

Environmental Aspects of Advanced Generation in California



California Energy Commission – PIER

PIER Advanced Generation Program

IEPR Staff Workshop on
RD&D of Advance Generation Technologies
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Water Use for Electricity Generation
Joe O'Hagan PIER
John Maulbetsch



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Overview

- Why is power plant water use important?
- How do power plants use water?
- Cooling technologies and tradeoffs
- PIER research



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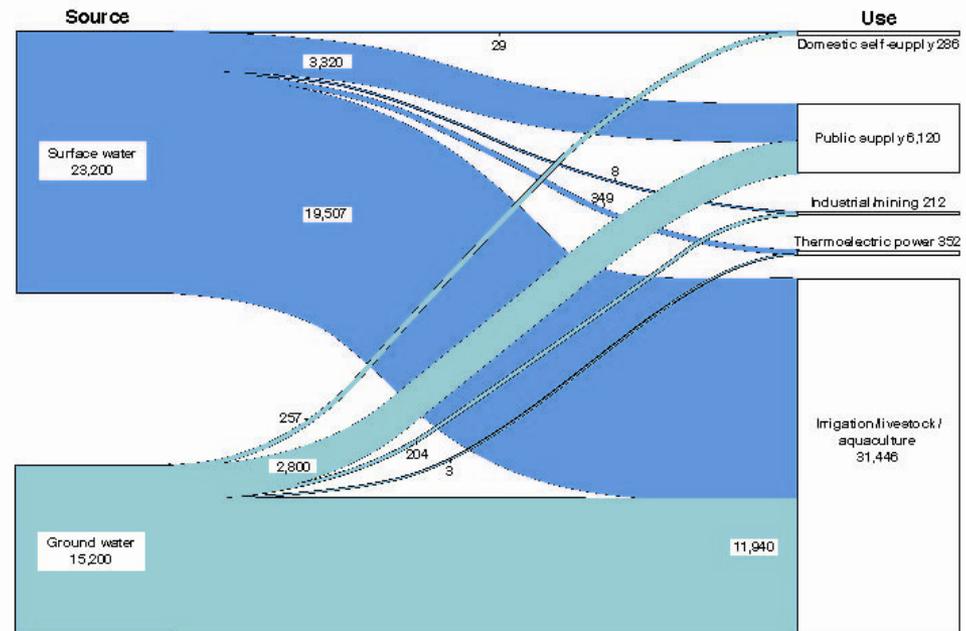


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Why is power plant water use important?

- California's limited freshwater resources are increasingly being stressed by a warming climate and population growth.
- The large volumes of water used by power plants using once-through cooling technology has raised concerns over biological impacts
- Water consumption by power plants is not significant on a statewide basis
- Can be significant on local or regional basis
- Reducing the effects of energy generation on water can reduce environmental damage and ensure energy reliability.

Figure 2. Estimated California Freshwater* Withdrawals in 2000: 38,400 Mgal/day



Source: U.S. Geological Survey, Circular 1268, Tables 1-4.
In addition, 12,888 Mgal/day of saline water was withdrawn, primarily for thermoelectric power purposes.
Note: Numbers shown may not add to totals because of independent rounding.

Lawrence Livermore National Laboratory, May 2004
<http://eed.llnl.gov/iow>

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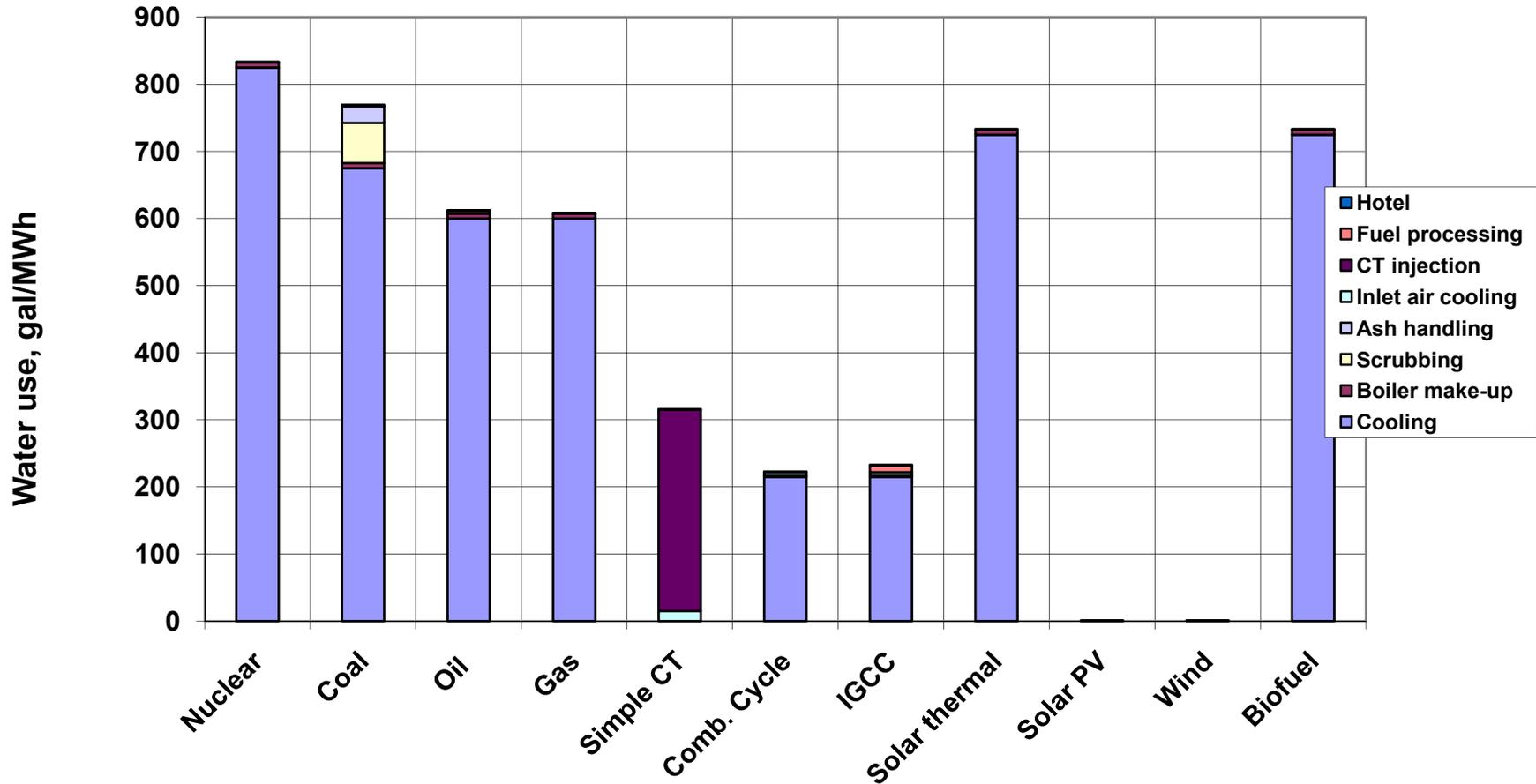


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How does a power plant use water?

Cooling (steam condensation) can represent 90% or more

Water Requirements by Plant Type



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How can we use less water?

- Degraded water sources
- Water conserving cooling technologies



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Degraded water sources

Sources

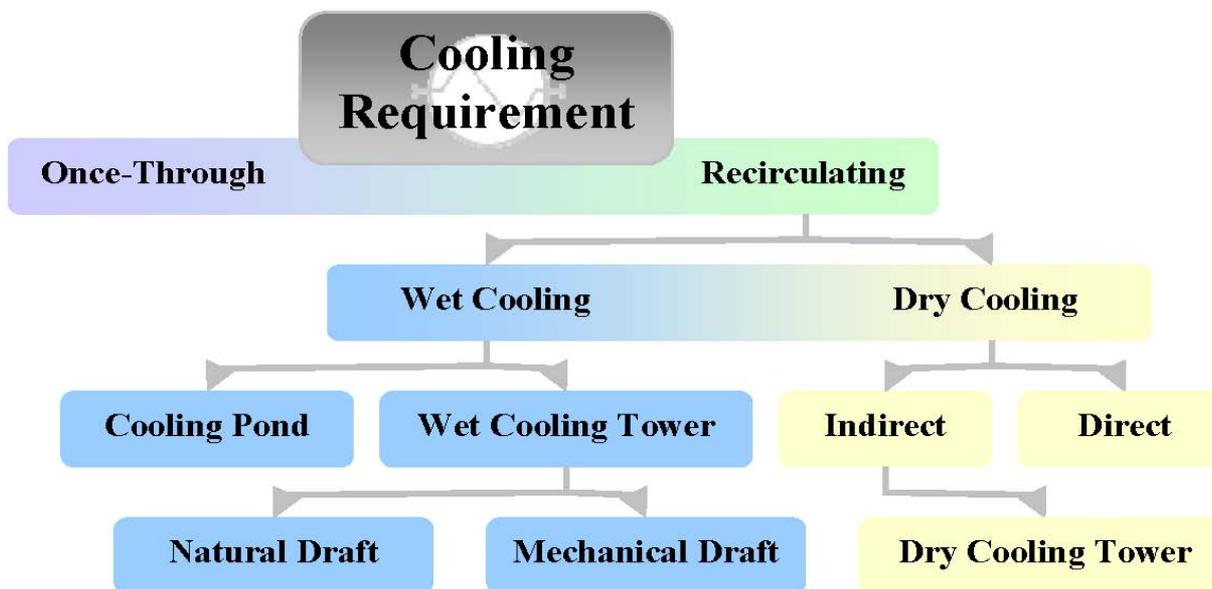
- Wastewater effluent
- Produced water from oil & gas extraction
- Irrigation return flows
- Contaminated/saline groundwater

Challenges

- Consistent water availability and quality
- Treatment costs
- Transportation costs
- Heat transfer surface
- Scaling & corrosion
- Disposal
- Drift/health



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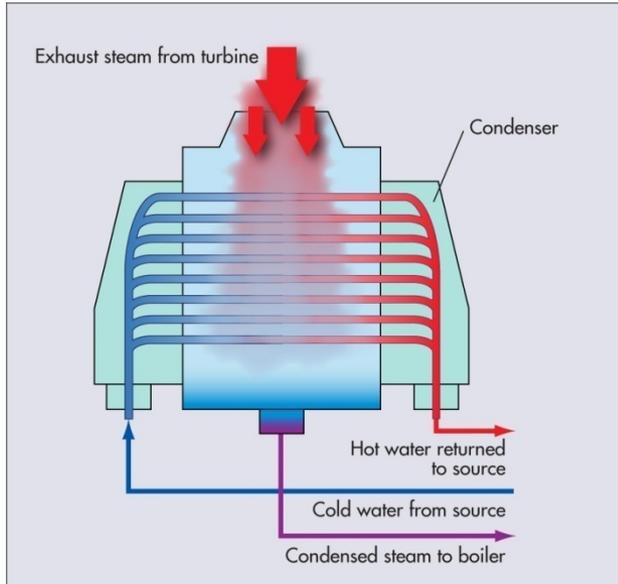
Once-through Cooling

Pros:

- High cooling efficiency, especially in areas with cold water
- Lower consumptive use of water
- Mature technology

Cons:

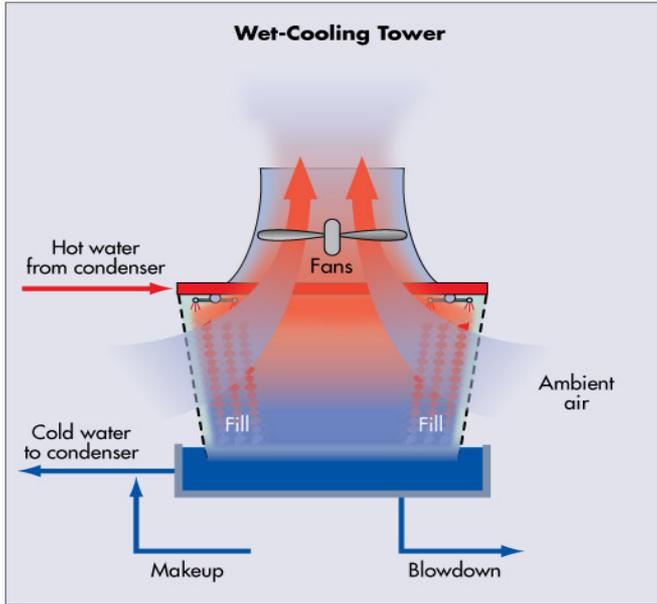
- State Water Resources Control Board Policy
- Clean Water Act 316(b) Rules for fish protection
- CWA 316(a) thermal discharge limits, especially in drought conditions



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EPRI 2008



Wet Cooling Towers

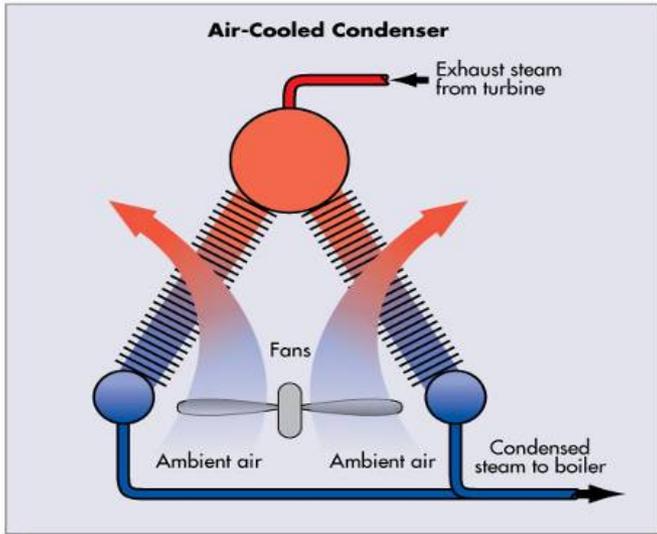
Pros:

- Substantially less water withdrawal than once-through
- System of choice for most plants
- Mature technology

Cons:

- Higher consumptive use of water
- Higher parasitic load
- Lower plant efficiency
- Blowdown
- Plume and drift issues

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Dry Cooling

Pros:

- No water consumption
- Eliminates plume/drift issues

Cons:

- Higher capital cost
- Higher power consumption
 - Lower plant efficiency
 - Hot weather impacts
 - Large space requirement
 - Wind effects

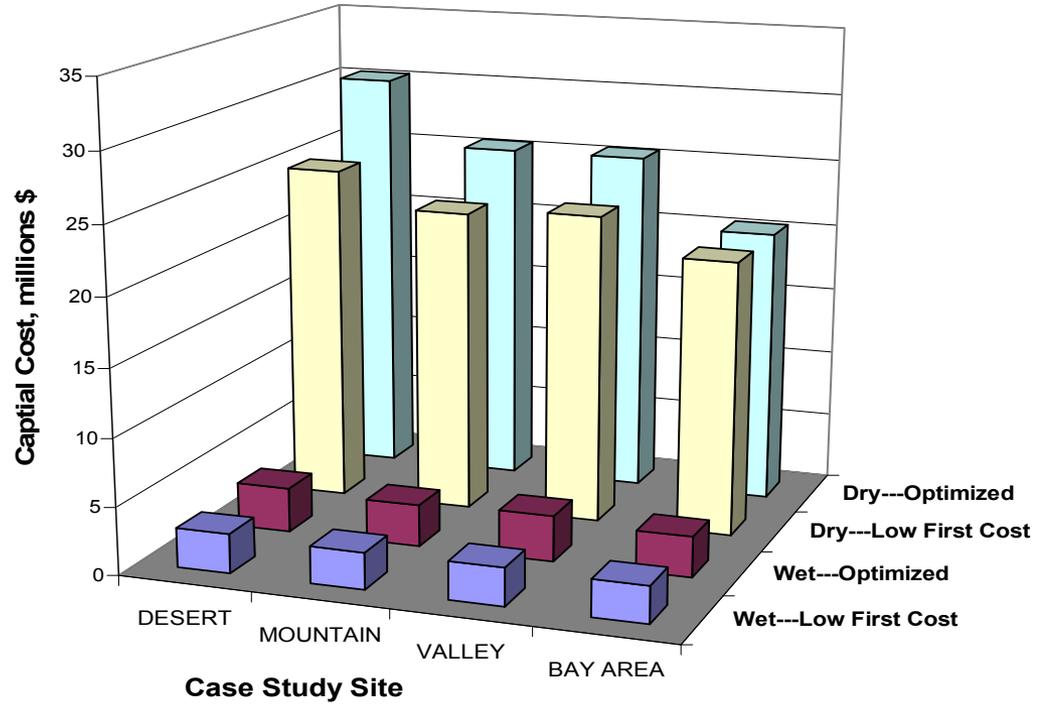
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Case Study Cost Summary



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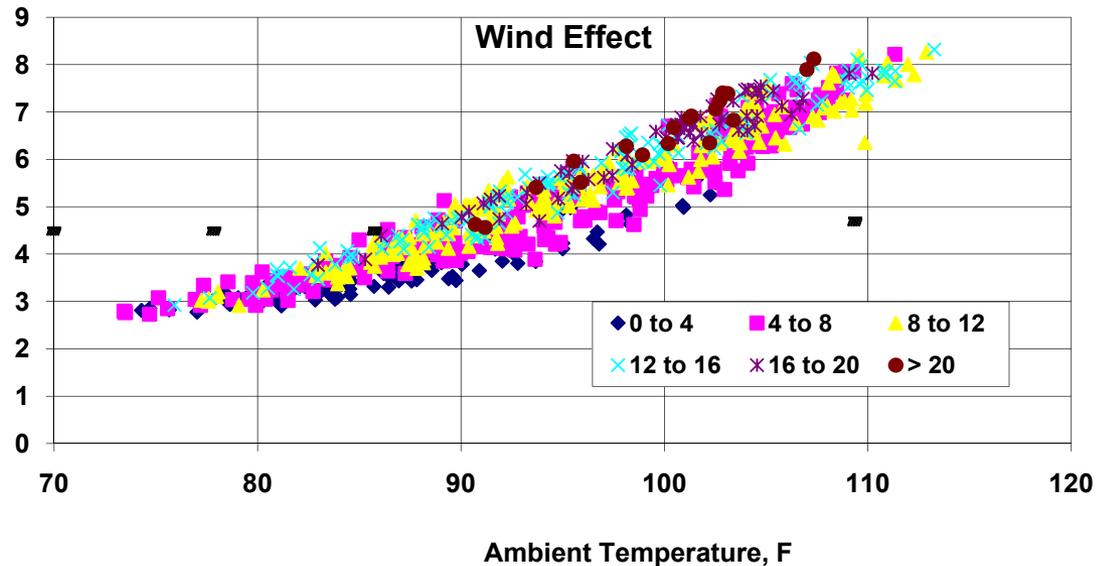
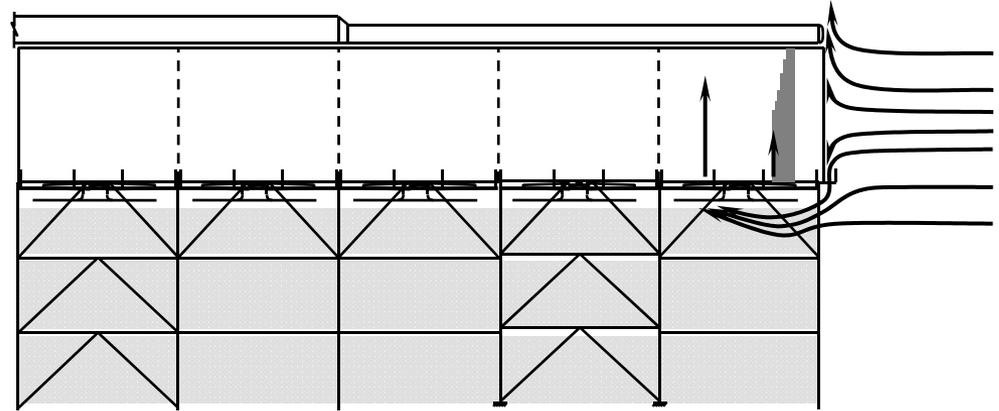
Research

- Spray-enhancement of air-cooled condensers
- Reduce wind effects on air-cooled condensers



Wind Effects on Air-Cooled Condensers

Wind can affect the performance of dry cooling systems by causing the recirculation of the hot exhaust plume back into the condenser or by reducing fan performance.



Environmental Research is making a difference



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- Questions?

