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OFFICE OF RATEPAYER ADVOCATES
CALIFORNIA PUBLIC UTILITIES COMMISSION

Tipping Point Analysis and Attribute Assessment for DPV2 – Testimony of Lon W. House, Ph.D.

ORA'S DPV2 Testimony Vol. 3 of 3

Application of Southern California Edison Company (U 338-E) for a Certificate of Public Convenience and Necessity Concerning the Devers-Palo Verde No. 2 Transmission Line Project

Order Instituting Investigation on the Commission's Own Motion into Methodology for Economic Assessment of Transmission Projects

San Francisco, California
November 22, 2005

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I. INTRODUCTION

" … public policy could itself become the captive of a scientific-technological elite." *Dwight D. Eishenower*, ***January 17, 1961***

*"**War is too important to be left to generals**" Clemenceau*
"But today, war is too important to be left to politicians. They have neither the time, the training, nor the inclination for strategic thought. "
General Jack D. Ripper, ***Dr. Strangelove, 1964***

President Dwight Eisenhower's famous farewell address from over 40 years ago cautioned us of the dangers of a 'technological elite" running public policy. We have a comparable concern in this type of proceeding at the California Public Utilities Commission (Commission), the establishment of an "analytic elite" that essentially drives the decision-making in transmission application cases. Or, following the thoughts of the immortal Jack D. Ripper, transmission analysis is too important and too complex to be left in the hands of the experts.

Transmission applications before regulatory agencies (including this Commission) typically exhibit a characteristic economists call "information asymmetry". Information asymmetry is a term used to describe when one party to a transaction has access to more and better information that the other party. The consequences of information asymmetry are summed up in the words of Levitt and Dubner:

> *"If you were to assume than many experts use their information to your detriment, you'd be right. Experts depend upon the fact that you don't have the information they do. Or that you are so befuddled by the complexity of their operation that you wouldn't know what to do with the information if you had it. Or that you are so in awe of their expertise that you wouldn't dare challenge them".*[1]

Transmission applications in California involve an analysis that includes tens of thousands of miles of transmission lines, thousands of individual generators, and encompasses parts of three countries (Mexico, Canada, and the U.S.), multiple western states and hundreds of economic assumptions. The application by Southern California Edison (SCE) in this

[1] Steven Levitt and Stephen Dubner, **Freakonomics**, Harper Collins, 2005.

proceeding is typical, composing of multiple sophisticated and proprietary models that simultaneously simulate multiple variables. Their conclusion of this vast modeling effort can be summed up in a simple statement claimed by the applicant – Devers Palo Verde 2 is a cost effective investment.

The problem in this process is that other parties (other than the applicant) that do not have a vested interest in transmission lines are typically overwhelmed and out-gunned, not having access to or, in many cases the experts that can challenge the myriad of models and assumptions. The ISO's filing in this proceeding is the mirror image of the utilities'; a proprietary analysis that includes tens of thousands of miles of transmission lines, thousands of individual generators, encompassing parts of three countries (Mexico, Canada, and the U.S.), multiple western states, and hundreds of economic assumptions, even down to using exactly the same price differential in natural gas prices between Arizona and California assumed by the applicant. The decision makers in such a process are often left with a less than satisfactory vetting of the purported benefits of the project.[2]

In actuality, there are typically a couple of pivotal points in any analysis (in engineering terms we would call these "fulcrum points"), economic relationships and assumptions in which slight changes can drive the economics of the project from positive to negative. These points are directly analogous to "tipping points" in the social literature.

Analysts should identify which variables/assumptions are driving their conclusions in a way that is clear to experts, policy makers, and intervenors. Some may object that such a simplifying approach *"… is not needed, not defined, and won't add value"*[3]. We beg to differ. Such an identification and summarization of the critical parameters and assumptions that

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[2] All this being said, ORA notes that there are efforts underway to move transmission analysis and evaluation upstream to give the public more access to the complexities of siting HV lines. Efforts include (a) the CEC's Strategic Assessment of Transmission, (b) though complex, and with a stakeholder process that is being revised, the ISO's TEAM approach is attempting to make the economic analysis of transmission more accessible; and, (c) the PIER Transmission Research Program has initiated research in better planning tools, and tools that can be accessed as transmission proponents go through the local permitting process and interact with the affected communities along transmission routes.

[3] *Reply Comments of the Southern California Edison Company (U-338-E) on the Proposed Scope of Phase 1,* California Public Utilities Commission, A.05-04-015/I.05-06-041, October 20, 2005.

determine the results of an analysis are critical to open and comprehensive decision making in this venue. It is extremely difficult for other parties to meaningfully participate in transmission proceedings at this Commission, and difficult for the Commission to make an informed decision, unless the advocates of the transmission projects portray their results and assumptions in a completely understandable way. One such way is to perform a tipping point analysis and provide the results of such an analysis with their filings at the Commission.

II. TIPPING POINT ANALYSIS IN ECONOMIC EVALUATIONS

" (W)e take it, as a given, that the more information decisionmakers have, the better off they are."

…

" It doesn't seem to make sense to us that we can do better by ignoring what seems like perfectly valid information."

Malcolm Gladwell, 2005[4]

II.1 Background

"Tipping Point" analysis has gained popularity as a paradigm in the social sciences since Gladwell's 2000 book "How Little Things Can Make A Big Difference"[5]. A typical social analysis is to define the topology of the interactions (e.g. figure below[6]) and then determine which interactions are critical to the outcome (tipping points).

Figure 3. Example of Social Topology

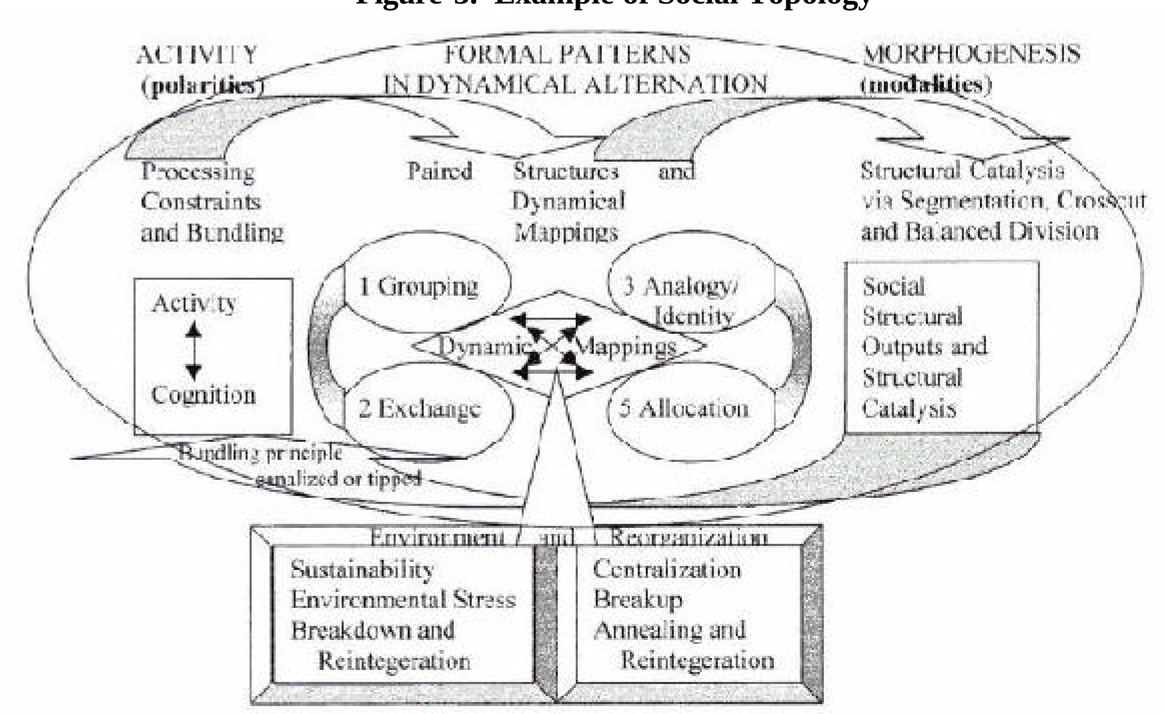

Figure 1: Process Model of Relational Coherence between Statics and Dynamics

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[4] Malcolm Gladwell, **Blink,** Little Brown and Company", New York, 2005

[5] Malcolm Gladwell, **The Tipping Point: How Little Things Can Make A Big Difference**, Little Brown and Company, New York, 2000.

[6] Douglas R. White, *Network Analysis and Social Dynamics*, NSF grant #BCS-9978282, in Longitudinal Network Studies and Predictive Cohesion Theory, 1999-2001.

While one of the principal criticisms of tipping point analysis in the social sciences is that is generally done retrospectively[7], the goal of tipping point analysis is to provide decision makers with the critical relationships that should be concentrated on in order to affect the outcome.

The focus of the original "Tipping Point" was an examination of social epidemics but the basic concept of tipping point analysis has been expanded to analyses involving everything from wireless data applications[8] to land use planning[9] to country economic projections[10] to election results[11] to global warming[12].

The concept of tipping points - the identification of relations/assumptions that determine the results of the analysis - can be a valuable tool for public policy makers at this Commission, helping them to identify what are the critical assumptions in these overwhelming data and model intensive applications that they have to decide on, and can be invaluable to interveners, allowing them to concentrate their efforts on assumptions and relationships that truly influence the outcome of the analysis instead of being forced to try and decipher tens of thousands of data points and assumptions, as well as numerous hierarchical models that takes teams of model experts to run.

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[7] Such as determining that the two-penny duty on tea caused the Boston Tea Party which lead to the American Revolution.

[8] Phil Hendrix, "*Verifying Opportunities, Igniting Demand for Wireless Data Applications*", October 2004, http://www.immr.org/immr%20Documents/immr%20-%20MAppTrac%20Overview.pdf

[9] *Southern California Compass2% Strategy*, Southern California Association of Governments, http://www.socalcompass.org/2percent/services/suite.htm, *Michigan Tipping Point Tutorial*, Computational Ecology & Visualization Laboratory Michigan State University, http://www.cevl.msu.edu/Documentations/Landuse/Tippingpoint.pdf

[10] Gray Newman and Fergus McCormick, *Argentina: Tipping Point Number Two -- Debt Rollover*, (New York), http://www.morganstanley.com/GEFdata/digests/20010808-wed.html; *Brazil: Tipping Points*, Gray Newman, Claudia Castro and Jaime Valdivia (New York), http://www.stock-channel.net/stock-board/showpost.php3?p=162017&postcount=33

[11] Anthony Gill, Ph., Supplemental Report Regarding Invalid Ballots Cast in the 2004 Washington State Gubernatorial Race, April 2005, http://www.secstate.wa.gov/documentvault/362.pdf

[12] Johathan A. Foley, *Tipping Points in the Tundra*, **Science**, Vol. 310(28), October 2005.

II.2 Tipping Point Methodology

The basic steps in applying a tipping point analysis to a transmission application can be found in Table 1.

Table 1. Tipping Point Analysis for Transmission Applications

1) Establish an Economic Threshold for the Project

2) List Potential Tipping Points

3) Test Potential Tipping Points (Determine Relative Impact on Results)

4) Determine Tipping Point Value for Each Identified Tipping Point (Knife Edge Determination)

5) Summarize Tipping Points Analysis

II.2.1 Establish an Economic Threshold for the Project

This is the minimum economic benefit necessary for the project to be cost effective. There are a variety of economic determinations, such as net present value (NPV), benefit cost ration (B/C), internal rate of return (IRR), payback period (PP). For this proceeding we chose, for ease of illustrating the methodology, to use annual levelized revenue requirements.

II.2.2 List Potential Tipping Points

This step requires using professional judgment to separate issues/variables/assumption into three categories (bins): potential tipping points, “tweeners”, and nontippers.

The first bin is composed of potential tipping points[13]: variables that slight changes in are likely to change the results of the analysis. Potential tipping points are relationships/values/assumptions which are highly likely to change the results. This activity identifies potential tipping points that are to be tested.

Second bin consists of "tweeners": variables that, in combination, can drive the project economic or non-economic but singly are not significant enough to shift the project from positive to negative economics. "Tweeners" are significant variables in the economics of the project but require combinations of them to tip the project between economic and noneconomic.

The final bin is "non tippers": variables that do not have much of an impact on the economics of the project. Reasonable changes in these values which will not change the results of the economic assessment.

II.2.3 Test Potential Tipping Points (Determine Relative Impact on Results)

This portion of the analysis consists of running the economic analysis with changes in a tipping point value to determine if it changes the conclusions. Plausible, but extreme values of the tipping points are used in the analysis to see if changes in assumptions on that variable can tip the economics of the project.

The results of this step is a completed list of analysis tipping points, those assumptions/variables that singly can shift the project economics from positive to negative. Variables/assumptions that are not significant enough to tip the conclusion are removed from the tipping point category and are transferred to the "tweeners" bin.

[13] In engineering, we could call these fulcrum points, and in scenario analysis they're typically called thresholds, but the issue is the same (where little changes make big differences in the results).

II.2.4 Determine Tipping Point Value for Each Identified Tipping Point (Knife Edge Analysis).

Once tipping point variables/assumptions are determined, the next step is to determine what is each tipping point variable/assumption value that slight changes in will tip the economics of the project positive or negative. This is commonly called a "Knife Edge Determination" in scenario presentations

II.2.5 Summarize Tipping Point Analysis

The summary of a tipping point analysis list the tipping points and the "knife edge" values for each tipping point.

It also can provide a list of the "non-tippers", assumptions and variables in which the range of reasonable values will not change the results of the analysis.

A list of the "tweeners" can be provided, but a complete analysis of this bin requires a significant amount of work. A goal for this bin is to develop the list of "tweeners" and their values that are necessary for the project to be economic. This requires a significant amount of multiple simulations to develop for transmission projects.

II.3 Tipping Point Analysis Applied to DPV2

<u>II.3.1 Analysis</u>

<u>II.3.1(a) Establish an Economic Threshold for DPV2</u>

First we need to establish the economic threshold necessary for DPV2 to be cost effective. As found in SCE's work papers, the levelized DPV2 revenue requirement is $61.9 million per year (SCE work papers, pg. 179).

<u>II.3.1(b) List Potential Tipping Points</u>

We relied upon two sources for the separation for variable/assumption into bins: our professional judgment on which bin the variables/assumptions should initially go into, and an analysis of the scenarios that the ISO ran in their analysis of DPV2.

As Table 2 shows, we identified four variables as candidates for tipping points: the assumed natural gas price differential between Arizona generators and California generators, the resource plan in Arizona assumptions, the impact of a Palo Verde (Palo Verde Nuclear Generating Station) outage, and the wholesale cost of natural gas.

Table 2. Initial Tipping Point Bin Allocation

<u>Initial Tipping Point Variables:</u>

- Natural gas price differential between Arizona and California,
- Resource plan in Arizona,
- Palo Verde outage,
- Wholesale natural gas prices[14]

<u>Initial "Non-Tippers" list:</u>

- Hydro variability[15],
- Demand Forecasts[16],
- Production cost model used,
- Import limits (SCIT Nomogram),
- Combined cycle heat rates,
- Wheeling revenues,
- ETCs revenues,
- Losses

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[14] Based upon ISO simulations, changes in natural gas prices for 2008 change the results between +100% and -76%; for 2013 +75% and -63% (see table VII.3 in *Palo Verde-Devers Economic Assessment Report*, February 2005).

[15] Based upon ISO simulations, changes in hydro for 2008 change the results between +16% and -3% (-$2 million); for 2013 +19% and -15%, not enough to tip the results (see table VII.3 in *Palo Verde-Devers Economic Assessment Report*, February 2005).

[16] Based upon ISO simulations, changes in demand forecasts for 2008 change the results between +6% and +12%; for 2013 +10% and -5% (-$7 million), not enough to tip the results (see table VII.3 in the ISO *Palo Verde-Devers Economic Assessment Report*, February 2005).

Natural Gas Prices

The applicant (and the ISO) assumed that natural gas prices to generators in Arizona are always approximately $0.35/MMBTU cheaper than gas prices to generators in California. This understandably makes natural gas fired generation in Arizona cheaper than California natural gas fired generation. However, this assumption is not supported by the facts: neither assumptions on distribution charges, current natural gas futures prices, or historic gas prices.

Distribution Charges

It is true that generation plants that connect directly to an interstate pipeline and avoid local distribution costs will have a cost advantage. A generation plant on SoCal Gas will have to pay for El Paso and SoCal charges while a direct connect (pipeline interconnection) will only have El Paso charges. However, many Arizona generation plants pay more than SoCal because they have El Paso and Southwest Gas LDC charges. The assumption that all generation facilities in California will connect at the distribution level and that natural gas generators in Arizona will connect directly to the interstate (El Paso) pipeline is unsubstantiated.

Current Natural Gas Prices

The following table provides natural gas futures prices (November 8, 2005). The first column on the table is the date of the contract (i.e. Q4-07 natural gas purchased for the fourth quarter of 2007). The next column, NYMEX, is the commodity cost of the gas (in $/MMBTU). The next three columns are the "basis" price, which is basically the adjustment to the commodity (NYMEX) price for delivery at the referenced delivery point: SoCal border is the Southern California border, PG&E Citygate is PG&E citygate delivery, and Arizona is the connection between El Paso pipeline and Southwest Gas at Phoenix.

For example, the cost of purchasing natural gas for calendar year 2010 is $6.45/MMBTU for SoCal delivery ($6.90NYMEX - $0.45 SoCal Basis), and $6.64 for Arizona delivery. Southern California gas for 2010 delivery is $0.19/MMBTU <u>cheaper</u> than

Arizona gas. Note that throughout the entire period SoCal gas is cheaper than Arizona gas, the exact opposite of what the applicant and the ISO assumed.

Table 3. Natural Gas Futures Contracts (11/07/05)

Day Ahead for 11/8 delivery traded around $7.90 at PG&E Citygate and $6.60's in SoCal.

Indicative forward prices for packages of 1,000 per day at the market open on 11/07/05:

Dec '05- $11.06 NYMEX;

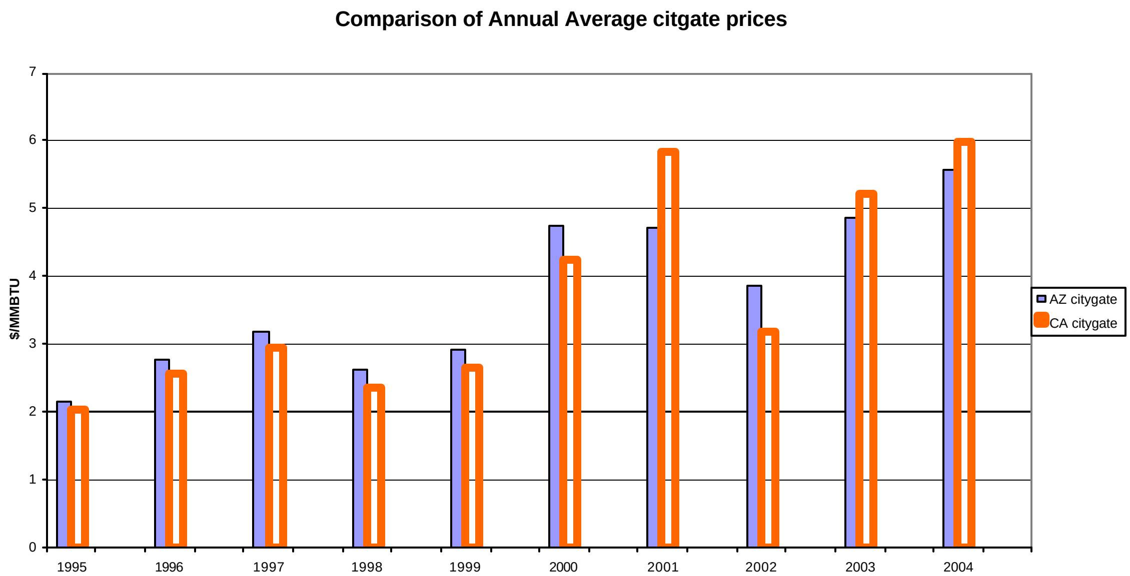
-$2.08 SoCal Basis; -$1.70 PG&E Citygate Basis; -$1.95 Phoenix, AZ Citygate Basis (Southwest Gas)

Q1-06-	$11.95 NYMEX	-$1.90 SoCal	-$1.50 PG&E	-$1.65 Az
Q2-06-	$9.72 NYMEX	-1.00 SoCal	-.60 PG&E	-.70 Az
Q3-06-	$9.74 NYMEX	-.53 SoCal	-.17 PG&E	-.15 Az
Q4-06-	$10.26 NYMEX;	-.80 SoCal	-.42 PG&E	-.70 Az
Q1-07-	$10.92 NYMEX;	-.79 SoCal	-.41 PG&E	-.60 Az
Q2-07-	$8.46 NYMEX;	-.72 SoCal	-.29 PG&E	-.49 Az
Q3-07-	$8.46 NYMEX;	-.53 SoCal	-.14 PG&E	-.31 Az
Q4-07-	$8.97 NYMEX;	-.77 SoCal	-.33 PG&E	-.58 Az
Calendar 2008-	$8.10 NYMEX	-.62 SoCal	-.20 PG&E	-.40 Az
Calendar 2009-	$7.40 NYMEX	-.50 SoCal	-.09 PG&E	-.30 Az
Calendar 2010-	$6.90 NYMEX	-.45 SoCal	-.05 PG&E	-.26 Az

Historic Natural Gas Prices

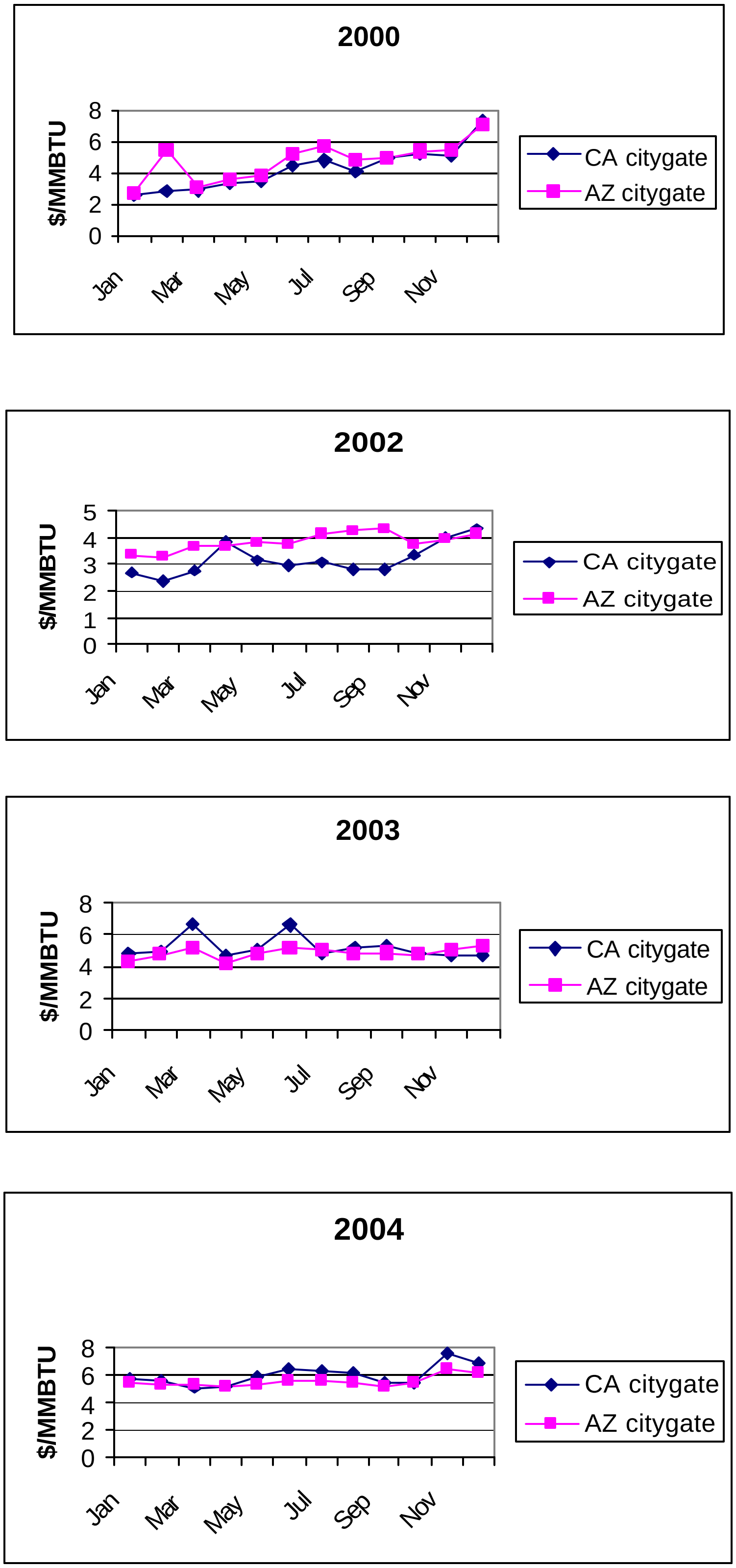
The following figure historic natural gas prices for the last 10 California and Arizona as reported by the Energy Information Agency (EIA). Note that for seven of the last ten years, California citygate natural gas prices have been cheaper than Arizona citygate prices.

Figure 1. EIA Arizona/California Historic Price Comparison



Even within the recent years where California gas has been more expensive on an annual average basis, there is considerable monthly variation, with months almost every year when California gas is cheaper than Arizona gas, as the following figures show.

Figure 2. Historic Monthly California and Arizona Natural Gas Prices



Additional Generation in Arizona

One of the purported reasons for DPV2 was take advantage of the over 6,000 MW of surplus generation in the Southwest[17]. It is true that the Southwest is currently overbuilt and has excess generating capacity to sell, but that overcapacity is projected to drop from current (2005) summer reserve margins of 28.4% down to 13.2% by 2014, as the following WECC 2005 Assessment[18] table shows. Southwest winter reserve margins are projected to remain high (over 65%) throughout the 10 year planning period. Basing the purported value of DPV2 on a continual overbuilding of generating capacity in the desert Southwest is unrealistic.

The desert southwest has a very significant impediment to the continued construction of additional thermal generation – a serious lack of water. Most of Arizona is located in an area the Department of the Interior has categorized as "Highly Likely" to have conflicts over water by 2025[19]. The Palo Verde Nuclear Power Plant uses treated wastewater from cities in Maricopa County that is piped nearly 40 miles to Palo Verde, but that source is severely constrained and virtually all of the new thermal generation facilities propose to use fresh water as a cooling source. Arizona has been identified as one of the areas in the country that is facing an extremely limited supply of cooling water for power plant operation[20]. This shortage of water in Arizona for power plant cooling is manifested in two ways: 1) a reduction in the number of power plants that are allowed to be built in the area, and 2) decreased efficiency of the power plants that are built as they have to utilize dry cooling instead of wet cooling.

[17] A.05-04-015, *Proponents Environmental Assessment*, Vol. 1, Part 1, pg. 2.2, April 5, 2005.
[18] *WECC 10 year Coordinated Plan Summary,* June 2005.
[19] *Water 2025: Preventing Crises and Conflict in the West,* www.doi.gov/water2025
[20] *Water Sustainability in the United States and Cooling Water Requirements for Power Generation* Sujoy B. Roy, Karen V. Summers, and Robert A. Goldstein, *WATER RESOURCES UPDATE*, Issue 126, pgs 94-99, November 2003.

Table 4. WECC Arizona/New Mexico/So. Nevada 2005 Resource Plan

Table 24 - Arizona-New Mexico-So. Nevada Power Area Estimated Peaks Demands, Resources, and Reserves 2005 - 2014

	SUMMER PEAK							Adverse Hydro Conditions		
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Month	JUL	JUL	JUL	JUL	JUL	JUL	JUL	JUL	JUL	JUL
Loads – Firms	26691	27626	28524	29451	30397	31368	32255	33055	33951	34799
Int. & Load Mgt	281	254	254	255	257	256	257	258	260	261
Total - MW	26972	27880	28778	29706	30654	31624	32512	33313	34211	35060
Growth from Previous Yr. - %	5.2	3.4	3.2	3.2	3.2	3.2	2.8	2.5	2.7	2.5
Generation ± Transfers - MW	34313	36279	37291	37960	38528	38827	38641	38687	38951	39412
Maint./Inoperable Cap. - MW	31	31	31	31	31	31	31	31	31	31
Reserve Capability MW	7591	8622	8736	8478	8100	7428	6355	5601	4969	4582
Percent of Firm Peak Demand	28.4	31.2	30.6	28.8	26.6	23.7	19.7	16.9	14.6	13.2

Projected Average Annual Summer Compound Growth Rate (2004-2014) - 3.2%

	WINTER PEAK							Adverse Hydro Conditions		
	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15
Month	JAN	JAN	JAN	JAN	JAN	JAN	JAN	JAN	JAN	JAN
Loads – Firms	17609	18120	18642	19198	19787	20320	20813	21323	21845	22357
Int. & Load Mgt	253	255	255	257	256	257	258	260	261	262
Total - MW	17862	18375	18897	19455	20043	20577	21071	21583	22106	22619
Growth from Previous Yr. - %	2.9	2.9	2.8	3.0	3.0	2.7	2.4	2.4	2.4	2.3
Generation ± Transfers - MW	33299	36675	37400	38039	38154	38371	38267	38381	38711	38711
Maint./Inoperable Cap. - MW	1767	1183	1825	1688	1773	1060	1231	1712	1505	1444
Reserve Capability MW	13923	17372	16933	17153	16594	16991	16223	15346	15361	14910
Percent of Firm Peak Demand	79.1	95.9	90.8	89.3	83.9	83.6	77.9	72.0	70.3	66.7

Projected Average Annual Winter Compound Growth Rate (2004/05-2014/2015) - 3.0%

Cooling water availability played an important role in the Arizona Corporation Commission's (ACC) decision to halt two out of three proposed gas-fired power plants that came up for review within a three-month period in 2001[21]. One of the principal reasons the ACC commissioners used in denying these generation facilities was the effect of the groundwater pumping that was proposed as the source of cooling water for these facilities[22]. The 600-MW extension of Duke Energy's Arlington Valley power plant in Arizona was only approved under the stipulation that it participate in Arizona's groundwater recharge program, agreeing to recharge1,000 acre-feet each year during the useful life of the plant.

As Southwest Gas Corporation testified before the Arizona Corporation Commission:

> "*According to (ACC) Chairman Hatch-Miller, "A scarce water supply…may complicate the state's effort to add new power plants. Arizona is moving toward full use of its groundwater supplies and its three rivers. Water supplies are already an issue in deciding where to build plants."* [23]

One requirement that may allow more generation to be constructed in the desert Southwest is requiring shifts to dry cooling as a means to reduce water consumption by electrical generation. There are a number of sources that discuss the difference between wet and dry cooling[24]. Suffice it to say that the generators preferred technology for power plant cooling is wet cooling. It is the least expensive to construct and operate, but uses the most water. Dry cooling, while it can reduce a power plant cooling water requirements by a factor of 10, it decreases the electrical efficiency of the power plant, sometime up to 15% or more. Assuming that all new generation in the desert Southwest will be using wet cooling with a resultant low heat rate (as the applicant did in the resource plan used to model the benefits of DPV2) is simply unrealistic.

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[21] "Arizona Climate Chills For Power Developers", The Arizona Republic. December 10, 2002.
[22] *The Last Straw: Water Use by Power Plants in the Arid West*, The Energy Foundation and The Hewlett Foundation, April 2003.
[23] Comments of Southwest Gas Corporation on the Staff Request For Comments on Resource Planning" , ACC Docket No. E-00000E-05-0431, August 3, 2005, pg.8.
[24] such as: *Wounded Waters – The Hidden Side Of Power Plant Pollution*, Clean Air Task Force, February 2004.

Palo Verde Outage

Recent events at the Palo Verde Nuclear caused us to question the viability of DPV2 is the Palo Verde units are unavailable for extended periods.

A reactor at the Palo Verde nuclear power plant has been shut down for the third time this year due to a leaking oil seal. Arizona Public Service Co. described the repair of the oil seal in Unit 3's coolant pump as a planned move to take care of the persistent problem, which also forced the reactor's shutdown in May and July.

Two units (Units 2 and 3) at the 3,875-megawatt Palo Verde nuclear power station were shut down relating to concerns the plant's emergency core cooling system might not operate as designed, the U.S. Nuclear Regulatory Commission said in a report. A potential problem with the emergency reactor core cooling system at the nation's largest nuclear power plant went undetected from 1986, when it began producing power. The potential safety problem involved whether pumps that provide water to the emergency core cooling system would sense that a tank was getting low on water and switch to another source. Analysis performed by APS over the next week appeased the NRC and the plants were allowed to restart.

Unit 1 had been out of service since Aug. 12 because of problems with a backup power generator.

II.3.1(c) Test Potential Tipping Points (Determine Relative Impact on Results)

A more complete description of the modeling effort that we did can be found in the testimony of Daniel Suurkask. In summary, we ran a deterministic base case that was comparable to the applicant's base case, and then ran additional simulations. For the Natural Gas Price case we equalized Southern California gas prices and Arizona generator gas prices. For the Southwest Resource Plan case we removed some additional coal plants starting in the latter years of the simulation and substituted combustion turbines for them. For the Palo Verde out case we removed Palo Verde from the simulation. For the high wholesale natural gas price we took the 2009 and 2010 wholesale Topock gas price found in Table 5 and allocated it monthly among basins as per SCE's convention, and then escalated those basin prices into the future as per SCE's modeling conventions.

Model Conventions Used

One thing that surprised us was the impact that the modeling conventions SCE used on the results. As Suurkask's testimony describes, the following SCE model base case toggles/switches were changed: 1) instead of a stochastic simulation we ran a deterministic simulation, 2) instead of doing the simulation every four hours per week we simulated every hour (a typical week was still used to represent each month as per SCE modeling approach), 3) a random Monte Carlo was changed to a convergent Monte Carlo, and 4) the use of MAPP (England/Wales 1990) pricing was changed to variable operating cost of the marginal unit.

As Table 5 shows, the simple adjustment of these modeling parameters, without changing any of the modeling input assumptions, drove DPV2 uneconomic.

Table 5. Modeling Conventions Tipping Point Analysis ($million/year)

DPV2 economic threshold	levelized revenue requirements	$61.90

ISO Total TEAM Benefits of DPV2 ($M)

year	SCE Stochastic Basecase	SCE Deterministic Basecase
2009	$45.60	$24.02
2010	$88.20	$44.24
2011	$91.80	$50.99
2012	$89.10	$57.73
2013	$117.60	$69.70
2014	$111.60	$61.84
2015	$123.60	$62.91
2010-15 annual average	**$103.65**	**$57.90**

Natural Gas (Az/Ca Difference and Wholesale Prices)

Table 6 shows the natural gas tipping point analyses. The equalizing of California and Arizona generator gas price further reduced the benefit of DPV2 by about $9 million per year (approximately 15%). The use of current natural gas futures prices ($6.45/MMBTU instead of SCE's assumption of $4.49/MMBTU in 2010)[25] increased the benefit of DPV2 by $15 million per year (approximately 25%) and made the project cost effective.

Table 6. Natural Gas Price Tipping Points Analysis
($ million/year)

DPV2 economic threshold $61.90

ISO Total TEAM Benefits of DPV2 ($M)

year	SCE Deterministic Basecase	Natural Gas Price Differential	Current Natural Gas Prices
2009	$24.02	$25.29	$29.32
2010	$44.24	$39.73	$41.89
2011	$50.99	$42.77	$55.17
2012	$57.73	$52.21	$71.68
2013	$69.70	$54.93	$68.38
2014	$61.84	$50.80	$87.93
2015	$62.91	$54.94	$110.30
2010-15 annual average	**$57.90**	**$49.23**	**$72.56**

Palo Verde Outage and Changes in Southwest Resource Plan

The economic changes due to changes in the Southwest resource plan and of a Palo Verde outage are shown in the following table. Changes in the Southwest resource plan resulted in a very slight improvement (1/10th of 1 percent) in the economic benefit of DPV2, but not enough to make it cost effective. A Palo Verde outage dramatically reduces the available surplus generation in the Southwest that can be imported into California via DPV2 and reduces the benefit of DPV2 by almost $21 million per year (36 percent).

[25] The original SCE assumption of the constant generator natural gas price differential of $0.35/MMBTU between Arizona and California as used for the current natural gas futures simulation.

Table 7. Tipping Point Analysis for Southwest Resource Plan Changes and Palo Verde Outage ($ million/year)

DPV2 economic threshold $61.90

ISO Total TEAM Benefits of DPV2 ($M)

year	SCE Deterministic Basecase	Southwest Resource Plan	Palo Verde Out
2009	$24.02	$24.02	$24.02
2010	$44.24	$44.24	$38.33
2011	$50.99	$50.99	$29.71
2012	$57.73	$57.73	$37.91
2013	$69.70	$68.04	$39.54
2014	$61.84	$65.93	$38.93
2015	$62.91	$65.27	$37.28
2010-15 annual average	**$57.90**	**$58.70**	**$36.95**

II.3.1 (d) Determine Tipping Point Value for Each Identified Tipping Point (Knife Edge Analysis)

The approach used is to: 1) do the economic analysis to determine which variables are tipping points and then 2) for each tipping point, determine the value at which the project just meets the economic threshold criteria, and 3) listing that point (knife edge point) for each tipping point variable.

Due to time constraints, we were not able to perform a modeling knife edge analysis for DPV2. However, if one assumes that the impact of natural gas prices is linear to what was found in the tipping point analysis, DPV2 becomes cost effective at a natural gas price slightly over $5.00/MMBTU[26] (2010 price) or if the price of natural gas for all Arizona generators was less than $0.50 cheaper than the cost of natural gas for all California generators.

[26] $5.014/MMBTU.

II.3.1 (e) Summarize Tipping Point Analysis

As a result of our analysis, we removed the resource plan in the Southwest as a tipping point for DPV2, and added modeling conventions as a tipping point. Our revised list of tipping points in the DPV2 analysis is shown in Table 8: modeling conventions used, natural gas price differential between Arizona and California, Palo Verde outage, and wholesale natural gas prices.

Table 8. Tipping Points Found in DPV2 Analysis

Initial Tipping Point Variables:
- Modeling conventions used,
- Natural gas price differential between Arizona and California,
- Palo Verde outage,
- Wholesale natural gas prices.

In order for DPV2 to be cost effective, the natural gas price differential between Arizona and California has to be greater than $.50/MMBTU, the wholesale Topock price of natural gas has to be greater than $5.00/MMBTU (2010), and Palo Verde has to be operating.

It is unknown what effect on natural gas prices and price distribution the impact of LNG coming into the United States from Baja, Mexico, or California, will have but they are likely to be significant. The one Baja LNG facility furthest along in construction, the Sempra Energy-Shell Oil joint venture at Costa Azul, is expected to start delivering about 1 billion cubic feet a day in 2008, and the companies are discussing upgrading the facility to be able to deliver 1.5 billion cubic feet of gas per day, a 1/3 increase in the total Southern California natural gas market. Importing this much gas into California will change the dynamics of natural gas pricing, particularly the basis determination, for rather than having most of Southern California's natural gas being imported from the east via the El Paso line, a significant amount will be coming directly into California from Mexico.

California currently has an inventory older, less efficient natural gas plants, while the Southwest has coal-fired facilities and current crop of very efficient combined cycles. This disparity can be expected to change in the future, as California retires or refurbishes its existing fleet of natural gas generators.

Even if the Southwest doesn't construct new generation as the applicant asserts, there is the possibility of excess generation in the Southwest for decades. at least during the off peak and in the winter. The book "The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest"[27] examines the potential for and benefits from increasing the efficiency of electricity use in the Southwest (Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming). The study models two scenarios, a "business as usual" Base Scenario and a High Efficiency Scenario that gradually increases the efficiency of electricity use in homes and workplaces during 2003-2020. The conclusions of the study is that an investment of approximately $80 million per year in the area could save 2,650 MW by 2015, and has the potential to eventually (post 2020) save over 6,000 MW in Arizona and over 22 billion gallons of water per year.[28] This would free up additional existing generation for importation into California via the DPV2 line.

[27] Southwest Energy Efficiency Project, *The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest*, November 2002, available at www.swenergy.org/nml/index.html.
[28] Howard Geller, "Energy Efficiency Policies and Programs in the Southwest", Presentation at the Energy Efficiency Task Force Meeting, Santa Fe, NM, March 22- 23, 2005.

III. ADDITIONAL ATTRIBUTES ASSESSMENT OF TRANSMISSION PROJECTS

"This is a money digging world of ours; and, as it is said, 'there are more ways than one to skin a cat,' so are there more ways than one of digging for money". Seba Smith, *'Way down East; or, Portraitures of Yankee Life*', 1854

In addition to the straight economic benefits (reductions in costs of electricity) there are a number of other characteristics that have been posited as benefits associated with the addition of transmission lines.

The Federal Department of Energy, in their National Transmission Grid Study[29] states that adding additional transmission lines will alleviate transmission congestion that significantly decreases reliability, restricts competition, enhances opportunities for suppliers to exploit market power, increases prices to consumers, and increases infrastructure vulnerabilities.

A California Energy Commission Report on planning for transmission lines lists these potential benefits: reliability, access to markets, fuel diversity, environmental, insurance against contingencies, and replacement for aging power plants[30] . Another CEC report calling for upgrading California's transmission system lists these benefits of transmission lines; least-cost, reliability, risk, market efficiency, fuel diversity, and resource flexibility[31].

The CEC's Strategic Transmission Investment Plan[32] lists these benefits associated with transmission lines:

- Insurance against contingencies during abnormal system conditions, such as low-probability but high-impact events.
- Price stability and mitigation of market power.
- Potential for increased reserve resource sharing.
- Environmental benefits.

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[29] Department of Energy, "*National Transmission Grid Study*", May 2002.
[30] California Energy Commission, *Planning For California's Future Transmission Grid. Review Of Transmission System, Strategic Benefits, Planning Issues, And Policy Recommendations*, P. 700-03-009, October 2003.
[31] California Energy Commission, *Upgrading California's Electric Transmission System: Issues and Actions For 2005 And Beyond*, P.700-2005-018, July 2005.
[32] California Energy Commission, *Strategic Transmission Investment Plan*, CEC 100-2005-006CTF, November 2005.

• Reduction in infrastructure needs.
• Achievement of state policy objectives.

The CEC, in their recently released "Proposed Criteria For Evaluation Of Transmission And Alternative Resources"[33], lists the following recommended criteria for evaluating transmission lines.

Recommended Evaluation Criteria

Evaluation Criterion	Measurement Description	Criterion Derivation
Least-Cost	Compute present value of costs for appropriate perspective	Computed
Reliability	Summarize reliability improvements not required or quantified	Subjective
Risk	Determine difference between expected and average worse case	Computed
Market Efficiency	Compare market prices to competitive costs	Computed
Fuel Diversity	Summarize energy consumed by originating fuel source	Subjective
Resource Flexibility	Describe capital fund flexibility for resource commitments	Subjective

The applicant stated that DPV2 would: increase California's access to low cost energy and reduce California energy costs, enhance competition among generating companies, provide additional transmission to facilitate the development of future energy supplies, and provide increased reliability of supply, insurance value against extreme events, and flexibility in operating California's transmission grid[34] but only attempted to quantify the economic value associated with access to low cost energy in Arizona.

[33] California Energy Commission, *Proposed Criteria For Evaluation Of Transmission And Alternative Resources*, CEC-700-2005-024, October 2005.
[34] A.05-04-015, *Proponent's Environmental Assessment Devers-Palo Verde No. 2 Transmission Line Project*, Vol. 1, part 1 of 2, pg.2-1, April 5, 2005.

In addition to the tipping point analysis which assessed the economic or energy benefit associated with DPV2, we list and quantify (where possible) the benefits DPV2 would provide that are associated with some of the other purported benefits. The following table provides an analysis summary.

Table 9. Analysis of DPV2 Attributes Summary

Attribute	Type of Analysis
Economic (energy)	Economic tipping point analysis
Reliability (capacity)	see Policy Section.
Environmental	Emissions Impacts (NOx, SOx, Carbon), Water Impacts
Strategic (Regional Diversity)	1,000 MW solar dish installation at Midpoint
Insurance (system-loss) (abnormal system conditions) (contingency)	SONGS out, Palo Verde out

III.1 Environmental Results

The environmental impacts of DPV2 are shown in the following table. Table 10 lists the emissions impacts of DPV2. DPV2 reduces the amount of NOx and Carbon that is produced in California by electrical generation, exporting it to the rest of the WECC area (primarily to the Southwest) and increases the amount of sulfur emissions in the WECC area..

Table 10. Emissions Impacts of DPV2

1000 tons/year

	NOX			SOx		Carbon		
year	California	WECC	exported from Ca	California	WECC	California	WECC	exported from CA
2009	-0.13	0.04	0.17	0.00	0.09	-8259	-52300	-44041
2010	-0.08	0.11	0.19	0.00	0.06	-5351	-36629	-31278
2011	-0.17	-0.03	0.15	0.00	0.04	-3508	-16732	-13224
2012	-0.17	-0.06	0.10	0.00	-0.01	-456	-50	406
2013	-0.16	0.03	0.20	0.00	0.06	2621	16687	14065
2014	-0.14	0.09	0.22	0.00	0.10	4529	36618	32089
2015	-0.10	0.08	0.18	0.00	0.06	7622	52295	44673
2010-15 ave	**-0.14**	**0.04**	**0.17**	**0.00**	**0.05**	**910**	**8698**	**7789**

Table 11 shows the water impacts of DPV2 operation. DPV2 allows California to reduce its electrical generation water consumption by over 5,000 acre-ft[35] of water per year.

Table 11. DPV2 Water Consumption Impacts

year	DPV2 Imports GWH	Water Use gallons	acre-ft
2009	5001	1,000,265,800	3,070
2010	8400	1,680,099,120	5,156
2011	8398	1,679,610,280	5,155
2012	8391	1,678,197,100	5,150
2013	8586	1,717,193,760	5,270
2014	8716	1,743,101,720	5,349
2015	8823	1,764,681,200	5,416
10-15 ave	**8552**	**1,710,480,530**	**5,249**

note: water use determined assuming average water consumption of 0.2 gallons/kWh

[35] An acre-ft of water is the equivalent to an acre of land covered by one foot of water, or approximately 325,851 gallons.

III.2 Strategic Value (1,000 MW solar)

The Commission recently approved an SCE contract with a major solar provider (up to 850 MW)[36]. To test the purported value of DPV2 for increasing renewable generation imports into California we used forecasted solar generation from a nominal 1,000 MW Stirling Solar Dish installation, interjecting the solar electricity into DPV2 at the Midpoint substation. Since most of the value from DPV2 comes from electricity imports into California during the winter (Figure 3), and most of the solar generation occurs predominantly during the summer (Figure 4), and exclusively during the day, one would suspect that solar electricity would be a complimentary addition to DPV2.

This turned out to be the case. Table 11 shows the impact of adding solar generation to the DPV2 line. The addition of solar generation (predominantly daytime and summer) significantly increases the amount of electricity imported over DPV2, increasing imports up to the maximum capacity of the line in almost every month. Almost two-thirds of the solar generation is additional generation that previously was not imported over DPV2. Only about one-third (1,125 GWH) of the solar generation displaces thermal generation previously imported over the DPV2 line.

The addition of solar on the DPV2 line has environmental benefits. The solar reduces the amount of emissions that are associated with DPV2 operation, driving NOx emissions negative, reducing SOx emissions by one-half, and saving 1,315,000 tons of carbon emissions per year. The solar generation also will save 690 acre-ft of water per year.

The economic impacts of adding solar to the DPV2 line are out of proportion to the amount of energy produced. A 1,000 MW solar generation facility will compose approximately 33 percent of the DPV2 imported electricity, but it increases the economic

[36] CPUC Resolution E-3957, October 27, 2005.

Figure 3. Annual DPV2 Imports: 2015

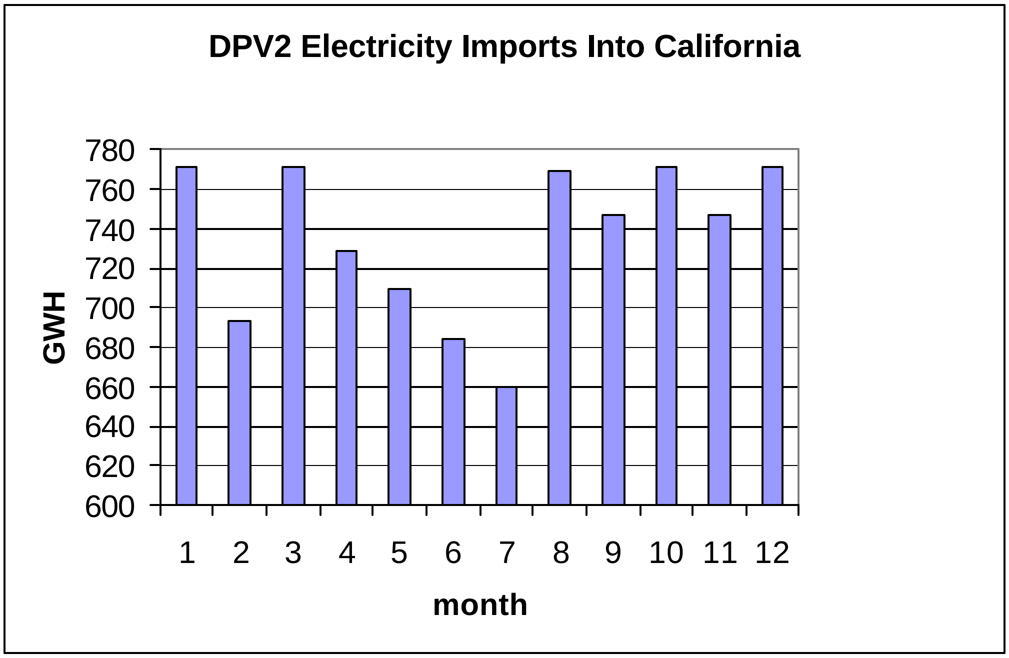
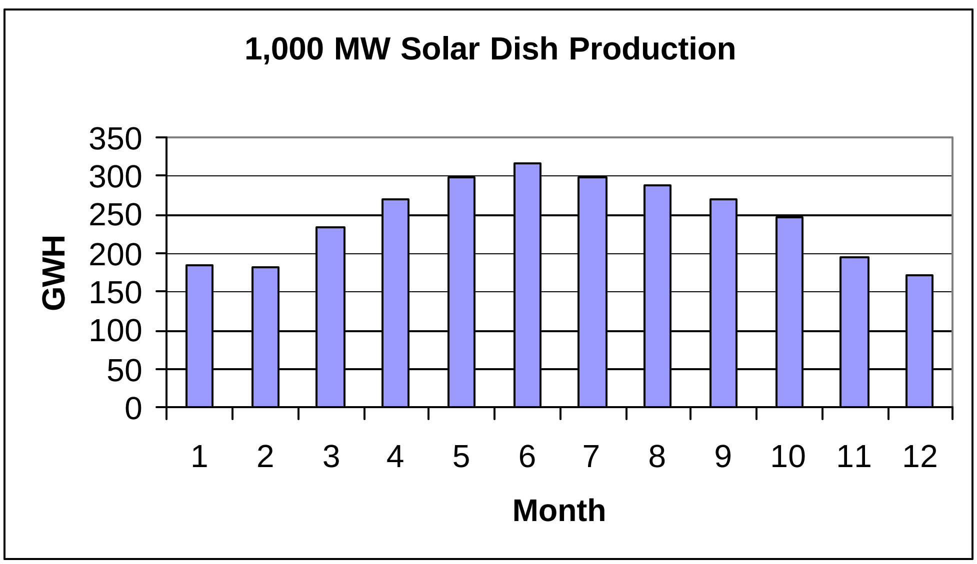


Figure 4. Solar Dish Electrical Production



benefits associated with DPV2 by over 60%. This is because the solar generated electricity, in the daytime and more in the summer than winter, is much more valuable than the predominately off peak, winter imports occurring on DPV2 without solar. Other renewable generation, such as intermittent or base load generators, will not have this impact, and could be expected to compete with imports already coming over the DPV2 line.

Table 11 Impact of 1,000 MW Solar Dish Input at Midpoint

Emission Impacts

2015	**NOX**	**SOX**	**Carbon**
	1000 tons	1000 tons	1000 tons
No DPV2	512.40	342.37	362,505
DPV2	512.49	342.44	414,800
DPV2 w/solar	511.92	342.40	413,485
due to DPV2	**0.08**	**0.06**	**52,295**
due to DPV2 w/solar	**-0.48**	**0.03**	**50,980**

	gallons/year	**acre-ft/year**
water use reduction due to solar	**224,942,725**	**690**

DPV2 Annual Imports - 2015

2015	**GWH/year**
DPV2	8,852
DPV2 w/solar	9,677
solar production	2,951
Additional DPV2 imports with solar	1,826
Reduced DPV2 Thermal generation with solar	1,125

	ISO Total Team Benefits	
	DVP2	**DPV2 w/solar**
Economic impact	$ million	$ million
2015	$62.91	$102.39

III.3. Insurance (system-loss) (abnormal system conditions) (contingency)

The following table shows the impact of SONGS (San Onofre Nuclear Generating Station) being out and Palo Verde being out. DPV2 is more valuable to California in the event of a SONGS outage than it costs California in the event of a Palo Verde outage. DPV2 provides an additional $33 million per year benefit in the event of a SONGS outage, while it reduces the benefit due to DPV2 by $21 million in the event of a Palo Verde Outage.

Table 12. Impact of SONGS and Palo Verde Outages

DPV2 economic threshold	$61.90

ISO Total TEAM Benefits of DPV2 ($M)

year	SCE Deterministic Basecase	Palo Verde Out	SONGS Out
2009	$24.02	$24.02	$51.23
2010	$44.24	$38.33	$72.10
2011	$50.99	$29.71	$76.89
2012	$57.73	$37.91	$77.48
2013	$69.70	$39.54	$98.35
2014	$61.84	$38.93	$112.81
2015	$62.91	$37.28	$109.17
2010-15 annual average	**$57.90**	**$36.95**	**$91.13**

IV. POLICY ISSUES

"Providing forecasts to policy-makers will help them formulate social policy. The new social policy, in turn, will affect the future, thus changing the accuracy of the forecast." *David Walonick*[37]

"Yet public policy continues to favour central plants and big transmission lines. Transmission is still centrally planned, and needn't compete fairly with its cheaper alternatives.

….

"Our problem isn't too few power lines; it's obsolete rules, rewarding perpetuation of an inherently vulnerable grid.

….

"Letting all options compete fairly -- whether they save or produce energy, no matter how big they are, what kind they are, or who owns them -- would gradually and profitably build a power system as resilient as the Internet. Then major failures, instead of being inevitable by design, would become impossible by design."

Amory Lovins, 2003[38]

IV.1 Exports

Transmission lines like DPV2 may serve to import cheaper electricity from out of state, but they also serve to export pollution, jobs, and money from California to out of state. The Commission needs to make a policy determination that these resultant exports are consistent with state policy.

As Section III of this testimony noted, one of the attributes of DPV2 operation is the export of emissions and water use from California to other states, particularly Arizona. The availability of DPV2 allows California to export 40 tons of N0x, 50 tons of SOx, 7,789,000 tons of carbon emissions, and over 1.7 billion gallons of water consumption annually to neighboring states.

[37] David Walonick, *An Overview of Forecasting Methodology*, available from: http://www.statpac.com/research-papers/forecasting.htm.

[38] Amory Lovins, *Towering Design Flaws*, The Globe and the Mail, Canada, August, 21, 2003.

Paralleling the flow of electrons from Arizona to California on the DPV2 line is the flow of cash from California to Arizona to pay for those electrons.

The applicant states *"… development of new transmission facilities to areas where generation has been more easily sited and constructed may spur the development of new competitive generation*"[39]. What is not mentioned is that the development of generation sources outside of California rather than inside California results in the exports of jobs from California to other states, jobs that were used to construct the generation facilities, and operate them after construction.

IV.2 Alternative Futures

Over 20 years ago the Rocky Mountain Institute was commissioned by the Pentagon to do a review of the security of the Unties States energy infrastructure. The resultant 1982 book, *Brittle Power: Energy Strategy for National Security*[40], concluded that America's energy policy promoted centralized, unforgiving, and vulnerable energy sources and infrastructures, while ignoring or suppressing the more diverse, dispersed, localized, and renewable options that could significantly reduce or make major supply failures impossible. The recent emphasis on security since 9/11 has resulted in renewed interest in the idea that complex, interdependent systems for the production and delivery of energy are vulnerable to simple but devastating acts of sabotage or natural disasters:

> *"National security is threatened not only by hostile ideology but also by misapplied technology; not only by threats imposed by enemies abroad but also by threats that America heedlessly—and needlessly—has imposed on itself. Despite its awesome military might, the United States has become extremely vulnerable, and is becoming more vulnerable, to the simple, low-technology disruption of such vital infrastructure as energy supply, water, food, data processing, and telecommunications."*

[39] A.05-04-015, *Proponent's Environmental Assessment Devers-Palo Verde No. 2 Transmission Line Project*, Vol. 1, part 1 of 2, pg.2-1, April 5, 2005.
[40] Amory B. Lovins and L. Hunter Lovins, **Brittle Power: Energy Strategy for National Security**, Rocky Mountain Institute, 1982. For reviews of this book see: *The Fragility of Domestic Energy*, The Atlantic Monthly, November 1983; *Reducing Vulnerability: The Energy Jugular* in: NUCLEAR ARMS Ethics, Strategy, Politics, Edited by R. James Woolsey, The Institute for Contemporary Studies, 1984.

> *"Terrorism, technical mishap, or natural disaster that damaged the domestic energy system could be nearly as devastating as a sizeable war."* [41]

There are a number of additional reports that illustrate the same problem, that the United States energy infrastructure is becoming increasingly "brittle"[42]. Hard, brittle energy paths are characterized by the following features:

- dangerous materials
- limited public acceptance, socially divisive
- highly centralized
- long, fragile supply routes
- limited substitution (few substitute fuels)
- continuity and synchronism in supply grids
- inflexibility of energy delivery systems
- interaction between supposedly independent systems
- high capital intensity
- long lead times
- specialized labor and control systems
- vulnerable to terrorist attack
- complex, high-tech

whereas soft energy paths have the following features:

- are diverse, not over-dependent upon any one source
- are flexible and relatively low-tech
- are matched in scale to end use needs
- are matched geographically to end use needs and make use of natural energy flows for distribution
- are matched in energy type and quality to end use needs
- are resilient
- are distributed widely over the service area.

The impact of shifting to a diverse, decentralized, soft energy systems "*reduces risks linked to fuel price forecasts, guesses about how fast future electricity demand will grow, and, as a bonus, increases grid reliability*".[43]

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[41] Amory Lovins, "Critical Issues in Domestic Energy Vulnerability", presentations to Alliance to Save Energy Summit, October 25, 2001, and Aspen Clean Energy Roundtable VIII, October 8, 2001.

[42] Electricity Infrastructure Security Assessment, Vol. I-II, EPRI, Palo Alto, Calif., Nov. and Dec. 2001; A. Amin, "*EPRI/DoD Complex Interactive Networks/Systems Initiative: Self-Healing Infrastructures*," Proc. 2nd DARPA-JFACC Symp. Advances in Enterprise Control, IEEE Computer Soc. Press, 2000; S.Silberman, "*The Energy Web*," Wired, vol. 9, no. 7, July 2001; Arjun Makhijani, "*Oil, Nuclear, and Electricity Vulnerabilities and a post-September 11, 2001 Roadmap for Action*", Institute for Energy and Environmental Research, November 2001

[43] Peter Asmus , "*Bringing Our Electricity Grid Into the 21st Century*" WEI Update, Spring 2002.

The problem is the addition of DPV2 results in further "hardening" of the California electricity system. This is not just the addition of a large (1,200 MW) transmission line spanning hundreds of miles to another state that is used to import large amount of electricity into the state, it is the addition of a transmission line whose economics are inextricably linked to the operations of a largest nuclear generation facility in the country, the Palo Verde Nuclear Generating Station. There are a number of studies that have contrasted the development of local generation sources, primarily smaller, distributed generation sources, to the addition of more transmission lines to the system.

Distributed generation reduces loading and use on transmission lines[44], distributed generation results in cost savings over centralized systems with long transmission lines[45]. A recent dissertation states: *"There are potentially significant reliability advantages to increasing the amount of distributed generation in a system"* and distributed electricity systems have *"demonstrably higher"* reliability advantages over a transmission dependent system[46]. A LBL report states that the benefits of a distributed generation system over a centralized system include:

> *"1. Electricity T & D Deferral and Congestion Relief*
> *2. Capacity Deferral*
> *3. Reduced Transmission Losses*
> *4. Voltage Support to Electric Grid*
> *5. Reduced Security Risk to Grid".* [47]

Yet in this proceeding, asking the Commission for approval to construct a new, multi-million dollar transmission line, there is no comparison of, nor even mention of, a distributed generation alternative to the proposed transmission line, nor how the construction of the proposed transmission line will prejudice the future, making a distributed generation future less likely in California.

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[44] Arthur D. Little, *Reliability and Distributed Generation*, Arthur D. Little, 2000.
[45] N.D. Strachan and H. Dowlatabadi, "*Distributed Generation and Distribution Utilities*" Energy Supply, 30 (8): 649-661, 2002.
[46] Hisham Zerriffi, "*Electric Power Systems Under Stress: An Evaluation of Centralized Versus Distributed System Architectures*", Carnegie Institute of Technology, Carnegie Mellon University, September 2004.
[47] E.Z. Gumerman, et al., "*Evaluation and Tools: Distributed Energy Resources*" Lawrence Berkeley Laboratory, Environmental Energy Technologies Division, February 2003.

It's not like other major entities aren't currently doing such analyses, they just aren't being done in California.

IV.3 BPA "Non-Wires" Solution Program

Bonneville Power Administration (BPA) owns and operates approximately 75 percent of the high voltage transmission in the Pacific Northwest. BPA had not added any significant transmission in the region since 1987. Faced with increasing load growth, constraints and congestion, BPA began planning additional infrastructure projects in the early 2000's. They commissioned a groundbreaking report, published in November 2001, entitled "*Expansion of BPA Transmission Planning Capabilities: A Report on Non-Transmission Alternatives*"[48]. This report made a number of recommendations for improving BPA's transmission planning process. In particular, it provided a model for assessing when non transmission alternatives are cheaper than the construction of a new transmission facility. The report stated:

> *"Before proceeding with the construction of transmission projects, BPA wants to ensure that there is a clear and compelling demonstration of project need and that it is providing the most cost effective solution to the region's transmission problems from an engineering, economic and environmental standpoint. As part of its evaluation, BPA must consider whether non transmission options can be employed as viable alternatives to transmission expansion. Non transmission solutions can include pricing strategies, demand reducing strategies, and strategic placement of generators."*[49]

In 2002, BPA implemented a Non-Wire Solutions Initiative, and adopted the following goals to develop:

> *"• Least-cost solutions that may result in deferring potential transmission reinforcement projects;*
> *• Ways to incorporate the planning methodology proposed in the study into the transmission planning process;*
> *• Opportunities for and potential constraints on integrating non-wires solutions into the transmission system;*

[48] Ren Orans, Snuller Price, Debra Lloyd, Tom Foley, and Eric Hirst, "*Expansion of BPA Transmission Planning Capabilities: A Report on Non-Transmission Alternatives*" prepared for the Transmission Business Line, Bonneville Power Administration, November 2001.
[49] Ibid, page 1.

• A set of criteria to help determine when non-wires solutions are feasible and when they are not, including developing a set of screening tools for future non-wires candidates; and

• Ways to integrate the work from this effort sufficiently early in the planning process so that non-wires solutions can make a difference."[50]

BPA describes non-wires solutions as*: "distributed generation, demand exchange, demand response, and conservation measures"* that *"may be lower cost, thus minimizing necessary rate increases to enhance needed regional transmission reliability. They may also have other benefits (e.g., lower demand charges, reduced electrical needs, reduced constraints on a distribution system, and improved plant efficiency)."* [51]

BPA has now institutionalized the assessment of non-wires alternatives in all transmission planning efforts:

> "*BPA has reconfigured its transmission planning process to include an initial screening of projects to assess their potential for a non-wires solution. BPA is now committed to using non-wires solutions screening criteria for all capital transmission projects over $2 million so it becomes an institutionalized part of planning.*"[52]

There are already several documents available that demonstrate how this process is used to defer or replace additional transmission construction[53].

If our neighbor to the north recognizes the value of such an analysis and the economic savings and reliability improvements such alternatives to transmission projects can provide (and has implemented it on an institution basis), California, by ignoring such alternatives, will

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[50] "*Transmission Planning through a Wide-Angle Lens: A Two Year Report on BPA's Non-Wires Solutions Initiative"* BPA, September 2004.

[51] "Non-Wires Solutions Questions & Answers. Exploring Cost-Effective Non-Construction Transmission Alternatives", BPA, available at: http://www.transmission.bpa.gov/PlanProj/Non-Wires_Round_Table/NonWireDocs/NonWiresQuestionsAnswers.pdf

[52] "*Transmission Planning through a Wide-Angle Lens: A Two Year Report on BPA's Non-Wires Solutions Initiative"* BPA, September 2004.

[53] for example, see: "*Olympic Peninsula Study of Non-Wires Solutions to the 500-kV Transmission Line from Olympia to Sheldon"* and "*Non-Wires to Lower Valley Power and Light Transmission System Reinforcement Project"* available at: www .transmission.bpa.gov/PlanProj/Non-Wires_Round_Table/

end up with a less economic, less reliable, less cost effective electrical system than we could have had.

V. CONCLUSIONS

Tipping Points

We identified four tipping points in the DPV2 economic analysis: the modeling conventions used, natural gas price differential assumed between Arizona and California, Palo Verde outage, and wholesale natural gas prices. In order for DPV2 to be cost effective, the natural gas price differential between Arizona and California has to be greater than $.50/MMBTU, the wholesale Topock price of natural gas has to be greater than $5.00/MMBTU (2010), and Palo Verde has to be operating.

Additional Attributes

The availability of DPV2 allows California to export 40 tons of N0x, 50 tons of SOx, 7,789,000 tons of carbon emissions, and over 1.7 billion gallons of water consumption annually to neighboring states.

DPV2's economics are inextricably linked to the operation of the Palo Verde nuclear facility. DPV2 is more valuable to California in the event of a SONGS outage than it costs California in the event of a Palo Verde outage.

The use of DPV2 for importing solar generated electricity has significant benefits. Solar generation (daytime and predominately in the summer) compliments the off peak, winter imports on the DPV2 line, with significant economic and environmental benefits.

The construction and operation of DPV2 will likely result in a decrease in reliability over a distributed generation alternative, but the lack of such an analysis in the proceeding prevents a definitive conclusion.

QUALIFICATIONS

Lon W. House, Ph.D.

Dr. House has a Bachelors, two Masters, and a Ph.D. in Engineering and Economics from U.C.Davis. He also has a CEM (Certified Energy Manager) certification. He taught engineering in Graduate School at U.C. Davis for a number of years. He worked for the California Energy Commission for five years as a utility planner, and he was the chief utility planner for the California Public Utilities Commission for five years. In 1990 he went out into the consulting business, starting his own business (Water and Energy Consulting). He has been the Association of California Water Agencies (ACWA) energy consultant since 1992, representing 500 water agencies which are responsible for over 90 percent of the water delivered in California; the Regional Council of Rural Counties (RCRC) energy advisor since 1999, representing 30 rural California counties encompassing over one-half of the land area of California; and an energy consultant for the Attorney General of the State of California since 2004.

Dr. House has testified numerous times before the California Public Utilities Commission, California Energy Commission, California Power Authority, California Independent System Operator, California State Legislature, State Water Resources Control Board, and the Federal Energy Regulatory Commission, as well as in numerous court cases.