Summary of Water/Energy Project Coordination Group Discussions

The Water/Energy Project Coordination Group (PCG) was created by the CPUC-Energy Division to discuss both technical and policy issues related to the development of a framework for analyzing the cost effectiveness of water/energy programs. This project has three distinct phases--one: the creation of the scope of work, two: the execution of the scope of work, and three: the consideration of the final work product by the CPUC. Members of the PCG represent a wide range of expertise relevant to the water/energy nexus in California. They include electric and gas IOUs, municipal and investor-owned water utilities, agricultural water users, other government agencies, energy consultants, NGOs and academics.

The purpose of the PCG is not necessarily to reach consensus on relevant policy or technical issues. Rather, its current purpose is to help Energy Division staff and their consultants gain a better understanding of water-related issues, and initially, it served to aid in the initial design of the framework, and to anticipate issues that needed to be addressed during the development of the framework. To this end, Staff proposed a series of questions on specific topics where Staff understood PCG input to be most important for developing project scope and direction.

This paper is not a position paper and viewpoints stated therein are not meant to reflect the views of each and every PCG member or the organizations represented in the PCG. However, where there is a stated "agreement," the intent is to reflect a consensus point reached by the PCG members during that discussion. The discussion points captured in this paper were reached based on actual meetings of the PCG, therefore, they are not meant to represent the viewpoints of the organizations represented by PCG members, but rather the thoughts expressed by PCG members throughout the course of initial "phase one" PCG meetings. Much of the PCG members' time was spent discussing issues in smaller "teams," and this paper is intended to reflect those discussions.

Section 1: Costs and Benefits that accrue to electric/gas ratepayers, water ratepayers, and/or society from Water/Energy Efficiency Projects:

Introduction: The discussions captured in this section, are, as a whole, about classification of benefits in the form of avoided costs. For topics 1a and 1b, we want to make sure there is a complete set of "inputs", e.g., so that all benefits of water-energy nexus projects are being captured. More specifically, we want to capture what the potential benefits are to water ratepayers, energy ratepayers, the environment and society. Topics A and B and C are about defining the benefits, who benefits, and what assumptions are being built in (e.g. assumptions about which benefits are passed on to customers, how much customers benefit from system benefits, etc.). Topic D then deals with allocation of these benefits.

Topic 1a: What are the additional costs and benefits to energy IOU ratepayers that should be considered when analyzing the cost effectiveness of water-energy programs?

The PCG discussed both energy and societal benefits that should be considered. The PCG agrees that the potential categories of *unique* energy benefits from water/energy programs are captured in the current energy efficiency cost-effectiveness framework, which considers a variety of avoided costs related to reduced energy consumption including:

a. Avoided cost of electricity generation (both energy and capacity related avoided costs)
b. Avoided cost of electricity transmission and distribution capacity
c. Avoided cost of natural gas (for natural gas consumption reducing energy efficiency investments)
d. Avoided cost of natural gas transmission and distribution capacity
   This is not to say that PCG members think the current cost effectiveness calculator used in Energy Efficiency programs is perfect and acknowledges that updates are under consideration.

A secondary energy avoided cost may be the reduction in lost hydro-generation that may be associated with the need to "spill" hydro feedstock due to depletion of surface water in streams and lakes.

The PCG agrees that the immediate need is to develop and approve an "avoided cost of embedded energy in water" so that it can be implemented for the post-2014 program cycle. The energy IOUs have authorization to include these avoided costs in their cost-effectiveness methodology for energy efficiency programs but stakeholders have not developed a consensus methodology to date. Therefore, developing this consensus is the highest priority need with respect to supporting the water/energy programs that can bring additional value to IOU customers and ratepayers.

The primary societal avoided costs that the PCG agreed could accrue are the costs and adverse impacts associated with environmental degradation due to depletion of scarce water resources. The PCG members assert that that these costs may be high and yet are hard to quantify, but nonetheless should not be ignored in the cost-effectiveness model. *(See discussion in 1c on environmental/societal benefits).*

Topic 1b: What are the additional costs and benefits to water ratepayers that should be considered when analyzing the cost effectiveness of water-energy programs?

One fundamental issue raised by PCG members is that the difference between “conservation” and “efficiency” is more than just semantics, some PCG members cautioned that because this effort is jointly with water and energy utilities, consultants should be careful not to use these terms interchangeably. This is important to keep in mind when discussing benefits of potential joint *efficiency* programs funded through *energy efficiency* dollars.

The PCG discussed the various types of avoided water costs related to water-energy efficiency programs and the related benefits. The following avoided costs were identified:

1. Avoided Water/Wastewater Capacity - avoided capital investment from system expansion, new infrastructure, etc. (all potential capital costs except development of new supplies)
2. Avoided Embedded Energy (direct energy savings to water utility)
3. Avoided Non-Energy Costs (e.g. chemicals, pump maintenance, etc.)
4. Avoided Extrinsic Marginal Supply (the avoided costs associated with developing and procuring a new water supply source)

The PCG agrees that any such avoided water costs are highly variable and region-specific and must therefore be modeled at the local water agency/service district level, as appropriate.

The reasons for the variability of such costs are:

- Short-term avoided costs are typically Operations &Maintenance costs and not Capacity/Capital costs, and have high variability depending on various factors
- In the long-term, certain types of capacity or storage needs may be deferred or avoided. However, the cost of these capital projects is highly variable due to differing local needs.
- Not all O&M costs are volume related (e.g., contractual agreements for purchased water, infrastructure lease/water storage agreements, etc.).
- Water saved through efficiency programs may or may not result in changed projections of base load demand and may or may not change the loading order of water supplies that might otherwise bring about a reduced marginal cost of water. For example, it is difficult to quantify water demand reduction that originated from a rate design change and simultaneous efficiency program implementation, creating an issue of attribution that would need to be addressed if programs need to “verify” savings.

- Wastewater treatment often follows a separate path in terms of the applicable operational entity and can have high variability in costs within a local region. Wastewater treatment typically has a proportionately higher base load component than drinking water treatment.

- Common and frequent changes in water supply mix, including basin replenishment assessments, wholesaler water unit cost changes, increased use of recycled water.

The PCG recognized the effect of reduced water supplies on energy efficiency (depth of wells, turbidity levels in declining aquifers) and the resulting additional energy benefits of efficiency programs.

Topic 1c: What are the environmental and societal benefits that may result from water efficiency projects?

Environmental:

The potential environmental benefits could be expressed as the opportunity costs that exist when water is used for consumption (residential, commercial, institutional, agricultural, industrial) rather than left in the environment. When water is left in the environment, it remains part of natural and man-made hydrologic cycles in California (either surface or groundwater). When considering the environmental costs there are many "positive feedbacks" that could be created when more water remains in the environment or in our man-made reservoirs. The following is an attempt to capture the types of benefits that could be created:

- Groundwater basin benefits
    - Ecological benefits from higher aquifer levels and higher groundwater table
    - Water quality (including prevention of saltwater intrusion)
- Surface water benefits: either increased stream flows or increased off-stream storage for flow augmentation
    - Ecological Benefits: Wildlife habitat restoration/creation, increased fish populations, other species protection(potential for off-stream water storage to create healthier fish populations as well)
    - Surface water quality (linked to ecological benefits and fish populations) (ex: decreased Delta salinity)
    - Upstream and downstream benefits (e.g.,reservoirs, lakes at various points in the state have higher water levels and decreased salinity)
    - Increased GHG sequestration due to restored habitats (wetlands, forests)

        - See Gund Institute report: payments for ecosystem services
    - Hydropower benefits: more water in reservoirs = more hydropower = decreased GHG of overall electric grid in CA

Other ways that water efficiency projects may have environmental benefits include:

- Potential for decreased wastewater flows/septic system loads
    - Reduced wastewater discharge quantity: may provide benefits:
        - Lower frequency of pipe breaks
        - Less overflow potential in a combined sewer system (SF)
        - Septic system benefits: decreased leaching: decreased nitrate contamination in groundwater
- Avoided GHG emissions and criteria air pollutants from large water system construction projects

Societal Benefits:

Aside from the environmental benefits generally, there are societal benefits that could be realized from increased water-use and/or system efficiency, leading to decreased consumption for existing residential/commercial/agricultural/industrial purposes. These could also be expressed in terms of the opportunity costs of directing water to a potentially "higher value" use: whether for recreational or economic activity. These may include the increased recreational opportunities at the state's reservoirs when they are full (vs. the lost recreational value and economic losses realized by local economies when the reservoirs are low). There is precedent for consideration of this value, which is often cited in environmental economics, and used in the CUWCC Environmental Avoided Cost Tool (see discussion below).

Another example would be water that is now being used inefficiently by one user, whether residential, agricultural, etc., represents an opportunity cost equal to the value that water would have to another user. For example: If farmer B were able to secure the water rights from his neighbor, farmer A, who no longer needs his full allocation because he is using water more efficiently, then the value of that water to Farmer B represents the opportunity cost of Farmer A's inefficiently used water allocation.[1]

[1] PCG members recognize that it is actually quite rare for farmers to transfer water rights, but that does not mean that the potential value of that transfer should not be considered as a potential economic benefit. Water rights transfers may become more common in future drought years.

Societal benefits from water efficiency projects that increase food production and/or improve the quality of food production may include: a significant benefit from the ability for farmers to increase production, i.e. the ratio of yield per water use increases. PCG members noted that it is very unlikely that farmers will give up or transfer their water rights; rather, they will use their existing water right to grow more crops and increase production. It is important to note that water use efficiency in agriculture does not necessarily equate to water savings, rather often to higher quality and higher yields.[2]

Groundwater benefits from increased water-use efficiency pose a unique sub-set of potential societal benefits. Such as, water security benefits associated with increased water storage in aquifers available for future use. This water could have a potentially high value in drought years. Groundwater benefits could also extend to society in the form of decreased contaminant concentrations, making groundwater supplies more fit for drinking water. For example, if currently contaminated groundwater basins require the public to purchase water from alternative sources, the avoidance of this cost would represent a real societal benefit. In some cases what is a “contaminant” in drinking water is not necessarily so for agriculture, i.e., Nitrates. So, where there is a benefit to better “match” a water source with its intended use, there could be real economic benefits to society.

Unfortunately there are also potentially *negative* environmental and societal side effects. PCG members noted potential drawbacks from increase water efficiency in agricultural settings. More efficient agricultural water use may have contributed in part to poor groundwater recharge. Therefore, it is important to think holistically when discussing water supply, efficiency, and energy associated with water transport, etc.

Topic 1d: How could costs be allocated in proportion to the benefits received by ratepayers (both IOU and water ratepayers and society)?

The PCG discussed how water-energy nexus program costs could be allocated in relation to the benefits that accrue to each partnering energy IOU and water agency. The PCG recognizes that the fundamental requirement for any water-energy nexus program is that the incremental cost to each ratepayer group, *i.e.*, energy and water ratepayers, not exceed the benefits realized by

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[2] It is important to keep in mind that for agriculture, the societal benefits may be more significant than energy or water saving benefits, because in agriculture the more efficient irrigation systems may use more energy on the farm, require pressurized systems run by electricity or diesel pumps. Drip irrigation, micro sprinklers and such all require more energy on the farm (compared to flood irrigation) and do not necessarily reduce the actual water deliveries to the farm. The major benefit is increased production, and therefore increased water use efficiency (growing more crops with the same TAF).

each ratepayer group. (This concept does not necessarily apply to societal or environmental benefits, since it is unclear how society as a whole would contribute to these kinds of programs/projects).

The PCG discussed the general question of cost allocation amongst energy and water utilities. The question was framed as: *should costs be allocated among energy IOUs and water agencies in proportion to the benefits realized by such partnering entities, or, whether another method of cost allocation should be employed*? The PCG's discussions focused on whether strict proportionality is necessary for allocating costs of water-energy programs between participating entities/utilities. It was discussed that if the benefits are equal to, not exceeding, the costs then, strict proportionality may be necessary to ensure that the cost to each ratepayer group does not exceed the realized benefits. (I.e., if the TRC=1, ensuring strict proportionality is important.) It was also discussed that if the benefits > costs (i.e., TRC >1) then other cost allocation methods may be permissible. PCG members did not reach consensus on this issue of proportionality, there was a clear split between ratepayer advocates and the utility representatives (both energy and water) on whether strict proportionality could be or should be required.

The PCG discussed feasibility of proportionality, and acknowledged that it may not be feasible to create and apply a methodology that fully and perfectly apportions costs and benefits, recognizing that cost effectiveness generally involves estimations. Many utilities echo the concern that requiring strict proportionality could make running joint programs impossible, and would create a higher burden than required for other programs (since the CPUC only requires that the entire EE portfolio for an IOU have a TRC≥1.)

Section II: Publicly Available Sources of Avoided Cost Information:

The question posed to the PCG was: what are the available tools for calculating avoided costs and cost effectiveness of water efficiency, and can they help us to craft a comprehensive Cost Effectiveness Framework?

Tools Available from the California Urban Water Conservation Council:

The California Urban Water Conservation Council has a few non-proprietary tools available to water agencies to help them calculate the avoided costs of a water efficiency measure, and then to calculate the cost-effectiveness of a specific measure or suite of measures. These tools were developed to aid water agencies in determining which of the "Best Management

Practices" or BMPs to run. It is important to note that CUWCC's tools are publicly available to all water utilities, even though not all water utilities are members of the CUWCC.

Currently, all large California Urban Water suppliers who are signatories to the Council's MOU are required to "comply" with the BMPs. However the dynamic of BMP compliance is changing based on implementation of SB 7X7, which mandates 20% reduction in per capita urban water use by 2020.[3] These tools were developed to help them choose conservation/efficiency programs that would be most cost effective. In some ways, this list of BMPs is similar to the Database of Energy Efficiency Resources (DEER) relied upon by the IOU Energy Efficiency programs to determine the savings value of EE measures. BMPs similarly capture changes to building codes over time, so that BMPs are theoretically only for measures "above code", but, unlike EE measures, water agencies can choose to create programs for code compliance, at their discretion, and get credit under the BMPs.

Information about BMPs and compliance with BMPs is available from the CUWCC. The CUWCC has also undertaken numerous other studies that discuss costs and benefits of water efficiency programs, such as their "Cost and Savings Study" and the "Best Management Benefits and Cost Study."

The CUWCC hosted, with US EPA, a workshop on the Avoided Cost of Water model and the Environmental Avoided cost models. This workshop was attended by numerous PCG members.

Utility Avoided Cost Tool:

The purpose of the Avoided Cost tool is to allow an individual water utility to go through the exercise of determining the benefit it receives, in the form of avoided costs, from their customers using less water. Therefore, this is a general, volume based calculator in an excel workbook, and is not a measure-by-measure calculator. The tool walks the user through the categories of avoided costs, beginning with a "common assumptions" worksheet. One of the assumptions requested is the % of system losses. Users also tell the model their "peak usage" season and, in an agency with multiple water suppliers, their "marginal water supply" (which is really just their most expensive supply in this model).

[3] Beginning in 2014, water agencies that are signatories to the CUWCC MOU will supplement their compliance with the BMPs, with additional reporting in their Urban Water Management Plans (UWMPs) related to SBX7-7 compliance. Specifically, in 2015, for their UWMPs, water agencies have the option to report on the Demand Management Measures (DMMs) or the Foundational BMPs in combination with Flex Track, Traditional BPMs or GPCD. In the Water Authority's service area the majority of retail agencies are using the GPCD method.

If one of these parameters has a measure of uncertainty, there is no way to apply that uncertainty to the model, rather, it is recommended to run some sensitivity tests using different values to see how the results are affected by this uncertainty.

The second section of the model is for variable operating costs, i.e., water purchases, chemical purchases, pumping costs. In the third section you can tell the model about any planned system expansions (in real dollars) in order to calculate long run avoided costs. The user tells the model their demand forecast and the model then calculates the deferral period and the economic value of that deferral (adjusted for inflation). This can be adjusted based on peak seasons. The user also can tell the model that the "avoided cost" would actually be in the form of deferred maintenance or system/equipment downsizing.

Also, the model has the optional capability of helping to calculate the on-margin probabilities for supply options. The user tells the model likely scenarios for future usage of supply options (not the other way around). In other words, this is not a system optimization model; it expects the user to have already figured out the optimal way to operate their system.

Conclusions: The outputs of this model are completely user driven, and therefore, our conclusion is that the user needs to be given very good guidance about inputs up-front to make the model useful. The model also presumes a utility is acquiring debt to make infrastructure expansions, so, if this is not the case the model will generate lower avoided costs. A lot of calculations are also required outside of the model. The guidance over how the user should arrive at many of the inputs (like those for avoided system expansion, etc.) is minimal. A major water-energy issue with this model is that it requires a utility's engineering staff to do volumetric estimations for the relationship between water volume and energy use (for pumping or treatment). Notably, the model does not have the ability to model and compare energy savings from various water efficiency approaches (in contrast to the A4WE Tracking Tool). Coordination between staff who may track energy use vs. water delivery volume at water utilities is often missing, which would lead to potentially low water-energy data quality. The model does not attempt to calculate the GHG emissions resulting from water conservation practices around the state. The success of utilities using these models is unknown. There are many places where user error seems highly likely, and therefore model outputs would have minimal utility for a statewide-type analysis.

Cost Effectiveness Tool: The Council assists members with calculating the potential water savings and overall cost/benefits of water conservation measure (the BMPs and Flex Track measures) with their Cost Effectiveness Analysis Tool. It has places to input in both energy and chemical costs, and the avoided costs calculations from the Avoided Costs tools. It also has measure-specific information about water savings, and along with utility cost inputs can help a water agency determine its priority water conservation efforts.

Environmental Benefits Tool: The CUWCC created an environmental benefits tool for use in calculating the avoided costs of water efficiency/conservation programs in terms of environmental benefits from increased water availability. The goal of this tool's development was to calculate the value in $/volume of environmental benefits from reduced water use, so that water agencies could use these values in a TRC type analysis of water conservation "best management practices" (i.e., efficiency programs). The tool mostly evaluates the benefits of reduced raw water withdrawals, but also includes reduced waste water treatment and GHG benefits. The tool uses data on fish habitat, riparian habitat and wetlands, recreation at lakes and reservoirs, and Bay/Delta salinity to predict benefits to the natural system from increased water availability. The model applies a Willingness to Pay proxy value to benefits such as increased fish habitat and recreational opportunities. The true value of the tool is that it is the only such tool we could find that assigns a dollar value to environmental benefits from water conservation and efficiency programs.

Alliance for Water Efficiency: Cost Effectiveness "Tracking Tool"

The California-specific version of the Alliance for Water Efficiency (A4WE) Tracking tool is essentially a water conservation lifecycle cost calculation embedded into an excel spreadsheet. This tool was designed to be used by water utilities to evaluate their options for running water efficiency/conservation programs. This tool is more than just a calculation platform in Excel. They have designed the entire spreadsheet around a library of conservation measures, demand forecasts, technology specifications, and other operational and cost parameters. The user selects values from the library, or enters utility specific values to include as inputs in the costs and savings calculations.

The CUWCC Avoided Cost model is actually used to calculate some user generated inputs to the A4WE model. Participant and utility costs, water and energy usage and losses are estimated over the full lifecycle of the measure. The costs are discounted using present value methods. The spreadsheet also tracks estimates on a yearly basis, enabling the user to see how programs evolve over time. Some of the key outputs from the model include demand forecasts, the avoided cost of water, the water savings, the energy savings, GHG emission reduction potential, and the potential revenue impacts.

Notably, the Tracking tool projects short and long term avoided cost forecasts and attempts to attribute changes in water system needs from conservation/efficiency programs vs. changes in the baseline due to updated building codes and standards. For long term avoided cost forecasts, either the user can input their own forecast, or the model will estimate them for the user based on a series of survey questions about the user's system.

For water demand forecasts, the model can help agencies "fact check" their own projections and compare demand forecasts with and without a suite of conservation/efficiency measures.

For the measures included in the model, expected useful lifetimes of installed measures is estimated so that projected savings diminish over time depending on the perseverance of the measure and its expected useful life. The Alliance has stated that this information is particularly pertinent to behavior-based programs.

Overall the spreadsheet has implemented all of the pieces to calculate the value of conservation programs for the purposes of this project. But there are some drawbacks. One is the robustness of data input, because numbers are derived from past studies, and the data may no longer currently be accurate or the best available.

Overall the A4WE tool is intuitive, easy to use, and displays and integrates data in informative ways. While not perfect, it's the most effective and easy-to-use existing platform that measures the water avoided costs, energy and GHG benefits of CA water efficiency projects. A key drawback however is that the tool is only accessible to A4WE member utilities.

Section III: Embedded Energy Avoided Cost Valuation Issues: "Team 4 Report"

The subject matter of this team's discussion is at the very heart of the nexus between energy and water in California. If investments are to be made in water efficiency as a means to reduce energy consumption and GHG emissions, there must be some ability to identify the source or sources of the water being saved and the energy embedded in that water that would predictably be saved if such water-saving investments were made. The energy intensity (EI) of the target water supply needs to be understood, and in many cases will need to be estimated where complete data does not exist.[4] For purposes of a general assessment of this strategy, some aggregation of energy intensity is both practical and necessary, and different approaches for this are discussed below.

Additionally, however, the responsiveness of a water supply to changes in end-use water demand, i.e., the degree of linkage between a change in demand induced by a water efficiency investment and a change in the operation of water supply works that will actually result in

[4] This year, for the first time, DWR will include estimates of the Energy Intensity of the State Water Project in the California Water Plan. Also, CPUC regulated retail agencies are currently required to submit their EI calculations to the CPUC (but these may not include all supply types procured by the utility).

reduced energy consumption, needs to be assessed. This is especially true for wholesale supply operations, where reductions in retail sales may result in no near-term change in withdrawals and conveyance (and their associated energy inputs) at all, but rather that water supplies are simply diverted to storage. San Diego County Water Authority (a wholesaler) has been able to document however, the water use reductions in retail agencies that are attributable to retail efficiency programs. SDCWA feels that they can verify that efficiency programs are resulting in changes in deliveries. For major wholesale suppliers, the cumulative effects of end-use reductions may take a few calendar years to produce changes in supply system operations that will actually reduce energy consumption. This time scale may be affected by the size of the supplier and their system (e.g., the State Water Project being the most complex and potentially slowest to respond). The role of a water supplier's carry-over storage in deferring energy savings associated with retail water use reductions needs to be carefully considered.

"Team 4" was charged with considering the following questions:

Should avoided embedded energy values be set by using present or marginal water supplies? And if using marginal supplies, should we take a short, medium, or long term view?

a. Present supplies. Given the considerable uncertainty regarding what would constitute long-run marginal water supplies due to unknowns about long-term future water supply strategies, available resources, and regulatory climate, a conservative approach that averages embedded energy values of present water supplies may be appropriate. This could simply involve calculations at a retail agency level based on the known local supply portfolio and averaged supply mix. Or, a more advanced approach would seek to quantify the embedded energy values that may be avoidable over a short-term period (e.g., 3 to 5 years). For a particular region, this approach would average the energy intensity of all existing water supplies and "dedicated" new supplies, which could include: a) forthcoming water supplies that already have incurred capital expenditures; b) planned water supply expansions adopted in a supplier's capital improvement plan; and c) contractual purchase obligations approved by governing boards. The avoided embedded energy values associated with water efficiency measures would then be calculated using this value. Averaging across a region should reduce the effect of outliers.

b. Marginal supplies. By definition, a marginal supply is "on the margin", meaning that it is either the "next" available supply when demand increases, or the supply that will become unnecessary when demand decreases. While there is considerable uncertainty regarding marginal water supplies, these supplies help to provide understanding of long-term avoided costs. Using a marginal supply approach also necessitates determining whether marginal supplies should be based on a short, medium, or long-term view. In the short term, consideration could be given to those currently operating water supplies in a given region that are most expensive and are unencumbered by take-or-pay pricing arrangements (thus truly avoidable). This approach presumes that the energy embedded in the most expensive current water supplies would be avoided with reductions in water demand. Thus, the marginal supply for *most* areas served by the Metropolitan Water District of Southern California (MWD) could be MWD water because it is *usually* the most expensive supply. An exception to this rule may be areas served by the San Diego County Water Authority -- that Agency has publicly stated that water supply reliability and security concerns outweigh present price considerations. For many remaining areas of the state, the short-term marginal supply may be lower quality groundwater from deeper wells. Because the purpose of this exercise is to consider which supplies are "on the margin" due to efficiency/conservation success, we are not considering conservation to be a "marginal supply".

Over the long-term, some members agreed that desalination could potentially be considered the marginal supply for the entire state (which has been suggested in public workshops), including inland areas that could exchange water with coastal cities that develop desalination facilities.

PCG members acknowledge that a major challenge for developing embedded energy values for marginal supplies is that without obtaining additional clarification as to how water agencies determine which supply is "marginal," this approach is subject to speculation. Many water agencies examine marginal supplies in the short run because peak demand is predictable over this timeframe, even though they predict and use both short and long run costs. While reducing risks to supply reliability is a primary concern for water agencies, many take into account factors other than cost or reliability concerns. For many agencies, legal and contractual obligations dictate which supplies are utilized at any given time. The highly particularized nature of these obligations may make it difficult to readily identify marginal water supplies. Yet, for water agencies that have entered into water purchase agreements without "take or pay" obligations, the purchased water source could be considered the marginal water supply.

Given the many variables inherent in determining marginal water supplies at the regional level, *a fundamental question that will need to be addressed is the degree of certainty regarding energy intensity values that is necessary for energy savings to be identified.*

Should there be an additional "long -term capacity" avoided cost value?

While appealing in concept, the team agreed that projections of new water supply capacity that might avoided in a period 10 to 20 years or further into the future, in order to identify the avoided energy embedded in such a future supply, are simply too speculative to incorporate into the analysis without greatly broadening the band of uncertainty that accompanies any projection.

Should marginal water supplies be set by hydrologic region? By Wholesaler? By Retail Agency?

Identifying marginal supplies for each individual retailer is a herculean task, and the PCG agrees that this would be an unnecessarily detailed objective for the analysis of water-saving options across the large service areas of the energy IOUs. At a much higher level of aggregation, the hydrologic and administrative regions of DWR and SWRCB could be considered. One proposal discussed was to take SWRCB regions generally, but divide the Central Valley into north and south, and combine regions in Southern California, such as Los Angeles and Santa Ana, based on similar supply makeup. However, DWR and SWRCB regions offer an imperfect fit for marginal water supplies, as surface water hydrology fails to correlate with developed groundwater resources.

It was also suggested that we need to look at wholesale supplies to as the best proxy for marginal supplies across Southern California. However, although several retail agencies have adopted explicit polices to reduce their wholesale purchases, other water suppliers project additional purchases of wholesale imports in the future.

PCG members presume that groupings of retail suppliers with similar supply profiles could be most helpful. In Southern California, the most likely units would be the sub-regional wholesalers, i.e., the eleven member agencies of MWD that are themselves wholesalers serving retail agencies within a county. Remaining retailers might be aggregated in clusters of retailers with roughly similar supply characteristics, as might be expected where retailers overlie a groundwater basin (whether adjudicated or not).

Groundwater supplies serve as marginal supplies for most agricultural suppliers and for individual water users themselves, because in most instances farmers use groundwater when their surface water supply is short, or non-existent. There is a presumption that if farmers had access to reliable surface water supplies they would not be drawing down their groundwater. Therefore, Agricultural suppliers, i.e., irrigation districts who include groundwater in their supply portfolio, could be grouped between those with policies and practices that stabilize their groundwater supplies and those continuing to draw groundwater from ever greater depths.

How should we treat inter and intra-annual variation of energy intensity? Over what period of time should we average EI values?

The team agrees that averaging energy intensity values over a 10-year period could address inter-annual variations in energy intensity that occur over wet, dry and "normal" years. The team did not agree as to how the "average" should be calculated, i.e., whether rolling or simple average. An adjustment mechanism may be appropriate to normalize the data for severe conditions such as prolonged drought For the assessment of individual water efficiency measures that have strong seasonality, such as landscape efficiency projects, a seasonally specific energy intensity value may be appropriate.

Discussion: The Elephant in the Room

Significant work remains to be done to make the transition from calculations of the energy intensity of water supplies to determinations of the amount of actual energy savings and associated GHG emission reductions that can be achieved by reductions in end uses of water. Of course, end use water efficiency is not the only way to reduce GHG emissions from the water sector. But other approaches, such as improving the efficiency of pumps, motors, and lighting at treatment plants, don't necessarily affect water production and don't require new tools to evaluate.

The PCG discussed long range conveyance systems in the context of energy. For background:

> "The three largest statewide conveyance systems – the state owned and operated State Water Project (SWP), the federally owned and operated Central Valley Project (CVP), and the Colorado River Aqueduct (CRA) owned by MWD are designed as inter-basin transfer systems: their primary purpose is to redistribute water . . . The SWP and CVP redistribute California water supplies; CRA brings water supplies from the Colorado River to supplement supplies in . . . southern California."[5]

In 2005, a report from the California Energy Commission[6] estimated that water-related electricity use consumed 19% of the electricity used in the state. CPUC's Study 1 concluded that the supply and conveyance of water makes up 6.6% of statewide electricity use (15.8 TWh annually).[7] California's long distance water conveyance systems, including the SWP, use approximately 4% of total statewide electricity. The SWP uses 60% of that total conveyance energy. Typically the electricity used on these conveyance systems is supplied from the wholesale energy markets, not from an IOU, whereas energy used for other supplies, including

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[5] CPUC "Embedded Energy in Water Relationship Study (Study 1)" GEI, (2010)

[6] (CEC-700-2005-011-SF)

[7] CPUC Study 1, Appendix N

groundwater, is usually IOU provided .[8] This has given rise to an important, but narrow question of whether water savings that save non-IOU embedded energy associated with conveyance can be counted in cost-effectiveness determinations for investment of energy IOU ratepayer dollars, or whether a societal test can be applied to capture GHG reduction benefits from non-IOU energy savings even if savings of energy *per se* are not.

But regardless of the conveyances' source of power (IOU, public or wholesale), another formidable issue remains to be addressed. It was noted during the discussions of Group 4 that the movement of water by wholesale conveyance works is not directly linked to retail water sales. This is due to a major distinction between energy supply systems, particularly for electric power, and water supply systems. Electric power systems generally lack utility-scale storage, and consequently they convey supplies to end users in real time. A reduction in electricity sales is linked to a reduction in energy generation. In contrast, water supply systems have utility-scale storage, for example, MWD has access to about 5.6 million acre-feet of groundwater and surface dry year storage nearly three times its average annual deliveries. Thus, water supplies that are procured by wholesale suppliers are often not immediately conveyed to end users.

Some in the PCG argued that this is irrelevant. Thus, there is a lack of agreement as to if end-use water savings will achieve reliable energy savings and associated GHG reductions from the large scale water conveyance systems. This led the PCG to discuss whether flows through conveyance systems are in fact the correct metric with which to measure water savings. A separate question is how one accounts for the "timing" of savings. Some PCG members suggest that it is not necessary to track "absolute" reductions in conveyance in order to demonstrate "upstream" energy savings from retail reductions. Some suggest the issue is really more about timing than absolute reductions, and that there are "real" energy savings from the conveyance systems, the timing is just not immediate. If demand stays down, there can be real reductions in conveyance (at least in wholesale systems, if not DWR controlled systems).

Water agency PCG members suggest that water going in to storage, whether pre-or post-wholesaler, is still "real" water savings with associated energy savings. For example, MWD raised that it can document that they have water allocations which they are not taking and are keeping in upstream storage (in Northern CA even), and therefore these are real water savings

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[8] CPUC Study 1 was the first effort to collect and compile detailed water-energy data from the state's largest wholesale water systems for the purpose of validating the amount of energy used by the Supply and Conveyance segment of the water use cycle, and to consider whether energy was provided by IOU. While the study did not result in a specific percentage for conveyance, of the CEC study's numbers it concluded: "The amount of energy previously attributed to the Supply and Conveyance segment of the water use cycle is likely understated."

with real embedded energy savings. Some PCG members assert that per-capita (as opposed to absolute) reductions in water deliveries still represent *avoided* future embedded energy, and therefore have value.

By way of example, if a family in San Diego participates in a clothes washer incentive program, and saves, say 4,000 gallons per year, it is likely that any local water treatment and distribution energy and any local waste water collection and treatment energy will be reliably reduced, accordingly, because these services are somewhat "load-following", more akin to the electricity paradigm. However, wholesale supply is different. There is no *assurance* that the amount of water pumped from the Colorado or from the Bay-Delta will be reduced, either in the same year or even in the same decade, as the installation of the new clothes washer. Water agency PCG members however said that it is still *likely* that, at scale, pumping will be reduced due to large scale water efficiency gains.

The PCG discussed whether MWD (and other State Water Project contractors) takes as much water each year as the project makes available and, also if it is MWD policy to keep its Colorado River pipeline full. MWD asserted that they do not, in practice, apply such policies. The PCG does agree that water that is not sold to retail agencies can be placed in storage, and there is no contractual or legal mechanism for MWD to immediately reduce its imports in proportion to conservation and efficiency savings (or recycled water production). However, as discussed above, water may be “stored” in upstream locations for long periods of time and there *are* associated energy savings/offsets over that time period, which likely have value.

Given the place of energy efficiency at the top of the CPUC’s loading order for new energy resources, it is imperative for the reliability of the power system that public goods charge investments in energy efficiency save energy in a reliable and predictable way. This issue needs further evaluation. It is not simply a computational problem, but a significant policy gap that needs attention as well. Energy and GHG savings ought not to be credited to water conveyance facilities without a mechanism to ensure that the savings are real.

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