Water-Energy Cost Effectiveness Analysis

Public Workshop Presentation – Water System Costs and Avoided Cost Methodology – PREVIEW SLIDES

June 24, 2014

Content of Report

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June 24, 2014

1. Project Overview
2. Defining Avoided Cost
3. Water Infrastructure Costs
4. Avoided Cost Calculation Methodology and Assumptions

1. **Project Overview**
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The goal of our research effort is to develop a method of valuing the monetary benefits of water savings via CPUC cost effectiveness tests.

- CPUC decision 12-05-01 stated it is *"not prudent to spend significant amounts of [energy] ratepayer funds on expanded water-energy nexus programs until the cost-effectiveness of these programs, and particularly the net benefits that accrue to energy utility ratepayers, are better understood."*
- Past water-energy studies have focused on a "snapshot" of water infrastructure and its energy requirements at that point in time.
- This analysis looks to the future: what future costs associated with water and energy infrastructure can be avoided as a result of water conservation?

California IOUs can already rebate high efficiency clothes washers …

… does it benefit energy ratepayers for IOUs to rebate high efficiency toilets?

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Our core objective is to recommend modifications to existing Cost Effectiveness (CE) frameworks to include consideration of water.

- Existing cost effectiveness frameworks value “Site Energy” savings using the avoided cost (AC) of energy.
- Avoided cost of energy is based on the characteristics of California's marginal energy supply.

$$Benefit\ Cost\ Ratio = \frac{Site\ Energy\ AC}{Equipment\ Cost + Program\ Cost}$$

Where:

$$Site\ Energy\ AC = Site\ Energy\ Savings\ x\ Avoided\ Cost\ of\ Energy$$

- Modifications to the benefits portion of the equation are needed to account for water savings.

$$Benefit\ Cost\ Ratio = \frac{Site\ Energy\ AC + Embedded\ Energy\ AC + Water\ Capacity\ AC + Environmental\ Benefits}{Equipment\ Cost + Program\ Cost}$$

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The marginal supply directly informs two major aspects of the cost effectiveness test; we are focusing on Water Capacity Avoided Cost in this presentation.

$$Benefit\ Cost\ Ratio = \frac{Site\ Energy\ AC + Embedded\ Energy\ AC + \boxed{Water\ Capacity\ AC} + Environmental\ Benefits}{Costs}$$

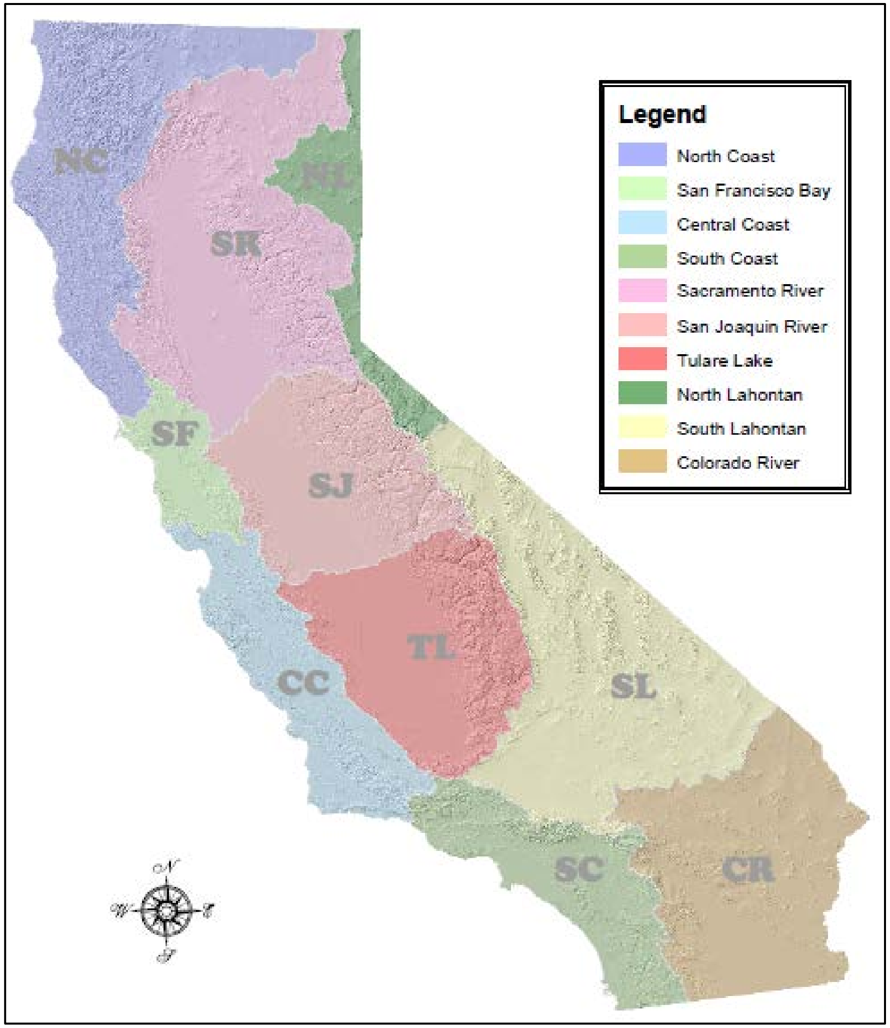
Represents the avoided investment cost that would have been required to develop and operate the marginal water supply.

Water Capacity AC = Water Savings x **Avoided Water Capacity Cost**

Avoided Water Capacity Cost is ultimately represented ~~as~~ dollars per unit water

The team is conducting analysis at the California Department of Water Resources Hydrologic Region level.

- Types of supplies available to each region differ
- Many water supply planning activities and data are available at this level; water supply options are relatively consistent within a hydrologic region.
- The Navigant team leveraged the multitude of existing studies and reports that already document water supplies and their energy intensities at the hydrologic region.



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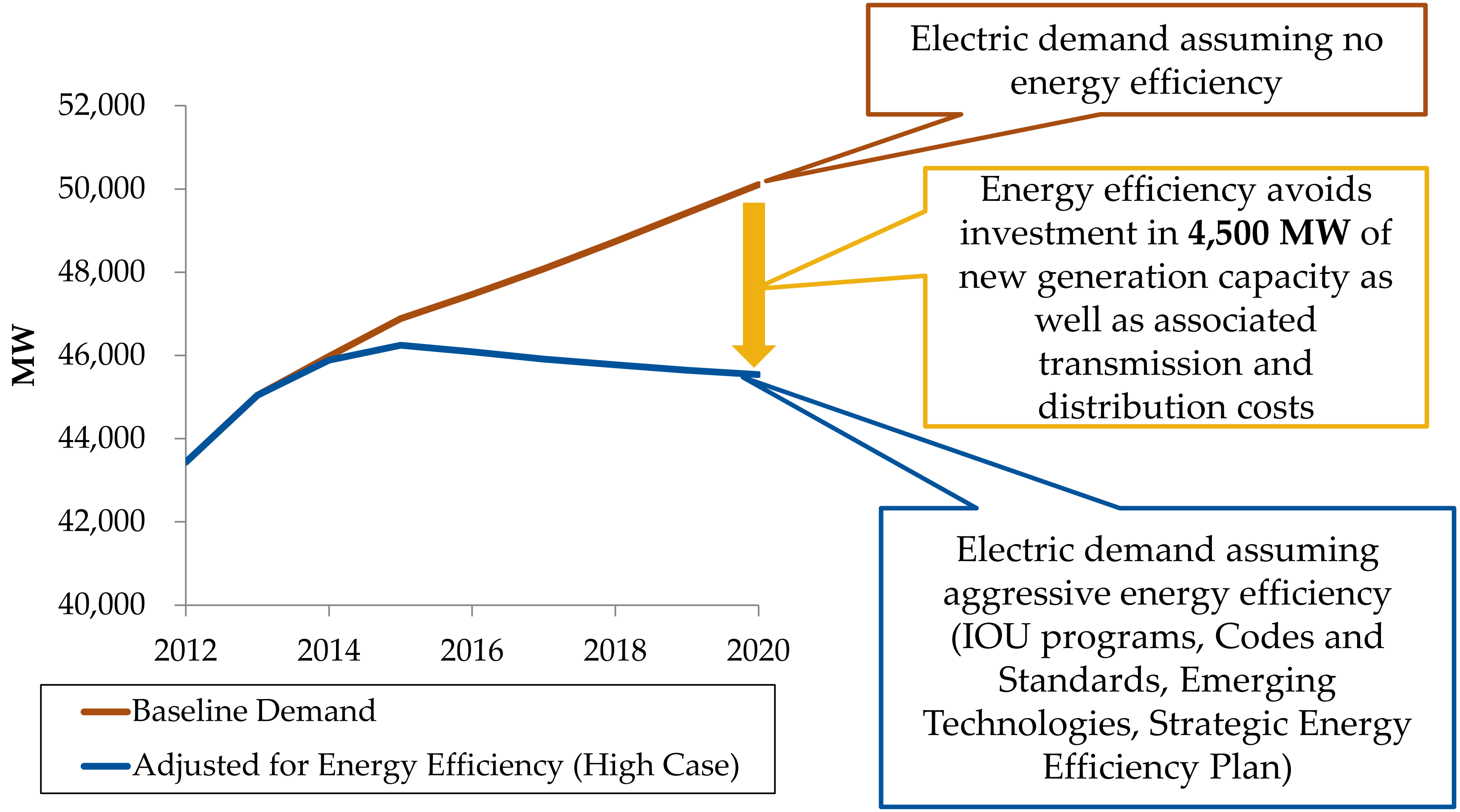
First, we look to California's electric sector to understand how energy efficiency is valued (we present a simplified interpretation).



CEC. *California Energy Demand 2014–2024 Final Forecast*. January 2014

The avoided cost of energy places an economic value on each unit of energy saved (avoided investment in generation, transmission, etc.)

- Standard practice assumes energy efficiency reduces reliance of energy supply "on the margin" (i.e. the Marginal Electric Supply)
- Energy efficiency avoids development of the **next** power plant
- While certain types of power plants are being phased out as a result of policy decisions, these are not considered to be the marginal supply

Avoided cost analyses looks at the next increment of supply that would be developed in the absence of efficiency. It does not look at the last increment of energy used.

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Water avoided costs will consider multiple components just like electric avoided costs.

Components of California's Avoided Cost of Electricity	Components the Navigant Team is Examining for the Avoided Cost of Water
• Energy (fuel) • Generation Capacity • Transmission and Distribution • Ancillary Services • System Losses • Emissions • Avoided Renewable Portfolio Standard	• Supply/Extraction • Conveyance • Treatment • Distribution • Wastewater treatment

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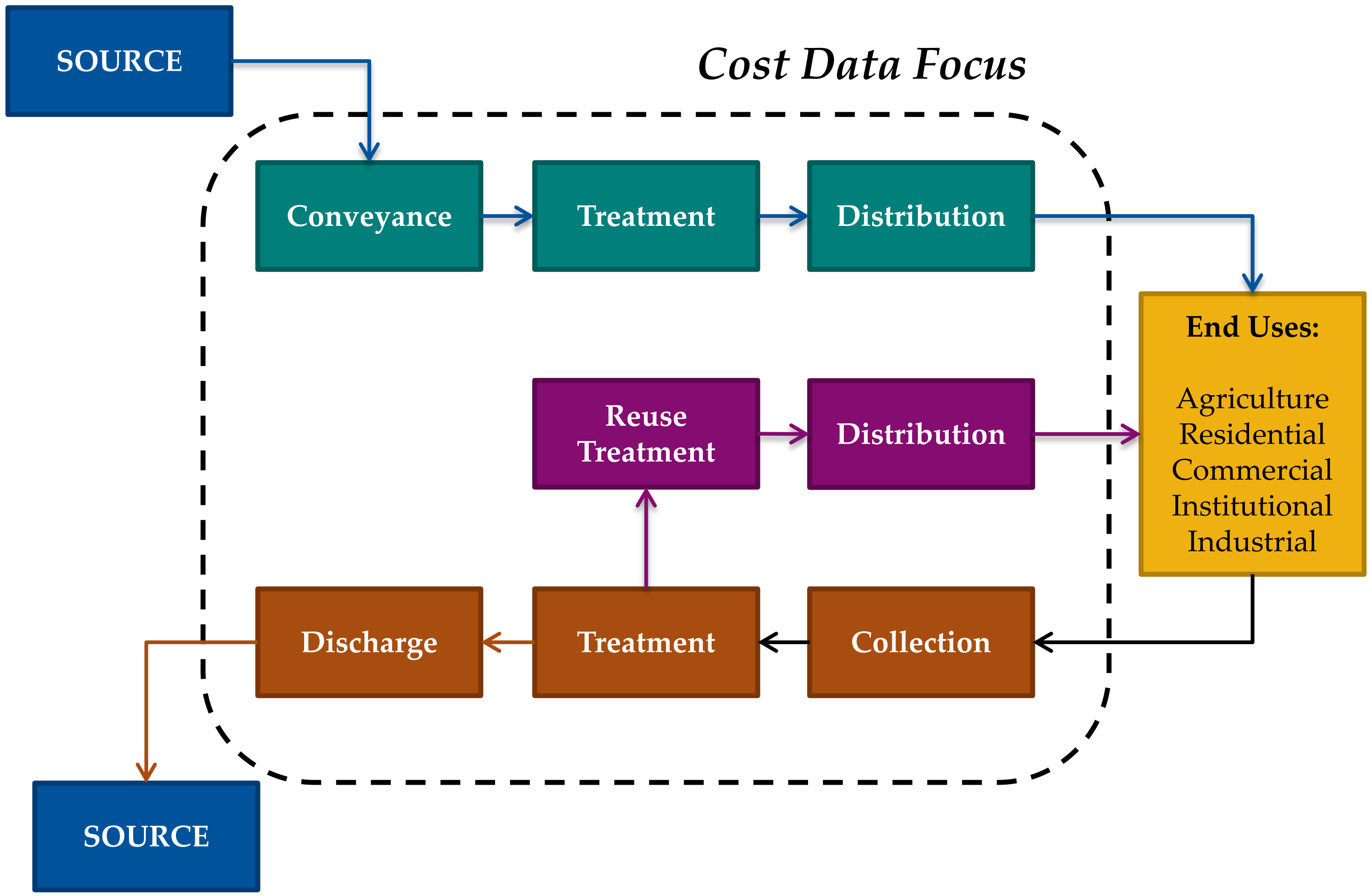
Our objective for this task is to develop an approach to quantify water avoided capacity costs.

- Water avoided costs capacity cost are defined as the change in cost triggered by the change in quantity
- Navigant has developed approaches that are methodologically similar to that which have previously been adopted in California (for energy avoided cost analysis) but account for the specific circumstances unique to water service
- Two main steps to developing avoided water capacity cost:
  - Determine the cost of building additional water supply, treatment, distribution and wastewater system infrastructure
  - Develop and implement cost calculations to levelize the system costs resulting in a dollar per unit volume value (i.e. $/gallon)
- The next two sections of our presentation cover these two aspects
  - **Water Infrastructure Costs** – our research and summary of available cost data
  - **Avoided Cost Calculation Methodology and Assumptions** – our general methodology for leveling costs

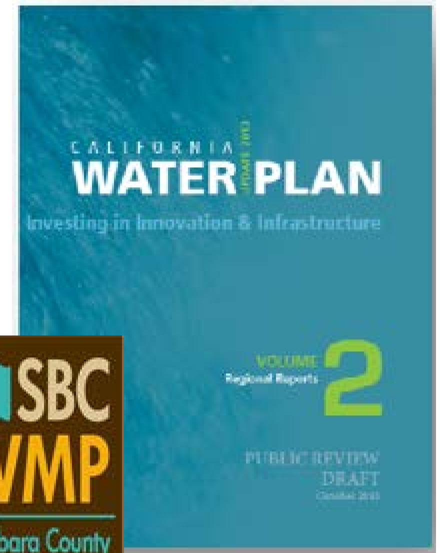
Infrastructure Related Cost Data

- Cost information was collected for major components of the water system infrastructure
- Types of data sought:
  - Cost data associated with system components of water supplies & wastewater
    - Capital cost
    - Operations and maintenance (O&M) cost
  - Qualifying information about the cost data was also collected
    - Capacity/size of components
    - Annual and peak production rates
    - Year of price estimates
    - Factors and costs included (labor, equipment, permitting, etc…)
    - Definitions of Capital and O&M costs
- Characteristics of Water Sources was completed previously

Types of Infrastructure – Commonly Used Water Use Cycle Diagram



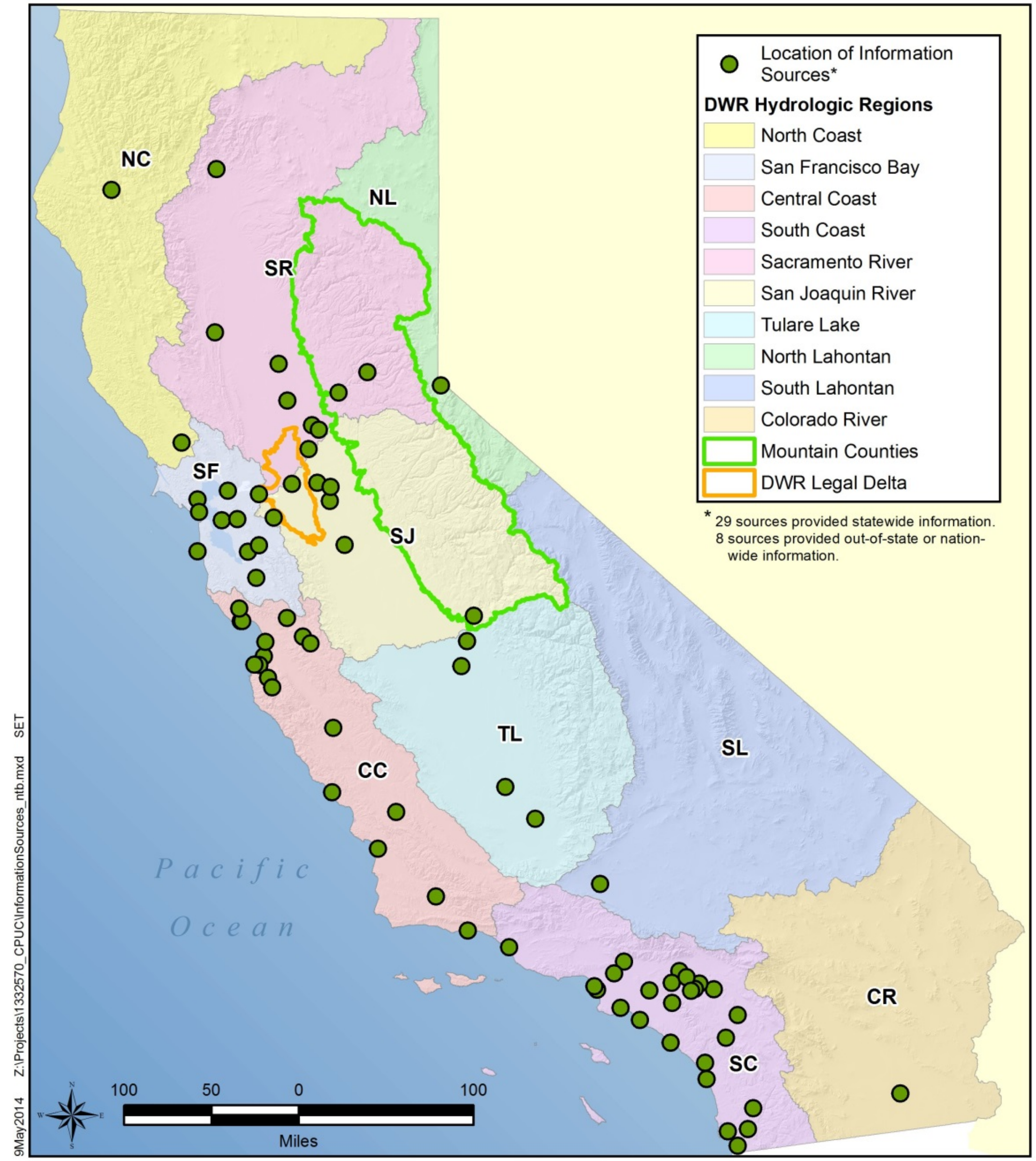
Where We Looked for Data



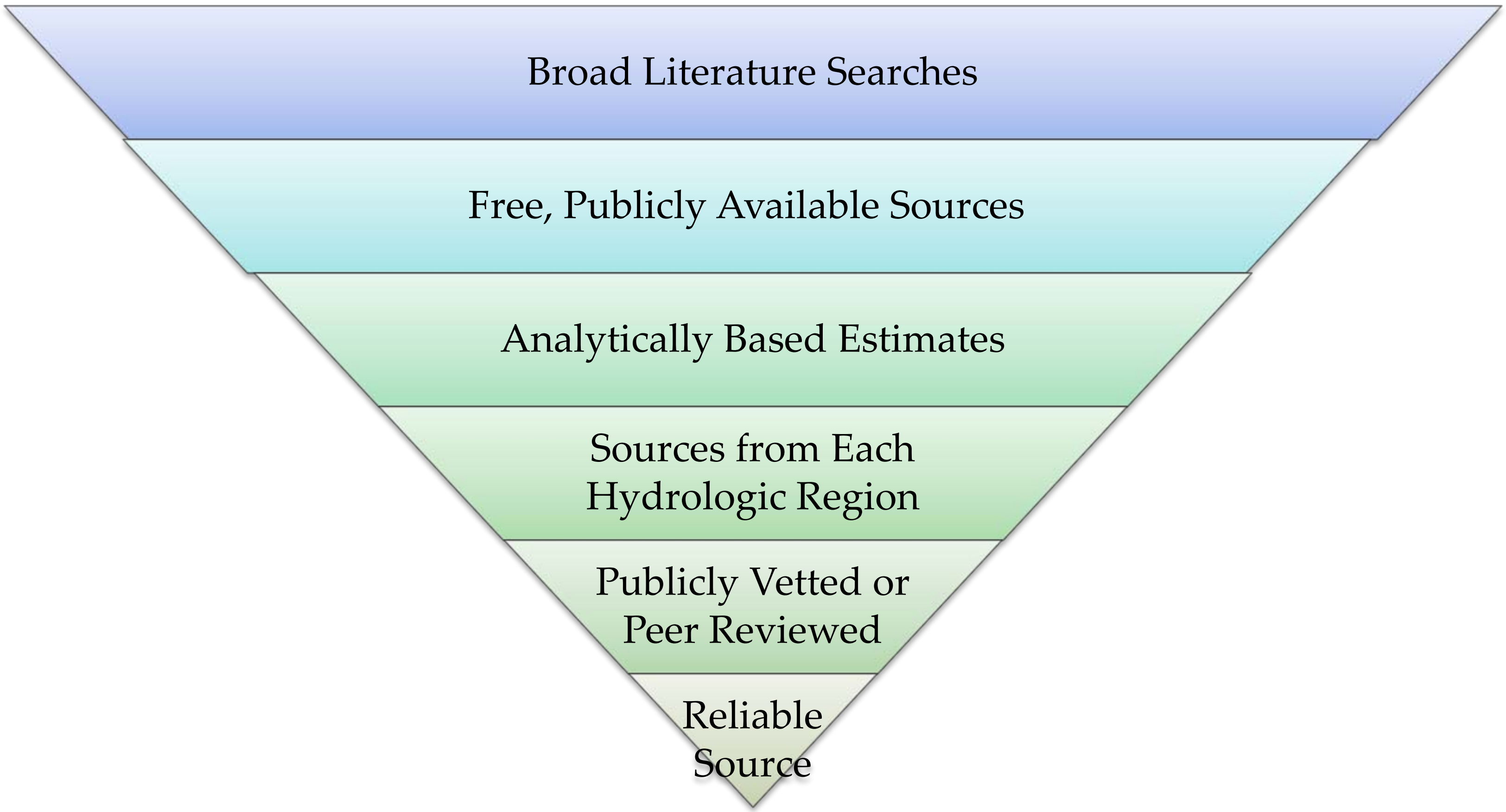
- Readily available public sources of information:
  - Integrated Regional Water Management Plans (IRWMP)
  - Capital Improvement Plans (CIPs)
  - California Department of Water Resources (DWR)
  - State and Local Agency Engineering Reports
  - Other Sources:
    - Local water agency websites
    - Academia and non-governmental organizations

SOURCES	REVIEWED
IRWMPs	~ 17
CIPSs	~ 11
State and Other Local Agencies	~ 45
CA DWR	~ 16
Pacific Institute/ EPA/ PPIC/ USBR/CPUC	~ 13
Others	~ 21

Regional Distribution of Data Sources



Approach to Data Source Selection



Information that was deemed valid was based on whether it came from a reliable resource.

Assumptions

- Levels of details associated with cost data varied. The study team, therefore, assumed:
  - Lump sum costs represented capital costs and did not include operations and maintenance costs unless otherwise specified.
  - Permitting, environmental studies/mitigation or financing costs were included in the cost data for both capital and O&M.
  - Variations based solely on location for similar water infrastructure elements could not be discerned from the available data and were therefore assumed to be negligible.
  - For desalination facilities, reports that compared costs tended to include costs of pilots projects in determining averages – these tend to not be representative of the scaled up version for several reasons including the difference in regulatory requirements for permitting and environmental compliance for such facilities. These costs were excluded from the compiled data to the extent identifiable.
  - Available published data for large-scale storage and conveyance facilities is very limited. The study team considered available data to be indicative and best available.
  - Data on non-potable desalting facilities was extremely limited and cost data was insufficient for purposes of this study.

Assumptions (continued)

- No cost data for desalinations plants proposed in Baja, California intended to serve US demand could be found and thus are not included in this study.
- To the extent possible, engineering studies and Capital Improvement Project (CIP) estimates are favored and viewed as the most accurate, but in the absence of such information, the study team relied on other sources to provide estimates of costs.
- IRWMPs complied with DWR's guidelines available at the time of the reports were prepared.
- IRWMPs are the best available assessments of water portfolios and future plans for a given region.
- Marginal supplies are the most likely supplies to be developed in the absence of conservation/efficiency efforts.
- Lesser quality supplies require some degree of treatment even for agricultural purposes.
- Potable grade water is used for urban residential outdoor landscape irrigation.

Types of Infrastructure Costs Data - Overview

» Treatment

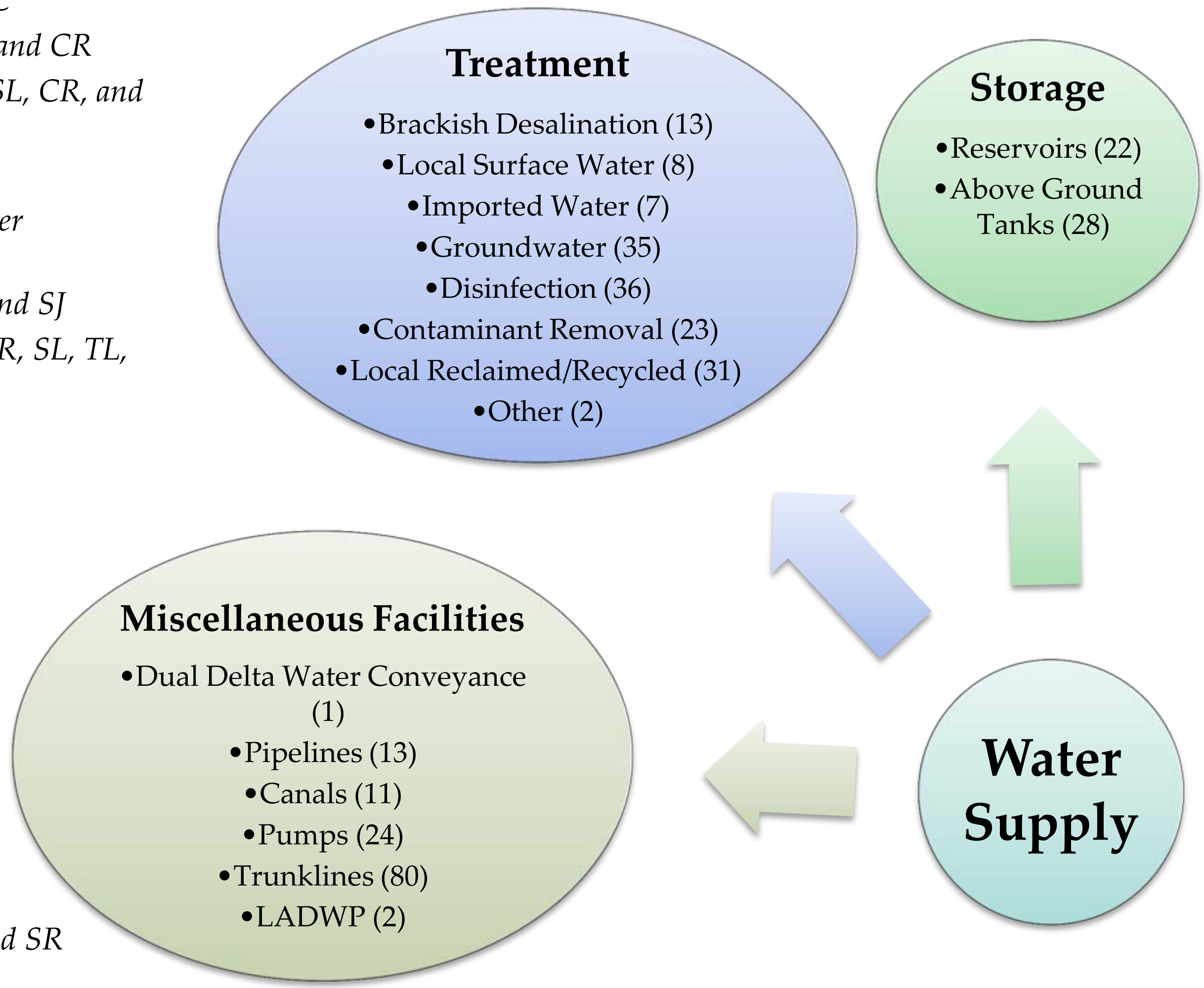
- Brackish Desalination: *SF, CR, and SC*
- Local Surface Water : *SR, SJ, SF, SC, and CR*
- Imported Water: *SR, SF, SJ, TL, CC, SL, CR, and SC*
- Groundwater: *SC, CR, SF, and SJ*
- Disinfection: *2003-2038 Drinking Water Infrastructure Needs Survey Estimates*
- Contaminant Removal: *SC, CR, SF, and SJ*
- Local Reclaimed/Recycled: *SC, SF, CR, SL, TL, NL, and NC*
- Other: *SC*

» Miscellaneous Facilities

- Dual Delta Water Conveyance
- Pipelines: *SJ, SC, SF, and CR*
- Canals: *SR, and SJ*
- Pumps: *SC, CR, SF, and SJ*
- Trunklines: *SF, SC, CR, and SJ*
- LADWP: *SC*

» Storage

- Reservoirs: *SF, SR, SJ, SC, and CC*
- Above Ground Tanks: *CC, SF, SC, and SR*



Types of Infrastructure Cost Summary

Water Use Cycle Components Breakdown	Size/Capacity	Capital Cost Low	Capital Cost High	O&M Cost Low	O&M Cost High
Water Conveyance					
Pipes			$80,000,000	N/A	N/A
Canals		$44,000	$20,000,000	N/A	N/A
Imports	Per acre-foot	$56.14	$1,545	N/A	N/A
Dual Conveyance	15,000 cfs	$8,600,000,000	$17,200,000,000	N/A	N/A
Water Treatment					
Disinfection	Low: 0.03 MGD High: 210 MGD	$12,472	$19,575,848	N/A	N/A
Contaminant Removal	High: 30 MGD	$77,000	$67,000,000	N/A	N/A
Ocean Desalination	Low: 0.2 MGD High: 50-150 MGD	$3,000,000	$1,900,000,000	$7,060,000	$157,000,000
Brackish Desalination	High: 10-20 MGD	$35,000,000	$181,000,000	$30,000	$15,500,000
Groundwater		$1,500,000	$973,356,000	$198,000/ MGD	$13,149,000/ MGD

N/A - *data not available in the sources the team reviewed*

Types of Infrastructure Cost Summary (continued)

Water Use Cycle Components Breakdown	Size/Capacity	Capital Cost Low	Capital Cost High	O&M Cost Low	O&M Cost High
Water Distribution					
Pumps		$29,000	$360,116,000	N/A	N/A
Pipes			$657,000		
Trunklines	Low: 16 MGD	$435,000	$722,792,000	$100,000	$200,000
Wastewater					
Secondary Treatment					
Recycled (Treatment)	High:45 MGD	$115,000	$1,922,402,777	3,453,100	$81,732,363

N/A - *data not available in the sources the team reviewed*

Future Marginal Water Supplies Cost by Hydrologic Region – Recycling

Hydrologic Region	Water Supply	Size	Technology	Capital Cost (Low)	Capital Cost (High)	Capital Cost/ Size	O&M Cost (Low)	O&M Cost (High)
SJ	Recycled	60,000 AFY (54 MGD)	tertiary-treated	96 M	102 M	$1.7 M/ MGD; $1.9/ MGD	N/A	N/A
NC	Recycled	6,700 MGY (18 MGD)	tertiary-treated	190 M	N/A	$10.5 M/ MGD	N/A	N/A
NL	Recycled	5.5 cfs or 2470 GPM (4 MGD)	tertiary-treated	N/A	N/A	N/A	N/A	N/A
SL	Recycled	13,331 AFY (12 MGD)	tertiary-treated	119 M	N/A	$9.9 M/ MGD	3.5 M	N/A
SR	Recycled	18-100MGD; 27,000 - 52,000 AFY	tertiary-treated	140 M	245 M	$7.7 M/ MGD; $2.45 M/ MGD	N/A	N/A

N/A - *data not available in the sources the team reviewed*

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Future Marginal Water Supplies Cost by Hydrologic Region – Desalination

Hydrologic Region	Water Supply	Size	Technology	Capital Cost (Low)	Capital Cost (High)	Capital Cost/ Size	O&M Cost (Low)	O&M Cost (High)
SF	Brackish Desalination	10-20 MGD	RO	168.5 M	181 M	$16.85 M/MGD ;$9.05 M/ MGD	10.4 M/year	N/A
CC	Ocean Desalination	Smaller: 330 AFY, 0.6 MGD Larger: 5,000 FY, 5 MGD	RO	11.9 M	126 M	$19.8 M/ MGD; $25.2 M/MGD	370,000	7.2 M
SC	Ocean Desalination	Smaller: .20 MGD Larger: 56,000 AFY, 50 MGD	RO	3 M	1.2 B (1200 M)	$15 M/ MGD; $24 M/ MGD	N/A	53 M
CR	Brackish Desalination	Smaller: 15,000 - 25,000 AFY, 13 – 22 MGD Larger: 50,000 AFY, 45 MGD	RO	1.12 M	153 M	$.09 M/MGD; $3.4 M/MGD	6 M	15 M
TL	Brackish Desalination		RO	1.12 M	153 M	$.09 M/MGD; $3.4 M/MGD	6 M	15 M

N/A - *data not available in the sources the team reviewed*

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Next Steps to Finalize Cost Data Sets

» Complete Data Gathering and Finalize Data Sets
  - Address comments and incorporate additional data from workshop participants and PCG
  - Define needed proxies to fill data

» Define indicative costs based on expert judgment and compiled data
  - Based estimates on peak capacity due to sizing requirements for water systems

» Summarize methodology and results in written report

» Address any comments or questions related to water supplies and associated costs in the support of the model development

Dual Goals of the Avoided Cost Methodology

» **Develop an Avoided Cost Model**
- Develop a model which is flexible enough to address future study needs
- Capable of cost calculation by Hydrologic Region – with the capability of additional regions
- Calculation by function
- Long-and Short-run capabilities
- Ability to toggle between IOU and municipal financial structures

» **Perform an Avoided Cost Study**
- Use data from this study to perform a study of avoided costs in California
- Preliminary focus of the study is Supply which is the primary resource challenge in California
- Assumed that the marginal cost of conveyance and distribution are zero
  - No significant conveyance projects in several decades
  - Conveyance is often used to move low cost commodity from one region to another
  - Natural monopoly argument for distribution

The goal of the model is to develop a flexible tool that can service the needs of policymakers in California in future studies. In contrast , the goal of the avoided cost study is to establish an initial estimate of avoided capacity costs which can be the foundation of further study.

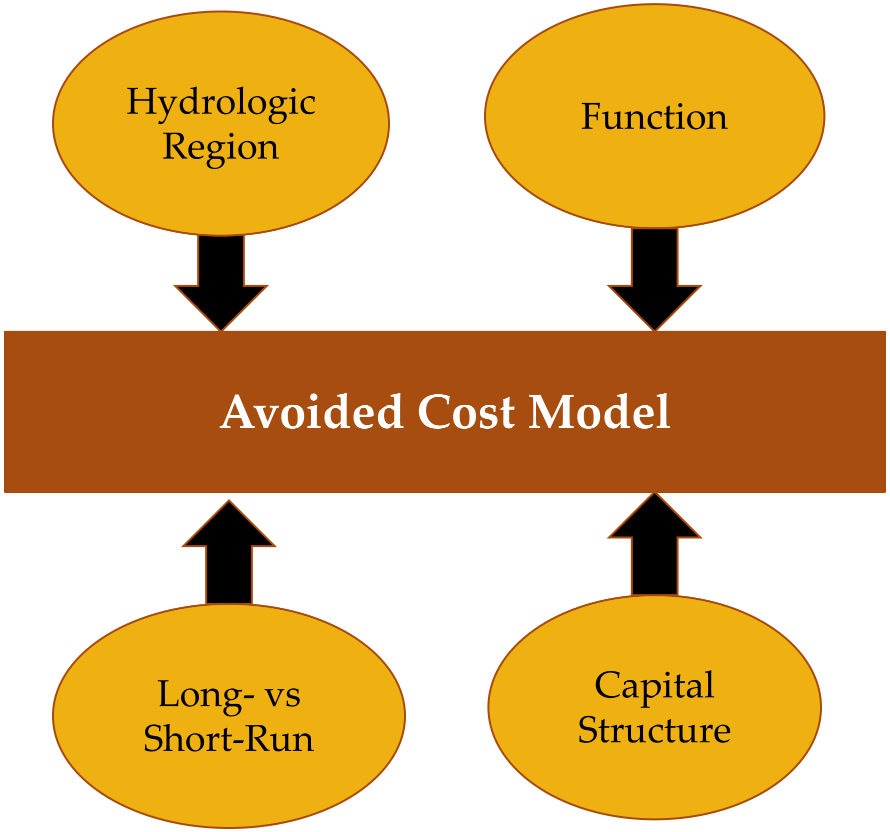
General Capabilities of the Model

» Defines costs by Hydrologic Region

» Analyses each function separately
  – Supply
  – Conveyance
  – Water Treatment
  – Distribution
  – Wastewater Treatment

» Water supply technologies can be characterized as long-run and short-run

» Capabilities for estimating IOU and municipal capital structures



Approach for Estimation of Avoided Capacity Costs

Our Primary Focus of the Avoided Cost Study Was Water Supply

- » Supply is the key component in estimating marginal capacity costs.
- » The marginal supply technology varies by region
- » Many of the other water supply service functions are characterized as being fixed

Long-run vs Short-run

- » Water supply technologies can be characterized as long-run and short-run
  - – Short-run are those technologies which are expected to be employed in the next 10 years
  - – Long-run technology anticipated to be employed in time periods greater than 10 years

Approach for Estimation of Avoided Capacity Costs (Cont'd)

Conveyance

» Few significant conveyance projects have occurred in several decades

» Many of the water supply technologies anticipated in the future will not rely upon distant water supplies

Conclusion: Marginal conveyance capacity costs have been set to zero.

Distribution

» The cost structure of distribution systems differs significantly from region to region

» In many parts of California per capita usage on distribution systems has decreased as opposed to increased

» Distribution investment appears to be driven by interconnection of customers and not the demand / quantity of water delivered

» Distribution system capacity is often influenced by emergency fire flow requirements

Conclusion: Navigant proposes that we conclude that avoided water distribution systems capacity costs are fixed costs in both the short- and long-run

Supply Treatment and Wastewater Treatment

Supply Treatment

» Recognize that treatment may differ dependent upon the source of supply

» Assumed capital costs of supply treatment were similar across regions for the same technology

Wastewater Treatment

» Navigant plans on designing capabilities into the model enabling different wastewater treatment for each region

» For the purposes of the study we assumed that wastewater treatment plants in each hydrologic region were identical

Conversion of Capital Costs to Annualized Marginal Capacity Cost Estimates

» Adopt fixed charge rate calculations similar to those employed in California

» Calculator will have a "toggle" enabling the movement from IOU to municipal cost of capital and revenue requirement calculations

- IOU cost of capital assumptions based upon guidance from CPUC
- Municipal cost of capital assumptions based upon guidance from local Navigant experts and from CPUC

» All cost-of capital assumptions are input into the calculator and can be controlled by the user.

IOU Capital Cost Approach

- Traditional Fixed Charge rate calculation
- Levelized return of revenue requirement
- Cost of capital consistent with California IOU's
- Standard income tax assumptions

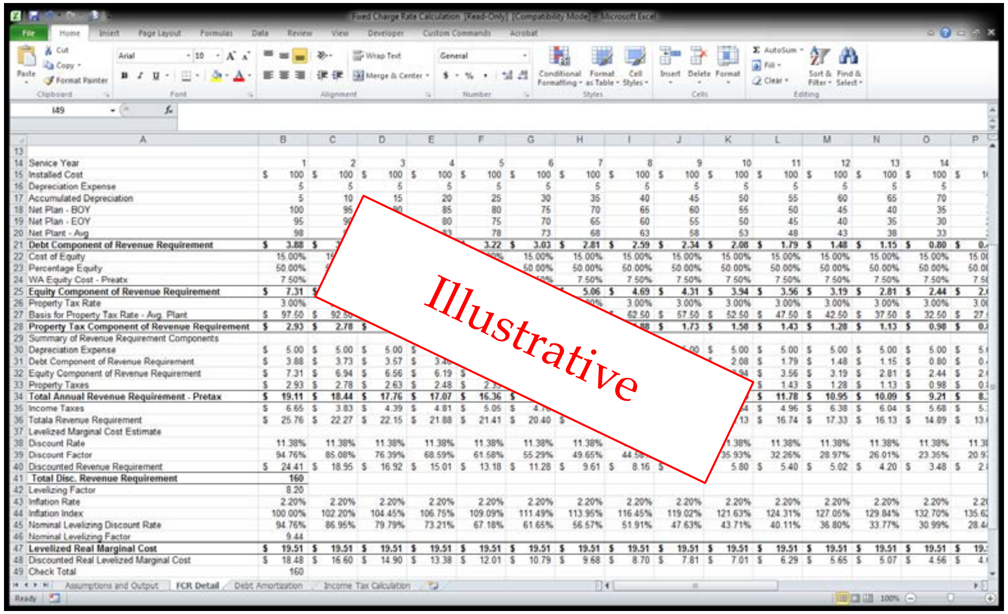
Municipal Capital Cost Approach

- Traditional Fixed Charge rate calculation
- Cash flow model
- Cost of capital consistent with California munis
- Coverage ratio consistent with industry expectations

Example Calculations: Capital Cost Approaches

» The team will now walk through a few illustrative examples of the capital cost calculation approaches

» Example calculations are presented in a separate spreadsheet



Discussion

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