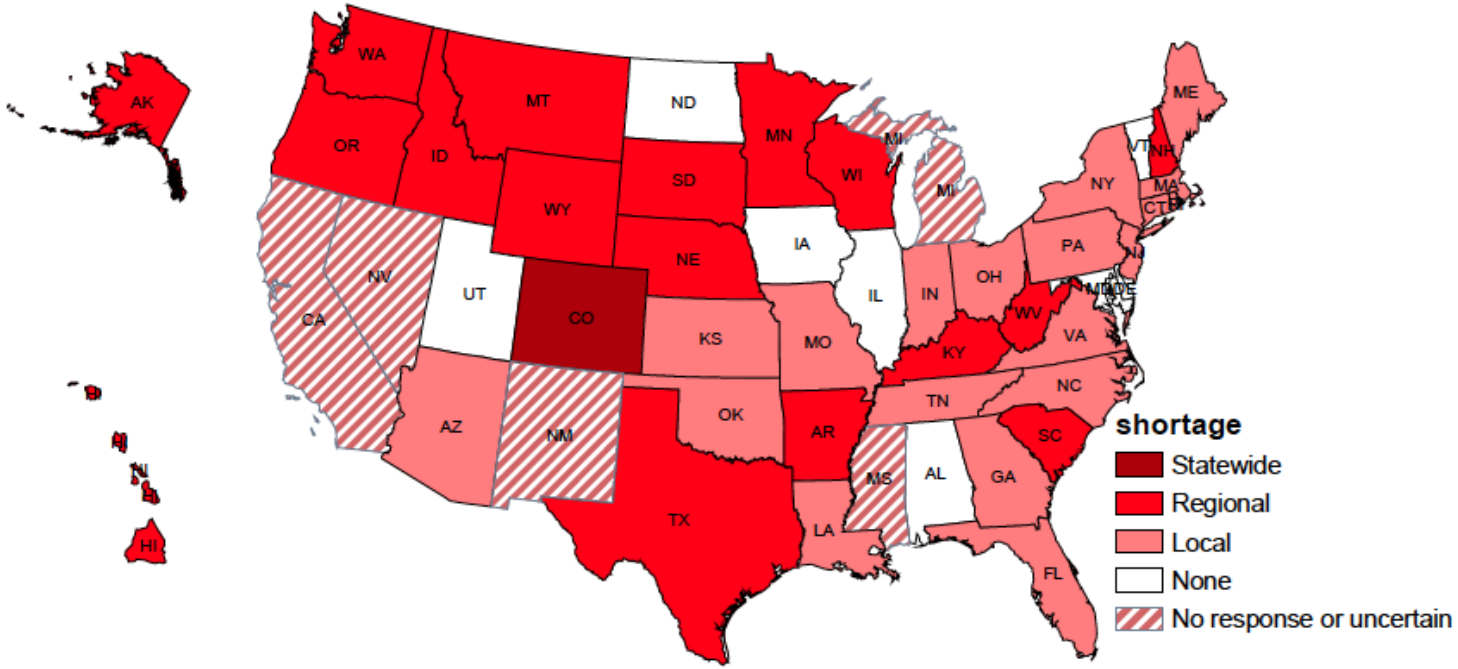
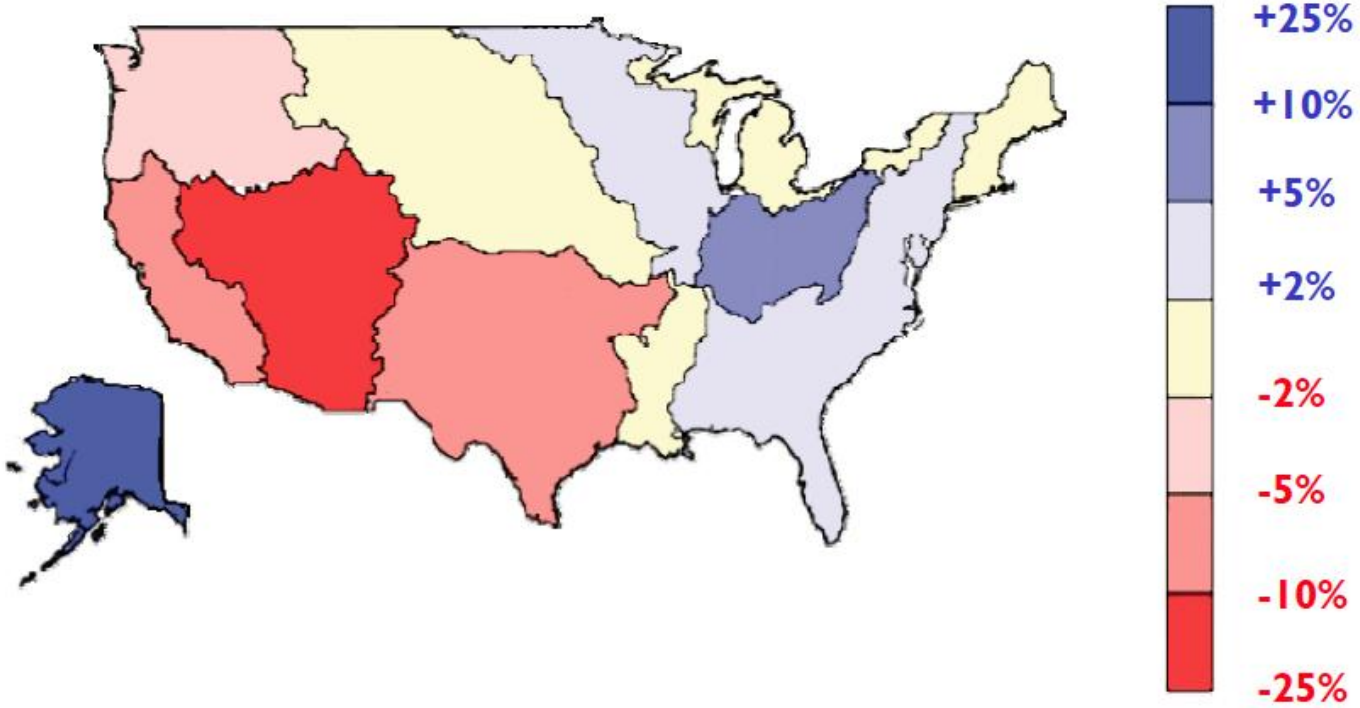


Figure IV-1. Survey of Likely Water Shortages over the Next Decade under Average Conditions (GAO, 2003)

Climate Change

Water flow change 2040-2060



U.S. Climate Change Science Program

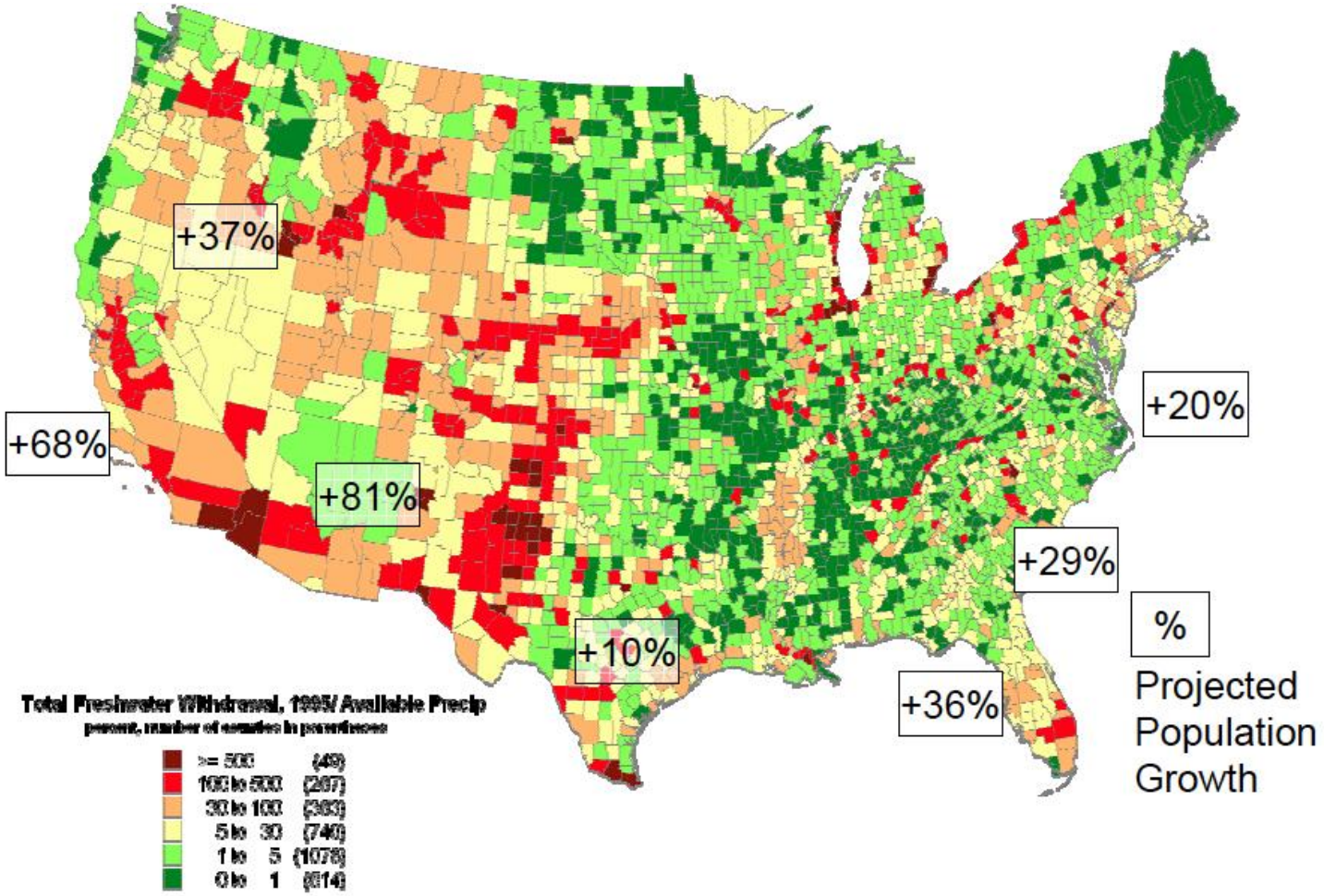
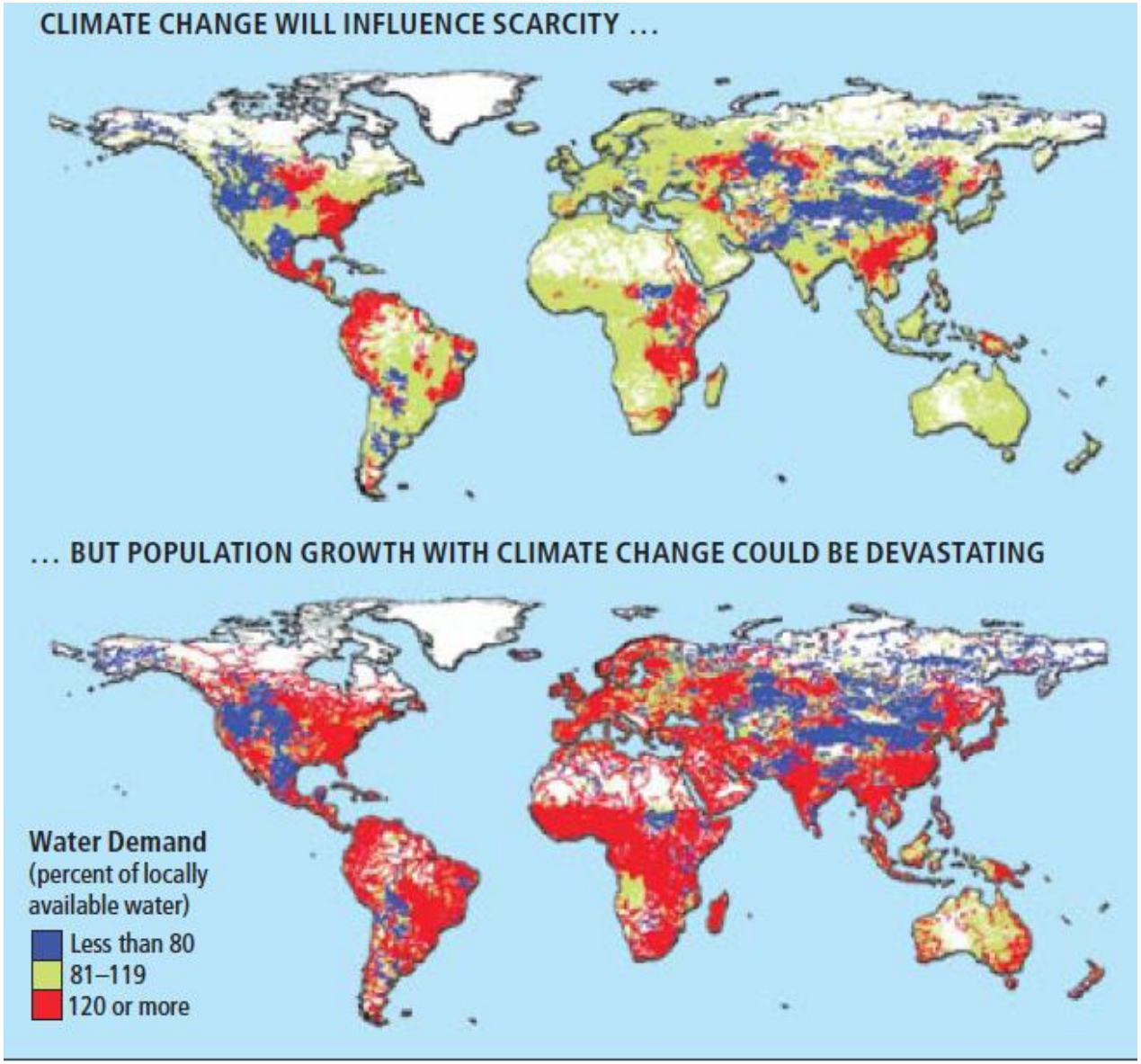


Figure I-2. Water Shortages and Population Growth



2025 projections

Losing Las Vegas

The Bellagio

=

Lake Mead &
Hoover Dam

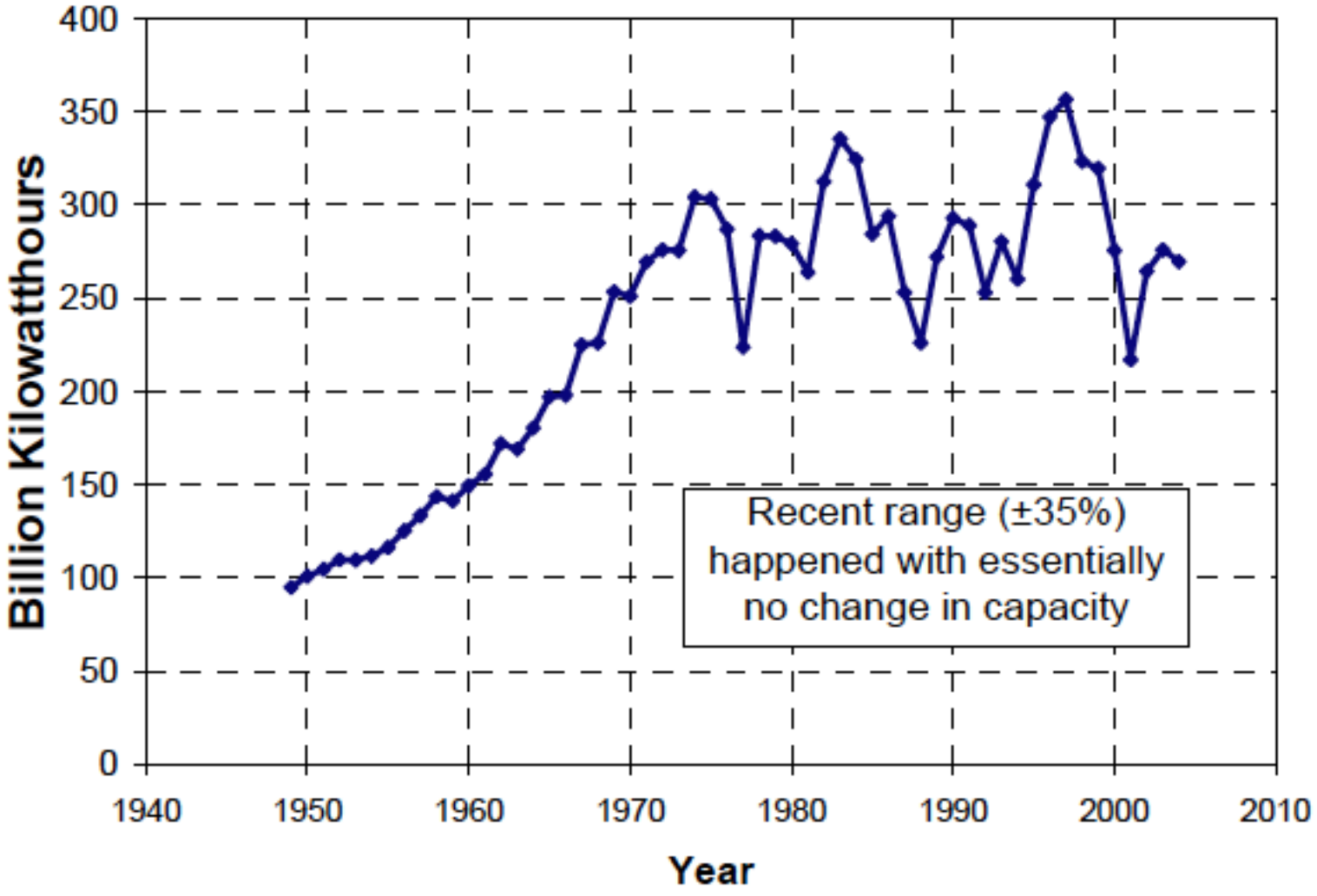
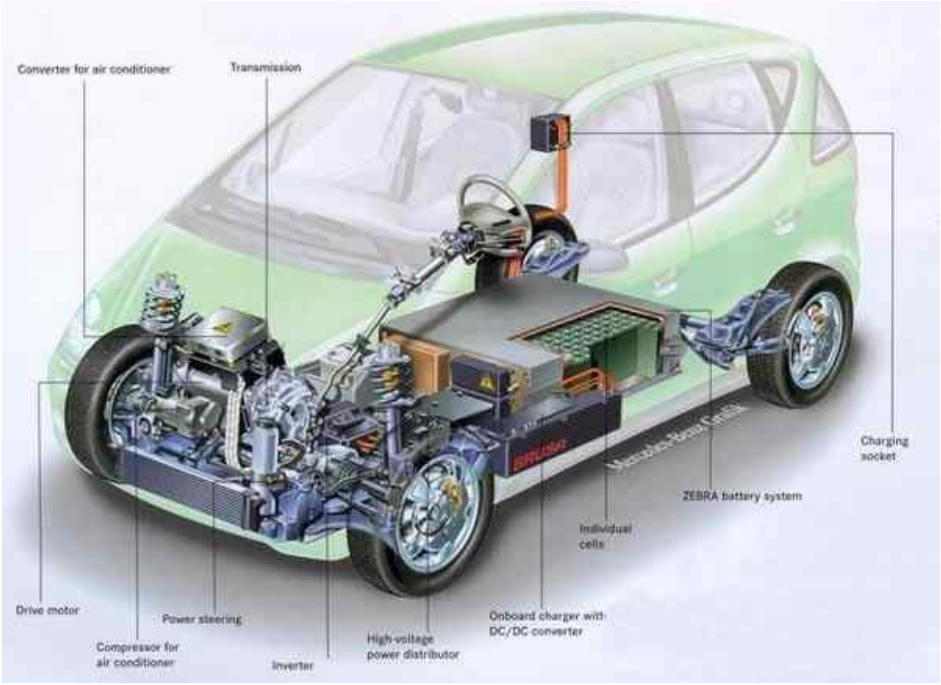


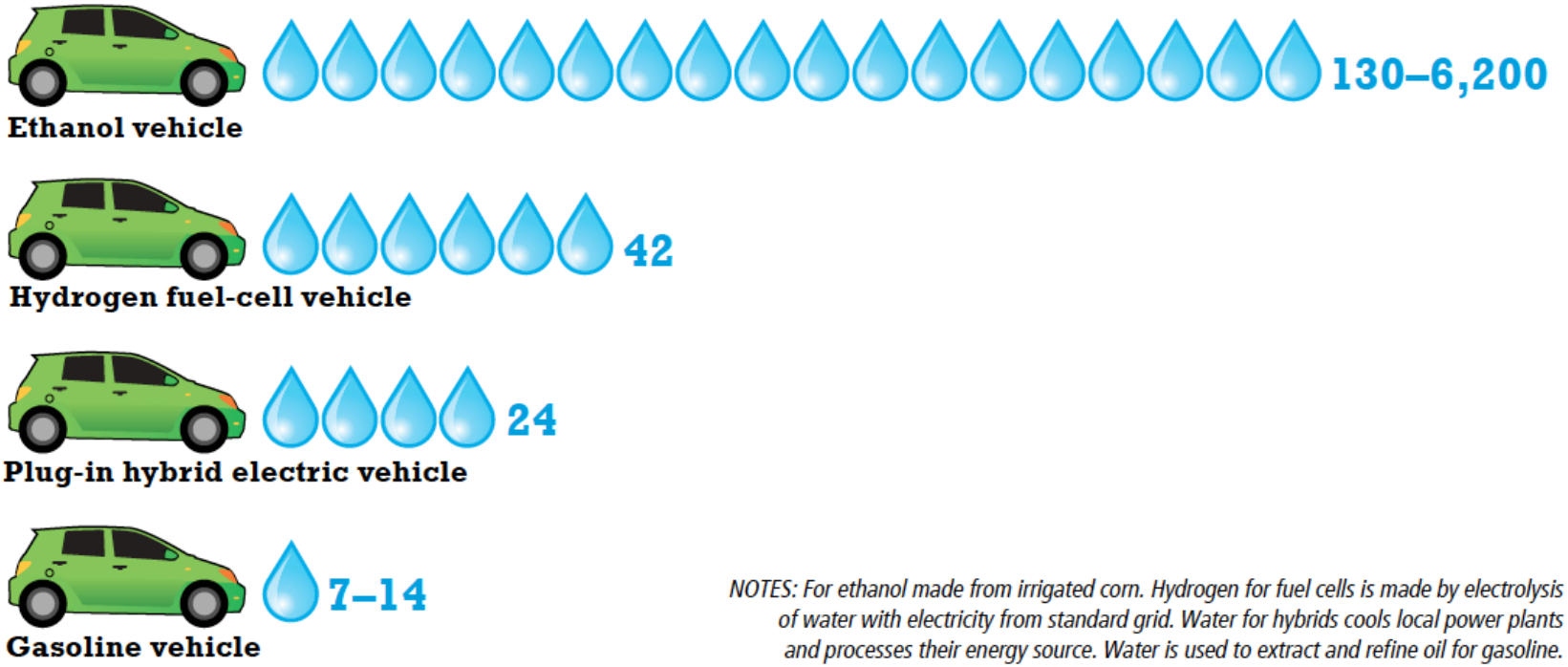
Figure II-5. U.S. Hydropower Production (EIA, 2005)



Electric, Hybrid & Alt Fuel Cars:
Maybe Good for Energy and Climate
—but Bad for Water?

Alternative vehicles: They use less petroleum, but producing their fuel guzzles more water.

Gallons of Water Depleted to Travel 100 Miles



NOTES: For ethanol made from irrigated corn. Hydrogen for fuel cells is made by electrolysis of water with electricity from standard grid. Water for hybrids cools local power plants and processes their energy source. Water is used to extract and refine oil for gasoline.

LUCY READING-IKKANDA

Nuclear Power:
It Runs on Water

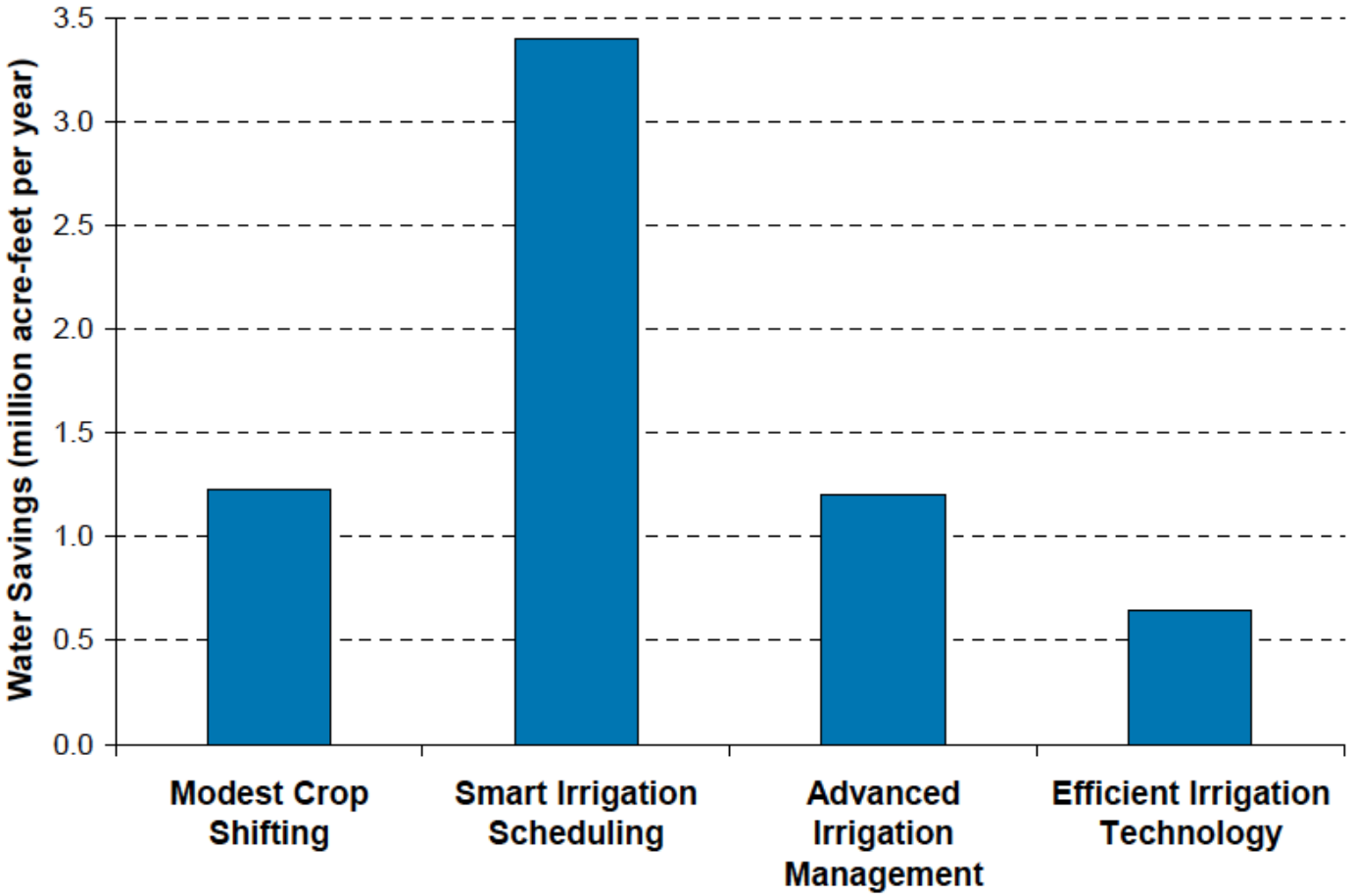
Desalination:
Trading Energy for Water

Examples of Science and Technology Research Directions

- Improve sensors, collection frequency capability, and data base management systems to better assess and understand water availability and water use.
- Improve common decision support tools to enable collaboration among federal and state agencies and industry to improve integrated energy and water planning and management.
- Improve modeling of climate variability, meteorology, and hydrology to improve energy and water resources planning.
- Develop and accelerate the use of technologies that reduce fresh water consumption in alternate energy and bioenergy production and/or electric-power generation.
- Develop and introduce more water efficient energy technologies.
- Develop system analysis approaches to enable tradeoffs in infrastructure improvements; Examples: Co-location of energy and water facilities, or improved national transmission capabilities.
- Develop new materials and processes to treat and use nontraditional, brackish, or produced water in energy applications.

—from "Energy-Water Science &Technology Research Roadmap," 2005

Figure ES-1. Water Savings by Scenario



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