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INTERVENOR CITY OF OXNARD

EXHIBIT ___

Testimony of James H Caldwell

Re: Project Need and Alternatives

I am a Consultant for V John White and Associates of Sacramento, CA. I am submitting this testimony on behalf of the City of Oxnard. A copy of my resume is included as an exhibit with the City of Oxnard's testimony. I actively participated in the CPUC 2012 Long Term Procurement Plan proceeding that led to the subject Application, published extensive peer-reviewed studies of California's electricity grid and its low carbon future and have reviewed the record in this proceeding. I have previously testified in CEC and CPUC proceedings and before the Board of the CAISO on matters related to this Application.

Summary of Testimony

This testimony addresses conclusions in the Final Staff Assessment (FSA), dated December 16, 2016, in Docket No. 15-AFC-01, Puente Power Project or "P3", regarding alternatives to P3. It also addresses whether P3 meets the public convenience and necessity and whether other alternatives are available as required by Public Resources Code § 25525; 20 C.C.R. §§ 1752(k), 1755(b). As set forth in my testimony, P3 is an oversized, inefficient and unnecessary response to the Local Capacity Requirements identified for the Moorpark subarea. The identified need as it exists today can be met with a much smaller solicitation of resources with a much broader range of technologies. These resources can almost certainly be preferred resources rather than a conventional gas fired plant. Or, if a gas-fired plant is eventually found to be necessary, it can be much smaller and more efficient than P3. Finally, there is ample time to assess new information about the viability of environmentally and economically superior alternatives to P3 that must inform a Commission decision before issuing an AFC for this project.

Statement

With the publication of the FSA last month, P3 is at the critical stage for an Energy Commission decision to authorize construction (grant an AFC) under the California Environmental Quality Act (CEQA) and CEC Siting Regulations. Regardless of how we have arrived at the current status of the project, it is time to step back and take one last hard look at the potential result of approving the project as defined.

There is no doubt that some investment in electric infrastructure in the "Moorpark region" that encompasses P3 is required. However, our conclusion is that, given

the existing record in this proceeding on land use, economics, reliability, and environmental grounds, the P3 project as defined by the FSA, represents, at best, an unnecessary, expensive, extremely unimaginative solution that barely satisfies short term reliability needs and runs counter to the state's long term goals for the electric sector. Therefore, the Commission cannot make the findings necessary to override Oxnard's land use authority to declare this project a non-conforming use to its General Plan. A new Request for Offers (RFO) could produce a much more robust selection of alternatives that would meet the actual need identified for the Moorpark area and would be consistent with both the City's land use policies and California's renewable procurement standards. There is no urgent need for immediate action to preserve grid reliability because there are multiple short term and long-term alternatives to P3 that have not been addressed in this Application.

Before discussing each of the above issue areas, the investment that is required versus the investment that is optional in the Moorpark region needs to be made clear. This was crystalized in the CPUC 2012 Long Term Procurement Plan Track 1 which dealt with, among other issues, local reliability needs that might be caused by the retirement of Ormond Beach Units 1 & 2 and Mandalay Units 1 & 2 in 2020-2021. This proceeding authorized SCE to "start the process to procure between 215 and 290 MW in the Moorpark sub-area of the Big Creek/Ventura local area.[1]" It is critical to understand that this finding identified a "need to mitigate reliability issues in the Moorpark sub-area of the Big Creek/Ventura local area, caused by a *contingency* (emphasis added) of voltage collapse from a potential loss of area transmission lines.[2]" No other "need" for new investment in the Moorpark sub-area has ever been found.

The extensive discussion in the FSA regarding the potential use of P3 to supply "flexibility" for future grid operations refers to a *system* operational need, not a *local* reliability need that would require those flexible resources to be located in the Moorpark sub-area. In fact, resources to supply this flexibility could be located anywhere within the eleven Western States, two Canadian provinces, and Baja California interconnected grid where sufficient transmission capacity is available for imports into the CAISO Balancing Authority. Every comprehensive study conducted regarding future Western electricity grid flexibility needs[3] has concluded that these needs over at least a fifteen year planning horizon can be met with existing resources. To provide this flexibility, historical business practices may need to be changed, tariffs may need to be amended, contracts may need to be renegotiated – all of which are feasible, environmentally superior, and cost

[1] CPUC D.13-02-015, Feb 13, 2013 at p. 73.
[2] id at p. 68
[3] See, e.g., Western Interconnection Flexibility Assessment, Energy + Environmental Economics and National Renewable Energy Laboratory, December 2015; or California 2030 Low Carbon Grid Study, Phase II at http://lowcarbongrid2030.org/materials/

effective, but the very large expenditure of California ratepayer money to construct new fossil resources such as P3 is not necessary. The "need" for P3 is solely based on the rare but serious local capacity requirement (LCR) related to transmission outages stated above.

In reaching its Moorpark sub-area need determination, the CPUC implicitly assumed that Mandalay 3, a 130 MW peaking plant adjacent to Mandalay 1 & 2, was operational – which, among other factors, led to a reduction from CAISO's original estimate of 430 MW need[4] that assumed Mandalay 3 as well as Mandalay 1 &2, was retired due to being 40 years of age -- the default planning assumption absent other specific information. In its 2014 - 2015 Transmission Plan (TPP), CAISO updated its local area need assessment for the Moorpark area. However, CAISO again assumed Mandalay 3 was retired. Even with the assumption that Mandalay Unit 3 had retired, CAISO now determined Moorpark area need to be only 230 MW in the year 2024. [5] This result was affirmed in the latest CAISO Local Capacity Technical Analysis[6] that determined Moorpark area need to be 234 MW in 2025. The substantial reduction in CAISO's estimate of local capacity need from its estimate in the 2012 LTPP was not the result of transmission upgrades or other physical changes to energy supply in the region, but rather to planned additional energy efficiency measures that reduced load forecasts and "updates to SCE system modeling that result in better representation of switching and utilization of existing static reactive support in the Moorpark sub-area and the surrounding area between the transient and post-transient time frame."[7] The CAISO, in all of the referenced studies, describes the need as mitigating the most critical contingency of the loss of the Moorpark-Pardee 230 kv #3 transmission line followed sometime later by the loss of the Moorpark-Pardee #1 and #2 lines, which, together, would cause voltage collapse in the Moorpark sub-area under peak load conditions. This is termed an "N-1-1 contingency." Voltage collapse is a very serious reliability issue and would, in this instance, cause the loss of about 1600 MW of customer load -- an area wide blackout of the entire Moorpark region. CAISO planning standards and practices (which are not in dispute here), following national and Western Interconnection reliability standards, require that

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[4] Opening Brief of the California Independent System Operator, R.12-03-014, September 12, 2012, Table 1 at p. 34

[5] Appendix E to CAISO 2014-2015 Transmission Plan, p. 86, https://www.caiso.com/Documents/AppendixEBoardApproved2014-2015TransmissionPlan.pdf

[6] Appendix D to CAISO 2015-2016 Transmission Plan, pdf p. 62. https://www.caiso.com/Documents/AppendixD-Board-Approved2015-2016TransmissionPlan.pdf

[7] Testimony of Robert Sparks on Behalf of the California Independent System Operator Corporation, CPUC A.14-11-016.

enough resources be available in the Moorpark area, as defined, to prevent this unplanned loss of load.

However, Mandalay 3 is not slated for retirement and will be available to help meet the identified need. Applicant, NRG, states: "it intends to continue operation of this unit as future market conditions allow. There is no looming regulation that affects Mandalay Unit 3's permitted operations. With continued maintenance, Mandalay 3 will be capable of operating well into the future.[8]

When the CPUC approved the 20-year PPA between SCE and NRG for the proposed P3 project in May of 2016, it also approved 12 MW of contracts with preferred resources that serve to fill a portion of the observed need.[9] Thus the remaining need to be filled by the 262 MW P3 project is: 230-234 MW of identified LCR need minus 130 MW Net Qualifying Capacity (NQC) for Mandalay 3, minus 12 MW NQC for the new preferred resource procurement equals 88-92 MW. Thus, P3 is significantly oversized for the indicated N-1-1 need.

LAND USE ISSUES

One only need glance at the cover of the FSA report to graphically illustrate the land use problems with the P3 project. If the project is completed as planned, Oxnard will be saddled with a 47 acre piece of prime beachfront property with 3 acres of new power plant including a 180 foot tall exhaust stack and 2 acres of filled coastal wetlands in the Northwest corner, and a three acre fifty year old power plant (Mandalay 3) on the Southeast corner with ramshackle buildings, sprawling waste ponds, scraped bare earth and stray pipelines in between. The existing site will consist of a 10-acre electric switchyard, with unused, rusting seventy-year old switchgear potentially containing PCBs and toxic heavy metals typical of switchgear of that age. It is hard to imagine a more unsightly and inefficient use of beachfront real estate. The site itself is in an aging, shrinking industrial area with McGrath Lake State Park to the North and planned upscale residential/retail development to the South. The site is located in an area subject to sea level rise, tsunami, and other coastal hazards. It is no wonder that the City of Oxnard has reaffirmed that the P3 project is a non-conforming land use under its General Plan. In the FSA, Staff has confirmed this designation and recommends a specific Commission override finding, which requires the Commission to find that: (1) that public convenience and necessity require the

[8] TN# 214303 http://docketpublic.energy.ca.gov/PublicDocuments/15-AFC-01/TN214303_20161031T163914_Applicant's_Responses_to_Robert_Sarvey's_Data_Request_Set_2.pdf

[9] A.14-11-016, Decision Approving, in part, Results of SCE LCR Request for Offers for Moorpark Sub-Area Pursuant to D.13-02-015, Issued June 1, 2016.

project, and (2) that there are not more prudent and feasible means of achieving public convenience and necessity. Pub. Res. Code § 25525. For the reasons detailed below, we do not believe this finding can be made based on the information in the FSA.

RELIABILITY CONSIDERATIONS

Grid reliability considerations exist in both the planning timeframe and in real time operations. As summarized above, construction of the P3 project at 262 MW indeed does ensure that the planning need identified in the CAISO Transmission Plan for the Moorpark sub-area would be met well into the next decade. Again, assuming that, as indicated by Applicant, Mandalay Unit 3 continues to be operational, P3 is three times larger than necessary to satisfy minimum Local Capacity planning requirements.

However, neither the Application nor the FSA discuss how the physical resources in the Moorpark sub-area need to be deployed in practice to ensure operational reliability. In summary, and with apologies for over-simplifying an extremely complicated process, it is not enough that adequate facilities in the right locations have simply been constructed. There is also a process to ensure that enough of these facilities are available in real time to be dispatched in a timely manner by the grid operators. The final step in this process is called Minimum Operational Commitment or ("MOC"), which is an algorithm embedded in the CAISO Hour Ahead Market software that ensures sufficient capacity is "committed" (that is, started up and synchronized to the grid) to ensure reliability. Thus, if P3 is not selected for "economic dispatch" as one of the least cost units to supply energy to the grid (highly likely given its low efficiency relative to the remainder of the fleet), but the Moorpark sub-area does not have enough resources on-line at the top of the hour to withstand a contingency event,[10] P3 would be committed by the MOC process "out of merit order." At the same time, a more efficient unit(s) outside the Moorpark sub-area would be backed down to maintain system load/resource balance. In the specific case of the identified N-1-1 planning need, this means that, whenever one of the Moorpark-Pardee transmission lines "trips," (the N-1 event) the CAISO would manually check to see if enough resources were already on line to prevent voltage collapse if the other Moorpark-Pardee lines were also to trip (the N-1-1 event). If the check showed a problem, the CAISO would order one or more off-line units in the area, including P3, Mandalay 3, McGrath and Ellwood, to immediately start up "out of merit order," and more efficient unit(s) outside the Moorpark sub-area would back down to maintain system load/resource balance.

[10] Here, "contingency" has a broader meaning than simply the identified N-1-1 loss of the Pardee-Moorpark transmission lines.

Although this process meets reliability standards, it comes at a price in both higher costs and higher emissions. Any time gas fired units are dispatched "out of merit order," more gas is purchased and consumed and more emissions are generated than the economic optimum given the loads and resources existing at that particular time.

From a broader perspective, exclusive reliance on construction of new natural gas plants for reliability makes what is arguably the system's greatest vulnerability—over-reliance on natural gas and the threat of common mode failure of the natural gas delivery/storage system—at least marginally worse. Indeed, many of the "Alerts" since the Energy Crisis of 2001 (public notifications of impending system stress that warrants voluntary explicit actions to reduce demand) were caused by issues with the natural gas supply system. Among the events that have triggered Alerts in the recent past are: severe weather on the East Coast which caused insufficient gas supplies to interstate pipelines into California even though generic gas storage was at or near record levels, and routine maintenance on an interstate pipeline that turned out to take much longer than planned.[11] The most obvious and well-known demonstration of this issue is the "panic" caused by the massive leak at the Aliso Canyon gas storage facility last year that continues to potentially impact electric reliability.

All of this is to say that non-gas alternatives for reliability need to be rigorously examined, even if superficially more complicated to procure, before simply resorting to a default construction of new gas fired plants. The FSA does not consider this issue at all.

ECONOMICS

The FSA in Section 4.1 describes a future operating P3 scenario where the "new, efficient" plant displaces older, less efficient natural gas facilities thus generating operational savings and lower greenhouse gas emissions during its operating hours. The FSA projects that the plant will operate roughly 10% of the hours of the year in this mode. However, it is highly unlikely that this describes P3's future operations. It ignores the following:

- ALL of the old, slow start, inefficient gas fired steam plants on the CAISO system are slated for retirement in the next five years[12]. Therefore P3 will be among the LEAST efficient large gas plants operating in California almost from the day it is scheduled to start up.

[11] A history of grid alerts, warnings and emergencies can be found at www.caiso.com/Documents/Alerts_WarningsandEmergenciesRecord.pdf
[12] FSA at p. 4-1.144

- Zero marginal cost renewable resources will supply 50% or greater of the energy on the grid. This, plus the dramatic increase in behind the meter solar, plus zero marginal cost hydro will mean reduced wholesale prices even in high load hours. P3 dispatch being "in the money"[13] at full load will be an exceedingly rare event.

- Policy driven greenhouse gas emission reduction targets will mean that total gas burn to serve California load must be dramatically lower than today. As much as 50% lower by 2030 should be planned for. Capacity factors for even the very efficient combined cycle fleet will likely be similar or lower than today's roughly 35%, and any plant without a locational advantage will be at high risk of retirement.

- System capacity need that justifies new wholesale market construction (other than RPS eligible resources) is not on the planning horizon. Construction of P3 almost inevitably means at least an equivalent amount of existing gas capacity will be at risk of retirement because they will not receive RA payments or guaranteed PPA capacity prices like P3.

If the AFC is granted and P3 becomes operational, it is highly likely to almost never be dispatched except out of merit order by the hour-ahead MOC algorithm or other perceived or actual reliability related issues. Almost all of these "contingency dispatches" will be at or near minimum load where P3 is much less efficient than the advertised 8400 MBTU/kwh full load heat rate. The only significant revenues available to keep P3 operating will be the 20-yr PPA fixed capacity payments. Given that P3 is roughly 3 times larger than required by the actual LCR need, and the PPA price is a large multiple of RA prices offered to existing facilities,[14] the "locational premium" for P3 is likely to be at least a factor of 10! This exorbitant price will appear as a sunk cost and stifle any economic incentive to design and procure cleaner and cheaper resources to serve the Moorpark region.

ENVIRONMENTAL CONSIDERATIONS

For the same reasons that P3 is an extremely expensive solution to a reliability issue, it represents a real impediment in California's drive to decarbonize the electricity sector. In addition, the plant is projected to emit up to 30 tons/yr. of NOx and 10 tons/yr. of PM 2.5 in an atmosphere that is in non-attainment status

[13] That is, system wholesale prices higher than P3 marginal costs.
[14] See The 2015 Resource Adequacy Report, CPUC Energy Division, January 2017 p. 25

for ozone and PM10,[15] and require filling in over 2 acres of scarce coastal wetlands.

The FSA estimates that P3 will directly emit almost 300,000 MTCO2/yr. at an emissions rate of 0.51 MTCO2/Mwh[16] or roughly 1% of the electric sector's preliminary 2030 target in the Draft CARB Scoping Plan at four to five times the projected emissions rate of the grid as a whole.[17] As explained in the previous section, at a minimum, the emissions rate is grossly underestimated because P3 will most often be dispatched at a rate well below its efficient full load operating point. In and of itself, these quantities do not threaten the policy goals, but P3 is hardly the only use of natural gas to satisfy an LCR need or, more broadly, ancillary services. In order to meet our long-term carbon goals, we must decarbonize reliability investments and the delivery of ancillary services as well as the production of energy. To spend this much money on new resources, to take this step backwards, is quite simply not sustainable. P3 will be a "stranded asset" from day 1. If it weren't for the guaranteed RA capacity payments, it is easy to predict that serious efforts will be underway to retire P3 in the near future – probably before first ignition. However, guaranteeing payments to an obsolete facility is not a prudent use of public funds that would be much better spent on more efficient resources that are consistent with state procurement goals.

ALTERNATIVES

The search for cheaper and cleaner alternatives as required under CEQA needs to start now—not after spending hundreds of millions of dollars on a solution that is obsolete before startup. The FSA itself recognizes that the use of natural gas in the manner proposed by the project is a stopgap measure. The FSA states:

> California's commitments to dramatically reduce GHG emissions over the next four decades include moving to a high-renewable/low GHG electricity system. However, natural gas-fired power plants – and the GHG emissions associated with their output – will still be integral to the reliable operation of the electricity system *at the outset of this period* (emphasis added). In the long run, zero- and low-carbon resources including demand-side management and storage resources may provide a majority, if not all of the balancing services needed to integrate variable renewable resources. However, the technologies that are needed to do so are not expected to be available in

[15] FSA, Part 1, Table 21a at p. 4.1-30.
[16] FSA, Part 1, Table 3 at p. 4.1-139
[17] Discussion Draft 2030 Target Scoping Plan Update, California Air Resources Board, December 2016

> sufficient quantities by the early- to mid-2020s to obviate the need for dispatchable, flexible, natural gas-fired electricity generation.[18]

No one proposes that all natural gas usage for the electric grid be replaced by 2020, only that the last 1% of the total represented by P3 be rigorously examined for cheaper, cleaner alternatives.

The first step is to define more precisely the resource characteristics required to satisfy the 88-92 MW of identified LCR need. The CAISO, having sharpened its modeling pencil and also having gained significant knowledge of the opportunities presented by the latest innovations in preferred resources since the need assessment conducted for the 2012 LTPP over five years ago, should be directed to restudy the issue with a fresh sheet of paper. The fact that the indicated shortfall in local resources to avoid voltage collapse following a transmission outage decreased significantly when the static VAR support in the area was modeled correctly is a strong indicator that additional dynamic voltage support is likely to significantly increase the threshold for voltage collapse, or, at a minimum, increase the time available to deploy contingency reserves. The use of synchronous condensers or other dynamic VAR support options needs to be explicitly explored. Transmission enhancements originally suggested by Calpine in the 2012 LTPP[19] should be revisited. Even if, after the restudy, CAISO still concludes that preferred resources cannot supply 100% of the LCR need. If the conclusion were that some active flexible fossil generation in the area is still required, and this conclusion is affirmed in this AFC process, an alternative that provides, say, one GE LMS 100 that is more efficient than the proposed Frame 7 machine with a rated capacity much closer to the actual indicated reliability need would be obvious. This unit could be equipped with a clutch to allow the generator to also operate as a "free" synchronous condenser for voltage support without combustion. This alternative would save roughly half of the project expense and virtually all of the GHG emissions.

More likely, a 100% preferred resource alternative seems likely. Starting with roughly 50 MWH of batteries costing $10-20M at today's prices[20] would buy an additional one-half hour to deploy contingency reserves including "slow-start" demand response that cannot, by itself, meet the rigorous requirements for LCR capacity. This could save even more ratepayer dollars as well as roughly 40 acres of prime coastal real estate as well as set the stage for retirement of at least Mandalay 3 -- if not McGrath and/or Elwood as well. Southern California Edison has announced its intention to conduct a new solicitation in the first quarter of 2017 for preferred resources in the Goleta area and has targeted the Goleta area in

[18] FSA at p. 4.1-141
[19] Calpine Opening Brief in Track 1 of R.12-03-014 at p. 7
[20] Lazard's Levelized Cost of Storage – Version 2.0, December 2016

its 2016 energy storage solicitation.[21] This solicitation could be easily expanded to include the entire Moorpark area. We note that SCE's Preferred Resource Pilot 2 ("PRP 2") resulted in contracts for 125 MW of preferred resources for an area with a peak demand that is less than Moorpark. These resources offset 124.9 MW of SCE's LCR procurement requirement in the "J-S Region" – a load pocket similar to Moorpark in Orange County.[22] As Edison stated:

> Perhaps most importantly, SCE's procurement of preferred resources for the J-S Region is reasonable and in the best interest of customers because it supports the State's important and ambitious environmental and energy policies, including those embodied in the Assembly Bill (AB) 32 and Senate Bill (SB) 32's Greenhouse Gas (GHG) Cap-and Trade Program, Renewables Portfolio Standard (RPS), SBs 327 and 350, and the Loading Order. As California moves toward a low-carbon future, the State is increasingly looking to electric utilities to procure cleaner sources of energy, or preferred resources, to meet energy and reliability needs.[23]

What is true for Orange County is equally true for Ventura County. These recent results and a rapidly maturing market for preferred resources that are fully capable of supplying a full range of ancillary services strongly suggests that 88-92 MW of additional preferred resource procurement for Moorpark is not only feasible in the timeframe required, but significantly less expensive in meeting the indicated need while being totally consistent with the Oxnard General Plan and State policy to decarbonize the electric grid.

Most of the public information that makes it possible to make this statement with a high degree of confidence has become available in the past three months, that is, after comments were received on the PSA and long after the CPUC approved the PPA for P3. In view of this new information, the CEC cannot make the findings required by Public Resources Code section 25525. Moreover, all of this effort to explore true alternatives to the expensive and deeply flawed P3 project—the

[21] A.14-11-016 Phase 2 Testimony of Southern California Edison Company on the Results of its 2013 Local Capacity Requirements Request for Offers for the Moorpark Sub-Area, September 22, 2016 p. 14

[22] A.16-11-002 Application of Southern California Edison Company for Approval of the Results of its Second Preferred Resources Pilot Request for Offers, November 4, 2016, p. 2

[23] id p. 3

CAISO special study, the SCE RFO for preferred resources—can be accomplished in one year. That allows ample time to implement the findings before the indicated need for the project arises.

Any residual risk of electric grid reliability concerns with a delay in issuing the AFC is easily mitigated. Although a controlled load drop following the N-1 event of loss of one Pardee-Moorpark transmission line, if necessary to prevent voltage collapse in the event of a loss of the other transmission lines in this corridor, is not allowed as a permanent reliability solution by current CAISO Planning Standards, this practice is not only allowed but commonly used as a temporary measure during construction of the permanent solution. No change in current CAISO reliability standards or practices, no abrogation of CPUC decisions or CEC practices is required. In fact, based on facts, as they are known today, the only decision that meets all of these standards is to delay the AFC process, explore the newly available alternatives, assess the new information, and make the appropriate decision at that time.

Signature

January 17, 2017
Date

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James H. Caldwell Jr.
1650 E Napa Street
Sonoma, CA 95476
Phone: 707 939 1650
Cell: 443 621 5168
E-mail: jhcaldwelljr@gmail.com

James Caldwell is a renowned energy professional with fifty years experience in virtually all phases of energy production and public policy. He has Chemical Engineering and MBA degrees with an extensive plant operations and construction management background, as well as hands on corporate planning and finance experience. He has managed large organizations, been an officer of a Fortune 100 company, and started his own business. Relevant experience is as follows:

PRIVATE CONSULTING (October 2010 to Present)
For the past six years, Mr. Caldwell has used his expertise to leverage the achievement of California's goal for producing a large majority of its electricity from renewable resources with an interim goal of 33% of electric demand by 2020 while maximizing development of in-state renewable resources, managing customer bills through cost control of renewable development and grid integration, improving energy efficiency, and actively involving consumers through what is known as Demand Response. He serves as Senior Advisor for the Center for Energy Efficiency and Renewable Technologies (CEERT) in advocating this long term policy and near-term actions to achieve defined milestones before the California Public Utilities Commission, the California Energy Commission, the California Independent System Operator, the Legislature, Governor's Office, and other state and local government agencies. He also advises a number of renewable development companies on specific project matters typically involving grid interconnection, transmission and wholesale market issues.

SOLAR MILLENNIUM, LLC (February 2010 to October 2010)
Mr. Caldwell was an executive consultant to Solar Trust of America, a German owned manufacturer/developer of solar thermal technology, assisting them in permitting and interconnecting 2250 MW of solar projects in California and Nevada. He devised a transmission strategy to interconnect 1500 MW of these projects to the CAISO grid with over 90% of the required transmission upgrades funded by the interconnecting utility rather than the project developer. This strategy required two policy changes by the CAISO and favorable FERC and CPUC rulings.

He also functioned as President of Solar Millennium, LLC (the development arm of Solar Trust of America) in charge of permitting before the California Energy Commission and the Bureau of Land Management. This strategy resulted in receiving both State and Federal authorization to commence construction on 1500 MW of new solar thermal facilities covering more than 11,000 acres in the Eastern Mojave Desert. Formal agreements to support the projects were reached not only with State and Federal regulatory agencies, but also with Riverside County, Native American Tribes, labor unions, and five national and regional environmental groups.

LOS ANGELES DEPARTMENT OF WATER AND POWER (December 2006 to October 2009)
Mr. Caldwell joined the Los Angeles Department of Water and Power as a full time executive consultant reporting to the General Manager and the Board of Water and Power Commissioners. In March 2008, he was appointed Assistant General Manager of LADWP for Environmental

Affairs. He resigned from that position in October 2009. He managed corporate environmental affairs and advised the Department on its Power Integrated Resource Plan to dramatically increase the use of renewable energy, eliminate reliance on coal, engage the customer base in energy efficiency and clean distributed generation, and improve the efficiency and flexibility of the Department's natural gas generation. He also advised the Department on its Water Integrated Resource Plan to generate all new water resources for the City of Los Angeles from recycling and storm water capture while significantly reducing per capita water consumption. In addition to the Corporate Planning role for both the Water and the Power System Integrated Resource Plans, Mr. Caldwell had line responsibility for siting, permitting and obtaining California Environmental Quality Act approvals for the projects that made up the Department's Integrated Resource Plans. He also designed and implemented new City Planning ordinances for water conservation, customer based renewable energy development (called a "Feed In Tariff"), and low impact development.

PPM ENERGY (June 2004 to December 2006)
Mr. Caldwell joined PPM Energy (now Iberdrola Renewable Energy) as Director of Renewable Policy. At PPM, he was responsible for regulatory affairs, transmission policy, and wholesale market structure issues nationwide, and legislative affairs in California. PPM Energy has a wind project development pipeline of over 10,000 MW spread throughout the country. Mr. Caldwell was responsible for ensuring that state legislation, transmission tariffs, market rules, and transmission expansion projects are in place to facilitate the build-out of that pipeline. Much of this effort focused on implementation of ambitious Renewable Portfolio Standard programs in California, Colorado, Minnesota, New York, Iowa, and Texas.

AMERICAN WIND ENERGY ASSOCIATION (May 2001 to May 2004)
As Policy Director, Mr. Caldwell was responsible for AWEA's Transmission Initiative to integrate wind into the nation's wholesale electricity market structure and create regional grids capable of moving significant amounts of wind energy from resource rich areas to load centers. He led the wind industry effort at the Federal Energy Regulatory Commission to adopt balanced national market rules to facilitate entry of this unique technology into wholesale electricity markets while ensuring grid reliability and avoiding subsidies to wind and/or cost shifting onto other technologies and market participants. This effort led to a series of FERC Orders and adoption of innovative market rules at, for example, the Bonneville Power Administration, the California Independent System Operator, the Midwest Independent System Operator, the PJM Independent System Operator, ERCOT (Texas), the New York Independent System Operator, and the Western Area Power Administration. He advised AWEA's Legislative and Communications staff on all technical matters and served as liaison to regionally based environmental/energy company organizations (including CEERT in California) pursuing renewable energy development.

RENEWABLE RESOURCES (October 1980 to April 2001)
Mr. Caldwell is the former President of ARCO Solar Inc., the photovoltaic subsidiary of Atlantic Richfield Company. In that position, he was also a Vice President of Atlantic Richfield Company. As President of ARCO Solar, Mr. Caldwell took that company from a research organization with less than $3 million in revenue to an integrated worldwide manufacturing and marketing operation with over $30 million in sales. He created joint ventures in Japan and Germany, and partnered with ninety-six exclusive distributors selling ACRO Solar products in 126 countries. Prior to becoming President, Mr. Caldwell was the Senior Vice President for Manufacturing, Research, and Engineering where he constructed what, at the time, was the world's largest photovoltaic central station power plant, the 6.5 MW Carisso Plains project in Central California, as well as every large grid connected photovoltaic project constructed anywhere in the world prior to 1990. When Atlantic Richfield decided to sell ARCO Solar, Mr.

Caldwell left ARCO and attempted to purchase the company. He raised over $50 million in equity to purchase and fund the company's business plan, but was outbid by Siemens AG in July of 1989.

After leaving ARCO, Mr. Caldwell started his own consulting/project development business. He developed numerous power plant projects around the globe in partnership with Bechtel Enterprises and several European organizations. Projects included a 300 MW combined cycle gas fired power plant in Thailand, a 30MW gas turbine/water desalination cogeneration facility in an oil refinery on the island of Cyprus, a 10 MW waste wood fired power plant in northern California, and a 5 MW diesel generator/water desalination cogeneration facility in the Cape Verde Islands.

Mr. Caldwell's consulting clients included most of the national environmental organizations with a direct interest in energy policy including the National Resources Defense Council, the Sierra Club, Union of Concerned Scientists, and Environmental Defense. He also consulted for several independent power producers including Enron and PG&E's National Energy Group, and regional transmission organizations such as the California Independent System Operator.

ATLANTIC RICHFIELD COMPANY (August 1965 to September 1980)
Prior to his assignment with ARCO Solar, Mr. Caldwell held a variety of positions over a twenty-four year career with Atlantic Richfield. After graduating from college, he began employment with ARCO's predecessor, Richfield Oil Corporation, as a Refinery Process Engineer. A fourteen-year stint in refinery operations culminated in the position of Refinery Operations Manager at ARCO's Los Angeles refinery.

Mr. Caldwell was then assigned as Manager of Downstream Planning in ARCO's Corporate Planning Department. He oversaw ARCO's capital budget and worldwide strategic business plan for refining and marketing; petrochemicals; transportation including oil and gas pipelines and marine shipping; and ARCO's non-energy related diversification program. He led a corporate team that developed company investment and research policy for all synthetic fuels including coal gasification, coal liquefaction, biomass to energy, and concentrating solar power.

After leaving Corporate Planning and before assignment to ARCO Solar, he was the Project Manager and Owner's Representative for the Colony Oil Shale Development Company in Denver CO -- ARCO's primary venture into synthetic fuels. In addition, he managed ARCO's non-energy diversification effort into agricultural genetic engineering and vegetable seed production.

AFFILIATIONS
Mr. Caldwell is a former member of the Clean Air Act Advisory Committee for the Environmental Protection Agency, the Energy Modeling Committee of the Energy Engineering Board of the National Academy of Sciences, the Advisory Committee on Energy Policy for the Office of Technology Assessment, and the Advisory Board for the USAID Energy Training Program. He is a life member of the IEEE and the AIChE. Along with his wife, Jan McFarland and V. John White, in 1990 he helped found the Center for Energy Efficiency and Renewable Technologies in Sacramento, CA, and currently serves as Senior Advisor and At Large Member of the Board of Directors.

EDUCATION

Mr. Caldwell received a B.S. Degree in Chemical Engineering from Stanford University (1965) and an MBA from California State University at Long Beach (1978). He is married with three children and three grandchildren.

References on request.