

DRAFT

Pasadena Water and Power

Integrated Resource Plan

2007

**January 31, 2007**

## **Section 1 - Executive Summary**

### ***Key Findings and Recommendations***

Pasadena Water and Power (PWP) continues to focus on delivering reliable, low cost, and environmentally responsible electricity to the Pasadena community. PWP has a stable supply of fixed-rate electrical energy available through a series of long-term power purchases. PWP also remains committed to maintaining local generation to ensure a secure and reliable source within the city.

The age of the local generation -- three of the five local units have been in service for more than 40 years -- should be corrected. This resource plan recommends replacing these three units over a five- to seven-year timeframe with newer technology that burns natural gas more efficiently at a lower overall cost and with fewer environmental impacts.

The plan also addresses the ongoing efforts to introduce more renewable resources into Pasadena's energy portfolio. The renewable projects available in the western states have increased tremendously in the last several years, as all power utilities work to fulfill their Renewable Portfolio Standards. These goals within Pasadena that are set by the City Council remain at 10 percent renewable energy (including large hydro) by 2010 and 20 percent renewable energy (including large hydro) by 2017. Joining the global effort to curb greenhouse gas emissions is central to the evolution of the city's power resource portfolio.

At the same time, PWP continues to improve its energy efficiency programs. The programs have centered on public awareness and targeted rebates for improving energy efficiency citywide, among both residential and commercial consumers. While Pasadena does have a reliable power supply for the foreseeable future, efficiency programs are nevertheless cost-effective to reduce peak power. As part of these conservation efforts, the city of Pasadena continues its commitment to the green building movement, in which long-term energy savings are obtained through efficient new construction and restoration of existing infrastructure. These energy efficiency measures are an effective means of reducing the environmental impacts of power production by reducing greenhouse gas emissions.

This Integrated Resource Plan also recognizes continuing changes to the energy market and the need for PWP to understand, adopt and manage this change. This requires recognition of the dynamics of the evolving market, as well as preparedness for an aging workforce. This means ensuring that PWP concentrates on doing the right things correctly, and committing valuable human resources to those activities that will best maintain the utility's infrastructure assets. While the local generation plant requires new technology, it also requires new facilities and the ongoing development of plant personnel. The interaction of resources, efficiency, demand-side response, markets and reliability is complex and challenging.

Along these same lines, the personnel responsible for the long-term contractual agreements for future power resources, as well as the personnel responsible for the mid-

term and short-term marketing of power and natural gas, must continue to be supported in the organization. This will ensure the complex energy portfolio that provides reliable, environmentally responsible and cost-effective electricity to the city is maintained and improved through the coming decades.

The California energy market remains a work in progress, with great uncertainty and many divergent viewpoints on its future direction. PWP continues to understand the importance of monitoring and managing this uncertainty and providing a buffer for customers. A municipal utility should not be paternalistic, but it should provide a service; in the current evolution of the California energy market, this service includes managing complexity and uncertainty.

### ***Power Requirements***

The city of Pasadena's power requirements are driven by the city's General Plan, customer habits and the success of PWP's conservation message. The General Plan calls for growth to serve community needs and to enhance quality of life. This growth has most recently been impacted by the Gold Line, which has generated a series of mixed-use development complexes. While the city's major institutions, including Caltech, Huntington Hospital and the Rose Bowl, continue to flourish and benefit the community, their growth translates to increased energy use.

The impact of this increased consumption is mitigated by energy-efficient building standards, ongoing efficiency improvements in electrical appliances and the continued promotion of conservation by PWP and the state. Despite the success of our community, Pasadena has seen little growth in electricity consumption, and the forecasts for growth indicate a modest increase over the next decade, with a flattening as the city reaches an energy equilibrium.

### ***Power Supply Resources***

PWP has a respected history of providing long-term solutions for the city's power needs. The continuous availability of local generation for over 100 years has been instrumental in supporting both the development and quality-of-life goals of the city. Pasadena was an original participant in the Hoover Dam project during the 1930s, and has continued to invest in large projects to build a stable and diversified energy portfolio.

Since the adoption of Pasadena's Renewable Portfolio Standard in 2003, setting new goals for importing "green power," PWP has augmented its existing hydroelectric resources with investments in wind, geothermal and landfill gas projects.

### ***Regulatory Issues***

The California power market continues to work to establish a sustainable market infrastructure. The federal government continues to attempt to establish a stable energy market with reduced dependence on foreign oil. In the meantime, natural gas prices, the prime driver of California's power costs, remain at high levels, with significant volatility. This crucial commodity must be utilized as efficiently as possible. The natural gas market

is a significant factor in the recommendation to replace Pasadena's aging generation units with newer and more efficient technology.

At the same time, the California Independent System Operator (CAISO), established in 1996, is undertaking a major market redesign and technology upgrade. This initiative is currently slated to become operational in November 2007. This significant change will require continuing improvements to PWP's information systems, as well as significant training within PWP's Wholesale Operations Group, which interacts with CAISO on a daily basis.

The California State legislature continues to support initiatives to improve the functioning of the energy market and to encourage the implementation of energy efficiency programs and adoption of renewable resources. The adversarial regulatory environment established for investor-owned corporations is not appropriate for publicly owned utilities that are guided by directly elected representatives. This difference between for-profit private corporations and public municipalities continues to be a challenge in developing a comprehensive energy policy. PWP and the city council continue to work with California legislators to develop workable solutions on a variety of energy issues.

### ***Local Generation***

PWP has been providing the citizens of Pasadena with power since 1907. One hundred years ago, the savings PWP provided over private utility rates was approximately 40 percent. These savings continue today. During the deregulation movement of the late 1990s, many people believed local generation was not required. This was a mistake that was clearly seen in late 2000 and 2001, when the California energy crisis made national and international news. While this crisis has passed, the need to provide local generation continues. PWP depends tremendously on joint projects through entities like the Southern California Public Power Authority (SCPPA), but the ability to produce power locally remains a strong benefit to Pasadena's citizens, providing reliability and lower overall costs.

This Integrated Resource Plan strongly recommends replacing the city's three generation units (GT-1, GT-2, and B-3) that are over 40 years old. Along with this replacement, we recommend a new facility that supports a centralized operations center, maintenance facilities, engineering support and administrative offices. This effort is expected to take five to seven years to implement, as there are significant technical, logistic and staging issues to address.

### ***Greenhouse Gas***

Since the commercial operation of the Intermountain Power Project (IPP) in the 1980s, PWP has relied on low cost coal power to supply a majority of the electricity needs of the city. This reliance on coal is becoming a major issue as the impact of greenhouse gases is becoming more widely understood. A coal fired generation unit produce about twice as much carbon dioxide (CO<sub>2</sub>) as a natural gas fired generation unit. This plan recommends

a gradual reduction in the coal component of generation and recommends investigating carbon mitigation strategies as well as alternatives to IPP.

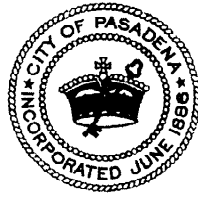
### ***Renewable Resources and Energy Efficiency***

PWP has made significant strides in procuring additional renewable resources and is on target for meeting the goals established by the City Council in 2003. This plan recommends continuing these efforts and increasing the goals for both 2010 and 2017.

PWP also recognizes that additional energy efficiency programs must be introduced and a methodology to measure the costs and benefits of these programs must be improved. The energy efficiency programs and demand side management programs introduced to date have been effective but more can be done.

### ***Balance***

As mentioned throughout this report, PWP must balance many conflicting interests. Customers want low cost and reliable electricity at a stable price with little or preferable no adverse impacts on the environment. PWP hopes this report indicates that these competing goals are carefully considered and the recommendations are an effort to indicate a direction forward. This plan is an effort to articulate that direction, but the ultimate direction will be set by the citizens and business stakeholders in the community through the elected representatives on the City Council. PWP's priority is to serve the community and implement their vision for the City.



WATER AND POWER DEPARTMENT  
**MEMORANDUM**

June 13, 2007

To: ENVIRONMENTAL ADVISORY COMMISSION  
IRP AD HOC COMMITTEE

From: Eric R. Klinkner  
Assistant General Manager

Subject: **APPROVE IN CONCEPT PASADENA WATER AND POWER'S  
INTEGRATED RESOURCE PLAN**

Thank you for your thoughtful consideration and comments regarding Pasadena Water and Power's (PWP) 2007 Integrated Resource Plan (IRP).

Prior to directly answering questions in the IRP Ad Hoc Committee's June 7, 2007 memorandum on this issue, I believe that the following additional information and clarifications may be helpful to the Environmental Advisory Commission (EAC) in developing their recommendation to the City Council regarding the IRP.

PWP's recommendation that the City Council approve the IRP "in concept" means that the Council:

- Concurs with the key objectives to balance costs, reliability, and environmental impacts in the IRP process;
- Concurs with need to improve the efficiency and reliability of aging PWP's local generation facilities in order to meet reliability requirements and reduce fuel consumption and emissions; and,
- Recognizes the need to continue procuring cost effective renewable resources to meet the existing Renewable Portfolio Standard (RPS) goal and continue implementing cost-effective energy efficiency programs.

The IRP is PWP's least-cost resource plan to meet the City's electric loads within the constraints of existing policy objectives and regulatory requirements such as safety, reliability and environmental stewardship. The EAC will have an opportunity consider changes to the relevant resource planning policies and objectives in the near future, as

PWP anticipates bringing forth several specific recommendations for Council consideration in the coming months, including:

- Adoption of enhanced energy efficiency and demand response goals to decrease overall consumption of electric power and peak demand in the city of Pasadena;
- Establishment of enhanced RPS goals;
- Adoption of goals for PWP's solar photovoltaic program; and,
- Establishment of rate mechanisms to provide additional funding necessary to implement the above goals.

The EAC will have an opportunity to review each of these policy recommendations and advise the Council. As more aggressive goals are established, PWP's planning, procurement, and programs, will be updated accordingly and future IRP's will reflect such goals.

In any case, PWP will continue its efforts to meet Pasadena's Urban Environmental Accords goals through the following activities:

- Seeking out cost effective renewable resources, regardless of whether the established RPS goal has been exceeded;
- Maximizing the energy efficiency gains from existing Public Benefits funds;
- Offering a relatively high incentive for PV systems to residential customers;
- Along with other Southern California Public Power Authority (SCPPA) members, proactively pursuing carbon reduction strategies for Intermountain Power Project (IPP) by through feasibility studies, and lobbying for government funding for carbon removal and sequestration test site; and
- Seeking feasible and economic options to reduce its dependency on coal through partial divestiture of IPP.

In conclusion, PWP has recommended that the City Council adopt the 2007 IRP in order to support PWP's immediate efforts to initiate the local generation project, procure additional renewable resources beyond the current RPS target (which has already been substantially exceeded), and enhance energy efficiency programs as described in the IRP. PWP respectfully requests the EAC to provide their recommendations to the Council in light of existing policy in addition to any comments the commission may offer regarding development of more ambitious policy goals.

PWP's response to the "Summary of the Committee's Comments and Questions" from the June 7 memo follows.

### Summary of the Committee's Comments and Questions

1. *The RPS goals do not appear consistent with Pasadena's promotion of itself as a green leader. As a minimum it would seem that a goal of 20% renewables (excluding large hydro) by 2010 be adopted, in keeping with mandates for IOU's. The Cities of Oakland and Los Angeles are given as examples of cities with goals higher than Pasadena. The example of Oakland has two target numbers: one for the RPS process (20%) and another overall City goal (40-50%).*
  - PWP will support the City's environmental goals. As stated above, the IRP is PWP's plan to achieve existing goals in a cost effective manner. While the IRP suggests the economically achievable and feasible level of renewables, given current policy, available resources, and the underlying economic assumptions included in the study, the RPS targets could be set higher for policy reasons.
  
2. *Given the limitations on importation of renewable energy from outside the City, there should more exploration and quantification of the potential for distributed solar energy within the City. What are the theoretical maximum capabilities, and what could be done to increase this source? A study on the potential for commercial and residential opportunities is needed.*
  - Import limitations are not a significant issue for acquiring additional renewable resources outside of Pasadena, but do create a need to maintain local capacity and increase the value of reliable distributed resources.
  - As shown in the table on Page 5, PWP's current PV incentive is a relatively low-cost means to reduce GHG emissions from a rate impact perspective; however, the total or "societal" cost is very on a per-pound reduction basis. Residential customer participation has not been strong due to high initial system costs and relatively long payback. PWP's commercial customers are currently not eligible for an incentive. PWP will be recommending that the Council adopt goals (tentatively in July or August) to increase the use of PV in Pasadena through increased funding and broader eligibility for PWP's PV program. Under SB-1, PWP's share of the 3,000 MW statewide PV goal is approximately 14 MW by 2017.
  - PWP's theoretical maximum PV penetration is not known at this time, nor are any studies currently underway to analyze this potential.
  
3. *Similarly, there needs to be more quantification of the historical and future potential of conservation and efficiency measures, and their relationship to cost.*
  - From a societal and ratepayer perspective, energy efficiency appears to be the most cost-effective means to meet Pasadena's environmental goals. PWP will be recommending that the Council adopt specific goals (tentatively in July or August) to increase PWP's energy conservation and demand reductions efforts through increased funding. PWP will be challenged to ramp up its capabilities in this area.



- PWP estimates the cumulative impact of past energy efficiency (EE) programs to be about 60 GWh/year (or 5% of annual load) as of FY2006. In FY2006, PWP's EE programs resulted in a 0.34% annual load, and this amount is the assumed "status quo" baseline level of future EE in the IRP.
4. *The plan should be reviewed in time periods of 18 months or less to ensure it reflects relevant current conditions. The City should consider an annual review of green energy portfolio options, conservation/energy efficiency, and greenhouse gas inventory results.*
    - While PWP concurs in principle, the IRP is a costly and resource-intensive effort that PWP has historically undertaken about every five years. This timeframe generally coincides well with the timeline to implement the major IRP recommendations (such as repowering local generation or contracting for a set of new renewable resources). Preparing the IRP involves substantial research on resource options and energy market trends; contracting (and educating) outside consultants to model and analyze PWP's loads and resources; developing reports and presentations; and seeking input from the public. Key challenges for routine IRP updates include staff resources, costs to perform analysis, procure and maintain appropriate software, and maintaining current knowledge of supply and demand side options. There may be less formal means to periodically review PWP's progress and alternatives.
  5. *There should be a means to begin evaluat[ing] costs in a way that incorporates environmental impacts. One means to do this would be to consider the relationship between the energy portfolio and GHG emission (as tracked through the California Climate Action Registry).*
    - This is appropriate. The IRP included a scenario with \$10/ton carbon pricing and higher natural gas prices (a reasonable consequence due to increased demand for gas as coal is used less). The table below summarizes the levelized annual costs for various scenarios and portfolios (in \$ millions).

Portfolio	GED Gas Market		High Gas Market			High Gas + Carbon Tax		
	Annual Cost	Portfolio Savings	Annual Cost	Portfolio Savings	Scenario Increase	Annual Cost	Portfolio Savings	Scenario Increase
As-Is	58.3	--	67.1	--	8.7	75.5	--	17.1
LM6000 Simple Cycle	59.0	(0.7)	65.1	2.0	6.1	73.5	2.0	14.4
LM6000 Combined Cycle	57.2	1.1	59.7	7.4	2.5	67.8	7.7	10.6
LMS100 Combined Cycle	55.2	3.2	55.9	11.1	0.8	63.9	11.6	8.7
Wartsila	59.1	(0.8)	64.6	2.5	5.4	72.9	2.6	13.8
Aggressive RPS (+LMS CC)	58.7	(0.3)	62.5	4.6	3.9	70.4	5.1	11.8

- Key observations: While annual costs under the aggressive RPS portfolio are less susceptible to high gas costs and carbon taxes than the "As-Is" portfolio, the LMS-100 CC portfolio performs better in all scenarios.

- Another way to consider the issue is to evaluate which resources can reduce carbon at the lowest relative cost. The table on Page 5 shows that, unlike any other supply-side resource, the combined cycle plant can reduce emissions and costs. Several renewable resource can reduce emissions for less than the \$25/ton "benchmark" that is commonly used as a high-end cost.

**Options to Reduce Green House Gases - Comparative Costs**

Energy Resource Option	Energy Resource Characteristics			Relative Cost to Reduce Emissions		
	Energy Cost (\$/MWh)	Market Value <sup>2</sup> (\$/MWh)	GHG Emission Rate <sup>3</sup> (tons/MWh)	vs Market Value <sup>4</sup> (\$/ton)	vs New CC (\$/ton)	vs IPP (\$/ton)
<b>Existing Resources:</b>						
IPP (Marginal Costs)	20	55	1.00	--	--	--
Local Generation (M/C) <sup>1</sup>	78	70	0.54	47	--	125
<b>Utility Resources:</b>						
New Combined Cycle <sup>1</sup>	55	61	0.41	(19)	--	59
Biomass	65	55	0	14	24	45
Geothermal	65	55	0	14	24	45
Solar Thermal	125	77	0	69	171	105
Wind	60	50	0	15	12	40
<b>Distributed Resources:</b>						
Solar PV (system cost)	200	125	0	107	355	180
Solar PV (PWP incentive)	91	88	0	5	88	71

<sup>1</sup> Average fuel cost is approximately \$5.50/mmbtu

<sup>2</sup> Market Value reflects timing (on peak, base load, or intermittent) and location of energy output. Solar PV system cost compared to PWP average retail rate for illustration.

<sup>3</sup> Neglects fabrication, delivery, and construction emissions

<sup>4</sup> Assumes market emission rate of 0.7 tons/MWh

The chart above represents a simple "screening" analysis to identify the most cost-effective means of reducing greenhouse gas (GHG) emissions. The characteristics and

the market value of these generation resources are representative of the average values used in developing the 2007 IRP.

The three columns listed under "Relative Cost to Reduce Emissions" reflects the approximate cost premium incurred by PWP (or the customer) to reduce GHG emissions (in dollars per ton reduced) by selecting or utilizing alternative energy resources, as compared to various benchmarks, to meet PWP's electric demands. Specifically by:

1. Using the energy resource listed to offset market purchases. This is PWP's preferred metric, as it best represents PWP's options and operations;
2. Using the energy resource listed in lieu of a new combined cycle plant; and
3. Using the energy resource listed in lieu of taking full deliveries from PWP's coal plant

These illustrative results indicate the following:

1. A new combined cycle plant is the most cost effective means to reduce PWP's GHG footprint. In fact, PWP customers will actually save money as a result of this investment.
2. Assuming a desired maximum expense of \$10/ton for GHG emissions, PWP's solar incentive (at the current \$3.50/W) is the only renewable alternative that meets the target; however, from a customer or societal perspective (based on total system cost, before incentives), PV has the highest cost to reduce emissions by any measure.
3. Biomass, geothermal, and wind technologies could reduce GHG emissions for less than \$25/ton – commonly considered the upper threshold for an acceptable range of "carbon costs."
4. On average, backing down the output of IPP to reduce GHG emissions is a very expensive means to reduce PWP's carbon footprint.

Note that a higher gas cost would not reduce the cost effectiveness of a new combined to reduce GHG emissions, however it would increase the relative cost effectiveness of renewable resources.