BEACON ECONOMICS

Analysis. Answers

The Bay Delta Conservation Plan:

Should we DIG the tunnels?

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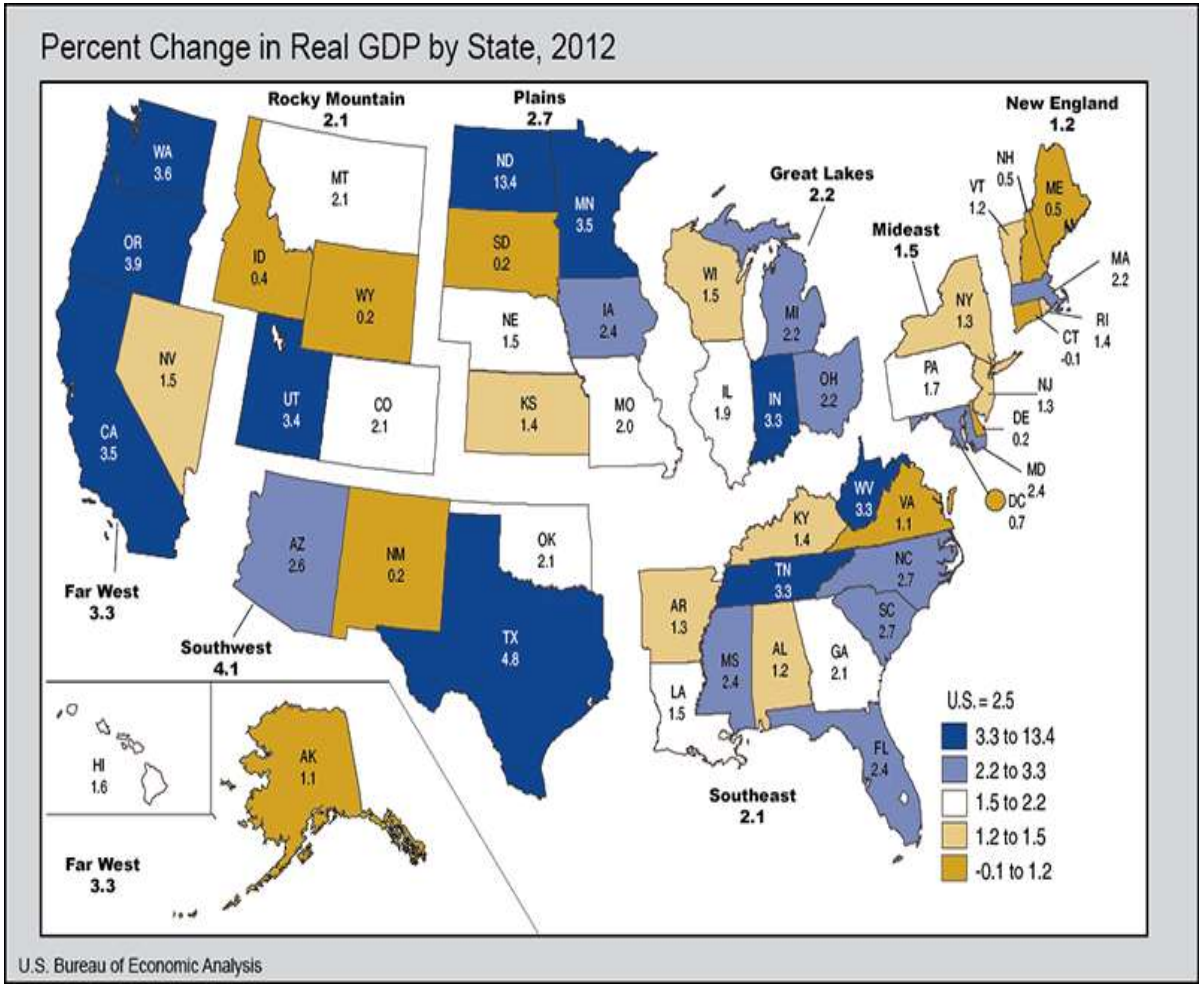
Overview: Tunnel or not?

- The state's economy is yet again growing
  - Start thinking ahead: how to deal with future growth
  - The portfolio approach to water issues
- A Brief Refresher: The Delta in context
  - Role in meeting state water needs
  - Small amount of exports mean a lot for those who rely on the aqueducts
- The Delta Tunnels: Outlining a cost-benefit analysis
  - The Sunding Analysis—different than a traditional NPV
  - Current Critiques: Michael, Smith
  - Beacon Economics: consolidation, expansion, communication
- Summary: We think it makes sense
  - More work needed to firm up estimates

California: Where art thou?

Budget Issues
High Taxes
Unaffordable Housing
Business Unfriendly Regulations
Strained Infrastructure

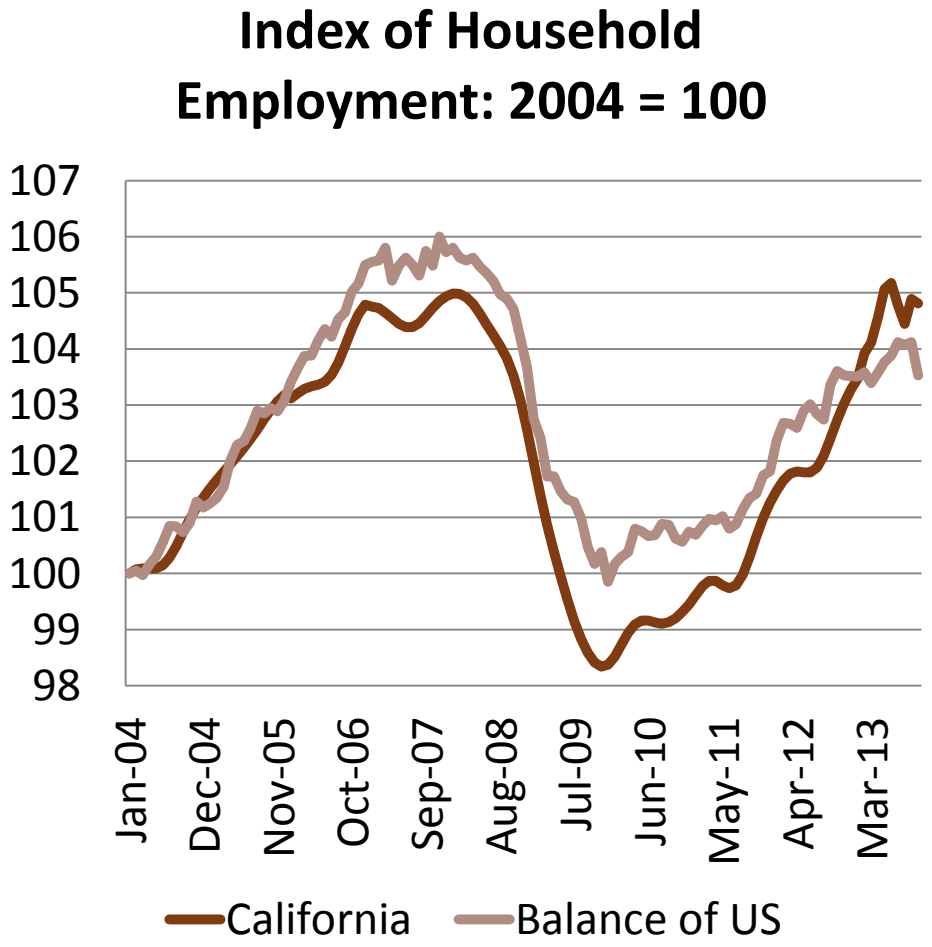
Regional Growth: A Different Message

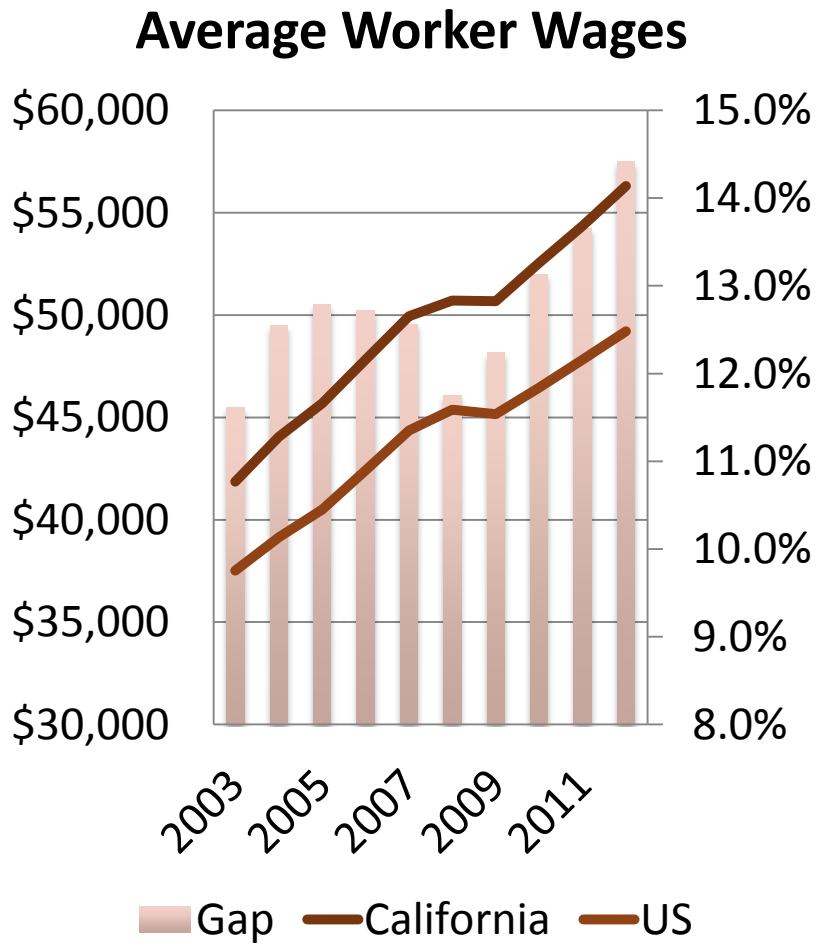


GDP Growth by State (2012) (%)

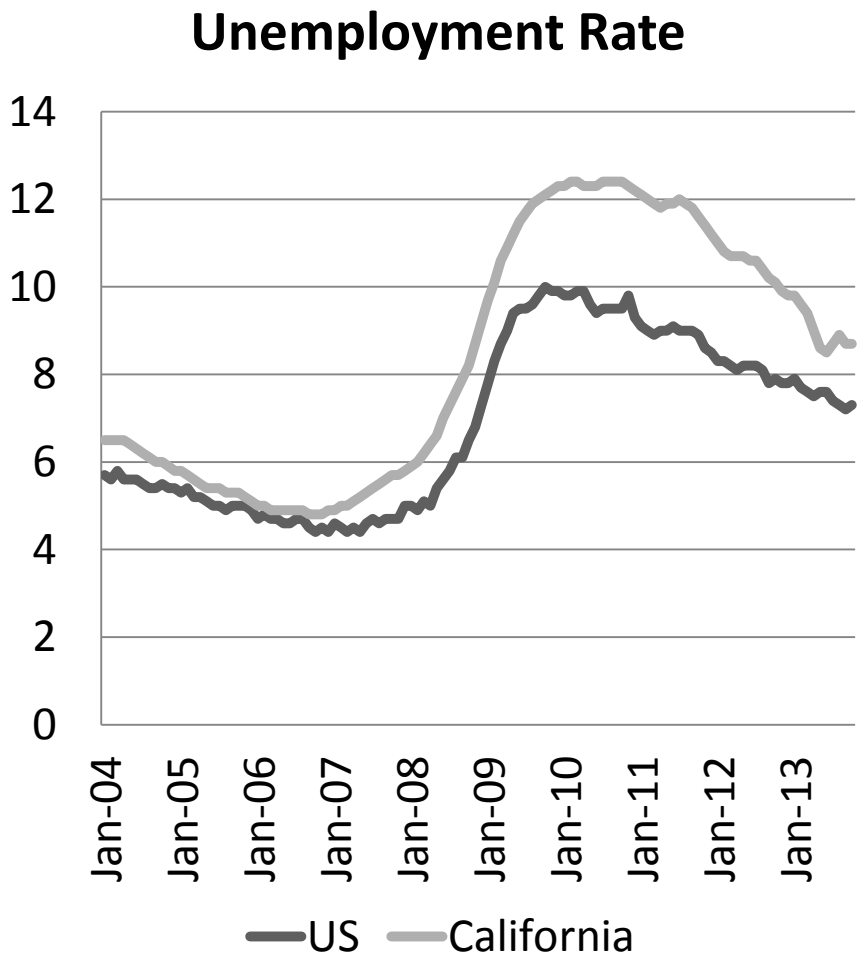
Rank	State	Growth
-	USA	2.46
1	N Dakota	13.38
2	Texas	4.82
3	Oregon	3.95
4	Washington	3.63
5	Minnesota	3.55
6	California	3.47
7	Utah	3.42
8	Indiana	3.30
9	Tennessee	3.28
10	W Virginia	3.27
11	N Carolina	2.68
12	S Carolina	2.68
13	Arizona	2.60
14	Florida	2.43
15	Maryland	2.43

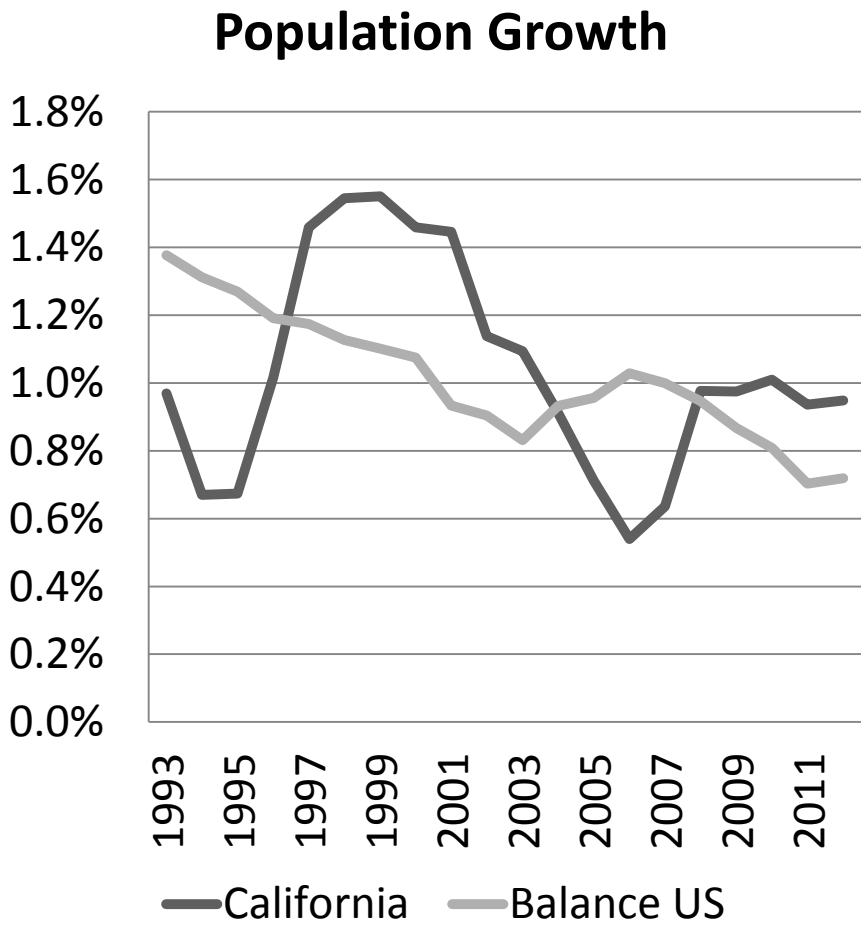
California: Ahead of the Game



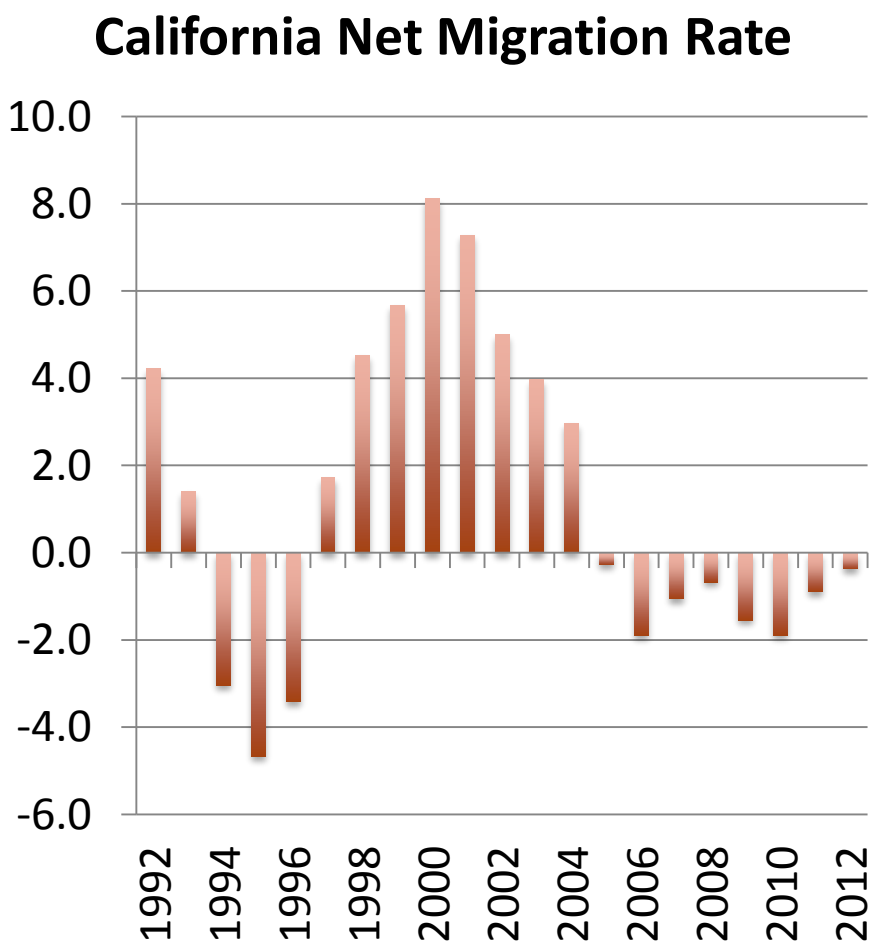


Long Term Trends Returning





Population Growth Trends



Region	2010	2060 (est)	Change
State Total	37,309	52,694	15,385
So Cal	21,176	28,087	6,911
South C.V.	3,365	6,758	3,393
Bay Area	7,493	10,024	2,531
North C.V.	2,744	4,373	1,629
No Cal	1,158	1,701	543
Central Coast	1,373	1,751	378

Meeting the State's Water Needs

- Issues
  - A growing, wealthier populace driving increased demand
  - State population and economic growth concentrated in southern, arid areas
  - Greater awareness of environmental impacts, particularly in regard to endangered species
  - Greater variability of supply across and within years due to climate change
  - Vulnerability of supply system to natural disasters, earthquakes
  - Rising sea levels
- Efforts
  - Ensure reliability of existing supplies
  - Create new supplies
  - Promote reuse / conservation
  - Investment in storage

A changing portfolio of MWD supplies

MWD Water Supplies over Time

1990

Source	Proportion of Total Supply
Colorado River	27%
State Water Project	33%
Local Supply	34%
Conservation and Recycling	**7%**

2015

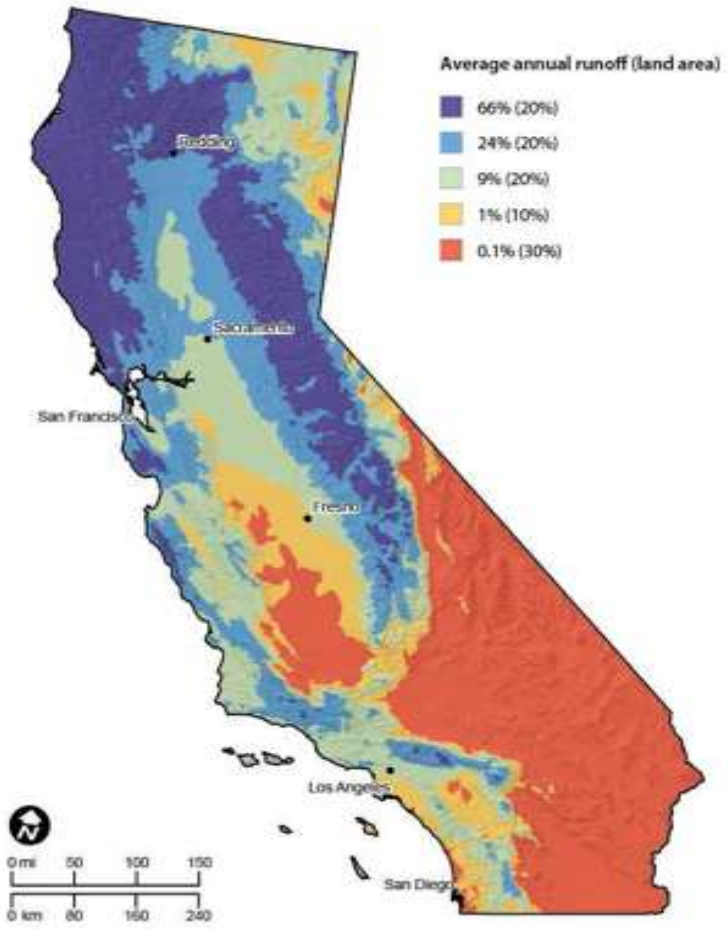
Source	Proportion of Total Supply
Colorado River	20%
State Water Project	22%
Local Supply	32%
Conservation and Recycling	**26%**

2035

Source	Proportion of Total Supply
Colorado River	14%
State Water Project	22%
Local Supply	31%
Conservation and Recycling	**33%**

2015, 2035 based on expected average yearly supply deliveries from IRP. 1990 data is actual

The Delta in California



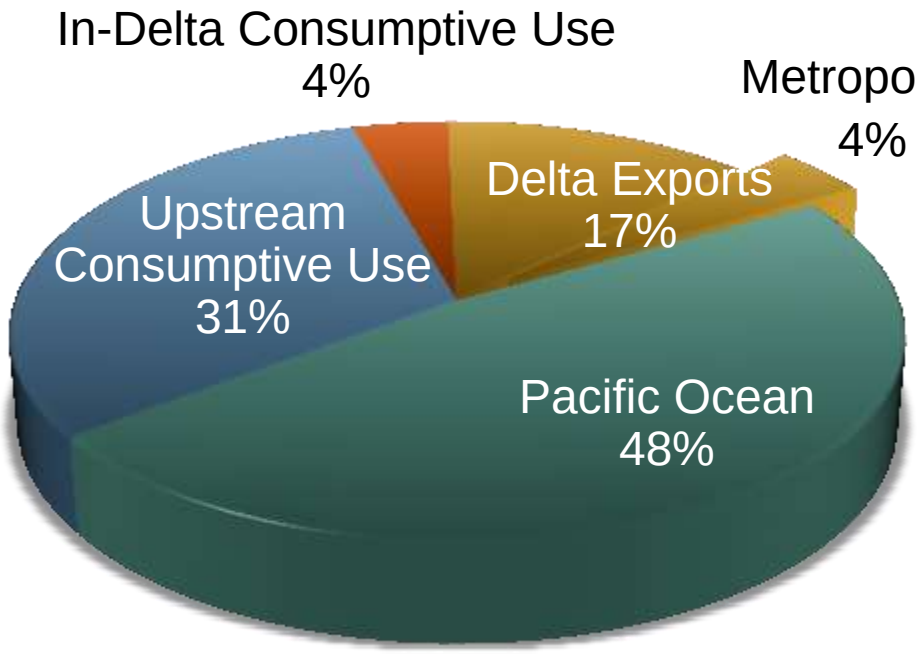
Annual Average Supply and Consumption

1998-2005 Net m.a.f.

	Ag	Urban	Envir.	Total
North Coast	0.6	0.1	21.0	21.7
Sacramento River	6.6	0.7	7.6	14.9
San Joaquin River	6.0	0.4	1.0	7.4
Tulare Lake	7.7	0.3	0.1	8.1
South Coast	0.7	3.5	0.1	4.3
Colorado River	3.7	0.5	0.0	4.2
San Francisco Bay	0.1	1.0	0.6	1.7
Central Coast	0.8	0.2	0.1	1.1
North Lahontan	0.4	0.0	0.2	0.6
South Lahontan	0.3	0.1	0.1	0.5
California	27.0	6.6	31.0	64.6

Source: PPIC, "Managing California's Water: From Conflict to Reconciliation," Chapter 2

Average Distribution of Delta Water



Source: Delta Vision Report, Average 90-05
Based on annual average 32.9 maf

Delta exports mean a lot to a lot of places

Share of Deliveries from SWP*	
San Jose via Santa Clara Valley Water District	40%
Los Angeles via LADWP	44%
Fremont via Alameda County Water District	27%
Livermore, Pleasanton, San Ramon, Dublin via Zone 7 Water District	61%
Share from CVP	
Federal Water**	65%

* Rough approximations based on available data
** Share of Federal deliveries of water to central valley, does not include other sources

Supply Disruption: The Federal Biological Opinions

- Prior to Opinions
  - Annual export capability averaged ~6 maf per year from south end of Delta
- 2008 / 2009 Biological Opinions
  - Water operations / diversions jeopardizing Delta smelt, salmon populations
  - New regulations led to drop in total water exports to an average of 4.7 maf per year
- *The problems are not fixed*
  - In 2013, CDFW abundance counts of endangered Delta fish to date have showed some of the lowest totals in 46 years for Delta smelt, Longfin smelt, and Threadfin shad
  - 12 new species have been added to the federal and state ESA lists since 1994 including 2 since 2010
  - Without broader program and different approaches exports likely to be cut further and may still not fix issues

The BDCP

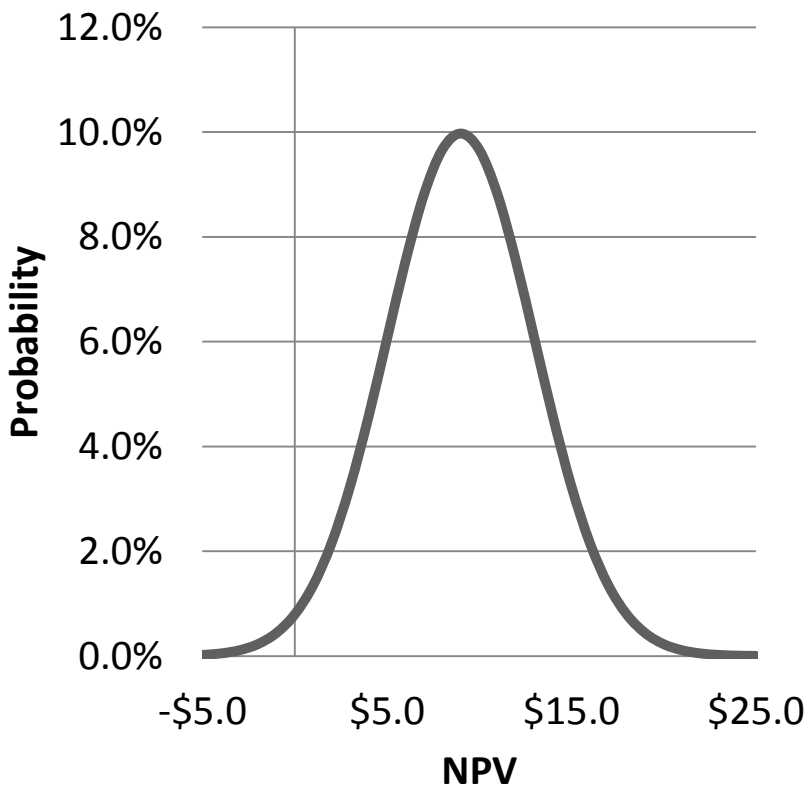
- Ecosystem Restoration & Preservation
  - Reduce pollutants, invasive species, poaching
  - Improve hatchery practices
  - Up to 145,000 acres of habitat restoration, preservation
  - Expanded recreation areas
- A New Conveyance System
  - New intakes in the north
  - Two gravity flow tunnels (~30 miles; 9,000 cubic-feet per second) delivering to South
  - Would complement southern pump extraction
  - Allow for better management of delta species
  - Potential to restore supplies for SWP, CVP
  - Protection from earthquake and sea level rise risk by providing alternative delivery method

Economic Cost-Benefit Analyses

- The Debate: Are the tunnels worth building?
  - Step 1: Estimate Future Costs
    - Direct (construction, maintenance)
    - Indirect (decline in agricultural output, environmental impacts, construction disruptions)
  - Step 2: Estimate Value of Future Benefits
    - Restoration of water supplies, Increased quality, Value of environmental improvements
    - Option value to deal with uncertainty, reduction in supply risks (earthquakes)
    - Increased usage value of other assets—reservoirs
  - Step 3: Collapse time flows to present value
- Avoid common pitfalls
  - It's not about right and wrong, its about the allocation of scarce resources
  - The aggregate NPV is what is important—but there will be winners and losers in the process, and those issues need to be dealt with
  - Environmental mitigation *only* as relates to the construction of the tunnels: do not include issues that are outside the tunnel such as rising sea levels which are an issue for *all* users of the Delta to deal with collectively

It isn't that easy…

- Hard to accurately quantify some parts of the analysis
  - Many values hard to estimate: value of species preservation? Value of 'water' for usage?
  - Appropriate metrics—discount rate?
  - Deal with future uncertainties: lots of things can happen
  - Quantifying political choices: how will we ration in event of an earthquake?
- Ultimately we are looking to be in a safe range
  - Try to find the best 'average' outcome
  - Scenario analyses to test the range



Economic Cost-Benefit Analyses

- The Results so far
  - Sunding Analyses, 1 and 2: Positive Net Present Value (NPV)
    - First report: in the 10's of billions
    - Amended report from rate payer perspective, removed non-use values, still positive result
    - Water value based on price elasticity: assumes rising price to cut consumption
  - Jeff Michael: Negative NPV, dismissed many positives
  - Rodney Smith Critiques: No real analysis, Thinks costs higher, discount rates too low
- Michael Report Critical Differences
  - Relies on BDCP numbers
    - Quibbles with what is included, not numeric values
  - Higher cost of salinity impact on Delta Ag
    - note still lower than value of reduced salinity for water projects
  - Dismisses environmental use and non-use benefits
  - Does not foresee future reduction in supplies
    - Sunding does see reductions of 30% more
- Smith has vague concerns
  - Has no complete NPV analysis
  - Assumes cost overruns
  - Thinks the discount rate is too low

Summary Results of Studies to Date

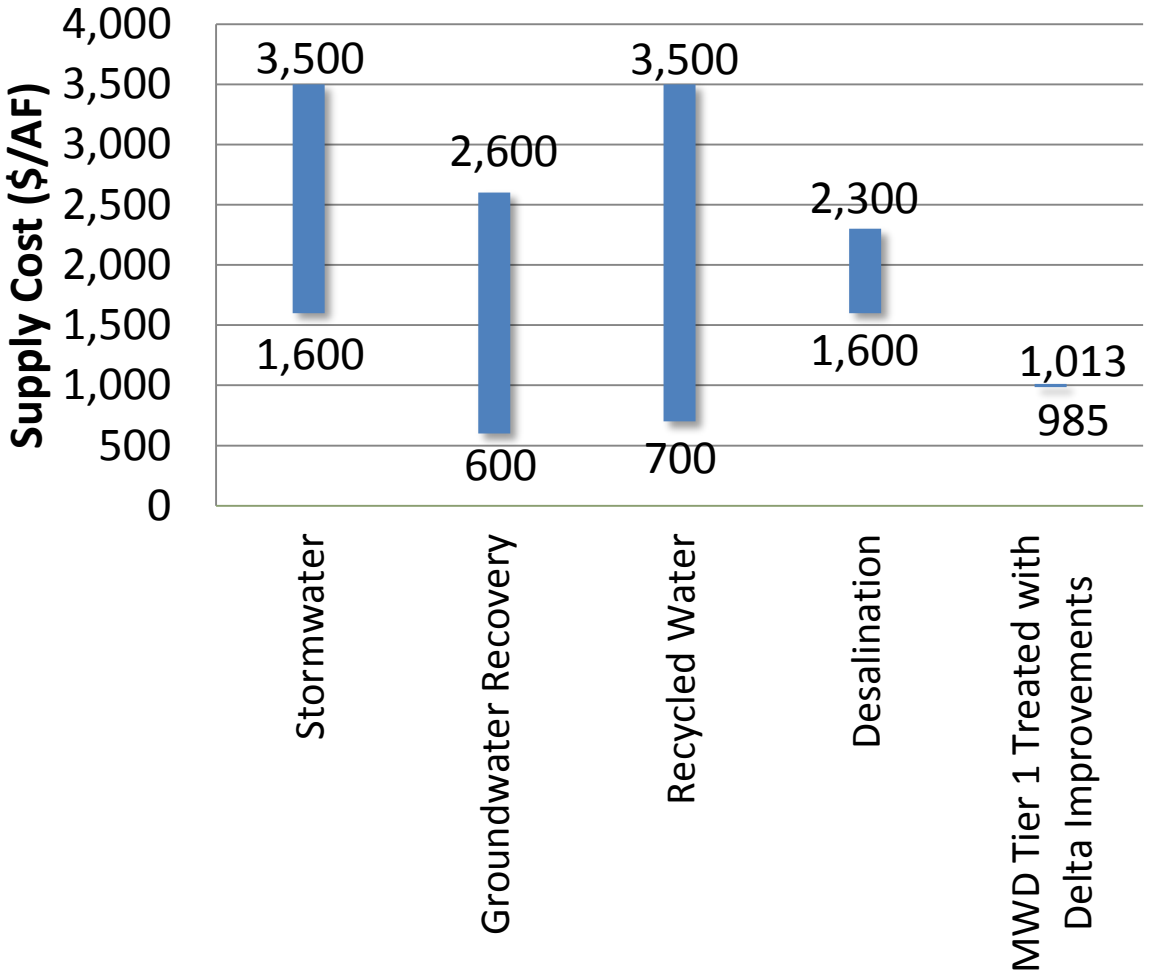
	Sunding Analyses			Michael
Costs	Prelim	Low	High	Report
Tunnel Construction		$12,207	$12,207	$12,207
Operations and Maintenance		$673	$673	$673
Increased Salinity of Delta Agl Water		$34	$34	$1,173
Other Costs*		$595	$782	$0
Total Costs	~$18,500	**$13,509**	**$13,696**	**$14,053**
Benefits				
Value of Restoring Water Supply over Current Levels	$3,036	$4,079	$4,079	$3,916
Value of Avoiding Future Reductions	$11,643	$11,643	$11,643	$0
Value Improved Water for Delivery	[illegible]	$1,819	$1,819	$1,819
Reduced Seismic or Flooding Risk	$2,093	$470	$470	$866
Recreational Value	$1,442	$224	$374	$0
Greenhouse Gas Emissions Reductions	$0	$35	$715	$0
Non-Use Value of Habitat Restoration	$34,210	$0	$0	$0
Total Benefits	**$54,226**	**$18,270**	**$19,100**	**$6,601**
Net Benefit	$35,726	$4,761	$5,404	-$7,452

* Includes Restrictions on Outdoor Recreation (due to land conservation) Transportation Disruptions and Delays (due to construction) Reduced Regional Air Quality (due to tunnel system construction and operations) Greenhouse Gas Emissions Mitigation Costs Other Mitigation Costs

Beacon's Take on the Value of Water

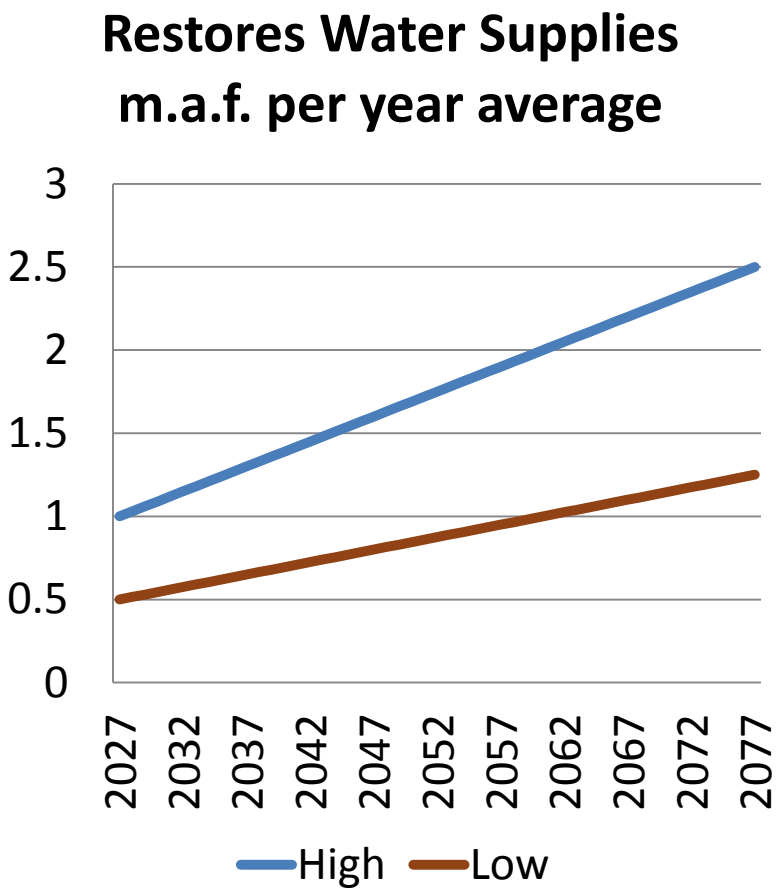
- Water supplies are likely to be reduced from current levels without tunnels
  - Clear evidence of ongoing degeneration of conditions; implies tighter regulation and more restrictions on southern pump exports
  - Even without new limits, increased variability of supply imply less exports if supply availability occurs in environmentally sensitive times of the year
  - Sunding's estimate (~$11 billion) likely closer to the truth
- Water supply restoration may be less than hoped
  - Current estimate is up to ~1 maf per year on average, maybe less
  - This implies the restoration value could be less than $4 billion
- Both may be underestimating the *value* of the restored water supplies
  - Sunding limits the time in his model to 23 years—50 year project
  - What is the loss of consumption value?
  - What is the cost of replacing this with other supplies?

Replacement Cost Analysis



- Cost relative to other sources, $1000 / af cheaper on average
- $1 billion per year and growing, NPV of this is > $250 billion
- As per Sunding, most would have to be absorbed through reduced consumption, higher prices for consumers

Willingness to Pay Analysis



- Net of water NPV 'cost' of tunnels per Michael $11.5 bil (probably lower)
- Urban Delivery Cost: $850 per af
- 1.5% net discount rate
- Sunding Estimate ~$15 billion
- Prices paid in CA range from $600 to $1900 per acre foot

Willingness to Pay		NPV Water Supplies	
Urban	Ag	High	Low
$1,200	$140	**$12,022**	$6,011
$1,400	$160	$17,420	$8,710
$1,600	$180	$22,817	**$11,409**
$1,800	$200	$28,215	$14,108
Higher Discount Rate as Per Smith			
$1,400	$160	**$12,050**	$6,025
$1,600	$180	$15,784	$7,892
$1,800	$200	$19,517	$9,759
$2,000	$220	$23,251	**$11,626**
$2,200	$240	$26,985	$13,493

The North / South Option Value

- Two tunnels are better than one
  - There is a value to being able to shift exports between north and south Delta, depending on environmental conditions
  - Smaller snowpack means short periods of water availability within one year
  - Dealing with the variability of water availability across years
  - Earthquake risks
  - Value of not stranding assets
  - Better able to deal with salinity issues from rising sea levels

- Truth on environmental issues is in between
  - Michael's critique correct: much of the value of environmental restoration in initial Sunding analysis comes from non-tunnel efforts, and should not be included in the cost-benefit analysis
  - Don't dismiss *all* the environmental value, as per updated studies. Having alternative North-South routes of transfer allow for fish stocks to be better managed
  - Actual value: unknown, but remember that 10% of non-use value is still $5.4 billion

The Earthquake Risk

Number of Island Failures	Probable Earthquake Characterization	Annual Frequency of Exceedence	Probability of Exceedence in 50 Years	Approximate Time to Repair Levees (days)	Approximate Start of Exports (days)
3	Moderate	0.082	0.984	120-330	230
20	Large	0.032	0.974	620-880	780
30	Massive	0.019	0.620	1,120-1,520	1,160

Probability weighted estimates of tunnel benefit less than $1 billion

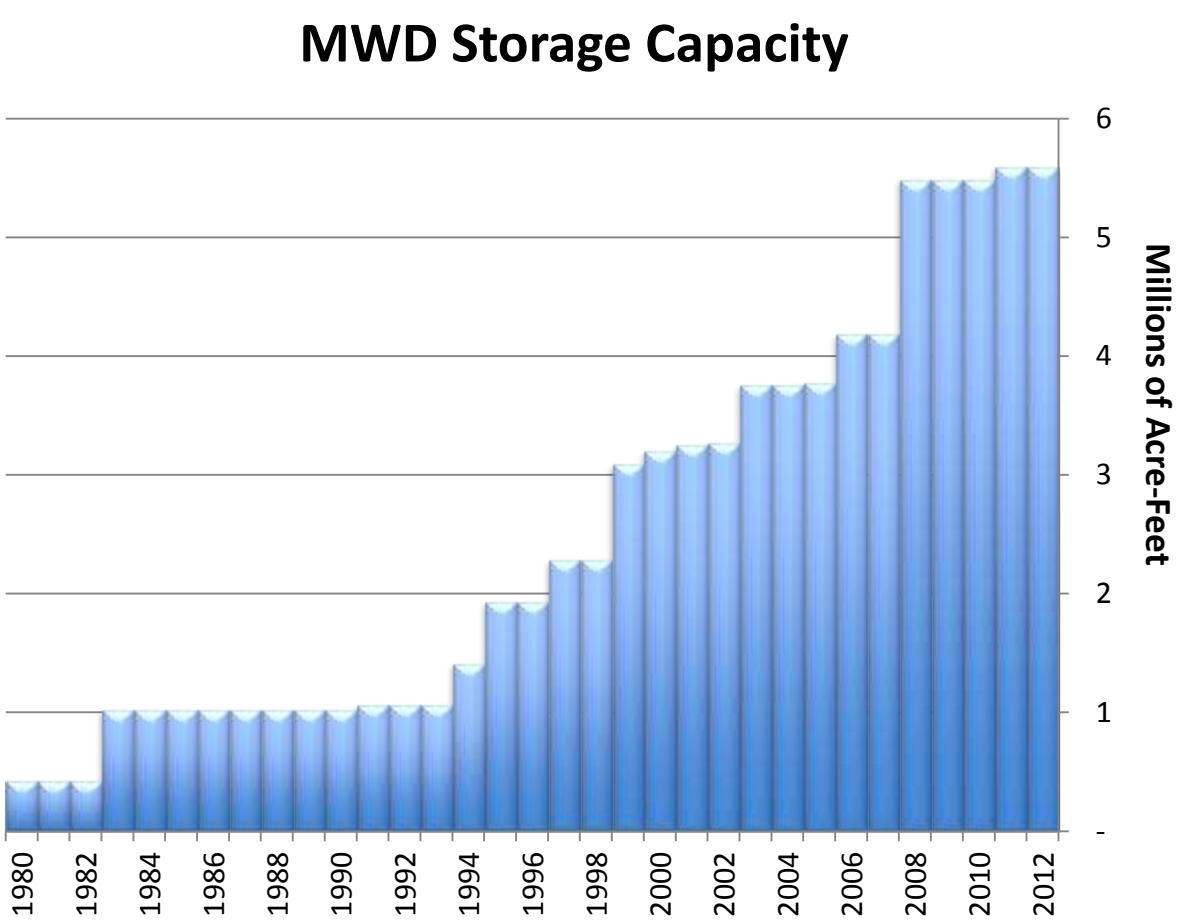
What are the actual costs of a major earthquake in the Delta?

- Economic disruption (jobs, construction) and the multiplier effects
- Cost of procuring new supplies, direct and indirect
- Short- and long-term Delta mitigation efforts
- Water rationing and emergency ordinances

Can't Levee Repair do the Job?

- $4 billion in repairs can't guarantee they will hold up
- Repairs will have to be made again and again
- Just a back-door subsidy

Stranded Assets?



- Storage capacity has increased 13 times since 1980
- Right now, 2.7 million acre-feet of water is being stored
- MWD continues to make investments in storage projects, such as roughly $2 billion for the construction of Diamond Valley Lake

Economic Cost-Benefit Analyses

- The tunnel will restore some supplies and increase reliability
  - Restoration occurs even as the ecology of the Delta improves
  - It's a big project—but not that big, and paying for it is built in
  - It's not THE solution to water in California, but a part of it.
  -
- Stop hitting the panic button!
  - 33 million acre-feet of annual runoff through the Delta
    - 16 million acre-feet of that water flows into the ocean
    - 10 million acre-feet of that water is used upstream of the Delta
  - Even before the federal biological opinions, less than 6 million acre-feet of water was exported per year on average
    - On average less than 20% of runoff through the Delta was used for exporting
    - Little will change even if Delta exports are restored to as much as 5.9 maf / year

Summing Up

- We think it is clear that the Tunnel's NPV is > 0
  - Alternative supplies are simply far more expensive
  - The value of restoring water supply seems large enough to justify the project
  - Adding in the option value of two access points will make it more obvious
  - Concerns about issues with the entire Delta system need to be met by all delta users, not just the southern access exporters
- Must compare results across range of solutions
  - The 9000 cfs tunnel system gives best bang for buck according to current modeling
  - Are there alternative 'Delta' plans that have similar net benefits?
  - What is the NPV of these other options? Are these options politically viable?
- There is more to figure out
  - How to measure the option value of having the two options for water extraction rather than just one on both environmental mitigation and water management
  - What would be the economic impact of a massive earthquake in the region?
  - Understanding how the tunnel system adds to the overall ability to deliver water, i.e. using the extensive reservoir system
  - How does climate uncertainty play a role

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