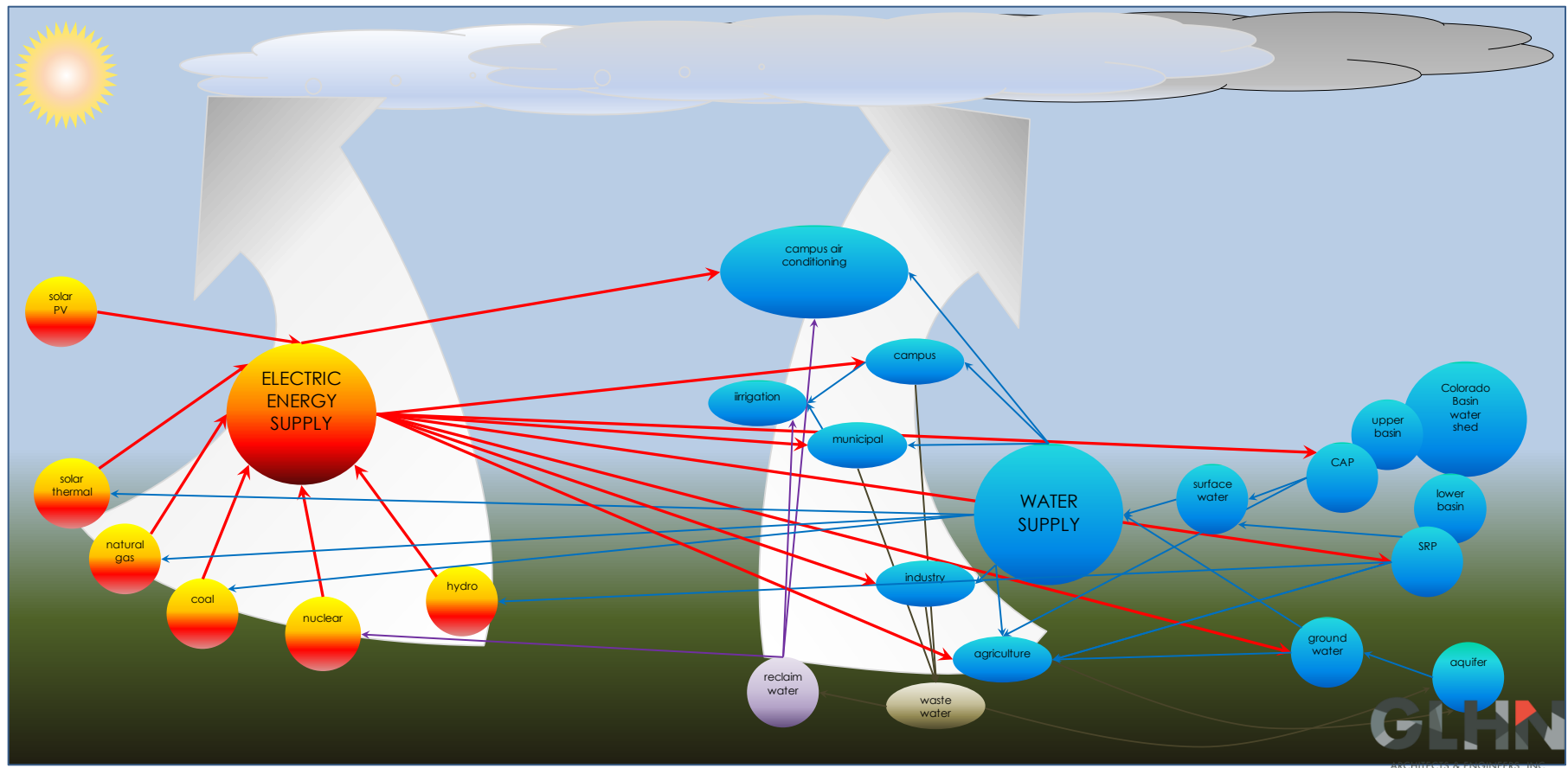


Energy Water Air Conditioning Cooling Tower Water Consumption Nexus

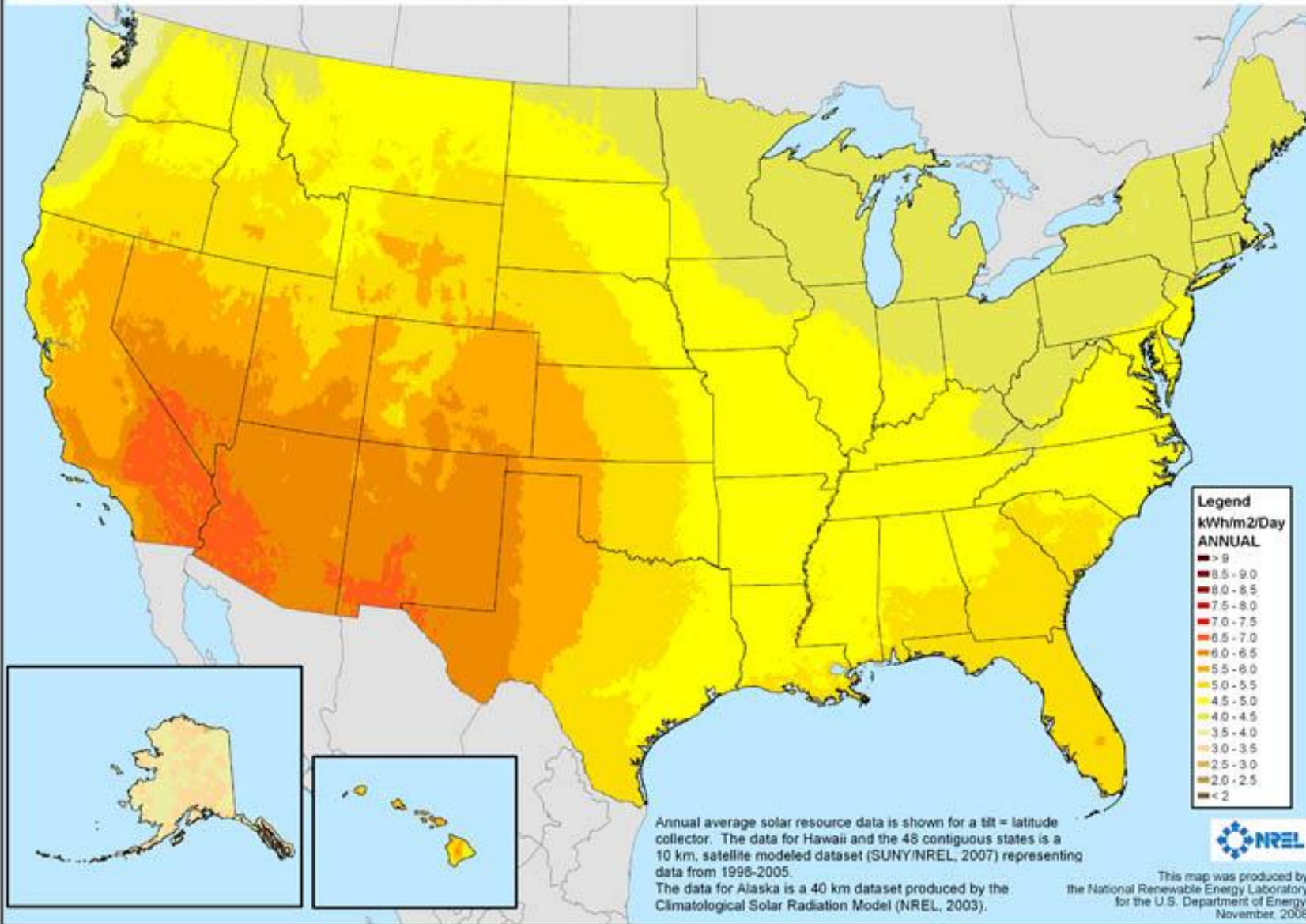




Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
© 2016 Google
US Dept of State Geographer

Photovoltaic Solar Resource: Flat Plate Tilted South at Latitude

Annual





California

Nevada

Utah

Colorado

New Mexico

Arizona

Los Angeles

Phoenix

San Diego

Tucson Arizona

Baja California

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

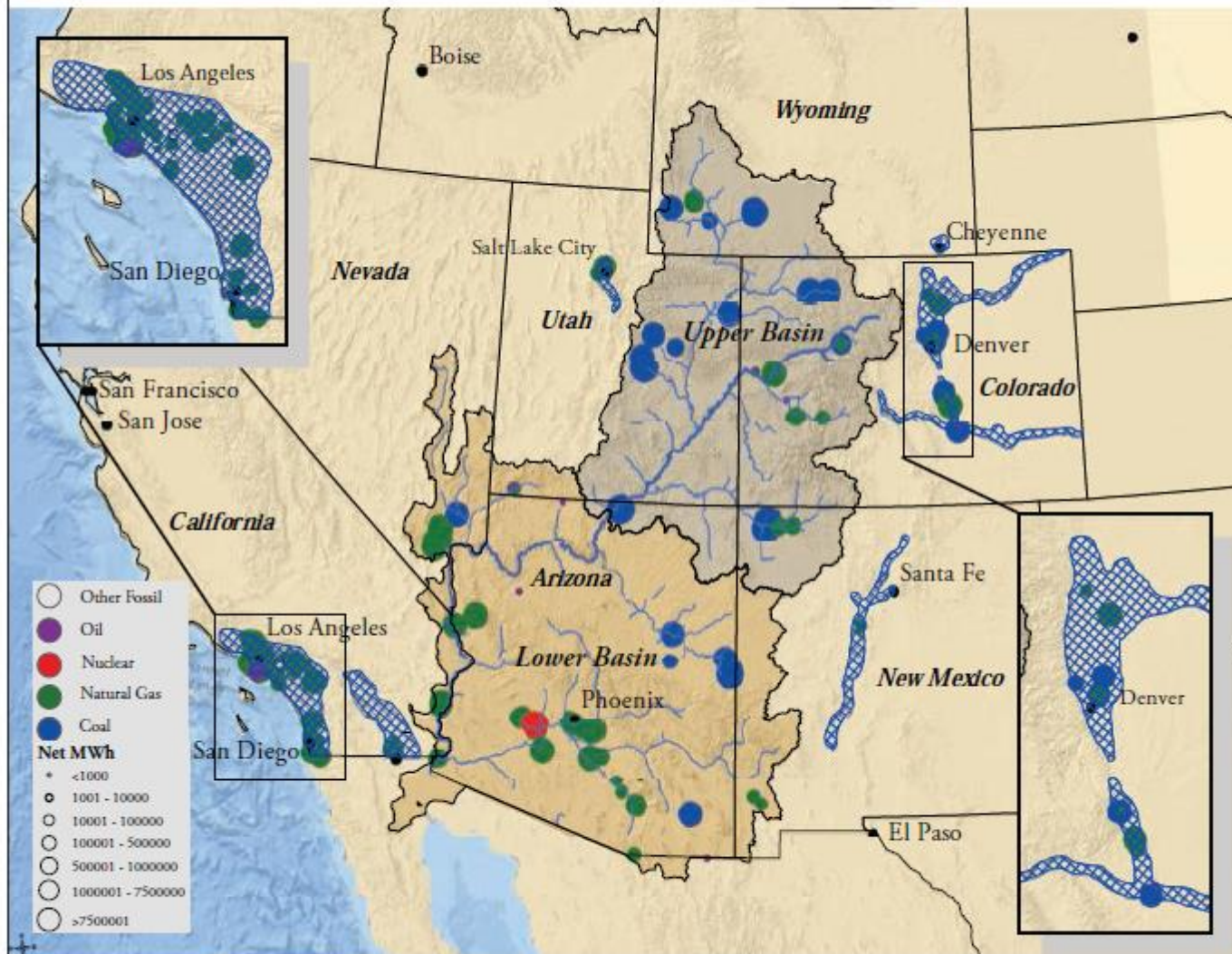
Image Landsat

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ENERGY

Figure 3: Nonrenewable Power Plants by Fuel Type in the Basin



Source: United States Environmental Protection Agency. eGrid Survey. Year 2009 eGRID2012 Boiler, Generator, Plant, State, PCA, eGRID Subregion, NERC Region, U.S., and Grid Gross Loss (%) Data Files. eGRID plant year 2009 data (4/27/12). 2012.

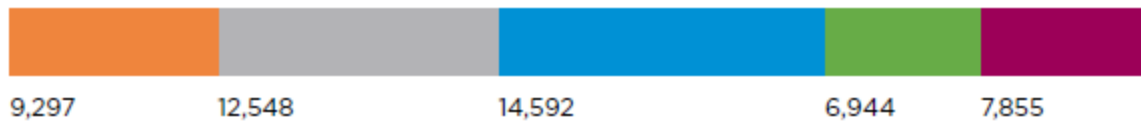
HOW THE PORTFOLIO MAY CHANGE

COMPOSITION OF ENERGY MIX BY RESOURCE (GWH)

2014



2029



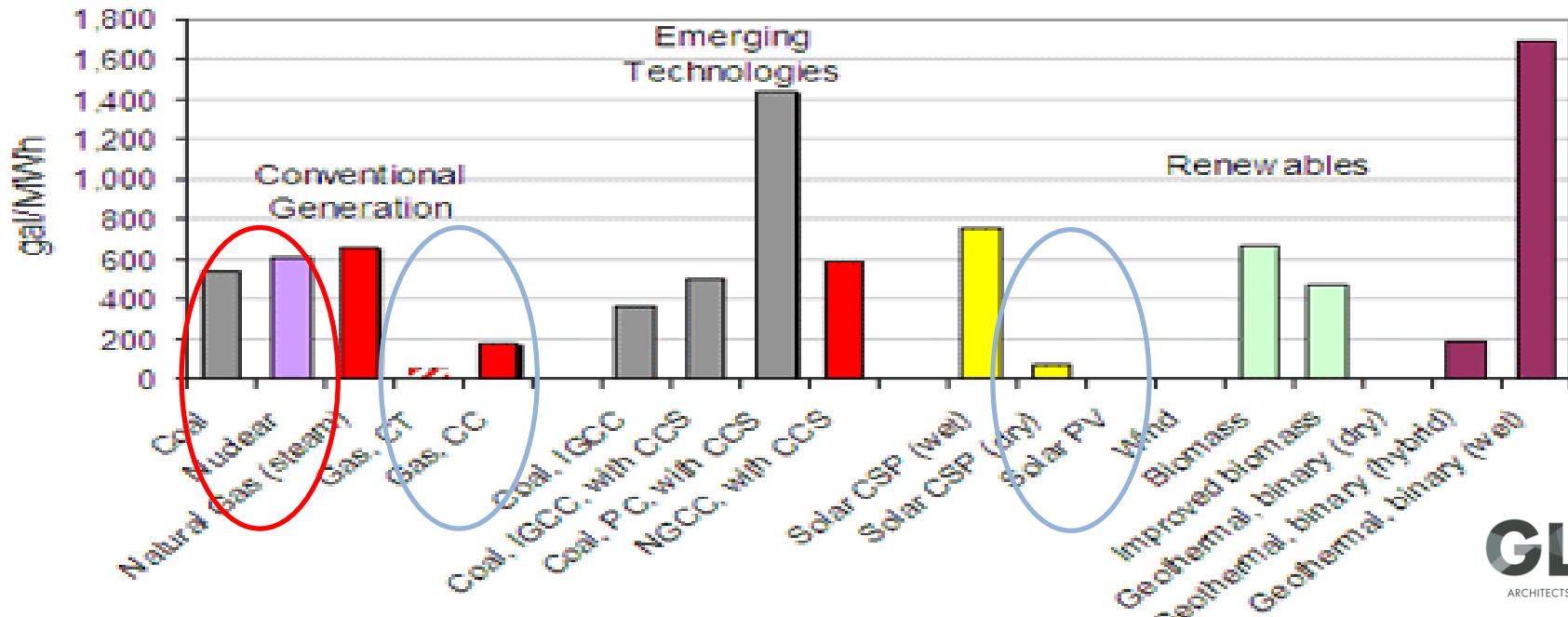
■ Nuclear
 ■ Coal
 ■ Natural Gas
 ■ Renewable Energy
 ■ Energy Efficiency

Figure ES-2 - 2014 vs. 2029 Energy Mix

Improves Environmental Performance:

- CO₂ Intensity ▼ 14%
- Water Intensity ▼ 24%

Water Intensity of Electricity Generation



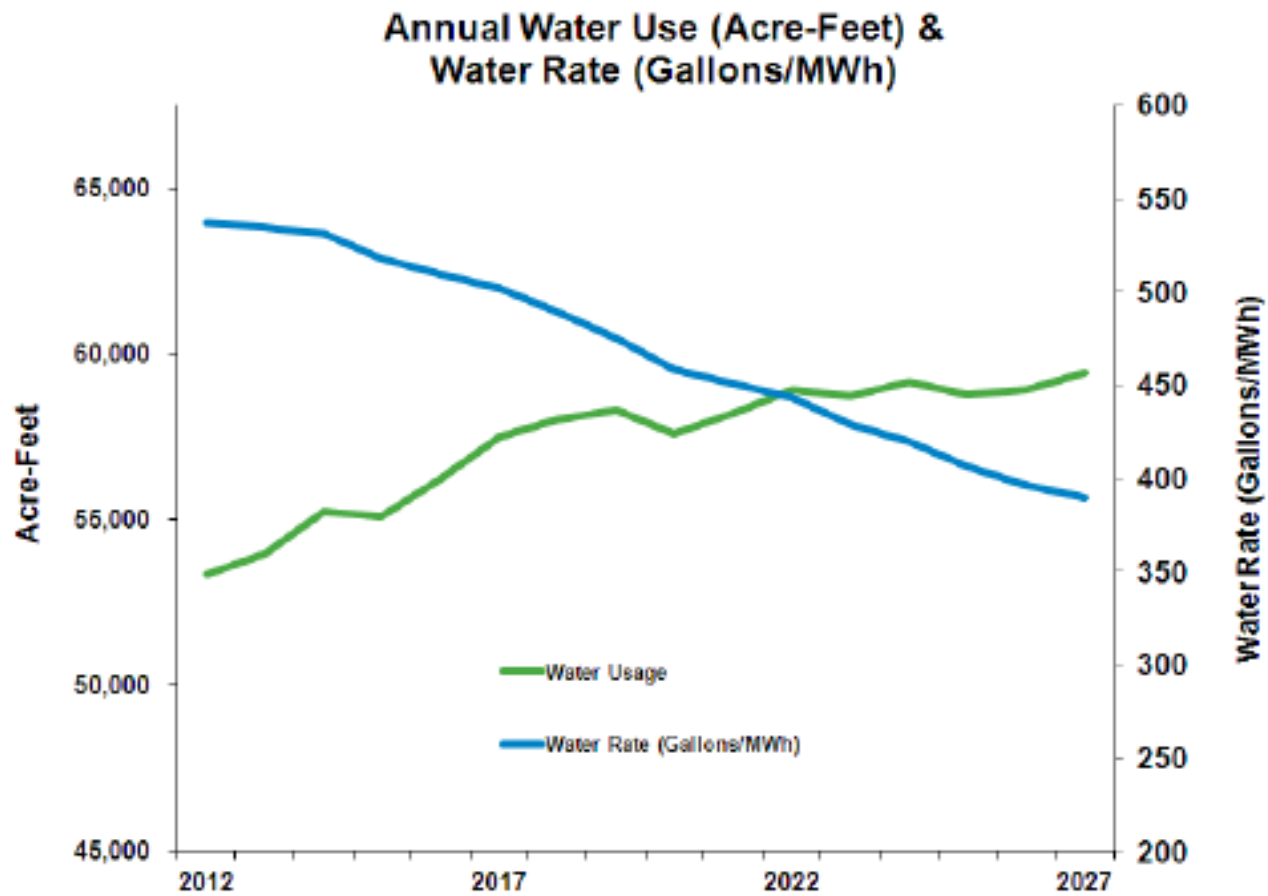
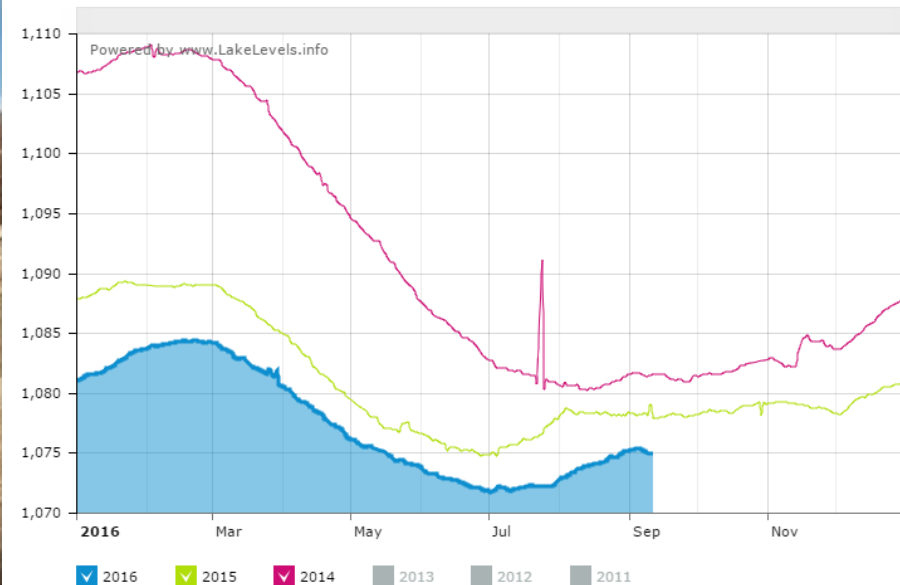
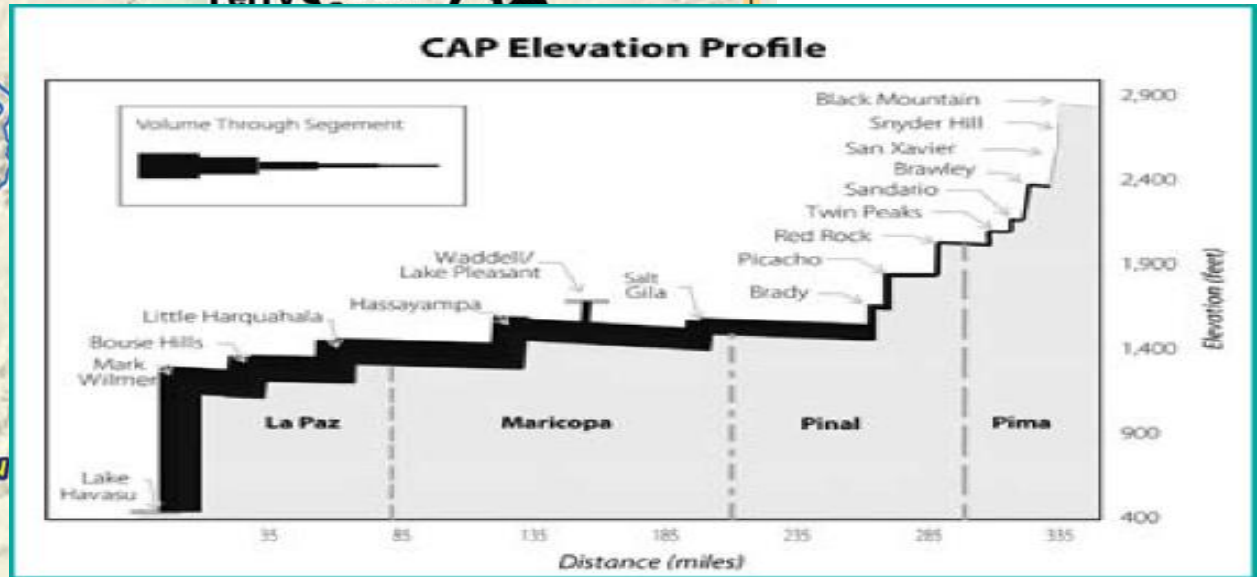
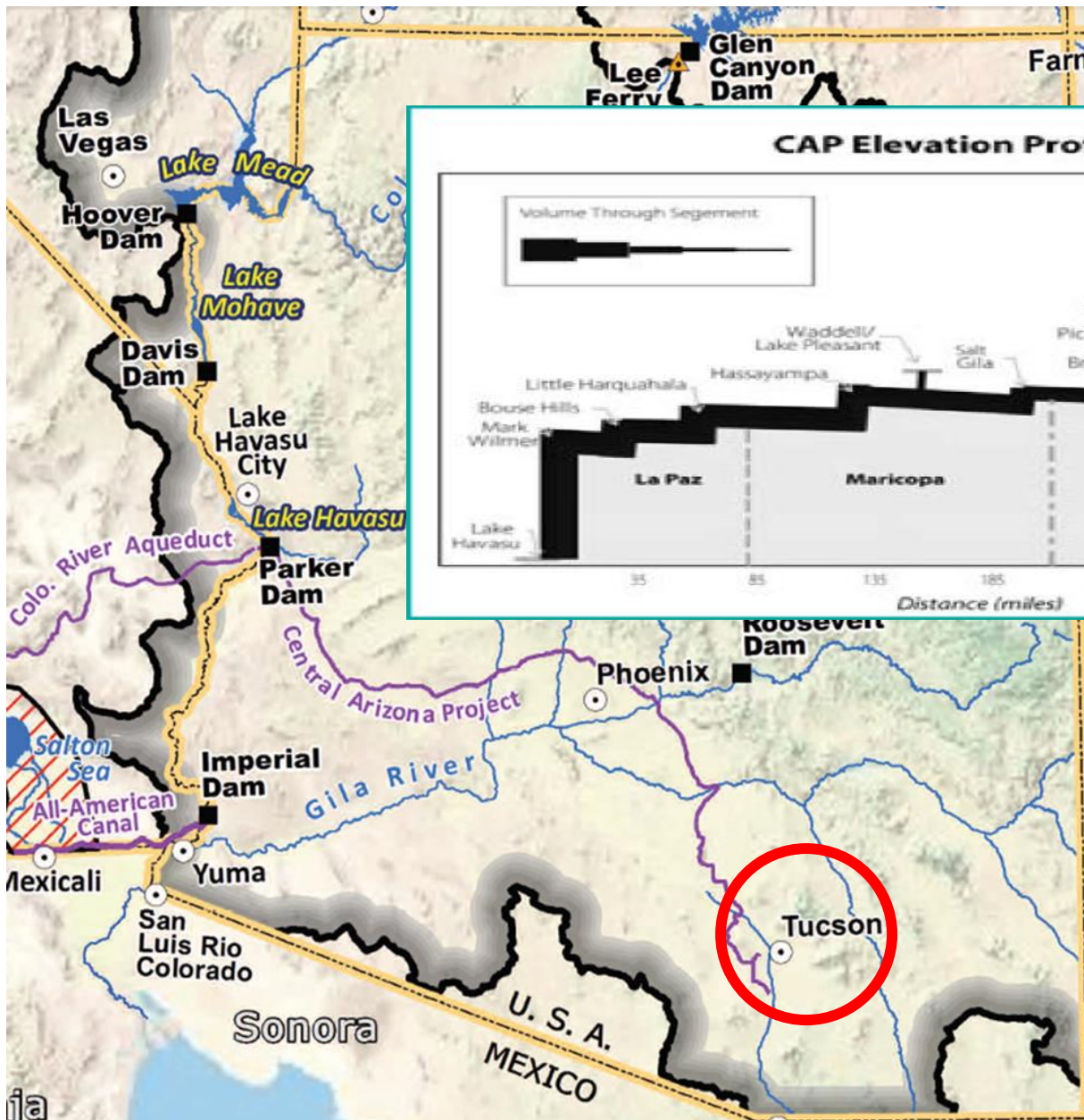
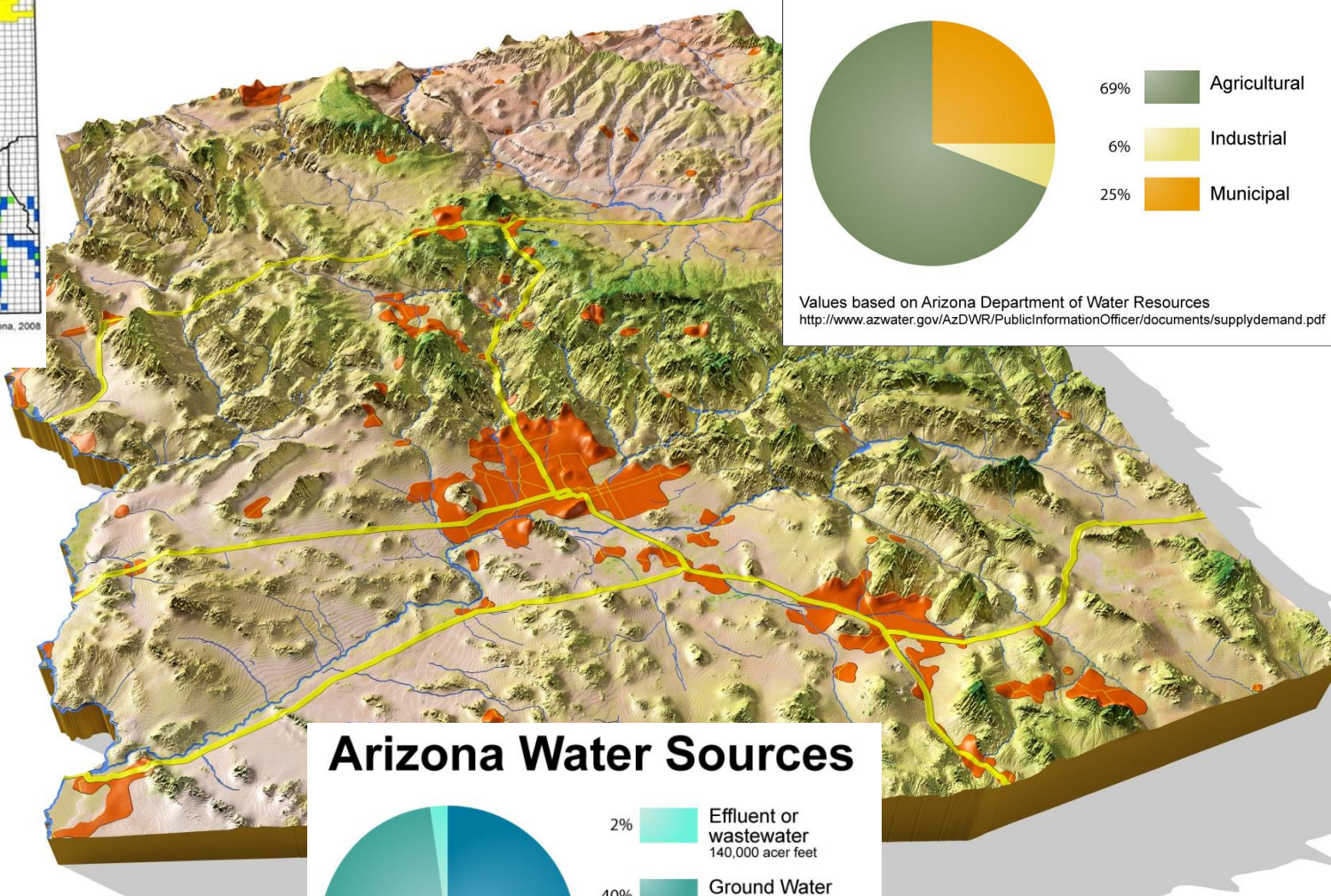
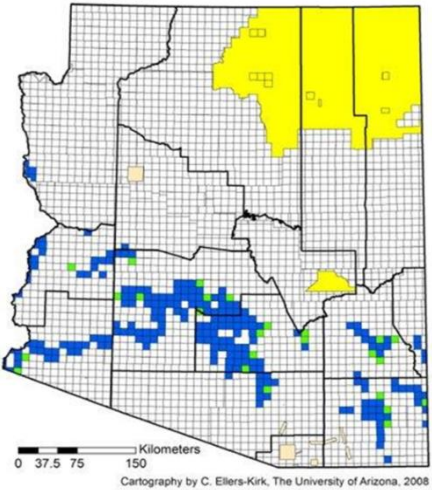


Figure 41 - Forecast of Water Consumption and Intensity

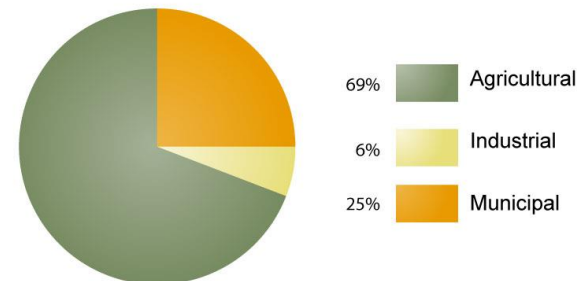
Source: Arizona Public Service Integrated Resource Plan 2012





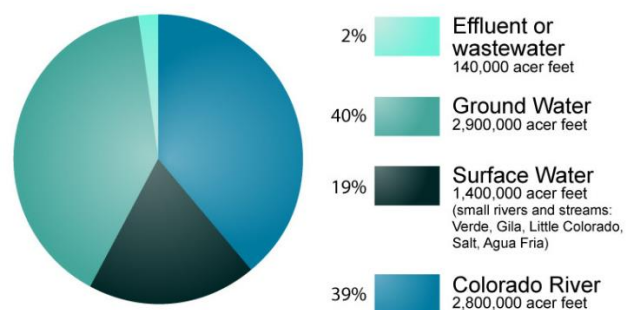


How do we use water?

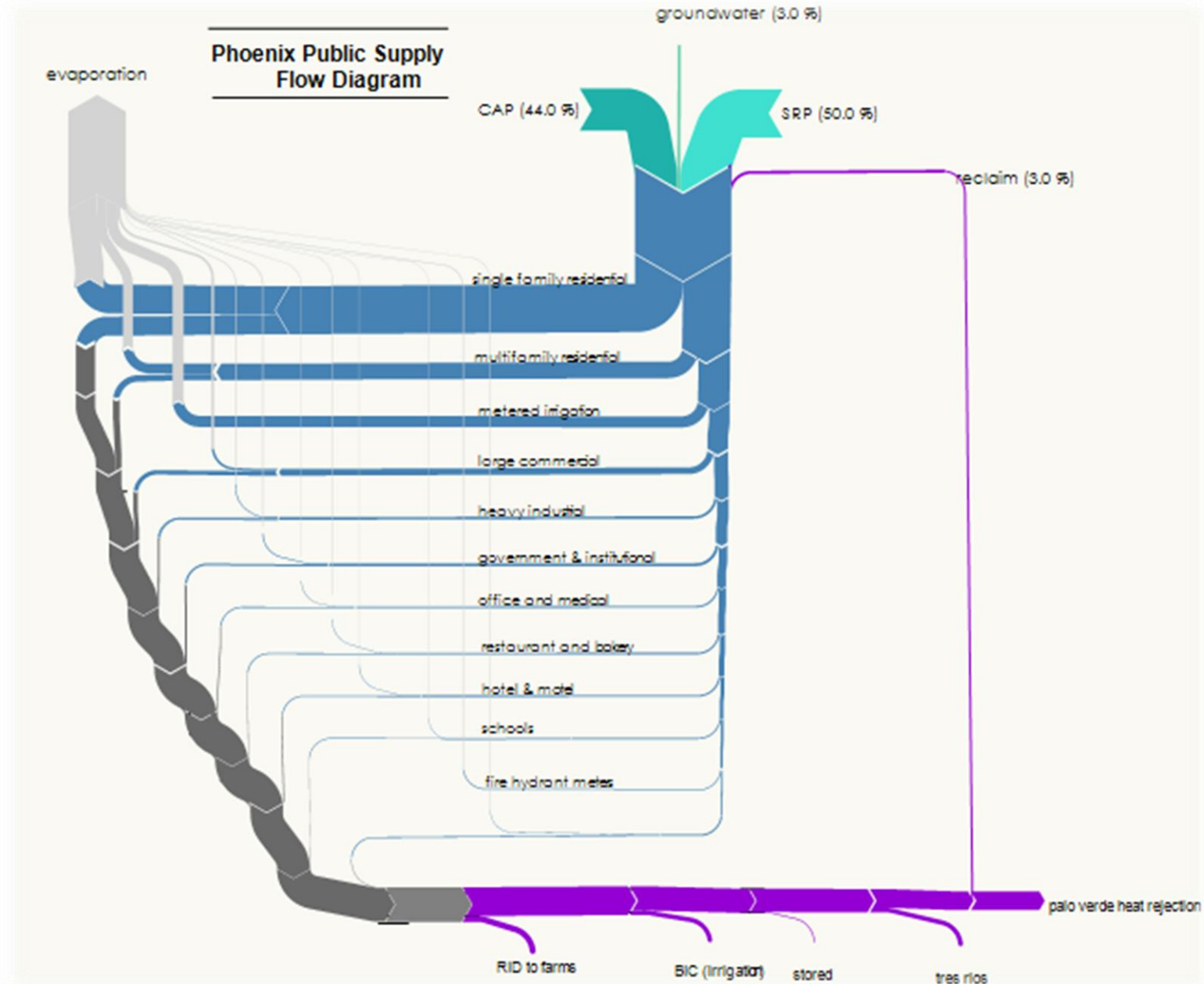


Values based on Arizona Department of Water Resources
<http://www.azwater.gov/AzDWR/PublicInformationOfficer/documents/supplydemand.pdf>

Arizona Water Sources



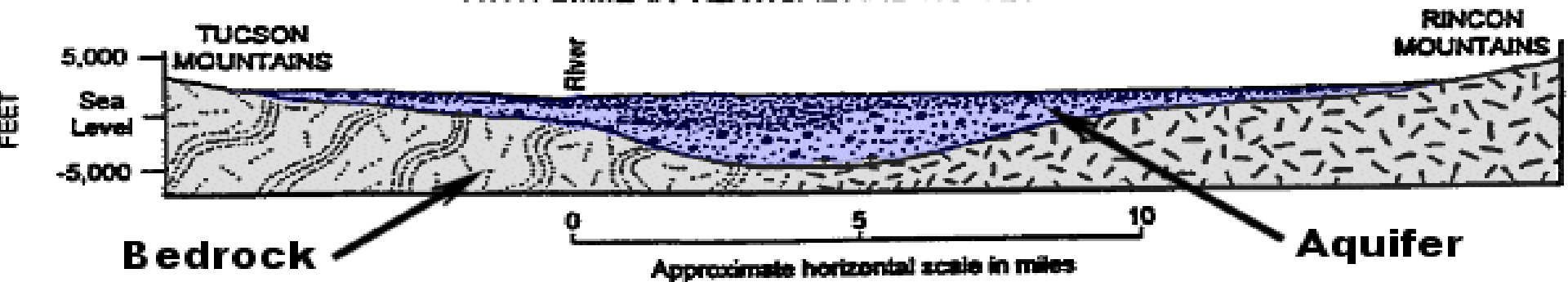
Values based on Arizona Department of Water Resources ABC's of Water
<http://www.azwater.gov/AzDWR/PublicInformationOfficer/ABCofWater.htm>

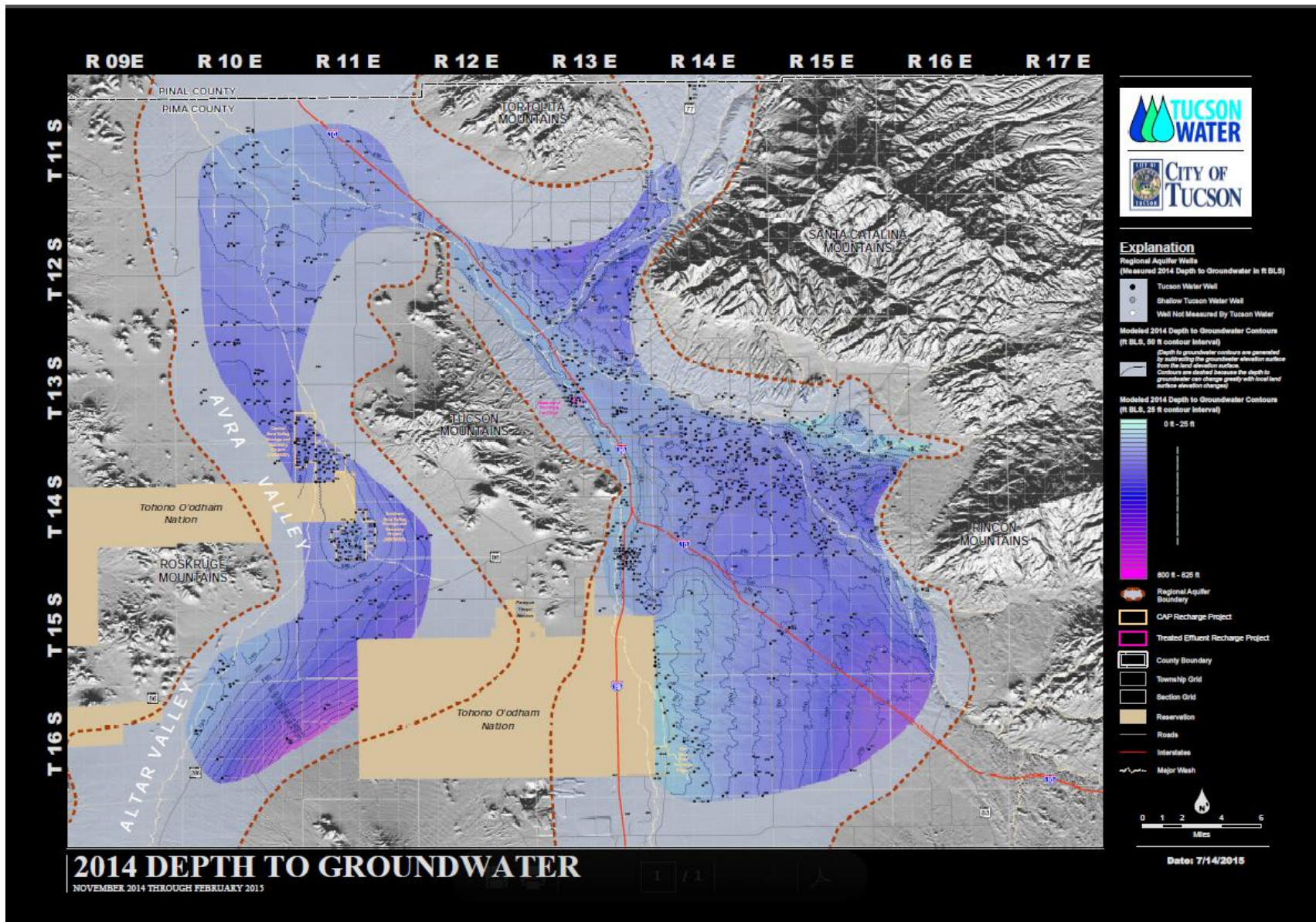


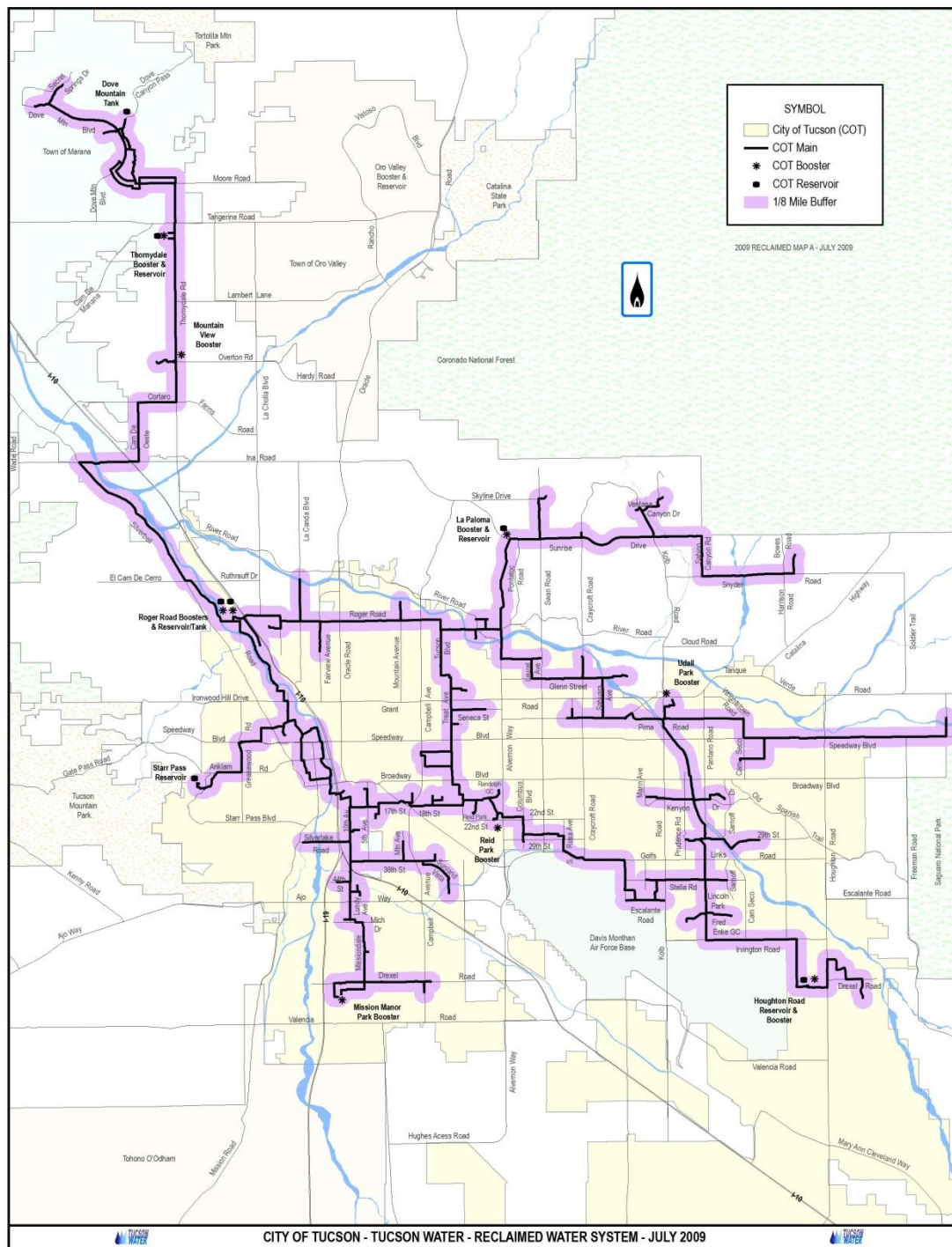
Source: City of Phoenix Water Services Department 2011 Water Resource Plan



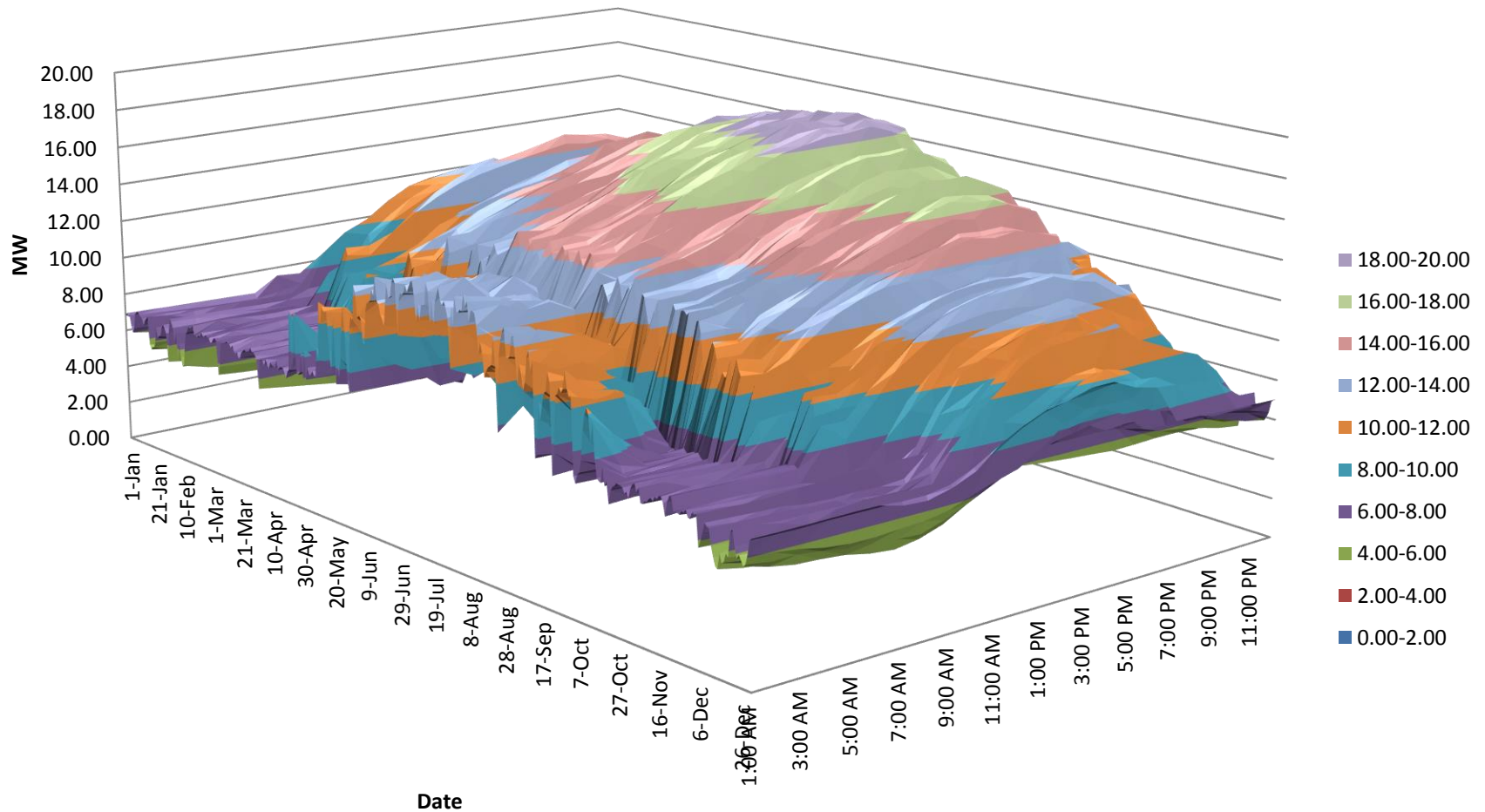
**SCHEMATIC CROSS SECTION OF UPPER SANTA CRUZ VALLEY SUBBASIN
WITH SIMILAR VERTICAL AND HORIZONTAL SCALES**





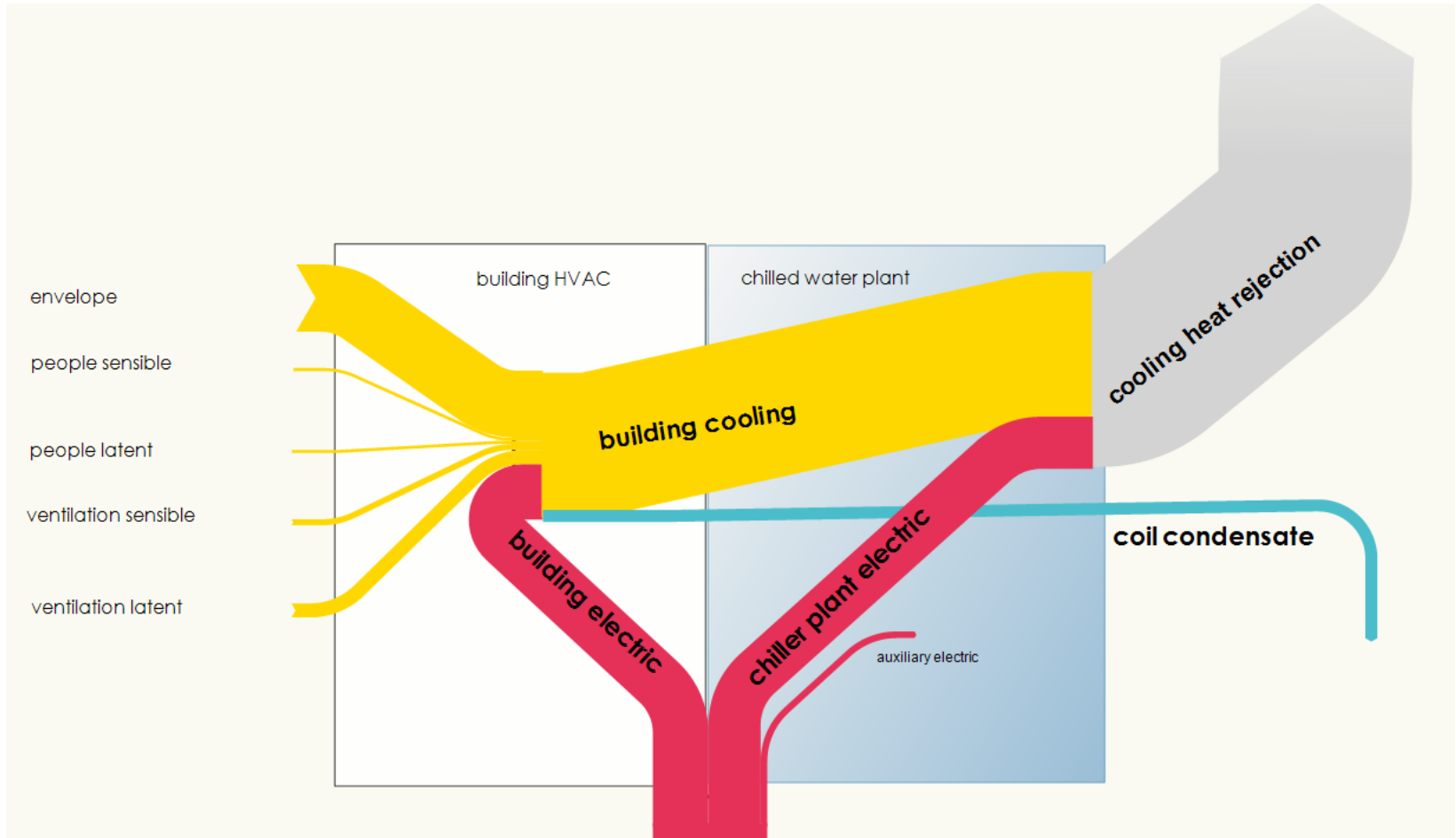


Annual Load Profile



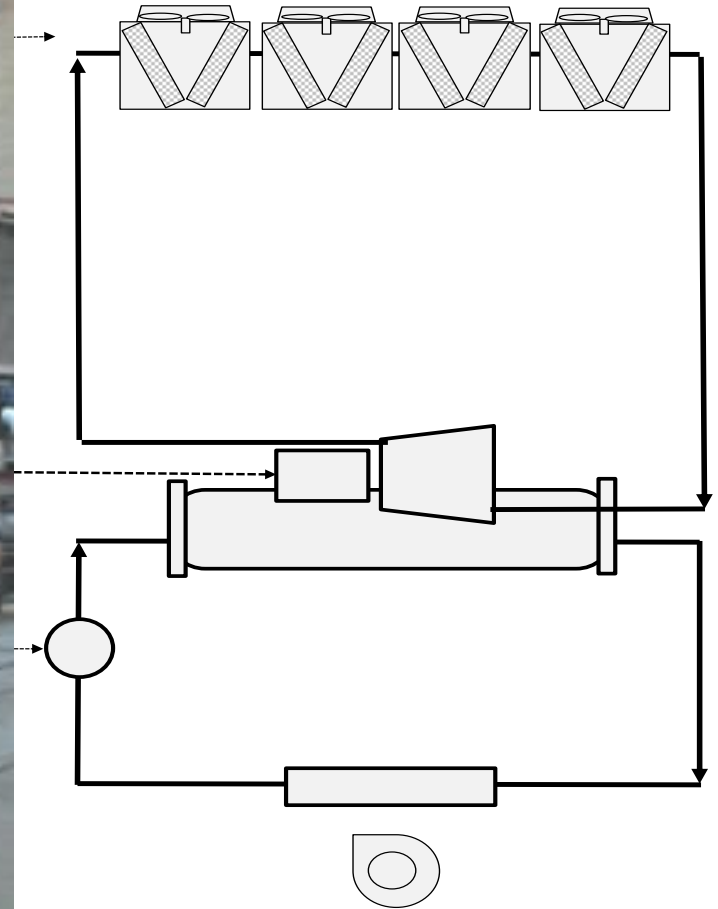
Note: All data points are as reported by NOAA for Tucson International Airport.

Building Cooling Load

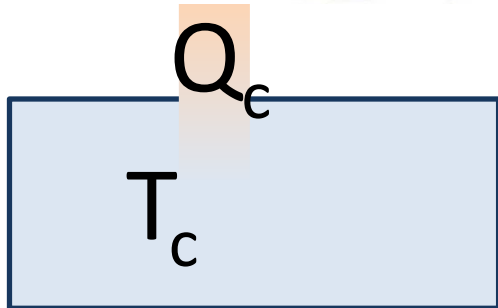
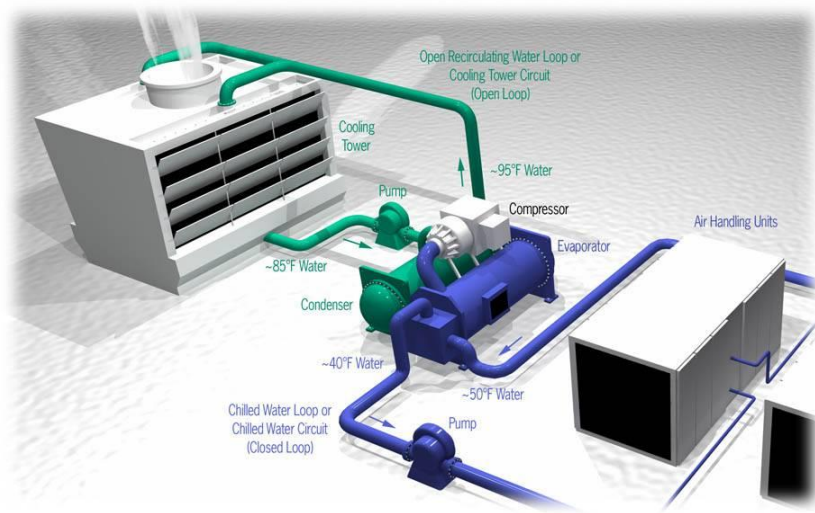
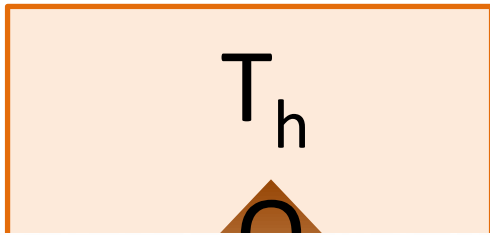
 Q_h Q_c  W

Chiller Efficiency

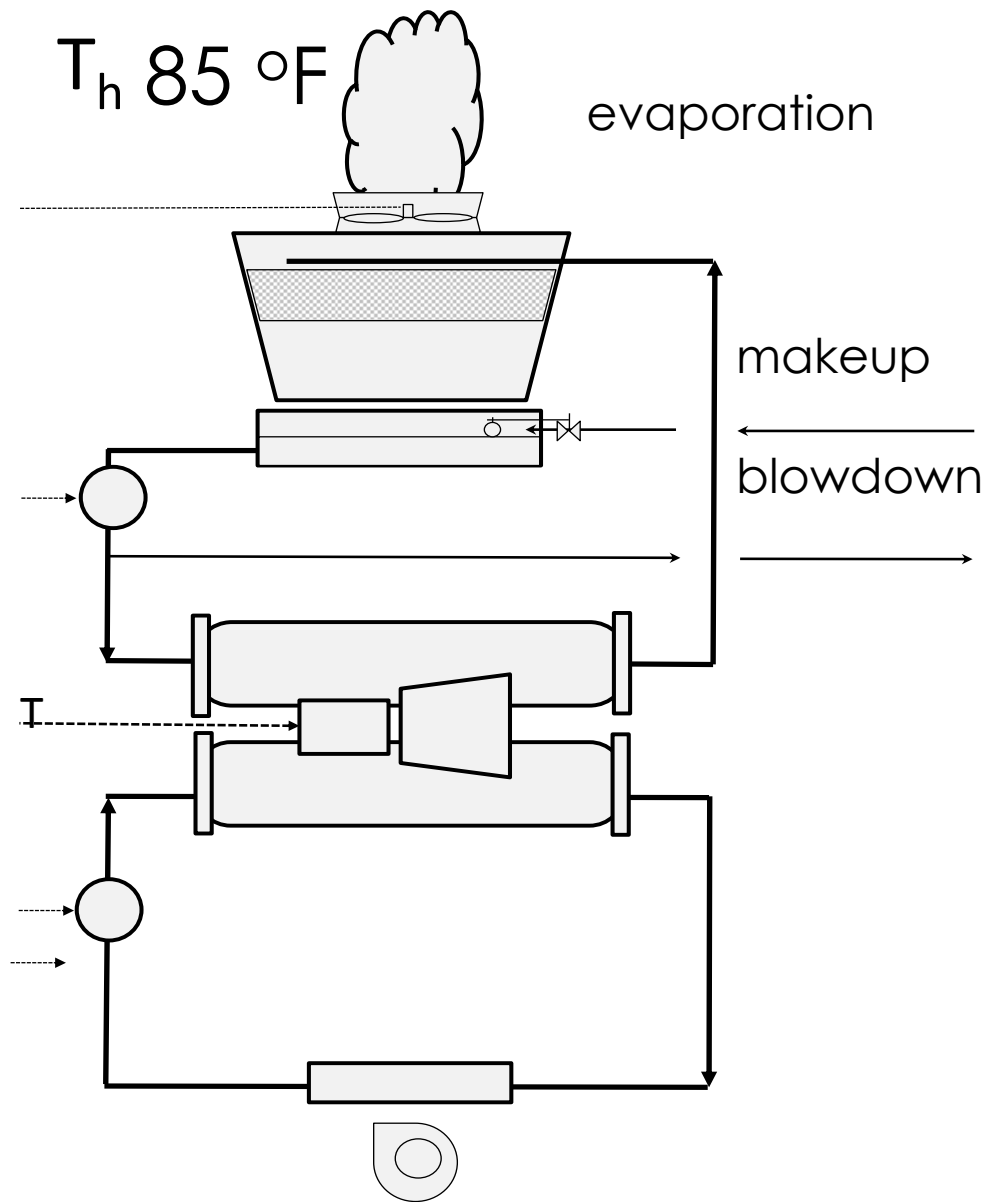
T_h 110 °F



Air Cooled Condenser



Heat Engine

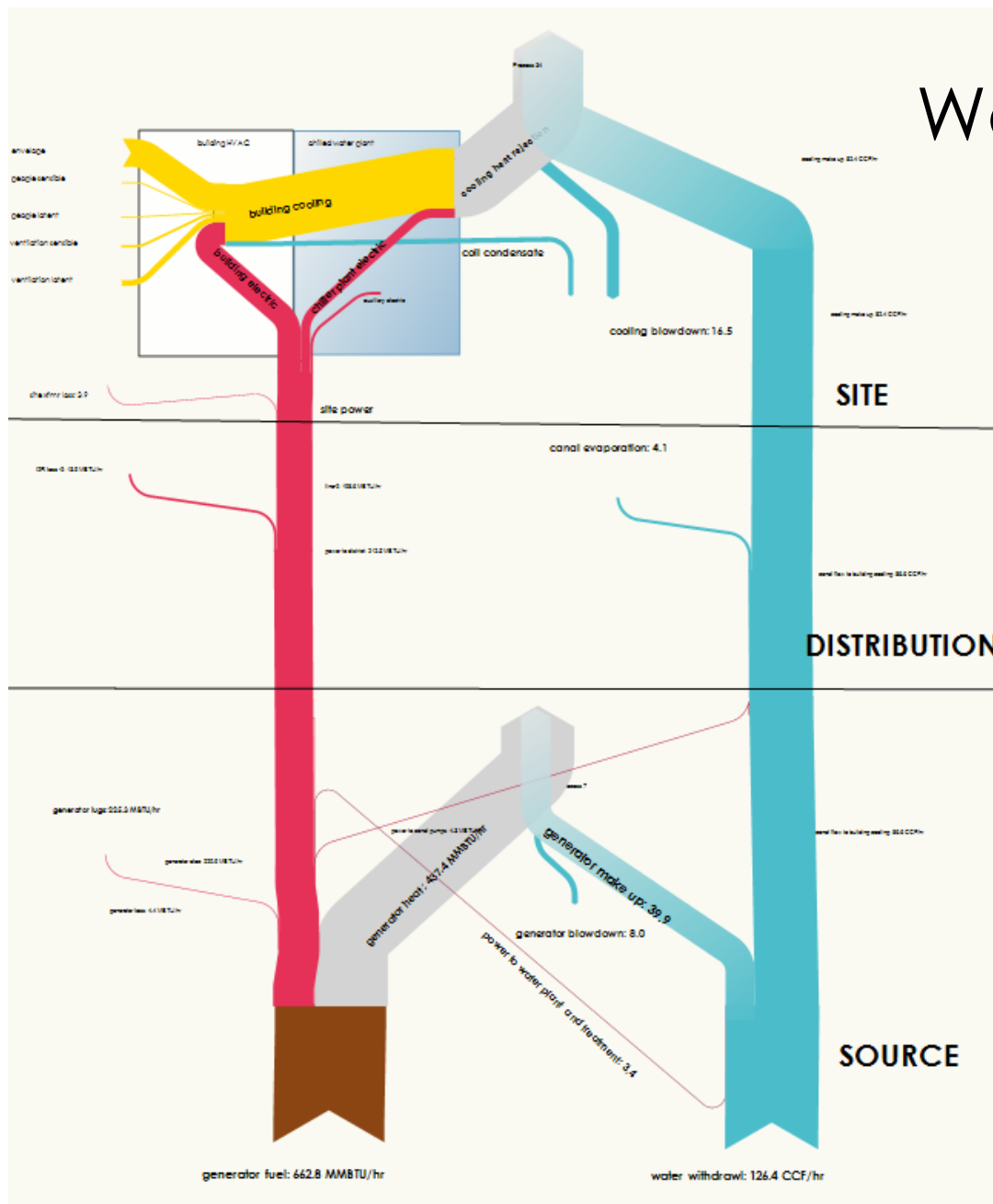


Water Cooled Condenser

Downloaded from <https://www.cambridge.org/core>. University of Cambridge, on 02 Jun 2020 at 10:00:00, subject to the Cambridge Core terms of use, available at <https://www.cambridge.org/core/terms>. <https://doi.org/10.1017/9781009054000.007>

Gal/Tonhr

1000



Water- Air Conditioning

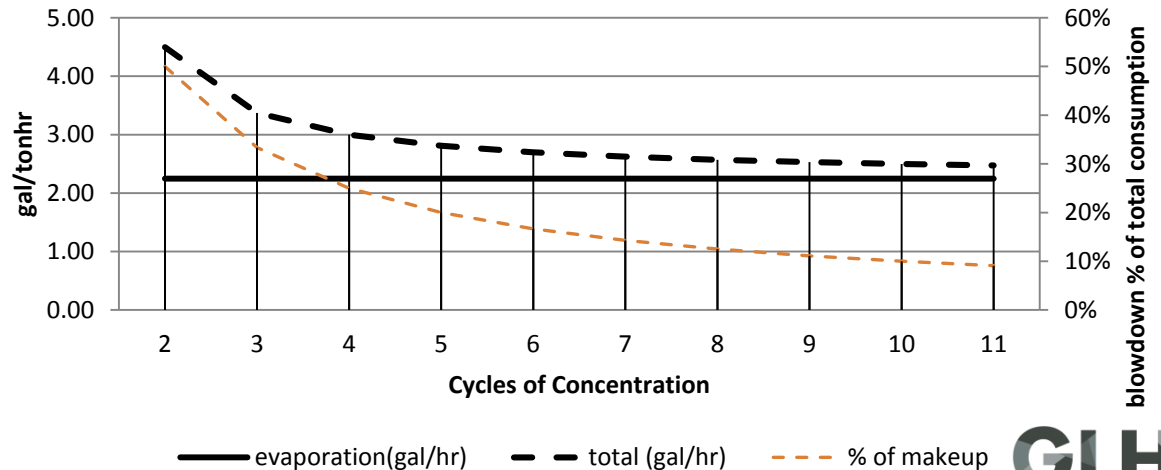
15,000,000
BTU/hr

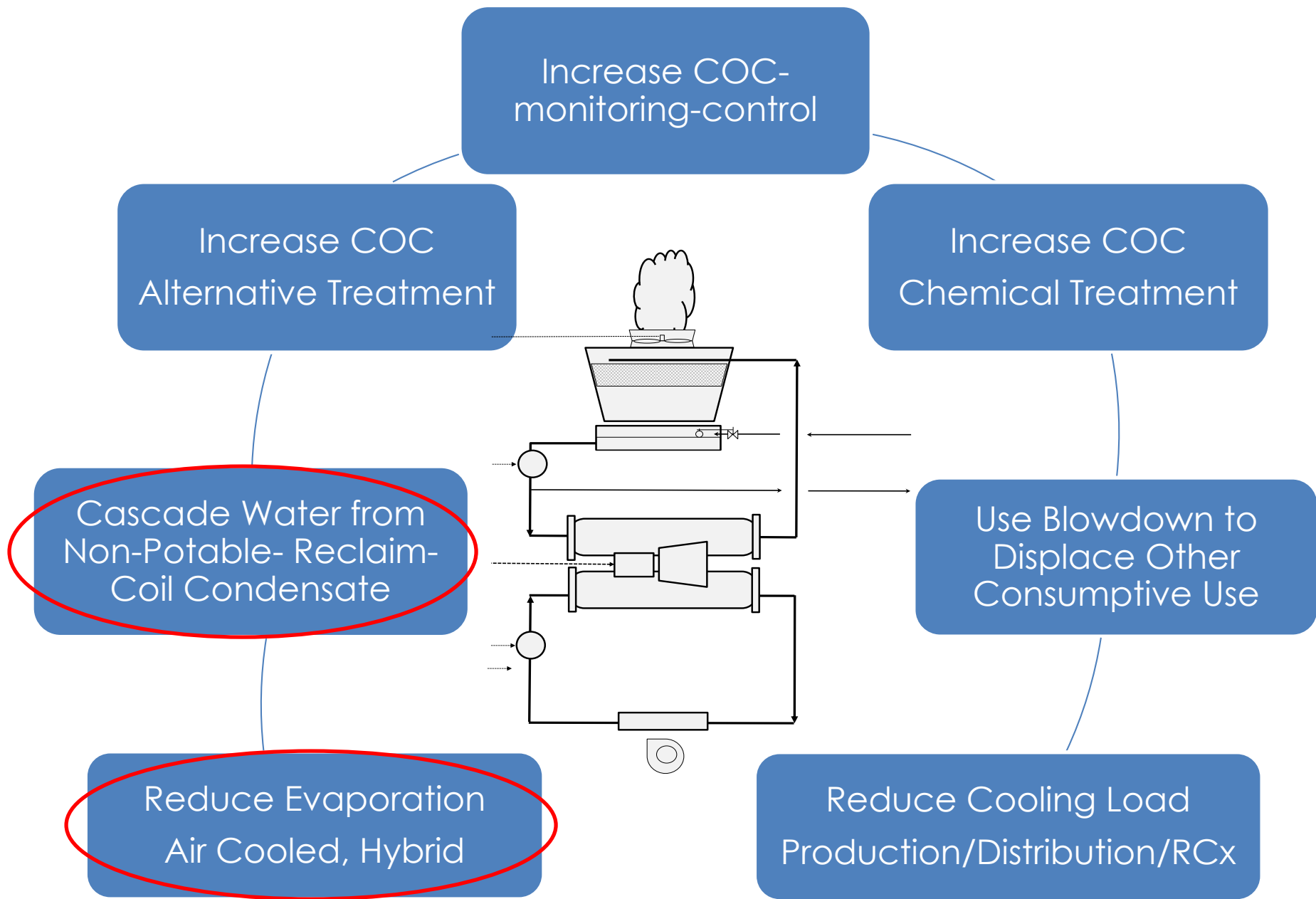
Evaporation: 1.8 Gal/Ton

Makeup: 2.25 Gal/Tonhr

Blowdown: 0.45 Gal/Tonhr

Cooling Tower Water Consumption



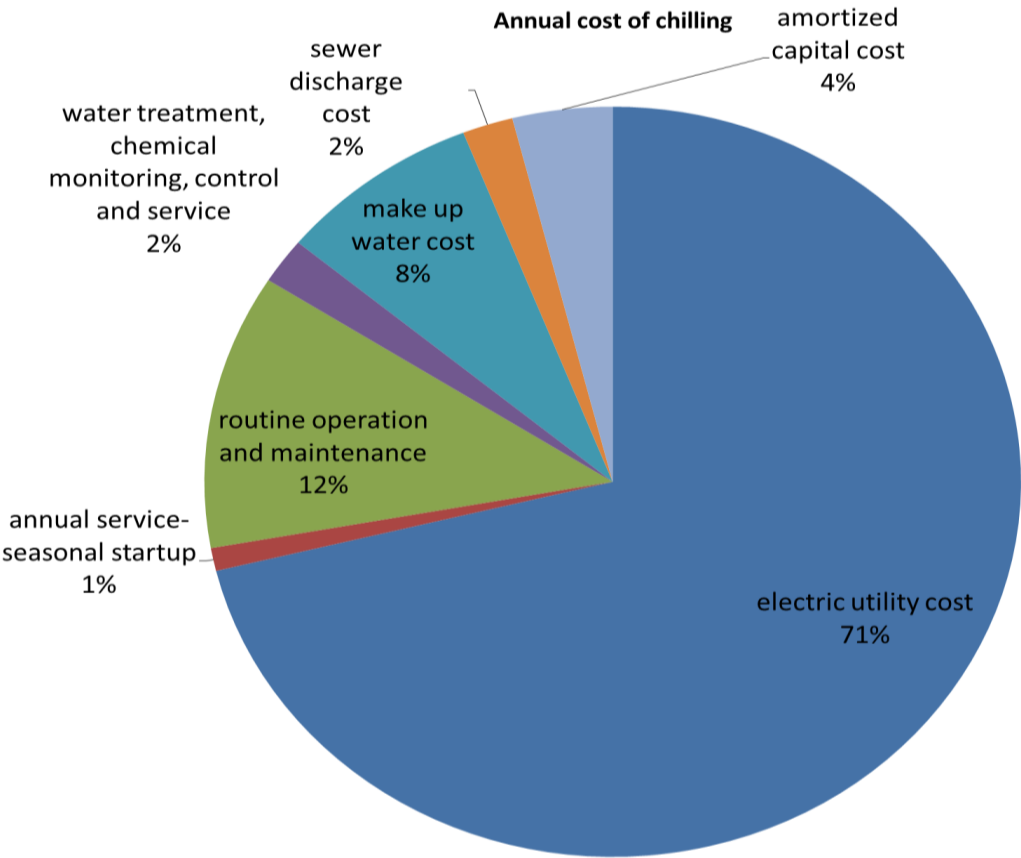


Routes to Air Conditioning Water Conservation

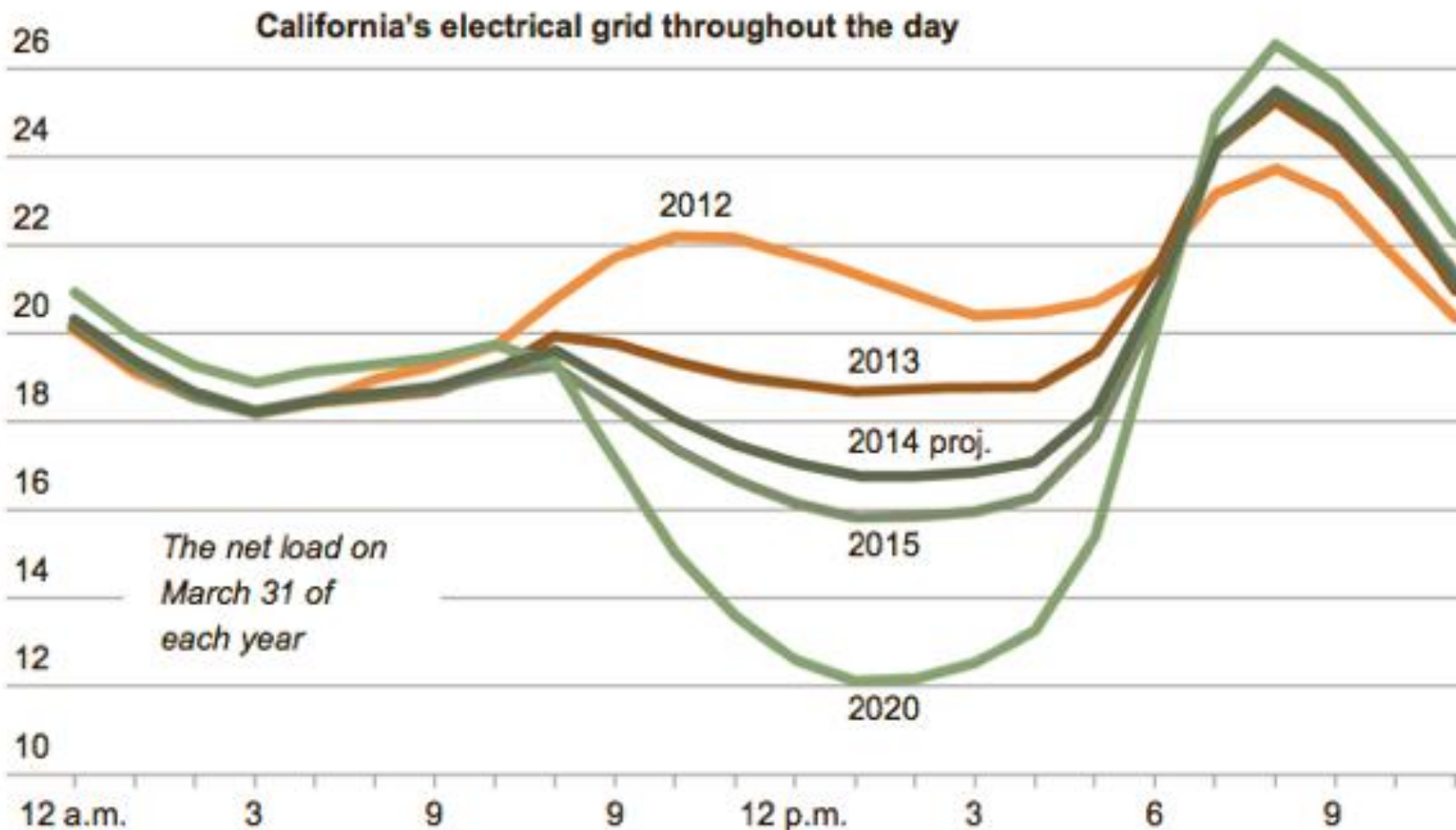
Life Cycle Cost Factors

Capital Cost –
primary & ancillary
equipment
construction- installation
real estate
environmental mitigation
utility connection fees
major renewal replacement

Operating Cost

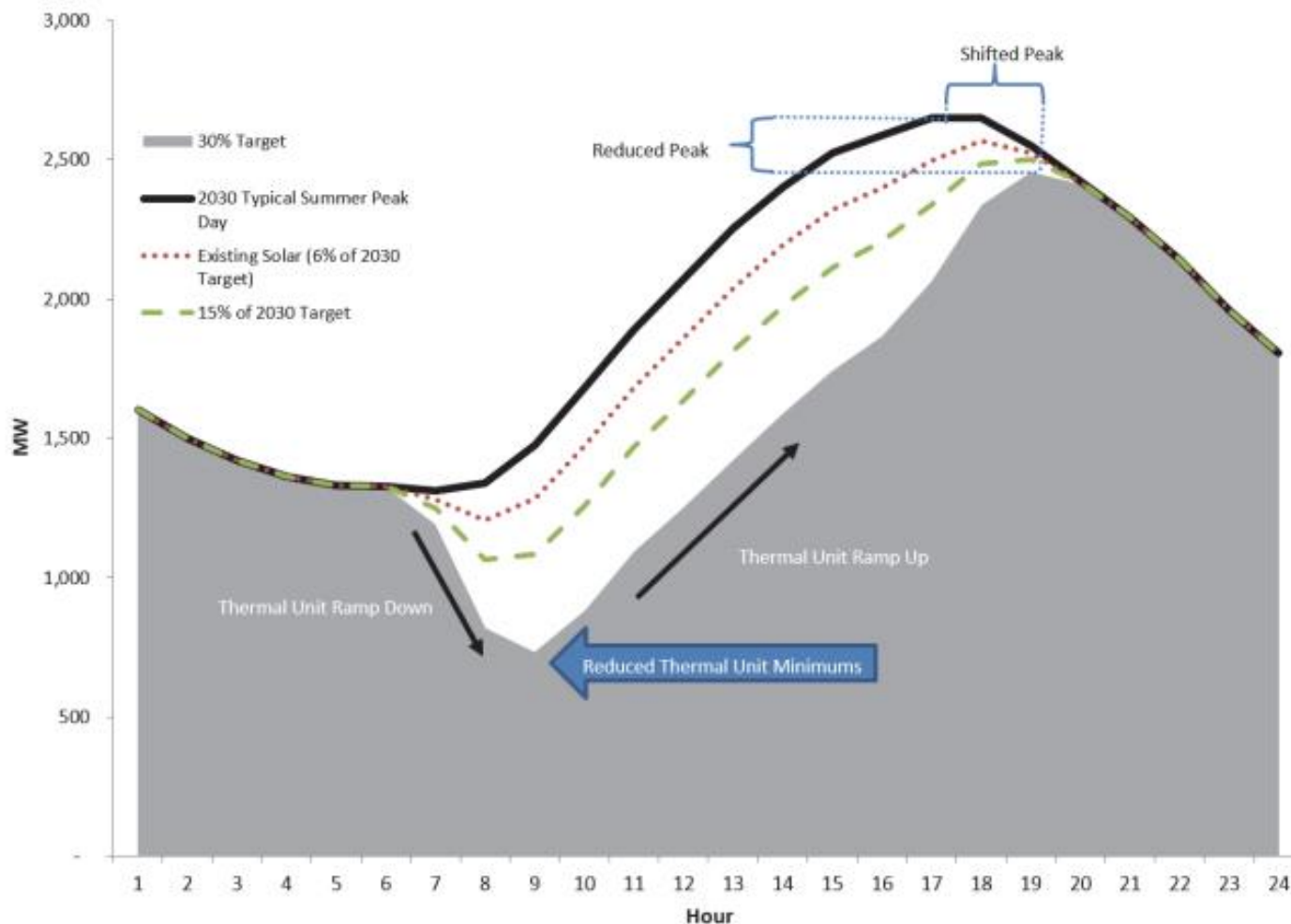


28 thousand megawatts

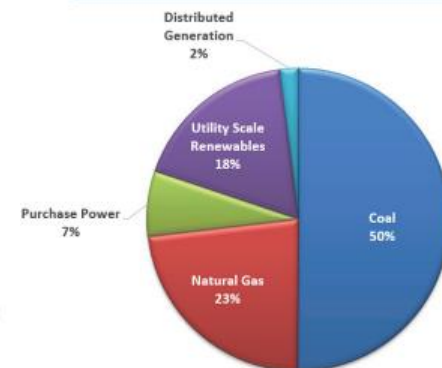


Source: CalISO

Chart 9 – Impact of Increased Solar Production (Duck Curve)

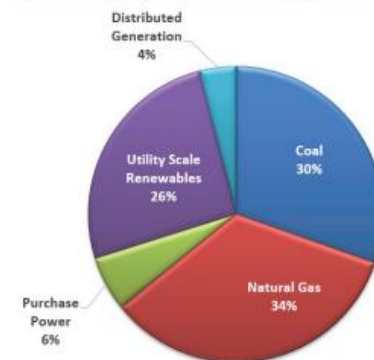


2023 Portfolio Energy Mix



Results assume the exit from San Juan Unit 1 in 2022. Utility Scale Renewables and Distributed Generation reflect 20% of Retail Sales

2032 Portfolio Energy Mix



Results assume the exit from Navajo Generating Station in 2030 and the Four Corners Power Plant in 2031. Utility Scale Renewables and Distributed Generation reflect 30% of Retail Sales

- TEP plans to continue with its utility scale build out of its current renewable energy standard implementation plans. TEP anticipates that an additional 1100 MW of new renewable capacity will be in-service by the end of 2030 raising the total distributed generation and utility scale capacity on TEP's system to approximately 1500 MW. By the end of 2016, renewable resources will make up close to 13% of TEP's total nameplate generation capacity. As a result, TEP is currently investing its time and resources into a number of research and development activities that will determine the future need for storage and smart grid technologies to support the grid, including two 10MW energy storage projects slated for in service by 2018.



Larger Capacity 14 Condenser Unit TSC Module



Regionally Unique

