



PASADENA WATER AND POWER
MEMORANDUM

June 2, 2015

To: Environmental Advisory Commission

From: Phyllis E. Currie *Phyllis E. Currie*
General Manager

Subject: SUPPORT RECOMMENDATION TO THE CITY COUNCIL TO ADOPT PWP
2015 UPDATE TO POWER INTEGRATED RESOURCE PLAN ("IRP")

RECOMMENDATION:

It is recommended that the Environmental Advisory Commission support staff's recommendation that the City Council adopt the 2015 Update to the Power Integrated Resource Plan ("IRP").

EXECUTIVE SUMMARY

On March 5, 2012, the City Council approved an update to the Pasadena Water and Power ("PWP") Integrated Resource Plan for power resources (the "2012 IRP"), which among other objectives affirmed the commitment of the City of Pasadena ("City") to a goal of obtaining 40% of its energy from renewable resources by 2020, procuring specific amounts of local solar power, reducing its greenhouse gas ("GHG") emissions by 40% from 2008 levels, also by 2020, and replacing the Broadway power plant with a comparably sized new combined cycle plant.

PWP has executed several long-term contracts for renewable power supplies, and expects to meet not only the current state-wide mandatory requirement of at least 33% renewable energy by 2020, but the City's voluntary 40% Renewable Portfolio Standard ("RPS") goal by 2020, and its interim RPS goals in the each of the years prior to 2020.

Because of changes in the way GHG emissions are attributed to electric utilities since 2009, and conditions affecting the potential sale of power from the coal-fired Intermountain Power Project ("IPP"), it is highly unlikely that PWP will be able to attain the previous IRP goal of reducing PWP's GHG emissions by 40% from 2008 levels by 2020.

In addition, the rate at which PWP customers have adopted local solar is not as rapid as anticipated in the 2012 IRP. There is a significant technical potential for distributed (i.e., local) solar in Pasadena, as indicated in the Black & Veatch report provided as Exhibit 1. Local solar (e.g., on rooftops or parking structures) is more than twice as

costly as utility scale solar. However, there is strong community interest in some level of utility support for local solar.

For its 2015 update to the Integrated Resource Plan (“2015 IRP”), PWP engaged the consulting firm Black & Veatch to conduct analysis and modeling. The 2015 IRP Update considers the 20-year planning horizon from 2015 through 2034. The Stakeholder Technical Advisory Group recommended a shortlist of five resource portfolios for further analysis, and each of these five resource portfolios was examined under four different “scenarios,” or combinations of potential market conditions. The analysis produced scorecards with a number of measurements for comparing each of the alternatives in terms of financial, reliability, and environmental impacts.

The conditions under which PWP operates have undergone considerable change since the 2012 IRP, and many of these conditions are still evolving. Accordingly, it is prudent to choose a plan that is flexible, adaptable, and incorporates a “least regrets” frame of reference.

Portfolio 1 – “Stay the Course” – is the Preferred Resource Portfolio. It includes a continuation of the City of Pasadena’s aggressive 40 percent RPS by 2020, with the coal-fired IPP generation offered into the market using PWP’s revised IPP dispatch guidelines¹. The Preferred Portfolio most closely resembles PWP’s current resource strategy in pursuit of those goals in the 2012 IRP that can reasonably be achieved. It is: (i) the least cost of the five portfolio options, (ii) does not preclude adopting any of the other portfolios at a later date as PWP gains more clarity with respect to a number of variables that have changed or are changing, and (iii) meets or exceeds all of PWP’s current legal, regulatory, reliability and environmental requirements, while achieving an impressive 60% GHG reduction by 2030, well ahead of the California statewide target under Executive Order B-30-15.

PWP’s 2015 IRP Recommendations include the following goals:

1. PWP will target GHG reductions of at least 60% from 1990 levels by 2030² (to approx. 367,500 metric tons) through the most cost-effective and expedient means available.
 - a. PWP will eliminate coal-fired generation from the PWP power portfolio no later than 2027. Discussions are underway for an IPP amendment that would facilitate a 2025 repowering with natural gas or and/or an alternative. This would provide an earlier exit from coal. The proposed amendment of the power sales agreement requires the consent of all existing 36 participants. In addition, each participant can choose to participate in the proposed repowering project or not. Pasadena’s

¹ IPP is offered into the market when the sum of:

(i) PWP’s IPP variable costs, including actual carbon cost and
(ii) an additional carbon premium above PWP’s actual carbon cost,
is at or below the CAISO day-ahead locational market price at the IPP market hub.

² California’s statewide target is a 40% reduction by 2030 (Executive Order B-30-15, issued 4/29/2015) & 80% by 2050 from 1990 levels (Executive Order S-03-05, issued 6/1/2005).

participation should be conditioned on satisfactory resolution of key issues:

- i. Pasadena should preserve its IPP-related transmission rights.
 - ii. Pasadena should have an option to reduce or opt out of any IPP repowering in 2019.
 - iii. Until IPP is repowered, PWP should reduce IPP generation when operationally and economically practicable.
- b. PWP will continue to acquire all cost-effective and viable energy efficiency.
 - i. PWP will target energy efficiency equal to at least 1% of annual net energy load (retail electric energy plus distribution losses) and 0.7% of average peak demand. For Fiscal Years 2015 through 2023, this amounts to 12,750 MWh/year of energy efficiency, and 2.3 MW/year of demand reduction, as approved by the City Council in 2013 (see Exhibit 2).
 - c. PWP will continue to acquire cost-effective renewable energy.
 - i. PWP will procure renewables pursuant to Renewable Portfolio Standard Policy provided in Exhibit 3 and the annual Procurement Plan approved by the City Council to meet or exceed state-wide and local renewable energy targets and to achieve the GHG emission reduction goal. Pasadena's renewable energy target is currently 40% of retail load by 2020. The state-wide goal is currently at least 33% of retail load by 2020, but is proposed to increase to 50% by 2030.
 - d. PWP will support local renewable energy resources and community solar efforts.
 - i. PWP will establish a Feed-in Tariff by the end of 2016³.
 - ii. PWP will launch a Community Solar pilot project by the end of 2016.
2. PWP will continue to ensure reliability and flexibility to respond to electric industry changes.
 - a. PWP will explore and procure viable, cost-effective new technologies (including distributed generation resources and energy storage) and efficient conventional technologies as needed to meet reliability and flexibility requirements.
 - b. PWP will preserve existing local generation.
 - i. PWP will evaluate repair and/or replacement options for Glenarm Unit 2.

BACKGROUND

PWP's Integrated Resource Plan ("IRP") is based on an industry-standard twenty year planning horizon, and is updated every two to three years.

³ A comparison of some neighboring utilities' current feed-in tariff rates and the status of associated program subscriptions is provided in Exhibit 4.

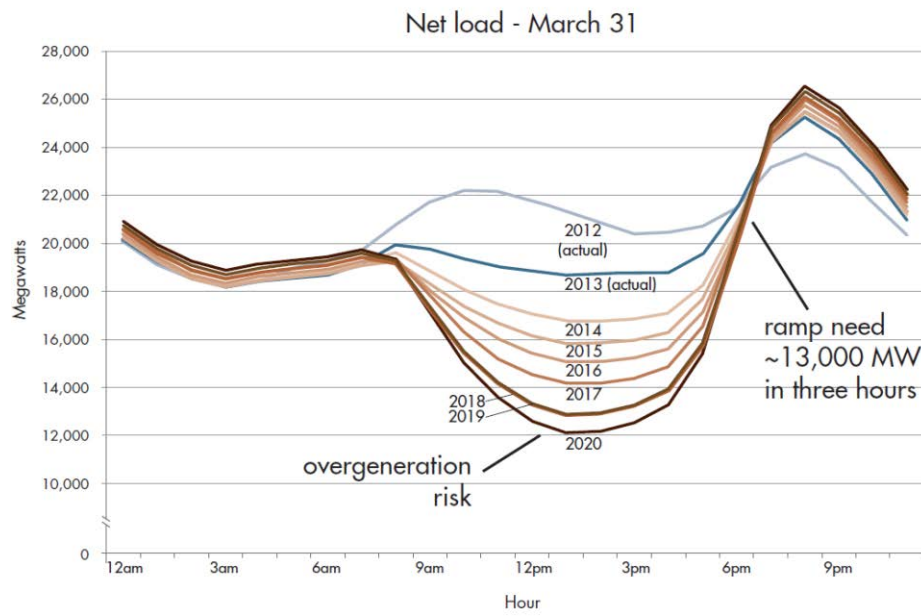
CHANGING CONDITIONS

There are a number of circumstances that have changed or are changing since the 2012 IRP. The IRP Recommendations take these changing circumstances into consideration. For example:

- **CAISO Reliability Requirements** have evolved to include local and flexible resource adequacy capacity allocations. Future flexible resource adequacy capacity (“FRAC”) requirements are difficult to predict, because the algorithm is partially based on the actions of other market participants, and the net impact on the CAISO as a whole, not just on the loads and resources of PWP. Exhibit 5 includes analysis performed for PWP by Black and Veatch of CAISO Level Integration Costs.
- **The Energy Imbalance Market** (“EIM”) has formed and is growing with a regional footprint outside of the CAISO, including current participants PacifiCorp and NV Energy and prospective participants Puget Sound Energy and Arizona Public Service. The EIM provides additional resources from outside the CAISO footprint to help reduce the cost to balance intermittent renewable energy, but also introduces additional wholesale energy competition, which puts downward pressure on market prices, and reduces wholesale revenues during periods when PWP has surplus generation. Wholesale revenues are used to lower rates.
- **The “Duck Curve”** is the result of a changing net load profile⁴, and may alter market prices and the timing of “peak” and “off-peak” load periods. Changes in the overall resource mix in California is expected to increasingly result in periods of over-generation during certain periods when there may be significant amounts of renewable energy available, and other periods when there is a tremendous need for fast ramping dispatchable resources. This changing net load profile is sometimes referred to as the “Duck Curve” because the net load bottoming out during the middle of the day as a result of solar energy production peaking resembles a duck’s belly, while the steep increase in the late afternoon and evening as the sun sets resembles the duck’s neck.

⁴ Net load is the difference between actual load and variable resources (wind and solar) directly connected to the transmission grid. A load profile refers to the shape of the graph of electric demand (in MW) over time (e.g., hourly or seasonally). The Duck Curve is an example of a Net Load profile.

**FIGURE 1:
THE DUCK CURVE**



- **Retail Load** is difficult to predict, given the potential for increasing penetration of distributed generation (such as rooftop solar and micro grids), which would reduce load, and the need for electric vehicle charging, which would increase load. These factors could not only change the hourly and seasonal shape of PWP's load, but its load factor (i.e., ratio of average energy requirements to peak demand). Most new energy resources, including renewables, require long-term (i.e., at least 20 year) contractual commitments to obtain financing. PWP must be prudent about the commitment it makes to fixed cost contracts if it is to facilitate customer access to distributed generation and other technology choices that may result in reductions in retail load and potentially higher costs for remaining customers as fixed costs are spread over fewer customers and kWh.
- **California's carbon Cap-and-Trade Program** ("Program") took effect in early 2012. The Program runs through 2020. It is unknown whether the Program will continue past 2020, or will be replaced by a federal carbon tax, or some other program.
- **Greenhouse Gas Emission Levels** in California are targeted at 1990 levels by 2020 under The Global Warming Solutions Act (California AB32), and Governor Schwarzenegger's Executive Order S-3-05 calls for an 80 percent reduction below 1990 GHG emission levels by 2050. In Executive Order B-30-15 issued April 29, 2015, Governor Brown established a new interim statewide GHG emission reduction target of 40 percent below 1990 levels by 2030 in order to ensure that California meets its 2050 target.
- **California's RPS** is currently at least 33% by 2020 under AB32, but Governor Brown has proposed "Golden State Standards" (aka the "50/50/50" plan) that

could have the state headed toward a 50% RPS by 2030, as well as doubling energy-efficiency of existing buildings by 2030, and reducing automobile dependency on oil and gas by 50% by 2030, which could have impacts on the power industry as a result of the shift to electric vehicles. Legislation (e.g., SB350) is pending to implement the Governor's vision.

- **The Costs of Renewable Resources and Energy Storage** are generally expected to continue to decline, but actual costs and technology changes are difficult to predict, especially given the uncertainty of tax incentives, legislative changes, and reliability requirements. In addition, the uncertain cost of integrating increasing levels of variable production renewable energy into the transmission and distribution system presents another planning challenge. Exhibits 5 and 6 are studies performed for PWP by Black and Veatch assessing CAISO level integration costs and distribution level PV integration costs, respectively.
- **The Intermountain Power Project Contract** was originally to terminate in June of 2027, but if amended, the coal contract would be replaced with natural gas in 2025. PWP could "opt out" of the gas-fired project in 2019, but under the proposed amendatory agreement, would receive a reduced amount of power from the natural gas-fired project between 2025 and mid-2027, when the original power sales contract would have terminated. Preserving PWP's valuable rights to transmission from the area around IPP, where renewable energy such as PWP's current Milford Wind project is delivered, is dependent upon participation in the gas-fired repowering project, but PWP would have an option to reduce its participation or "opt out" of the gas project in 2019 under a memorandum of understanding recently negotiated.

PWP's 2015 IRP PROCESS

To prepare the 2015 IRP update, PWP retained the nationally recognized consulting firm of Black & Veatch to advise staff and perform analysis and modeling. The assumptions and other key analytical information are provided in Exhibit 7. A Stakeholder Technical Advisory Group ("TAG") was formed, including representatives from key customers, environmental groups, educational institutions, government, and others to review the IRP work and advise PWP. The public involvement process also included a series of public meetings, a non-scientific customer/stakeholder survey, website and social media postings, an on-line form to receive comments and for stakeholders to join the electronic distribution list to receive additional information, as well as comments from individuals and groups.

CUSTOMER/STAKEHOLDER SURVEY

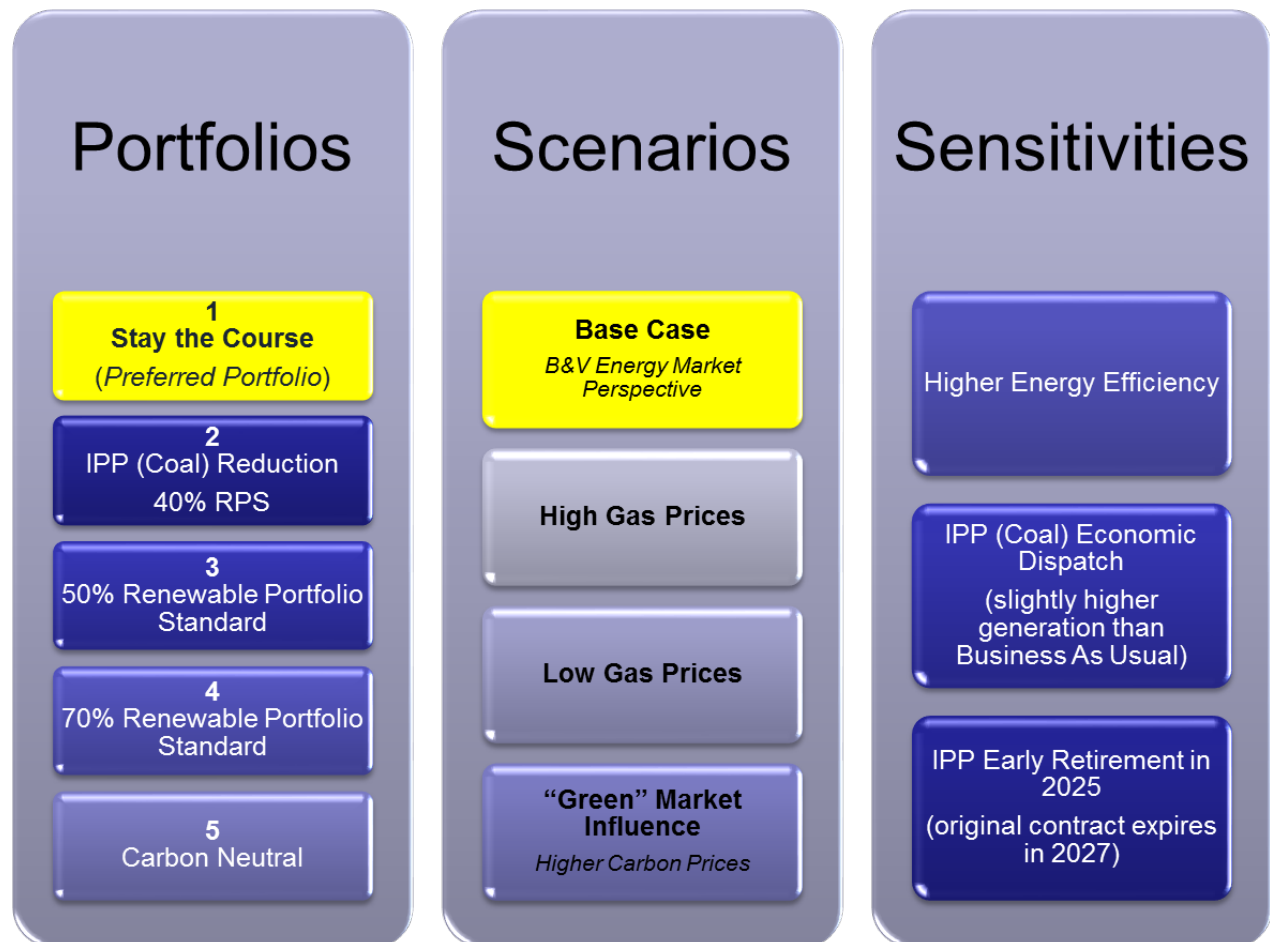
PWP conducted a non-scientific survey on-line and via hard-copies at various public events to provide customers and other stakeholders another means of providing input to the IRP process. Respondents self-selected whether or not to participate and were allowed to respond multiple times if they wished. Over the course of several months, 470 responses were received. Of those responding, 83.5% indicated that they live in Pasadena, and 48.1% indicated that they work or own a business in Pasadena.

Respondents indicated that 82.8% were answering from a residential customer perspective. The results of this survey, including individual comments, are summarized in Exhibit 8.

PORTFOLIO ANALYSIS

PWP and the Stakeholder TAG narrowed the analysis to a shortlist of five “Portfolios,” or groups of power supply resources. Each Portfolio was run through four sets of market assumptions, or “Scenarios.” There were also three “Sensitivities,” or basic model variations that were run as special cases. These concepts are summarized in Figure 2 below:

FIGURE 2: IRP CONSTRUCT



The five Portfolios selected by the Stakeholder TAG for further analysis were as follows:

1: Stay the Course (“Preferred Portfolio”) – This Portfolio most closely resembles PWP’s current resource strategy under the 2012 IRP, with certain modifications. It achieves an impressive 60% reduction in GHG emissions from 1990 levels by 2030 through a combination of retiring the IPP coal-fired generating project,

maintaining the aggressive 40% RPS by 2020, and continuing PWP's energy efficiency programs. It also assumes continuation of PWP's revised dispatch guidelines for the IPP coal-fired generation project prior to retirement, which currently includes an additional GHG "penalty" of \$5-\$6/MWh in addition to PWP's actual cost of carbon.

- 2: IPP Reduction/40% RPS** – This Portfolio would maintain the 40% RPS by 2020, but would reduce IPP generation by approximately 70 MW from its maximum (below the take-or-pay level) to the operational minimum of approximately 38 MW in order to further reduce PWP's GHG emissions.
- 3: 50% RPS by 2025** – This Portfolio would maintain the IPP Reduction and the 40% RPS from Portfolio 2, but would increase the RPS to 50% by 2025 (5 years ahead of the current proposal by Governor Brown).
- 4: 70% RPS by 2030** – This Portfolio would maintain the achievements of Portfolio 3, but increase the RPS to 70% by 2030.
- 5: Carbon Neutral by 2030** – This Portfolio would immediately avoid any non-renewable market purchases, procuring carbon credits to offset any purchases that were unavoidable (e.g., due to energy imbalances), and would reduce IPP generation to minimum until the contract expires. All natural gas generation would be fueled with renewable bio-methane in order to meet reliability requirements. By 2030, all coal-fired generation would be eliminated, and all generation would be carbon neutral (e.g., approximately 88% renewable, and the remainder non-carbon emitting, such as the existing Hoover large hydro project and the Palo Verde nuclear project).

Scorecards were created that compared the five Portfolios across a number of measurements in the areas of reliability, financial and environmental impacts. The results of that analysis are provided as Exhibit 9. Projections were made to estimate the potential impact of each Portfolio on the direct costs of the energy service charge component of PWP operating expenses, in order to compare the potential effect of each Portfolio on future customer bills. A comparison of the estimated impact on customer bills is provided as Exhibit 10.

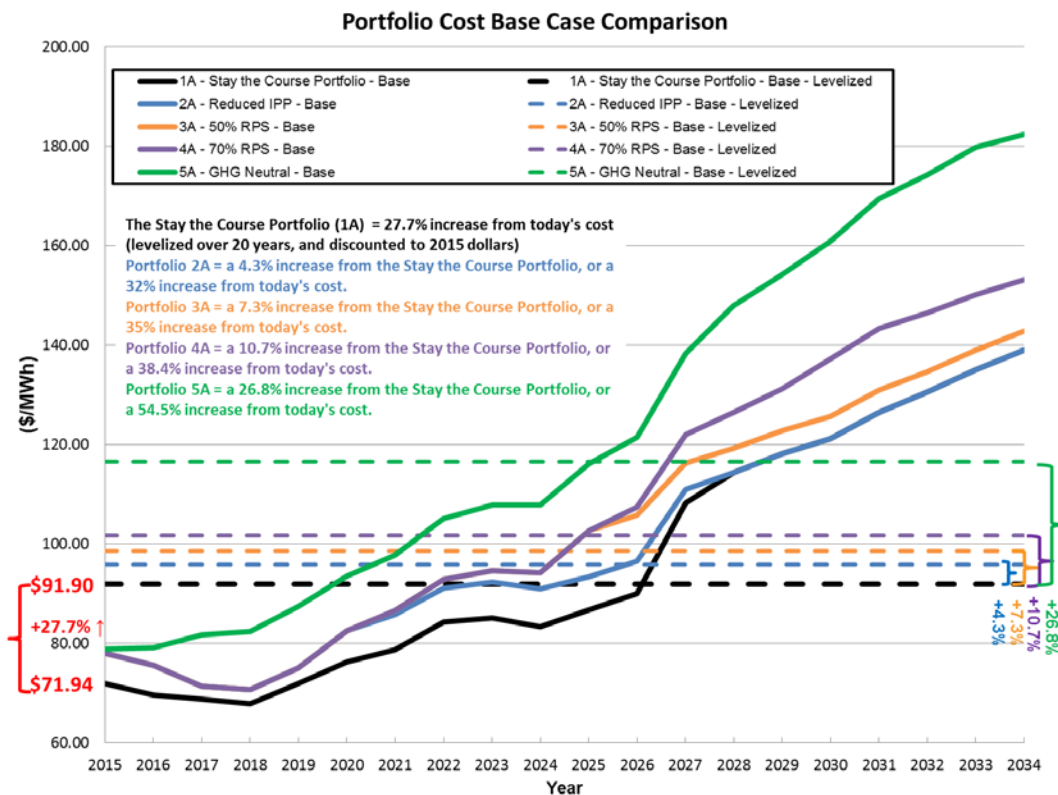
Table I and Figure 3 below compare the Portfolio Costs of the five Portfolios under Base Case market conditions. The solid lines in Figure 3 show how costs would change over time, while the dashed lines illustrate those same costs levelized over 20 years in 2015 dollars. Today, PWP's resource portfolio has direct costs of approximately \$71.94/MWh. Over the 20-year planning horizon, the Stay the Course Portfolio Base Case is projected to result in levelized costs of \$91.90/MWh, an increase of 27.7% from today's costs. The Reduced IPP Portfolio adds an additional 4.3% increase on top of the Stay the Course Portfolio (a total 32% increase), the 50% RPS would add 7.3% on top of the Stay the Course Portfolio (total 35% increase), the 70% RPS would add 10.7% on top of the Stay the Course Portfolio (a total 38.4% increase), and the Carbon Neutral Portfolio would add 26.8% on top of the Stay the Course Portfolio (a total 56.5% increase). For comparison, in the 2008 IRP, the "Status Quo" would have produced a

20-year levelized increase of 28% (compared to the 27.7% increase projected for “Stay the Course”). The 40% RPS Portfolio, which was selected as the Preferred Portfolio, was projected to result in an increase of 6% above the then Status Quo, for a total of 34% over 20 years. That 2008 Preferred Portfolio is now the Stay the Course Portfolio, and is expected to have remaining cost increases of approximately 27.7% (in \$2015) over the next 20 years out of the originally projected 34% increase (in \$2008).

TABLE I: PORTFOLIO COST COMPARISON

PORTFOLIO	Expected Increase from Starting (Today's) Cost to 20-Year Levelized	Increase from Status Quo (2008) or Stay the Course (2015)	Total Portfolio Cost Increase
2008 IRP (\$2008)	28%	6%	34%
1A – Stay the Course (\$2015)	27.7%	N/A	27.7%
2A – Reduce IPP (\$2015)	27.7%	4.3%	32.0%
3A – 50% RPS (\$2015)	27.7%	7.3%	35.0%
4A – 70% RPS (\$2015)	27.7%	10.7%	38.4%
5A – GHG Neutral (\$2015)	27.7%	26.8%	54.5%

FIGURE 3: PORTFOLIO COST COMPARISON



GHG REDUCTION

The Intermountain Power Project (“IPP”) coal-fired facility produced approximately 46% of PWP’s energy in 2014, but almost 90% of its GHG emissions. Reducing or eliminating IPP generation is the most expedient means of reducing PWP’s GHG footprint. The California Air Resources Board (“CARB”) has provided guidance known as “Resource Shuffling” rules that could effectively prohibit the type of transaction that was envisioned in the last two IRPs for reducing PWP’s GHG emissions, i.e., selling 35 MW of generation from IPP outside of California by 2016. In addition, PWP struggled to find willing and qualified buyers, even before the CARB Resource Shuffling rules were issued. PWP has been able to achieve some reduction in GHG levels by adding a financial “carbon penalty” to IPP’s economic dispatch (in addition to the actual cost of carbon allowances). In 2014, PWP’s GHG emissions were approximately 19.1% lower than in 2008. However, PWP cannot meet its previous IRP goal of reducing GHG emissions by 40% from 2008 levels by 2020 without significant cost impacts.

When the IPP contract expires (2027 in the original power sales contract, or 2025 if the contract is amended), PWP’s GHG emissions will be reduced by over 60%. Much of IPP will be replaced with renewable energy. However, in order to meet reliability requirements, some of the IPP power will likely be replaced by flexible gas-fired generation with approximately one half of the carbon emissions of coal, so the reduction in GHG will not be the full 90% produced by IPP today.

CONCLUSIONS

Having met and surpassed its 2014 goal with 29% renewable energy, PWP is on track to meet the aggressive 40% RPS target established in the 2009 and 2012 IRPs. Construction on GT-5 is well underway, and expected to be completed by June of 2016. New energy efficiency goals were adopted by the City Council in 2013, and PWP expects to present an updated study, with new recommendations to the City Council for consideration in FY 2017. However, some of the other 2012 IRP goals appear less achievable in light of developments in the last couple of years.

The objective of the IRP process is to identify the optimal portfolio to achieve a sustainable balance of system reliability, fiscal responsibility, and environmental stewardship. Based on the 2015 IRP analysis, PWP’s Preferred Portfolio at this point in time is Portfolio #1 – Stay the Course, which continues many of the objectives established in the 2012 IRP, and lays the groundwork for the other Portfolios. Most importantly, this Portfolio will allow PWP to achieve an impressive 60% reduction in GHG from 1990 levels by 2030, well ahead of the state-wide target set by Governor Brown of 40% from 1990 levels in 2030.

The Preferred Portfolio meets or exceeds all of PWP’s current legal, regulatory, reliability and environmental requirements, and is the least cost of the five 2015 IRP Portfolios. Furthermore, with the exception of the Carbon Neutral Portfolio, PWP’s procurement action plan over the next two to three years would likely be the same for all Portfolios as with the Preferred Portfolio, since material changes among the portfolios do not occur until 2025. The key short-term difference is in the operational dispatch of the IPP coal

plant. For the Carbon Neutral Portfolio, the other difference would be in the procurement of bio-methane, a decision that may well be better deferred to a later date when availability may be improved, prices may be lower, or when energy storage may provide a viable alternative. If the state of California adopts a more aggressive RPS before the next IRP Update, PWP can address it in its annual procurement plan, since it is highly unlikely that the higher target will be before 2020.

EXHIBITS:

- Exhibit 1 2015 IRP Black & Veatch Report on Pasadena Renewable Energy - Distributed PV Potential Assessment
- Exhibit 2 2015 IRP Energy Efficiency and Demand Reduction Goals (Adopted by City Council January 28, 2013)
- Exhibit 3 2015 IRP PWP RPS Policy (Revised March 2, 2012)
- Exhibit 4 2015 IRP Comparison of Neighboring Utility Feed-in Tariff Rates
- Exhibit 5 2015 IRP Black & Veatch Report on CAISO Level Integration Costs
- Exhibit 6 2015 IRP Black & Veatch Report Assessing Distribution Level PV Integration Costs
- Exhibit 7 2015 IRP Key Assumptions and Analysis
- Exhibit 8 2015 IRP Customer Survey Results Summary
- Exhibit 9 2015 IRP Portfolio Scorecards
- Exhibit 10 2015 IRP Bill Impact Analysis
- Exhibit 11 2015 IRP Acronyms