BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE

STATE OF CALIFORNIA

Order Instituting Rulemaking to Establish)	
Policies and Cost Recovery Mechanisms)	Rulemaking 01-10-024
For Generation Procurement and Renewable)	RPS Phase
Resource Development.)	
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Testimony of the Union of Concerned Scientists on Order Instituting Rulemaking 01-10-024 RPS Phase

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For

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Dated: April 1, 2003

1. Introduction

This testimony is presented on behalf of the Union of Concerned Scientists (UCS). Established in 1969, UCS is an independent nonprofit partnership of over 60,000 citizens and scientists across the country combining rigorous scientific analysis, innovative policy development, and effective citizen advocacy to achieve practical environmental solutions. The UCS Clean Energy Program examines the benefits and costs of the country's energy use and promotes energy solutions that are sustainable both environmentally and economically. The program analyzes, develops, and promotes innovative technology and market-based strategies to reduce harmful environmental impacts of energy production and use, improve energy efficiency, and to commercialize and deploy a diverse array of renewable energy technologies at the lowest cost; and provides information to policymakers, the media, and the public about energy's impact on public health, the environment, and the economy.

UCS has been a leading analyst of and an advocate for minimum renewable energy requirements at the state and federal levels. UCS has an office in Berkeley, California and nearly 15,000 individual members and activists in California. UCS' California members, most of whom are customers of PG&E, SDG&E or SCE, are concerned about renewable energy, diversity of electricity supply, and the public health and environmental consequences of California's procurement policies.

My qualifications are presented in Section 5 below. I have over twenty years of experience researching energy and environmental issues. The primary focus of my work includes electricity industry regulation and restructuring; technical and economic analyses of electricity systems; energy efficiency program design and policy analysis; renewable resource technologies and policies, clean air regulations and policies, municipal aggregation, performance-based ratemaking; and many aspects of consumer and environmental protection. I have worked directly on renewable portfolio standard (RPS) policies in Massachusetts, Maryland and New Brunswick, and have performed several technical studies of renewable generation potential, including *Repowering the Midwest* (Environmental Law and Policy Center, 2001) *Powering the South* (Renewable Energy Policy Project, 2002) and an on-going study of the states in the Western Electricity Coordinating Council (Land and Water Fund of the Rockies, 2003).

The purpose of my testimony is to discuss the appropriate methodology for determining the market price referent that will be used to determine payments from the Public Good Charge (PGC) to cover the above-market costs of renewables. My testimony begins with an overview of the items that should be accounted for in determining the market price referent. I then discuss options for estimating the fuel price hedge value that renewable generation offers relative to natural gas generation.

2. Methodology for Determining the Price Referent

The Purpose of the Market Price Referent

The California RPS law (SB 1078) requires the California Public Utilities Commission (the Commission) to establish a methodology to determine the market price of electricity. This "market price referent" will be used determine payments from the PGC to cover the above-market costs of renewables. Thus, it represents a benchmark that will be used to divide the costs of the renewables between the electric utilities (and their ratepayers), and the PGC.

It is important that the market price referent reflects the real-world costs of generating electricity in California. This will ensure that the limited funds in the PGC are adequately and fully utilized to support the public benefits available from renewable generators, while achieving these benefits at the least cost.

However, there is no single measure of electricity market prices. Market prices depend upon the particular service that is being provided by the electricity product. That is, any one market price exchanged between a competitive seller and a buyer may depend upon many factors, such as the time of day the electricity is provided, the time of year it is provided, the duration of the sale, the firmness of the power provided, the location where it is provided, and whether there is a fixed price or an indexed price.

For the purposes of determining the referent, the market price should resemble as closely as possible the electricity services provided by the renewable generators. In this way, the benchmark will provide an appropriate means for allocating the costs of the renewables between the electric utilities and the PGC.

The California RPS law includes the following language regarding the establishment of the market price referent:

> The commission shall establish a methodology to determine the market price of electricity for terms corresponding to the length of contracts with renewable generators, in consideration of the following:
>
> (1) The long-term market price of electricity for fixed price contracts, determined pursuant to the electrical corporation's general procurement activities as authorized by the commission.
>
> (2) The long-term ownership, operating, and fixed-price fuel costs associated with fixed-price electricity from new generating facilities.
>
> (3) The value of different products including baseload, peaking, and as-available output.[1]

By referring to fixed-price contracts, fixed-price fuel costs and fixed-price electricity, the law clearly intends that the market price referent be based on a market price that

[1] P.U. Code Section 399.15(c).

resembles as closely as possible the services provided by renewable generators, because renewable generators tend to have fixed prices due to the lack of fuel costs. It is important that the market price referent adequately reflects this feature, as well as others, of renewable generation – and is not a simplistic estimate of a market price that reflects a different type of electricity product.

The Market Price Referent Should be Based on a Natural Gas Facility With All Appropriate Costs Factored In

I recommend that the market price be based on a real-world natural gas facility (or facilities), and that it accounts for all the appropriate costs necessary to finance, permit, construct, operate and maintain such a facility in California. The cost of the natural gas generation should be determined using the analytical framework of the recent CEC Staff Report on the costs of power plants in California.[2] However, the cost of gas generation should account for several factors that may not have been accounted for in the CEC Staff Report. In particular:

- The natural gas generation costs should include the costs associated with obtaining all necessary permits in an appropriate location in California.
- The natural gas generation costs should include the costs of mitigation of environmental impacts, such as the costs of purchasing emission offsets to meet local and state air quality requirements.
- The natural gas generation costs should include the costs of infrastructure support, such as the costs of interconnection to the electrical grid, interconnection to gas fuel supply, and water interconnections.
- The natural gas facility construction costs should incorporate appropriate financial assumptions that reflect financing costs for merchant power projects.
- The natural gas facility should be assumed to use dry cooling technologies, instead of wet cooling.
- The gas facility's heat rate should be based on heat rates from recently-constructed facilities, and should account for real-world operating conditions and heat rate degradation over time.
- The natural gas fuel price forecast should reflect the best forecast available from several perspectives. A gas price forecast that is based on an average of several independent forecasts may provide a better indication of the future gas prices than using a single source, because the average would smooth out any limitations or biases that may exist in any one forecast.
- The natural gas generation costs should incorporate any other costs that might have been excluded from the CEC Staff Report, such as future capital additions and corporate overheads.

[2] California Energy Commission, *Comparative Cost Of California Central Station Electricity Generation Technologies*, Staff Draft Report, 100-03-001SD, February 11, 2003 (CEC Staff Report).

It is my understanding that other witnesses in this proceeding will address many of these factors in more detail. Therefore, I will not address them further here. The remainder of my testimony will focus on how the market price referent should explicitly account for the fuel price hedge value of renewable generation.

3. The Fuel Price Risk Value of Renewables

Long-Term, Fixed Price Fuel Costs

The California RPS law clearly intends for the market price referent to account for the fact that most renewable generators do not incur fuel costs, and thus provide a hedge against the volatility of natural gas prices.[3] As noted above, the RPS law states that the establishment of the market price referent should consider "the long-term ownership, operating, and fixed-price fuel costs associated with fixed price electricity from new generating facilities."

The RPS law also requires that electric utilities offer contracts of "no less than ten years in duration" when soliciting power from renewable developers.[4] Therefore, for the purpose of setting the market price referent, long-term means at least ten years and could be longer depending upon the proposals received from the renewable developers.

Current gas price forecasts do not provide a good indication of long-term fixed-price gas costs. The best theoretical measure of long-term fixed-price gas costs would be the price associated with an actual contract for fixed-price gas for the next ten years or more.[5] I am not aware that any such contracts are available in the market in California today.

Another measure of long-term fixed price gas costs would be in the form of a financial hedge, such as the cost of gas price futures. Gas futures can be bought and sold through the New York Mercantile Exchange (NYMEX), for gas sold at the Henry Hub in Louisiana. However, the longest term available for these gas futures is only six years, thus they do not provide a useful long-term fixed price costs for determining the market price referent. Also, these futures do not account for the difference between prices at the Henry Hub and prices in California. Therefore, the Commission will need to develop a different methodology for estimating long-term, fixed price gas costs.

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[3] While biomass plants do incur fuel costs, the fuel sources are generally more locally available than fossil fuels, and their fuel sources and prices are relatively independent of fossil fuel supplies. Thus biomass plants also provide a hedge against fossil fuel price volatility.

[4] P.U. Code Section 399.14(a)(4).

[5] While it is possible that the price of such gas contracts might not turn out to be equal to actual gas prices in future years, such contracts still provide an indication of the long-term fixed-price gas costs. Regardless of whether a contract price turns out to be different from the actual price or not, a utility could enter into such a contract and thereby be protected from any such differences.

Gas Price Hedge Adder

One option is to increase the gas price forecast by a measure that reflects the value of a long-term financial gas hedge. Lawrence Berkeley Laboratory (LBL) recently conducted a study which estimated the financial hedge value of renewables to be roughly $5/MWh.[6] This estimate was derived by comparing the cost of financial hedges for gas prices with the forecasts of gas prices prepared by the US Energy Information Administration (EIA). For the financial hedge prices, the LBL study used gas "swap" prices available from Enron in 2001 and 2002.[7] The swap prices were for 2-year, 5-year and 10-year periods.

This LBL estimate is a good starting point for calculating a gas price hedge value to add to the market price referent. However, it may underestimate the true cost of a relevant financial hedge, for three important reasons.

First, the LBL gas price hedge value is based on relatively short-term hedge products, of 2-year, 5-year and 10-year duration. Thus, they may not capture some of the hedge value provided by longer-term contracts with renewable generators. The gas price hedge value is likely to increase over the long-term, as there could be greater uncertainties and more unanticipated shifts in the gas market over more years. Furthermore, long-term financial hedge products contain a certain amount of risk regarding the financial standing of the company providing the hedge. Over a longer period of time, there are greater chances of the hedge provider being unable to deliver on the product due to financial and credit constraints. This risk can become increasingly significant if the hedge provider under-forecasts the long-term price of gas and frequently finds itself providing gas at a price that is less than the actual price turns out to be.

Second, and more importantly, the LBL gas price hedge value is derived from financial hedge products that are unlikely to take full account of the long-term risks associated with natural gas prices. Electric utilities typically pass the costs of purchasing gas for their power plants on to their ratepayers. Thus, electric utilities (from the shareholders' perspective) face very little risk from future gas price volatility and uncertainty. Since they face so little long-term risk, it is unlikely that they would be willing to pay much to hedge against it. In addition, regulated utilities may be concerned that purchases of hedging "insurance" would be deemed by regulators to be imprudent, and cost recovery disallowed. Furthermore, utilities may be concerned about the risk that past and future restructuring efforts will erode their customer bases, making it more difficult to recover hedging costs from remaining customers. These could be some of the reasons why there are so few products on the market that provide electric utilities with long-term hedges against gas prices.

Third, the LBL hedge value is derived from financial hedge products that are unlikely to account for the long-term risks to gas prices associated with future environmental

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[6] Lawrence Berkeley Laboratory, *Quantifying the Value that Wind Power Provides As a Hedge Against Volatile Natural Gas Prices*, Mark Bolinger, Ryan Wiser, and William Golove, Environmental and Technologies Division, June 2002.

[7] Enron no longer offers these financial hedge products, due to its bankruptcy, and thus these products are not available to use for the purpose of setting the market price referent.

regulations. It is quite possible that within the next ten to twenty years some form of CO_2 regulations will be applied to power plants in California and elsewhere, which would significantly increase the price of natural gas. (My reasons for this assertion are provided in the following sections.) But such regulations, and their associated costs, are unlikely to be included in today's gas futures markets, for several reasons:

- The gas price financial hedges that are currently offered, and that were used in the LBL study, tend to be for such short time periods that they do not have to account for environmental regulations that are not anticipated to be in place during those time periods.
- Electric utilities (again, from the shareholders' perspective) would not expect to bear much of the costs of future environmental regulations. They would expect to pass most of these costs on to their customers through their electric rates. Since electric utilities do not bear the full risks of future environmental regulations, they do not have a financial incentive to protect themselves against these risks through gas price hedges.
- The demand for, and price of hedges, will be depressed to the extent that utilities and other market participants believe that global climate change is not a serious problem or that significant carbon reductions will not be required during a time frame of interest to them.

Since the gas price hedge products used in the LBL study do not account for the long-term risks associated with future environmental regulations, they understate the true value of long-term fixed-price fuel costs.

CO_2 Emissions and Climate Change

CO_2 is the most prominent greenhouse gas leading to climate change – the increase in the temperature of the Earth's atmosphere due to the increase in heat-trapping gases. Climate change is expected to result in dire long-term consequences for the planet, including higher sea levels, coastal wetland floods, fish and bird habitat loss, prolonged droughts, lost crop production, increased hurricanes, increased heat-related deaths, animal and plant extinction, and a spread in the geographical range of dangerous pests and diseases. A study by the Union of Concerned Scientists (Global Environment Program) and The Ecological Society of America found that global climate change would likely have significant negative consequences for California.[8]

While there has been much debate in the past about the extent of the threat of global warming, there is now a growing consensus among mainstream scientists about the reality of climate change. As Dr. Robert Watson, then Chairman of the Intergovernmental Panel on Climate Change, said in 2001, "The overwhelming majority of scientific experts, while recognizing that scientific uncertainties exist, nonetheless

[8] Christopher B. Field *et. al*, *Confronting Climate Change in California: Ecological Impacts on the Golden State*, Union of Concerned Scientists and The Ecological Society of America, Cambridge, Massachusetts, November 1999.

believe that human-induced climate change is already occurring and that future change is inevitable."[9]

It is quite possible that CO_2 emissions will become regulated nationally and/or in California within the next ten years. The United States produces 25% of global CO2 emissions, even though it is home to just 5% of the world's population. California alone emits over 400 million tons of CO2 a year, an amount surpassed by only eight countries in the world. Thus, the US and California will have to play important roles in mitigating greenhouse gases.

Furthermore, power plants, including those serving California electricity customers, are likely to be among the key targets of CO_2 regulations. Power plants are the single largest source of CO2 emissions in the US. Over 70% of the electricity generated in the U.S. comes from fossil fuel-burning power plants. These plants emit 2,200 million tons of CO2 a year, accounting for 40% of the U.S. total.[10] In addition, the CO_2 emissions from the electricity sector come from relatively few large sources, in comparison with the transportation and the industrial sectors. Thus, power plants provide a key opportunity for reducing CO_2 emissions through regulations.[11]

Actions to Address Climate Change

Many countries have already recognized the importance of regulating CO2 emissions in order to mitigate climate change. Most of the world's industrialized nations have ratified the Kyoto Protocol, an international agreement that holds participating countries to reducing carbon emissions to below 1990 levels. While the US has not ratified the Kyoto Protocol, it will be under increasing domestic and international pressure to ratify it or to take comparable actions to reduce greenhouse gas emissions.

In the US Congress there have been several efforts in recent years to regulate CO_2 emissions, although none of them have been successful yet. There are two proposals currently pending in Congress. First, the Clean Power Act (S. 366) would limit CO2 emissions from the electric sector to 2.05 billion tons by 2009 (roughly equivalent to 1990 levels), with flexibility measures possibly including trading and emission allowance auctions. This measure passed the Senate Environment & Public Works Committee in 2002. Second, the McCain-Lieberman bill (S.139) has more conservative mandates for CO2 reductions to 2000 levels by 2010 and 1990 levels by 2016, but applies to the

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[9] Bert Metz, *Statement on Behalf of the Chairman of IPCC, Dr. Robert Watson*, delivered at the Seventh Conference of Parties to the United Nations Framework Convention on Climate Change, Marrakech, Morocco, November 7, 2001.

[10] Environmental Protection Agency, *Global Warming – Emissions: International Inventory*, available at http://yosemite.epa.gov/oar/globalwarming.nsf/content/EmissionsInternationalInventory.html, last updated October 11, 2002.

[11] While the CO2 emissions from natural gas combined cycle plants are lower than those of coal- or oil-fired plants, they are significant nonetheless. A typical NGCC plant can emit roughly 117 lb/MMBtu of CO2, which means that with a heat rate of 7400 Btu/kWh, would emit roughly 866 lb/MWh. A 500 MW gas plant operating at a capacity factor of 80% would thus emit roughly 1.5 million tons of CO2 emissions per year.

commercial, industrial, and fuel sectors as well as the electricity sector. While it is not clear whether or when these proposals will succeed, there is a significant probability that some form of CO_2 regulation will be applied to the US electricity sector within the next ten years or so.

Furthermore, there has been greater activity at the regional and state levels to regulate CO_2 emissions in the electricity and other sectors. For example,[12]

- California. In July 2002 Governor Gray Davis signed a first-of-a-kind law (AB 1493) to limit the emissions of CO_2 from new cars and trucks sold in the state. The law requires the California Air Resources Board to write regulations to achieve the maximum feasible reduction in CO_2 emissions from cars and trucks, beginning with the 2009 model year.

- Massachusetts. The Massachusetts Department of Environmental Protection (DEP) issued "Emissions Standards for Power Plants" (310 CMR 7.29) in April 2001. This multi-pollutant legislation requires emission reductions from the six largest, most polluting power plants in the state. The CO2 standard of 1,800 lbs/MWh by 2006 represents a 10 percent reduction from the historic baseline (1997-1999). Facilities are allowed to meet their reduction requirements through offsite CO2 reductions, subject to DEP approval. The compliance deadline is extended to October 2008 for any facility that undergoes repowering. In addition to this legislation, the state's Energy Facilities Siting Board requires *new* power plants with a capacity greater than 100 MW to offset 1% of the facility's CO2 emissions for the next 20 years, as long as the cost of offsets does not exceed $1.50 per ton.

- New Hampshire. The New Hampshire "Clean Power Act" (HB 284), approved in May 2002, requires emission reductions from the three existing fossil-fuel power plants in New Hampshire. The law requires the plants to stabilize their CO2 emissions at 1990 levels (which is approximately three percent below their 1999 levels) by the end of 2006. This CO2 emission reduction is consistent with the Climate Change Action Plan adopted by the New England Governors and Eastern Canadian Premiers (see below). Plants have the option to reduce their emissions on site or to purchase emissions credits from outside of the state.

- New Jersey. The Department of Environmental Protection (DEP) released the New Jersey Sustainability Greenhouse Gas Action Plan in April 2000. The Plan provides a framework for reducing greenhouse gas emissions in New Jersey to 3.5 percent below their 1990 levels by 2005. Under the Plan, the Public Service Enterprise Group (PSEG), the state's largest utility, pledged to reduce total emissions from all of its fossil fuel-based plants by 15% below 1990 levels by 2005. This would require its fossil fuel-fired units to limit their CO2 emissions to

[12] Unless otherwise noted, the state information presented below was taken from Synapse Energy Economics, *Multi-Pollutant Programs in CT, MA, NH, NJ and NY*, prepared for the Ozone Transport Commission, June 2002; and Barry Rabe, *Greenhouse and Statehouse: The Evolving State Government Role in Climate Change*, prepared for the Pew Center on Global Climate Change, November 2002.

1450 lbs/MWh in 2005, compared to 1706 lb/MWh in 1990. If PSEG fails to achieve the goal, it must pay the DEP $1 per pound/MWh it falls short of its goal, up to $1.5 million. The fund will be used to support CO2 reduction projects within New Jersey.

- New York. The New York Greenhouse Gas Task Force was created by Governor Pataki in June 2001. The purpose of the Task Force is to develop recommendations for ways to significantly reduce the state's emissions of greenhouse gases, and the state is currently considering whether to adopt the recommendations of the Greenhouse Gas Task Force. The 2002 State Energy Plan also recommends that the state commit to a goal of reducing greenhouse gas emissions by 5 percent below 1990 levels by 2010, and 10 percent below 1990 levels by 2020.[13] It also recommends the state to develop a greenhouse gas emission registry program.

- Oregon. In 1997 Oregon established the first formal standard for CO2 emissions from new electricity generating facilities in North America.[14] The standard holds any proposed new or expanded power plant to a CO2 emissions rate of 0.675 pounds per kWh, which is 17 percent less than the most efficient natural gas-fired plant currently operating in the U.S. At the same time, the state also created a non-profit known as the Climate Trust to implement CO2 offset projects with funds provided by the electric generating industry. A generator can choose to either meet the emissions standard or donate funds to the Climate Trust. The donation level was originally set at $0.57 per ton of CO2, but is subject to change based on the actual cost of CO2 offsets.

- New England and Eastern Canada. In August 2001, the New England Governors and Eastern Canadian Premiers signed an agreement for a comprehensive regional Climate Change Action Plan.[15] The plan centers on three main goals: The short-term goal of the Plan is to reduce regional greenhouse gas emissions to 1990 levels by 2010; the mid-term goal is to reduce regional GHG emissions by at least 10% below 1990 levels by 2020, and establish an interactive, five-year process, starting in 2005, to adjust the goals if necessary and set future emission reduction goals; and the long-term goal of the Plan is to reduce regional greenhouse gas emissions sufficiently to eliminate any dangerous threat to the climate, which recent science suggests will require reductions of 75-85% below current levels. The Plan also provides for the establishment of a regional standardized inventory and registry of greenhouse gas emissions.

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[13] New York State Energy Research and Development Authority, *2002 State Energy Plan and Final Environmental Impact Statement*, June 2002.

[14] Anne Egelston, *Oregon, Massachusetts Lead the Way in GHG Reductions*, Environmental Finance, July-August 2001.

[15] New England Governors and Eastern Canadian Premiers, *Climate Change Action Plan: 2001*, August 2001.

- Chicago Climate Exchange. The Chicago Climate Exchange is a voluntary private pilot program for trading greenhouse gases in North America.[16] It was founded by 14 North American corporations in different industries. Each exchange member has agreed to reduce its CO2 emissions by 4 percent from 1998-2001 levels over the next 4 years. Members that exceed the reduction requirements can sell excess reductions to other members. However, questions remain over whether trading will work without enforceable targets.

- State Climate Change Action Plans. In addition to the regulations and programs described above, 25 states are working with the EPA to develop climate action plans that identify cost-effective options for reducing greenhouse gas emissions at the state level. At least 19 states have completed an action plan to date.

All of these recent activities demonstrate that there has been growing pressure to adopt regulations to reduce the emissions of greenhouse gases, particularly CO_2. This pressure is likely to increase further over time, as climate change issues and measures for addressing them become better understood by the scientific community, by the public, and by elected officials.

Environmental Regulations Can Also Indirectly Affect the Price of Gas

It is also important to recognize that environmental regulations can indirectly increase the price of natural gas. It is expected that environmental regulations, particularly CO_2 regulations, would cause a shift from coal-fired generation to natural gas-fired generation. This shift would increase the demand for natural gas, which would in turn increase the price of natural gas. If the environmental regulations were nation-wide or regional, the effect on gas prices could be significant.

This effect was demonstrated in a recent study by the Energy Information Administration, which investigated a variety of effects of multi-pollutant strategies, including the effects on natural gas demand and prices.[17] The study made the following findings in this regard:

- For the case where NO_X, SO_2, mercury (Hg), and CO_2 are regulated, with CO_2 capped at 1990 levels by 2008, gas prices were projected to increase by 18% in 2010 and by 15% by 2020.

- For the case where NO_X, SO_2, Hg, and CO_2 are regulated, with CO_2 capped at 7% below 1990 levels by 2008-2012, gas prices were projected to increase by 27% in 2010 and by 16% by 2020.

The study also looked at the impacts of using a national renewable portfolio standard as a means of helping to comply with the emission caps at a lower cost. It modeled the effects

16 Chicago Climate Exchange, *Chicago Climate Exchange website*, available at http://www.chicagoclimatex.com/html/about.html.

17 US Energy Information Administration, *Analysis of Strategies for Reducing Multiple Emissions From Electric Power Plants: Sulfur Dioxide, Nitrogen Oxides, Carbon Dioxide, and Mercury, and a Renewable Portfolio Standard*, July 2001 (the EIA-McIntosh study).

of a national RPS that required 20% of generation to come from renewables within the next 20 years. The study found that the gas price increases would be significantly less with the RPS, because the increase in renewable generation mitigates the increased demand for natural gas. When the 20% RPS is included, the gas price impacts were as follows:

- For the case where NO_X, SO_2, Hg, and CO_2 are regulated, with CO_2 capped at 1990 levels by 2008, gas prices are expected to increase by 3.5% in 2010 and to be reduced by 4% by 2020.
- For the case where NO_X, SO_2, Hg, and CO_2 are regulated, with CO_2 capped at 7% below 1990 levels by 2008-2012, gas prices are expected to increase by 9% in 2010 and by 3% by 2020.

I do not necessarily endorse all the specific assumptions, methodology and conclusions of this EIA report. The EIA assumes very high costs for increasing renewable energy generation, for example, and no policies to increase energy efficiency, both of which would increase the use of fuel-switching to gas as a compliance option, and increase the price of natural gas. Nevertheless, the study provides a useful estimate of the risk to natural gas prices in one potential compliance scenario.

In sum, future environmental regulations – especially CO_2 regulations – can significantly increase the price of natural gas, well above the forecasts that are typically used to estimate the operating costs of gas power plants. The price of gas might be increased directly as a result of compliance costs, or indirectly as CO_2 regulations cause an increase in the demand for natural gas. This risk is unlikely to be factored into the financial gas price hedge products that are available today, because (a) the hedge products do no cover a long-enough period to capture this risk, (b) electric utilities do not face the risk of bearing these costs and (c) some utilities may not believe that the costs are likely to be imposed within a time frame of interest to them.

The Costs of Complying With Future Environmental Regulations

While it is difficult to estimate the compliance costs for future environmental regulations, it is important to make the best estimate possible in order approximate as closely as possible the "fixed-price fuel costs associated with fixed price electricity." A good estimate of such future compliance costs is more likely to be correct than the assumption that they will not exist at all.

The EIA-McIntosh study of multi-pollutant strategies, referred to above, provides an estimate of the costs of complying with multi-pollutant environmental regulations. A follow-up study was performed to estimate the costs of complying with federal multi-pollutant legislation proposed in 2001 by Senators Jeffords and Lieberman.[18] The EIA-Jeffords-Lieberman study utilizes assumptions from the Five Labs Clean Energy Future study, which includes very aggressive assumptions about the availability of efficiency

[18] US Energy Information Administration, *Analysis of Strategies for Reducing Multiple Emissions From Electric Power Plants with Advanced Scenarios*, October 2001 (the EIA-Jeffords-Lieberman study).

and renewables.[19] Thus, these two EIA studies provide a reasonable range of estimates for the costs of complying with future environmental regulations: the EIA-McIntosh study assumes that efficiency and renewables will play a very small role in compliance, while the EIA-Jeffords-Lieberman study assumes that they will play a very large role.

The Table 1 provides several estimates of the costs of compliance with future environmental regulations. It includes a series of CO_2 costs (in $/ton) for 2003 through 2020, and then converts that series to a real levelized value that can be used to compare with, and add to, the market price referent.

Table 1. Levelized Cost of Compliance with Future Environmental Regulations

	CO2 Cost ($/ton)						
	CO2 Regulations Phased In			EIA Jeffers-Lieberman		EIA McIntosh	
Year	Low	Med	High	Moderate	Advanced	w/o RPS	w/RPS
2003	0	0	0	8	7	2	0
2004	0	0	0	7	10	9	5
2005	0	0	0	11	14	8	5
2006	2	3	5	14	14	16	14
2007	4	6	10	20	16	26	20
2008	6	9	15	17	14	26	21
2009	8	12	20	17	14	23	21
2010	10	15	25	18	15	23	23
2011	11	16	28	20	14	27	21
2012	12	17	30	18	14	28	22
2013	13	18	33	19	14	30	24
2014	14	19	35	21	14	31	24
2015	15	20	38	21	14	31	23
2016	16	21	40	20	14	33	22
2017	17	22	43	20	14	33	22
2018	18	23	45	19	14	35	21
2019	19	24	48	19	14	35	20
2020	20	25	50	19	14	37	19
2021	20	25	50	19	14	37	19
2022	20	25	50	19	14	37	19
Real Cumulative PV ($/ton)	82	112	204	152	124	220	163
Real Levelized ($/ton)	4.09	5.58	10.22	7.61	6.22	11.01	8.15
Real levelized ($/MMBtu)	0.24	0.33	0.60	0.45	0.36	0.64	0.48
Real Levelized ($/MWh)	1.77	2.42	4.42	3.30	2.69	4.77	3.53

Natural Gas Combined Cycle:		
Unit Heat Rate (Btu/kWh)	7,400	From Marcus testimony, 5/31/02. For the Mission Sunrise contract.
CO2 Emission Factor (lb/MMBtu)	117	From STAPPA/ALAPCO CO2 Study, 1999.
CO2 Emission Factor (lb/MWh)	866	
Nominal discount rate	10.8%	From CEC Staff Report, 2/11/2003
Real discount rate	8.6%	
Inflation rate	2.0%	From CEC Staff Report, 2/11/2003

The EIA-McIntosh study estimates that the costs of compliance with multi-pollutant regulations could range from $2/ton to $37/ton without an RPS, and $5/ton to $20/ton with an RPS. The EIA-Jeffords-Lieberman study estimates these costs to range from $7/ton to $20/ton. In this latter study, the moderate case refers to moderate assumptions about efficiency and renewables, and the advanced case refers to aggressive assumptions. These costs of compliance translate to $3.5/MWh to $4.7/MWh for the EIA-McIntosh study, and to $2.7/MWh to $3.3/MWh for the EIA Lieberman study.

[19] Interlaboratory Working Group on Energy Efficient and Clean Energy Technologies, *Scenarios for a Clean Energy Future*, November 2000.

The EIA studies assume that environmental regulations begin to take effect as early as 2002, which has not happened. Therefore, they overstate the amount of compliance costs that might occur in the early years of this analysis. The first three columns in Table 1 indicate the potential costs of three different scenarios where compliance costs are phased in gradually over time. In these cases, it is assumed that the costs begin in 2006, increase linearly to the estimate of CO_2 cost in 2010 ($10/ton in the low case, $15/ton in the medium case, and $25/ton in the high case), and then increase linearly to the estimate of CO_2 costs in 2020. These scenarios are illustrative – to indicate the potential compliance costs of regulations that are phased in more gradually than those of the EIA studies. They show that even with a phased in approach, the costs of compliance are likely to be within the ranges found by the EIA studies.

While it is difficult to predict the types of future environmental regulations, or their costs, I believe that the estimates provided by the EIA-Jeffords-Lieberman study in the moderate scenario provide a good basis for the likely costs of future environmental regulations. This study assumes that energy efficiency and renewables can play an important role in complying with environmental regulations, and they assume a level of efficiency and renewables that is realistic and achievable.

4. Recommendations

I recommend that the methodology that is used to determine the market price referent should fully account for the real-world costs of generating electricity from a new gas-fired generation facilities. The analytical framework in the CEC Staff Report on the costs of power plants in California should be used as a starting point in this process, but should be amended to account for factors that have not been accounted for in that report. These factors include: the costs of permitting a gas plant; the costs of mitigating environmental impacts as required by current regulations and laws; the costs of infrastructure support; financial assumptions relevant to merchant power projects; the costs of dry cooling technologies; heat rates based on real-world operating conditions; a gas price forecast based on the average of several independent forecasts; and any other real-world costs that may have been excluded or overlooked in the CEC Staff Report.

Furthermore, I recommend that the market price referent include an estimate of the fuel price hedge value that renewables offer relative to generation from gas-fired power plants. This is the only way to ensure that the market price referent accounts for "the *long-term* ownership, operating, and *fixed-price* fuel costs associated with *fixed-price* electricity from new generating facilities" (emphasis added).

The LBL study should be used as a starting point for determining the risk value of renewables. However, the Commission should recognize that the LBL methodology is likely to significantly understate the full magnitude of the fuel price hedge value of renewable generation. Any methodology adopted by the Commission to estimate the fuel price hedge value of renewables should account for the fact that current gas price hedge products do not address (a) the long-term risk of gas price increases in general, or (b) the long-term risks to gas prices associated with future environmental regulations.

Accordingly, the fuel price hedge value should include an estimate of the costs of complying with future environmental regulations. In the absence of a better estimate of these costs, I recommend that the Commission use the results of the EIA-Jeffords-Lieberman study. These results suggest that the fuel price hedge value should include additional costs of $0.45/MMBtu, which is equal to $3.3/MWh.

5. Statement of Qualifications of Timothy Woolf

Q. What is your name, position and business address?

A. My name is Timothy Woolf. I am the Vice-President of Synapse Energy Economics, Inc, 22 Pearl Street, Cambridge, MA 02139.

Q. Please describe Synapse Energy Economics.

A. Synapse Energy Economics is a research and consulting firm specializing in electricity industry regulation, planning and analysis. Synapse works for a variety of clients, with an emphasis on consumer advocates, regulatory commissions, and environmental advocates.

Q. Please describe your experience in the area of electric utility restructuring, regulation and planning.

A. My resume, attached, provides detail on my professional experience. Electric power system planning and regulation have been a major focus of my professional activities for over twenty years. In my current position at Synapse, I investigate a variety of issues related to the electric industry; with a focus on energy efficiency, renewable resources, air quality, environmental policies, performance-based ratemaking, market structure, customer aggregation and many aspects of consumer protection.

Q. Please describe your professional experience before beginning your current position at Synapse Energy Economics.

A. Before joining Synapse Energy Economics, I was the Manager of the Electricity Program at Tellus Institute, a consulting firm in Boston, Massachusetts. In that capacity I managed a staff that provided research, testimony, reports and regulatory support to state energy offices, regulatory commissions, consumer advocates and environmental organizations in the US. Prior to working for Tellus Institute, I was employed as the Research Director of the Association for the Conservation of Energy in London, England. I have also worked as a Staff Economist at the Massachusetts Department of Public Utilities, and as a Policy Analyst at the Massachusetts Executive Office of Energy Resources.

I hold a Masters in Business Administration from Boston University, a Diploma in Economics from the London School of Economics, a BS in Mechanical Engineering and a BA in English from Tufts University.

Q. Have you previously participated, testified, or appeared before the California Public Utilities Commission?

A. No, I have not.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to discuss the appropriate methodology for determining the market price referent that will be used to determine payments from the Public Good Charge to cover the above-market costs of renewables.

Q. Does this conclude your statement of qualifications?

A. Yes, it does.

Timothy Woolf

Vice President
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PROFESSIONAL EXPERIENCE

Synapse Energy Economics Inc., Cambridge, MA. Vice President, 1997-present. Conducting research, writing reports, and presenting expert testimony pertaining to consumer, environmental, and public policy implications of electricity industry regulation. Primary focus of work includes electricity industry regulation and restructuring, electric power system planning, energy efficiency programs and policies, renewable resources, power plant performance and economics, performance-based ratemaking, market power, air quality, and many aspects of consumer and environmental protection.

Tellus Institute, Boston, MA. Senior Scientist, Manager of Electricity Program, 1992-1997. Responsible for managing six-person staff that provided research, testimony, reports and regulatory support to consumer advocates, environmental organizations, regulatory commissions, and state energy offices throughout the US.

Association for the Conservation of Energy, London, England. Research Director, 1991-1992. Researched and advocated legislative and regulatory policies for promoting integrated resource planning and energy efficiency in the competitive electric industries in the UK and Europe.

Massachusetts Department of Public Utilities, Boston, MA. Staff Economist, 1989-1990. Responsible for regulating and setting rates of Massachusetts electric utilities. Drafted integrated resource planning regulations. Evaluated utility energy efficiency programs.

Massachusetts Office of Energy Resources, Boston, MA. Policy Analyst, 1987-1989. Researched and advocated integrated resource planning regulations. Participated in demand-side management collaborative with electric utilities and other parties.

Energy Systems Research Group, Boston, MA. Research Associate, 1983-1987. Performed critical evaluations of electric utility planning and economics, including production cost modeling and assessment of power plant costs and performance.

Union of Concerned Scientists and Massachusetts Public Interest Research Group, Cambridge and Boston, MA. Energy Analyst, 1982-1983. Analyzed environmental and economic issues related to nuclear plants, renewable resources and energy efficiency.

EDUCATION

Masters, Business Administration. Boston University, Boston, MA, 1993.
Diploma, Economics. London School of Economics, London, England, 1991.
B.S., Mechanical Engineering. Tufts University, Medford, MA, 1982.
B.A., English. Tufts University, Medford, MA, 1982.

RECENT REPORTS

A Clean Energy Plan for the Interior West, prepared for the Land and Water Fund of the Rockies, with Tellus Institute, Ron Lehr and Jayson Antonoff, forthcoming.

Air Quality in Queens: Cleaning Up the Air in Queens County and Neighboring Regions, prepared for a collaboration of Natural Resources Defense Council, Keyspan Energy, and the Coalition Helping to Organize a Kleaner Environment, forthcoming.

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Market Distortions Associated With Inconsistent Air Quality Regulations, prepared for the Project for a Sustainable FERC Energy Policy, November 18, 1999.

Measures to Ensure Fair Competition and Protect Consumers in a Restructured Electricity Industry in West Virginia, prepared for the West Virginia Consumer Advocate Division, Case No. 98-0452-E-GI, June 15, 1999.

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The Role of Ozone Transport in Reaching Attainment in the Northeast: Opportunities, Equity and Economics, prepared for the Northeast States for Coordinated Air Use Management, with the Global Development and Environment Institute, July 1998.

Grandfathering and Environmental Comparability: An Economic Analysis of Air Emission Regulations and Electricity Market Distortions, prepared for the National Association of Regulatory Utility Commissioners, with the Global Development and Environment Institute, June 1998.

Performance-Based Regulation in a Restructured Electric Industry, prepared for the National Association of Regulatory Utility Commissioners, with Resource Insight, the National Consumer Law Center, and Peter Bradford, February 1998.

Massachusetts Electric Utility Stranded Costs: Potential Magnitude, Public Policy Options, and Impacts on the Massachusetts Economy, prepared for the Union of Concerned Scientists, MASSPIRG and Public Citizen, November 1997.

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Regulatory and Legislative Policies to Promote Renewable Resources in a Competitive Electricity Industry, prepared for the Colorado Governor's Office of Energy Conservation, Tellus Study No. 96-130-A5, January 1997.

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Electric Resource Planning for Sustainability, prepared for the Texas Sustainable Energy Development Council, Tellus Study No. 94-114, February 1995.

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Connecticut Department of Public Utility Control (Docket No. 01-10-10). Direct testimony regarding the United Illuminating Company's service quality performance standards in their performance-based ratemaking mechanism. On behalf of the Connecticut Office of Consumer Counsel. April 2, 2002.

Nevada Public Utilities Commission (Docket No. 01-7016). Direct testimony regarding the Nevada Power Company's Demand-Side Management Plan. On behalf of the Bureau of Consumer Protection, Office of the Attorney General. September 26, 2001.

US Department of Energy (Docket EE-RM-500). Oral testimony at a public hearing on marginal price assumptions for assessing new appliance efficiency standards. On behalf of the Appliance Standards Awareness Project. November 2000.

Connecticut Department of Public Utility Control (Docket No. 99-09-03 Phase II). Direct testimony on Connecticut Natural Gas Company's proposed performance-based ratemaking mechanism. On behalf of the Connecticut Office of Consumer Counsel. September 25, 2000.

Mississippi Public Service Commission (Docket No. 96-UA-389). Oral testimony on generation pricing and performance-based ratemaking. On behalf of the Mississippi Attorney General. February 16, 2000.

Delaware Public Service Commission (Docket No. 99-328). Direct testimony on maintaining electric system reliability. On behalf of the Public Service Commission Staff. February 2, 2000.

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Challenges Faced by Clean Generation Resources Under Electricity Restructuring, speaker at the Symposium on the Changing Electric System in Florida and What it Means for the Environment, Tallahassee Florida, November 1999.

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Efficiency, Renewables and Gas: Restructuring As if Climate Mattered, The Electricity Journal, Vol. 11, No. 1, January/February, 1998.

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Overview of IRP and Introduction to Electricity Industry Restructuring, training session provided to the staff of the Delaware Public Service Commission, April, 1996.

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Competition and Regulation in the UK Electric Industry, speaker at the Illinois Commerce Commission's workshop on Restructuring the Electric Industry, August, 1995.

Competition and Regulation in the UK Electric Industry, speaker at the British Columbia Utilities Commission Electricity Market Review, Vancouver, British Columbia, February, 1995.

Retail Competition in the Electricity Industry: Lessons from the United Kingdom, The Electricity Journal, Vol. 7, No. 5, June, 1994.

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Energy Efficiency in Britain: Creating Profitable Alternatives, Utilities Policy, July 1993.

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Developing Integrated Resource Planning Policies in the European Community, Review of European Community & International Environmental Law, Energy and Environment Issue, Vol. 1, Issue 2. 1992.

Resume dated March 2003.

CERTIFICATE OF SERVICE

I hereby certify that I have on this day served a copy of the Union of Concerned Scientists' Testimony in the Rulemaking 01-10-024 on all known parties to this rulemaking by electronic mail to each party on the R.01-10-024 service list and by U.S. Mail to the Public Utilities Commission, 505 Van Ness Avenue, San Francisco, CA 94102.

Executed in Berkeley, California on April 1, 2003.

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Lisa Duffy