

CALIFORNIA AGRICULTURE: THE WATER – POWER CONNECTION

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A BRIEF OVERVIEW OF CALIFORNIA

Geography and Land Use



Geographical Information Center
California State University, Chico
1300 45th Street
Chico, CA 95926-0001
www.gis.calstatechico.edu

Institute for Sustainable Development
California State University, Chico

Source:
Water and land use data from the U.S. Census Bureau.
Topographic data from the U.S. Department of Agriculture (National Engineering Experiment Station, Corvallis, Oregon).
Elevation and stream data were derived from U.S. Geological Survey Digital Elevation Model data.

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A BRIEF OVERVIEW OF CALIFORNIA

Groundwater Supply



A BRIEF OVERVIEW OF CALIFORNIA

Groundwater Supply and Agriculture

Subsidence, as a result of groundwater overdraft, is a major issue for some agricultural areas of the state.



A BRIEF OVERVIEW OF CALIFORNIA

Groundwater, continued.



A BRIEF OVERVIEW OF CALIFORNIA

Surface Water Supply and Demand

Approximately 200 million acre feet of surface water are available in a normal precipitation year.

Dedicated Supply

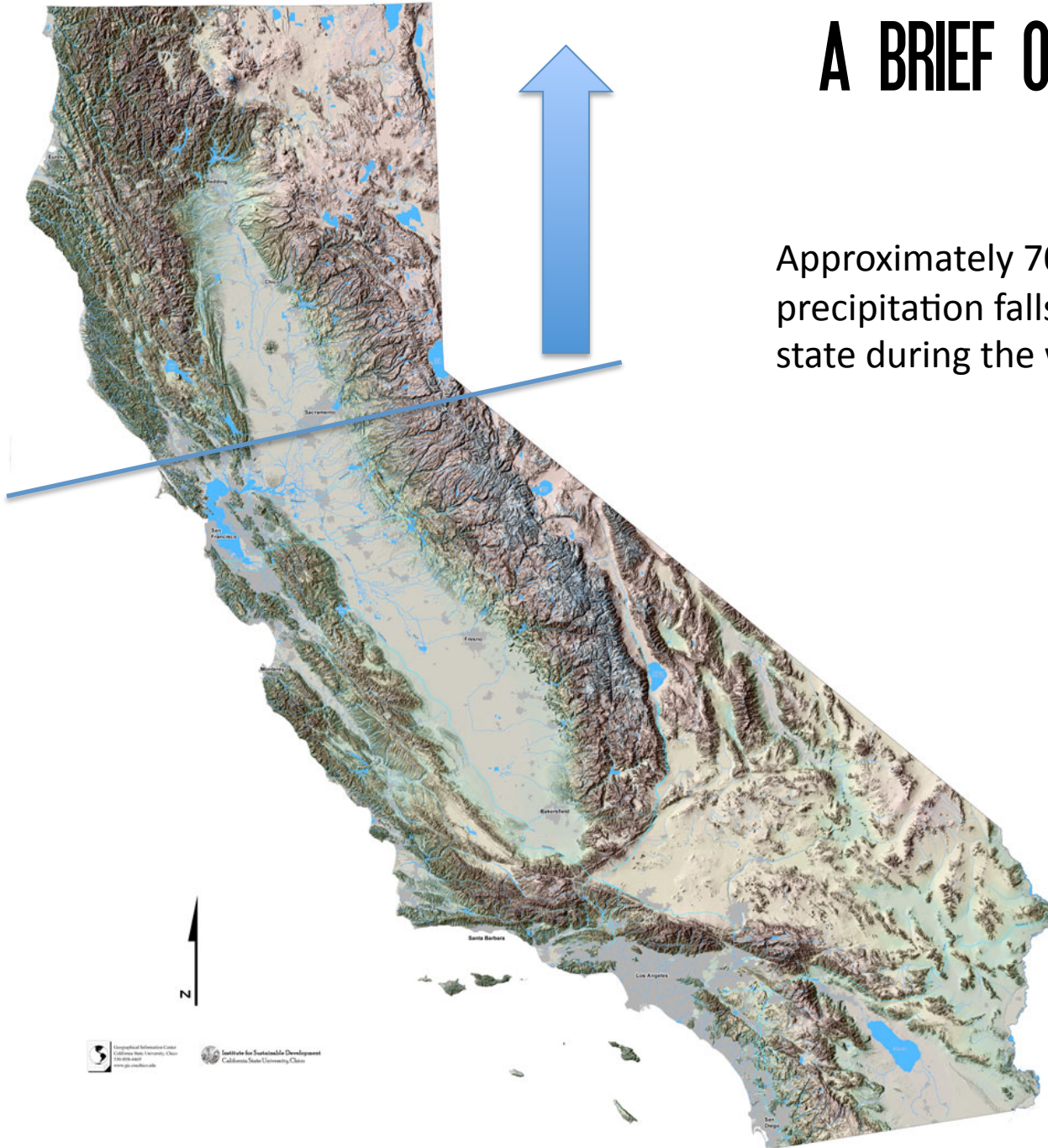


Uncaptured

A BRIEF OVERVIEW OF CALIFORNIA

Water Supply and Demand

Approximately 70 percent of California precipitation falls in the northern third of the state during the winter months.



A BRIEF OVERVIEW OF CALIFORNIA

Surface Water Supply

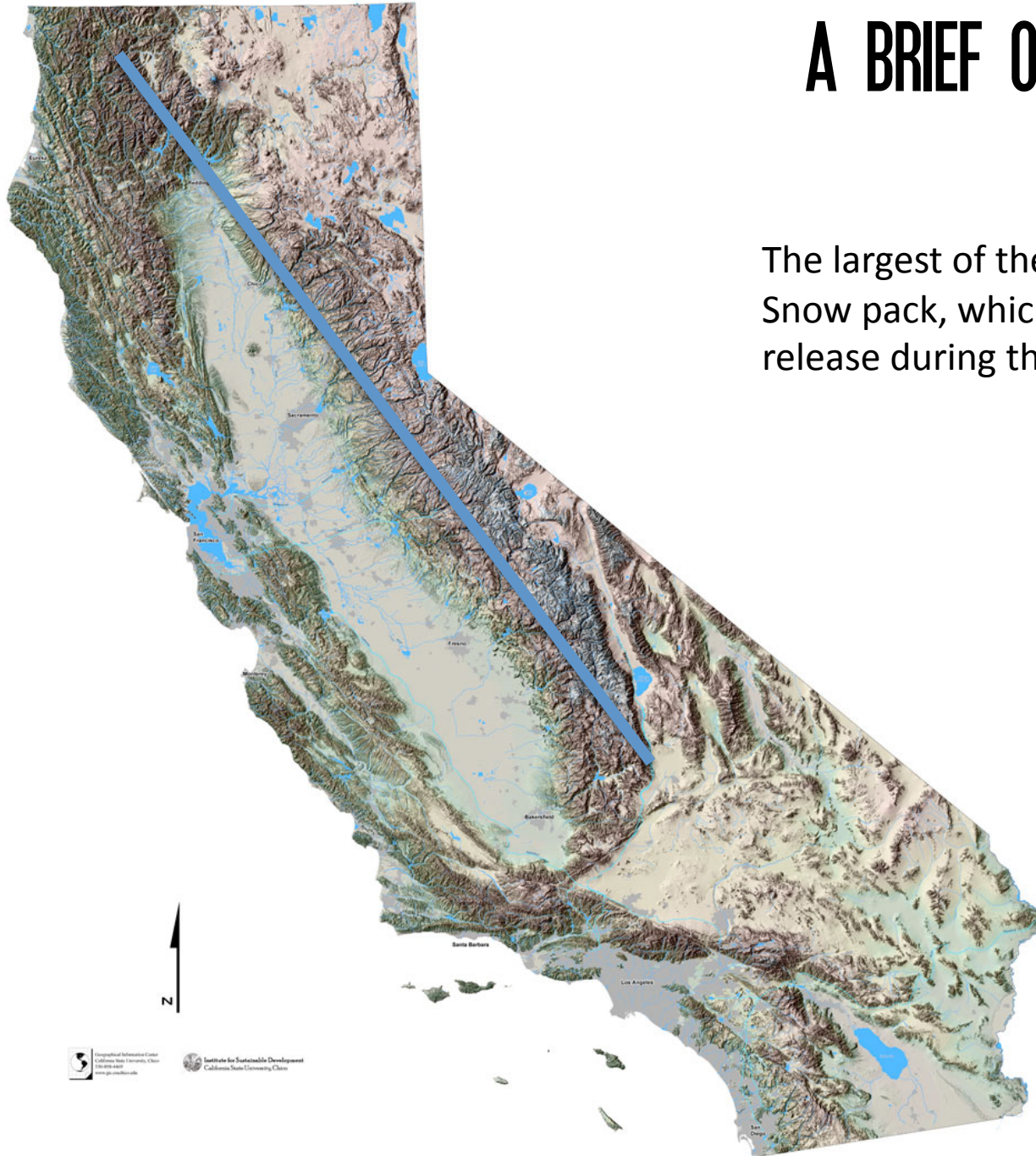
California relies on a complex network of more than 1,200 surface reservoirs to store and meter out water through the months of March-November.



A BRIEF OVERVIEW OF CALIFORNIA

Surface Water Supply

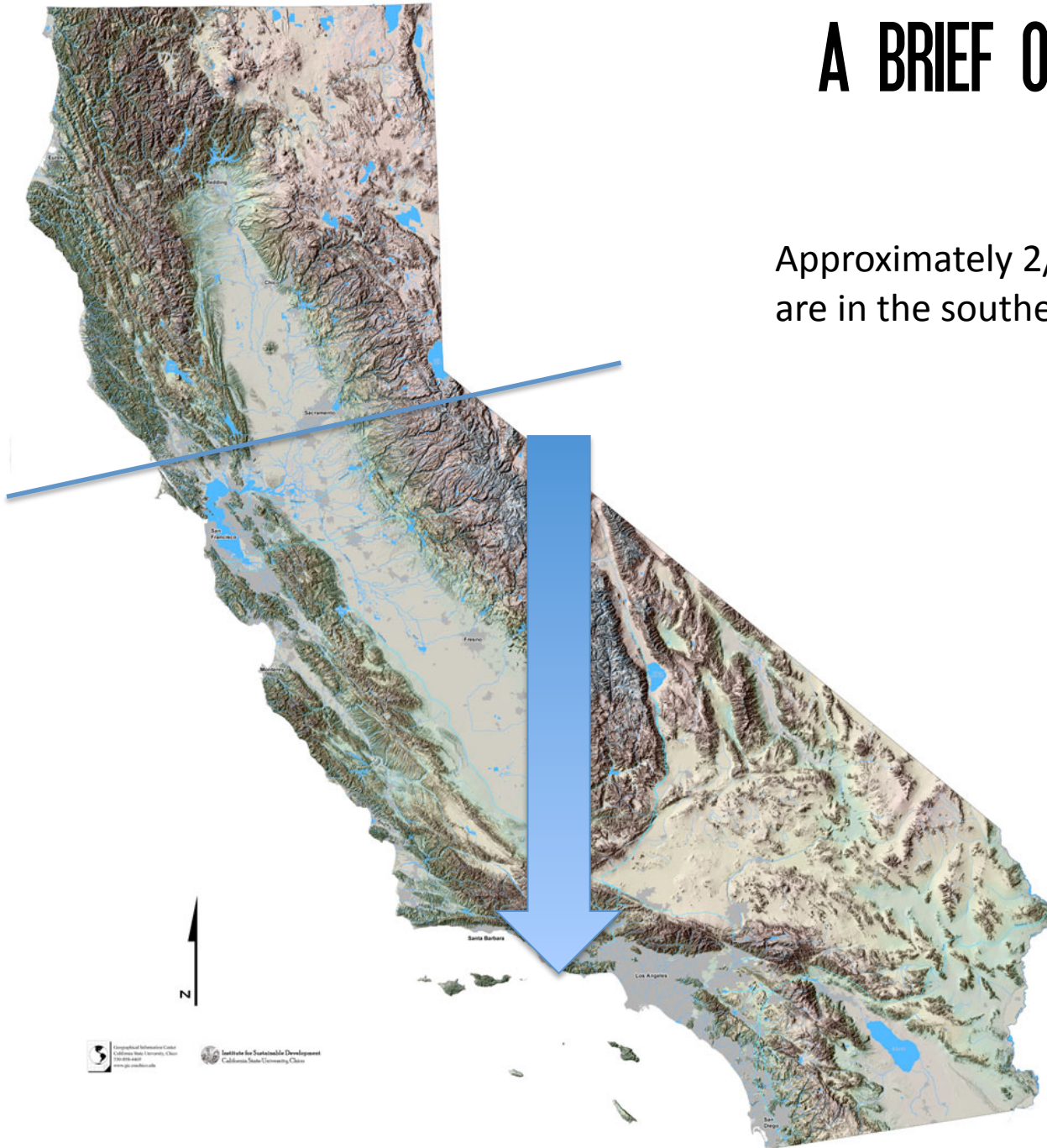
The largest of these reservoirs is the Sierra Snow pack, which provides gradual melt release during the summer months.



A BRIEF OVERVIEW OF CALIFORNIA

Water Demand

Approximately 2/3 of California water needs are in the southern half of the state



Major Rivers

State Projects

Federal Projects

Local Projects

Redding

Sacramento

San Francisco

Fresno

Santa Barbara

Los Angeles

San Diego

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Source:
Urban and county base data is from the U.S. Census Bureau.
Hydrology data was modified from the U.S. Department of Agriculture California Interagency Watershed Mapping Committee (CAHWS).
Elevation and shaded relief was derived from U.S. Geological Survey Digital Elevation Model data.

MOVING WATER



MOVING WATER



A BRIEF OVERVIEW OF CALIFORNIA

Enough Already!- What about Electricity?

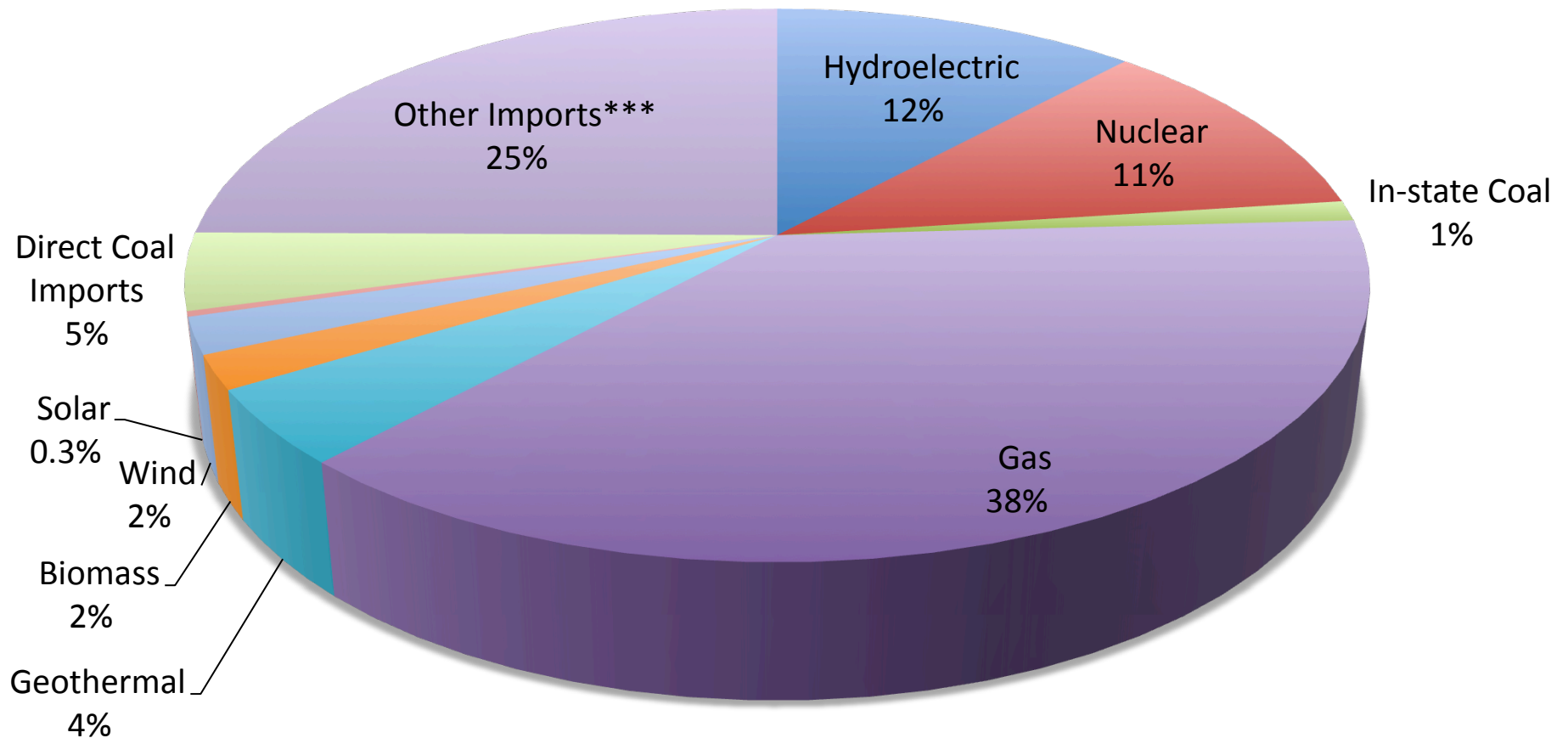


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CALIFORNIA ELECTRICITY

Electrical Generation

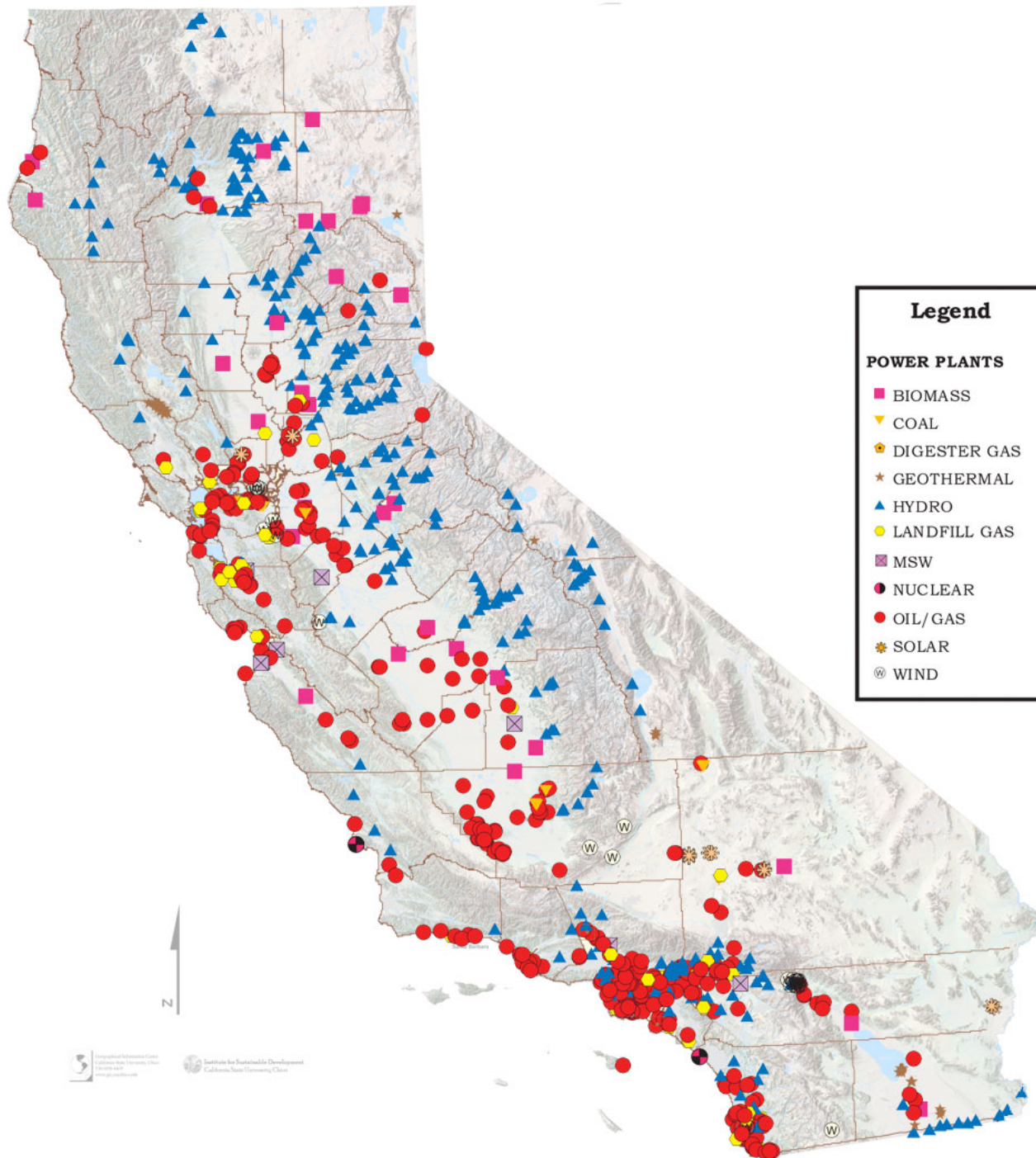
California Electrical Portfolio – (On Grid)



*** We have only a vague notion how this energy is being produced- but we're working on it.

CALIFORNIA ELECTRICITY

Electrical Generation



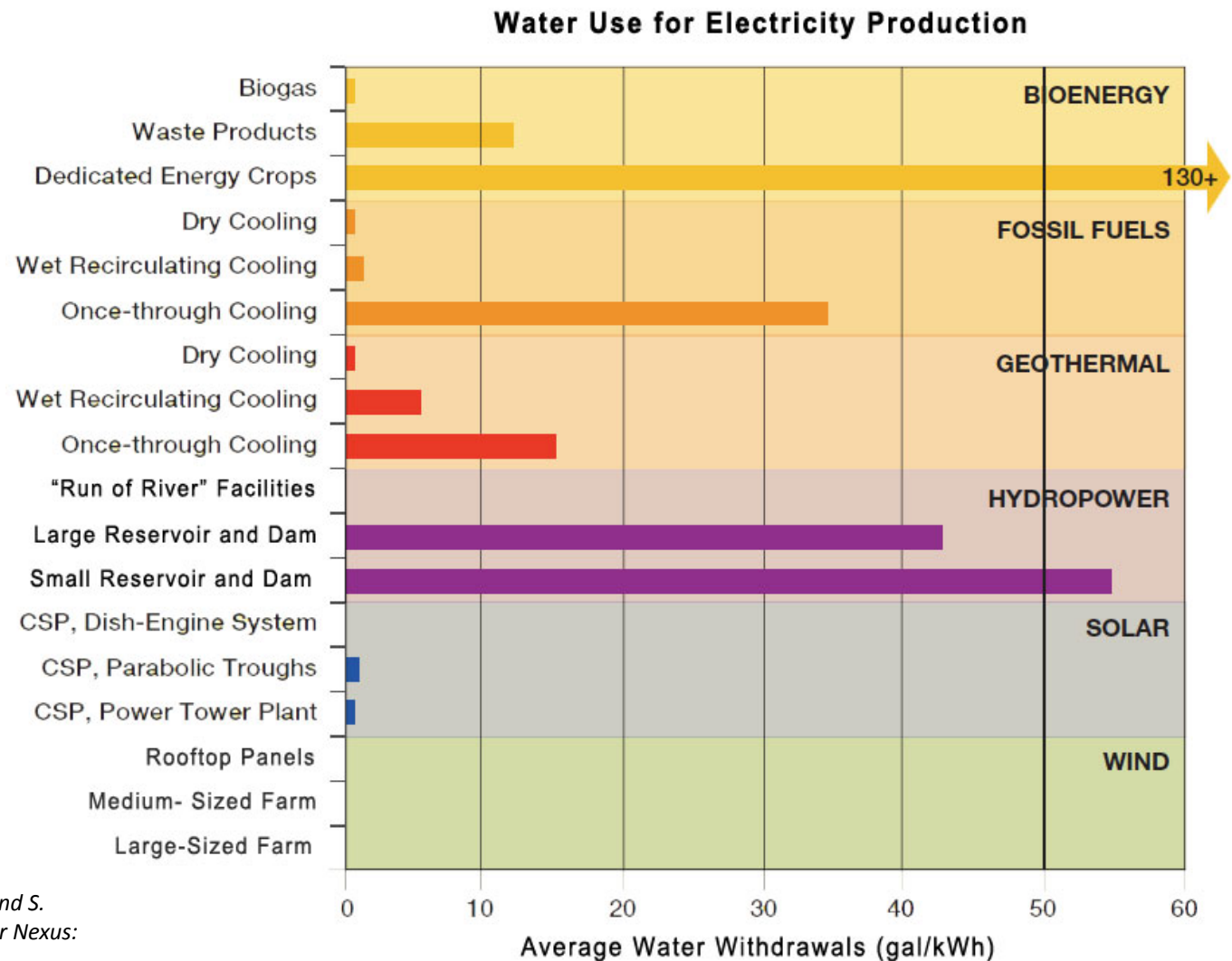
WATER USE FOR ELECTRICAL IN CA

Energy Production and water “use”

Water use for energy production

How can we optimize water use in electrical production?

Are there ways to derive multiple benefits?



Graph: Dennen, A., D. Larson, C. Lee, J. Lee, and S. Tellinghuisen, 2007. *California's Energy-Water Nexus: Water Use in Electricity Generation.*

ELECTRICAL USE AND WATER IN CA

The big picture

It's complicated...

ELECTRICAL USE AND WATER IN CA

The big picture

Water-related energy use (2005)

Electricity (GWh)	
WER Table 1-1	
Water Supply and Treatment	
Urban	7,583
Agricultural	2,788
Water End Uses	
Agricultural	7,372
Residential	28,258
Commercial	
Industrial	
Wastewater Treatment	2,012
Total Water-Related Energy Use ⁷	
	48,013
Total California Energy Use	250,494
Percent	19.2%

CALIFORNIA AG WATER ENERGY USE

Energy Use and Agricultural Water

Table 1-4: Energy Consumed in Agriculture for Water

Category	Energy Consumption (GWh)
Conveyance to Irrigation Districts by the State and Federal water projects	1,720
Conveyance to Irrigation Districts by the Western Area Power Administration	400
Irrigation District surface water pumping	822
Irrigation District ground water pumping	246
On-farm ground water pumping	4,499
On-farm booster pumping	2,873
Subtotal	10,560
Electric equivalent for diesel and natural gas engine driven water pumping	1,231
Total	11,791

ELECTRICAL USE AND WATER IN CA

Part of the Story

Unconventional fossil fuels—such as “liquid coal” or oil from tar sands or shale—can have serious water implications. A coal-to-liquids plant in Wyoming, for example, consumes most 5 billion gallons of water in a year.²¹ Coal-to-liquids plants do not account for the large volumes of water needed to mine and wash the coal before processing.

7 THE FLIP SIDE—California uses 19 percent of its electricity and 32 percent of its natural gas for water.²² Just as energy production requires large amounts of water, the inverse is also true: substantial amounts of energy are used to pump, transport, treat, and heat the water we use every day. Nationwide, the EPA estimates, treating and distributing drinking water and wastewater together account for 3 percent of energy use. In some parts of the country, the energy toll is much higher.

California’s single biggest user of electricity is the State Water Project.²³ This system, serving 29 local water agencies, consumes enough to power more than 450,000 households²⁴ or a city roughly the size of San Diego. Similarly, the Central Arizona Project, a 336-mile aqueduct delivering water to Phoenix and Tucson, is Arizona’s largest electricity user.²⁵

WATER UNREST—Water supply conflicts are growing across the United States. Particularly in the West, conflicts between competing water users—e.g., farmers,

From: “The Energy-Water Collision: 10 Things You Should Know”

By: Union of Concerned Scientists

drought or other water stress.²⁶ Even without factoring in the exacerbating role of climate change, water supply conflicts involving several major Southwest cities—including Denver, Albuquerque, Las Vegas, and Salt Lake City—are considered highly

ELECTRICAL USE AND WATER IN CA

The Rest of that Story

Unconventional fossil fuels—such as “liquid coal” or oil from tar sands or shale—can have serious water implications. A coal-to-liquids

“California’s single biggest user of electricity is the State Water Project”

“The California State Water Project consumes 5.1 billion kWh.”

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The State Water Project (SWP) **IS** the single largest consumer of electricity in the state, consuming about 5.1 billion kilowatt hours annually.

It also **produces between 6.5 and 8.57 billion kilowatt hours annually**; mostly through hydroelectric plants on the system.

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lary in the West, conflicts between competing water users—e.g., farmers, an energy dimension, are expected to intensify, especially during periods of drought or other water stress.²⁶ Even without factoring in the exacerbating role of climate change, water supply conflicts involving several major Southwest cities—including Denver, Albuquerque, Las Vegas, and Salt Lake City—are considered highly

ELECTRICAL USE AND WATER IN CA

Electrical Use On-Farm

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CALIFORNIA TRENDS

Factors to Consider: Water Use Efficiency

- University research indicates that as farmers improve their irrigation management, specific high acreage crops (almonds, alfalfa) have actually been under-irrigated.
- Irrigation application methods are changing. Efforts to improve water use efficiency is causing a trend away from gravity-driven irrigation methods such as basin and furrow toward filtration and pressure-dependant microdrip and sprinkler systems

CALIFORNIA TRENDS

Factors to Consider: Other Pressures

-Air Quality Regulations- California's stringent air quality regulations will necessitate a move away from diesel and gasoline operated engines.

-Water Quality Discharge Regulations- California's efforts to heighten control over groundwater may require collection of tailwater at the field and farm level.

-Surface Water Supply Instability- Due to variability in surface water supplies, growers will expand groundwater pumping to provide the water needed for high-cost permanent plantings (grapes, almonds, walnuts, etc.)

CALIFORNIA ON-FARM ENERGY PROGRAMS

APEP – Agricultural Pump Efficiency Program

Run by the California State University, focused on improving grower extraction and booster pumps

Also provides grower education on testing, improving irrigation efficiency

TOU – Time of Use Programs

Operated by the largest electrical utilities, designed to shift use to off-peak times



GOT QUESTIONS?



Institute for Sustainable Development
California State University, Chico

Source:
Digital and vector data: NOAA's Coast Data Center, NOAA
Geographic data: USGS, Department of Agriculture, California Department of Water Resources, California
Elevation and vector data: National Oceanic and Atmospheric Administration, National Oceanic and Atmospheric Administration