PACE

4401 Fair Lakes Court
Fairfax, VA 22033-3848 USA
Phone: 1.703.818.9100
Fax: 1.703.818.9108

2009 Integrated Resource Plan Report

Prepared for:

City of Pasadena Water and Power Department

February 13, 2009

TABLE OF CONTENTS

EXHIBITS

EXECUTIVE SUMMARY

In this 2009 Integrated Resource Plan (2009 IRP), Pasadena Water and Power ("PWP") identifies its Preferred Resource Plan for satisfying its electric power requirements, consisting of energy efficiency, demand side management resources, renewable resources and other supply side resources over the next twenty years. This Preferred Resource Plan best meets the multiple objectives of meeting PWP's long term electricity needs in a reliable, cost competitive, flexible, and environmentally conscious manner under a wide variety of market, regulatory, and economic conditions. The Preferred Resource Plan therefore improves PWP's ability to attain a position of environmental leadership, consistent with the City's broader environmental goals and commitments.

In preparing the 2009 IRP, PWP engaged public involvement in a participatory process over six months that included meetings of a Stakeholder Advisory Group representing the major constituencies in PWP's service territory, meetings with the Environmental Advisory Commission ("EAC") and the Municipal Services Committee ("MSC"), and several public meetings that were attended by a diverse group of stakeholders. The Stakeholder Advisory Group had monthly meetings, run through a facilitated process with PWP's participation, but organized by an independent consultant (Pace Global Energy Services or Pace) who was responsible for setting the agenda and facilitating the process. The Stakeholder Advisory Group reached unanimous consensus on the Preferred Resource Plan presented here.

The Preferred Resource Plan resulted from a structured, two-stage process. Phase I consisted of the screening of around 15 technology options and over 100 portfolios, representing combinations of these technology additions over different years. The number of uncertainties considered in the Phase II "risk" stage of the process is measured in the thousands, as uncertainty in load, gas prices, dispatch for technology choices, carbon prices, capital costs for technologies, market penetration of renewable and demand side options, and power prices for sales from the Intermountain Power Plant ("IPP") were quantified and considered. Regulatory uncertainty regarding both carbon legislation and renewable portfolio standards was also considered explicitly in the process. The Phase II "risk analysis" reveals the strengths and risks associated with each portfolio by exposing them to a wide range of conditions to see how portfolios compare on average and at extreme conditions. In this way, the stability of the portfolio was assessed for rate impacts, and the range of costs that might be required to achieve higher levels of environmental stewardship was evaluated.

PREFERRED RESOURCE PLAN

The Preferred Resource Plan represents a dramatic reconfiguration of PWP's existing electricity portfolio over the next 20 years, accompanied by significant reductions in the portfolio's greenhouse gas ("GHG") emissions, facilitated by the addition of substantial amounts of new, efficient and renewable resources to replace existing resources that have a much higher environmental impact. The Preferred Resource Plan consists of a diverse mix of resource additions to PWP's existing generation portfolio including a range of renewable resources such as wind, solar, geothermal, and landfill gas (LFG) resources, aggressive use of demand-side options including energy efficiency and load management programs, and a new local gas-fired combined cycle plant that will replace some inefficient existing local generating units located within Pasadena. The Preferred Resource Plan also includes a reduction in PWP's purchase of power from its entitlement to power from the coal-fired IPP facility, which is replaced by the resources listed above. The plan would help the City meet or exceed the United Nations Urban Environmental Accords for renewable energy, energy efficiency, and climate change. Key elements of the incremental changes to PWP's current portfolio in the Preferred Resource Plan include:

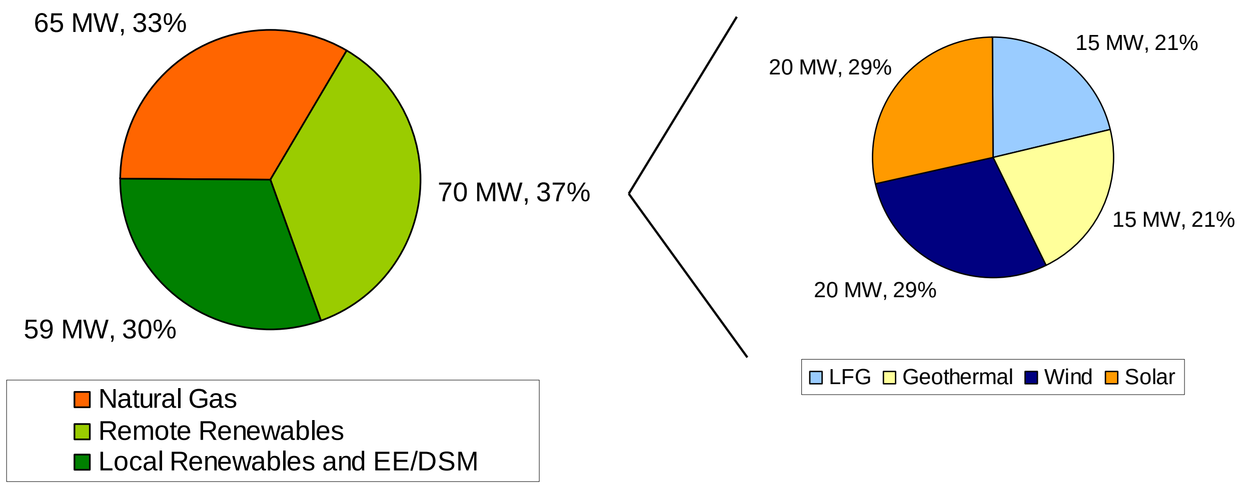
- **Diverse Renewable Energy Additions:** The Preferred Resource Plan adds 20 MW of solar thermal, 20 MW of wind, 15 MW of geothermal, 15 MW of landfill, 19 MW of local solar photovoltaic capacity, and a new feed-in tariff program for 10 MW of local renewables.
- **Partial Sale of Intermountain Power Project (IPP):** Approximately 35 MW of IPP capacity would be removed from the portfolio and sold to markets outside of California under the Preferred Resource Plan. This reflects the amount of IPP capacity that PWP believes may be feasible to sell under the existing contract arrangements. The 35 MW is comprised of one contract share that is currently recallable in Utah and a remaining share of capacity above and beyond PWP's minimum capacity factor requirements.
- **New Local Generation:** The Preferred Resource Plan adds a new 65 MW gas-fired combined cycle facility at the site of Broadway 3, which would be retired at the time the new facility achieves commercial operation. The addition of this new local generation, at an estimated capital cost of $107 million, is the most cost-effective means to ensure PWP's ongoing ability to satisfy reliability requirements.
- **Upgrades of Existing Generation:** A capital budget of $17 million has been assumed to maintain and upgrade the existing Glenarm 1 & 2 generating units in order to extend their operating lives. This is a minimum requirement for maintaining these older, local gas-fired generation options over the next twenty years.
- **Deferral of Transmission Investments:** While some capital expenditures are required to maintain the existing transmission system within the City and are included in all potential resource options, the Recommended Resource Plan is expected to defer the need for over $100 million in transmission upgrades that would be necessary to address transmission constraints and reliability concerns in the absence of adding the new local generation

Exhibit 1 provides a summary of the Preferred Resource Plan as it is expected to evolve over time, with unit additions and subtractions relative to the existing portfolio shown by installation date. The changes summarized in the table are incremental to the existing portfolio. A negative number refers to a resource retirement or removal from the portfolio. In the case of local, gas-fired resources, for example, the Preferred Resource Plan retires 65 MW of old capacity and replaces it with a new 65 MW combined cycle. The pie charts below the table illustrate the balance and diversity of the Preferred Resource Plan, as they display the mix of total incremental resource additions. It should be recognized that these resource strategy elements represent an overall vision for PWP's long-term electric resource portfolio, and developments over the next 20 years may result in changes to the Preferred Resource Plan during that period.

Exhibit 2 illustrates the historical resource generation mix for PWP in Fiscal Year 2008 and the expectations for 2020 under the Preferred Resource Plan. Generation shares are calculated against total retail sales rather than against total generation.

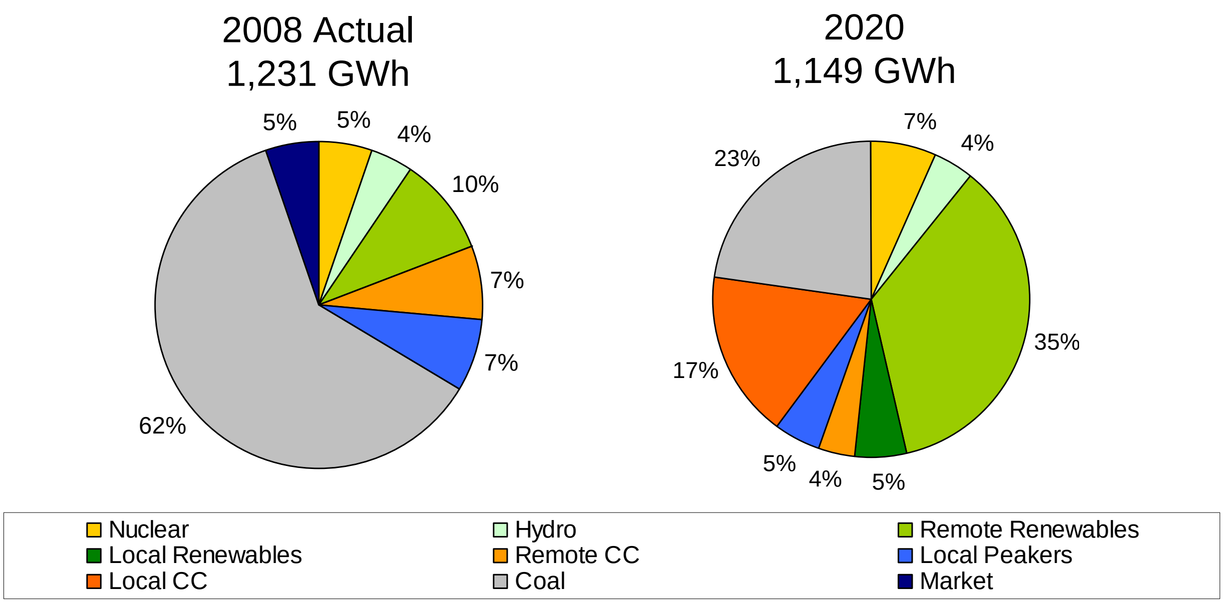
Exhibit 1: Summary of Preferred Resource Plan

Year	Remote Renewables (MW)				Local Renewables (MW)			Fossil (MW)		
	LFG	Geo	Wind	Solar Thermal	DR	Solar PV	Feed-in Tariff	CC	Gas Peaker	Coal
2008						0.9				
2009						1.0				
2010						1.1	0.7			
2011						1.1	0.7			
2012	5	5	5	5	5	1.2	0.7			
2013						1.4	0.7			
2014						1.5	0.7	65	-65	
2015						1.7	0.7			
2016	5	5	5	5		1.9	0.7			-35
2017	5	5				2.2	0.7			
2018						0.7	0.7			
2019						0.7	0.7			
2020			10	10		0.7	0.7			
2021						0.7	0.7			
2022						0.7	0.7			
2023						0.7	0.7			
2024						0.7				
2025										
Total	**15**	**15**	**20**	**20**	**5**	**19**	**10**	**65**	**-65**	**-35**



Source: Pace

Exhibit 2: Energy Mix of Current Portfolio and Preferred Resource Plan



*Note that the generation shares are calculated as the proportion of total retail sales, rather than total generation.
Source: PWP and Pace

IRP POLICIES AND ACTION PLAN

Development of the Preferred Resource Plan considered a wide range of potential options, and there were several criteria against which these options were evaluated. These criteria included:

- Environmental Stewardship (measured in carbon reductions and the proportion of the overall energy mix provided by renewable resources)
- Competitive Rates (measured in lowest present value of revenue requirements and levelized resource costs)
- Rate Stability (measured as deviation in the range of costs from expected levels)
- Reliability (evaluated based on reducing exposure to PWP's aging local generating units)
- Flexibility (evaluated based on the ability to respond to uncertain future developments)
- Financial responsibility (measured by the amount of capital expended)

The Preferred Resource Plan is not rated the highest in every single objective category but rather provides the best balance of all objectives over a wide range of outcomes. This portfolio:

- Rated near the top of all portfolios with regard to overall cost, renewable percentage, reliability, and diversity
- Rated in the middle for price risk (rate stability) and total carbon emission reductions, with the only potential weakness being exposure to spot market power price volatility, a risk that can be managed.

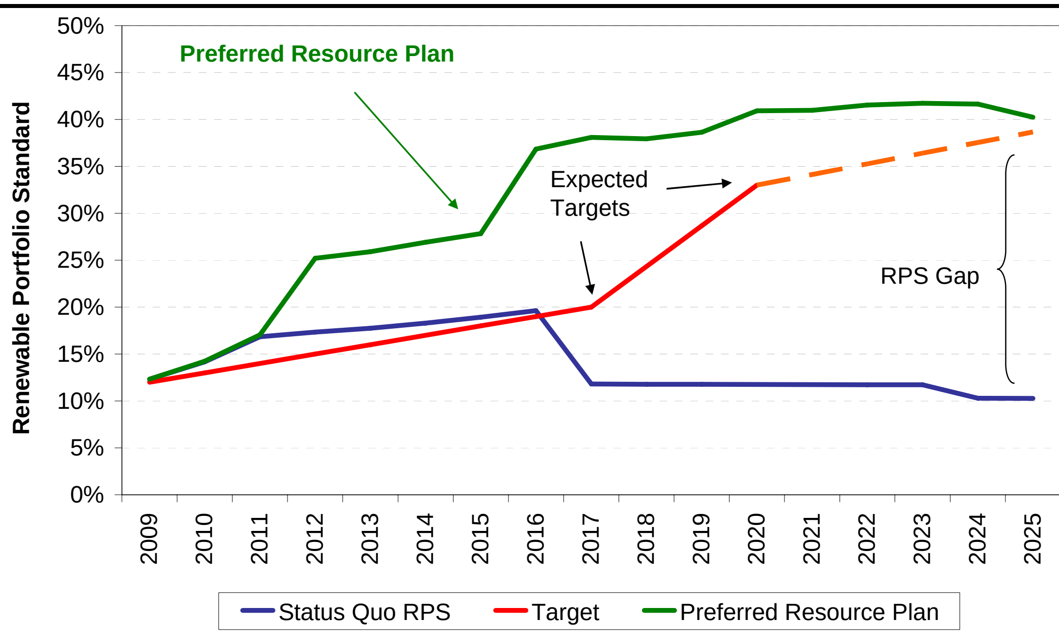
- Rated high in environmental stewardship in all of the carbon price scenarios and rated high in the efficiency of expenditures for environmental stewardship.

The Preferred Resource Plan calls for several action items to meet certain policy objectives and benchmarks established in the plan. These can be summarized as follows:

- **Coal Power Displacement:** By 2016, reduce purchases of power from the IPP coal plant by at least 35 MW
- **New Local Gas-Fired Generation:** By 2014, retire the existing 65 MW Broadway 3 power plant and replace it with a comparably sized new combined cycle plant at the same site
- **Energy Efficiency and Load Management:** Implement programs to achieve significant reductions in electricity consumption according to the following timeline:
    - **Energy Savings:** Reduce energy sales by 12.5% below expected levels by 2016
    - **Peak Load Savings:** Reduce peak load by 10% below expected levels by 2012
    - **Demand Response:** Reduce peak load by an additional 5 MW by 2012 through programs that provide customers with information and economic incentives to reduce their consumption during peak load periods
- **Renewable Energy:** By 2020, increase the proportion of PWP's energy mix provided by renewable energy sources to 40% according to the following general guidelines:
    - 15% by 2010
    - 33% by 2015
    - 40% by 2020

  Exhibit 3 displays the expected annual renewable generation share for the Preferred Resource Plan along with the "status quo" and expected targets.

Exhibit 3: Renewable Generation Share of Preferred Resource Plan



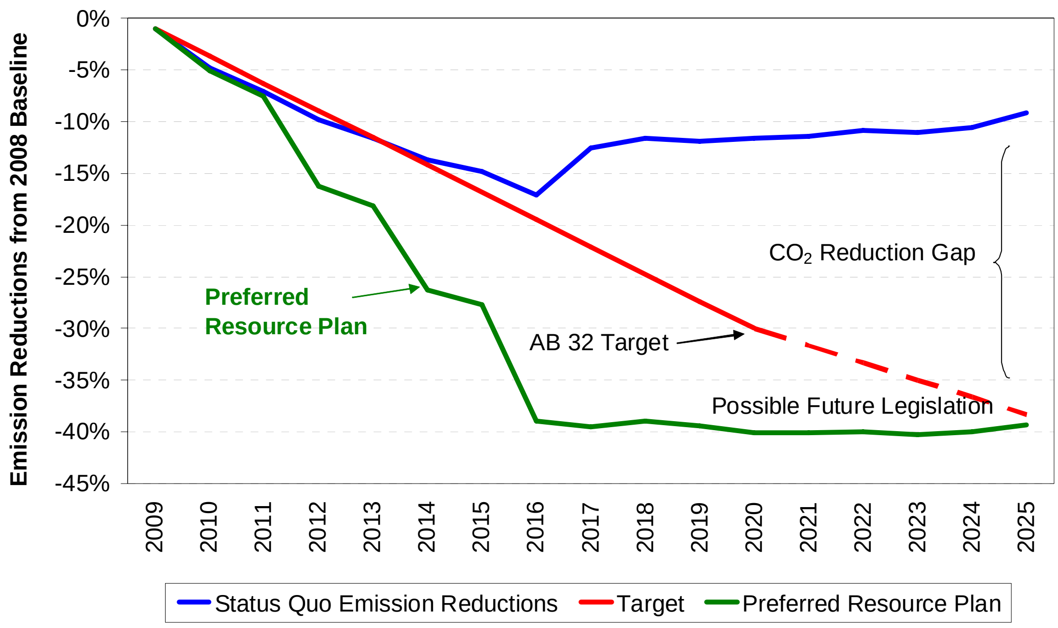
Source: Pace

- **Solar Photovoltaic:** By 2024, develop programs to add at least 19 MW of solar photovoltaic installations in Pasadena according to the following timeline:
  - 3 MW by 2010
  - 10 MW by 2015
  - 15 MW by 2020
  - 19 MW by 2024

  Analysis of the performance of different solar technologies indicates that a rebate of approximately $4/Watt would prove the incentive to make solar PV expansion cost-competitive.
- **Feed-In Tariff:** By 2020, establish a feed-in tariff program offering to purchase up to 10 MW of qualifying renewables of all technologies located inside Pasadena at an average price up to 15 cents/kWh
- **GHG Emissions Reductions:** By 2020, achieve CO_2 emission reductions of at least 40% according to the following timeline:
  - 5% by 2010
  - 25% by 2015
  - 40% by 2020

  Exhibit 4 displays the expected annual GHG reductions for the Preferred Resource Plan along with the "status quo" and the expected regulatory targets.

Exhibit 4: GHG Emission Reductions for Preferred Resource Plan



Source: Pace

Related elements of the recommended action plan to implement the Preferred Resource Plan over the next four years include:

- Complete the ongoing transmission system options study being conducted with RW Beck. This study is considering the evaluation of required investments to PWP's transmission infrastructure and how it will affect the reliability of its system over time.
- Conduct an assessment of the potential sale of IPP power. Determine the sale prices and quantities of PWP's IPP entitlement that can be achieved, and over what time frame. This will determine the potential for replacing this block of power with carbon-reducing technologies.
- Evaluate the potential load management impacts from the proposed aggressive demand side and energy efficiency programs.
- Continue to evaluate the potential from landfill, geothermal, wind, and solar technologies from remote sources and at what price.
- Continue to assess the potential from solar photovoltaic and rooftop solar programs. Determine the market potential from subsidy programs to determine how cost effective they are.

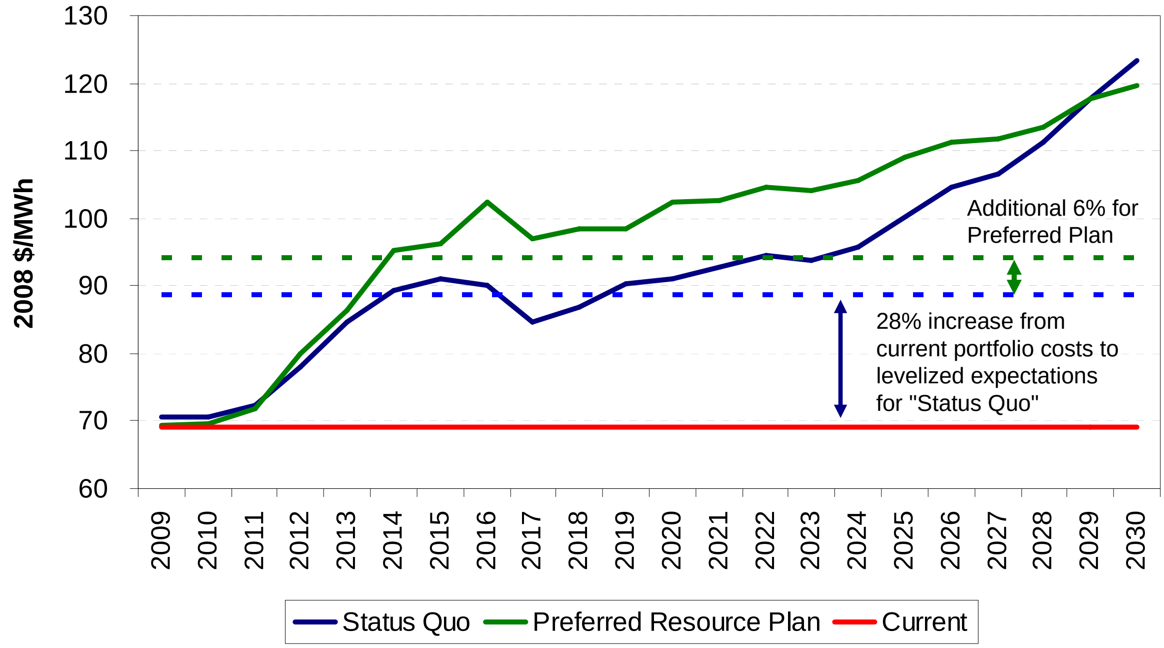
In addition, PWP should immediately commence with the following short-term implementation steps that are common among all of the long-term strategies:

- Continue securing contracts for power from a diverse mix of new renewable energy sources, balanced among landfill gas, geothermal, wind and solar projects
- Expand PWP's already aggressive energy efficiency programs
- Develop demand response programs and rates to provide customers with economic incentives to reduce their peak electricity consumption
- Develop a new feed-in tariff program in which PWP will offer to purchase power, at a fixed price, to any qualifying renewable energy project within the City in order to facilitate the development of local renewable energy sources
- Evaluate innovative new financing approaches and electric rate structures in order to spur more PWP customers to install solar photovoltaic projects inside Pasadena

RATE IMPACTS OF THE PREFERRED RESOURCE PLAN

Implementation of the Preferred Resource Plan, when measured over the entire 20 year planning horizon covered by the 2009 IRP, is projected to lead to a levelized increase in PWP's generation costs of approximately 36% over 2008 levels over a 20-year period. Such an increase may at first appear to be unreasonably large and beyond many customers' ability or willingness to pay for such increases. However, it is critical to recognize that PWP's costs are projected to increase by approximately 28% even if PWP made no incremental changes to its existing portfolio. Accordingly, the estimated cost impact of Preferred Resource Plan is actually projected to produce an increase of approximately 6% above "status quo" operations in the absence of the actions recommended in the Preferred Resource Plan. These projected cost increases for the Preferred Resource Plan and the Status Quo portfolio are expressed in real, 2008 dollars that are not adjusted for future inflation. Exhibit 5 displays the expected annual portfolio cost impacts under the Preferred Resource Plan and assuming the status quo.

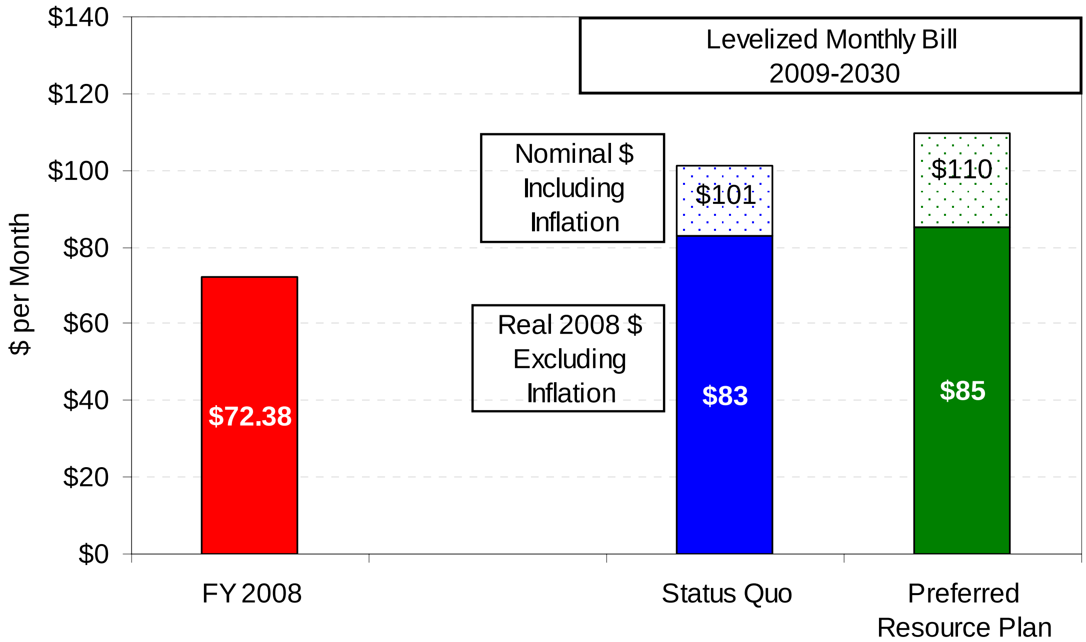
Exhibit 5: Expected Impacts on Portfolio Costs of Preferred Resource Plan



* Note that bill values are for power only and exclude water rates
Source: Pace

Exhibit 6 displays the expected PWP electricity bill impacts of the Preferred Resource Plan on a levelized basis over the entire planning horizon along with the current average residential electricity bill and the expectations under the "status quo." In addition to presenting the levelized values in real 2008 dollars, the expectations in nominal terms are also shown. After adjusting for inflation at an assumed rate of 2.5% per year, the Preferred Resource Plan is projected to lead to approximately a 9% increase in PWP's costs and rates over the status quo when measured over the 20 year planning horizon. While no rate increase is desirable, the Preferred Resource Plan is a cost-effective strategy for satisfying PWP's long-term electricity requirements, particularly given the significant benefits provided by the Preferred Resource Plan with regard to environmental stewardship, reliability and flexibility to respond to an uncertain future.

Exhibit 6: Expected Impacts on Residential Electricity Bill of Preferred Resource Plan



* Note that bill values are for power only and exclude water rates
Source: Pace

FUTURE IRP UPDATES

In order to ensure that Pasadena's resource strategy remains robust and responsive to evolving regulatory and market conditions, PWP should commit to the following schedule for IRP updates in the future:

- Conduct a comprehensive IRP evaluation every five years
- Update the most recent IRP every two years to account for new developments occurring during that period

This approach to updating the 2009 IRP is intended to allow PWP to adjust its resource strategy over time, as needed to account for new information and new developments as they occur.

PLANNING ENVIRONMENT AND KEY DRIVERS

PWP has provided reliable and economical electric service in the City for over one hundred years, but now faces critical new challenges as it makes plans to continue doing so well into the future:

- New and emerging laws will require PWP to reduce the greenhouse gas emissions associated with serving Pasadena's energy needs, although the exact reductions that ultimately will be required are still unknown.
- Pasadena aspires to a position of environmental leadership, which could drive PWP to reduce its GHG emissions even more than these new laws may require, through significantly expanded use of renewable energy and energy efficiency improvements.
- PWP relies on the coal-fired Intermountain Power Plant in Utah for a significant share of its current power supply, so achieving significant GHG emissions reductions depends in part on the feasibility of displacing power from Intermountain with cleaner sources, most of which will be more expensive than the costs that PWP incurred in the past.
- The natural gas-fired generating units located within the City are critical to ensuring the continuing reliability of PWP's service, but they are old and inefficient and PWP's ability to rely on these facilities in the future is increasingly uncertain, so there may be a need to invest in new local generation to resolve this critical exposure.
- The costs of serving Pasadena's electricity requirements will inevitably increase in the future because new energy resources are more expensive than the current supply mix.
- PWP must continue to invest in new infrastructure to maintain and improve its supply and delivery systems.

The manner in which PWP addresses each of these concerns could have a significant impact on the rates that PWP charges its customers and how well it achieves the City's environmental objectives. PWP has conducted a detailed assessment, known in the utility industry as an "Integrated Resource Plan ("IRP")," to identify a preferred approach for meeting all of these challenges. The IRP, which was guided by active participation among PWP, a Stakeholder Advisory Group, and the public, included the following key steps:

- Developing a set of realistic resource strategies, which call for GHG emissions reductions of at least 25% and perhaps as much as 80%, that could guide PWP's future power resource decisions;
- Evaluating a full range of energy efficiency, load management, and new supply options available to PWP to reconfigure its current portfolio of energy sources and identifying the best options for PWP to achieve its GHG emissions reduction strategy;
- Assessing the critical trade-offs between reliability, cost, environmental stewardship and risk that are inherent in each resource strategy in order to appropriately balance these conflicting objectives;
- Choosing a recommended long-term resource strategy as well as a short-term action plan focusing on immediate steps PWP should take over the next two years.

KEY DRIVERS AFFECTING PWP'S IRP OPTIONS

Integrated Resource Planning for electric utilities like PWP is an exceptionally complex undertaking accompanied by significant risk and uncertainty. Commitments made by utilities to specific resource options such as new power plants or power purchase agreements typically last 20 years or more. At the same time, legal, regulatory and market conditions that affect the apparent wisdom of those choices are changing constantly and require ongoing monitoring and adjustment. These considerations affect all electric utilities generally, but the key issues driving the choices that PWP must make in its 2009 IRP are as follows:

- Volatile fuel and capital costs
- Rising Renewable Portfolio Standards
- Carbon constraints weighing on fossil fueled generation sources
- Significant exposure to potential cost increases
- Evolving regulatory and environmental challenges
- Ongoing technology advances opening new opportunities
- Power supply reliability and local generation requirements

Each of these driving forces represents a key source of risk and uncertainty that must be considered in an IRP process. While these risk issues are discussed in greater detail in the body of this report, the following section highlights the evolving regulatory environment and environmental mandates that are driving PWP's resource planning needs.

REGULATORY ENVIRONMENT

There are a wide variety of regulatory policies and requirements, but the most significant regulatory policies affecting the 2009 IRP involve the mandates to reduce the environmental impact of providing electric service:

- **Renewable Portfolio Standards (RPS):** State law that requires electric utilities to obtain a minimum percentage of their electricity requirements from renewable resources that have a smaller environmental impact than most conventional resources.
- **Greenhouse Gas (GHG) Reductions:** State law that requires electric utilities to reduce the level of GHG emissions they produce through the provision of electric service.

Renewable Portfolio Standards

California is a world leader in the development and utilization of renewable energy supplies that reduce the State's dependence on fossil fuels and the environmental impacts of electricity consumption, and also support the development of indigenous resources within the State. California's current RPS policy intends to require all investor-owned electric utilities to obtain at least 33% of their electricity requirements from renewable resources by 2020, although this current law does not require PWP to achieve this RPS level. Moreover, a proposed new RPS mandate in AB 64, introduced in the California Assembly on December 9, 2008, would establish a new RPS requirement of 50% renewables by 2035. While PWP currently obtains approximately 10% of its electricity requirements from renewable resources and has announced a goal to achieve a 20% RPS level by 2017, those goals fall significantly short of the existing

33% RPS policy as well as the potential increase to 50%. The 2009 IRP needs to address this significant shortfall between PWP's existing RPS targets and potential RPS requirements that it may be obligated to meet in the future.

Greenhouse Gas Reductions

California's policy for addressing global warming risks through reductions in greenhouse gas emissions was established by Assembly Bill ("AB") 32, the California Global Warming Solutions Act of 2006. AB 32 requires California to reduce its GHG emissions to 1990 levels by 2020, which is estimated to require a 30% reduction relative to the GHG emissions levels in 2020 that would be expected without any specific action to reduce emissions. Achieving GHG emissions reductions of 30% or more by 2020 will require PWP to make significant changes to its existing portfolio. Attaining a position of environmental leadership, through even larger GHG emission reductions, ultimately will require displacement of at least a portion of PWP's purchases of coal-fired power from IPP. Such significant changes to PWP's existing portfolio of electric resources will have dramatic, lasting changes on PWP's costs of service, and the 2009 IRP needs to clearly assess the trade-offs between cost and environmental stewardship associated with achieving higher levels of GHG emissions reductions.

REVIEW OF PREVIOUS IRP PROCESS

PWP prepared its 2007 Draft IRP beginning in late 2005 and throughout 2006, presenting its first draft to the public in November 2006. Subsequent to the initiation of this IRP, the City Council adopted United Nations Urban Environmental Accords of 2005 ("UEA"), and developed the Green City Action Plan. In late 2006, the California Legislature also adopted several electric generation and environmental initiatives such as AB32, AB2021, SB107, and SB1368. Pasadena's Renewable Portfolio Standard ("RPS"), which was adopted in 2003, was updated in light of the City's and the state's evolving environmental goals. On September 24, 2007, the City Council adopted Energy Efficiency ("EE") and Demand Reduction ("DR") Goals, and an SB-1 compliant Solar Photovoltaic ("PV") program and goals, along with a funding mechanism for these programs. These goals collectively require significant reductions in both peak and average load from energy efficiency and demand side reduction programs, reductions in greenhouse gas emissions, and increases in the mix of renewable energy in PWP's generation portfolio. They also establish greater priorities for cost effective, reliable and feasible load reduction and efficiency improvement measures.

The City Council instituted an Environmental Advisory Commission ("EAC") in early 2007 to oversee and advise the City Council on the City's environmental initiatives. The EAC concluded that the underlying policies that guided the 2007 Draft IRP may not fully reflect the City's updated broad environmental objectives. After their review, in mid 2007, PWP and the EAC decided that the 2007 IRP should be re-evaluated and revised as necessary prior to adopting a new IRP. It was recommended that an independent consultant review the energy and environmental policies, recommend potential policy changes, and identify additional opportunities to jointly meet the City's environmental goals and other key objectives. It was also recommended that the IRP development and review process include more thorough public and stakeholder participation. Exhibit 7 summarizes the key shortcomings in the 2007 Draft IRP identified by the EAC and how they have been addressed in this 2009 IRP.

Exhibit 7: Key Shortcomings in the 2007 Draft IRP

Shortcoming	Resolution in 2009 IRP
Inadequate weighing of environmental impacts	• GHG emissions costs incorporated into all price projections and cost metrics • Explicit consideration of the environmental and cost trade-offs across options
Opportunity costs of fossil fuel vs. local renewable investments; opportunities for fossil-fuel reductions	• Evaluation of local fossil-fuel and renewable options throughout portfolios • Evaluation of cost and environmental effects of reducing IPP generation as well as consideration of gas-fired vs. renewable-focused portfolios
Inadequate RPS goals and consideration of local renewable resources	• Evaluation of significant expansion of RPS and GHG policies beyond expected State requirements (including both RPS and GHG policies) • Specific evaluation of local renewable options vs. remote renewable options
Expanded energy efficiency efforts and balance between residential & commercial	• Evaluation of significantly expanded energy efficiency programs consistent with AB 2021 targets; evaluation of even more aggressive targets • Explicit selection of most cost-effective mix of commercial and residential options
Partnership opportunities to pursue green and clean power opportunities	• Discuss options for meaningful partnership opportunities with business and research organizations to pursue clean and green opportunities consistent with preferred portfolio options and recommendations

Source: EAC and Pace

PUBLIC OUTREACH AND STAKEHOLDER INPUT

In order to improve the IRP process and ensure that the resulting plan would reflect the needs of the Pasadena community and its various stakeholders, PWP engaged in a public participation process with active stakeholder involvement.

From the beginning of the planning process in July 2008, the 2009 IRP was developed with the intent to satisfy several key objectives:

- Ensure alignment with the City's aspirations to be an environmental advocate and leader
- Directly address several issues raised in the previous IRP
  - Quantification of environmental impacts (CO_2 costs)
  - Resources options considered (In-city generation, local renewable energy, energy efficiency, fossil-fueled generation)
  - Aggressiveness of policies (RPS)
  - Strategic partnerships with local entities
- Conduct a collaborative process for public and stakeholder involvement in the planning process

In order to facilitate a productive dialogue with a diverse and representative group of Pasadena stakeholders, PWP and Pace agreed to conduct the 2009 IRP process to provide several opportunities for stakeholders to provide input and direction to the plan. The two primary avenues of public/stakeholder participation were:

- **IRP Stakeholder Advisory Group:** A working group that attended monthly half-day sessions reviewing analysis and providing input and suggestions for the IRP analysis
- **Public meetings:** Presentations to the public at large to discuss findings and solicit feedback

PWP and Pace conducted a total of 15 separate meetings with the various stakeholder groups and the public, which provided immense value to the quality and completeness of the entire 2009 IRP process and recommendations. Many comments from the Stakeholder Advisory Group and various members of the public have been directly incorporated into the analysis. In response to the preliminary recommendations and the draft report, PWP and Pace received written comments from Dr. Carol Carmichael of the EAC, Caltech, and the Pasadena Group of Sierra Club. The comments from Caltech revolve primarily around implementation planning and will be addressed by PWP in a future implementation plan. The other written comments and responses are summarized in the appendix and can be found with other public comments and responses in the section on the Public Input Process.

PWP SITUATION ASSESSMENT

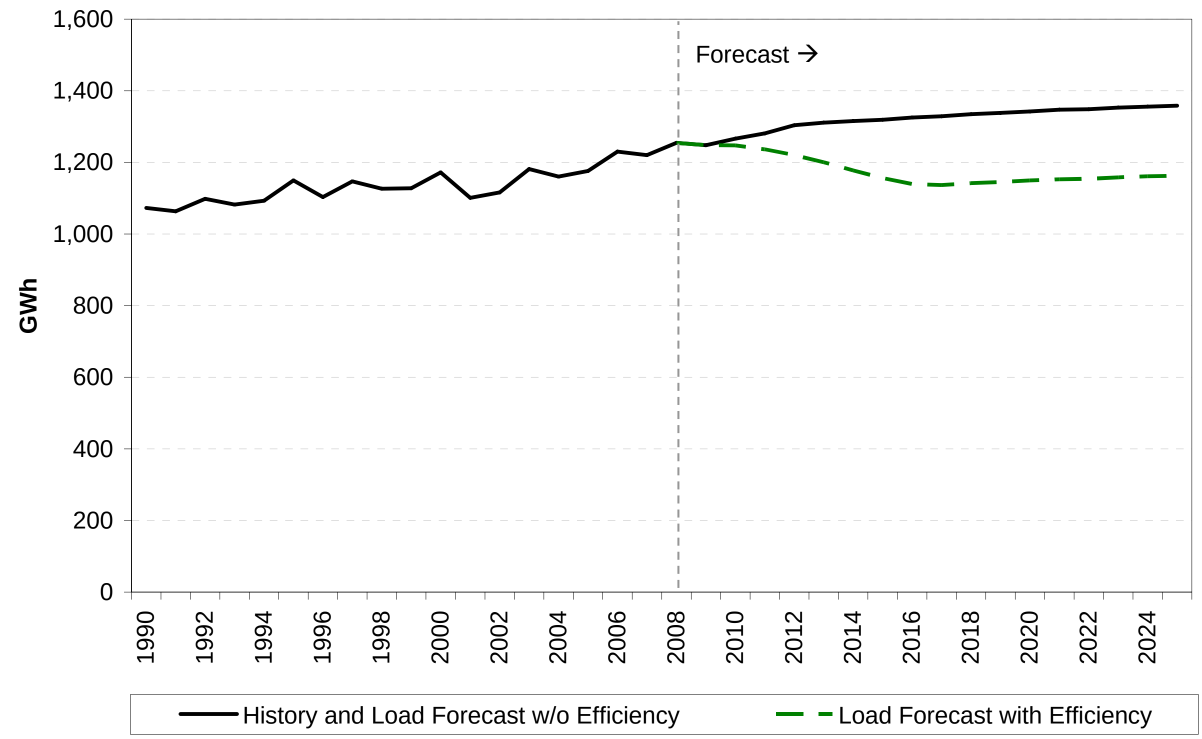
LOAD GROWTH AND EFFICIENCY GOALS

PWP is a municipal utility that manages a service territory of 58,000 customers with a peak load of slightly more than 300 MW. PWP's electricity sales growth has averaged less than one percent per year over the past two decades, due in large to limited opportunities for expansion of the residential and business customer base. Total sales grew from 1.07 TWh in 1990 to 1.22 TWh in 2007, for an average annual growth rate of 0.8%. As part of the 2009 IRP process, a long-term forecast of electricity sales for PWP was developed, based on forecasts of population growth, employment, commercial floor space, and retail electricity prices.

Without accounting for demand side management and energy efficiency programs, sales growth over the near term is estimated to average 1.2% per year, and long-term growth (through 2030) is estimated to average 0.5% per year. Peak load growth rates are expected to exceed sales growth rates due to relatively faster sales growth in summer months. Peak load is projected to grow at an average annual rate of 0.52% during the 2010-2030 period compared with sales growth of 0.38% during that period. Additional details on load forecast methodology and detailed results can be found in the appendix section on PWP Load Forecast.

The City of Pasadena's Green City Energy Action Plan calls for significant reductions in peak demand. PWP has a standing goal of reducing the City's peak load by 10% by 2012. PWP currently has several energy efficiency and demand response programs aimed at accomplishing this goal and aimed at reducing total energy sales by 12.5% below their expected levels by 2016. This target represents deployment of 100% of all economically feasible efficiency options and programs. As part of this plan, the load forecast analysis incorporated all economical energy efficiency programs, as per the Rocky Mountain Institute's energy efficiency model. Deployment of such programs serves to lower the long-term energy demand forecast considerably. Exhibit 8 presents the historical and forecasted net energy for load forecasts for PWP with and without energy efficiency improvements. Uncertainty in the success of these targets is dealt with in the Phase II risk analysis.

Exhibit 8: Historical and Forecast PWP Net Energy for Load



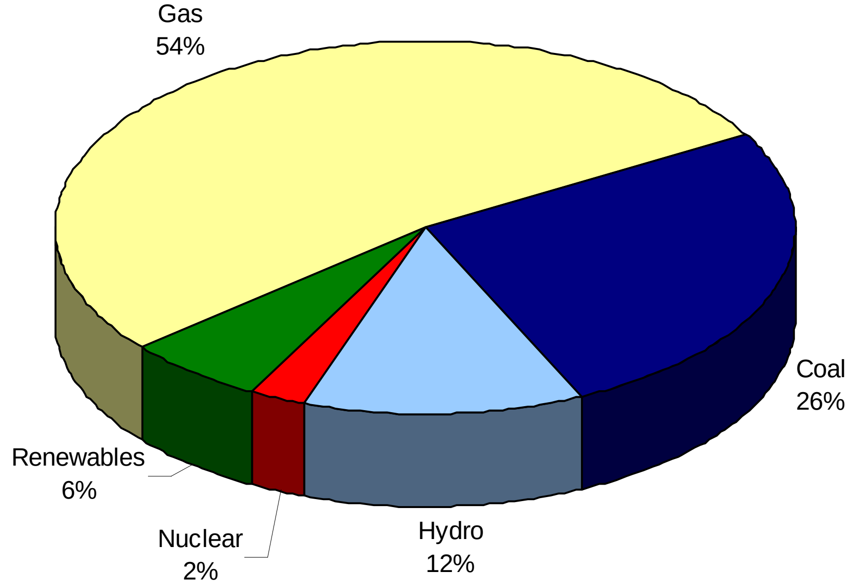
Source: PWP and Pace

EXISTING SUPPLY RESOURCES

The City of Pasadena owns over 200 MW of on-site, natural gas-fired local generation and is capable of importing up to 215 MW more through its interconnection with Southern California Edison. Pasadena also has ownership shares and long term contracts with a number of power generation facilities located throughout the west. The share of all Pasadena owned and contracted capacity by fuel type is displayed in Exhibit 9, and a more detailed summary of the existing portfolio is shown in Exhibit 11. Additional summary descriptions of the plants and contracts can be found in the appendix section on the Existing PWP Portfolio.

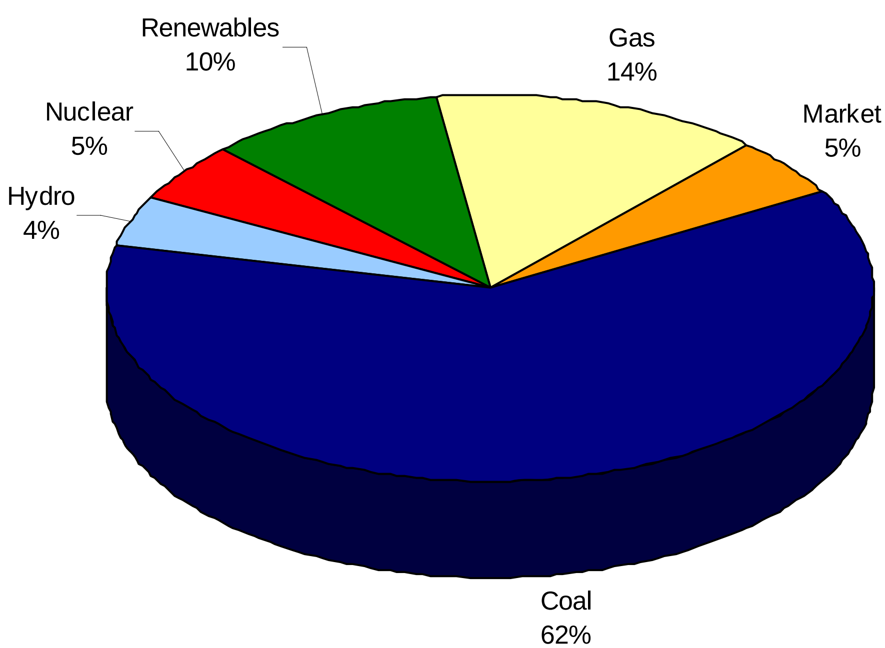
Although the majority of the portfolio's installed capacity is natural gas-fired, PWP relies on power generation from the coal-fired Intermountain Power Plant IPP for over 60% of its energy needs. This is because the coal plant has a lower variable cost of operation compared with the gas resources. As such a significant part of the overall portfolio, IPP costs heavily influence the overall costs of generation for PWP. Exhibit 10 displays the share of actual power generation by fuel type, indicating a significant difference with installed capacity.

Exhibit 9: Share of Capacity by Type



Source: PWP and Pace

Exhibit 10: Share of Generation by Type



Source: PWP and Pace

PWP is a participant in the California Independent System Operator ("CAISO"), which operates the high voltage electric transmission grid throughout most of California. The CAISO also facilitates the buying and selling of power in wholesale energy markets in California and the broader Western market in order to balance energy requirements. Such transactions expose the portfolio to fluctuations in market prices that prevail in the wider market area. Energy prices in the wider market area are governed primarily by fuel prices, demand for energy, and the mix of generating technologies producing power at any given time. Because PWP has a significant amount of gas-fired capacity, it is also exposed to natural gas price volatility if fuel purchases are un-hedged.

Exhibit 11: PWP Plant Details

Plant Name (Contractor)	Unit Type	Primary Fuel	Start	End	Capacity (MW)	% FY 2008 Energy*
Intermountain Power Project	Steam Turbine	Coal	1987	2027	108	62%
Hoover Power Plant	Hydro	Hydro	1941	2017	20	4%
Azusa	Hydro	Hydro	1933	-NA-	15	<1%
Palo Verde	Steam Turbine	Nuclear	1988	2030	9.9	5%
Broadway	Steam Turbine	Gas	1965	-NA-	65	3%
Glenarm	Combustion Turbine	Gas	1975	-NA-	22.3	4%
	Combustion Turbine	Gas	1975		22.3	
	Combustion Turbine	Gas	2004		42.4	
	Combustion Turbine	Gas	2004		44.8	
Magnolia Power Plant	Combined Cycle	Gas	2005	2033	19	7%
BPA Exchange	Contract	Contract	2008	2013	15	<1%
High Winds (Iberdrola)	Wind Turbine	Wind	2003	2023	2	2%
Milford (UPC/First Wind)	Wind Turbine	Wind	2009	2029	5	NA
Heber South (Ormat)	Steam Turbine	Geothermal	2007	2032	2.1	2%
Tulare & West Covina Landfill (Minnesota Methane)	Combustion Turbine	Landfill Gas	2007	2016	9.5	6%
Chiquita Canyon Landfill (Ameresco)	Combustion Turbine	Landfill Gas	2009	2029	6.7	NA
				Total Capacity:	**409**	

*Note that the total does not add to 100%, as market purchases made up the remaining balance.
Source: PWP and Pace

SYSTEM RELIABILITY

System reliability is a priority objective for the IRP planning process, and it depends critically on PWP's local generating units. One of the dominant factors affecting PWP's ability to maintain reliable electric service is that PWP has a single point of connection with the California power grid with Southern California Edison at the TM Goodrich substation on Pasadena's Eastern border. PWP's imports at Goodrich are limited to 215 MW, so local units must be used when customer demand exceeds this level, and when constraints on PWP's cross-town transmission lines limit PWP's ability to serve customers reliably through imports. Since PWP's peak load exceeds 300 MW, significant local, in-city capacity is currently required to be available in order to meet this requirement. Furthermore, recent history indicates that PWP operates the local units approximately 50% of the hours during the year to comply with various reliability criteria, including the 215 MW import limit and constraints on PWP's cross-town transmission system.

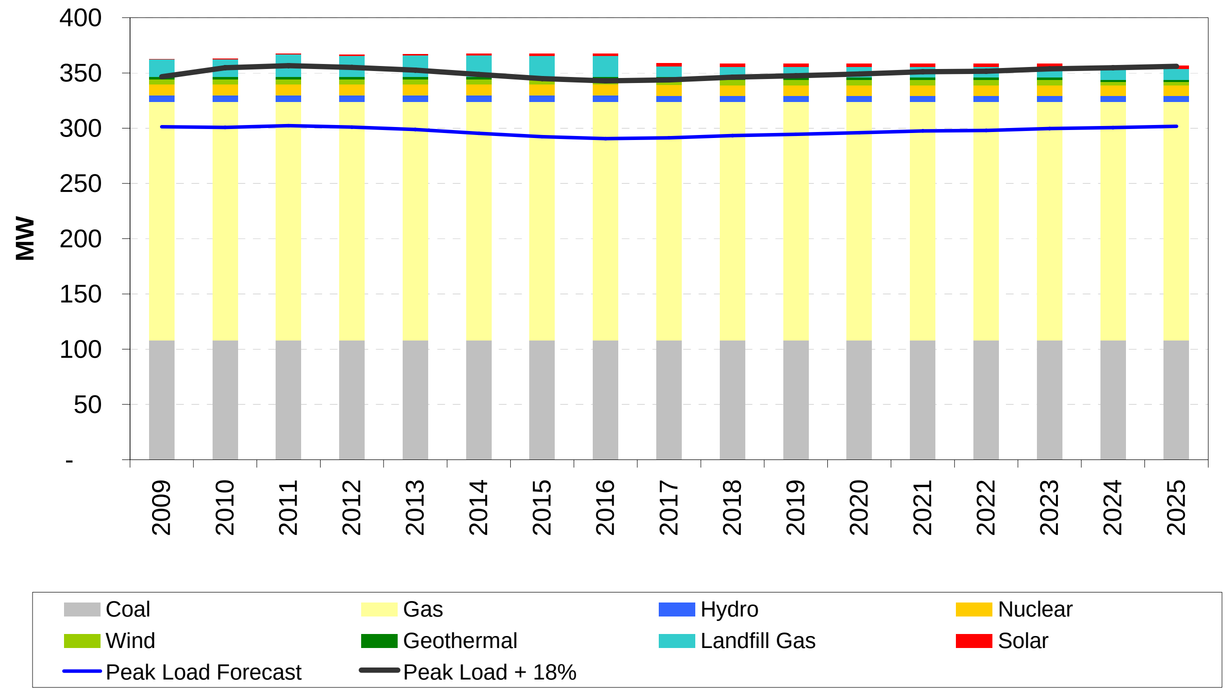
Three of the five local gas-fired units (Broadway 3 and Glenarm 1 & 2) are aging, inefficient, and increasingly difficult for PWP to keep operating. These units are all over 33 years old and comprise about 110 MW of PWP's portfolio. This is about 25% of PWP's total installed capacity and over 50% of the in-city capacity. Continued reliance on the Broadway 3 and Glenarm 1 & 2 units places PWP's service reliability at increasing risk in the future, given the ongoing need to maintain local generation in light of the Goodrich import limit and the cross-town transmission constraints.

Significant capital investments are required to extend the units' operating lives. PWP estimates these costs at $20 million over the next 10 years and $65 million over the next 20 years. In addition, PWP may need to upgrade its transmission system, such as increasing the capability of the single Goodrich interconnection and its cross-town tie lines, in order to mitigate reliability risks relating to long-term reliance on the aging local units. The costs of such potential transmission upgrades, estimated at a minimum of $100 million pending the completion of a detailed evaluation of transmission upgrade alternatives, has been incorporated into the economic evaluation of resource options later in this report.

SUPPLY AND DEMAND BALANCE

Exhibit 12 presents the long term supply and demand balance for PWP, assuming all existing resources and contracts, as well as full deployment of energy efficiency and demand side measures to reduce peak load. The full capacity of all resources and contracts is assumed, unless the resource is intermittent. In those cases, average annual capacity factors were used to display firm capacity levels. All existing resources are assumed to remain in service in this display, and all contracts are assumed available until their expiration dates. The level of capacity required to achieve an 18% planning reserve margin is also displayed.

Exhibit 12: Business as Usual Long Term Supply and Demand Balance

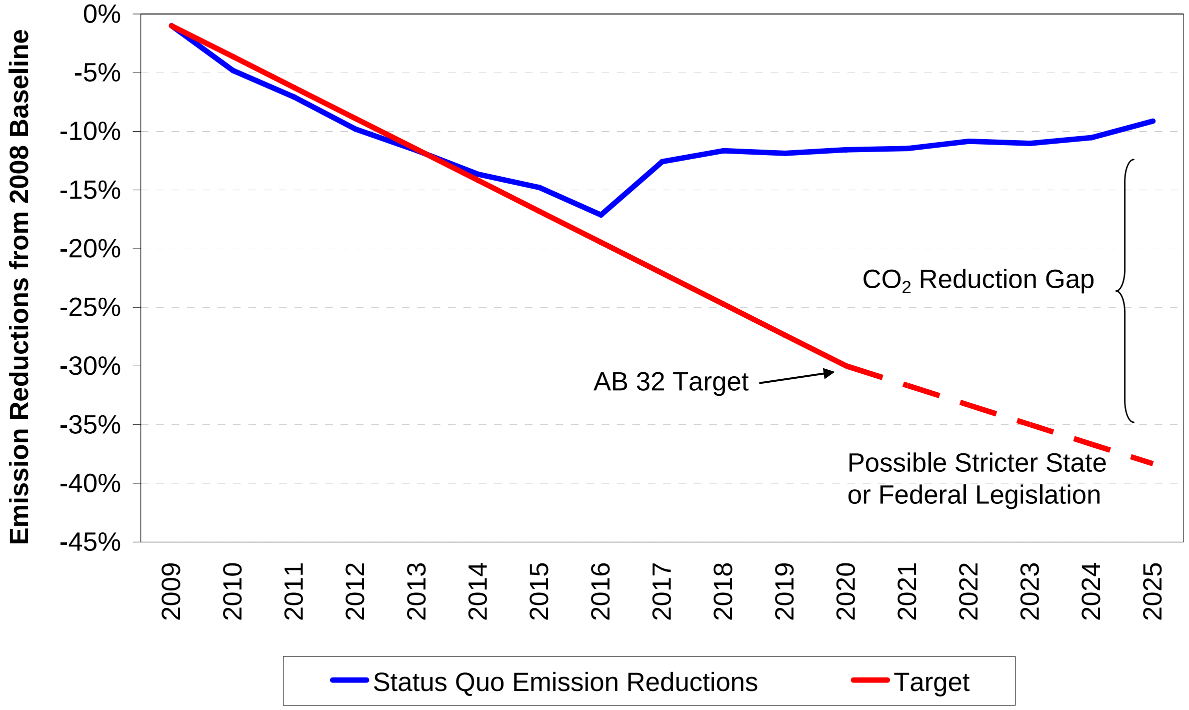


Source: PWP and Pace

CO_2 EMISSIONS

Reducing CO_2 emissions is a primary objective of the 2009 IRP planning process. As a member of the California Climate Action Registry, PWP reports its total CO_2 emissions from owned generation, purchased generation, and market power purchases. The last detailed accounting was performed in 2005, when PWP reported total emissions of 953,000 metric tonnes of CO_2. Of this total, over 600,000 metric tonnes were generated from PWP's fossil fueled power plants, with the majority coming from IPP. This illustrates the fact that significant carbon reductions are only possible with some displacement of power from generation of the coal-fired IPP unit. Compliance with California's AB 32 will require emissions to be reduced to 1990 levels by 2020, likely representing a reduction for PWP of about 30% from current emission levels. Exhibit 13 presents expected CO2 emission reductions for the status quo portfolio, assuming no additional resource additions or changes are made (aside from anticipated solar PV expansion and efficiency improvements), along with the projected target for emission reductions for current state law and potential future regulations. As is shown, a significant reduction gap is expected to develop.

Exhibit 13: Business as Usual CO_2 Emission Reduction Projections with Targets

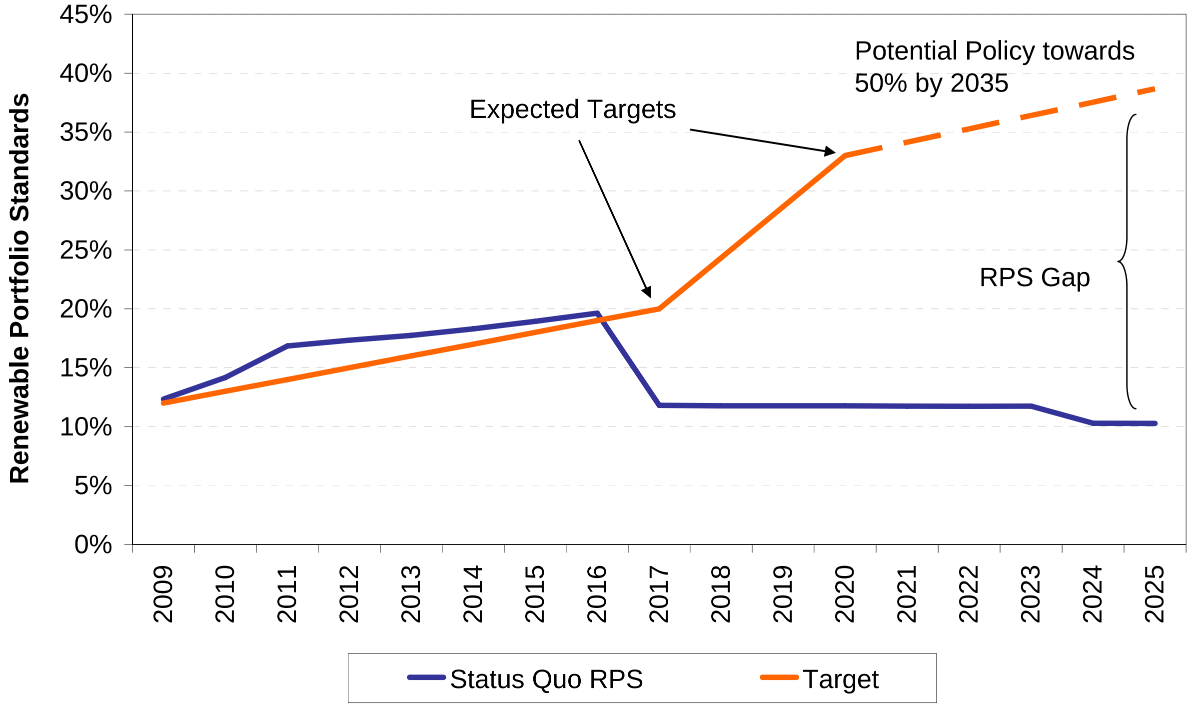


Source: Pace

RENEWABLE PORTFOLIO STANDARDS

PWP's existing renewable energy goals call for 10% of its electricity supply to be obtained from renewable sources by 2010 and 20% by 2017. California's current policy, as articulated recently by the AB 32 scoping plan issued in December 2008, is for all electric utilities like PWP to obtain at least 33% of their electricity supplies from renewable resources by 2020. Thus, PWP's existing renewable energy commitment falls short of existing statewide goals and indicates a clear need to reassess these commitments and adjust them upward, especially given the emerging need to reduce GHG emissions pursuant to AB 32. Exhibit 14 displays PWP's projected RPS percentage, assuming no resource additions other than committed contracts, solar PV expansion and efficiency goals, along with the expected targets.

Exhibit 14: Business as Usual RPS Projections with Targets



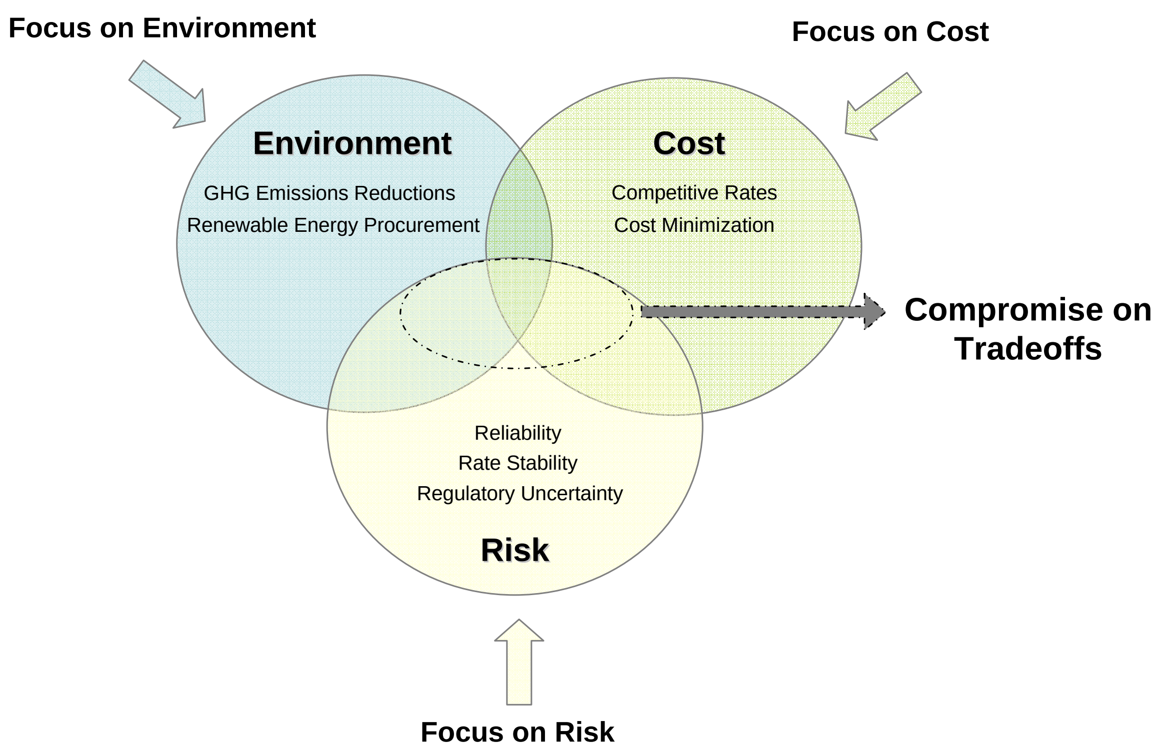
Source: Pace

PLANNING OBJECTIVES AND METRICS

To properly evaluate resource decisions, the planning objectives were identified very early in the resource planning process, through facilitated discussions with the Stakeholder Advisory Group. The Stakeholder Advisory Group was set up to guide the process from start to finish. The members of the Group represented a cross section of all of the customer classes in the City. The Group met every month from July 2008 through January 2009 to track progress, establish guidelines, reflect stakeholder positions, provide counsel and evaluate results. Ultimately, the Stakeholder Advisory Group developed a consensus around the Preferred Resource Plan by selecting the portfolio that best met the planning objectives over a wide range of regulatory and market outcomes. Metrics for each planning objective were created to form a basis for comparing different portfolios.

Even with the appropriate metrics identified for each planning objective, the tradeoffs associated with resource decisions represent the biggest challenge for resource planning. Exhibit 15 displays three competing objectives identified as priorities by the stakeholders and the public. As is shown, focus on any one objective can move the resource plan away from focus on the others. In the IRP process, a wide range of metrics were used to rank portfolios for each objective, helping the stakeholder group evaluate the tradeoffs associated with different portfolio options and ultimately arrive at a resource plan that balances many competing goals.

Exhibit 15: Competing Stakeholder Objectives



Source: Pace

The following section describes the list of planning objectives that were identified by the Stakeholder Advisory Group for the current IRP and defines the metrics used throughout the analysis to evaluate the performance of the different portfolio options.

PRIMARY PLANNING OBJECTIVES, CONSTRAINTS, AND METRICS

Environmental Leadership

Environmental stewardship is at or near the top of Pasadena's resource planning objectives. Although the current supply mix of Pasadena is extremely diverse and includes some renewable technologies, dependence on generation from the coal-fired IPP project has become an increasing concern due to new and pending CO_2 legislation. Significant CO_2 reductions and increased generation from clean resources have played a primary role in the evaluation of adequate portfolios for PWP.

Increased environmental stewardship is generally associated with higher costs. Increases in CO_2 reductions, for example, are generally associated with higher cost actions. The willingness of utilities to pay for improvements in desirable metrics such as environmental stewardship will depend on how much they value reductions in carbon. There is an obvious trade-off between cost minimization and environmental stewardship.

CO_2 Emission Reductions

An increasing concern regarding global climate change has put specific emphasis on the carbon intensity associated with different power generating resource options. Although coal-fired generation remains one of the most efficient sources of power generation, its potential environmental impacts pose a growing concern to the public and utility planners alike. Moreover, the potential advent of significant costs associated with CO_2 emissions constitutes a major risk for coal plant owners.

Different portfolio options were evaluated based on the achieved CO_2 reductions by 2020 from a 2008 baseline. Assuming all other metrics are the same, any portfolio that achieves a higher CO_2 emission reduction will be preferable under this metric.

Renewable Generation (RPS 2020)

Specific regulations concerning RPS standards for utilities in California will drive renewable resource additions. Increasing generation from renewable resources will also directly result in reduced CO_2 emissions for the portfolio. Due to the uncertainty surrounding future RPS regulations in California, assuming all other metrics are the same, the percentage of generation from renewable resources is the metric used to reflect greater renewable stewardship.

Annual RPS percentage was tracked, and different portfolio options were evaluated based on the percentage of the utility's net energy for load that is served by qualified renewable generation by 2020.

Preserve Competitive Rates (Cost)

Preserving competitive rates is a common objective for utilities. In the case of Pasadena, there is a concern about keeping its rates below that of the local Investor Owned Utilities, such as

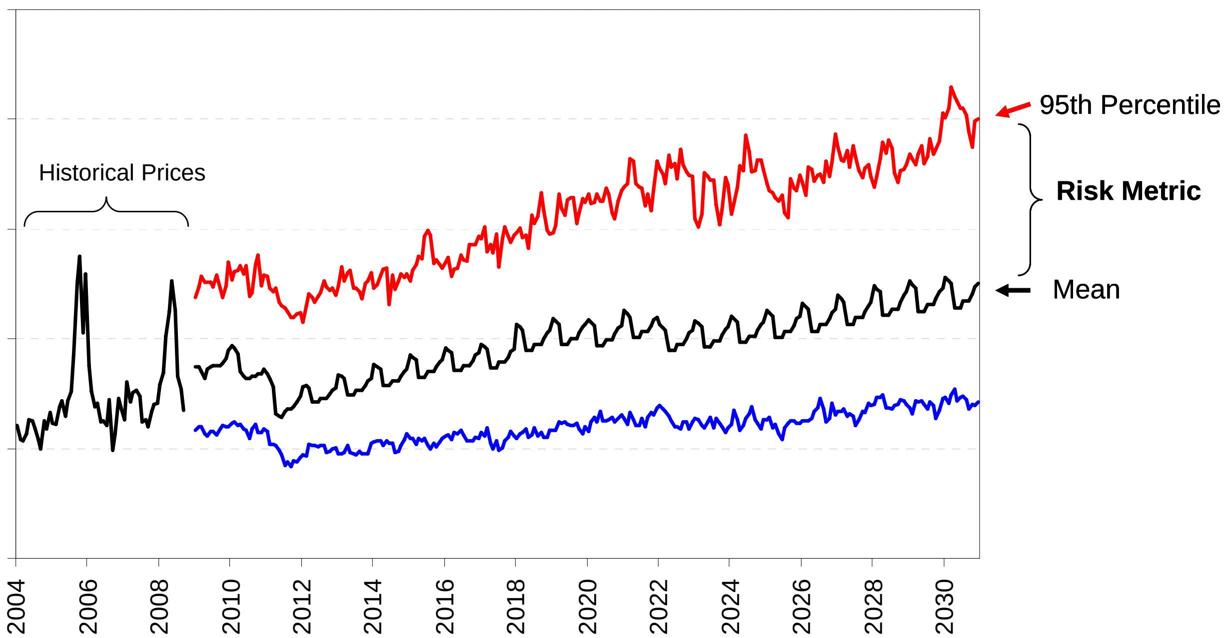
Southern California Edison. Since it is difficult, if not impossible, to estimate SCE's IRP long-term rate trends, we used cost minimization as a proxy for maintaining competitive rates. For comparison purposes, different portfolio options were evaluated based on the levelized net present value of all generation-related costs associated with serving the utility's load (2008$/MWh). Pace's cost metric includes the variable cost of generation, fixed costs, capital costs investments, and the cost of net market transactions (purchases minus sales).

Maintain Stable Rates (Price Risk)

Without proper hedging programs in place, fuel and power price volatility can result in significant changes in cost. Portfolios that can mitigate significant market swings can also achieve higher rate stability. Rate stability can be measured by different metrics like standard deviation or probability bands.

Portfolios were evaluated against statistically derived distributions on key market drivers, like natural gas prices, energy demand, power market prices, and capital costs. Rather than record portfolio costs under one set of assumptions, costs were measured under a distribution of the key assumptions drivers. In this context, portfolios were evaluated based on the difference between the mean of the distributions of total incremental generation costs and the 95% confidence band of the distribution of these costs. This represents a metric of how wide the distribution of costs can get for each portfolio. The lower the difference between the mean and the 95% confidence band, the less exposed the portfolio is to market volatility. Exhibit 16 presents an illustrative display of the quantification of this metric. As is shown, the mean and the statistically derived 95^{th} and 5^{th} percentiles are shown along with historical observations. The difference between the mean and the 95^{th} percentile is used as the measure of price risk in this analysis.

Exhibit 16: Illustration of Risk Metric



Source: Pace

Provide Reliable Service (Reliability)

System reliability is a primary concern for any load-serving entity, and long-term utility planning is usually done using a capacity reserve margin criterion, such as the 18% planning reserve margin used by PWP. In this context, PWP would plan to have reliable resources in place to meet 118% of its customers' expected demand in order to ensure reliability even after the loss of one or more key resources, where the 18% reserve margin provides sufficient flexibility to adjust to such contingencies. However, reliability planning for PWP is complicated by the fact that PWP has only a single interconnection with the CAISO grid and the loss of that interconnection would have very serious reliability consequences. Due to Pasadena's dependence on a single 215 MW transmission line into the City, PWP historically has placed significant reliance on maintaining local generation inside the City to mitigate those reliability consequences, and any portfolio that includes additional local generation reduces Pasadena's reliance on that line to serve load. Moreover, about 70% of the capacity currently installed in-city is more than 30 years old. Even with reliable transmission, an unplanned outage of the in-city resources could lead to unserved load during high load months. Newer, more reliable in-city resources help mitigate the probability of unserved load by decreasing the probability of unplanned outages for the local resources.

Although the likelihood of rolling blackouts in Pasadena related to the loss of transmission and/or local generation resources is relatively small, such outages could have potentially catastrophic consequences for the safety and well-being of PWP's customers. For context, an industry-accepted standard reliability standard in the electric utility industry is to target outages that are no more frequent than 1 day in 10 years. PWP's ability to satisfy that standard is at significant risk given its reliance on a single interconnection point and aging local generation.

Given the complexity of the electric utility system and the interdependent nature of the various components of the system, modeling reliability and developing a quantitative assessment of the reliability, beyond reserve margin, of alternative resource portfolios generally is not attempted in a typical IRP evaluation. Instead, each portfolio was evaluated from a reliability perspective on a qualitative basis with regard the replacement of the aging local generation with new, modern and efficient in-city generation facilities. Additionally, Pace developed an economic comparison of portfolios that included development of new, in-city generation resources versus portfolios that emphasized transmission system upgrades to permit expanded use of imported resources.

Maintain Fiscal Health (Capital Charges)

The Portfolio Cost metric mentioned above illustrates the total portfolio cost for the utility on a net present value ("NPV") basis throughout the Study Period. This metric encompasses capital costs, fixed operating costs, variable costs of generation, and the costs of all net market transactions. The level of capital investments by themselves, however, constitutes another important metric. The financial stability of the utility can be greatly influenced by the size and timing of the investments it makes.

For comparison purposes, the levelized capital costs of all capacity additions in 2030 was evaluated for all portfolios. This metric illustrates the size of capital investments associated with the resource additions in each of the portfolios.

Manage Market Risks (Spot Market Dependence 2020)

Although the ability to sell and buy in the spot market represents a significant benefit to the utility by allowing it to optimize the use of its resources, significant reliance on the spot market can constitute a risk for the utility. The spot market is highly volatile and the utility's dependence on a large volume of market transactions increases the market uncertainty associated with each portfolio.

The annual volume of net market transactions was analyzed as a percentage of the utility's load in 2020. Portfolios with net market sales are recorded with positive percentages, while portfolios with net market purchases are recorded with a negative percentage. High exposure in either direction can pose significant market risks for overall portfolio costs.

Provide Diversity and Flexibility (Regulatory Risk)

A diverse portfolio is a means of achieving an objective of minimizing the risks of any concentrated portfolio. But it is also an objective consistent with an intention of having the flexibility to adapt to changing circumstances. A portfolio that commits to one technology or assumes that legal and regulatory conditions will remain constant through the planning horizon may be unable to adapt quickly to changing market conditions. Hence, flexibility and diversity are objectives that are on the list of key objectives from the perspective of the stakeholder group.

Exhibit 17 summarizes PWP's primary planning objectives for this study and the corresponding metrics evaluated throughout this analysis. The rankings placed on each of these metrics by members of the Stakeholder Advisory Group and the Pasadena community, as compiled through the Stakeholder Advisory Group meetings and public questionnaire results, are summarized as well. A lower number denotes a ranking with higher priority. As illustrated earlier in Exhibit 15, achieving ideal outcomes in all of the top three metrics is likely not feasible with a single resource plan. Instead, certain compromise actions may be necessary to strike a balance between the competing objectives and achieve positive outcomes on as many of the priority objectives as possible.

Exhibit 17: Summary of Primary Planning Objectives and Associated Metrics

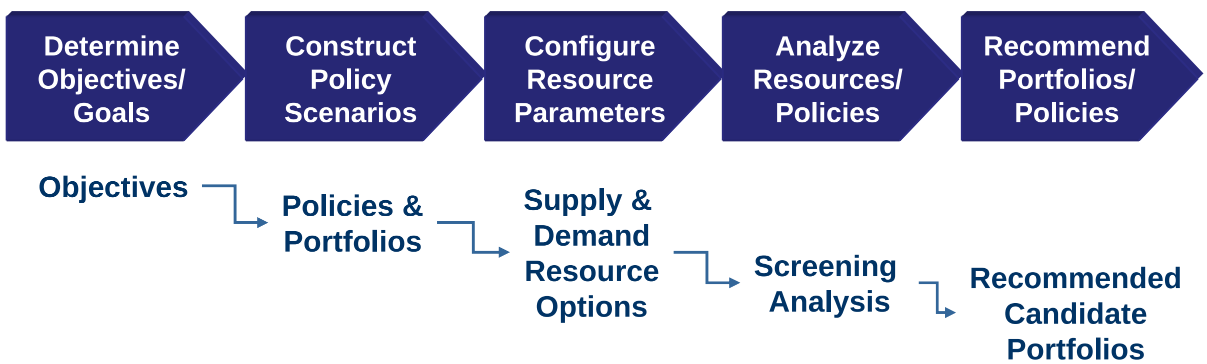
Objective	Metric	Unit	Advisory Group Ranking	Public Ranking #1	Public Ranking #2
Environmental Leadership	CO_2 Emission Reductions in 2020 from 2008 Baseline	%	2	2	1
	Renewable generation as a percentage of net energy for load	%			
Preserve Competitive Rates	Mean of the levelized NPV of Total Portfolio Costs	*2008* $/MWh	5	3	2
Maintain Stable Rates	Difference between the mean of the distributions and the 95% confidence band	*2008* $/MWh	3		3
Provide Reliable Service	Exposure to risk of loss of existing local, in-city resources	Qualitative	1	1	4
Maintain Fiscal Health	Levelized costs of all capacity additions in 2030	*2008* $000	7		7
Manage Market Risks	Annual volume of net market transactions as a percentage of load in 2020	%	6		5
Allow for Flexibility	Exposure to risk of emerging GHG regulations and market mechanisms	Qualitative	4		5

Source: Pace and PWP Public Questionnaire Results

ANALYSIS OF IRP STRATEGIES AND TRADEOFFS (PHASE I)

The resource planning approach taken in this 2009 IRP consists of two major phases. The first phase is designed to screen all the feasible resource options that meet the utility's timing and size requirements. The screening process includes a representation of all expected market conditions and planning constraints (RPS standards, emission reduction rules, and transmission limits). These options are evaluated based on the utility's objectives and different policy scenarios. A number of portfolios are then selected based on different planning objectives to be further evaluated during the "risk" phase of the analysis. Exhibit 18 summarizes the steps taken in the Phase I process.

Exhibit 18: Phase I Overview



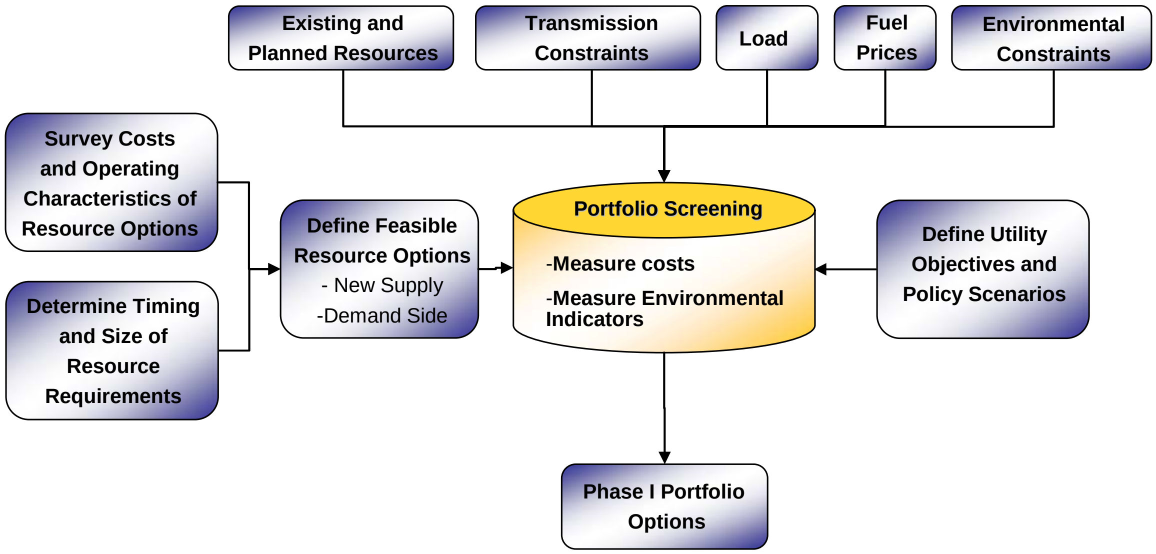
Source: Pace

SCREENING ANALYSIS

Once the goals have been established and the objectives and metrics formed, feasible resource plans need to be developed and configured. The existing resource mix, size and timing requirements, and the costs of new resource additions need to be evaluated against the utility's key planning objectives. This process is used to narrow all possible alternatives down to those options that are practical for the utility. Screening analyses were performed with a customized screening tool, which is able to rapidly evaluate key metrics for a variety of technology combinations within the framework of PWP operations. Screening analyses were performed in the context of different environmental goals in order to focus the exercise around the planning objectives and constraints that were established in the stakeholder process and outlined in the previous chapter.

The screening process was performed in accordance with Exhibit 19. As is noted, the screening analysis incorporated a detailed representation of portfolio resources, PWP demand, local transmission constraints, and all relevant costs such as fuel prices, power prices, environmental compliance costs, and fixed operating charges. The process involved a survey and review of resource options, an analysis of requirements to meet reserve margin and regulatory targets and an accounting of costs and environmental indicators in order to meet planning objectives and policy goals. The process was performed in two distinct steps: resource screening and more detailed portfolio screening.

Exhibit 19: Process Diagram for Screening Analysis



Source: Pace

Resource Screening

In order to analyze new resource options, an assessment of costs and operating characteristics was performed for a broad range of technologies. The following options were evaluated:

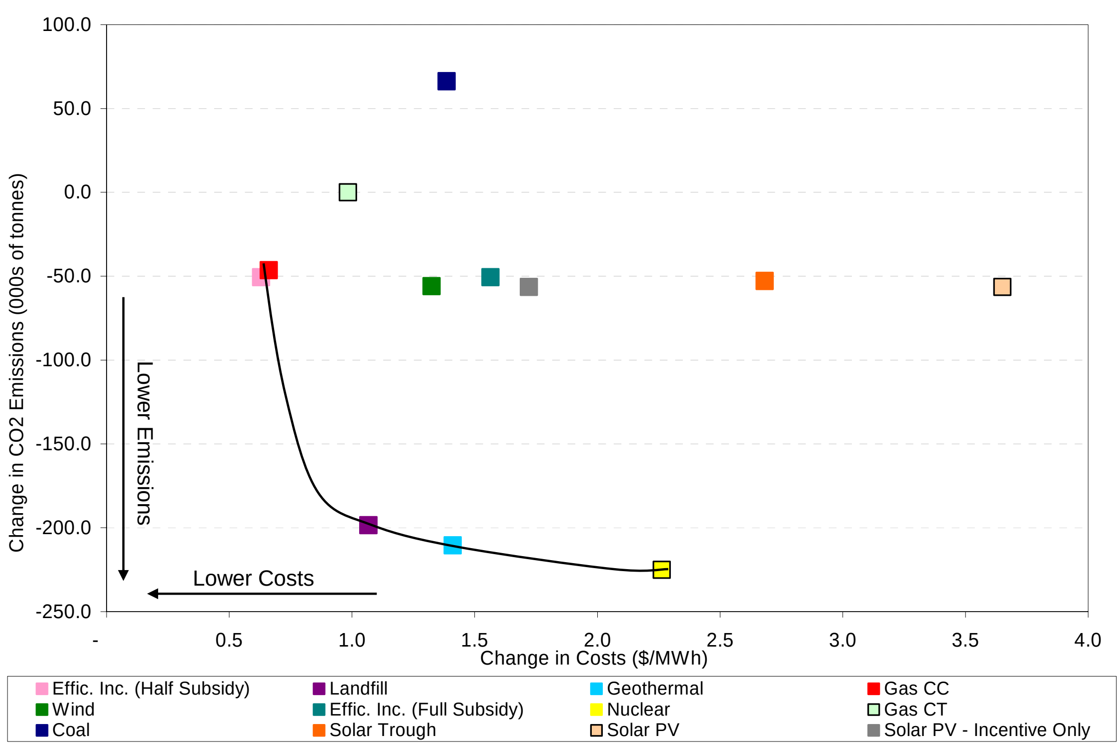
- Coal-fired steam turbine
- Coal-fired Integrated Gasification Combined Cycle ("IGCC") with and without sequestration
- Nuclear
- Natural gas-fired combined cycle turbine
- Combined heat and power
- Geothermal
- Landfill gas
- Biomass – combustion and anaerobic digester
- Wind
- Solar thermal – trough and tower technology
- Solar photovoltaic
- Hydroelectric
- Energy efficiency options

Capital cost estimates and operating profiles were developed for these resource options from a combination of information from project bids received by PWP, Pace technology assessments from consulting projects and public reports from California. These estimates were combined with financing assumptions and tax rules to develop appropriate cost comparisons. Operational parameters were applied and specified at the hourly level, where appropriate. Details on these cost assessments are summarized in the appendix section on Phase I Analysis of IRP Strategies and Tradeoffs.

Before developing complete portfolios, the screening analysis evaluated the impact of resource additions on portfolio costs and the performance of individual technology options in reducing CO_2 emissions. As is illustrated in Exhibit 20, the resource screening analysis targeted several technology options as preferred for further analysis in Phase II. Those technologies closer to the bottom left axis in Exhibit 20 perform best on reducing carbon emissions at the lowest incremental cost to the portfolio. All technologies that were above and to the right of the line had higher costs and lower emission reductions than those on the line. In order to rank resource options on a similar footing, costs per tonne of CO_2 reduced were calculated for each technology. Exhibit 21 summarizes the relative performance of each of the technologies on this metric.

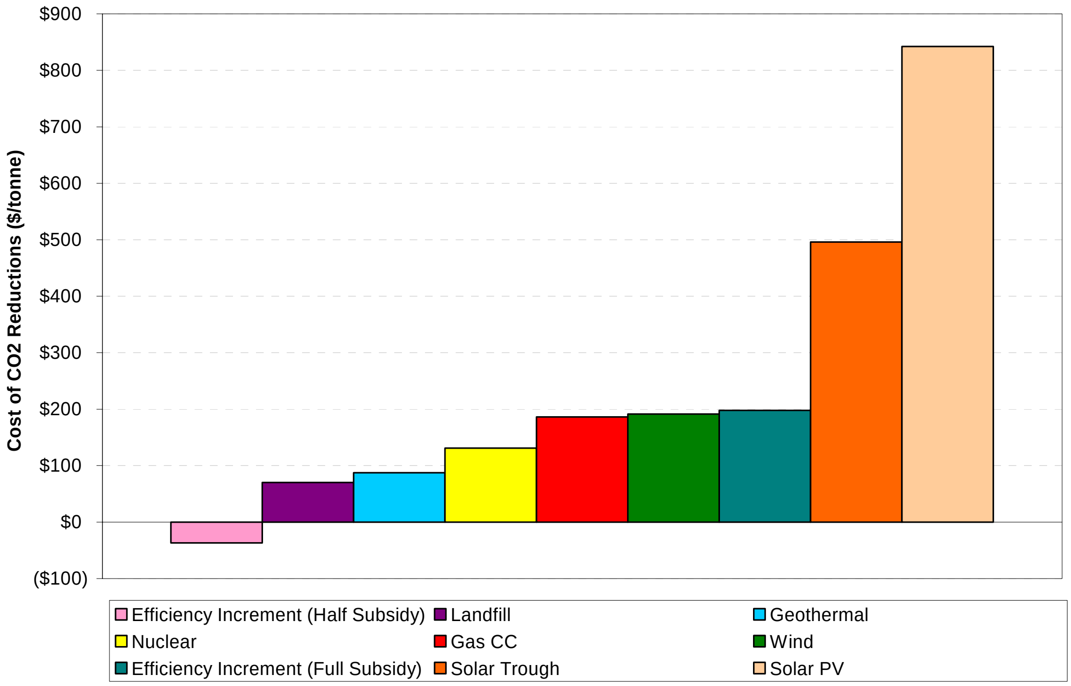
The analysis indicated that certain renewable resources (landfill gas and geothermal) and efficiency measures were preferable for future resource planning. Although nuclear proved best on CO_2 emission reductions, it was deemed an infeasible technology option for PWP on the grounds of capital requirements and general availability. Coal-fired and gas-fired combustion turbines were determined to be ineffective at reducing carbon emissions, and it was concluded that gas-fired combined cycle technology was the preferred local fossil resource.

Exhibit 20: Resource Screening Summary of Costs and Emission Reductions



Source: Pace

Exhibit 21: Resource Screening Costs per Tonne of CO_2 Summary



Source: Pace

The key conclusion of the initial resource screening was that numerous resource options are available to satisfy Pasadena's multiple objectives, but they each carry significant risks that must be considered:

- Landfill and geothermal are least-cost, but may have limited availability and may depend on new transmission to make them feasible in significant quantities.
- Wind and solar thermal are feasible, but at a higher cost. They might also increase PWP's exposure to reliability and commodity market risks because of their intermittent and unpredictable delivery patterns.
- Local non-traditional resource options are viable, but with significant risk that customers may not adopt their use as quickly or to the extent anticipated or desired. A feed-in tariff program can be a way to encourage such local renewable resource development by offering a fixed price for any qualifying resources that can come to market within the City of Pasadena. A price of $150/MWh was determined to be an appropriate level to evaluate such a program. The proposed price of $150/MWh is set at a premium above the market clearing price because it is designed to encourage the development of local resources and because the price incorporates the locational value associated with procuring resources that avoid transmission investment, line losses, and congestion. While the average price is $150/MWh, the program structure should include time-differentiation to provide a price signal that encourages delivery during on-peak time periods. On-peak prices should be $225/MWh (+150%) or higher, with off-peak prices adjusted accordingly.
- A solar rebate of approximately $4/Watt would make the PV technology cost-competitive with competing solar options on a $/ton basis.

Portfolio Screening

With the resource screening analysis conclusions guiding portfolio development, specific details regarding PWP's projected supply/demand balance and required reserve margins were analyzed in order to develop practical timing and size (capacity addition) parameters for resource additions. Within those parameters, portfolios were developed around specific planning objectives, based on environmental goals.

The environmental goals and strategies used to guide portfolio development were categorized generally as follows:

- Minimum: 20% carbon reduction by 2020 and 20% RPS by 2017
- Low: 30% carbon reduction by 2020 and 33% RPS by 2020
- Medium: 60% carbon reduction by 2020 and 50% RPS by 2020
- High: 80% carbon reduction by 2020 and 80-90% RPS by 2020

A strategy that pursued a 100% carbon reduction was also explored in the screening analysis. Costs escalated significantly in this portfolio, however, and the requirements of PWP to balance energy requirements with dispatchable gas-fired resources, as well as the need to maintain significant local capacity made achievement of such a reduction infeasible. Therefore, it was concluded that an 80% reduction would represent the high-end target.

In the course of portfolio development, a structured methodology was followed in order to build resource plans around different technologies and timing, using the results from the resource screening analysis. The following process was employed:

- Add resources when needed to either meet reserve requirements, the carbon reduction requirement, or the RPS requirement
  - Preferred resources from the resource screening phase were added first (landfill gas and geothermal before wind and solar resources, for instance)
  - Portfolios were constructed to recognize limitations of the preferred resources in a given year or over the entire planning period
- Change the timing of the portfolio additions to reflect feasibility concerns, impacts on total costs, and extrapolated annual environmental targets
- Consider more diverse portfolio options in response to stakeholder and public comments

PHASE I RESULTS

Portfolio options were narrowed down in accordance with each environmental strategy, in order to develop a set of options that performed adequately in each of the stated objectives. The screening tool allowed for analysis and measurement of all cost and environmental metrics to in the course of portfolio summary. In response to stakeholder and public comments, diverse portfolios were preserved. Several key conclusions were reached in the course of the Phase I analysis. They can be summarized as follows:

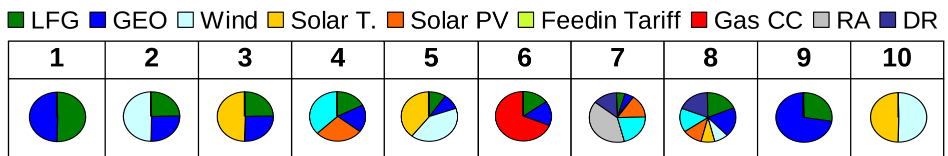
- Achievement of greater emission reductions is associated with higher portfolio costs over the planning horizon. The Phase I analysis indicated that for approximately every additional 10% increase in CO_2 emission reductions, costs would be expected to increase by 4%. Selection of a preferred Pasadena resource plan hinges primarily on customers' willingness to pay to reduce PWP's environmental impacts, while ensuring the reliable operation and financial integrity of the utility.

- Options premised on the displacement of IPP power carry significant risk related to (i) the feasibility of selling the power, (ii.) getting credit for reduced carbon emissions and (iii.) the price that can be realized in the market for the displaced power.
- Overall preferences for carbon reduction strategies can be refined as follows:
  - The minimum (20%) reduction strategy should be dropped, as it fails to achieve likely minimum renewable portfolio standards in emerging state policy and does not represent environmental leadership;
  - The low (30%) reduction strategy can be achieved with modest incremental cost impacts through reconfiguring the existing supply portfolio with renewables to achieve a 33% RPS target;
  - The medium (60%) and high (80%) carbon reduction strategies are feasible if IPP coal generation can be displaced, but they create potentially significant cost and risk exposures.
- Each carbon reduction strategy involves similar planning and procurement decisions over the next 3-5 years, so it may be possible to defer a final commitment to a specific carbon reduction strategy to develop further clarity regarding emerging carbon policies, IPP displacement options, and the cost/availability of alternative renewable resources.

The Phase I analysis resulted in the creation of ten distinct portfolios that met the three preferred carbon reduction goals with a variety of potential resource options. The ten selected portfolios are summarized in Exhibit 22 as incremental additions to the existing PWP portfolio. The total MW added, IPP displacement, and general portfolio resource mix for each portfolio is shown in the legend below the table. As the 14 MW solar PV expansion and energy efficiency targets are common to all portfolios, the legend below does not include them in the total MW added calculation.

Exhibit 22: Phase I Portfolio Details (Incremental Changes to the Existing Portfolio)

Carbon Reduction Target	Portfolio #	Remote Renewables: Landfill	Remote Renewables: Geo thermal	Remote Renewables: Wind	Remote Renewables: Solar Thermal	Local Renewables/DSM: Solar PV (Existing)	Local Renewables/DSM: Solar PV (Expand)	Local Renewables/DSM: Feed-In Tariff	Local Renewables/DSM: Energy Efficiency	Local Renewables/DSM: DR & RA	Fossil-fueled: Local Gas	Fossil-fueled: Coal
Low	1: LFG/Geo	15	15			14			26			
	2: Wind	10	10	20		14			26			
	3: Solar	10	10		20	14			26			
	4: Local	10	10			14	15	21	34			
Med	5: Remote Renew	15	15	60	60	14			26			-47
	6: CC	15	15			14			26		65	-108
	7: Local	5	5			14	15	21	34	55		-108
High	8: Diverse	25	25	10	10	14	15	21	34	25		-108
	9: LFG/Geo	25	65			14			26			-108
	10: Wind/Solar			125	125	14			26			-108



	1	2	3	4	5	6	7	8	9	10
Total MW Added	30	40	40	56	150	95	101	131	90	250
IPP Replacement					47	108	108	108	108	108

Source: Pace

The details of each of the incremental portfolio options referenced in Exhibit 22 are outlined below. Once again, the common 14 MW of solar PV expansion and the reference case efficiency improvements are not explicitly mentioned in the summaries.

1. **Low LFG/Geo** – A total of 30 MW of landfill gas and geothermal capacity, added to the portfolio between 2012 and 2017.
2. **Low Wind** – 10 MW each of landfill gas and geothermal capacity, supplemented by 20 MW of wind.
3. **Low Solar** – 10 MW each of landfill gas and geothermal capacity, supplemented by 20 MW of solar thermal.
4. **Low Local** – A portfolio centered on an incremental 15 MW of solar PV and 21 MW of local renewables procured through a $150/MWh feed-in tariff offering. Capacity additions are supplemented by landfill gas and geothermal additions in order to meet CO_2 target.
5. **Med Remote Renewables** – Liquidation of the electricity from 47 MW of the IPP coal plant and replacement with a diverse (landfill gas, geothermal, wind, solar thermal) set of remote renewable options.
6. **Med Combined Cycle** – Liquidation of the electricity from all shares of the IPP coal plant and replacement with 15 MW each of landfill gas and geothermal and a 65 MW natural gas combined cycle unit.
7. **Med Local** – Liquidation of the electricity from all shares of the IPP coal plant and replacement with an emphasis on local efficiency programs, demand response, solar PV, and feed-in tariff procurement. Due to limitations on local resources, additional capacity requirements are procured through resource adequacy purchases.

8. **High Diverse** – Liquidation of the electricity from all shares of the IPP coal plant and an "all-of-the-above" strategy for meeting resulting energy needs, including expanded efficiency, demand response, local renewables, and remote renewables.
9. **High LFG/Geo** – Liquidation of the electricity from all shares of the IPP coal plant and replacement with 25 MW of landfill gas capacity and 65 MW of geothermal capacity by 2016.
10. **High Wind/Solar** – Liquidation of the electricity from all shares of the IPP coal plant and replacement with 125 MW each of wind and solar thermal capacity.

Outstanding Risks Factors for Further Consideration

The Phase I analysis highlighted several key risks that cannot be accounted for in a screening exercise reliant on single point estimates for key market drivers. As a result, further evaluation of the following key risks was determined to be required as part of the Phase II analysis:

- Evaluation of the exposure of all of the portfolio options to statistically quantifiable risk factors, such as:
  - Customer demand and regional load
  - Natural gas prices
  - Power market prices
  - Capital costs for resource additions

- Evaluation of certain portfolio options in the context of quantum events through scenario analysis that explore the:
  - Feasibility of liquidating IPP power and the price that can be realized for it
  - Availability of renewable resources to displace IPP
  - Uncertainty around the reliability of local generation
  - Emerging state/regional/federal carbon policy constraints and valuation

QUANTITATIVE AND RISK ASSESSMENT OF PROPOSED PORTFOLIOS (PHASE II)

RISK INTEGRATED RESOURCE PLANNING APPROACH

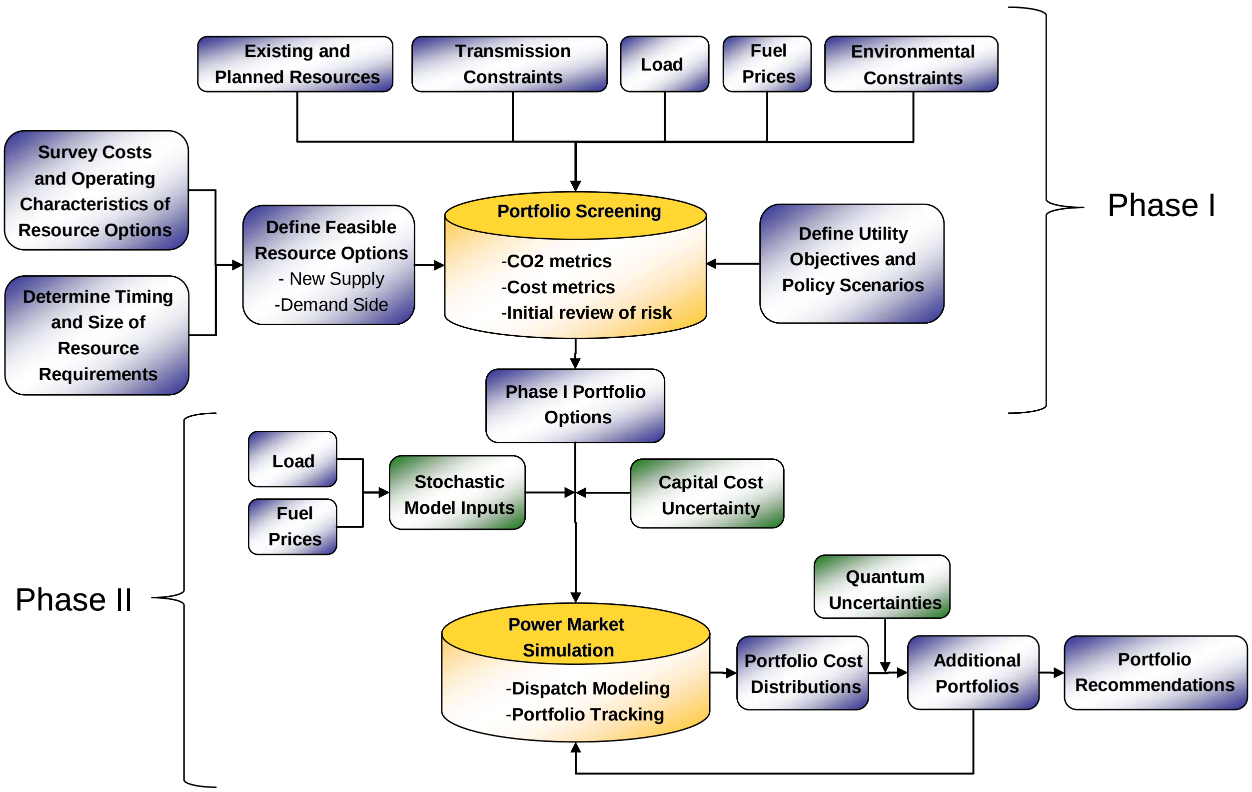
PWP, just like most electric utilities, has to make resource decisions under a great deal of uncertainty. A resource decision that meets all objectives when judged only under current or best guess forecasted conditions may prove to be a future financial burden on the utility over time if the forecasts are wrong. Fuel market volatility, capital cost uncertainty, load uncertainty, emission regulations, and regulatory changes will all affect how a resource portfolio performs throughout its operational life. Understanding the range of potential market volatility and the severity of impending regulatory changes on alternative generation portfolios is crucial to make the appropriate portfolio choices. The least expensive resource addition may not be the best if it also exposes PWP to severe market volatility or severe negative effects associated with an impending regulatory change. The tradeoffs between costs, risks, reliability, environmental stewardship, and other utility objectives need to be quantified for each portfolio and need to inform the selection of the portfolio that performs best according to those objectives the utility ranks as its highest priorities.

As introduced in the previous chapter, the 2009 IRP took a risk-based approach to resource planning.[1] The first phase screened all the feasible resource options through an analysis that included a representation of all expected market conditions and planning constraints (RPS standards, emission reduction rules, and transmission limits). These options were evaluated based on the utility's objectives and different policy scenarios. A number of portfolios were then selected based on different planning objectives to be further evaluated during the second phase of the analysis.

The portfolios in Phase I were constructed to capture a broad spectrum of resources, size, and timing possibilities in the context of its critical objectives. This allows PWP to evaluate all viable resource options and identify the resource characteristics and combinations that constitute a good portfolio. Phase II of the 2009 IRP process focuses on the quantification of risks and the impact of different uncertainties on the performance of all portfolios selected from the screening process. The Phase II process was designed to assess the impact of different uncertainties on each portfolio and allow the utility to rank the importance of all metrics based on their hierarchy of objectives. Exhibit 23 illustrates the details of the Phase I and Phase II components of the 2009 IRP process.

[1] Pace employed its Risk Integrated Resource Planning ("RIRP") approach in analyzing feasible portfolio options in the context of a variety of uncertainties in order to measure performance under multiple planning objectives.

Exhibit 23: Risk Integrated Resource Planning Process



Source: Pace

The Phase II process focuses on the quantification of uncertainty, which can be measured through different methodologies. Uncertainty was evaluated using two main methods: statistically-driven stochastic analyses and scenario analyses. Stochastic simulations are generally deemed appropriate for variables that have a wide and continuous range of potential outcomes that can be quantified based on historical relationships and volatilities. In this analysis, load, fuel, and capital cost uncertainty were evaluated using stochastic inputs. Discrete events that result in significant or quantum changes for portfolio performance or market outcomes were evaluated through scenario analyses.

Uncertainty is measured as a distribution of the aggregation of all potential costs (capital, O&M, fuel etc) of the incremental generation portfolio decisions over time. By quantifying the costs over a wide range of potential market and regulatory outcomes, we can get an accurate picture of the full range of risks associated with any portfolio over the entire planning horizon. Additional detail on the Phase II process and tools can be found in the appendix.

STOCHASTIC (QUANTIFIED RISK) PORTFOLIO ANALYSES

Stochastic inputs used in Phase II were based on a combination of historic volatility and expectations for future market trends. Pace's market insight is used to develop a view on future market trends; statistical and modeling tools are then employed to quantify the uncertainty around the expected trends and evaluate the performance of each portfolio under different uncertainties. Additional information about the development of stochastic inputs and stochastic simulations can be found in the appendix section on Phase II Risk Analysis.

As with any resource plan, the first step in the process was the development of a load forecast. The load forecast, developed by Pace, used an econometric analysis, supplemented by full inclusion of all economical energy efficiency measures. The forecast and supporting analyses are described in the appendix section on PWP Load Forecast. Then for each generating facility in the fleet and potential generation addition, operating characteristics, fuel cost projections and emission characteristics were developed. These are also described more fully in the appendix.

The Phase II analyses require that uncertainties in these forecasts are determined. The effects of fuel and load uncertainty on the portfolios are quantified by simulating the hourly operations of all portfolio resources over the study horizon under 500 different load and fuel combinations. As stated previously, these distributions were based upon historical statistical analyses of load and fuel prices. This simulation results in 500 different cost outcomes associated with fuel and load uncertainty for each portfolio, for each year in the Study Period. In other words, the stochastic simulation of load and fuel results in a distribution around portfolio costs for each year of the Study Period. Cost distributions represent the probability of occurrence over a range of outcomes.

Capital cost uncertainty is evaluated by defining stochastic bands around the capital costs of each resource addition in the portfolio for each year of the Study Period, based on historical commodity cost volatility and breakdowns of capital costs for different generating technologies. The capital cost distributions were added to the distribution of costs associated with fuel and load uncertainty in order to arrive at a Total Cost distribution for each portfolio.

SCENARIO ANALYSES

For any given portfolio, there are significant sources of uncertainty that cannot be quantified using stochastic simulations. Quantum cases developed around discrete assumptions changes have been analyzed through separate scenario analyses. In this study, the portfolio risks evaluated using scenario analyses included:

- Uncertainty around the sale price of IPP
- Availability of renewable generation
- Uncertainty around the reliability of local generation
- Regulatory risk: GHG emission accounting uncertainty
- Regulatory risk: CO_2 prices

Uncertainty around the Sale Price of Power from the Intermountain Power Plant (IPP)

Several (6 out of 10) of the portfolios analyzed were constructed around the replacement of part or all of the IPP generation. In order to significantly reduce CO_2 emissions, the generation from IPP has to be replaced by cleaner resources. Replacing IPP, however, involves significant costs and risks, by removing a significant source of supply and replacing it with new capacity. The ability of PWP to offset some of these costs will depend on the price that can be secured for the sale of the IPP generation. Under the current regulatory environment and the expectation for more stringent environmental regulations, there is significant uncertainty around the terms and conditions that can be negotiated for the sale of coal generation into a different market area. The larger the contemplated size of the displacement, the more the portfolio is exposed to risk around the price that can be achieved for the sale of IPP power.

In its reference case analysis, Pace assumed that IPP power would be sold at a slight discount to the market for power in the southwest. In our sensitivity analysis, Pace has analyzed the impact of a sale of IPP generation at a price of zero for all the portfolios. This means that PWP is still responsible for all fixed and variable costs associated with IPP operations, without receiving any benefit from the resulting power. Portfolios that replace more generation from IPP will be more exposed to the possibility of a zero price for its energy.

Availability of Renewable Generation

The limitations on the availability of certain renewable resources to generate electricity are an important factor to consider when evaluating renewable-intensive portfolios. Renewable resource options like geothermal, for example, are highly limited by geographic location and may face transmission obstacles in delivering power to Pasadena. Resource options like landfill gas, on the other hand, are limited by the general resource availability in the area. Pace's portfolio review incorporated the impact on total portfolio costs of less-than-anticipated availability of renewable resources. Pace evaluated the impact of this in portfolios where landfill gas and geothermal are the predominant resource options. If significant capacity of this type is unavailable, energy and capacity shortfalls would have to be replaced by market purchases with their associated carbon emissions. As a result, costs would be expected to increase and emission reductions decrease. In the reference case, portfolios were constructed as if the availability of landfill and geothermal was unlimited. In Portfolio 9 for example, it was assumed that 65 MW of geothermal and 25 MW of landfill gas capacity was available for development and delivery into PWP service territory. In the sensitivity case, we assumed that only 15 MW of this power combined was available and the rest of the required power had to be purchased in the market.

Uncertainty around the Reliability of Local Generation

About 70% of the capacity located within the City of Pasadena is more than 30 years old. Even with reliable transmission, an unplanned outage of the in-city resources could lead to unserved load during high load hours. In order to assess the potential reliability risks of continued reliance on the 110 MW of aging local generating units, Pace reviewed PWP operating criteria for the local, in-city units as well as projected load data. PWP studies indicate the need to initiate rolling blackouts when customer loads exceed 253 MW and the 110 MW of aging local units is unavailable.

- Pace's analysis indicates this has a 2.04% probability of occurring (179 hours/year)
- An accepted industry planning standard is 0.027% probability (1 day in 10 years)
- Achieving the industry standard requires at least a 76.2% probability that each of the three aging local units will be available when called to meet PWP customer's electricity requirements. The age of the existing units could put pressure on this requirement if upgrades or replacements are not made.

Previous analyses of PWP's transmission system upgrade options as an alternative to maintaining local generation capacity indicate that such options would be difficult and costly to achieve. A Black & Veatch study completed in April, 2003 evaluated transmission interconnection of Pasadena on its west side with City of Glendale and Southern California Edison (Eagle Rock substation) and recommended not to pursue such options further due to high environmental impact, cost, difficult terrain and congestion of transmission lines. PWP also has a 40 MW "emergency only" interconnection with Los Angeles Department of Water & Power ("LADWP") on the southwest side. Since this interconnection cannot be used simultaneously with the Goodrich interconnection due to phase differences between LADWP and Southern California Edison, and it does not have sufficient capacity to handle PWP's external resources, PWP would only use it when the Goodrich interconnection failed. Given the interconnection constraints and design of the sub-transmission system, PWP has historically pursued a balanced approach between local generation and transmission for import of energy.

As noted previously, reliability assessments in an IRP context do not lend themselves to precise modeling and quantitative comparisons, given the complexity of electric utility system operations and the interdependent nature of the various components of the system. Instead, each portfolio was evaluated from a reliability perspective on a qualitative basis with regard to the replacement of the aging local generation with new, modern and efficient in-city generation facilities. Additionally, Pace developed an economic comparison of portfolios that included development of new, in-city generation resources versus portfolios that emphasized transmission system upgrades to permit expanded use of imported resources.

Regulatory Risk: GHG Emission Accounting Uncertainty

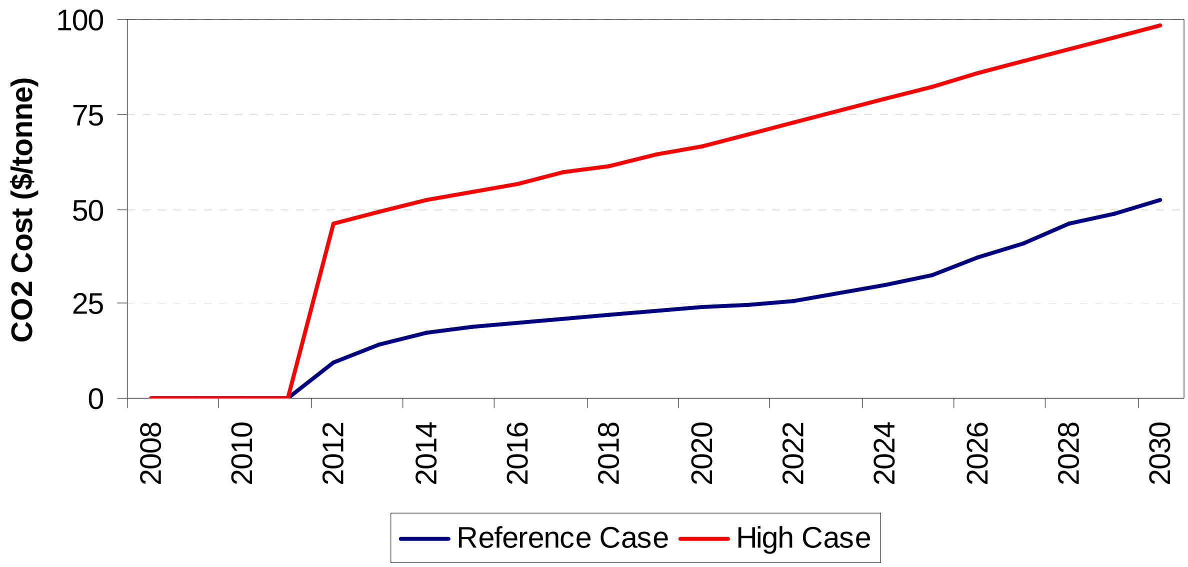
The emission reduction goal of this planning process is driven by both an environmental stewardship objective and by the need to comply with existing and potential greenhouse gas reduction regulations. The level of reductions above what is required by law will be, in part, determined by the customers' willingness to pay for additional emission reductions. The accounting norms for CO_2 emissions, however, will impact how the emissions associated with serving the utility's load are recorded. Determining the appropriate accounting rules will define which portfolio achieves the desirable emission reductions.

Pace analyzed the resulting CO_2 emission reductions around three possible accounting mechanisms. The reference case counts emission reductions for market sales at a portfolio average emission rate. An optimistic case assumes that the cleanest resources will serve native load first and that emissions from dirtier resources will only be counted if used to serve native load. A pessimistic case assumes that the emissions associated with all PWP power generation count towards their carbon footprint.

Regulatory Risk: CO_2 Prices

Significant CO_2 emission compliance costs are expected over the Study Period. The uncertainty surrounding the timing and pricing level of such costs represents a big risk for any CO_2-intensive portfolio. Pace's analysis included the evaluation of all portfolio costs under a high CO_2 case. Exhibit 24 displays the annual CO_2 compliance costs assumed in the reference case and the high CO_2 case. Portfolios with a larger share of IPP will suffer a relatively greater impact than those with less reliance on coal. Pace evaluated the relative impact of CO_2 on costs based on the NPV of portfolio costs under a high CO_2 scenario.

Exhibit 24: CO_2 Costs for Reference Case and High Case



Source: Pace

PORTFOLIO RISK ASSESSMENT RESULTS

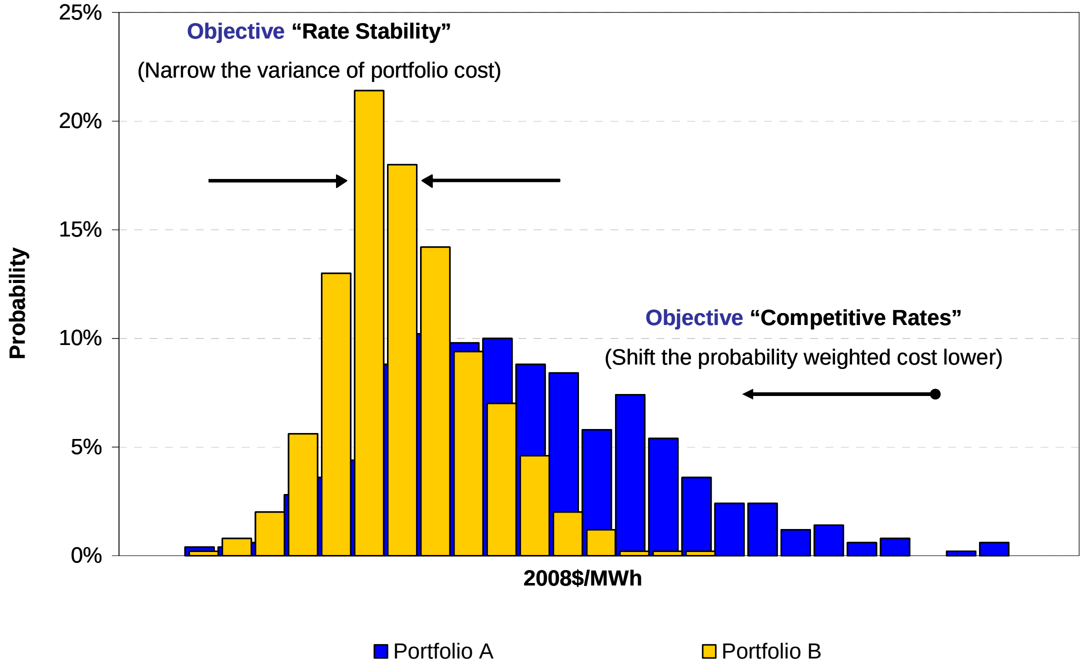
The quantification of risks within the Phase II analysis was performed first through stochastic analysis. This analysis quantified distributions around the total costs of each of the portfolios and calculated the associated emission reductions. Key result metrics included the net present value of portfolio costs (computed as a levelized annuity price per MWh), the width of the distribution (the difference between the mean and the 95th percentile outcome), and the percent reduction in CO_2 emissions by 2020. Additional scenario analyses were then performed to measure the exposure of each of the utilities to other risk factors, such as major regulatory changes or uncertainties around particular aspects or components of the portfolio. Where appropriate, the impact of these scenarios on the total portfolio costs was measured as an increment to the mean of the portfolio distributions.

Cost Distributions

Whereas traditional "base case" approaches quantify the effects of one set of fuel price, load, and capital cost assumptions, the stochastic simulation of these variables results in distributions around the "base case." Portfolio cost distributions convey information regarding the general cost level of different portfolios, but also provide valuable insight into the risks associated with each portfolio.

Exhibit 25 presents two illustrative portfolio distributions. In the example, Portfolio B's distribution is centered further to the left. This implies that the mean of the costs for Portfolio B are lower than the mean of the costs for Portfolio A. As shown, Portfolio B also has a tighter distribution than Portfolio A. This means that there is more risk associated with Portfolio A since the uncertainty around its costs is bigger.

Exhibit 25: Portfolio Cost Distributions



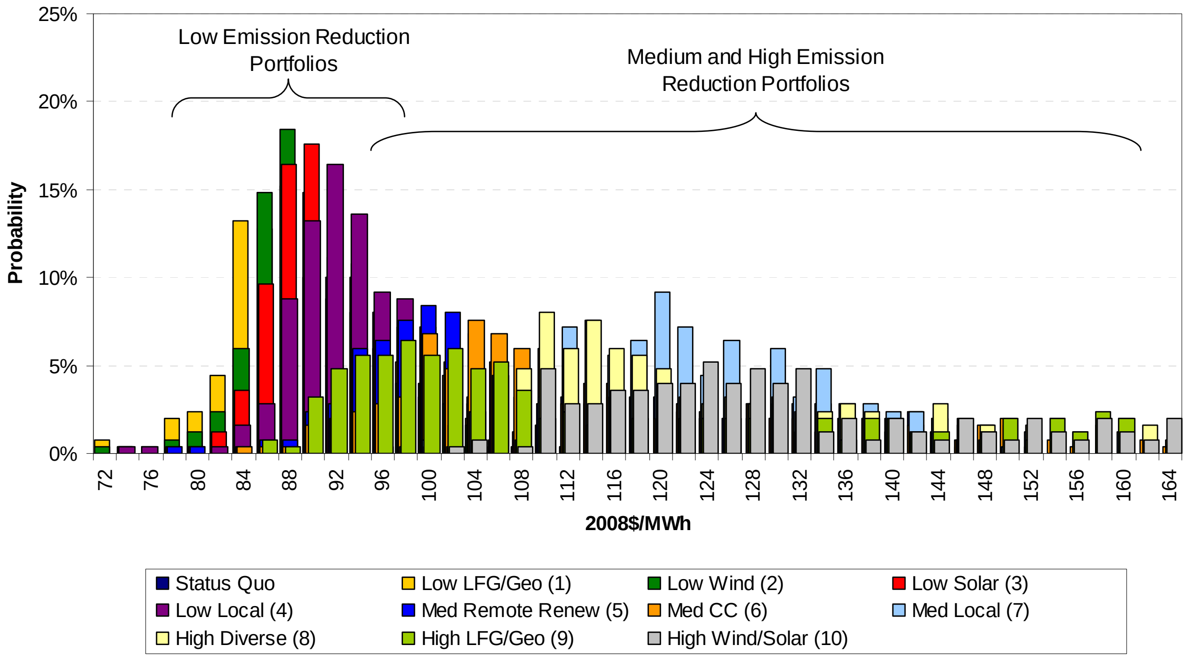
Source: Pace

As the different portfolio distributions were evaluated throughout this analysis, portfolio costs were compared based on the mean of the distribution; the market risks associated with the portfolio were evaluated based on the width of the distribution. The status quo, represented as PWP's existing portfolio plus existing goals on efficiency and solar PV expansion, was evaluated with any future energy needs being met by market purchases. This "risk profile" was then compared against the other ten portfolios.

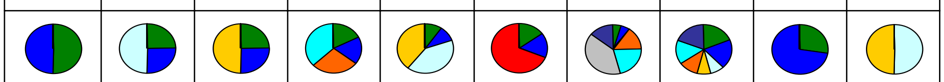
Stochastic Analyses Results

The status quo portfolio is analyzed in the stochastic analysis against each of the other resource plans in order to evaluate the costs and risk exposure of a suite of alternatives. Exhibit 26 presents a summary of cost distributions for each of the portfolios selected from Phase I. As an illustrative example, the year 2016 is displayed. This represents a year when many major portfolio decisions are already made. Although the shape and center of the distributions may change year by year, the relative portfolio costs and risks for 2016 are reflective of the relationships that exist over the entire Study Period. As can be seen, the low emission reduction portfolios are generally lower cost than the medium and high emission reduction portfolios. Furthermore, they have narrower distributions, meaning that the price risk associated with them is lower. For reference, the total MW added, IPP displacement, and general portfolio resource mix is shown below the graph.

Exhibit 26: Total Cost Distributions for Phase I Portfolios (2016)



LFG GEO Wind Solar T. Solar PV Feedin Tariff Gas CC RA DR

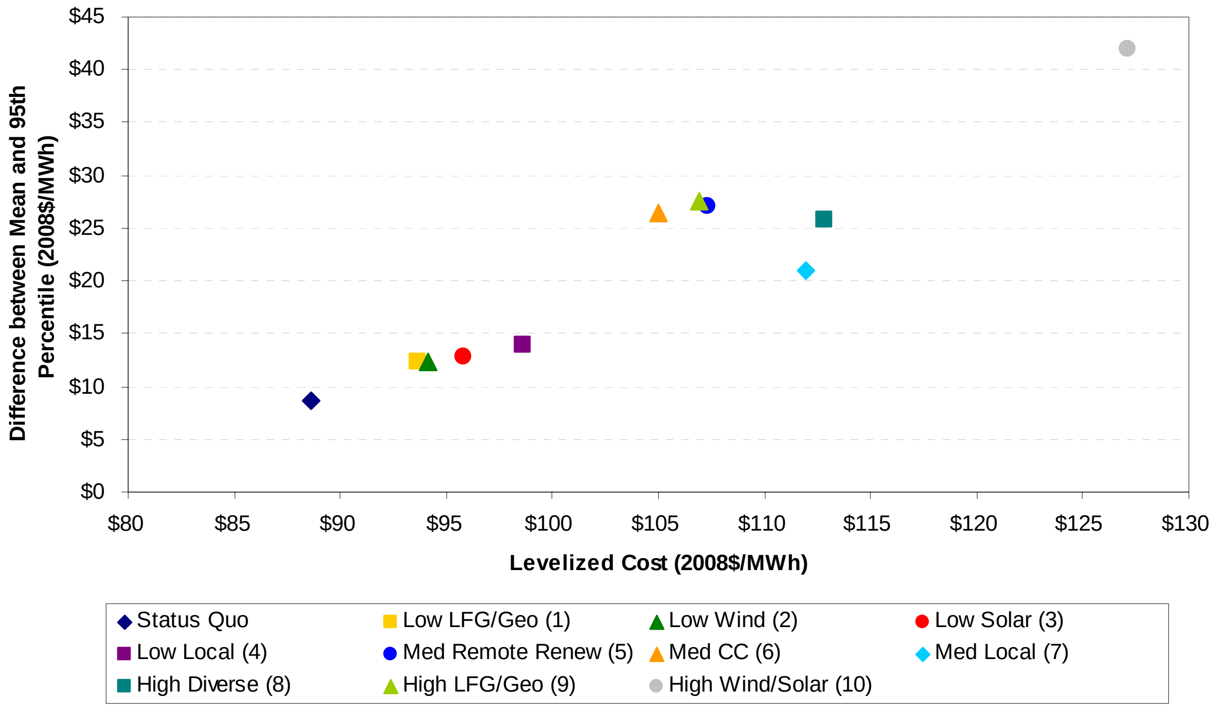
	1	2	3	4	5	6	7	8	9	10
										
Total MW Added	30	40	40	56	150	95	101	131	90	250
IPP Replacement					47	108	108	108	108	108

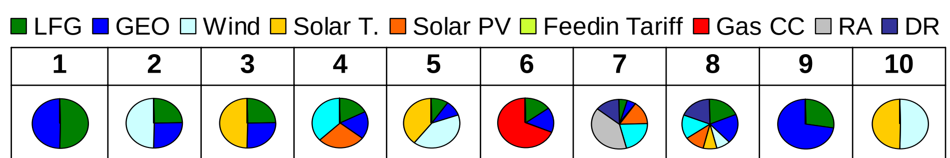
Source: Pace

Costs and Market Risks

For portfolio comparison purposes, the yearly distributions of all portfolios were summarized into a levelized annuity, which is the Net Present Value ("NPV") of revenue requirements spread into an average $ per MWh over the planning horizon. Exhibit 27 presents the summary of the expected (probability weighted) annuity prices for each portfolio on the horizontal axis and the measure of risk (the difference between the mean and 95% outcome) on the vertical axis. As shown, portfolios with distributions centered closer to the y-axis in Exhibit 26 show a lower mean cost in Exhibit 27. Similarly, portfolios with wider cost distributions in Exhibit 26 show a higher difference between the mean and the 95th percentile in Exhibit 27. For reference, the total MW added, IPP displacement, and general portfolio resource mix is shown below the graphs.

Exhibit 27: Summary Cost and Risk Metrics for Phase I Portfolios





	1	2	3	4	5	6	7	8	9	10
Total MW Added	30	40	40	56	150	95	101	131	90	250
IPP Replacement					47	108	108	108	108	108

Source: Pace

As shown in Exhibit 27, portfolios with higher levelized costs over the Study Period generally show a higher difference between the mean and the 95th percentile of their cost distribution. The portfolios in Phase I were created around different levels of IPP displacement, so those resource plans that displace IPP also remove a relatively stable cost component of the portfolio. Furthermore, the higher capital investments needed to replace more of IPP are generally also associated with higher capital cost risks.

Although the level of costs and risks associated with the portfolios will depend in part on the assumed capacity mix, in general, the tradeoffs between the costs and risks need to be evaluated in the context of achieved emission reductions. For most portfolios, the tradeoff between costs and risks is not sufficient to evaluate their performance in the context of the planning objectives.

Emission Reductions

As mentioned before, one of the primary objectives of the current resource plan is to identify the best alternatives to reduce the CO_2 emissions associated with serving the utility's load. In order to significantly reduce CO_2 emissions, the existing coal generation in the portfolio needs to be replaced with cleaner resources. In general, the more IPP capacity that a portfolio displaces, the more capacity that needs to be built to replace the coal generation. This results in higher costs for the portfolio and higher exposure to capital cost risks. The achieved emission reductions for the level of costs and risk incurred will define how portfolios are compared against each other.

For comparison purposes, portfolios were grouped based on the mean of the distribution of emission reductions:

- Low: Illustrates reductions on the low-end (<30%) of AB 32 scoping plan requirements and generally corresponds with a 33% RPS
    - Portfolios 1 to 4

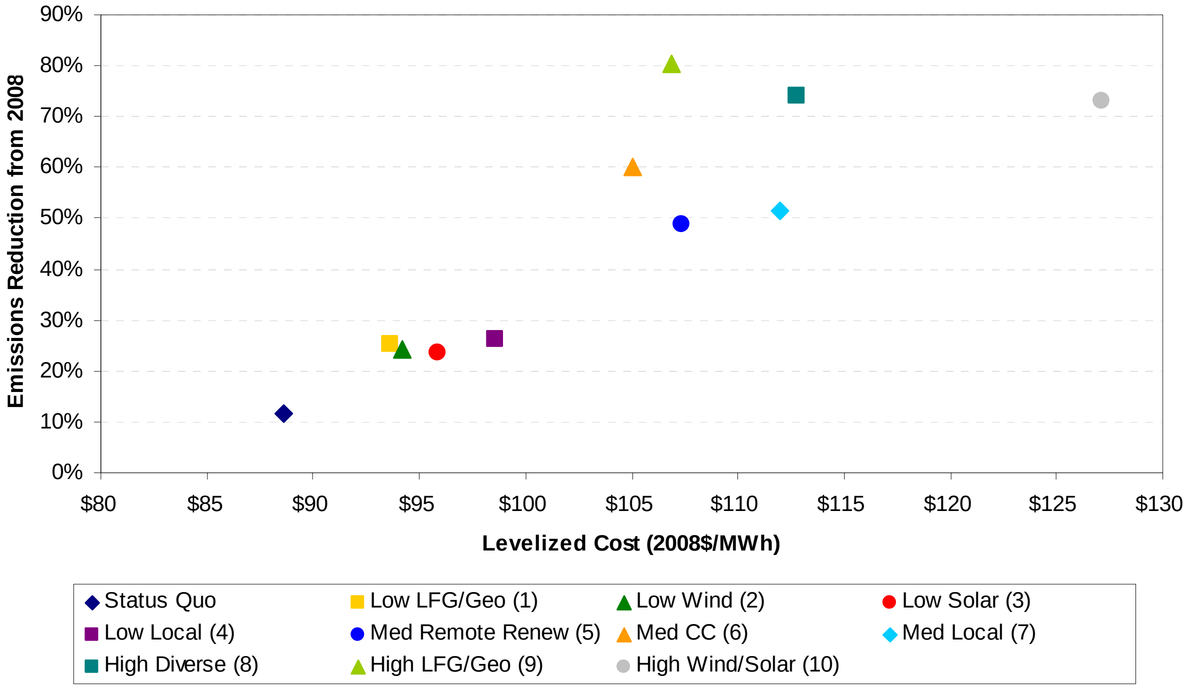
- Medium: Illustrates a range (35% - 60%) of reductions more in line with a scenario where AB 32 mandates are imposed disproportionately on a utility like PWP; higher reductions correspond with higher displacement of IPP
    - Portfolios 5 to 7

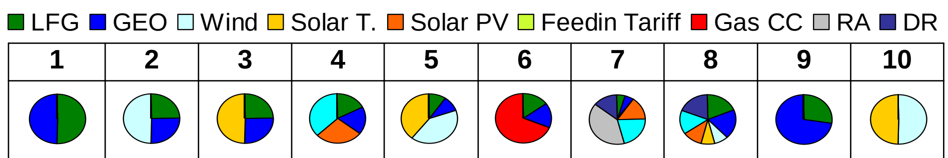
- High: Illustrates a high level of environmental leadership by achieving reductions approaching the state's long term goal (80% reduction by 2050) in an accelerated manner
    - Portfolios 8 to 10

Exhibit 28 summarizes the mean of the Total Costs for each portfolio from Phase I and the mean of the achieved emission reductions. The actual year-to-year CO_2 reductions for any given portfolio will depend on a number of factors like load, fuel prices, market purchases, and market sales. As will be discussed later, there is also uncertainty surrounding the accounting methodologies employed to measure the CO_2 emissions associated of market transactions. For reference, the total MW added, IPP displacement, and general portfolio resource mix is shown in Exhibit 28.

As can be seen, portfolios that achieve greater emissions reductions are generally associated with higher costs due to additional expenses associated with new renewable resource additions and the removal of shares of the IPP coal facility. There are plans, however, that can achieve modest emission reductions without increasing costs above those expected under status quo conditions. This is due to the addition of a modest amount of low-cost renewable resources that insulate the portfolio from market power purchases, which are exposed to natural gas prices and CO_2 compliance costs.

Exhibit 28: Summary Cost and CO_2 Reduction Metrics for Phase I Portfolios





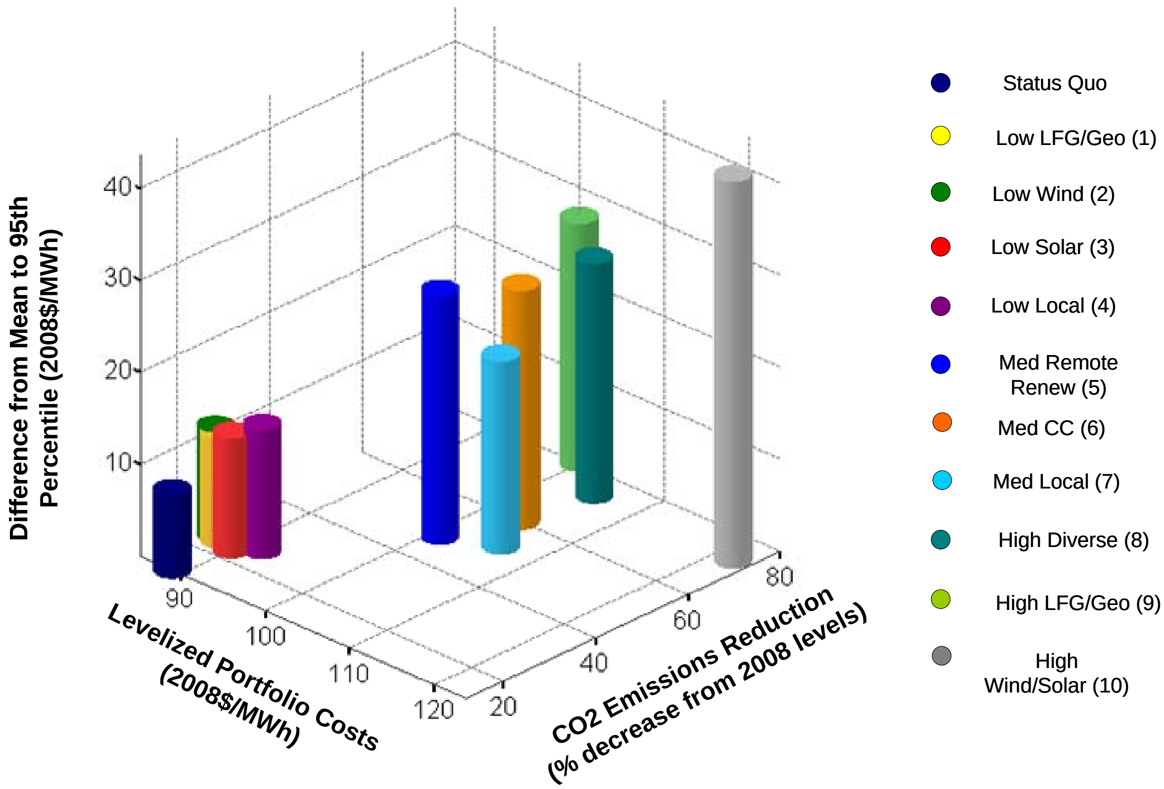
	1	2	3	4	5	6	7	8	9	10
Total MW Added	30	40	40	56	150	95	101	131	90	250
IPP Replacement					47	108	108	108	108	108

Source: Pace

Evaluation of Cost, Risk, and Emission Reduction Metrics

The required capital cost investment and associated risks for each portfolio need to be assessed within the context of emission reductions. This requires the simultaneous evaluation of costs, risks, and emission reductions. The tradeoff between these three metrics can be better visualized in three-dimensional space. Exhibit 29 illustrates the costs, risk, and emission reductions associated with the portfolios analyzed using a 3-D graph. As is shown, the portfolios with lowest emission reductions generally have lower costs (to the left on the cost axis) and lower price risk (shorter height on the risk axis). As higher and higher emission reductions are achieved, certain portfolios perform better on the cost metric, while others have lower risks. Exhibit 29 shows that some portfolios are candidates for elimination (Portfolio 10), but also illustrates that additional scenario analyses are needed to determine plan performance under a wider range of planning metrics.

Exhibit 29: Summary Cost, Risk, and CO_2 Reduction Metrics for Phase I Portfolios



Source: Pace

Scenario Analyses Results

As mentioned before, Pace evaluated the exposure of all portfolios to risks associated with several quantum scenarios. The results of these sensitivities can be summarized as follows:

Uncertainty around the Sale Price of IPP: Portfolios (e.g. Portfolios 5-10) that displace IPP will be exposed to significant uncertainty around the price at which the energy of IPP can be sold. The effects of this uncertainty on the total cost of the portfolio will depend on the quantity of IPP being sold. Portfolios that displace all of the IPP generation (e.g. Portfolios 6-10) would face an additional $24/MWh in levelized NPV costs if no revenue could be achieved from the sale of IPP power.

Availability of Renewable Generation: Portfolios (e.g. Portfolio 9) with a large amount of landfill and geothermal capacity will be exposed to the uncertainty surrounding the amount of these resources available to PWP. While these portfolios might perform well under other metrics, the feasibility of large landfill and geothermal capacity additions can be a significant limiting factor. Therefore, sole reliance on landfill and geothermal resources exposes portfolios to an unacceptable risk.

Uncertainty around the Reliability of Local Generation: Portfolios with a stronger focus on local capacity will increase the reliability of Pasadena's system by limiting its dependence on the single 215 MW intertie with the California power grid and adding back-up capacity for the aging in-city plants. Portfolios that add sufficient new gas-fired generation in-city to displace the need for Pasadena's older local generating units perform the best on reliability.

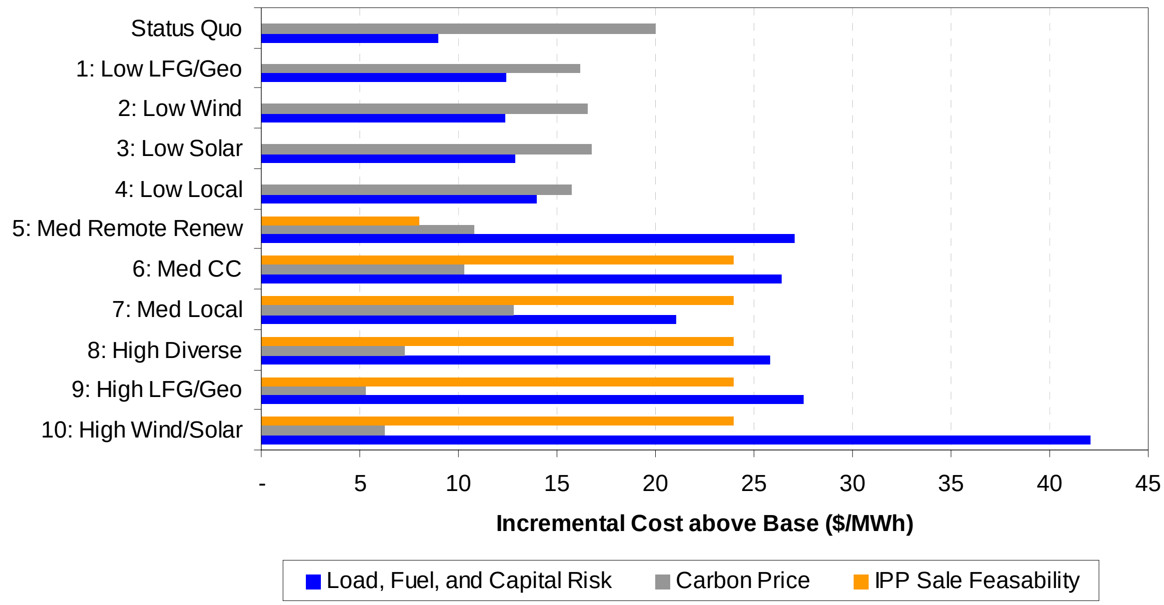
Expanding the transmission capacity into the City would be an alternative to local resource expansion that could improve system reliability. Portfolios that attempt to address existing reliability concerns through transmission upgrades would expect to require at least $100 million invested over the next 10 to 20 years to upgrade the existing single point of interconnection with SCE at Goodrich and PWP's in-city transmission system. These costs would not be incurred by portfolios adding new, natural gas-fired local generation within the City. As a result, summary cost metrics include this additional transmission costs.

Regulatory Risk: GHG Emission Accounting Uncertainty: The accounting rules for greenhouse gas emissions will impact how CO_2 emissions are counted for market sales. Because IPP is Pasadena's resource with the highest CO_2 intensity, this uncertainty will affect portfolios that keep all or part of IPP (e.g. Portfolios 1-5). The relative impact of these accounting rules, however, will also depend on the volume of market sales in a particular portfolio. Portfolios that keep a larger share of IPP but also have a lot of market sales will benefit more from a rule that counts the highest intensity resources towards market sales.

Regulatory Risk: CO_2 Prices: The risks associated with high CO_2 prices will be directly related to the amount of coal in the portfolio. Portfolios that displace a big part of IPP will significantly limit their exposure to high CO_2 prices, while portfolios that keep IPP face a significant cost risk if CO_2 prices are higher than anticipated. Portfolios that hold all of IPP (e.g. Portfolios 1-4) are exposed to an additional cost of $16-20/MWh on a levelized NPV basis in the event of a very high CO_2 price environment.

Exhibit 30 summarizes key price risks for each of the portfolios, as quantified through the scenario analyses. The expected portfolio cost increases associated with load, fuel, and capital risk (earlier referred to as "price risk"), sale price risk for IPP, and high carbon price risk are displayed together. As is shown, the risk associated with the IPP sale is as large as the combined risks associated with load, fuel prices, and capital at the 95th percentile for several portfolios that remove all of the IPP power. This indicates that such sale price risk needs to be considered in the selection process. In addition, for those portfolios that keep IPP, the carbon price risk is most significant. The portfolio that only removes a portion of the power from the coal-fired IPP facility (Portfolio 5) hedges against both of these risks.

Exhibit 30: Comparative Cost Risks for Each Portfolio



Source: Pace

Exhibit 31 summarizes the results of the stochastic and scenario analyses for the portfolios created in Phase I. The metrics presented for the planning objectives are consistent with those introduced in the Planning Objectives and Metrics chapter. The emission reductions, cost, and price risk metrics are summarized as discussed in detail above. The table displays projected RPS percentage in 2020 and denotes which portfolios withstand reliability concerns. Those portfolios that add some local generation above baseline solar PV additions are qualitatively deemed to be positive, while the portfolio with substantial gas-fired local generation (Portfolio 6) is deemed best, because it provides 65 MW of reliable, in-city capacity. The table also provides additional comparative metrics on total capital charges, the percent dependence on the spot market, the added costs of attaining zero price for IPP sale, and the impact of carbon price risk on portfolio costs. This summary is used to illustrate portfolio strengths and weaknesses and to narrow the list of potential resource plans.

Exhibit 31: Phase I Portfolios Summary Metrics

Portfolio	Emissions Reduction	Cost	Price Risk	RPS 2020	Reliability	Capital Charges	Spot Market Dependence 2020	IPP Sale Feasibility	Carbon Price Risk
	% Reduction from 2008	*Levelized $/MWh*	*Added cost for 95% $/MWh*	*% of NEL*		*Annual Levelized $MM in 2030*	*% of 2020 Load*	*Added Cost Levelized $/MWh*	*Added Cost Levelized $/MWh*
Status Quo	12%	89	9	12%		0	4%	0	20
1: Low LFG/Geo	25%	94	12	31%		21	22%	0	16
2: Low Wind	24%	94	12	29%		21	20%	0	17
3: Low Solar	23%	96	13	28%		24	19%	0	17
4: Low Local	26%	99	14	33%	✓	23	26%	0	16
5: Med Remote Renew	49%	107	27	58%		65	26%	8	11
6: Med CC	60%	105	26	33%	✓+	34	-2%	24	10
7: Med Local	52%	112	21	38%	✓	17	-40%	24	13
8: High Diverse	74%	113	26	74%	✓	49	-8%	24	7
9: High LFG/Geo	81%	107	27	72%		58	3%	24	5
10: High Wind/Solar	73%	127	42	66%		94	-4%	24	6

Source: Pace

Hybrid Portfolio Construction

The ability to identify and quantify the effects of different uncertainties on the specified metrics of each portfolio can be used to target particular portfolio characteristics that are desirable by the utility. This process can lead to the development of "hybrid" portfolios. For this analysis, hybrid portfolios were created based on the desirable characteristics of portfolios with similar metrics. This facilitates the comparison of portfolios and allows the insights obtained from the risk analyses to enhance the decision-making process. The hybrid portfolios created for this analysis are summarized below.

Hybrid Portfolio "1a"

Portfolio "1a" was created based on a combination of desirable characteristics in portfolios 1 to 4. These can be summarized as follows:

- Landfill and geothermal are the least costly renewable additions feasible for Pasadena. Subject to availability, capacity from these resources is desirable over other renewable options.
- Additional local renewables improve emission reductions and potentially reduce reliability risks.

Exhibit 32 presents the capacity mix assumed for Portfolio 1a in comparison with the resource additions in Portfolios 1 to 4.

Exhibit 32: Hybrid Portfolio 1a Characteristics

		Remote Renewables				Local Renewables/DSM					Fossil-fueled	
Carbon Reduction Target	Portfolio #	Landfill	Geo thermal	Wind	Solar Thermal	Solar PV (Existing)	Solar PV (Expand)	Feed-In Tariff	Energy Efficiency	DR & RA	Local Gas	Coal
Low	1	15	15			14			26			
	2	10	10	20		14			26			
	3	10	10		20	14			26			
	4	10	10			14	15	21	34			
	1a	15	15	10	10	14	5	5	26	5		

Source: Pace

Hybrid Portfolios "5a" and "5b"

Portfolios "5a" and "5b" were created based on the strengths of several other portfolios. These can be summarized as follows:

- Displacing only a portion of IPP reduces the risk associated with obtaining little or no revenue for its power. According to input from PWP, a displacement of 35 MW may be the most practical and feasible option for the utility at this time. This amount is based on the capacity currently deemed most feasible to sell. The 35 MW is comprised of one contract share that is currently recallable in Utah and a remaining share of capacity above and beyond minimum capacity factor requirements.
- Additional gas-fired, in-city generation addresses reliability concerns tied to the reliance of Pasadena on aging local generation.
- Greater diversification of renewable capacity additions with a greater emphasis on local generation improves emission reductions, increases RPS, decreases reliance on one technology type, and improves reliability.

Exhibit 33 presents the capacity mix assumed for portfolios 5a and 5b in comparison with the resource additions for the other medium and high emission reduction portfolios.

Exhibit 33: Hybrid Portfolios 5a and 5b

		Remote Renewables				Local Renewables/DSM					Fossil-fueled	
Carbon Reduction Target	Portfolio	Landfill	Geo thermal	Wind	Solar Thermal	Solar PV (Existing)	Solar PV (Expand)	Feed-In Tariff	Energy Efficiency	DR & RA	Local Gas	Coal
Med	5: Med Remote Renew	15	15	60	60	14			26			-47
	5a: Med Diverse Renew	15	15	20	20	14	5	10	26	5		-35
	5b: Med CC Renew	15	15	20	20	14	5	10	26	5	-65 + 65	-35
	6: Med CC	15	15			14			26		65	-108
	7: Med Local	5	5			14	15	21	34	55		-108
High	8: High Diverse	25	25	10	10	14	15	21	34	25		-108
	9: High LFG/Geo	25	65			14			26			-108
	10: High Wind/Solar			125	125	14			26			-108

Source: Pace

SUMMARY OF PLANNING OBJECTIVES AND PORTFOLIO METRICS

Exhibit 34 summarizes the results of the stochastic and scenarios analyses for all the portfolios created in Phase I and the hybrids developed during the Phase II analyses. As was shown above, in addition to the key results for emission reductions, cost, and price risk, all other metrics are quantified or summarized so all options can be compared across objectives. Additional detail on the summary metrics, the stochastic analyses, the sensitivity analysis, and the individual portfolio results can be found in the appendix section on Phase II Risk Analysis. This summary analysis formed the basis by which to compare portfolios and identify the preferred option, as outlined in the following chapter.

Exhibit 34: Phase I and Hybrid Portfolios Summary Metrics

Portfolio	Emissions Reduction	Cost	Price Risk	RPS 2020	Reliability	Capital Charges	Spot Market Dependence 2020	IPP Sale Feasibility	Carbon Price Risk
	% Reduction from 2008	*Levelized $/MWh*	*Added cost for 95% $/MWh*	*% of NEL*		*Annual Levelized $MM in 2030*	*% of 2020 Load*	*Added Cost Levelized $/MWh*	*Added Cost Levelized $/MWh*
Status Quo	12%	89	9	12%		0	4%	0	20
1: Low LFG/Geo	25%	94	12	31%		21	22%	0	16
2: Low Wind	24%	94	12	29%		21	20%	0	17
3: Low Solar	23%	96	13	28%		24	19%	0	17
4: Low Local	26%	99	14	33%	✓	23	26%	0	16
1a: Low Diverse	29%	96	16	40%	✓	31	29%	0	15
5: Med Remote Renew	49%	107	27	58%		65	26%	8	11
5a: Med Diverse Renew	38%	101	18	58%	✓	39	21%	5	13
5b: Med CC Renew	40%	94	23	41%	✓+	51	41%	5	12
6: Med CC	60%	105	26	33%	✓+	34	-2%	24	10
7: Med Local	52%	112	21	38%	✓	17	-40%	24	13
8: High Diverse	74%	113	26	74%	✓	49	-8%	24	7
9: High LFG/Geo	81%	107	27	72%		58	3%	24	5
10: High Wind/Solar	73%	127	42	66%		94	-4%	24	6

Source: Pace

SELECTION OF THE PREFERRED RESOURCE PLAN

The IRP process is designed to evaluate different resource options against the utility's planning objectives and required metrics. The tradeoffs between different resource options and planning strategies can be better compared when the risks associated with each alternative are methodically analyzed and understood. The planning process has been applied throughout PWP's 2009 IRP process, and is designed to quantify risk and identify the portfolio characteristics that help the utility achieve its desired metrics under different market and regulatory uncertainties.

Defining the utility's planning objectives is critical to the success of any IRP process. PWP and the Stakeholder Advisory Group defined the planning objectives of this study early in the process. A reminder of the primary planning objectives and associated metrics is presented in Exhibit 35.

Exhibit 35: Summary of Primary Planning Objectives and Associated Metrics

Objective	Metric	Unit
Environmental Leadership	CO_2 Emission Reductions in 2020 from 2008 Baseline	%
	Renewable generation as a percentage of net energy for load	%
Preserve Competitive Rates	Mean of the levelized NPV of Total Portfolio Costs	*2008* $/MWh
Maintain Stable Rates	Difference between the mean of the distributions and the 95% confidence band	*2008* $/MWh
Provide Reliable Service	Exposure to risk of loss of existing local, in-city resources	Qualitative
Maintain Fiscal Health	Levelized costs of all capacity additions in 2030	*2008* $000
Manage Market Risks	Annual volume of net market transactions as a percentage of load in 2020	%
Allow for Flexibility	Exposure to risk of emerging GHG regulations and market mechanisms	Qualitative

Source: Pace

The planning process quantifies the impact of different uncertainties and allows for the ranking of each portfolio based on each of the outlined metrics. The selection of the best portfolio, however, will depend on the importance the stakeholders place on each planning objective.

The following sections outline the portfolio selection process and define the ranking of a selection of options based on all planning metrics.

PORTFOLIO PERFORMANCE ASSESSMENT

Through this portfolio evaluation process, some portfolios were eliminated on the basis of costs and risks; others were eliminated because of feasibility concerns. The metrics of even those portfolios that were ultimately eliminated, however, were carefully analyzed. In some cases, the desirable characteristics of distinct portfolios were combined to create hybrids that would perform better under all uncertainties. A summary of the portfolio elimination and selection process is presented below. For reference, the summary metrics for all portfolios are shown in Exhibit 36.

Exhibit 36: Portfolios Summary Metrics

Portfolio	Emissions Reduction	Cost	Price Risk	RPS 2020	Reliability	Capital Charges	Spot Market Dependence 2020	IPP Sale Feasibility	Carbon Price Risk
	% Reduction from 2008	*Levelized $/MWh*	*Added cost for 95% $/MWh*	*% of NEL*		*Annual Levelized $MM in 2030*	*% of 2020 Load*	*Added Cost Levelized $/MWh*	*Added Cost Levelized $/MWh*
Status Quo	12%	89	9	12%		0	4%	0	20
1: Low LFG/Geo	25%	94	12	31%		21	22%	0	16
2: Low Wind	24%	94	12	29%		21	20%	0	17
3: Low Solar	23%	96	13	28%		24	19%	0	17
4: Low Local	26%	99	14	33%	✓	23	26%	0	16
1a: Low Diverse	29%	96	16	40%	✓	31	29%	0	15
5: Med Remote Renew	49%	107	27	58%		65	26%	8	11
5a: Med Diverse Renew	38%	101	18	58%	✓	39	21%	5	13
5b: Med CC Renew	40%	94	23	41%	✓+	51	41%	5	12
6: Med CC	60%	105	26	33%	✓+	34	-2%	24	10
7: Med Local	52%	112	21	38%	✓	17	-40%	24	13
8: High Diverse	74%	113	26	74%	✓	49	-8%	24	7
9: High LFG/Geo	81%	107	27	72%		58	3%	24	5
10: High Wind/Solar	73%	127	42	66%		94	-4%	24	6

Source: Pace

Initial Portfolio Evaluation and Elimination

- **Low Emission Reduction Concept:** Portfolios 1, 2, 3, and 4 perform very similarly on emission reductions, cost, and risk metrics.
  - To simplify the comparison of portfolios going forward, Pace analyzed the best performing aspects of these portfolios and combined them to create a "hybrid" portfolio.
    - Portfolio "1a" is created based on a combination of portfolios 1 to 4.
    - Portfolios 1 to 4 are eliminated

- **Medium Emission Reduction Concept:** Portfolios 5, 6, and 7 achieve similar emission reductions. The costs associated with portfolio 7, however, are significantly higher than the costs for 5 and 6.
  - Portfolio 7 is eliminated based on Total Cost
  - Portfolio 5 is not fully exposed to IPP sale risk and is low cost, but may not adequately address reliability concerns tied to reliance on aging local generation
  - Portfolio 6 addresses reliability concerns with new local gas-fired generation, but has higher costs and more exposure to market volatility and IPP sale price
    - The strengths of portfolios 5 and 6 were combined to create portfolios 5a and 5b

- **High Emission Reduction Concept:** Portfolios 8, 9, and 10 achieve similar emission reductions. The costs and risks associated with portfolio 10, however, are significantly higher than those for portfolios 8 and 9.
  - Portfolio 10 is eliminated based on Total Cost

- o In addition to the risk associated with the sale of IPP power, Portfolio 9 is heavily reliant on low-cost LFG and Geo, which have uncertainty associated with their general availability and with regard to transmission to PWP.
  - ▪ Portfolio 9 is eliminated, with the recognition that LFG and Geo procurement should still be pursued as much as possible.

Selected Portfolio Ranking

A summary of the metrics and ranking of the initial selection of portfolios discussed above is shown in Exhibit 37. For ease of comparison, red, yellow, and green rankings are provided for each category to highlight the relative performance of each of the portfolios across each objective. Some of the key points and conclusions include:

- Portfolio 1a has the lowest cost and price risk but, because it holds all of IPP, it achieves the smallest emission reductions and is significantly exposed to the impact of higher CO_2 pricing. Also, it may not adequately address reliability concerns.
- Portfolio 5 requires the most capital investment but achieves nearly 50% emission reductions; however, it may not adequately address reliability concerns.
- Portfolio 5a achieves moderate emission reductions, mitigates risk of IPP sale, and has low market risk; however, it may not adequately address reliability concerns.
- Portfolio 5b achieves moderate emission reductions at relatively low cost; however, it directly addresses reliability concerns due to the addition of new local gas-fired generation.
- Portfolio 6 achieves significant emission reductions but at a higher cost and with exposure to market and IPP sale uncertainty; however, it directly addresses reliability concerns.
- Portfolio 8 achieves the highest emission reduction, but at highest cost, exposure to IPP sale uncertainty; moreover, it may not adequately address reliability concerns.

Exhibit 37: Final Portfolio Ranking

	Primary Objectives					Secondary Objectives			
Portfolio	Emissions Reduction	Cost	Aggregate Price Risk	RPS 2020	Reliability	Capital Charges	Spot Market Dependence 2020	IPP Sale Feasibility	Carbon Price Risk
	% Reduction from 2008	*Levelized $/MWh*	*95% $/MWh*	*% of NEL*		*Annual Levelized $MM in 2030*	*% of 2020 Load*	*Added Cost Levelized $/MWh*	*Added Cost Levelized $/MWh*
Status Quo	12%	89	103	12%		0	4%	0	20
1a: Low Diverse	29% (red)	96 (green)	110 (green)	40% (yellow)	(yellow)	31 (green)	29% (yellow)	0 (green)	15 (red)
5: Med Remote Renew	49% (yellow)	107 (yellow)	133 (yellow)	58% (green)	(yellow)	65 (red)	26% (yellow)	8 (yellow)	11 (yellow)
5a: Med Diverse Renew	38% (yellow)	101 (yellow)	118 (green)	58% (green)	(yellow)	39 (green)	21% (yellow)	5 (yellow)	13 (yellow)
5b: Med CC Renew	40% (yellow)	94 (green)	115 (green)	41% (yellow)	(green)	51 (yellow)	41% (yellow)	5 (yellow)	12 (yellow)
6: Med CC	60% (green)	105 (yellow)	135 (yellow)	33% (yellow)	(green)	34 (green)	-2% (green)	24 (red)	10 (yellow)
8: High Diverse	74% (green)	113 (red)	136 (yellow)	74% (green)	(yellow)	49 (yellow)	-8% (green)	24 (red)	7 (green)

Source: Pace

As is shown in Exhibit 37, Portfolio 5b performs best in all of the primary objectives. It achieves the major environmental goals and performs best or second best on the cost, aggregate price risk (cost plus risk), and reliability metrics. The portfolio receives no red rankings and totals three out of five green rankings across the primary objectives. For each of the secondary objectives, Portfolio 5b achieves rankings in the middle of all of the candidate resource plans, indicating that there are no major weaknesses that should disqualify the option. For many of the secondary objectives, Portfolio 5b represents a compromise between more divergent plans.

RECOMMENDED IRP STRATEGY

The preferred portfolio options can be summarized according to different emission reduction options, as outlined below:

- **Reduce GHG emissions by about 30% (Portfolio 1a)** by 2020 through modest additions of renewable energy and other clean resources. This option seeks to minimize the upward pressure on PWP's costs, but may not address reliability concerns and PWP's ability to satisfy emerging environmental obligations.

- **Reduce GHG emissions by about 40% (Portfolio 5b)** by 2020 through a diverse mix of renewable energy, other clean resources, and efficient new natural gas-fired generation inside Pasadena. This option attempts to balance environmental, cost and reliability objectives without subjecting PWP to extreme risks.

- **Reduce GHG emissions by about 60% (Portfolio 6)** by 2020 through completely displacing existing coal resources and replacing them with efficient new natural gas-fired generation and modest additions of renewable energy and other clean resources. This option addresses reliability risks, but at higher cost and the risk that full coal displacement is infeasible.

- **Reduce GHG emissions by about 75% (Portfolio 8)** by 2020 through completely displacing existing coal resources and replacing them with a diverse mix of renewable energy and other clean resources. This option provides the highest GHG emissions reductions, but is the most expensive of the four options and may not adequately address reliability concerns associated with continued reliance on the aging local generating units.

A final selection among these alternatives required specific decisions in consultation with all stakeholders about the preferred balance between greater GHG emissions reductions, higher costs, and infrastructure improvements to reduce reliability risks.

The assessment of the impact of different risks and uncertainties on all portfolios has provided valuable insights into the best alternatives for PWP to mitigate risks and achieve its planning objectives. Key items that were considered in the recommendation of a Preferred Resource Plan included:

- **Minimum Environmental Performance:** Portfolio options break down into low, medium, and high emission reduction targets

- If the low reduction is considered a “non-starter” because it is deemed insufficient for likely carbon limits, then Portfolio 1a can be eliminated

- **IPP Sale Feasibility:** Uncertainties regarding the sale of IPP power may dictate how much is removed from the portfolio, and the level of emission reductions that is achievable
  - If no more than a 35 MW displacement is considered feasible at the present, then Portfolios 6 and 8 can be eliminated
- **Reliability:** What local infrastructure investments provide acceptable reliability?
  - If new local gas-fired generation is considered essential to providing an acceptable assurance of reliability (rather than extending the life of existing local units plus potential transmission system upgrades), then Portfolios 5, 5a, and 8 can be eliminated

After considering all metrics and these specific questions, the unanimous selection of the Stakeholder Advisory Group was Portfolio 5b. This portfolio consists of a diverse portfolio of 65 MW of new combined cycle capacity to replace old inefficient turbines and secure local generation options into the future, some remote renewable power from geothermal, landfill gas, solar, and wind, considerable energy efficiency, local solar PV and feed-in tariff options, and a significant reduction in coal-based IPP generation. This provides an intermediate reduction in carbon from current levels, meets expected RPS requirements through 2020, is the most reliable of the portfolio options as the result of preserving local generation and does so in a cost-effective manner. Of all the portfolios it has the highest ratio of positive (green light) rankings to negative (red light) of any of the portfolios and also is the most diverse.

For all of the above reasons, Pace recommends this portfolio as the Preferred Resource Plan, but also suggests that PWP keep its options open by evaluating its contractual obligations regarding IPP and re-evaluating as more information becomes available. The following section outlines a near term action plan that provides flexibility to adapt to changing conditions as more information becomes available, with the primary objective to follow a course consistent with Portfolio 5b.

ACTION PLAN

The Preferred Resource Plan includes the following key elements, which will require PWP to take specific actions to begin reconfiguring its existing portfolio over the next several years:

- **Coal Power Displacement:** By 2016, reduce purchases of power from the IPP coal plant of at least 35 MW
- **New Local Gas-Fired Generation:** By 2014, retire the existing 65 MW Broadway 3 power plant and replace it with a comparably sized new combined cycle plant at the same site
- **Energy Efficiency and Load Management:** Implement programs to achieve significant reductions in electricity consumption according to the following timeline:
  - **Energy Savings:** Reduce energy sales by 12.5% below expected levels by 2016
  - **Peak Load Savings:** Reduce peak load by 10% below expected levels by 2012
  - **Demand Response:** Reduce peak load by an additional 5 MW by 2012 through programs that provide customers with information and economic incentives to reduce their consumption during peak load periods
- **Renewable Energy:** By 2020, increase the proportion of PWP's energy mix provided by renewable energy sources to 40% according to the following general guidelines:
  - 15% by 2010
  - 33% by 2015
  - 40% by 2020
- **Solar Photovoltaic:** By 2020, develop programs to add at least 15 MW of solar photovoltaic installations in Pasadena according to the following timeline:
  - 3 MW by 2010
  - 10 MW by 2015
  - 15 MW by 2020
  - 19 MW by 2024
- **Feed-In Tariff:** By 2020, establish a feed-in tariff program offering to purchase up to 10 MW of qualifying renewables of all technologies located inside Pasadena at a price up to 15 cents/kWh
- **GHG Emissions Reductions:** By 2020, achieve CO_2 emissions reductions of at least 40% according to the following timeline:
  - 5% by 2010
  - 25% by 2015
  - 40% by 2020

This Preferred Resource Plan aligns with Portfolio 5b described above, but maintains a significant measure of flexibility to adapt to options regarding IPP and future regulations, and is a course that addresses all of the concerns associated with the previous IRP and the recommendations of the Environmental Advisory Commission.

- The approach fully considered all relevant technologies
- Both current and potential future environmental regulations were fully evaluated
- Competing objectives of cost competitiveness, risk and environmental stewardship were considered

- Reliability was considered in the context of both local generation and transmission options
- The potential of energy efficiency and load management was considered
- The risks and opportunities for reducing reliance on conventional coal fired generation were evaluated.

Every attempt was made to provide PWP and the Stakeholder Advisory Group a fair assessment of the trade-offs associated with a range of portfolio options and both market and regulatory outcomes over time. Fortunately, after full consideration of these options, a consensus solution was reached by PWP, the Stakeholder Advisory Group and the Consultant, on the best Portfolio and Actions that will provide guidance going forward considering the flexibility needed to adapt to changes over time.

In order to implement the Preferred Resource Plan, PWP should perform a series of ongoing evaluations to ensure that the plan can be adapted to changing circumstances, including:

- An evaluation of PWP customers' appetite for paying premiums for environmental stewardship
- An evaluation of the potential sales, GHG accounting treatment, and price for power sales from IPP
- An evaluation of whether new local gas-fired generation or transmission system enhancements (or both) is the preferred approach for ensuring reliability
- An evaluation of the availability of low cost geothermal and landfill gas renewable energy projects to achieve potential cost reductions

Regardless of the outcome of these evaluations, PWP should immediately commence with the following short-term implementation steps that are common among all of the long-term strategies:

- Continue securing contracts for power from a diverse mix of new renewable energy sources, balanced among landfill gas, geothermal, wind and solar projects
- Expand PWP's already aggressive energy efficiency programs
- Develop demand response programs and rates to provide customers with economic incentives to reduce their peak electricity consumption
- Develop a new "feed-in tariff" program in which PWP will offer to purchase power, at a fixed price, to any qualifying renewable energy project within the City in order to facilitate the development of local renewable energy sources
- Evaluate innovative new financing approaches and electric rate structures in order to spur more PWP customers to install solar photovoltaic projects inside Pasadena

The details for introducing and carrying out successful programs and initiatives in these areas should be outlined by PWP in a long-term implementation plan to be completed in the near future.