
Water, Energy, and Environment in the San Diego Region

City of San Diego Water Policy Implementation Task Force
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San Diego

Smart Energy 2020

THE 21ST CENTURY ALTERNATIVE



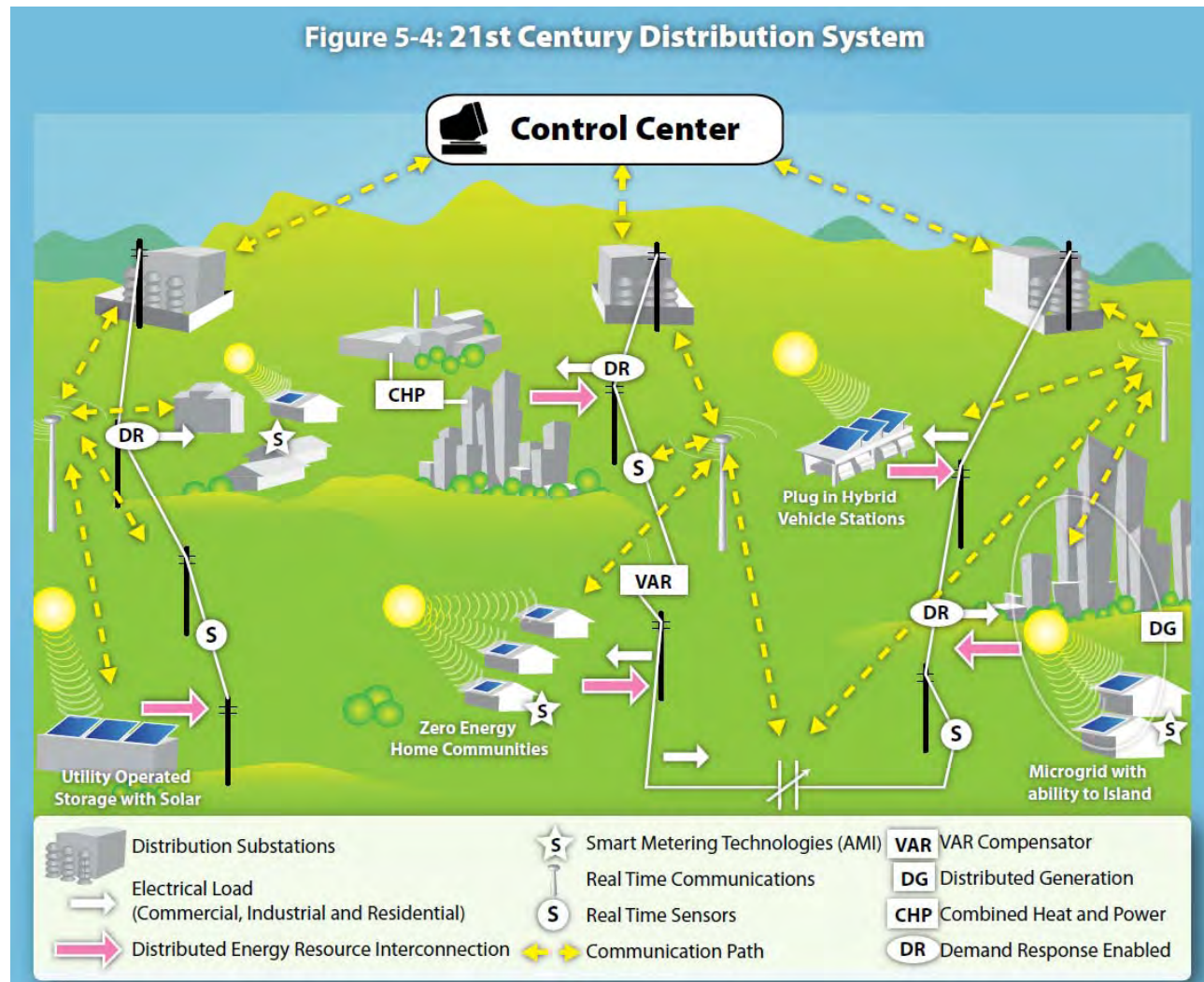
http://www.etchinternational.org/new_pdfs/smartenergy/52008_SmE2020_2nd.pdf

Main Elements – San Diego Smart Energy 2020

- 20% reduction in demand through energy efficiency.
 - 25% reduction in peak load thru A/C demand response.
 - Addition of 1,000 to 2,000 MW of rooftop/parking lot solar PV by 2020.
 - All rooftop/parking lot PV systems equipped with 3 hours of battery storage to meet peak power and emergency needs.
 - Addition of 700 MW of new combined heat & power (CHP) systems.
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California's state energy vision is local, local, local

source: CEC 2007 Integrated Energy Policy Report, December 2009, p. 155.



California Long-Term Energy Efficiency Strategic Plan, 2008

source: <http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/eesp/>.

- Energy efficiency & demand response
("net zero energy" buildings: energy efficiency + rooftop PV)
 - All new residential homes net zero by 2020
 - All new commercial buildings net zero by 2030
 - 25% of existing residential near net zero by 2020
 - 50% of existing commercial net zero by 2030
 - 30 – 40% reduction in existing building electricity demand via energy efficiency measures
 - Reduce air conditioning loads by 50% by 2020
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Urban residential rainwater – water recycle

source: www.rainharvest.com, photos of waterless electric & electric incinerator toilets.

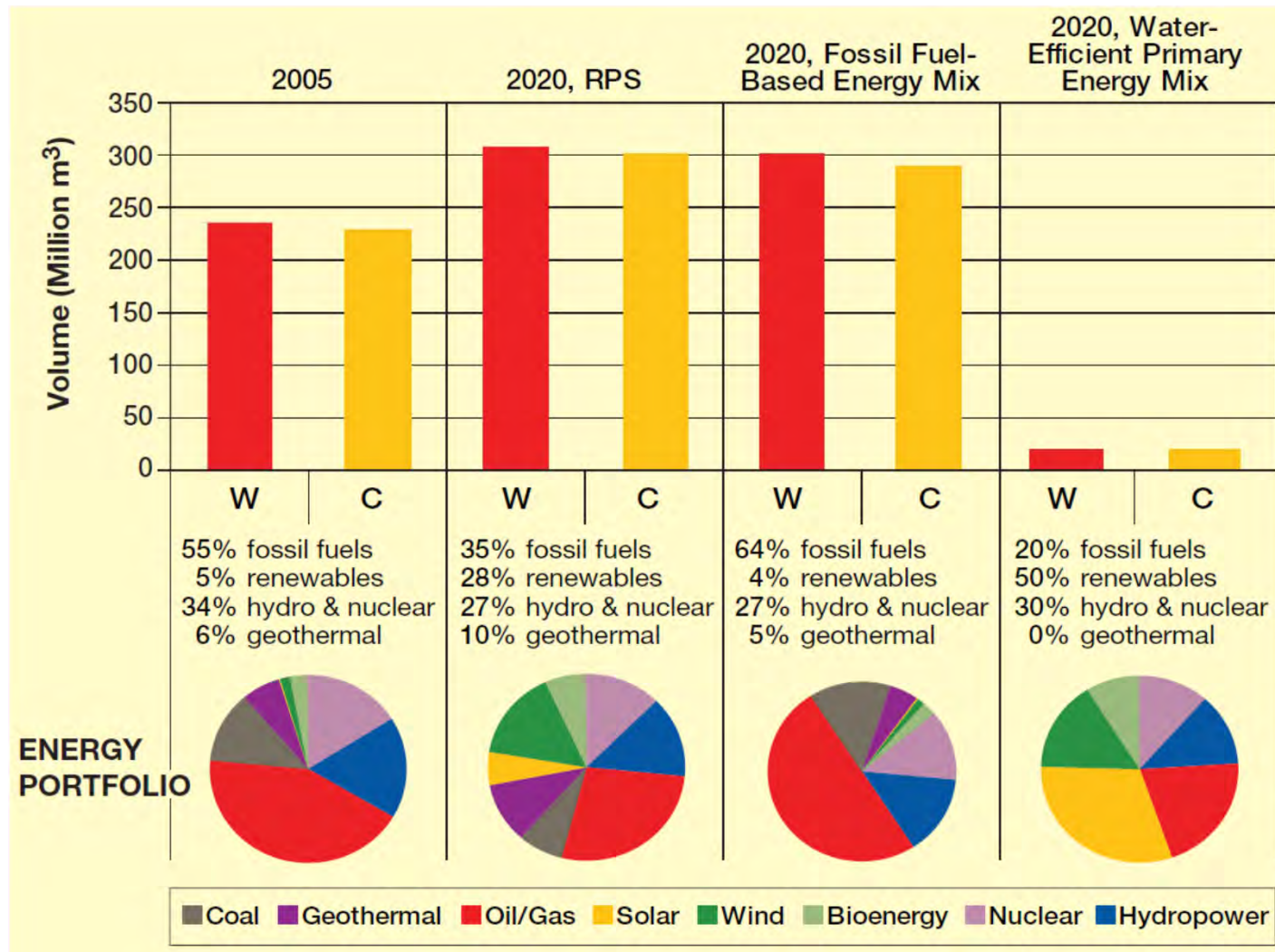


All-in residential cost of water/wastewater service and “local” alternative source: B. Powers residential home data

- Family of four water usage: $\sim 1/10^{\text{th}}$ acre-foot per year
 - Total annual water/wastewater bill: $\sim \$700$ per year
 - Gross cost of residential water service: $\$7,000/\text{acre-ft}$
 - Estimated cost of purified recycle water: $\$1,700/\text{acre-ft}$
 - Cost of closed-loop residential purified recycle system with waterless electric toilets: ?
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Water consumption and power generation

source: D. Larsen et al – UCSB, *California's Energy-Water Nexus: Water Use in Electricity Generation*, Southwest Hydrology, September 2007.



Wet cooling tower in power plant application

photo: 600 MW Metcalf Energy Center combined cycle power plant, San Jose, California, 3 – 4 Mgd demand



Air cooling nearly eliminates water consumption

photos: 600 MW Otay Mesa Energy Center, San Diego, California



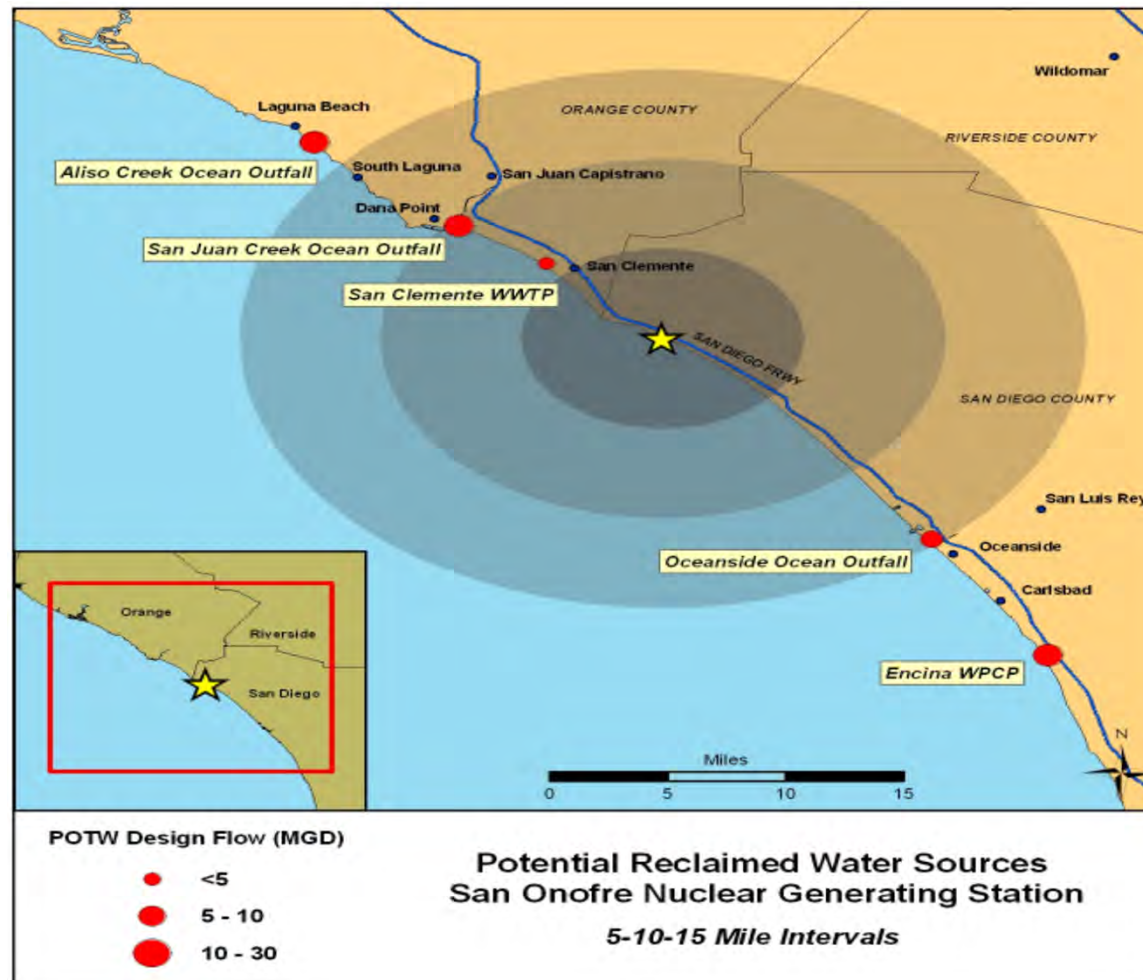
Goldendale 270 MW wet-dry cooled: 1 turbine, 10 dry cells, 2 wet cells

sources: GEA Power Cooling Systems and Calpine Corp. <http://www.calpine.com/power/plants.asp#137>



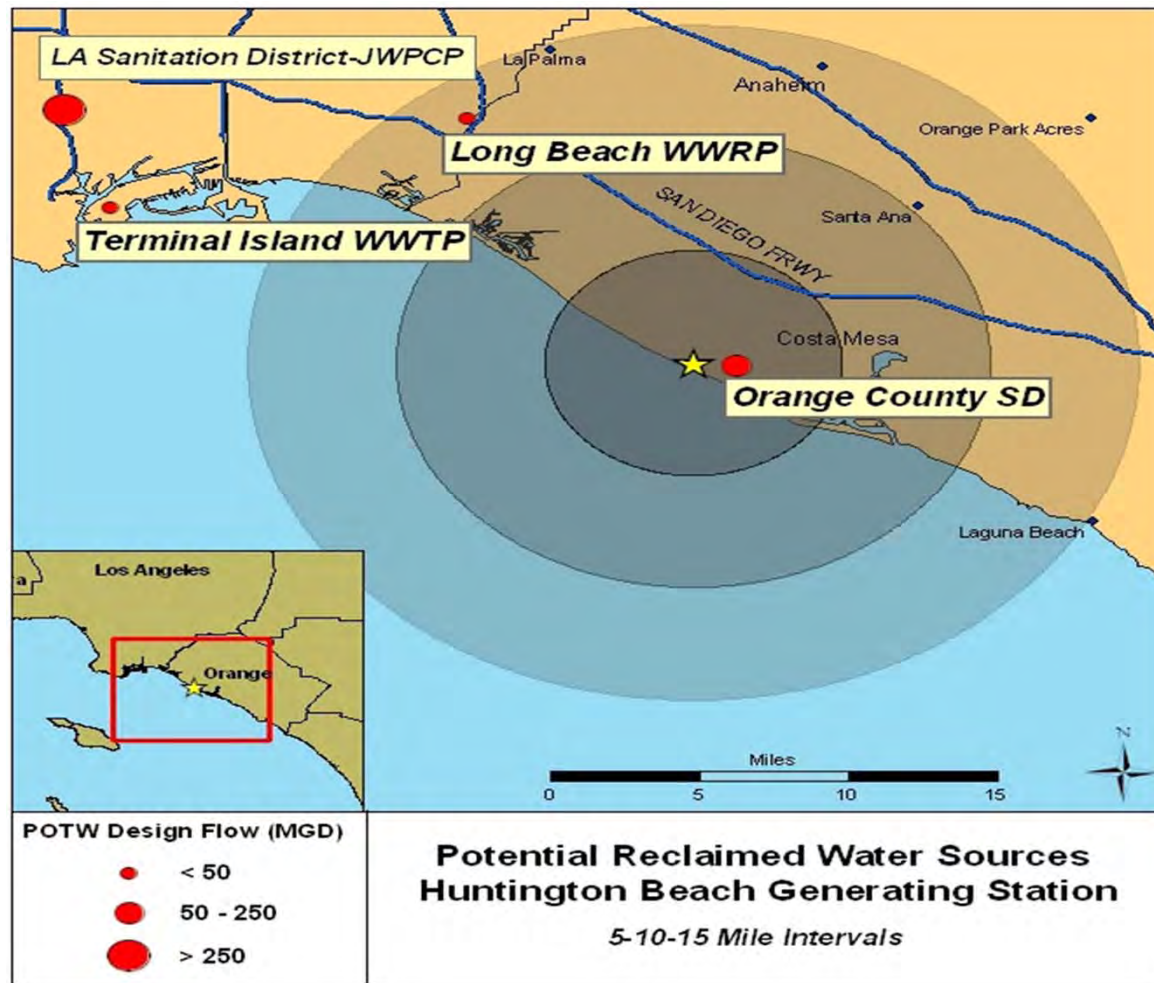
San Onofre Nuclear: ~2.5 billion gallons per day of seawater cooling flow

source: TetraTech, *California's Coastal Power Plants: Alternative Cooling System Analysis*, February 2008.



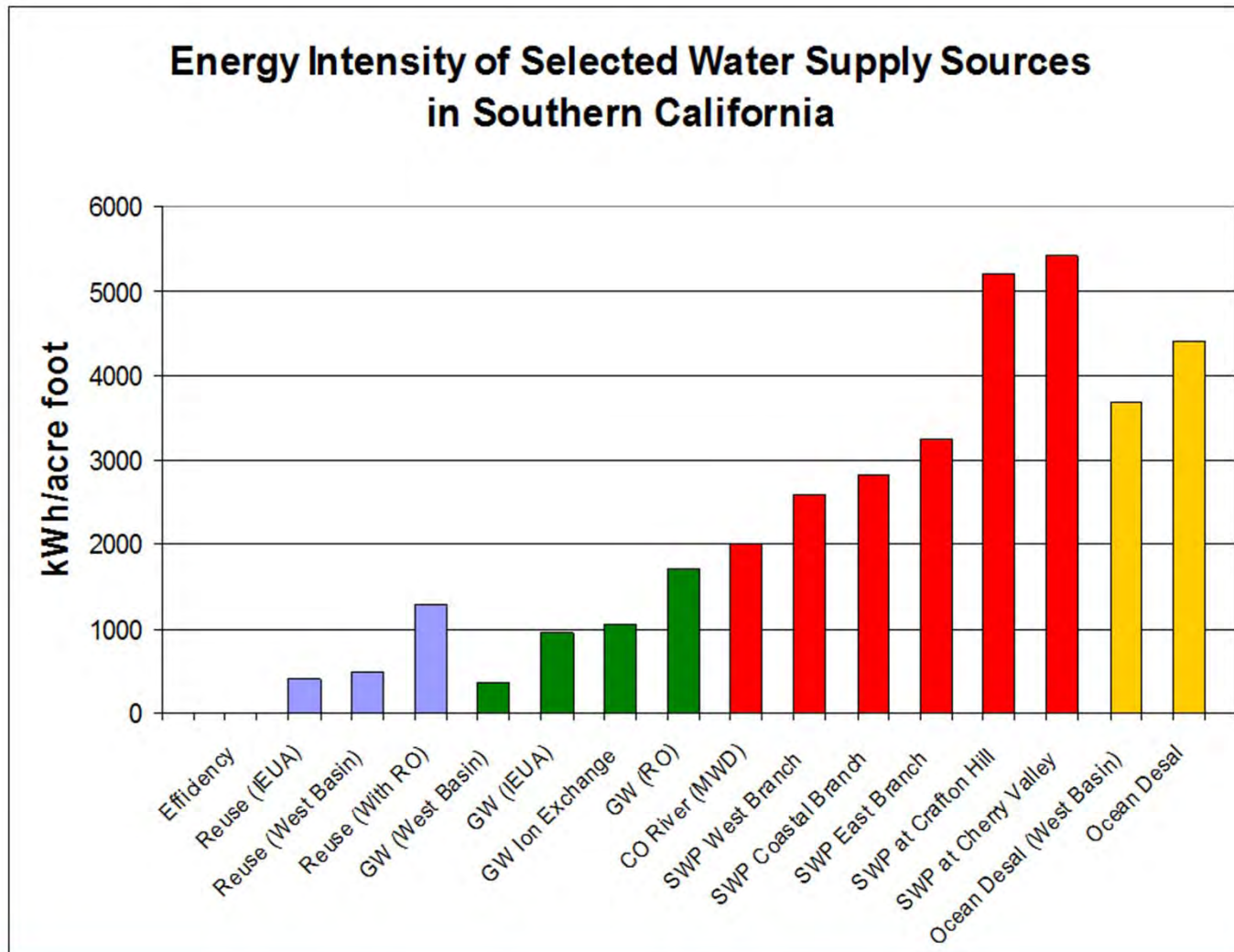
Huntington Beach Generating Station: adjacent to major treated wastewater ocean outfall

source: TetraTech, *California's Coastal Power Plants: Alternative Cooling System Analysis*, February 2008.



Energy intensity of SoCal water supply sources

source: R. Wilkinson – UCSB, *Congressional Hearing on Water Supply Challenges for the 21st Century*, Committee on Science and Technology, 2007, p. 9.



State Water Project supply system

source: R. Wilkinson – UCSD, *Methodology for Analysis of the Energy Intensity of California's Water Systems*, January 2007.



source: R. Wilkinson – UCSD, *Methodology for Analysis of the Energy Intensity of California's Water Systems*, January 2007.



Comparison of energy and greenhouse gas emission intensity of supply options

source: B. Powers, 2009.

Option	Energy intensity (kWh/AF)	Energy intensity compared to State Water Project imports (%)	CO ₂ emitted to produce and transport 56,000 acre-feet, equal to 50 Mgd (tons/year)
1. Conservation	0	- 100	0
2. Reuse, non-potable	400	- 88	10,000
3. Reuse, potable	1,200 to 2,200	- 31 to -63	30,000 to 58,000
4. Colorado River Water Transfers	2,000	- 38	51,000
5. State Water Project Transfers	3,200	baseline	82,000
6a. Desalination (linked to OTC), power purchased from Encina	4,700	+ 47	154,000
6b. Desalination (linked to OTC), open market power purchase	4,700	+ 47	120,000
7. Desalination (non-OTC), sub-seafloor intakes, open market power purchase	3,800	+ 19	98,000

***Feedwater
Supply Facilities***

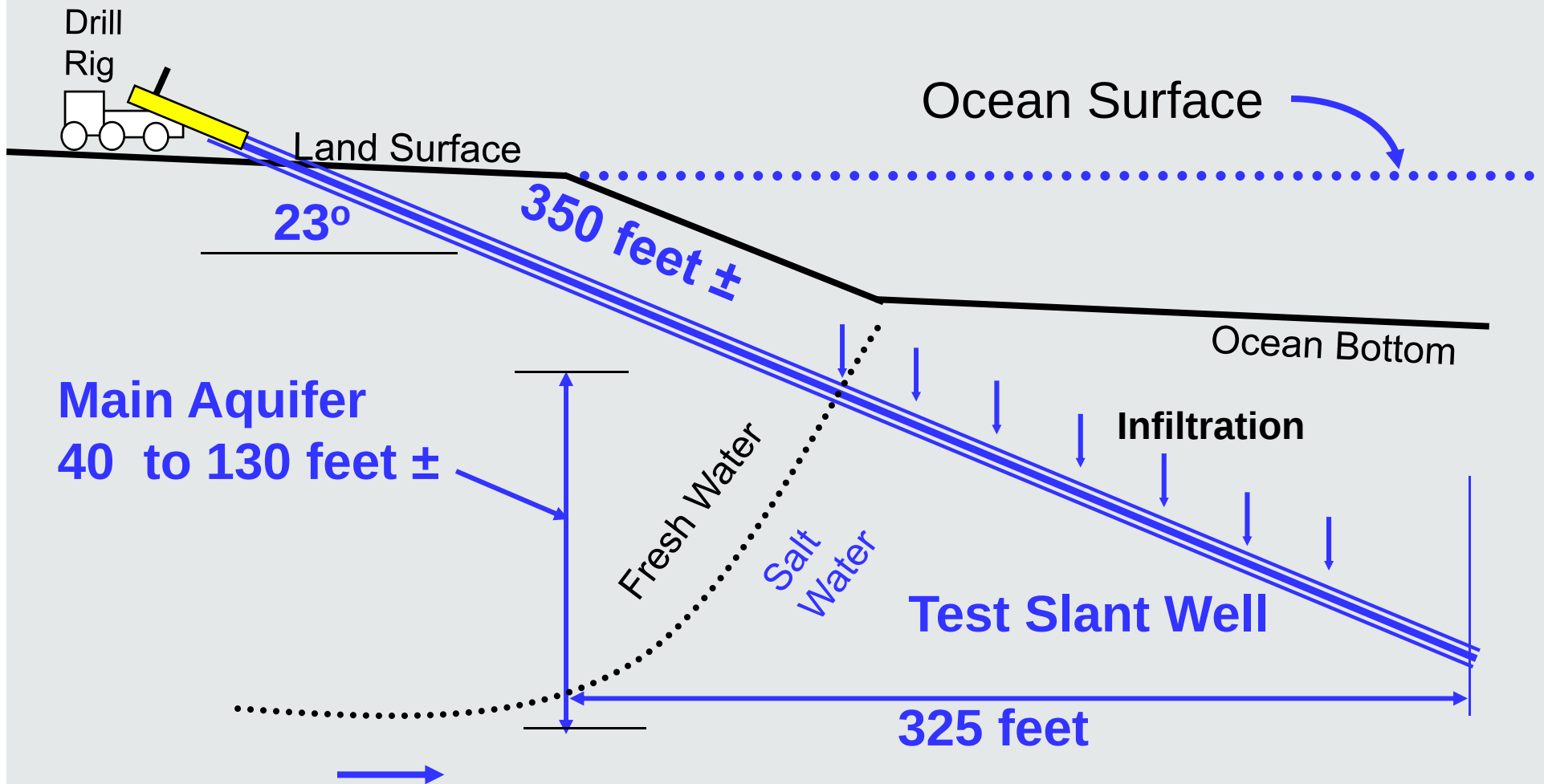
Desalination Plant Site

***Subsurface Slant Wells and
Buried Collector Intake System***

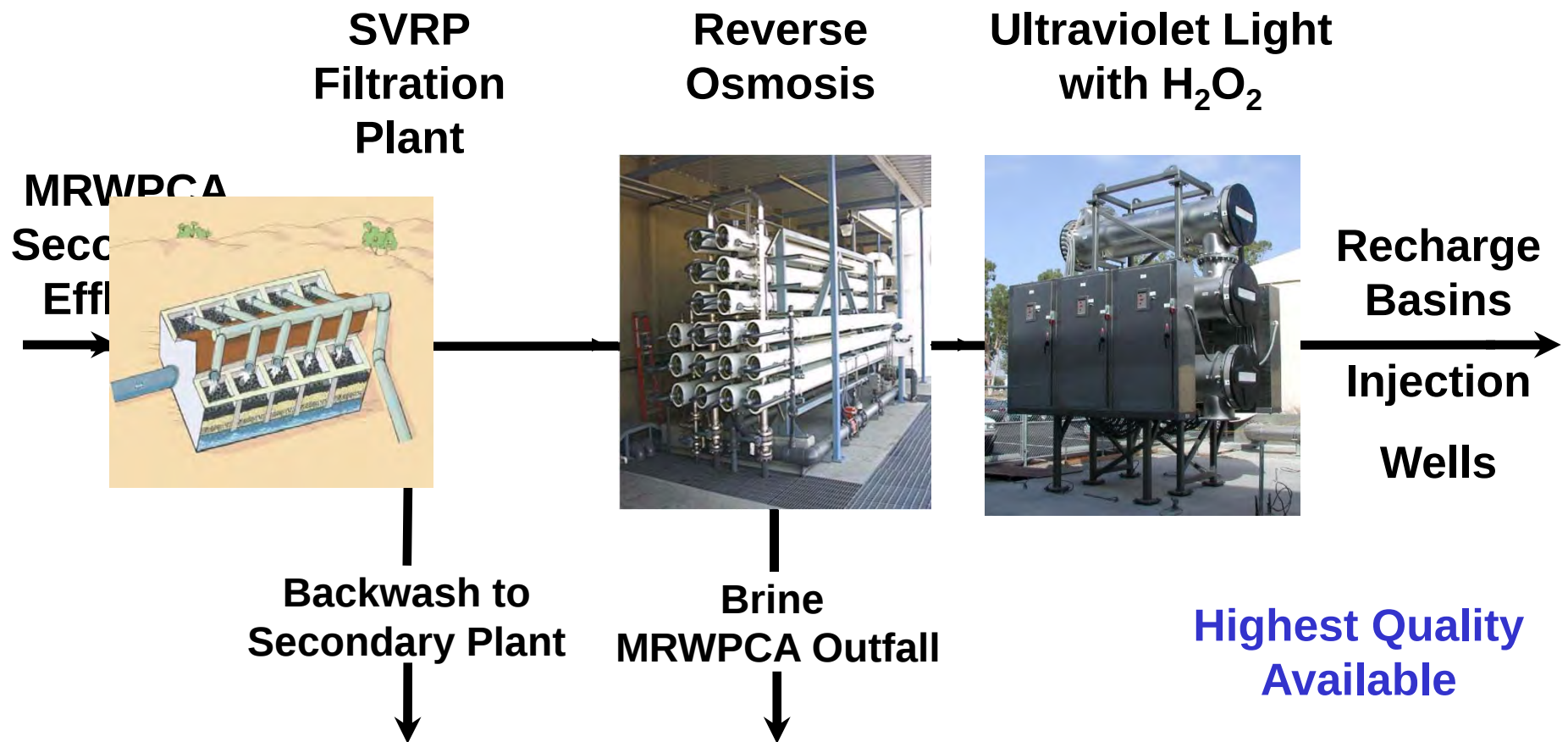
SOCWA Outfall



Test Slant Well Schematic

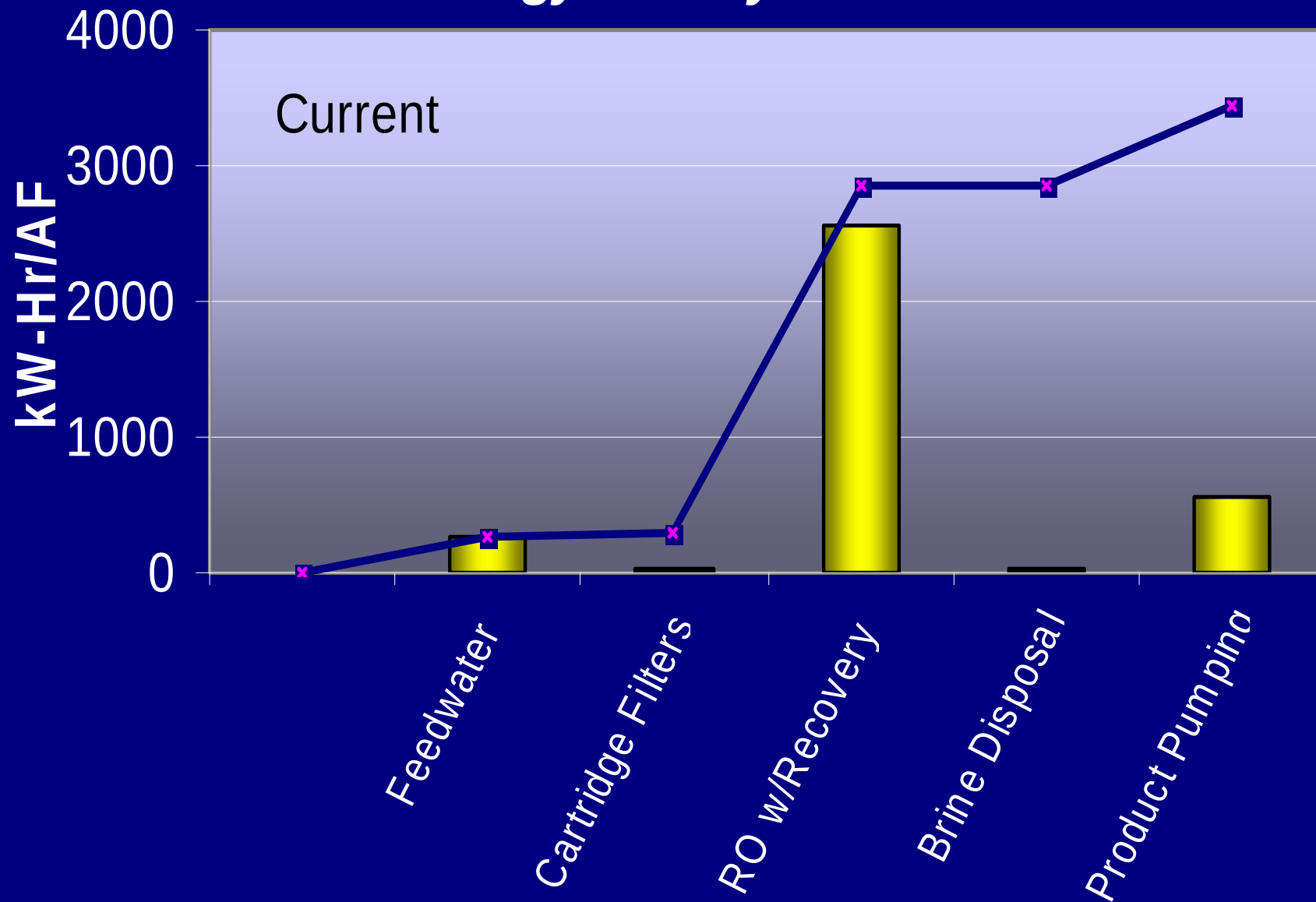


GWR System Treatment Scheme – A multiple barrier concept producing purified water



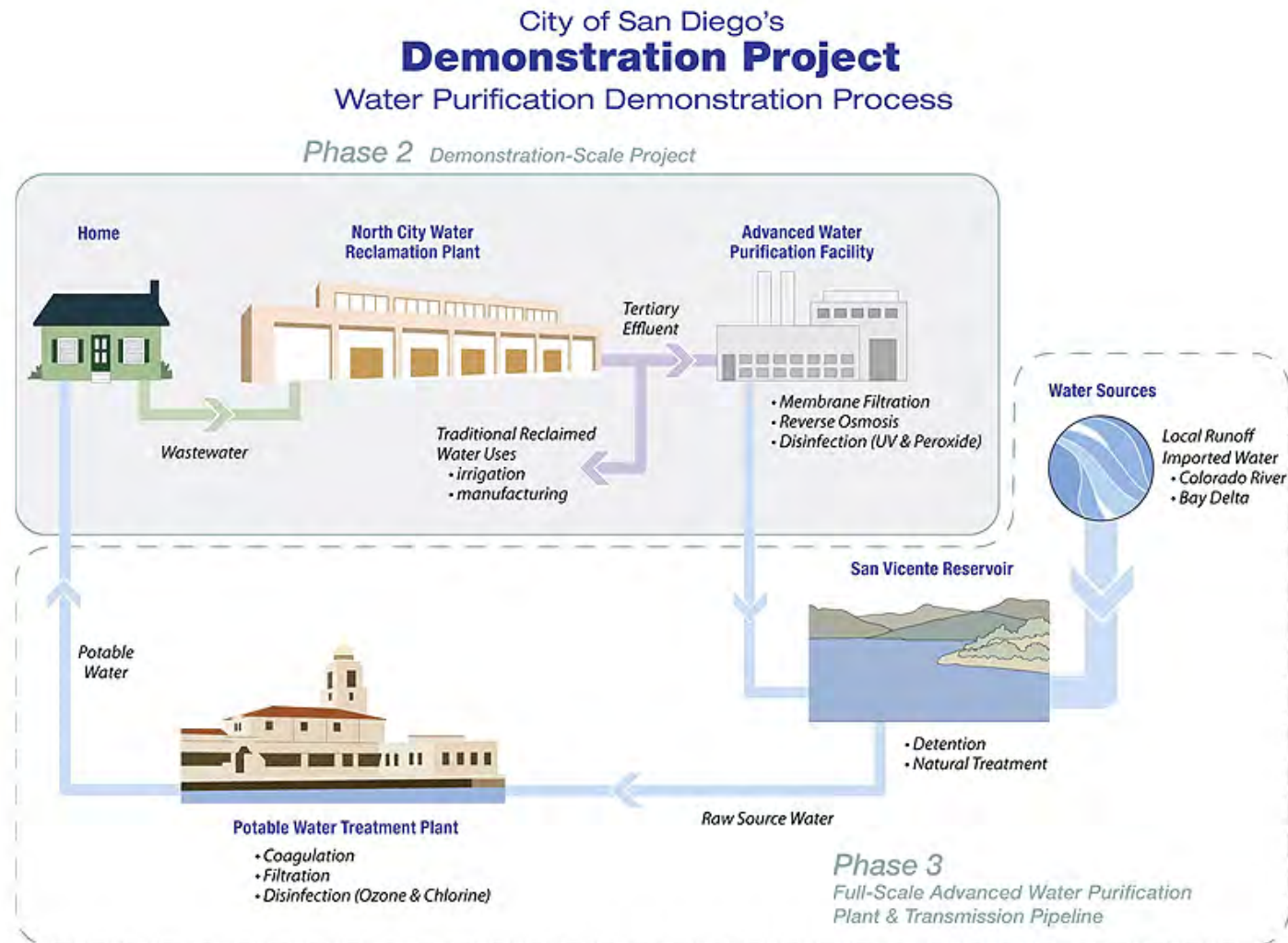
Dana Point Ocean Desalination Project

Energy Use by Unit Process



City of San Diego water purification pilot project

source: <http://www.sandiego.gov/water/waterreuse/fullra/index.shtml>

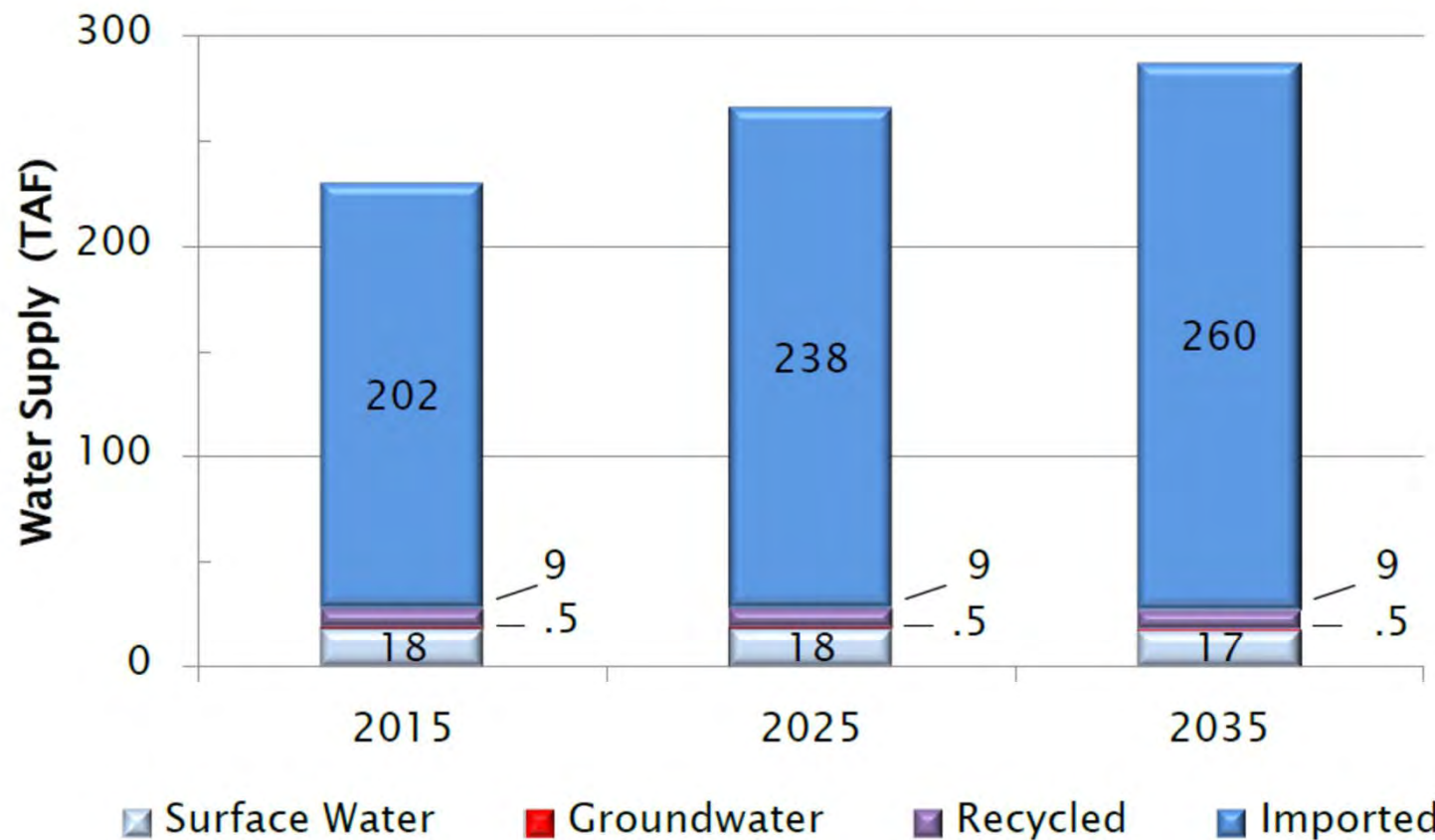


~\$1 billion to upgrade Point Loma WWT

source: KPBS Radio News, *San Diego Seeks a Faster Current for Water Recycling*, December 10, 2012.

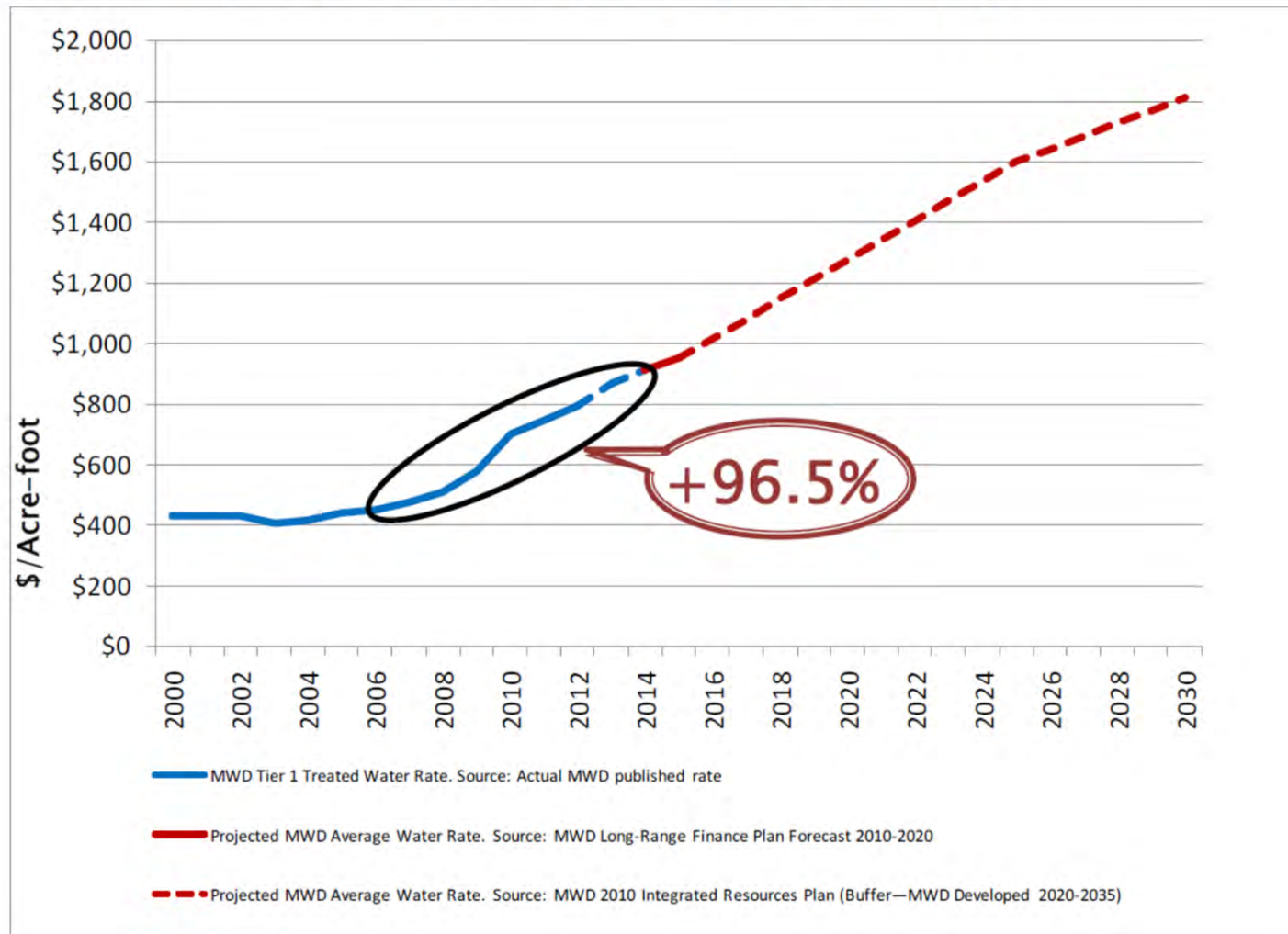


City of San Diego Projected Supply*



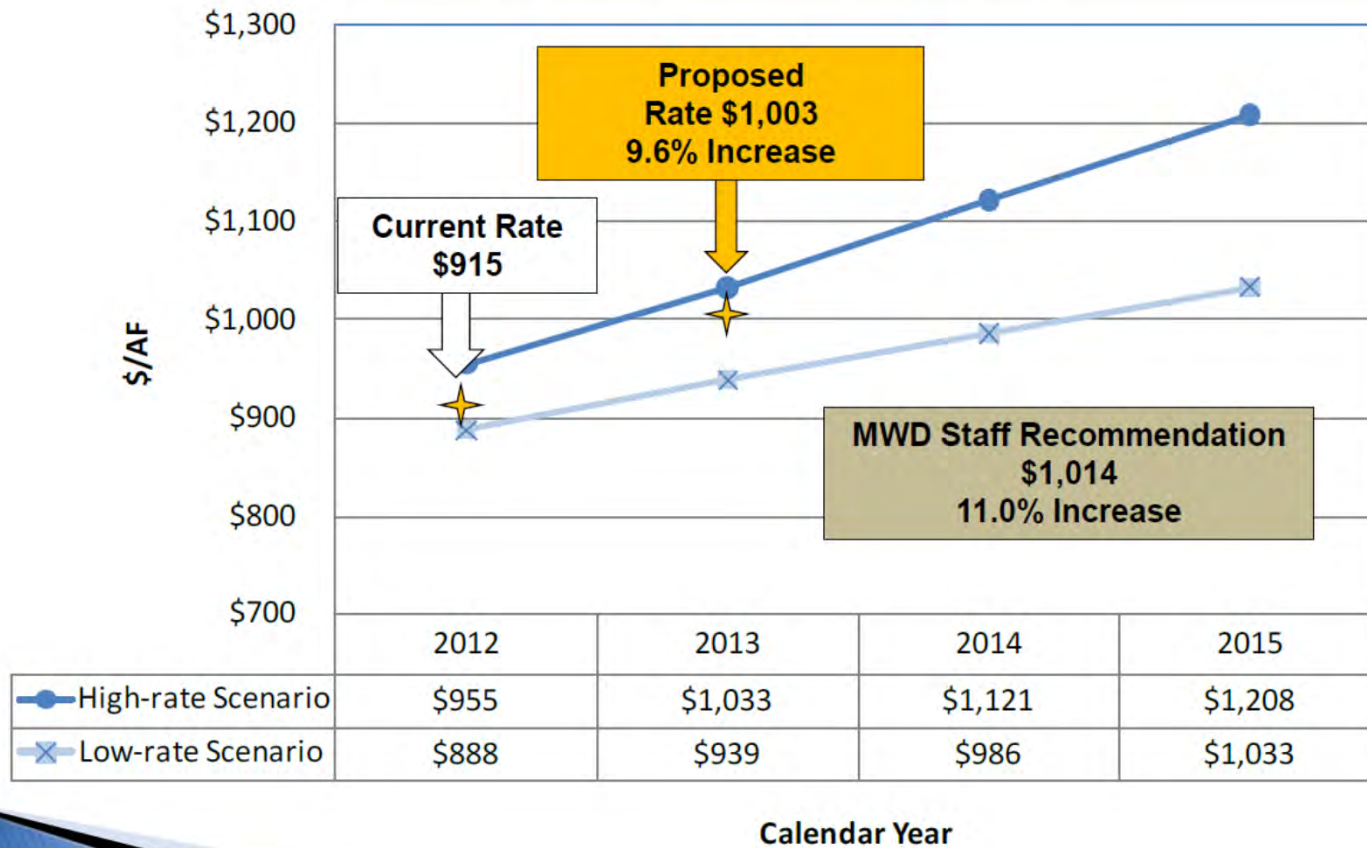
*Source: Water Authority 2010 UWMP - Verifiable Supplies (excludes IPR)

MWD's Water Rates are Up



2011 Rate Forecasts

"All-in" Untreated Water Rate

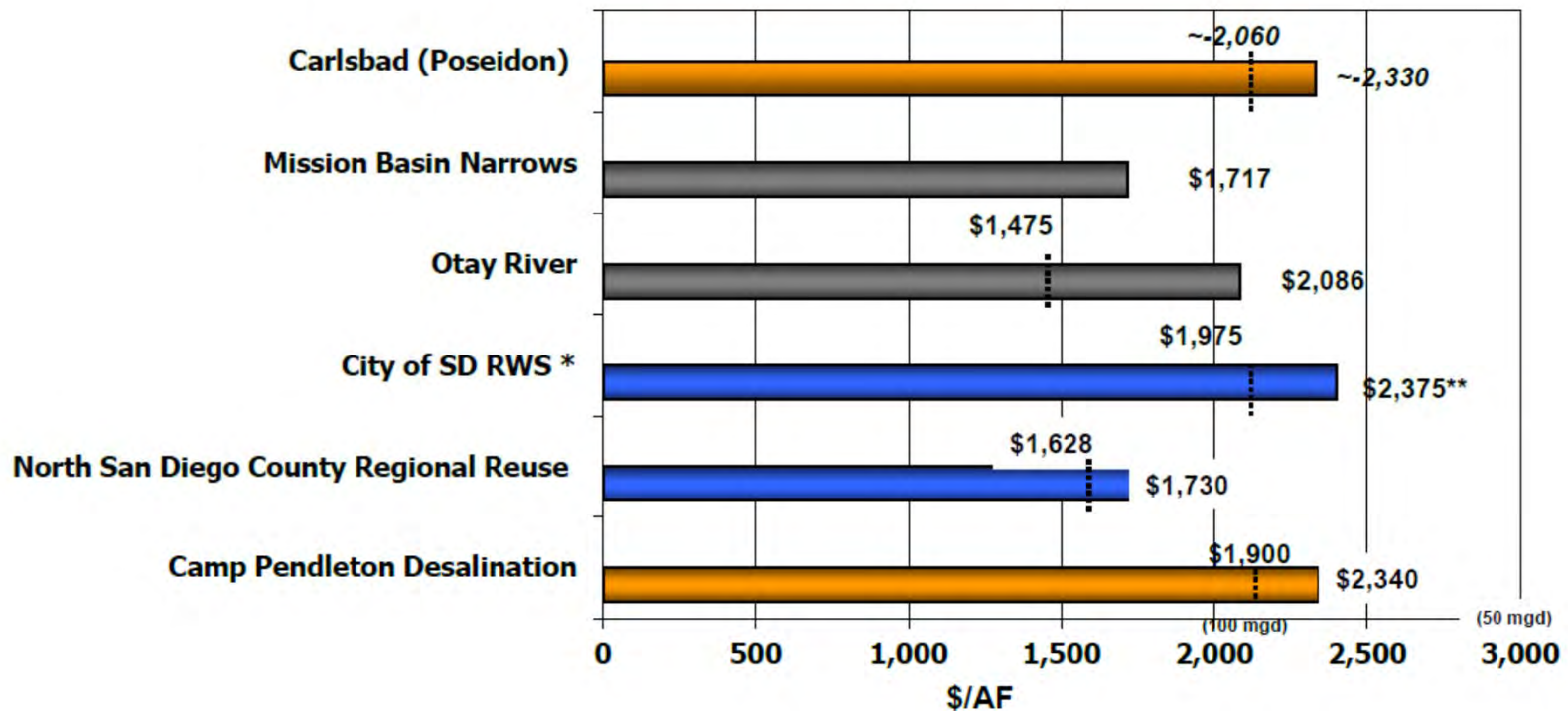


Cost of the Next Increment of Local Supply

Actual Proposed San Diego Region Project Unit Costs - \$/AF

(Before incentives, grants, or netting out avoided costs)

2011 Dollars unless otherwise noted



Cost range includes wastewater related costs that may reduce the unit cost by up to \$500/AF

** Incentive funding reduced at 2011 value of \$275 . RWS assumes deduction for incentives on 20 year NPV basis.

Conclusions

- Air cooling or processes with no cooling requirement (solar PV) nearly eliminate water consumption for power generation.
 - Long transport distances, State Water Project & Colorado River Project, result in high energy intensity for water delivery.
 - Seawater desalination is substantially more energy intensive than wastewater purification reverse osmosis.
 - Seawater desalination has potentially significance marine unless sub-sandbed intake galleries are used.
 - Cost parity between MWD water purchases and wastewater purification expected within 5 – 10 years.
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