Work Paper WPSDGEWEN0001

**Revision 1**

**San Diego Gas & Electric**

**Water Energy Nexus Measures**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | Refer to Table 1 |
| **Measure Description** | Refer to Table 1 |
| **Base Case Description** | Refer to Table 1 |
| **Units** | Refer to Excel Calculation Attachment |
| **Energy Savings** | Refer to Excel Calculation Attachment |
| **Full Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Incremental Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Effective Useful Life** | Refer to Excel Calculation Attachment |
| **Measure Installation Type** | Refer to Section 1.3 |
| **Net-to-Gross Ratio** | Refer to Section 1.4 |
| **Important Comments** | The latest version of the Water Energy Nexus Calculator (WEN Calculator version 1.05) was used to estimate embedded energy savings for measures identified in Table 1.  Where applicable, DEER cost-effectiveness values will be used first, then Metropolitan Water District (MWD) values and then values from CPUC Decision D.15-09-023.   * For example, for all direct energy savings measures in DEER with a water component, the NTG from that measure for the embedded energy component will be used and not the 0.85. On the other hand, if the measure does not have a direct NTG counterpart currently in DEER, then the MWD NTG, if any, would apply. In situations where both DEER and MWD NTG values are unavailable, then Decision D.15-09-023 would then apply and locks in a default NTG ratio of 0.85 (OP-7). |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 04/21/17 | RMS Energy Consulting, LLC | New Workpaper. |
| 1 | 09/17/19 | RMS Energy Consulting, LLC | * Master spreadsheet was updated to correct typos on naming on worksheets. * MWD commercial large rotary nozzle savings were corrected. * Applicable MWD outdoor measures were updated from urban to agricultural sector. * Master List Measures includes 110 WEN measures identified in the 2019-09-17 WEN Master Spreadsheet |

# Commission Staff and Cal TF Comments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rev** | **Party** | **Submittal Date** | **Comment Date** | **Comments** | **WP Developer Response** |
|  |  |  |  |  |  |

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

California continues to suffer through a severe multi-year drought. On January 17, 2014, Governor Brown declared a Drought State of Emergency, commenting that “*the magnitude of the severe drought conditions presents threats beyond the control of the services, personnel, equipment and facilities of any single local government*.” In 2016, Governor Brown issued Executive Order B-37-16 directing California to, prioritize and take concrete, measurable actions that “Make Conservation a California Way of Life” and “Manage and Prepare for Dry Periods” in order to improve use of water in our state. The California Energy Commission and Department of Water Resources have solicited and developed more programs targeting the water–energy nexus, not only to conserve water and energy but also to reduce GHG emissions.

Consequently, the California Public Utilities Commission (CPUC), with its broad jurisdiction over energy, water, and other investor-owned utilities, sought to investigate the immediate-term, mid-term, and long-term actions that could be taken to combat the drought and future climate challenges. Over the past several years the CPUC has expressed an overarching interest in determining the potential benefits of evaluating embedded energy impacts associated with water conservation measures. Decision 15-09-023 (D.15-09-023), the “Decision Regarding Tools for Calculating the Embedded Energy in Water and an Avoided Capacity Cost Associated with Water Savings” was issued adopting tools to allow the Commission to better quantify energy benefits of water saving measures. The Water-Energy Nexus Calculator (WEN Calculator), addressed in D.15-09-023, evaluated energy benefits associated with moving and treating water, along with related indirect off-site energy impacts. D.15-09-023 also evaluated the energy benefits associated with conservation of cold-water savings measures as well as off-site hot water savings.

**Workpaper Purpose**

Presently, these additional embedded energy benefits are not accounted for in existing investor-owned utility (IOU) programs. The purpose of this workpaper (wp) is to meet the current California Public Utility Commission (CPUC) Ex-Ante Review (EAR) team’s requirements by quantifying the additional embedded energy savings outputted from the latest version of the Water Energy Nexus (WEN) Calculator (1.05) through the use of two input sources including water savings values from existing approved utility wps and/or water savings values developed by the Metropolitan Water District (MWD).

More specifically, energy impacts for these measures will be quantified using the WEN Calculator and expressed as incremental energy savings, by hydrological zone, over and above the energy impacts, which may be associated with existing wps or programs. Energy impacts will be an additive savings to any approved wp since these incremental savings are off-site and not already accounted for within existing wps.

This WEN wp supplements any other wp (or potential custom installation) to account for off-site and embedded energy effects. These incremental savings are only proposed for the specific measures already quantified and approved by existing wps and/or MWD. Other water saving measures may be incorporated at a later date as data becomes available. However, until those additional measures are quantified, this wp is limited to the present MWD measures stated in Table A.9-3 in Appendix 9 of the MWD Integrated Water Resources Plan (IRP), Draft 2015 Update, discussed as a part of the 1/12/2016 MWD Board Meeting and/or existing IOU approved wps.

The first 10 IOU WEN measures are listed in **Table 1**. The complete IOU WEN measures can be found in the 2019-09-17 WEN Measures List 2019 – FINAL.xlsx included with the workpaper upload onto the workpaper archive (WPA) website.

Table 1: Statewide IOU WEN Measures and Codes

|  |  |
| --- | --- |
| **Statewide IOU WEN Measures** | |
| **Measure #** | **Measure Name** |
|
| 1 | Energy Star most efficient clothes washer, >2.5 cubic ft - SFM. MFM In-Unit |
| 2 | Energy Star most efficient clothes washer, >2.5 cubic ft - MFM Common Area |
| 3 | Energy Star most efficient clothes washer, >2.5 cubic ft - Non-Res |
| 4 | Commercial steam cooker Electric |
| 5 | Commercial steam cooker Natural gas |
| 6 | Commercial combination oven/steamer Electric (less than 15 pans) |
| 7 | Commercial combination oven/steamer Electric (15-28 pans) |
| 8 | Commercial combination oven/steamer Electric (more than 28 pans) |
| 9 | Commercial combination oven/steamer Natural gas (less than 15 pans) |
| 10 | Commercial combination oven/steamer Natural gas (15-28 pans) |

The first 10 MWD WEN measures are listed in **Table 2**. The complete IOU WEN measures can be found in the 2019-09-17 WEN Measures List 2019 – FINAL.xlsx included with the workpaper upload onto the workpaper archive (WPA) website.

Table 2: Statewide MWD WEN Measures and Codes

| **Statewide MWD WEN Measures** | | | |
| --- | --- | --- | --- |
| **Measure #** | **Measure Name** | | |
| 53 | Com-High Efficiency Toilet (Melded) | | |
| 54 | Com-4 Liter Toilet (Melded) | | |
| 55 | Com-Zero/Ultra Low Water Urinal | | |
| 56 | Com-Dry Vacuum Pump (/1/2 hp) | | |
| 57 | Com-Cooling Tower Conductivity Controller | | |
| 58 | Com-pH Cooling Tower Controller | | |
| 59 | Com-Weather Based Irrigation Controller-Stat | | |
| 60 | Com-Central Computer Irrigation Controller-Stat | | |
| 61 | Com-Rotary Multi-Stream Nozzle | | |
| 62 | Com-Large Rotary Nozzle | | |
| 63 | Com-Turf Removal (/square foot) | | |
| 64 | Com-Laminar Flow Restrictor | | |
| 65 | Com-In-Stem Flow Regulator | | |
| 66 | Com-Soil Moisture Sensor | | |
| 67 | Com-Plumbing Flow Control (/pair) | | |
| 68 | Com-High Efficiency Toilet (Fitness; avg M&F) | | |
| 69 | Com-Zero/Ultra Low Water Urinal (Fitness) | | |
| 70 | Res-High Efficiency Toilet (Melded Rate) | | |
| 71 | Res-Weather Based Irrigation Controller (each; < 1 acre) | | |
| 72 |  | Res-Weather Based Irrigation Controller (/Station; > 1 acre) |
| 73 |  | Res-Rotary Multi-Stream Nozzle |
| 74 |  | Res-Turf Removal (per square foot) |
| 75 |  | Res-Soil Moisture Sensor (each; < 1 acre) |
| 76 |  | Res-Soil Moisture Sensor (/Station; > 1 acre) |
| 77 |  | Res-Rain Barrel |

### Eligibility Requirements

1. The measures described in **Table 1** and **Table 2** are only available to California Investor-Owned Utility (IOU) customers paying the Public Goods Charge, and are customers of the IOU for which the measures described here are being offered through the IOU’s Energy Efficiency programs.
2. Customers attempting to participate in the program must be currently in good standing with the administering IOU.

### Implementation, Installation Requirements and Other Program Restrictions

***Rider Measures*** are measures that capture incremental embedded energy savings based on measures already quantified and approved through existing wps and/or MWD’s water savings list.

***WEN Measures***, identified in **Table 1,** are a type of Rider Measure and will adhere to the implementation, installation and program restriction requirements as identified in those approved already wps or MWD’s program requirements. As identified in **Table 1**, WEN Measures could come from Statewide IOU wps or WEN Measures could come from MWD as identified in **Table 2**.

A goal of this WEN program should attempt to minimize customer requirements to file multiple incentive applications with multiple parties. To realize this goal, appropriate delivery mechanisms should be evaluated and applied. An assessment of how to integrate the delivery mechanism between incentives offered by water agencies and those offered for energy efficiency needs to be discussed.

## 1.2 Technical Description

### Water Energy Nexus Cost Calculator

It takes energy to produce, deliver, and dispose of potable water. It can take energy to push or pull the water from the place where nature produces it to the place where it is needed. It often takes energy to move the water to storage or to deliver it to a customer. It takes energy to clean the water after it becomes waste and before it can be released to the greater environment. Thus, if it takes energy to use water, then it must save energy if one can avoid using it.

The Navigant Water/Energy Cost‐Effectiveness Analysis Final Report defined ***Embedded Energy*** in water as the amount of energy that is used to collect, convey, treat, and distribute a unit of water to end users, and the amount of energy that is used to collect and transport used water for treatment prior to safe discharge of the effluent in accordance with regulatory rules.

In Decision (D.) 15-09-023, the CPUC unanimously adopted in the Water Energy Nexus Cost Calculator tool (WEN Calculator) designed to calculate the embedded energy in water and the avoided capacity cost associated with water savings. Incorporating this tool within the energy efficiency discipline is ongoing, including updates. The most current version of the WEN Calculator (1.05) is used to estimate embedded energy savings for IOU Wen measures identified in **Table 1** and MWD WEN measures in **Table 2**.

Prior energy efficiency tools measured only the direct energy savings associated with reduced water use in site-specific energy savings programs directed at customers. Consequently, programs or projects targeting the energy required in the water system above and beyond the energy used in a site-specific program could not be quantified prior to the WEN Calculator. However, with CPUC approval of the new WEN Calculator, energy savings from water conservation projects and programs targeting the water system as well as how to allocate costs and benefits among program administrators can be quantified. The WEN Calculator assesses water-energy program cost effectiveness for energy efficiency portfolios. The intended use of water/energy cost-effectiveness analysis tool is to:

* Estimate the IOU and non-IOU embedded energy savings that result from joint water-energy programs;
* Assess the benefits that accrue to energy utilities and to water utilities from programs and measures that save both energy and water; and
* Determine if incentivizing measures and programs that save both energy and water is a cost- effective use of IOU energy utility funds.

## 1.3 Installation Types and Delivery Mechanisms

The IOU WEN measures identified in **Table 1** and MWD WEN measures identified in **Table 2** are ***Rider Measures*** and adhere to the installation types and delivery mechanisms already identified in the existing wps and/or MWD’s water savings list.

## 1.4 Measure Parameters

### 1.4.1 DEER Data

Table 3: DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Workpaper?** |
| Modified DEER methodology | No |
| Scaled DEER measure | No |
| DEER Base Case | No |
| DEER Measure Case | No |
| DEER Building Types | Yes |
| DEER Operating Hours | No |
| DEER eQUEST Prototypes | No |
| DEER Version | DEER 2019, READI v2.5.1 |
| Reason for Deviation from DEER | DEER does not contain embedded water energy savings for WEN measures |
| DEER Measure IDs Used | N/A |

**Net-to-Gross Ratio**

Where applicable, Rider Measures will use DEER cost-effectiveness values, including Net-to-Gross (NTG) values, first. When Rider Measures are not found in DEER (i.e. toilets) then Metropolitan Water District’s (MWD) NTG values are used. When both DEER and MWD parameters are not available, then NTG values derived from the California Public Utility Commission (CPUC) Decision D.15-09-023 are used to establish free ridership.

For example, for all existing direct energy savings Rider Measures in DEER, such as a showerhead that has a water savings component, the NTG from the showerhead energy wp (0.55) will be used for the embedded energy component and not the default (0.85) NTG value taken from Decision D.15-09-023. If the Rider Measure does not have a direct NTG counterpart currently in DEER, then the MWD NTG value would apply.

In situations where new water-energy measures are introduced or when both DEER and MWD NTG values are unavailable, then Decision D.15-09-023 would then apply and locks in a default NTG ratio of 0.85 (OP-7). Thus, MWD WEN Measures that do not have a direct NTG counterpart currently in DEER and where MWD does not provide an NTG value, a 0.85 NTG will be assigned to that MWD WEN Measure.

**Table 4** illustrates the first ten (10) IOU WEN Rider Measures that will use DEER NTG values based on existing approved energy wps. The complete list of IOU WEN Rider Measures can be found in the 2019-09-17 WEN Measures List 2019 – FINAL.xlsx included with the workpaper upload onto the workpaper archive (WPA) website. The MWD WEN Measures do not have a direct NTG currently in DEER and MWD does not provide NTG values for these measures at this time. Thus, these measures will be assigned a 0.85 NTG for cost-effectiveness calculation purposes.

Table 4: Net to Gross Ratio Table for Rider Measures Using Existing Energy WPs

| **Measure #** | **NTGR ID** | **Description** | **Sector** | **BldgType** | **Measure Delivery** | **NTGR** |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Res-sAll-mCW | Energy Star most efficient clothes washer, >2.5 cubic ft - SFM. MFM In-Unit | Any | Any | Any | 0.31 |
| 2 | Com-Default>2yrs | Energy Star most efficient clothes washer, >2.5 cubic ft - MFM Common Area | Any | Any | Any | 0.60 |
| 3 | Com-Default>2yrs | Energy Star most efficient clothes washer, >2.5 cubic ft - Non-Res | Any | Any | Any | 0.60 |
| 4 | Com-Default>2yrs | Commercial steam cooker Electric | Any | Any | Any | 0.60 |
| 5 | Com-Default>2yrs | Commercial steam cooker Natural gas | Any | Any | Any | 0.60 |
| 6 | Com-Default>2yrs | Commercial combination oven/steamer Electric (less than 15 pans) | Any | Any | Any | 0.60 |
| 7 | Com-Default>2yrs | Commercial combination oven/steamer Electric (15-28 pans) | Any | Any | Any | 0.60 |
| 8 | Com-Default>2yrs | Commercial combination oven/steamer Electric (more than 28 pans) | Any | Any | Any | 0.60 |
| 9 | Com-Default>2yrs | Commercial combination oven/steamer Natural gas (less than 15 pans) | Any | Any | Any | 0.60 |
| 10 | Com-Default>2yrs | Commercial combination oven/steamer Natural gas (15-28 pans) | Any | Any | Any | 0.60 |

**Spillage Rate**

Spillage rates are not tracked in wps; they are tracked in an external document which will be supplied to the Commission Staff.

**Installation Rate**

Realization rates, GSIA values, and overall installation rates are presented in the appendix and are proposed to be incorporated as best available data. The IR values were obtained using the DEER READI tool. The relevant IR values for the measures in this wp are in the table below.

Table 5: GSIA Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **BldgType** | **ProgDelivID** | **GSIAValue** |
| Def-GSIA | Default GSIA values | Any | Any | Any | 1 |

**IOU WEN Measures - Effective and Remaining Useful Life**

For the IOU WEN Measures, the EUL and RUL values were obtained using the DEER READI tool (DEER 2016, READI v2.5.1). DEER defines the RUL as 1/3 of the EUL value. The RUL value is only applicable to the first baseline period for an RET measure with an applicable code baseline. The relevant EUL and RUL values for the first ten (10) IOU WEN measures are shown in the **Table 6**. The remaining IOU WEN measures can be found in the 2019-09-17 WEN Measures List 2019 – FINAL.xlsx included with the workpaper upload onto the workpaper archive (WPA) website.

Table 6: IOU WEN Measures - EUL/RUL Table

| **Measure #** | **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Appl-EffCW | Energy Star most efficient clothes washer, >2.5 cubic ft - SFM. MFM In-Unit | SFM. MFM In-Unit | AppPlug | 11 | 3.7 |
| 2 | Appl-EffCW | Energy Star most efficient clothes washer, >2.5 cubic ft - MFM Common Area | MFM Common Area | AppPlug | 11 | 3.7 |
| 3 | ComLau-EffCW | Energy Star most efficient clothes washer, >2.5 cubic ft - Non-Res | Non-Res | AppPlug | 11 | 3.7 |
| 4 | Cook-ElecStmCooker | Commercial steam cooker Electric | Commercial | FoodServ | 12 | 4 |
| 5 | Cook-GasStmCooker | Commercial steam cooker Natural gas | Commercial | FoodServ | 12 | 4 |
| 6 | Cook-ElecCombOven | Commercial combination oven/steamer Electric (less than 15 pans) | Commercial | FoodServ | 12 | 4 |
| 7 | Cook-ElecCombOven | Commercial combination oven/steamer Electric (15-28 pans) | Commercial | FoodServ | 12 | 4 |
| 8 | Cook-ElecCombOven | Commercial combination oven/steamer Electric (more than 28 pans) | Commercial | FoodServ | 12 | 4 |
| 9 | Cook-GasCombOVen | Commercial combination oven/steamer Natural gas (less than 15 pans) | Commercial | FoodServ | 12 | 4 |
| 10 | Cook-GasCombOVen | Commercial combination oven/steamer Natural gas (15-28 pans) | Commercial | FoodServ | 12 | 4 |

Similar to NTG, when DEER EUL or RUL values are available, those values are used first. However, when DEER EUL or RUL values are not available, it is proposed to adopt the EUL that has already been evaluated and approved by MWD for the MWD WEN Measures. These values may differ from existing wps or potential custom projects.

Since the wp will be “incremental” to any existing savings values, the differences in EUL are expected to be minimal. There may also be differing values between proposed MWD EUL parameters and those contained in READI or other wps. Being an incremental wp, an assessment of the differences relative to the overall energy impact accuracy may be warranted. The relevant EUL and RUL values for the first ten (10) MWD WEN measures are shown in the **Table 7**. The remaining MWD WEN measures can be found in the 2019-09-17 WEN Measures List 2019 – FINAL.xlsx included with the workpaper upload onto the workpaper archive (WPA) website.

Table 7: MWD WEN Measures - EUL/RUL Table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Measure #** | **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| 53 |  | Com-High Efficiency Toilet (Melded) | Commercial |  | 20 | 6.67 |
| 54 |  | Com-4 Liter Toilet (Melded) | Commercial |  | 20 | 6.67 |
| 55 |  | Com-Zero/Ultra Low Water Urinal | Commercial |  | 20 | 6.67 |
| 56 |  | Com-Dry Vacuum Pump (/1/2 hp) | Commercial |  | 7 | 2.33 |
| 57 |  | Com-Cooling Tower Conductivity Controller | Commercial |  | 5 | 1.67 |
| 58 |  | Com-pH Cooling Tower Controller | Commercial |  | 5 | 1.67 |
| 59 |  | Com-Weather Based Irrigation Controller-Stat | Commercial |  | 10 | 3.33 |
| 60 |  | Com-Central Computer Irrigation Controller-Stat | Commercial |  | 10 | 3.33 |
| 61 |  | Com-Rotary Multi-Stream Nozzle | Commercial |  | 5 | 1.67 |
| 62 |  | Com-Large Rotary Nozzle | Commercial |  | 10 | 3.33 |

### 1.4.2 Codes and Standards Analysis

As indicated in prior sections, the WEN measures identified in **Table 1** and **Table 2** are Rider Measures and adhere to the applicable codes and standards already identified in the existing wps and/or MWD’s water savings list. Furthermore, Appendix 9 as well as D.15-09-023 addresses code impacts with regard to Plumbing Code and certain Title 24 Energy Code ramifications. Additional evaluation of T-24 with respect to the proposed measures is warranted.

## 1.5 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

### 1.5.1 Navigant’s Water/Energy Cost-Effectiveness Analysis

The 2015 Navigant Water/Energy Cost-Effectiveness Analysis Report provided the tools and analyses developed in this study have very specific functions in informing CPUC decisions about the use of energy ratepayer funds on joint water‐energy programs. The intended uses of the tools and analysis developed by this study include the following:

* Estimate the IOU and non‐IOU embedded energy savings that result from joint water‐energy programs;
* Assess the benefits that accrue to energy utilities and to water utilities from programs and measures that save both energy and water; and
* Determine if incentivizing measures and programs that save both energy and water is a cost-effective use of IOU energy utility funds.

## 1.6 Data Quality and Future Data Needs

### 1.6.1 Decision on Updating the Water Energy Nexus (R.13-12-011)

The conclusions of law at the end of the Commissioner Sandoval’s Decision on Updating the Water Energy Nexus (R.13.-12-011) indicated that:

* The Water Energy Nexus Cost Calculator (WEN Calculator) was approved in a unanimous Commission Decision 15-09-023;
* Within 60 days of the date of this Decision, PG&E, SCE, SDG&E, and Southern California Gas shall file and serve the proceeding service list with a work plan to Energy Division to, in consultation and direction from Energy Division, facilitate and enable the following updates to the water energy nexus cost calculator to:

1. create a GHG emissions reductions output value for water energy nexus energy efficiency measures, and,
2. connect the Calculator with the commonly used E3 energy efficiency program calculator.

In the Water Energy Nexus Cost Calculator 2.0 track of this proceeding, Energy Division staff is working with collaborating utilities on this effort. In this Decision the CPUC advances its work to integrate the WEN Calculator tool with the E3 Energy Efficiency Calculator, proposes to calculate the greenhouse gas (GHG) emissions savings resulting from the reduced energy used to move water through the water system, and integrates the embedded natural gas in the water sector into the WEN Calculator.

**1.6.2 Reporting for WEN WP Measures**

In November of 2016, the Energy Division’s Energy Efficiency Data Management and Reporting Team was asked to work with Water-Energy stakeholders, including IOU program managers, to propose a method for reporting savings claims for “embedded” energy savings derived from water-savings measures. Before the meeting ended, a list of questions was issued for stakeholder consideration before the reporting schemes for accounting for WEN measures were finalized. Questions included:

* Before adding this WaterMeasure table to the EE program tracking specification, the team has some threshold questions for energy water stakeholders:

1. Does this approach seem reasonable; if not, what modifications should be considered?
2. Does the table capture all of the appropriate fields?
3. Is there a reason why the calculator does not produce kW savings;
   1. Should kW be added to the table? Are kW savings available for reporting?
4. Is there a reason why the water calculator provides (AvAnnualTherms) as a savings field for embedded water/energy savings?
   1. This question will not impact the proposal necessarily; just informational.

# Section 2. Calculation Methodology

Navigant’s Water/Energy Cost-Effectiveness Analysis Report **Figure 1** provides an overview of tools and analysis developed in the study as well as their relationship to existing tools. The latest version of the WEN Calculator (version 1.05) includes all three water‐related benefits in a single tool that can be used for analyzing the benefits of water conservation measures. The Calculator provides:

* Analysis of the Avoided Embedded IOU Energy in Water is contained within the Water Energy Calculator.
* The Avoided Capacity Cost of Water is calculated by the Avoided Water Capacity Cost Model (developed by the Navigant team). These values feed into the Water Energy Calculator.
* Environmental Benefits of Reduced Water Use is obtained from secondary data review of existing environmental benefits models.



Figure 1: Navigant Consulting’s Overview of Tools and Analysis

The WEN Calculator estimates IOU and non‐IOU embedded energy savings. These embedded energy savings consider the energy intensity of the weighted average mix of water supplies to a given region as well as the energy intensities of the other system components (treatment, distribution, and wastewater systems as appropriate).

As indicated in section 1, embedded energy savings outputted from the WEN Calculator through the use of two input sources including water savings values from existing approved IOU wps and/or water savings values developed by the Metropolitan Water District (MWD). The following sections detail the step-by-step procedures on how the final embedded water energy savings are outputted from the Calculator.

### Embedded Energy Savings from Existing Approved IOU WPs

A statewide WEN measures IOU wp list was identified. **Figure 2** provides an example of WEN measures that are currently supported by existing and approved IOU wps.



Figure 2: Sample List of IOU WP WEN Measures

A WEN measure is then inputted into the WEN Calculator. Parameters that are fed into the input sheet include:

* Annual Water Savings (gallons)
* Installation Year
* Savings Profile (i.e. Constant, Cooling Tower or Irrigation)
* Hydrologic Region (10 in total)
* Sector (i.e. Urban or Agricultural)
* Water Use (i.e. Indoor or Outdoor)



Figure 3: Navigant Water Energy Calculator Input Tab

### Embedded Energy Savings from MWD Water Savings List

A similar process is performed for MWD WEN measures. For MWD WEN measures, the DRAFT: 2015 Integrated Water Resources Plan Update – Appendices describe the how the active water savings estimates are calculated. Page 3 of the Appendices indicated

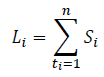
Device savings are limited by decay rates, or a corresponding device life, but not both at the same time. For example, a residential high-efficiency toilet (HET) saves about 38 gallons per day over a lifetime of 20 years with no assumed decay rate. For a complete list of current and past device and program savings factors, see Appendices A and B. Annual savings are expressed in acre-feet (AF).



Figure 4: Annual Savings Expressed in Acre-Feet (AF)

* *Si* is the annual savings in acre-feet (AF) for device *i*.
* *di* is the number of device *i* installed under an active conservation program.
* *ai* is the gallons per day savings from a baseline. Baselines are specific to each device and represent the typical amount of water usage for a conventional device prior to more efficient alternatives being made available, either through plumbing code enforcement or market innovations. For example, a HET with a 1.28 gallons-per-flush (GPF) has a savings factor of 38 gallons per day compared to the 3.5 GPF toilets available before the 1992 plumbing codes.
* 365 is the number of days assumed in one year for the purpose of simplifying the calculation.
* 325,851 is the number of gallons in one acre-foot of water.

Lifetime savings is the sum of annual savings over the life expectancy of the device.



* *𝐿𝑖 = Σ 𝑆𝑖 𝑛 𝑡𝑖=1*
* *Li* is the lifetime savings of device *i*.
* *n* is the number of years a device is expected to produce savings before it fails. This varies depending on the type of device.
* *t* is the year when device *i* is producing savings.
* *Si* is the annual savings in acre-feet (AF) for device *i*.

Similar to the IOU WEN measure, the water savings values from the MWD list are also inputted into Navigant’s WEN Calculator as shown in **Figure 3**. After the applicable input fields are entered, the WEN calculator outputs the applicable fields as illustrated in **Figure 5** including:

* Average Annual Embedded IOU Electric Energy (kWh)
* Average Annual Embedded Non-IOU Electric Energy (kWh)
* Average Annual Embedded Gas Energy (therms)
* Avoided IOU Electric Energy Costs (in 2014 dollars)
* Avoided Gas Energy Cost (in 2014 dollars)



Figure 5: Navigant Water Energy Calculator Output Tab

### Hydrologic Region to Climate Zone Table

Through collaboration with IOUs, the CPUC ED and CPUC Reporting Team, agreement was reached on how to take existing customer data (zip code) and determine hydrologic region, which is an input into the WEN Calculator. Particularly, in cases where a zip code has multiple hydrologic regions, it became difficult to assign that specific application to a hydrologic region. **Figures 6** and **7** illustrate an example of assigning a hydrological zone to a zip code that directly maps to a CEC climate zone.



Figure 6: Moss Landing Zip Code Map Bordering San Francisco Bay and Central Coast Hydrological Zones

The WEN Working Group collaboratively determined that the hydrological region assigned to that zip code would be the one with the largest area within the zip code. For example, Moss Landing is located on the coast within Monterey County, California. The primary zip code used by Moss Landing is 95039.

The California Energy Commission (CEC) Climate Zone places Moss Landing’s zip code (95039) in Climate Zone 3 as shown on the very left of **Figure 7**. Secondly, the 10 hydrological regions are depicted in the middle of Figure 7 where portions of Moss Landing’s zip code map to the San Francisco Bay hydrological zone while the majority of the zip code maps to the Central Coast hydrological zone. Lastly, the 16 CEC Climate Zones are shown on the right of Figure 7 where Moss Landing would be mapped to Climate Zone 3.



Figure 7: CEC Zip Code to Hydrological Zone to Climate Zone Mapping

Despite being near the coast and having both San Francisco Bay (SF) and Central Coast (CC) hydrological zones as possible options for zip code 95039, CC has the largest hydrologic region assigned to zip code 95039. Therefore, based on the WEN Working Group’s agreed upon approach, CC would be used as the hydrological zone mapped to CEC Climate Zone 3 because CC is the largest hydrological zone within the 95039-zip code.

**Table 8** is an example of how the zip to hydrologic region look-up table that will be used to understand the geographic variations in the number of measure installations by hydrologic region, water savings by hydrologic region, embedded energy savings by hydrologic region, etc. The full list is available in the attachments section.

**Table 8: Proposed Water Measure Table**

|  |  |  |  |
| --- | --- | --- | --- |
| **Zip-Code** | **Possible Hydrologic Regions** | **Largest Hydrological Region Assigned to Zip Code** | **Climate-Zone** |
| 95039 | SF, CC | CC | CZ 3 |

**Reporting for WEN WP Measures**

Although the WEN calculator originally was developed for use in energy efficiency portfolio and project development, the tool solely calculates embedded water energy savings and currently does not integrate into the E3 or CET calculator tools to quantify cost-effectiveness. Commissioner Sandoval's Proposed Decision on Updating the Water Energy Nexus (R.13-12-011) finding of fact indicated the following:

* A calculation, exogenous to the current version of the WEN Calculator must be performed to access the E3 Cost Effectiveness Calculator for mainstream EE program development.
* A calculation, exogenous to the current version of the WEN Calculator must be performed to determine GHG emissions saved from WEN energy efficiency programs
* The investor-owned energy utilities must use all 3 calculators to determine the GHG emissions reductions of WEN energy efficiency programs.

Additionally, as indicated in the Navigant Report,

“to the extent possible, measure‐specific data (e.g., energy impacts, net‐to‐gross ratios, costs and useful lives) used in the calculation of the TRC and PAC tests should be taken from the most up‐to‐date version of the Database for Energy Efficiency Resources (DEER). As water‐energy considerations enter the CPUC cost‐effectiveness framework, DEER will need to be updated to store new water‐related information.”

In November 2016, Energy Division’s Energy Efficiency Data Management and Reporting Team was asked to work with Water-Energy stakeholders, including IOU program managers, to propose a method for reporting savings claims for “embedded” energy savings derived from WEN measures. The overarching goals were to:

1. Minimize changes to the current EE program tracking claims reporting structure;
2. Minimize unnecessary fields which result in excessive 'blank' values for non-water measures; and
3. Allow very clear alignment of the resource measure (i.e. low-flow showerhead) and the water-energy measure.

After a discussion with the WEN Working Group, where the team learned details about an upcoming wp submission, it was determined that an appropriate reporting approach would be to create a secondary measure for the embedded savings associated with the water measure. While the water measure reports on-site energy savings, this secondary measure would solely report embedded savings.

To capture the relationship between the on-site savings and embedded savings from a water measure, the WEN Working Group created a Water Measure Table (**Table 8**), which, like the CustomMeasure and DeemedMeasure tables, has a 1-to-1 relationship with the Claim table. **Figure 8** depicts how embedded energy savings (Line 21) will be reported as a separate line item in the Monthly Energy Efficiency Program Report.



Figure 8: 2017 EE Monthly Report Template

Each Claim requires either a CustomMeasure or a DeemedMeasure record, and water-saving measures can be either Deemed or Custom measures. Claims that are water-saving measures also need a WaterMeasure 'sister' record, linked by the ClaimID. The WaterMeasure table contains the key inputs and outputs from Navigant's WEN Calculator. The process of adding this table to the EE program tracking specification would follow adopted change management guidelines, and the IOU Reporting Teams already has a list of proposed specification modifications for 2017 claims to which this would be added once agreed upon by the WEN Working Group.

Table 9 Proposed Water Measure Table



# Section 3. Load Shapes

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. Load shape is peculiar for Water-Energy programs as it is difficult hard to determine what time energy is being used for the delivery and treatment of water and wastewater. At the instant water is used on-site, energy is used many hours ahead and after that to treat and pump and collect.

At the February 14, 2017 WEN Working Group meeting, CPUC EAR team suggested using a Refrigeration energy load shape as the shape is constant and generally flat throughout the year and similar to how WEN cold water measures are typically used. However, at the March 14, 2017 WEN Working Group meeting, CPUC ED staff indicated that they would coordinate with the CPUC ED Reporting Team on creating a flat load shape for the IOU Reporting teams to use for MWD WEN measures.

For illustrative purposes, the relevant load shapes for the first ten (10) IOU WEN measures are shown in the **Table 10**. The remaining IOU WEN measure load shapes can be found in the 2019-09-17 WEN Measures List 2019 – FINAL.xlsx included with the workpaper upload onto the workpaper archive (WPA) website. Similarly, the relevant load shapes for the first ten (10) MWD WEN measures are shown in **Table 11**.

Table 10 Applicable Building Types and Load Shapes for IOU WEN Measures

| **Measure #** | **Measure Description** | **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| --- | --- | --- | --- | --- |
| 1 | Energy Star most efficient clothes washer, >2.5 cubic ft - SFM. MFM In-Unit | SFM | IOU:RES: DEER: Res\_ClothesDishWasher | RES |
| 2 | Energy Star most efficient clothes washer, >2.5 cubic ft - MFM Common Area | MFM | IOU:RES: DEER: Res\_ClothesDishWasher | RES |
| 3 | Energy Star most efficient clothes washer, >2.5 cubic ft - Non-Res | Com | IOU:RES: DEER: Res\_ClothesDishWasher | NON\_RES |
| 4 | Commercial steam cooker Electric | Com | IOU:RSD-Restaurant–SitDown-PROC\_OTH | NON\_RES |
| 5 | Commercial steam cooker Natural gas | Com | IOU:RSD-Restaurant–SitDown-PROC\_OTH | NON\_RES |
| 6 | Commercial combination oven/steamer Electric (less than 15 pans) | Com | IOU:RSD-Restaurant–SitDown-PROC\_OTH | NON\_RES |
| 7 | Commercial combination oven/steamer Electric (15-28 pans) | Com | IOU:RSD-Restaurant–SitDown-PROC\_OTH | NON\_RES |
| 8 | Commercial combination oven/steamer Electric (more than 28 pans) | Com | IOU:RSD-Restaurant–SitDown-PROC\_OTH | NON\_RES |
| 9 | Commercial combination oven/steamer Natural gas (less than 15 pans) | Com | IOU:RSD-Restaurant–SitDown-PROC\_OTH | NON\_RES |
| 10 | Commercial combination oven/steamer Natural gas (15-28 pans) | Com | IOU:RSD-Restaurant–SitDown-PROC\_OTH | NON\_RES |

Table 11 Applicable Building Types and Load Shapes for MWD WEN Measures

| **Measure #** | **Measure Description** | **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| --- | --- | --- | --- | --- |
| 53 | Com-High Efficiency Toilet (Melded) | Com | TBD: Flat Load Shape | NON\_RES |
| 54 | Com-4 Liter Toilet (Melded) | Com | TBD: Flat Load Shape | NON\_RES |
| 55 | Com-Zero/Ultra Low Water Urinal | Com | TBD: Flat Load Shape | NON\_RES |
| 56 | Com-Dry Vacuum Pump (/1/2 hp) | Com | TBD: Flat Load Shape | NON\_RES |
| 57 | Com-Cooling Tower Conductivity Controller | Com | TBD: Flat Load Shape | NON\_RES |
| 58 | Com-pH Cooling Tower Controller | Com | TBD: Flat Load Shape | NON\_RES |
| 59 | Com-Weather Based Irrigation Controller-Stat | Com | TBD: Flat Load Shape | NON\_RES |
| 60 | Com-Central Computer Irrigation Controller-Stat | Com | TBD: Flat Load Shape | NON\_RES |
| 61 | Com-Rotary Multi-Stream Nozzle | Com | TBD: Flat Load Shape | NON\_RES |
| 62 | Com-Large Rotary Nozzle |  | TBD: Flat Load Shape | NON\_RES |

# Section 4. Costs

For typical wps, all costs must be addressed including baseline cost, measure cost, and incremental cost for both ER and ROB measures. Discussion with MWD and other water agencies are expected to provide the cost elements necessary.

It is not proposed herein that any IOU undertake an extensive study to justify costs. Rather, where MWD or another water agency does not have required cost data, the wp will rely on simple internet searches, contractor discussions, professional judgement, or other simplified means of determining appropriate cost parameters. Because the WEN measures identified in **Table 1** and **Table 2** are considered ***Rider Measures***, costs have already been captured in existing approved wps or through MWD’s program requirements. Thus, the cost for WEN measures is assumed to be $0.

However, for cost-effectiveness calculation purposes, WEN measures are assumed to be $0.01 to allow cost-benefit values to be generated for program evaluation purposes. More specifically, direct savings IOU WEN measure will use $0.01 for the cost of the measure when running the water energy calculator since the costs of the measures are included in the calculations for the direct savings measure. For MWD WEN cold water measures, the IOUs will work with the water agencies to determine the dollar amount to assist with marketing and/or incentives based on the embedded energy savings output from the water energy calculator. For the wp cost-effectiveness calculation purposes MWD WEN cold water measures will also use $0.01 for the calculation purposes.

# References

1. Navigant’s Water/Energy Cost-Effectiveness Analysis
2. Commissioner Sandoval's Proposed Decision on Updating the Water Energy Nexus (R.13-12-011)
3. November 2016 Reporting Proposal for WEN WP Measures Meeting