IRP Member Agency Technical Workgroup

Retail Demands and Conservation
July 22, 2015

IRP Member Agency Workgroup Process

- April 2015
  - IRP/RUWMP Kick-off 4/8
  - Water Use Efficiency Meeting 4/16
  - Uncertainty 4/22
- May 2015
  - Imported Supplies 5/18
  - Water Use Efficiency Meeting 5/20
  - Groundwater (1 of 2) 5/27
- June
  - Groundwater (2 of 2) 6/11
  - Water Use Efficiency Meeting 6/18
  - Local Resources (1 of 2) 6/24

IRP Member Agency Workgroup Process

- July 2015
  - Local Resources (2 of 2) 7/8
  - Water Use Efficiency Meeting 7/16
  - Retail Demands and Conservation 7/22

Presentation Overview

- Retail demand model development
- Retail demand forecast methodology
  - Changes in demographic forecast
  - Conservation savings
  - Demand forecasts
- IRP Issue Paper Addendum input from the WUE Meetings
- Next steps


Retail Demand Model
Development

A Revised Model for Forecasting MWDSC M&I Demands

Presentation at IRP Member Agency Workgroup

July 22, 2015

David Sunding and Steven Buck

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Outline

I. Forecasting methods and MWD-MAIN
II. A brief review of econometric models
III. Comparison of MWD-MAIN & the Brattle Model
IV. Explanation of the revised model
   - SFR, MFR, CII
V. Concluding remarks

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Summary of forecasting methods

- **Engineering-style forecasts:** Simulation using Demand-Side Management Least-Cost Planning Decision Support System (DS).
- **Time series analysis:** Sometimes called an econometric model, but tends to be more statistical and less economic.
- **Econometric models with multiple regression:** Permits analysis of long-run changes in demand factors.

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Summary of MWD-MAIN Model

- MWD-MAIN is based on 3 econometric models.
- Uses observed consumption from 1980-1992 and demand factors (e.g., price, weather, household characteristics) to estimate a statistical relationship.
- Projections of demand factors are inputs into the econometric model to generate forecasts of future demand.

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Summary of the Brattle Model

- New model is based on 3 econometric models.
- Uses observed consumption from 1994-2009 and demand factors (e.g., price, weather, household characteristics) to estimate a statistical relationship.
- Projections of demand factors are input into the econometric model to generate forecasts of future demand.
- Estimates pre-conservation demands.

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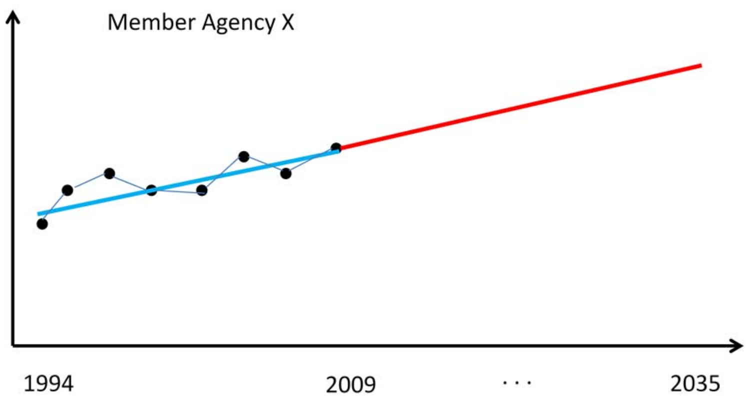
When we say "econometric model" we do NOT mean a simple time series analysis:



We are not fitting a line to a simple time series of consumption data by Member Agency.

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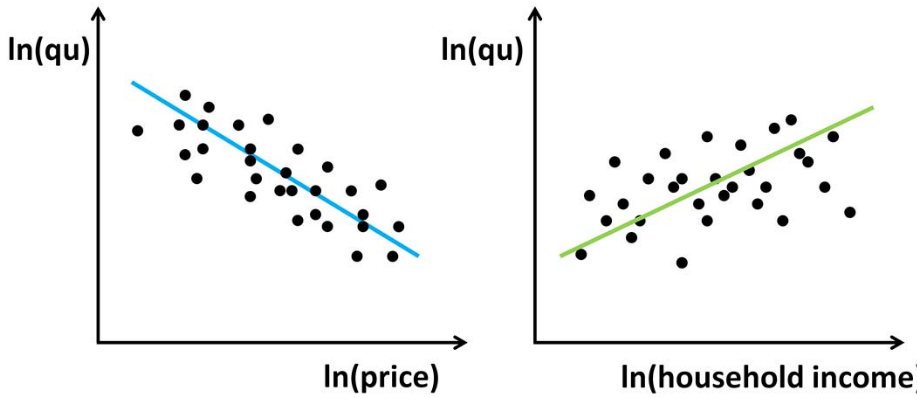
We ask: "What differences in demand factors cause consumption to go up or down?"

qu = consumption



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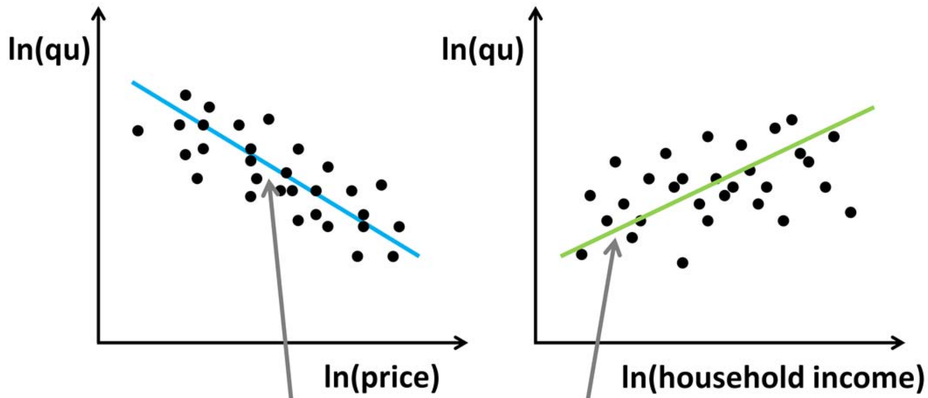

In an econometric model based on multiple linear regression we are able to simultaneously estimate these slopes as well as the effects of other demand factors on consumption.

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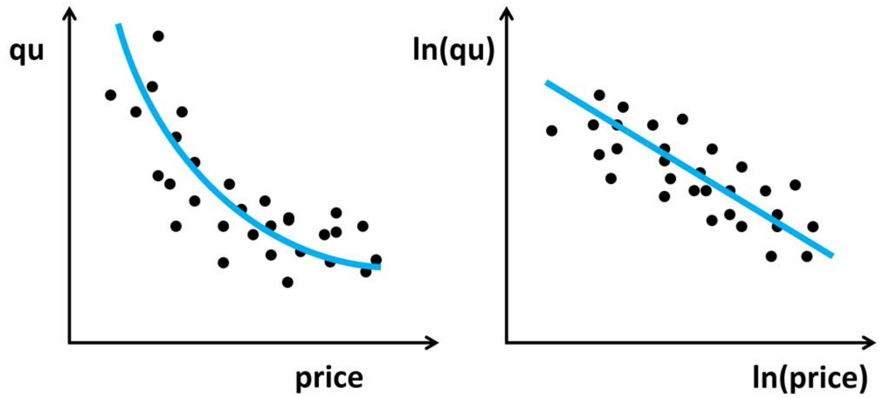
Modeling comment: Linear regression is very flexible and can be used to model non-linear relationships

qu = consumption



The relationship between consumption (qu) and price is not linear; however, the logarithmic form of these variables are linearly related.

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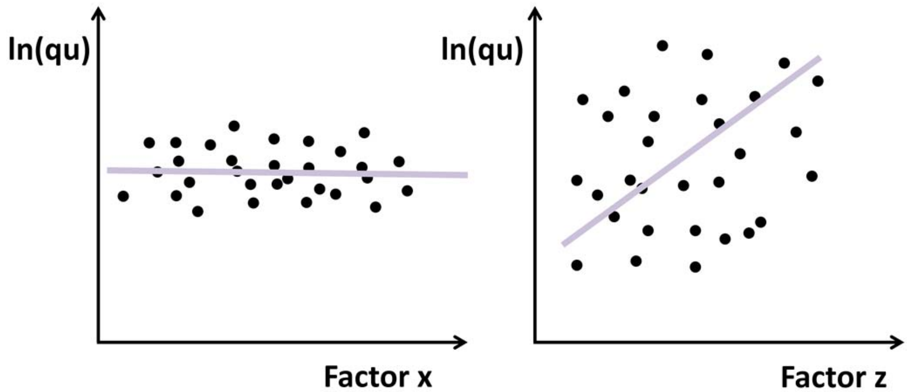
Modeling comment: Variables may have little economic effect on demand or may lack statistical significance

qu = consumption



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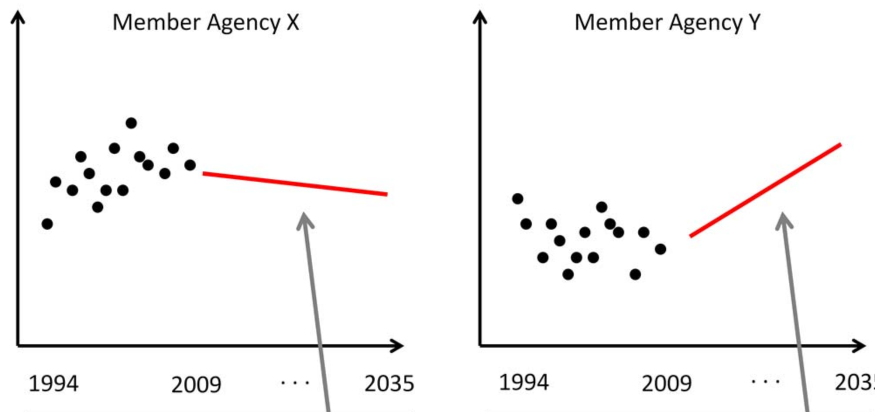
Ultimately, forecasts rely on estimates of slope coefficients and projected demand factors for each Member Agency



Despite upward trend in 'X' we may forecast a drop in demand if:
- Price goes up
- Income stays flat

Despite downward trend in 'Y' we may forecast a drop in demand if:
- [real] Price goes down
- Income goes up

Why a new forecast model?

- Both MWD-MAIN Model and the Brattle Model are based econometric models of demand.
- However, MWD-Main uses older data from 1980-1992.
- Authors of MWD-MAIN indicate spatial coverage should be more comprehensive.

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Data collection: Single family residential

- Rate and consumption data received directly from retailers (consumption data cross-checked with Public Water System Statistics).

- Contacted 153 retailers with 3,000 accounts or more in Metropolitan's service area

- Collected retail data for FY1994/98 through FY2010/11
  - 80% of SFR accounts
  - 1,225 observations
  - 26 out 26 member agencies

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Data collection: Multi-family residential

- Collected retail data from 53 retailers
  - 469 observations
  - 23 out of 26 member agencies (San Marino, Compton, and Foothill MWD not included)
  - Water rates almost identical to SFR sector
  - Consumption data based on Public Water System Statistics (PWSS)

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Data collection: Commercial, industrial and institutional

- Collected retail data from 75 retailers
  - 709 observations
  - 25 out of 26 member agencies (San Marino)
  - Water rate schedules from retailers
  - Consumption data from PWSS, augmented with data from retailers

Data Inspection

- Inspected data within each retailer at the annual time step
  - Rate
  - Retailer level aggregate consumption
  - Number of accounts data for each retailer
  - Implied average water use per SFR household, per MFR household, and per employee
  - Extreme outliers deleted

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Comparison of MWD-MAIN Model and the Brattle Model

	MWDMAIN	Brattle Model
Time period of regression data	1980-1992	1994-2009
Spatial coverage of regression data	SFR: 13 Member Agencies MFR: 12 Member Agencies CII: 14 Member Agencies	SFR: 26 Member Agencies MFR: 23 Member Agencies CII: 25 Member Agencies
Periodicity	Monthly	Annual
Price measure	SFR, MFR & CII: Rate at mean level of consumption	SFR: Avg. cost w/ rate on median tier MFR & CII: Rate on median tier

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Comparison of driver variables

Sector	Driver Variables	Dependent Variable	MWDMAIN	Brattle Model
SFR	SFR Households	Water-use per household	Climate Household size Income Price Housing Density	Total Average Cost Total Average Cost x Median Lot Size Annual precipitation Average Max Temperature Median Income Average Household Size Median Lot Size
MFR	MFR Households	Water-use per household	Climate Household size Income Price Housing Density	Median Tier Price Median Income Median Lot Size Average Household Size
CII	Urban Employment	Water-use per employee	Climate Price Industry/Service Emp. Share	Median Tier Price Cooling Degree Days Average Max Temperature Share of Emp. In Mfg. Median Tier Price x Share of Mfg.

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Improvements relative to MWD-Main Model

- The Brattle Model allows for different:
  - Consumption responses to price changes based on lot size in the single family residential sector
  - Consumption responses to price changes based on manufacturing base in the CII sector
- New model estimates agency specific baseline consumption levels (fixed effects) to improve slope estimates of demand factors
- Revises slope estimates for the effect of demand factors (e.g. income, hh size) on consumption

Summary of data sources

- Rate & consumption survey of retailers in MWDSC and Public Water System Survey
- Conservation savings from Metropolitan's water conservation model
- Geo-referenced data:
  - Weather data from PRISM Climate Group
  - Income & HH size data from the year 2000 and 2010 Census
  - Employment data from CA Department of Finance and the Census's Zip Code Business Statistics

Single family residential demand

1. Summary: We estimate that household consumption is
   - Negatively related to average price (elasticities: 0 to -0.5)
   - Price response depends on lot size
   - Positively related to income, household size and lot size
   - Negatively related to precipitation and positively related to temperature

2. We estimate pre-conservation demands.

3. Model accounts for baseline differences in consumption between Member Agencies using fixed effects.

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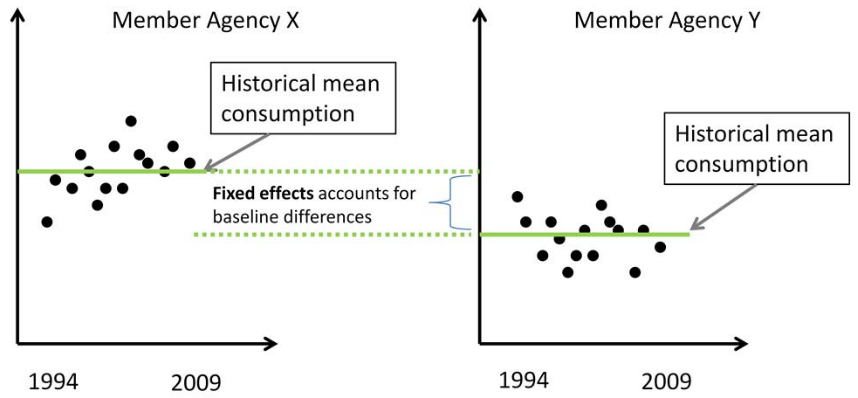
Graphical explanation of fixed effects



Benefits of fixed effects:

1. **Account for demand factors common to a Member Agency that are relatively constant (fixed) over historical record.**
2. **Estimation of agency specific intercept.**

Why do we use a model with fixed effects?

- To improve slope coefficient estimates of observed demand factors (e.g. price, income) by accounting for unobserved demand factors specific to each agency.

Examples of such unobserved factors:

-Share of lot with lawn, general preference for water intensive landscaping, soil quality, # of toilets, leakage

Simplified expressions for linear regression

Linear equation:

y = $\mathbf{m}x + \mathbf{b}$

where **m** is the slope coefficient and **b** is the intercept.

When variables are in logarithmic form, **m** tells us how a 1% change in a demand factor relates to a percentage change in demand (an elasticity).

Simplified linear regression equation:

$\ln(qu) = \mathbf{m}*\ln(income) + \mathbf{b}^{\text{Member Agency specific}}$

where,

$\mathbf{b}^{\text{Member Agency specific}} = \mathbf{b}$ + Member Agency specific fixed effect

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Single family residential: Regression slope coef. (elasticities)

Dependent variable: SFR avg. monthly household consumption (ccf) - pre-conservation				
Variable	Slope Coef.	Standard error	t-stat	% change in demand due 1% change in factor
ln(median income)	0.29	0.03	11.07	0.29%
ln(avg. household size)	0.10	0.05	1.93	0.10%
ln(annual precipitation)	-0.02	0.01	-2.41	0.02%
ln(avg. max. temperature)	0.95	0.11	8.44	0.95%
ln(price)	4.18	0.46	9.04	0% to -0.50%
ln(price) x ln(median lot size)	-0.49	0.05	-9.4	
ln(median lot size)	0.69	0.03	20.06	0% to 0.50%
ln(price) x ln(median lot size)	-0.49	0.05	-9.4	
Observations	1225		R-squared:	0.70

Summarizing the magnitude of demand factor effects

Dependent variable: SFR avg. monthly household consumption (ccf) - pre-conservation			
Variable	Slope Coef.	% change in demand factor	% change in demand
ln(median income)	0.29	30%	8.63%
ln(avg. household size)	0.10	15%	1.52%
ln(annual precipitation)	-0.02	2%	-0.04%
ln(avg. max. temperature)	0.95	2%	1.90%
ln(price)	4.18	30%	Median effect: -4.8%
ln(price)xln(median lot size)	-0.49		
ln(median lot size)	0.69	20%	Median effect: 6.8%
ln(price)xln(median lot size)	-0.49		

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Single family residential: Regression fixed effect intercepts

Dependent variable: SFR avg. monthly household consumption (ccf) - pre-conservation

Member Agency	Fixed effect intercept	Member Agency	Fixed effect intercept
Base (Anaheim)	-10.81	Los Angeles	0.05
Beverly Hills	0.55	MWDOC	-0.08
Burbank	0.19	Pasadena	0.01
Calleguas MWD	0.02	San Diego CWA	-0.17
Central Basin MWD	-0.11	San Fernando	0.00
Compton	-0.25	San Marino	-0.36
Eastern MWD	-0.15	Santa Ana	-0.05
Foothill MWD	0.22	Santa Monica	-0.02
Fullerton	-0.04	Three Valleys MWD	-0.02
Glendale	0.06	Torrance	-0.15
IEUA	0.22	Upper San Gabriel Valley MWD	0.04
Las Virgenes MWD	0.12	West Basin MWD	-0.02
Long Beach	-0.08	Western MWD	-0.05

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Other variations considered

- Alternative price measures (avg v marginal)
- Alternative income and household size measures (2000 & 2010 Census, ACS, interpolation)
- Sector specific household characteristics based on MFR versus SFR land use
- Alternative weather measures (summer temp, HDD)
- Post-conservation consumption

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Multi-family residential demand

1. We estimate that household consumption is:
   – Negatively related to marginal price (elasticity: -0.11).
   – Positively related to income, household size and lot size.
   – Weather is a less significant and consistent determinant of consumption.

2. We estimate pre-conservation demands.

3. Model accounts for baseline differences in consumption between Member Agencies using fixed effects.

Multi-family residential:
Regression slope coef. (elasticities)

Dependent variable: SFR avg. monthly household consumption (ccf) - pre-conservation				
Variable	Slope Coef.	Standard error	t-stat	% change in demand due 1% change in factor
ln(median price)	-0.11	0.04	-3.16	-0.11%
ln(median income)	0.17	0.06	2.88	0.17%
ln(median lot size)	0.16	0.03	5.77	0.16%
ln(avg. hh size in mfr sector)	0.14	0.08	1.76	0.14%
Observations	469		R-squared:	0.56

Commercial, industrial and institutional demand

1. We estimate that consumption per employee is:
   - Negatively related to average price (elasticity: ~ -0.18)
   - Price response depends on relative size of manufacturing sector
   - Positively related to cooling degree days and avg. maximum daily temperature
   - Positively related to share of employment in the manufacturing sector

2. We estimate pre-conservation demands.

3. Model accounts for baseline differences in consumption between Member Agencies using fixed effects.

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Commercial, industrial and institutional: Regression slope coef. (elasticities)

Dependent variable: CII avg. annual water use per employee (ccf) - pre-conservation				
Variable	Slope Coef.	Standard error	t-stat	% change in demand due 1% change in factor
ln(cooling degrees days)	0.11	0.05	2.33	0.11%
ln(avg. max. temperature)	0.34	0.27	1.26	0.34%
ln(median tier price)	-0.43	0.13	-3.22	~ -0.18
ln(median tier price) x Share of employment	2.65	0.90	2.95	
Share of employment in manufacturing	0.93	0.74	1.26	~ 0.26%
ln(median tier price) x Share of employment	2.65	0.90	2.95	
Observations	709		R-squared:	0.55

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Concluding remarks

- Models are sophisticated, yet simple representations of demand.
- All models include same basic tenets:
  - Residential sectors share common determinants
  - CII sectors include appropriate demand factors
  - All three models include fixed effects to account for baseline differences in demand
- Forecasts depend on the econometric model, but are also sensitive to projections of demand factors (e.g. projected household income).

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Retail Demand Forecast
Methodology

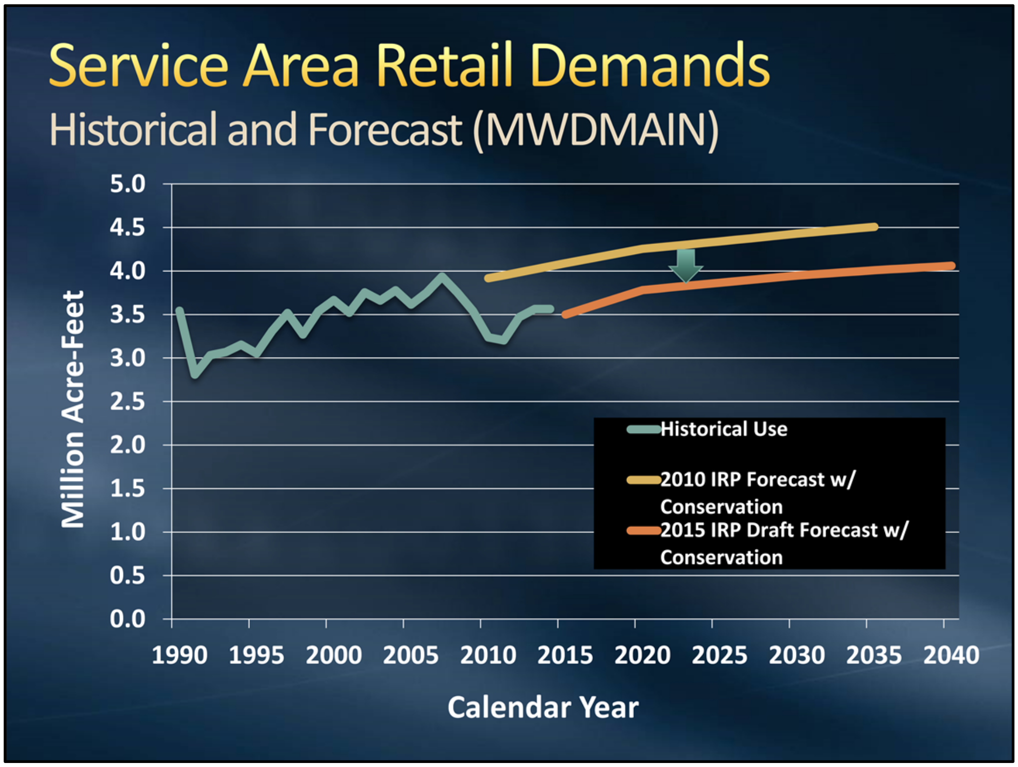
I would like to start by reviewing the changes in demographic forecasts since the 2010 IRP…

Follow by the types of conservation savings we calculate and the tools that we use to calculate it. I will show you our model results for conservation activities up to the end of this fiscal year.

And finally, draft retail M&I demand forecast for the 2015 IRP and agricultural demand.

On October 15, 2013, the Series 13: 2050 Regional Growth Forecast was accepted by the SANDAG Board of Directors for planning purposes. SANDAG projects the region's population will grow by nearly one million people by 2050. This forecast is consistent with previous expectations although future growth rates have been reduced due to increased domestic migration out of the region. The growth in population will drive job growth and housing demand within the region – adding nearly 500,000 jobs and more than 330,000 housing units by 2050.

Much of the region's growth will be driven by natural increase, total births minus deaths. Longer life expectancies will contribute to the aging population seen in the outer years of the forecast, while the trends of increased deaths (as a result of the older population) and net out-migration will factor into the slower growth rates anticipated in the future.



In April, at the start of this Workshop, we showed you this graphic.

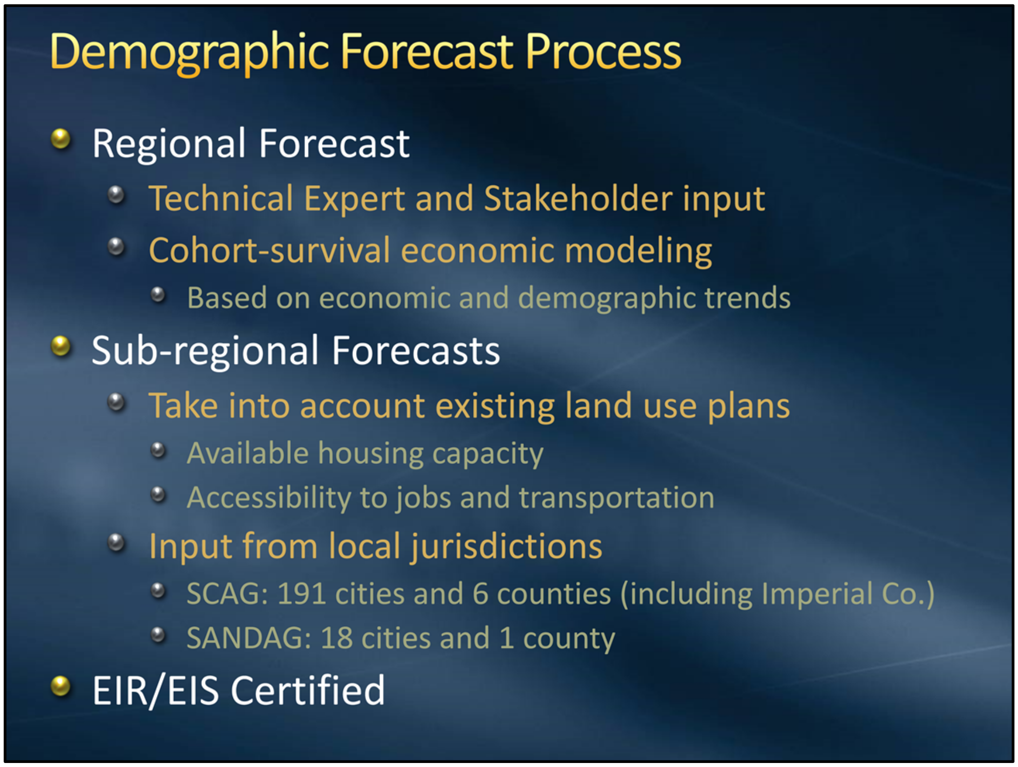
Here's the historical demand, the 2010 IRP forecast with conservation and the 2015 draft forecast also with conservation. Both of these demand forecasts are from the MWDMain model. I will show you the results of the demand forecast from the new model that Dr. Sunding just described to us toward the end of my presentation.

Now, I'm going to talk about the changes in demographic forecasts that caused this decrease in retail demand forecast.

We use demographic growth forecasts from 2 regional transportation planning agencies.

- For demographics, Metropolitan uses forecasts developed by two government agencies – the Southern California Association of Governments (SCAG) and the San Diego Association of Governments (SANDAG). Among their other responsibilities, SCAG and SANDAG prepare official projections of population, households, income, and employment for their regions. Both of them update their regional growth forecasts about every four years, at different times.
- Together, SCAG and SANDAG's official forecasts comprise the best available data concerning anticipated growth in their respective regions.
- The official forecasts undergo extensive review. They draw from several data sources . They are vetted by local governments.
- Importantly, SCAG and SANDAG official growth projections are backed by Environmental Impact Reports.
- Critically, from a practical standpoint, the their forecasts are at a high enough spatial resolution to allow us to shape and aggregate the data to represent the unique service areas of each of Metropolitan's member agencies, and of Metropolitan as a whole. This feature is very important to our analytical work.

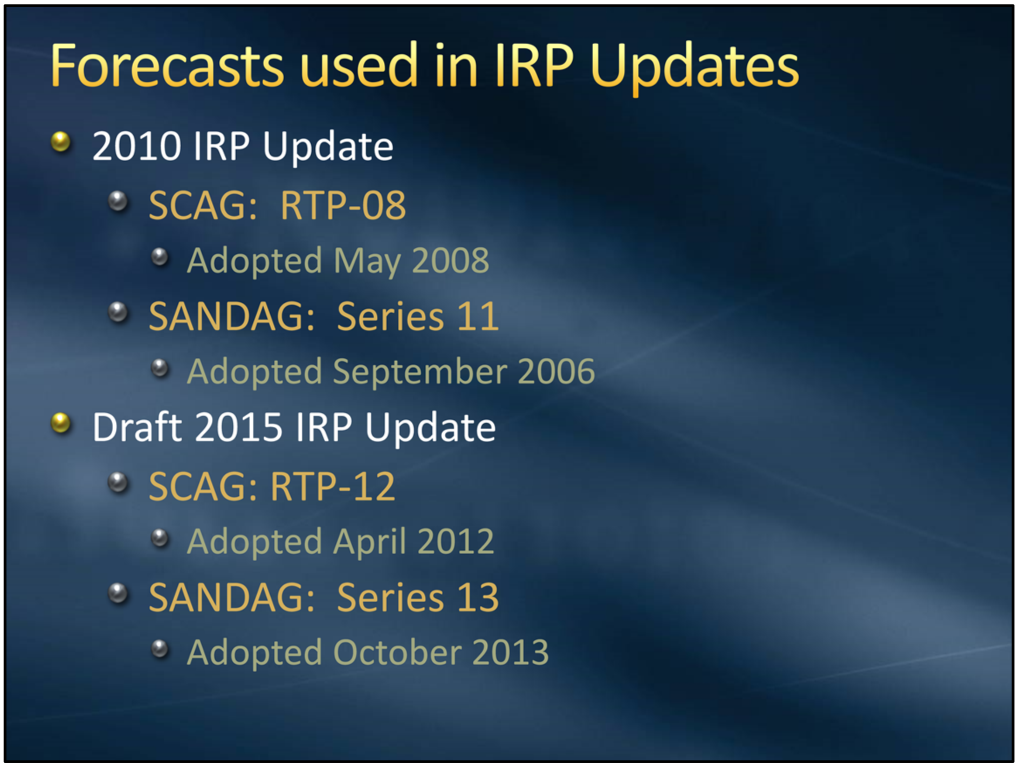
For the 2015 IRP Update, we are using SCAG's 2012 Regional Transportation Plan growth forecast, which was adopted in April 2012. We refer to it as RTP -12. For San Diego County, we use SANDAG's Series 13 2050 Regional Growth Forecast, which was adopted in October 2013.



SCAG and SANDAG follow extensive processes to develop their demographic forecasts. They begin with a Regional Forecast, which is based on economic and demographic trends. They take national and state-level forecasts and downscale them to a regional level. In doing this, SCAG and SANDAG receive input from expert panels and from stakeholders, and they use cohort modeling to track changes to the population by age and race across the region. Some of the things they consider are fertility, mortality and migration rates; migration rates are linked to availability of jobs, in different industries, to the working age population over time.

As a way of reality-checking, SCAG and SANDAG develop sub-regional forecasts by seeking input from their local jurisdictions and taking into account existing land use plans. Sub-regional forecasts distribute growth based on several factors, including capacity for housing and accessibility to jobs and transportation. It's an extensive process. SCAG is comprised of 191 cities and 6 counties, including Imperial County. SANDAG encompasses 18 cities and the county of San Diego.

The demographic forecasts and their regional transportation plans are EIR/EIS certified.



We'll talk about the differences between these 2 sets of forecasts

Pre-recession and post recession; pre-census and post census.

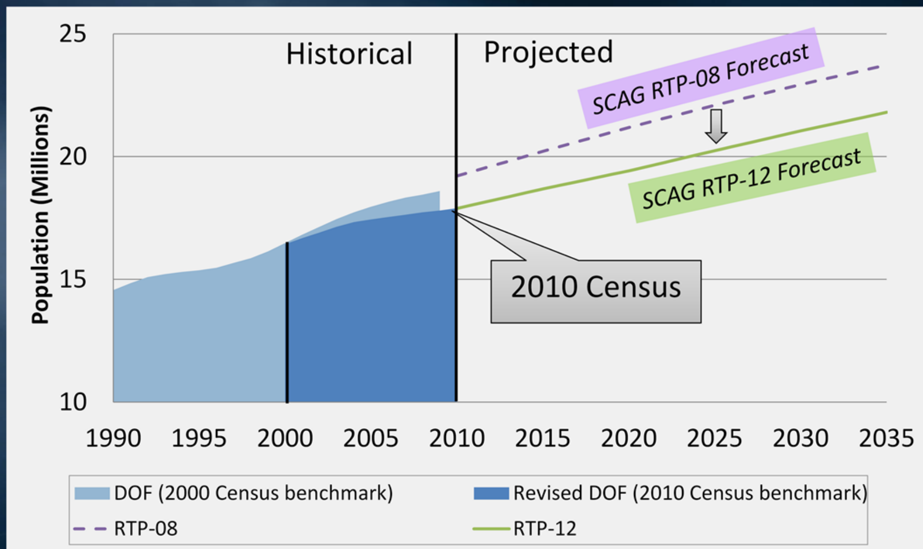
In review, here are the SCAG and SANDAG forecasts used in recent IRP Updates.

The 2010 IRP Update used SCAG RTP-08, which was adopted in May 2008, and SANDAG Series 11, which was adopted in September 2006. Those were the latest forecasts that were available at the time of the 2010 IRP publication.

For the upcoming 2015 IRP Update, which we are talking about today, we are using demographic forecasts from SCAG RTP-12, adopted in April 2012, and SANDAG Series 13, which was adopted in October 2013.

Next, I will be talking about differences between the two sets of demographic projections underlying the IRP Update. As you will see, there are significant differences between the two sets. And, as you will also see, these differences have implications for Metropolitan's retail demand forecast in the IRP.

Shift in Population Estimates after 2010 Census (5 SCAG Counties)



Changes Observed in the Forecasts
RTP-08 & Series 11 vs. RTP-12 & Series 13

Observations	Change
Population	↓
Birth Rate	↓
Death Rate	↓
Net Domestic In-migration	↓
Net Foreign Immigration	↓
Employment (Jobs)	↓
Housing	↓
Median Household Income	↓

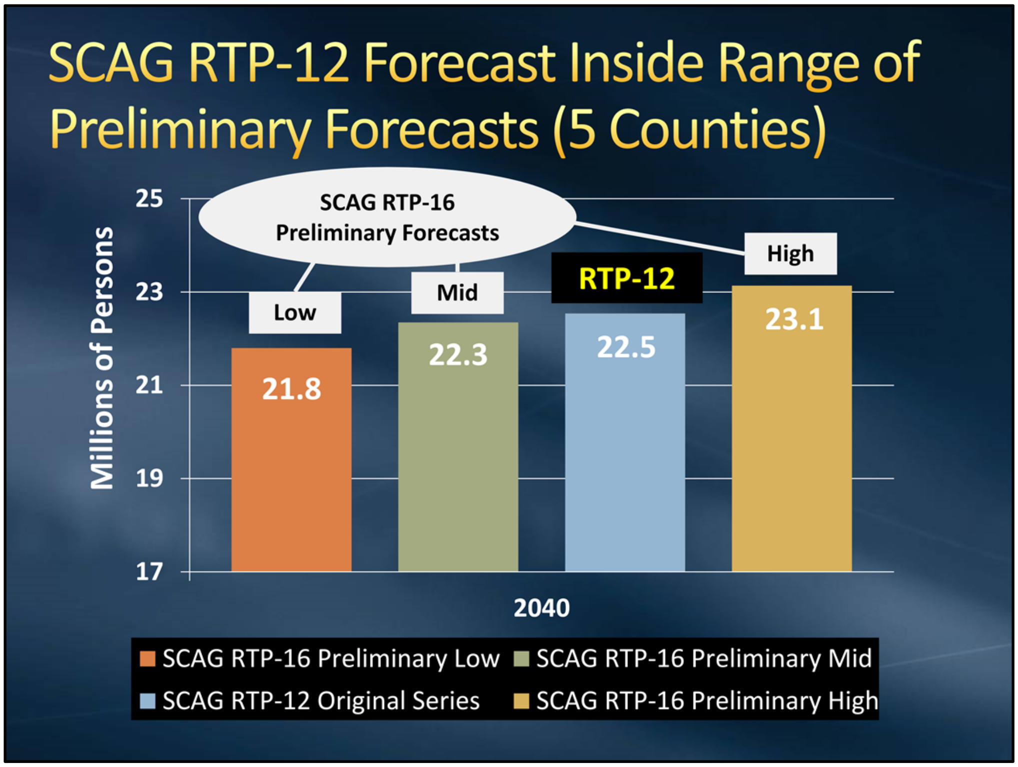
Future growth is expected to be homegrown. Given longer life expectancies and trends in fertility rates, natural increase is projected to account for nearly two-thirds of future population growth. Slow growth rate can be attributed in part to do a continual decline in fertility rate. New projection is lower; mainly due to births and immigration. Immigration counts for 71% of the SCAG growth differential.

Changes in Water Demand Inputs
Year 2040

Water Demand Drivers	RTP-08 & Series 11	RTP-12 & Series 13	Change	%
Population	23.0 M	21.8 M	-1.2 M	-5%
Households	7.4 M	7.3 M	-0.1 M	-1%
Employment	10.5 M	9.6 M	-0.9 M	-8%
Med. HH Income 1990$	$55,000	$49,000	-$6,000	-11%

2010 IRP is SCAG RTP-08 & SANDAG Series 11

2015 IRP is SCAG RTP-12 & SANDAG Series 13



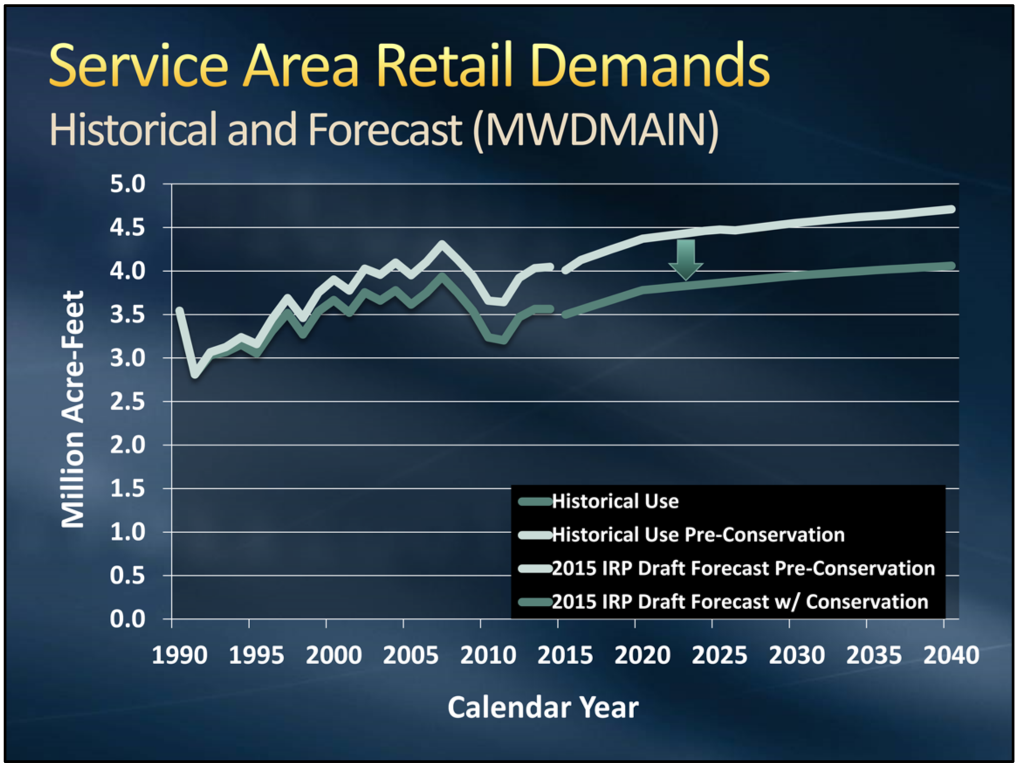
This illustrates that the SCAG has not significantly departed from the RTP-12 forecast as they develop their RTP-16 forecast ranges.

Excludes San Diego County. Includes only the 5 SCAG counties in MWD service area.

Demographic Change Summary

- The draft 2015 IRP Update uses newer demographic forecasts from SCAG and SANDAG
- These forecasts use updated assumptions about long-term growth since the 2010 Census and Great Recession
- Updated assumptions result in lower pace of growth than previous forecasts
- Lower growth has implications for retail water demand projections

Conservation Savings

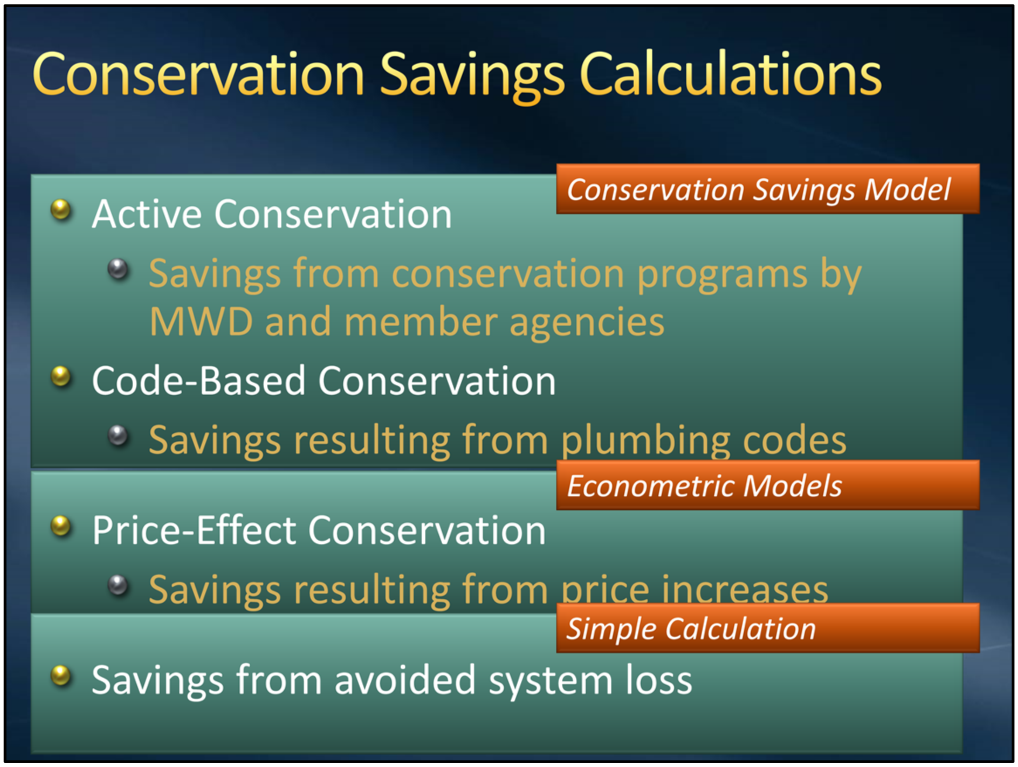


Up to this point, I've been showing you forecasts with conservation. In other words, after conservation.

Now, let's look at the 2015 draft forecast without conservation. But first, this is what historical demand would look like without conservation.

MWDMain forecasts pre-conservation retail demand. And here's the pre-conservation forecast.

With conservation, it shifts the forecast down. Now let's take a closer look at how we calculate conservation savings…

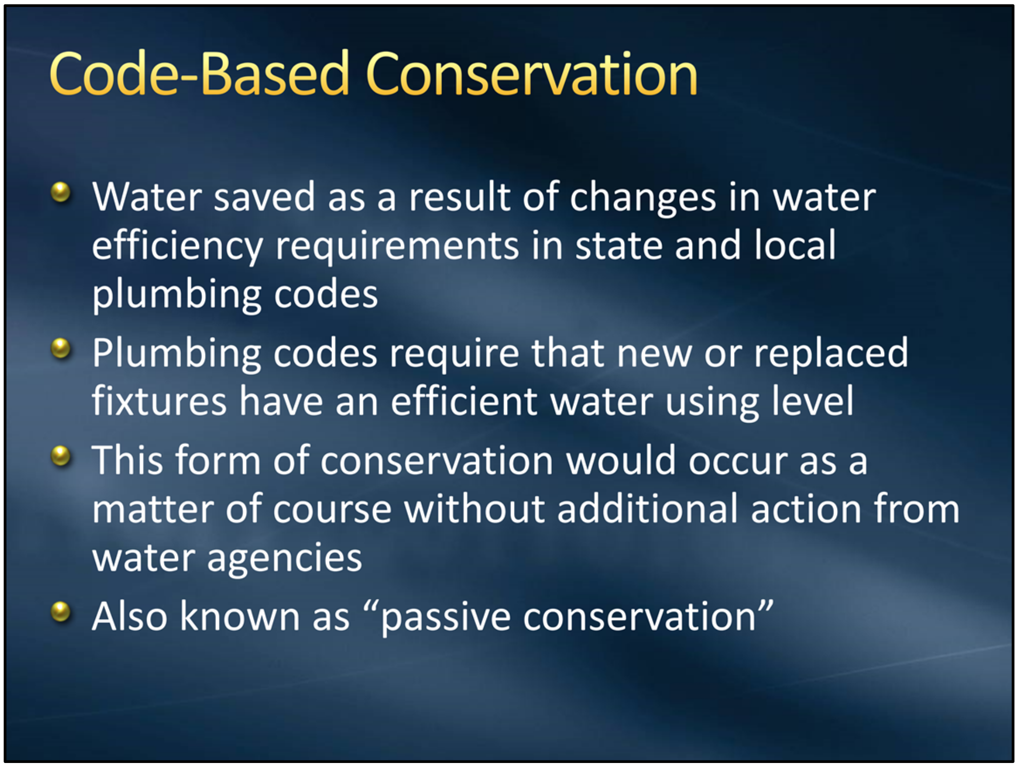


We calculate 4 types of conservation savings…

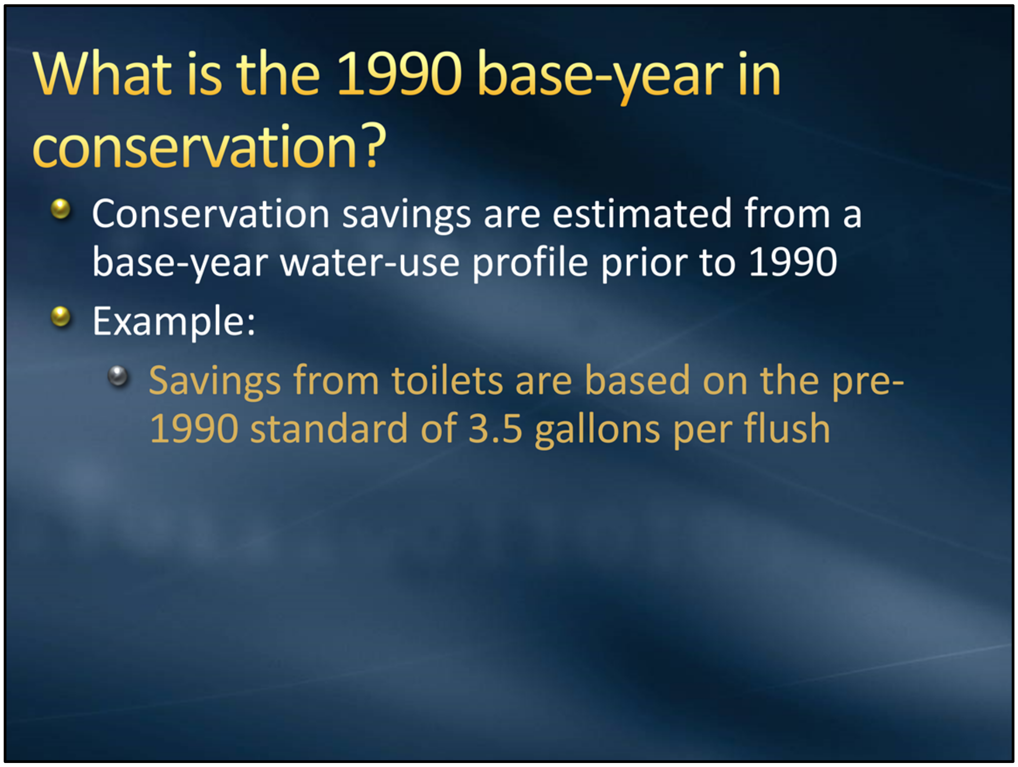
In the next few slides, I will explain how we calculate active and code-based conservation

Active Conservation

- Water saved as a result of conservation programs administered by water agencies
- Conservation programs are device distributions, incentives for purchase/installation, audits
- Active conservation is unlikely to occur without agency action

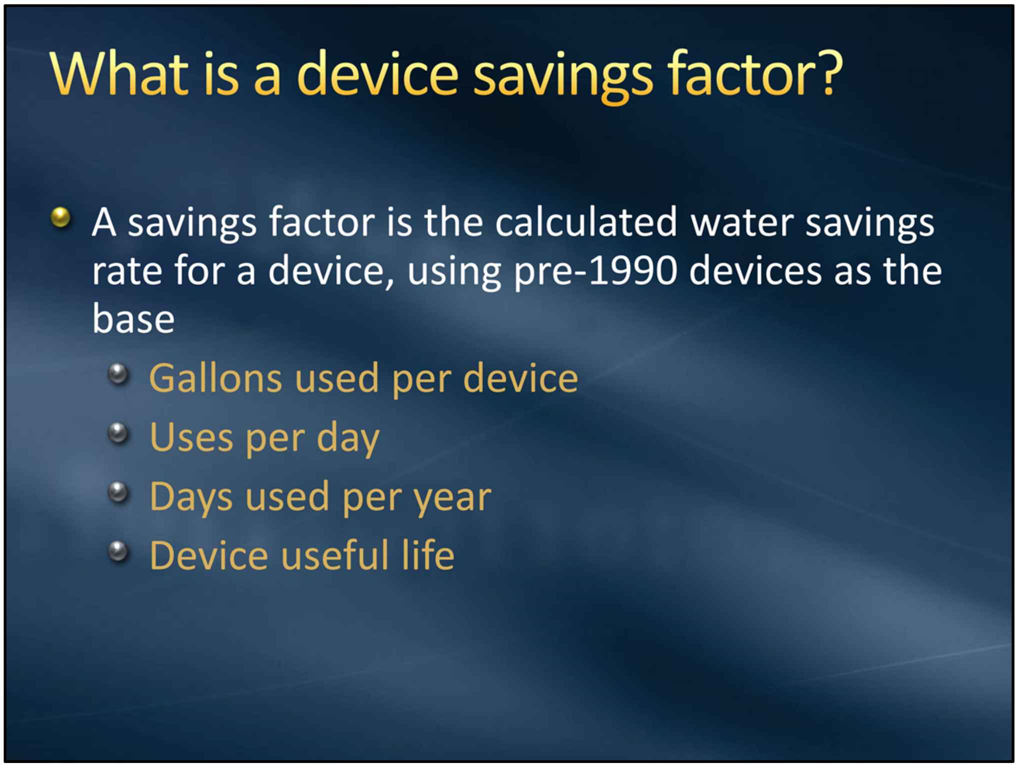


Before I start describing the models, I would like to talk about base-year and savings factors. Both are important elements in calculating conservation savings.



Our conservation model uses 1990 as the base-year. What this means is all calculated savings are compared the device water-use standard of pre-1990.

In this example, a more efficient toilet, say ULFT with 1.6 gpf will have a savings of nearly 2 gpf.



In calculating savings factors, we take into consideration of gallons used per device, uses per day, days used per year to compare with a non-conforming or a non-efficient device with pre-1990 standards.

The savings factors in the conservation model are based on studies and calculations by CUWCC, Metropolitan, member agencies and other interest groups.

Metropolitan staff and member agencies conservation coordinators continually review studies on water savings and update the savings factors as needed.

Active Conservation Model

- Savings are calculated based on devices installed by water agencies
- Equation:

$$S_i = \frac{d_i * a_i * 365}{\text{gallons per AF}}$$

  - S_i is the annual savings in AF for device *i*
  - d_i is the number of device *i* installed under an active conservation program
  - a_i is the gallons per day savings from a base year
- Lifetime savings is the sum of annual savings for the duration of the device's useful life

The active conservation model is a device-based model.

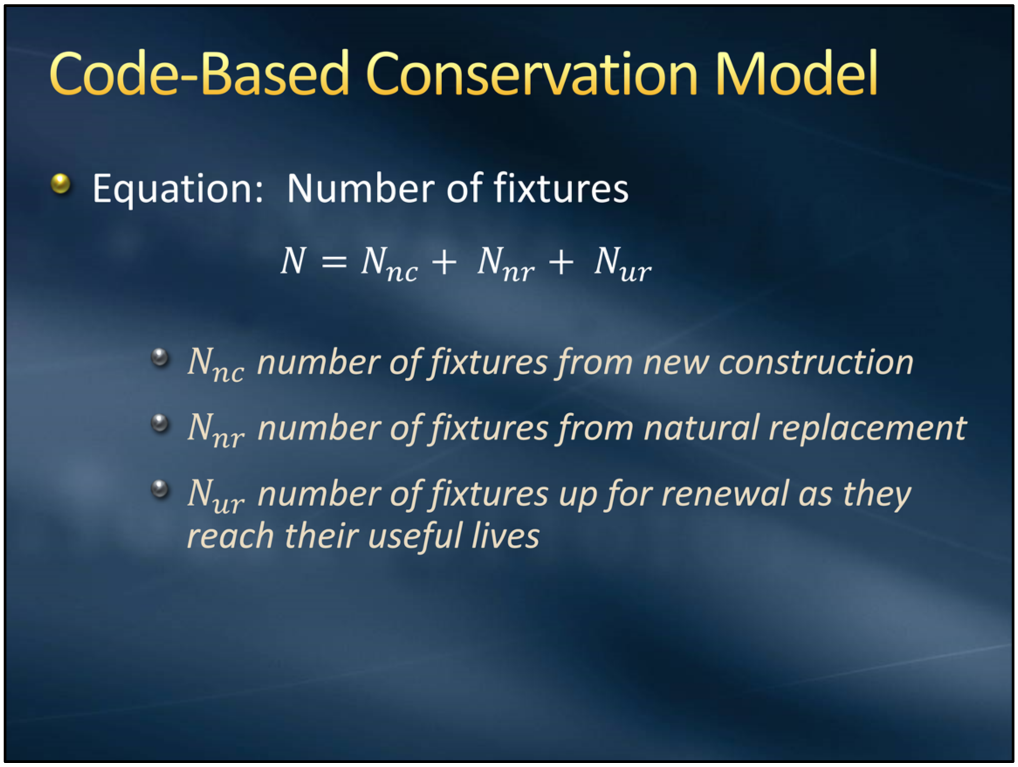
It calculates savings based on devices installed by water agencies.

The calculation is straight forward: It takes the number of device, multiply by the savings factor and the number of days per year, then converted to acre-feet.

The lifetime savings…

Code-Based Conservation Model

- Savings calculated from the number of fixtures per housing stock or per employee using device savings factors
- Driven by demographic forecasts
- Tied to total device stocks in active savings



The important element of the code-based model is estimating the number of fixtures that will by replaced each year.

The model tracks the number of fixtures from new construction, natural replacement and fixtures up for renewal as they reach their useful lives.

Plumbing Code Assumptions

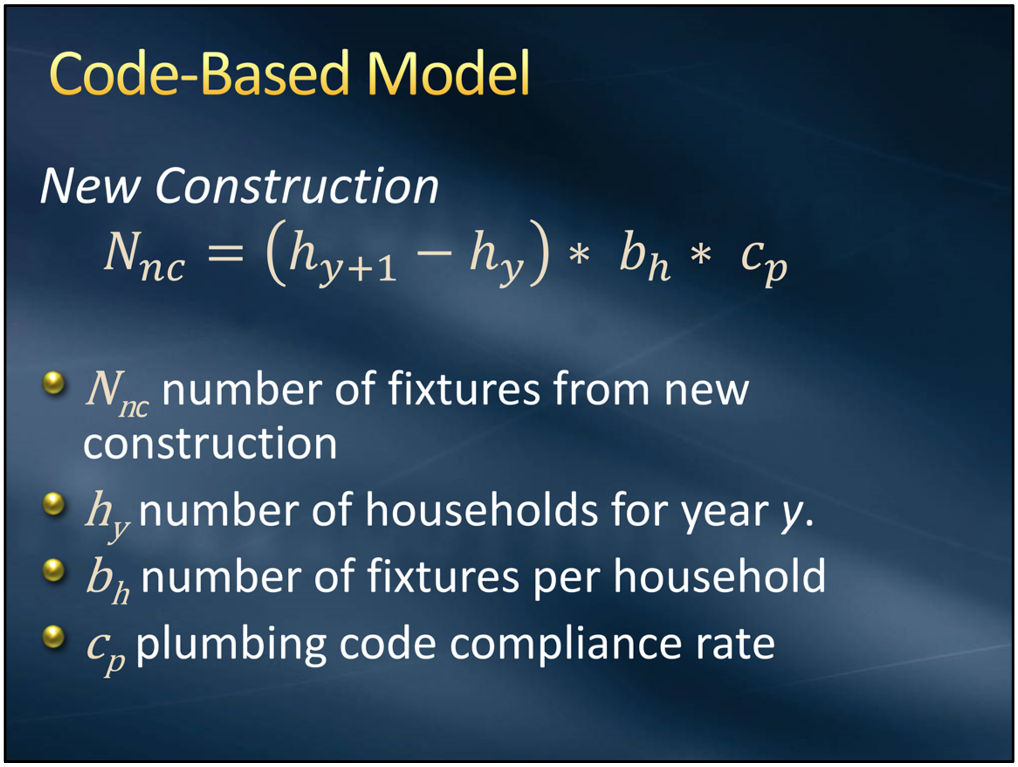
Plumbing code savings are determined by the device-specific assumptions used in the stock models. The stock models are driven by projections of housing and employment described earlier in this memo, so they are consistent with the demand projections. Initial device counts and growth in the number of devices are determined by the demographics combined with the assumptions described below:

- Devices per Household or Per Employee: This factor represents the average number of devices per household or per employee and is multiplied by the demographic projections to develop estimates of total number of devices or "stock." Devices per household and employee can vary by agency and change over time.
- Plumbing Code Compliance Rate: The plumbing code compliance rate is expressed as a percent and serves two purposes: (1) it indicates the presence of a plumbing code in a specific year, and (2) determines the overall compliance rate with the plumbing code. This allows plumbing code effects to be phased in over several years.
- Natural Replacement Rate: This represents the rate at which existing non-conserving devices are converted to conserving devices due to remodeling or device failure. It has a strong impact on the saturation rate of devices that existed prior to plumbing codes, such as pre-1992 toilets.
- Device Life: The stock models also account for device life for water-efficient devices installed after 1990. This allows the stock model to track devices installed through active conservation as they reach the end of their life and are replaced due to plumbing codes. The stock models use the same device life specified in the savings assumptions.

Code-Based Assumptions

Stock Model	Device per Household/ Employee	Compliance Rate	Natural Replacement Rate	Plumbing Code Year
Res. Toilets	2	99%	2%	1992
Res. Shower Heads	1.8	95%	10%	1992
Res. Aerators	3.5	90%	33%	1992
Res. Washing Machine	0.74	100%	6.7%	2007
CII Toilets	0.27	100%	2%	1992
CII Urinals	0.06	100%	4%	1992
CII Pre-Rinse Spray Heads	0.0055	95%	16.7%	2006
CII Washing Machine	0.0073	100%	5%	2007

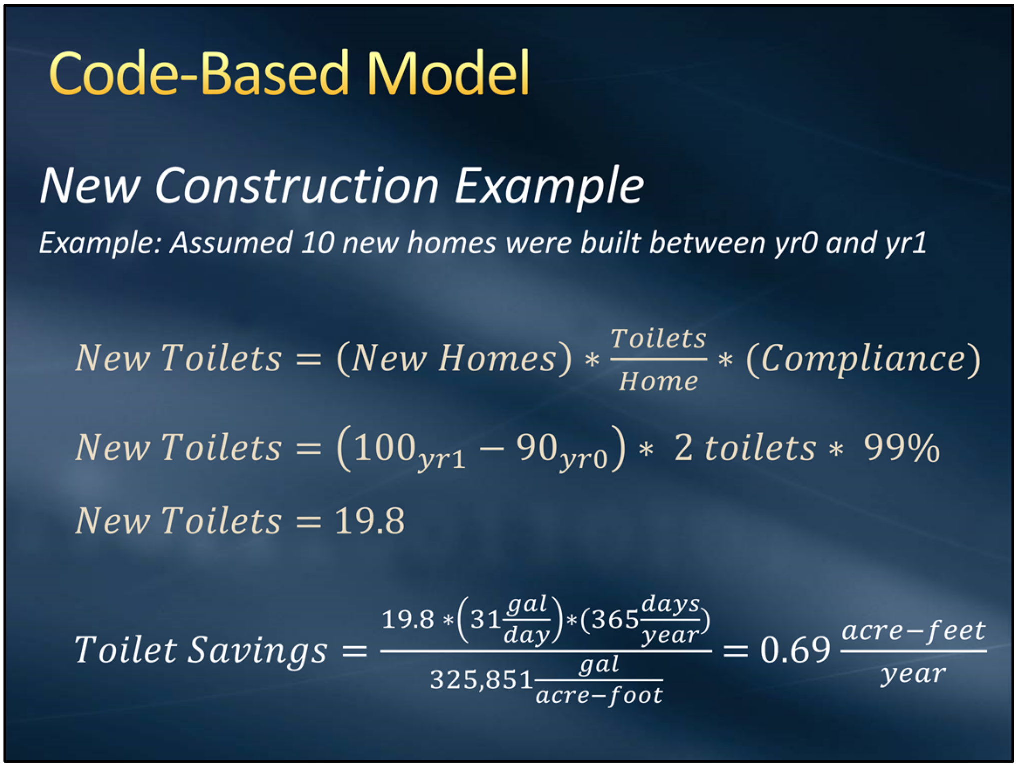
Talk about where these assumptions came from… CUWCC? Why 2% replacement rate and what is compliance rate.



Water fixtures installed due to new construction are assumed to be in compliance with the plumbing codes in effect when the new construction occurs. For instance, the model would assume a house built in 1997 would meet the efficiency standards set by California's 1992 plumbing code. Therefore, new construction is assumed to result in measurable savings from a non-efficient baseline. The Code-Based model uses 1990 as the baseline. Estimates and projections of the number of fixtures added through new housing units and offices is based on growth in housing units or employment. The following equation calculates the number of fixtures installed each year from new residential construction.

$$N_{nc} = (h_{y+1} - h_y) * b_h * c_p$$

N_{nc} is the number of fixtures installed from new construction.
h_y is the number of households for year y. This is used to measure housing growth from new construction from year to year.
b_h is the number of fixtures per household based on averages developed from single-family and multi-family housing units (e.g. 2 toilets per household).
c_p is the plumbing code compliance rate. The compliance rate increases over time as the conventional fixtures are phased out and replaced in the market.



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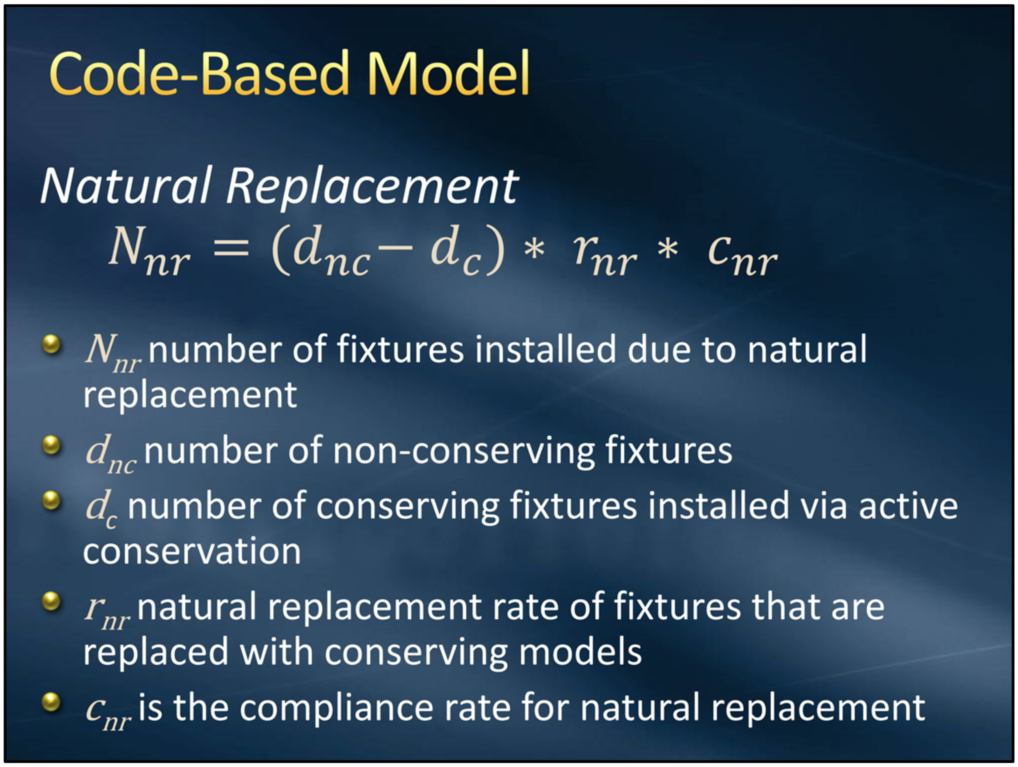
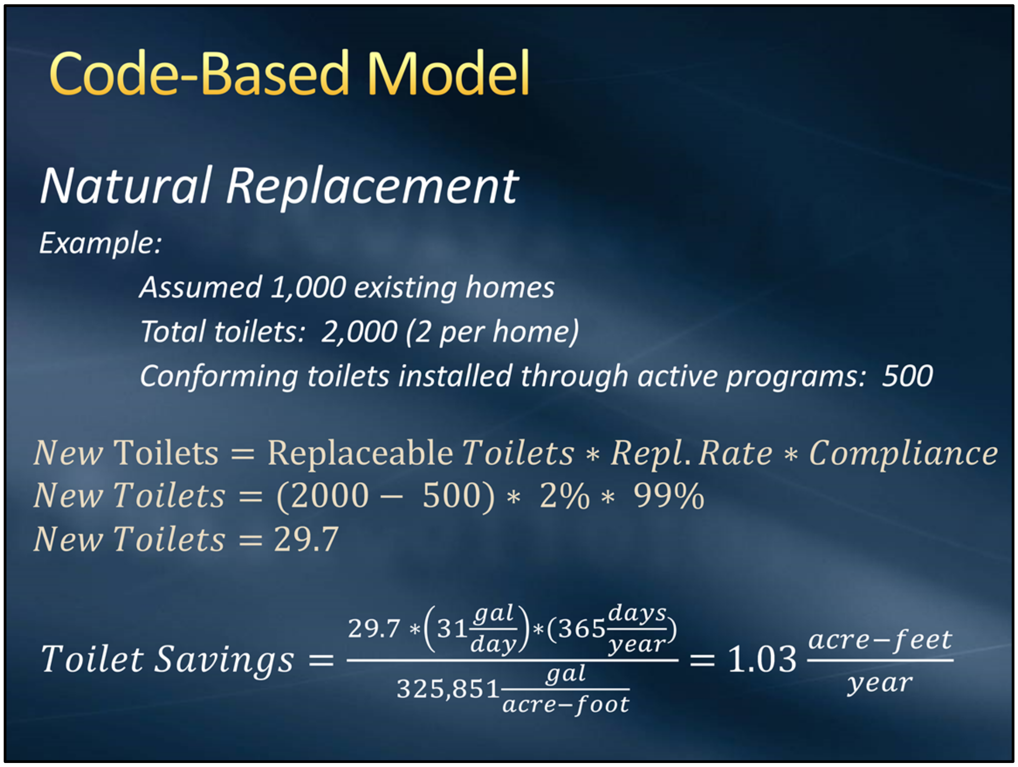


Natural replacement accounts for the savings that accrue when fixtures are replaced with more efficient models due to remodeling, failure or other reasons. The Code-Based model represents this effect with a "natural replacement rate" that is expressed as a percentage of existing fixtures that are replaced in a given year. Natural replacement rates vary by device and are linked to the expected life of the device. Devices with short lifespans will be replaced more frequently and thus have higher natural replacement rates. A simple percentage is used to account for this natural turn-over in non-conserving fixtures because it is difficult to back-calculate the age of the fixtures in pre-1990 construction. Metropolitan's model assumes that two percent of all non-efficient toilets in the residential sector are retrofitted due to natural replacement in any given year. The new toilets are assumed to meet the efficiency standards in effect at the time of the retrofit. For instance, a residence that retrofitted a broken toilet in 1997 is assumed to have replaced it with a 1.6 GPF toilet required by the 1992 plumbing code. The following formula represents this mathematically.

$$N_{nr} = (d_{nc} - d_c) * r_{nr} * c_{nr}$$

- N_{nr} is the number of fixtures installed from natural replacement.
- d_{nc} is the number of non-conserving or conventional fixtures.
- d_c is the number of conserving or water-efficient fixtures that are installed through conservation programs administered by water agencies.
- r_{nr} is the natural replacement rate of fixtures that are replaced with more efficient models due to remodeling or failure. For example, the CUWCC and other agencies use a four percent natural replacement rate for toilets. Metropolitan uses a lower rate of two percent to account for possible double-counting of ultra-low flush toilet rebates during the 1990s due to free-ridership.
- c_{nr} is the compliance rate for natural replacement. During the early phase-in period of plumbing code, it is presumed that consumers still have a choice between conserving fixtures that conform to the new plumbing code or the conventional fixtures. The compliance rate increases over time as the conventional fixtures are phased out and replaced in the market.

Customers who receive or take advantage of active conservation incentives to fund device retrofits they would have performed anyway (due to failure, remodeling or for other reasons) are known as "free-riders. While the model has the ability to account for free-ridership, this feature is not used by Metropolitan.



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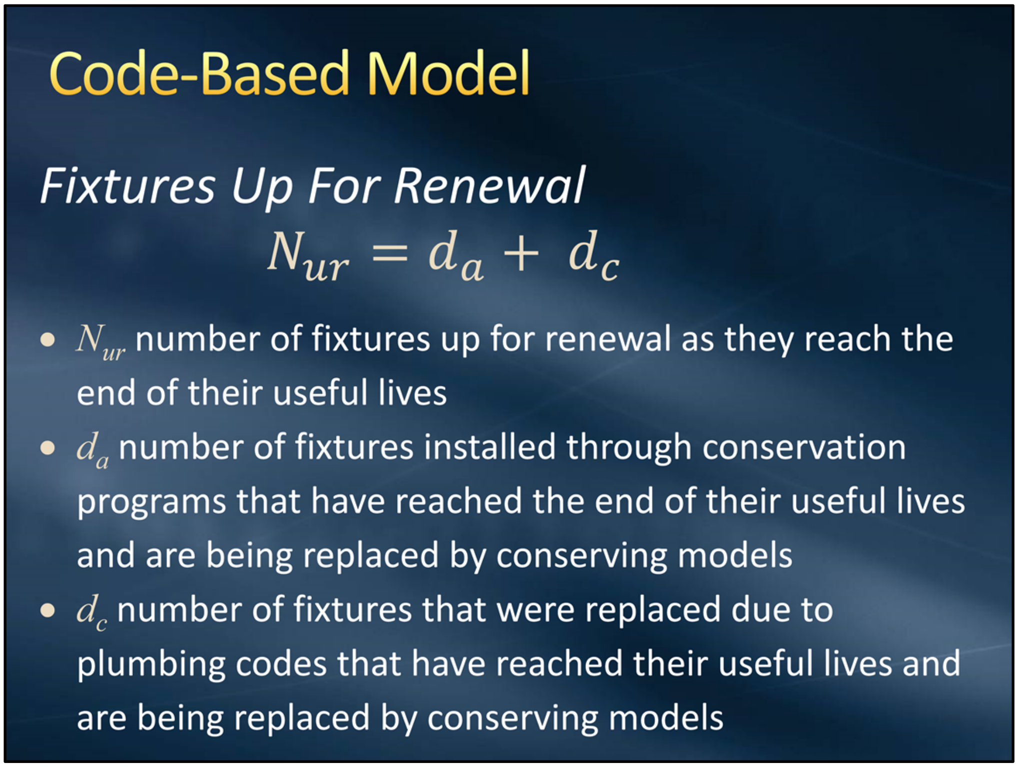
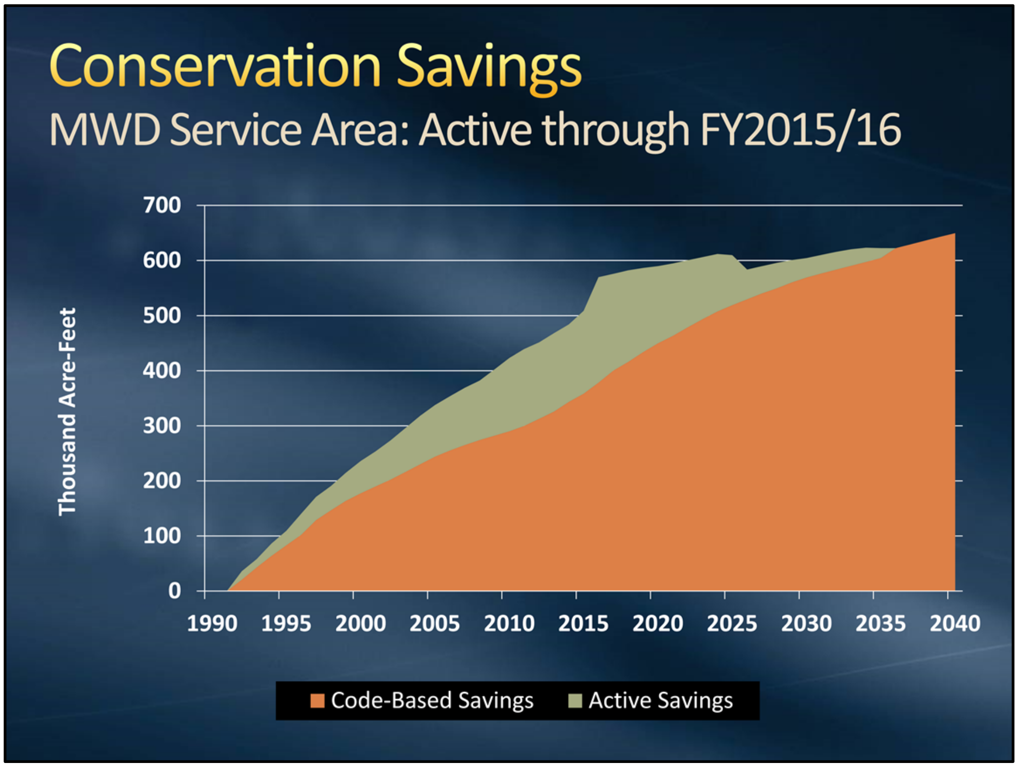


As water-conserving fixtures reach their useful lives and became defective or inefficient, they may be replaced with water conserving fixtures due to by plumbing codes. The water savings from the device is then considered "renewed" in the Conservation Model and the renewed savings is tracked. For example, a fixture that was installed through an active conservation program provides water savings that otherwise would not have been realized without plumbing codes. However, subsequent adoption of efficient plumbing codes means that when the fixture reaches the end of its life it will be replaced by the same or more water-efficient model. Fixtures up for renewal are calculated as follows:

$$N_{ur} = d_a + d_c$$

- N_{ur} is the number of fixtures up for renewal as they reach their useful lives.
- d_a is the number fixtures installed through conservation programs that have reached their useful lives and are being replaced by the same water-efficient models or better.
- d_c is the number of fixtures that were replaced due to plumbing codes that have reached their useful lives and are being replaced by the same water-efficient models or better.



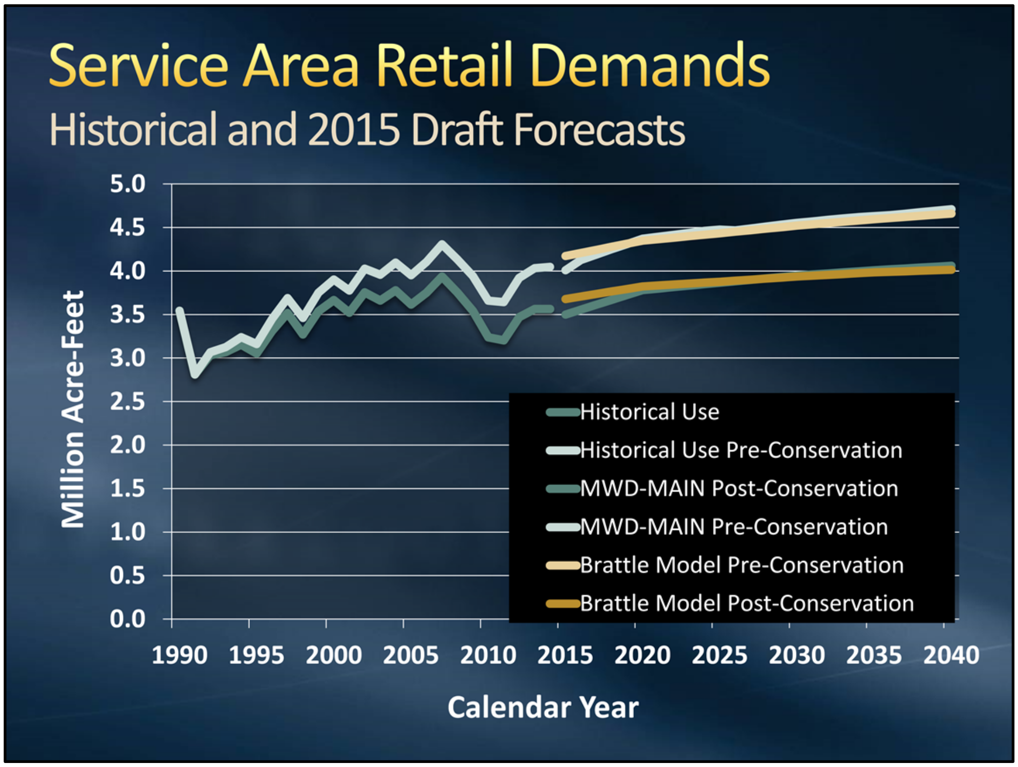
So, let's look at the model results. The graph I'm about to show you includes active conservation up to the end of this fiscal year.

Code-based conservation…
Price and unmetered water use…
Active conservation. We allocated the remaining balance of the $450 million biennial budget to different devices and programs in fiscal 2015/16.

The result is an increase in savings starting from 2015 to 2025. The tan line is the savings before FY2014/15.

Let's take a closer look at active savings in fiscal years 2015 and 2016…

Demand Forecasts

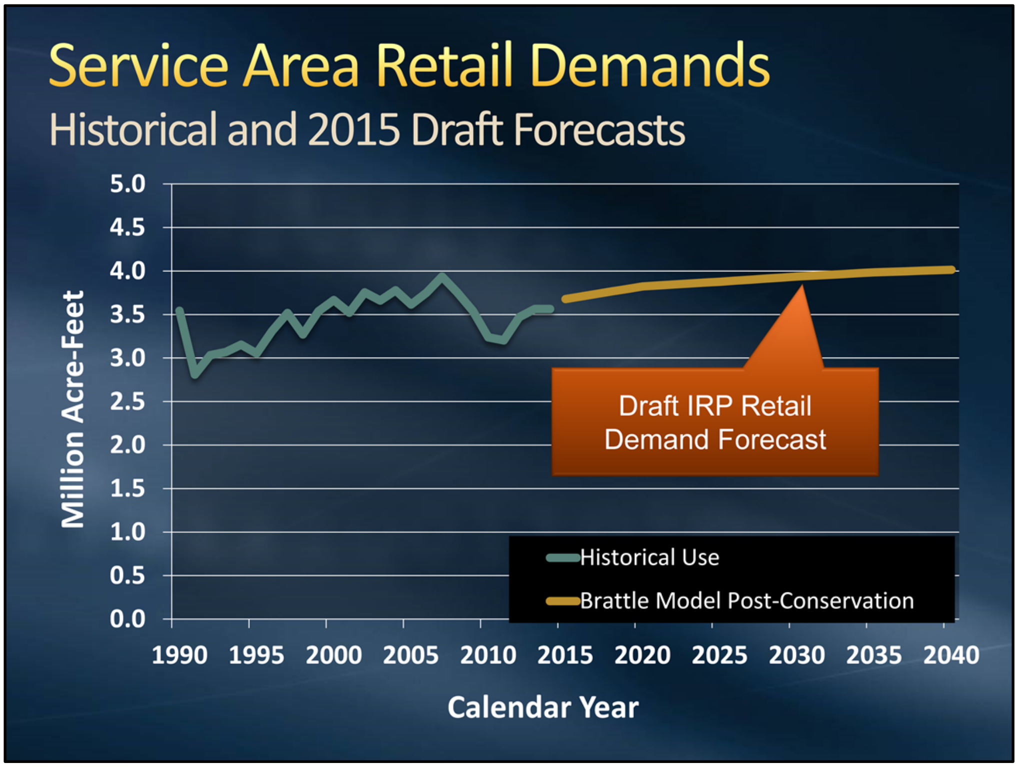


Up to this point, I've been showing you forecasts with conservation. In other words, after conservation.

Now, let's look at the 2015 draft forecast without conservation. But first, this is what historical demand would look like without conservation.

MWDMain forecasts pre-conservation retail demand. And here's the pre-conservation forecast.

With conservation, it shifts the forecast down. Now let's take a closer look at how we calculate conservation savings…



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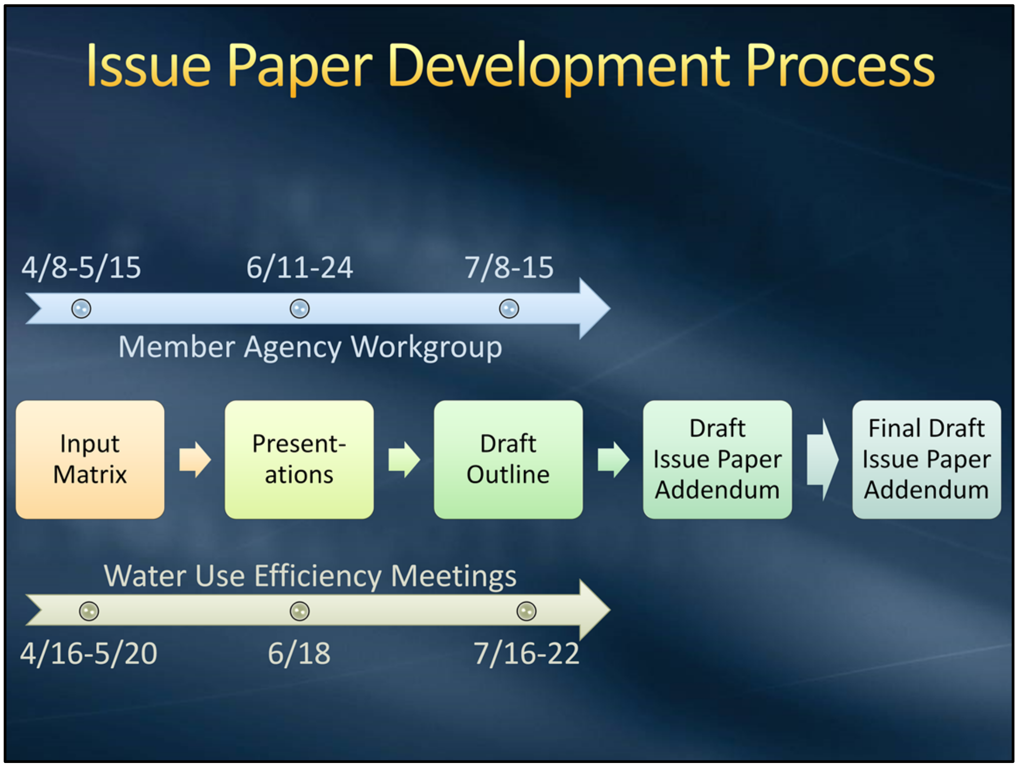
Agricultural Demand Forecast

- Forecasts provided by member agencies
  - Retail agency input
  - Land use conversion
  - Historical demands

IRP Issue Paper Addendum
WUE Meeting Input



Input matrix: introduced at the kickoff meeting, comments due 5/15
Presentations on the compiled input and issue paper content from 6/11 (groundwater part 2 workshop) to 6/24 meeting on local resources (all other resources)
Draft outline: presented and sent out for review on 7/8 (comments due 7/15)

Parallel process

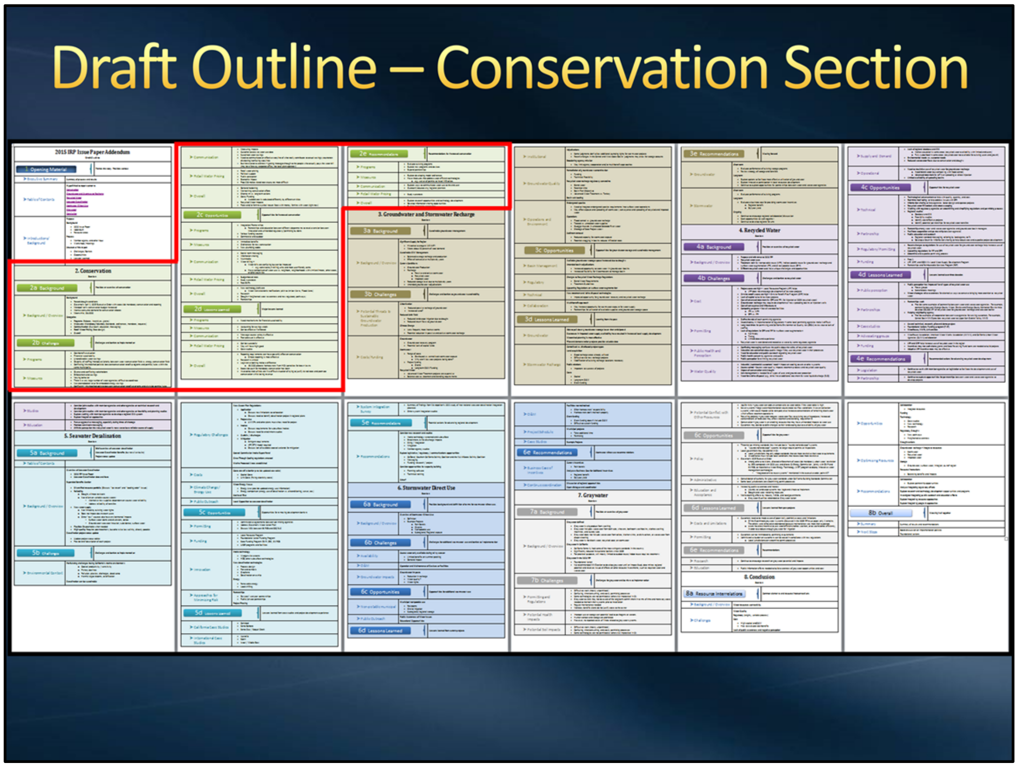
Utilizing an already established venue: monthly WUE meetings, comprised of member agency and Metropolitan conservation staff (generally on the 3rd Thursday of every month)

Also have flagged (and will continue to flag) policy items, which we will go through at the end

Organized further into more manageable bite-sized pieces, so it's easier to digest. These pieces are the major conservation pathways. Details are in the outline.

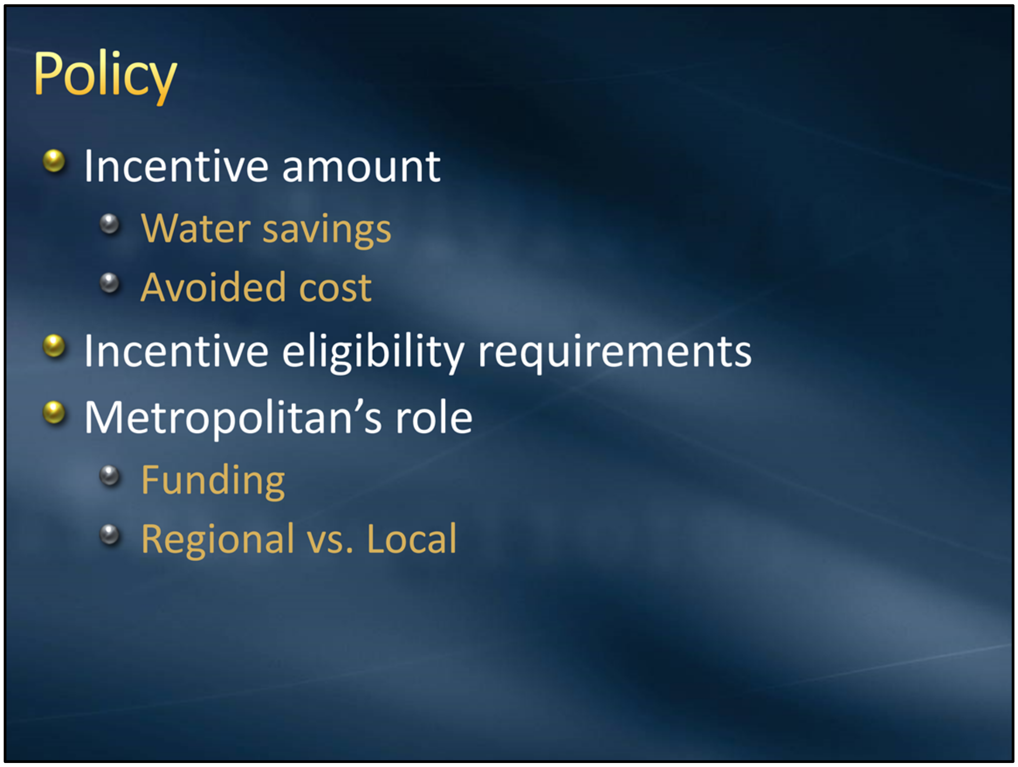
Communication: asking people to conserve, teaching them how to conserve, getting the message out there, types of messaging, understanding/awareness of their own water usage
Retail Water Pricing: allocation-based rates
Overall: some issues/opportunities/recommendations are common to all

Technology is incorporated into each of these categories



Conservation Section of the draft outline part of issue paper addendum draft outline sent to the member agencies

Outline in table form, designed to be easy to read and digest. Color coded per section. Hyperlinks to each section on the first page.
Not necessarily looking for edits to the outline. Looking more for major comments: significant content needs.



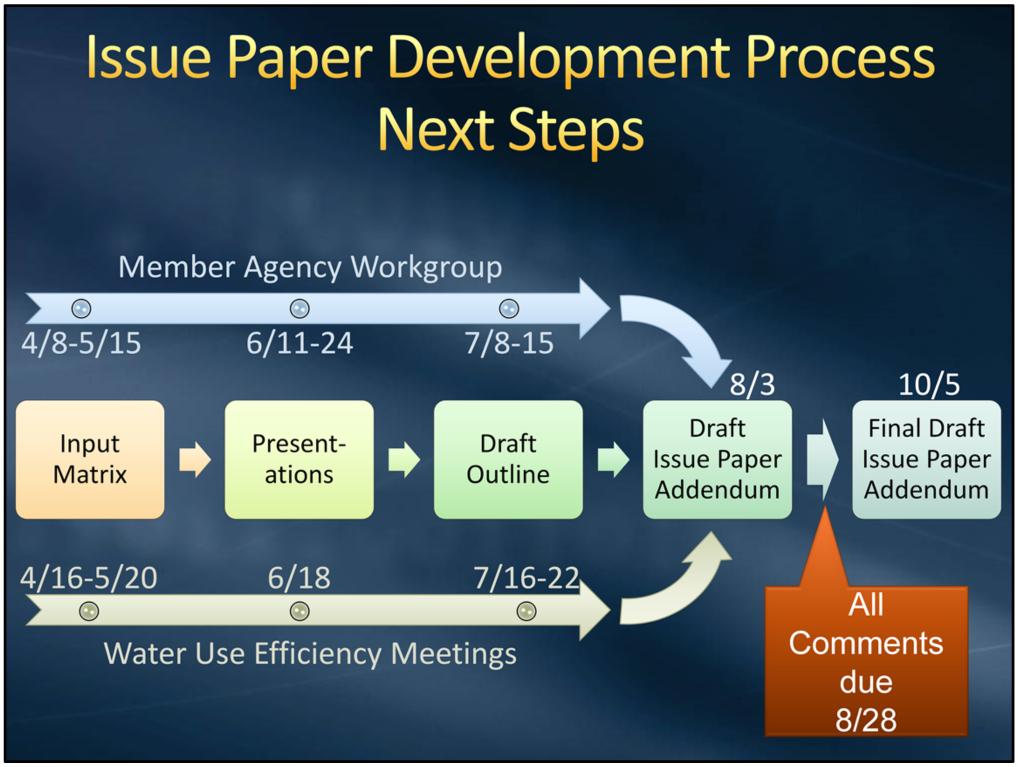
Flagged policy items

Incentive amount: how much…if any? How to calculate the amount? (currently at $195/AF)
Incentive eligibility requirements: who gets the incentives? should there be additional requirements to be eligible for incentives?
Metropolitan’s role:

What do we fund? Educational/behavioral vs. hardware (Metropolitan’s role to fund everything?)

Does Metropolitan continue to fund both regional and local programs? Metropolitan’s funding and involvement in local programs?

Who does what? Example, leading the research, studies, and technology development



The processes (and resource topics) come together for the draft addendum to be presented on August 3rd at the MA Workgroup meeting.

Next Steps

IRP Technical Update Next Steps

- Incorporate final technical refinements
- Review draft results with IRP workgroup
- Finish IRP Issue Paper Addendum
- Present results to IRP Committee

Upcoming Technical Process Activities

August 2015

- Member Agency Workgroup August 3rd
- IRP Committee Meeting August 18th
  - California Water Fix and the IRP
  - Technical process draft results
    - Local supply forecasts by type
    - Retail demand and conservation forecasts
    - Imported supply forecasts
    - Supply/demand/storage balances
  - Update on IRP outreach

Upcoming Technical Process Activities

September 2015

- Member Agency Workgroup September 9th
- IRP Committee Meeting September 22nd
  - Technical process draft results
    - Supply/demand/storage scenarios
    - Potential resource development targets
  - Update on IRP outreach

Upcoming Technical Process Activities

October 2015

- Member Agency Workgroup October 5th
- IRP Public Outreach Workshop October 20th
- IRP Committee Meeting October 27th
  - Update on IRP outreach
  - IRP Issue Paper Addendum
  - Inventory of policy issues
  - Approach for "IRP Phase 2" Board process


THE METROPOLITAN WATER DISTRICT OF
SOUTHERN CALIFORNIA