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The Role of Natural Gas in California's Climate Policy

The Honorable Timothy Alan Simon

Bishu Chatterjee, Ph.D.

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8730 Georgia Avenue, Suite 201
Silver Spring, MD 20910
Tel: 301-588-5385
www.nrri.org

National Regulatory Research Institute

About the Authors

Hon. Timothy Alan Simon is a Commissioner at the California Public Utilities Commission and Chair of the National Association of Regulatory Utility Commissioners' Gas Committee. He received a Juris Doctor from Hastings College of the Law, University of California.

Dr. Bishu Chatterjee is a Senior Energy Policy Advisor to Commissioner Timothy Alan Simon at the California Public Utilities Commission. He received a Ph.D. in Environmental Economics from the University of California, Davis.

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Introduction

The discovery and extraction of shale gas has pushed natural gas to the forefront of the energy revolution in the United States. With increasing supply, the price of natural gas has plummeted to historic lows. For the first time in U.S. history, natural gas is generating as much electricity as coal (Jelter, 2012). This increased use of natural gas could be decreasing greenhouse gas emissions substantially, but we have not yet seen data quantifying that conclusion. In fact, the U.S. is the largest natural gas producer in the world, and domestic production is accelerating as new shale deposits are discovered and extracted (U.S. Energy Information Administration, 2012).

The availability of cheap, abundant natural gas will have a significant impact on California's efforts to fight climate change while tapping a dependable energy source at a reasonable cost to citizens. It is important to anticipate how natural gas will impact the California energy-mix landscape. Too often, nationwide, discussion of natural gas has been one-dimensional. Proponents explain that natural gas is an economical fuel that pollutes less than coal and oil.[1] Natural gas opponents counter that natural gas is still a fossil fuel that emits too much methane in extraction by fracking, and that fracking is environmentally destructive and dangerous.[2] These claims and concerns must be resolved if natural gas is to play a role in California's energy future. This discussion will examine how natural gas, the cleanest-burning fossil energy available, can complement California policies on environmental measures within the framework of cap and trade, California's efforts to promote energy efficiency, and California's shift to more renewable generation (CARB, 2012a).

I. Background

California has become known as one of the states most concerned with climate change. In 2006, California passed the Global Warming Solutions Act (AB 32).[3] AB 32 includes numerous measures to reduce greenhouse-gas (GHG) emissions by 40% across all sectors of the industry by 2020. California climate policy mandates both regulatory and market approaches to achieve these GHG reductions. The regulatory approach calls for aggressive energy-efficiency programs and a Renewable Portfolio Standard (RPS) that mandates that at least 33% of California's electricity come from renewable sources such as wind, solar, geothermal, and biomass. Market approaches such as cap-and-trade create valuable products (in this case, emission allowances) and allow companies to buy and sell these amongst themselves.

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1 This *Huffington Post* editorial by former Colorado governor Bill Ritter is typical (accessible at http://www.huffingtonpost.com/bill-ritter/natural-gas-and-americas-_b_824252.html).

2 "Beyond Natural Gas," a page on the website of the Sierra Club, exemplifies this mindset (accessible at http://content.sierraclub.org/naturalgas/).

3 2006 Assembly Bill 32 Nunez/Pavley.

The California electricity sector produces about 25% of California's GHG emissions and is required, in the California Air Resources Board's (CARB's) Draft Scoping Plan for the implementation of AB 32, to provide approximately 40% of the total direct GHG reductions expected to come from direct emission reductions. In addition, depending on the allowance allocation of the cap-and-trade program, the electricity sector could be required to contribute additional reductions. Table 1 shows the planned GHG reduction measures from cap and trade and complementary programs as outlined by the CARB scoping memo.

In Table 1, "Cap-and-Trade" is an umbrella category that covers the first 12 measures listed, including energy efficiency and the promotion of renewable energy. Energy efficiency and the promotion of renewables, while both large categories of measures, are smaller than cap and trade, but within each of these three strategies listed (cap and trade, energy efficiency, and promotion of renewables), natural gas should play a substantial role.

II. Natural Gas and Cap and Trade

One of the most significant pieces of AB 32 is a cap-and-trade system, the second largest such system in the world after that of the European Union (Grandoni, 2011).[4] Cap and trade puts a price on pollution by allowing California's emission-producing industries to trade carbon credits. California is scheduled to hold its first auction of permits in November 2012, and the cap-and-trade market itself will begin on January 1, 2013 (California Air Resources Board [CARB], 2012b). Under this program, emission levels of carbon-dioxide equivalents (CO_2e) will be capped at a certain level, to be reduced each year, and permits will be auctioned off for the right to emit that CO_2e. Allowances sold at the auction will have a low floor price to ensure that there is a minimum cost for polluting ($10 for 2012 and 2013, set to increase 5% plus inflation each year thereafter). In addition, auctions will have a high ceiling price to ensure that cap and trade does not jar the market too roughly.

Cap and trade will affect California in two stages. In 2013, the cap will cover large industrial facilities (exceeding 25,000 MT CO_2e per year) and electricity generators. In 2015, during the second stage of the program, the cap will be expanded to include transportation fuels and natural gas, thereby covering 85% of carbon-emitting sources in California through a combination of upstream and downstream measures. Additionally, if companies are able to offset emissions (such as through forest conservation), they may do so to a limited extent in order to be allowed to emit more. Allowances and offset credits together act as compliance instruments. Because companies will be permitted to emit as much CO_2e as their compliance instruments allow, if any company is able to reduce emissions beyond what is required by its compliance instruments, it will also be able to sell its excess compliance instruments in the market. This possibility provides a strong incentive to reduce emissions as much as possible. Cap and trade can thus reduce emissions at the lowest social cost by providing regulated entities with the flexibility to procure the least-cost emission reductions available. As of now, that least-cost, emission-reducing form of energy is natural gas.

[4] In fact, this cap-and-trade program may become even larger, as it is designed to be linked with other Western Climate Initiative (WCI) partners once they establish their own cap-and-trade programs.

Table 1: Recommended GHG Reduction Measures

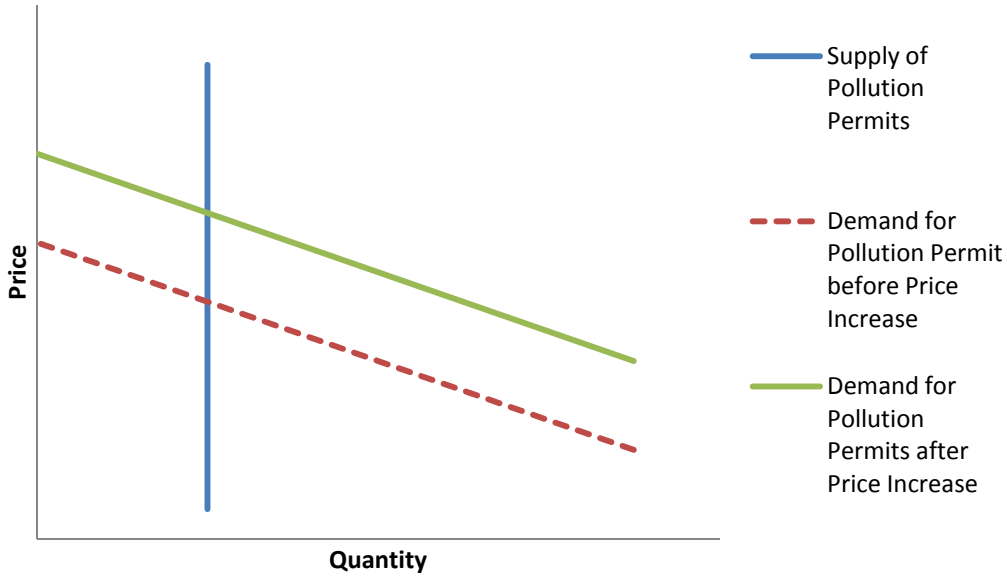
Recommended Reduction Measures	Reductions Counted Towards 2020 Target ($MMTCO_2E$)	
ESTIMATED REDUCTIONS RESULTING FROM THE COMBINATION OF CAP-AND-TRADE PROGRAM AND COMPLEMENTARY MEASURES		**146.7**
California Light-Duty Vehicle Greenhouse Gas Standards • Implement Pavley standards • Develop Pavley II light-duty vehicle standards	31.7	
Energy Efficiency • Building/appliance efficiency, new programs, etc. • Increase CHP generation by 30,000 GWh • Solar Water Heating (AB 1470 goal)	26.3	
Renewables Portfolio Standard (33% by 2020)	21.3	
Low Carbon Fuel Standard	15	
Regional Transportation-Related GHG Targets[16]	5	
Vehicle Efficiency Measures	4.5	
Goods Movement • Ship Electrification at Ports • System-Wide Efficiency Improvements	3.7	
Million Solar Roofs	2.1	
Medium/Heavy Duty Vehicles • Heavy-Duty Vehicle Greenhouse Gas Emission Reduction (Aerodynamic Efficiency) • Medium- and Heavy-Duty Vehicle Hybridization	1.4	
High Speed Rail	1.0	
Industrial Measures (for sources covered under cap-and-trade program) • Refinery Measures • Energy Efficiency & Co-Benefits Audits	0.3	
Additional Reductions Necessary to Achieve the Cap	34.4	
ESTIMATED REDUCTIONS FROM UNCAPPED SOURCES/SECTORS		**27.3**
High Global Warming Potential Gas Measures	20.2	
Sustainable Forests	5.0	
Industrial Measures (for sources not covered under cap and trade program) • Oil and Gas Extraction and Transmission	1.1	
Recycling and Waste (landfill methane capture)	1.0	
TOTAL REDUCTIONS COUNTED TOWARDS 2020 TARGET		**174**
Other Recommended Measures	**Estimated 2020 Reductions ($MMTCO_2E$)**	
State Government Operations	1-2	
Local Government Operations	TBD	
Green Buildings	26	
Recycling and Waste • Mandatory Commercial Recycling • Other measures	9	
Water Sector Measures	4.8	
Methane Capture at Large Dairies	1.0	

Source: California Air Resources Board, 2008, p. 17.

Cap and trade will serve as a major impetus for a shift from more emission-heavy fossil fuels to cleaner natural gas. This is because, as basic economics says, the existence of a cap on carbon emissions will reduce the demand for carbon-based fuels and therefore reduce the price of

those fuels. Because most energy sources can substitute for each other, however, and because natural gas has the fewest CO_2e of any major fossil fuel, it is not unreasonable to assume that cap and trade may increase the demand for natural gas as natural gas replaces other, more emission-heavy fuels (CARB, 2012a). In other words, although demand for fossil fuels in the aggregate will be reduced when a cap on pollution is imposed, it is possible that demand for an individual fossil fuel will rise if that fuel emits less CO_2e than other status quo fuels. This will likely be the case with natural gas.

Figure 1: GHG Allowance Price and Demand for GHG Allowances



Furthermore, as Figure 1, a basic supply-and-demand graph, illustrates, the availability of cheap natural gas will lower emissions in a cap-and-trade environment. In Figure 1, the compliance-instrument price is shown on the Y-axis, and GHG emission quantity is shown on the X-axis. Figure 1 shows that the demand for pollution allowances and the fixed GHG cap determine the price of GHG allowances. As the price of natural gas drops, electricity generators may find it more economical to use more gas-fired plants. Even if this increased use of natural gas is accompanied by reduced reliance on renewables, as many opponents of natural gas fear will happen, increased use of natural gas generation will shift the overall demand for compliance instruments. This increased demand for compliance instruments will raise their price. In this case, the rise in price will be substantial, because the supply of compliance instruments will remain fixed. Higher permit prices will thus ensure that no mass exodus occurs from renewable generation. Furthermore, higher permit prices may help push electric power generation away from burning dirty fuels and toward a sustainable future.[5]

5 Many California municipalities are still using significant coal-fired power generation from in-state and out-of-state sources. (California Energy Commission Quarterly Fuel and Energy Report, August 1, 2012). In October 2012, the Los Angeles City Council approved the L.A. Department of Water and Power's plan to invest in clean

III. Natural Gas and Energy Efficiency

Energy efficiency is the least expensive strategy available for reducing GHG emissions significantly in the electricity and natural gas sectors. In the status quo, many natural gas plants operate far from their most efficient state due to both design and operational issues. In fact, there is a spread of approximately 25% between inefficient and efficient natural gas plants (CARB, 2012a). Without a doubt, much room remains for improvement at many existing natural gas plants. Given that the Climate Change Scoping Plan endorses natural gas as an energy-efficient resource, and that the updated Energy Action Plan adopted by the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC) has determined that energy efficiency is "the most important tool for addressing greenhouse gas emissions in the energy sector," it seems sensible to support gains in efficiency in current natural gas plants (California Energy Commission and California Public Utilities Commission, 2008, p. 6). Such efficiency gains, as a complement to California's other measures for reducing emissions, are much more feasible than emissions reduction brought about by a total overhaul of generation infrastructure.

Utilities in California are rewarded for energy efficiency based on the cost-effectiveness of different programs. One of the key factors in driving the avoided cost of energy-efficiency programs is natural gas. Table 2 is from an Energy and Environmental Economics study that examines the avoided costs used by the CPUC to provide guidance to utilities for their two-year energy-efficiency programs (E3 Study 2011).

Table 2: Components of Electricity Avoided Cost

Component	Description
Generation Energy	Estimate of hourly wholesale value of energy
Generation Capacity	The costs of building new generation capacity to meet system peak loads
Ancillary Services	The marginal costs of providing system operations and reserves for electricity grid reliability
T&D Capacity	The costs of expanding transmission and distribution capacity to meet peak loads
Environment	The cost of carbon dioxide emissions associated with the marginal generating resource
Avoided RPS	The reduced purchases of renewable generation at above-market prices required to meet an RPS standard due to a reduction in retail loads

Source: Energy and Environmental Economics, Inc., *Energy Efficiency Avoided Costs 2011 Update.*

Table 2 clarifies how much of the avoided costs can be based on the cost of natural gas-fired generation. The avoided cost for energy-efficiency program evaluation is calculated as the sum of the six components shown in Table 2.

It is important to note that the long-run generation cost is the all-in cost of a combined-cycle gas turbine (CCGT) running 92% of the year. Since the cost-effectiveness of energy-efficiency projects is based in large part on utilities avoiding the long-run CCGT investments and

energy and wean the city off of coal, which is 39% of its current power mix (Los Angeles Department of Water and Power 2012 Power Integrated Resource Plan).

running costs, the lower natural gas prices will essentially lower the benefit of the energy-efficiency programs. This is because the utilities' avoided costs based on CCGT running costs will be lower if the price of natural gas remains low. After all, utilities' incentives are based on the magnitude of savings and the net benefits of cost-effective energy efficiency programs, which help avoid investments in new power plants. In a recent study, the American Council for an Energy-Efficient Economy (2012) pointed out that if natural gas prices drop significantly ($2 per MMBtu), then some natural gas efficiency measures will not be cost-effective on the margin, but the price of gas will be increasing and projected to level out between $4 and $7 per MMBtu. The study further states that, with such projected higher and more stable natural gas prices, well-designed natural gas efficiency programs will remain cost-effective.

This means that the interplay between natural gas prices and energy efficiency is much more complex than it may seem at first glance. If nothing else, it should make clear that much more discussion of natural gas is needed as Californians seek to understand its role in the state's future. Nevertheless, this measurement of energy efficiency is no reason to discount the promise of cheap natural gas. If cheap natural gas reduces incentives to increase energy efficiency, then California should provide greater support for energy efficiency or revise the means by which energy efficiency is calculated so that natural gas can even more effectively complement the emission reductions it achieves, in synergy with cap and trade and efforts to support renewables.

IV. Natural Gas and Renewable Energy

California is strongly committed to using renewable resources to reduce GHG emissions and reach AB 32 goals. Hence, the California RPS requires that investor-owned utilities procure 33% of their electricity from renewables by 2020. In order to ensure that California meets its RPS requirements, the CPUC and CEC, along with the California Independent System Operator (CAISO) and publicly owned utilities, have joined together to form the Coordinating Committee of the Renewable Energy Transmission Initiative, which identifies and helps develop bulk transmission to deliver renewable energy to consumers. In addition, state agencies are working to overcome contracting, permitting, and grid-integration challenges to ensure that the goal of obtaining 33% of the state's electricity from renewables becomes a reality.

Integrating renewable generation, however, will require adequate amounts of ancillary services for flexible ramping. For real-time operations, natural gas peaker plants, which are ideal for ancillary generation, can quickly ramp up or down. This quick ramping ability is critical to grid stability, because generators must produce precisely enough electricity to meet load demand at any given time. Because it is impossible to control when renewable resources will generate power and it is difficult, expensive, or both to control how much power they will generate, and because base load generators cannot quickly ramp up or down to adjust to changes in renewable generation and demanded load, ancillary natural gas-powered generation is necessary. For example, high energy demand on cloudy or windless days creates a substantial risk of under-generation, which could result in brownouts or blackouts if ancillary services are not utilized. Furthermore, because of this risk of under-generation, it will be difficult, if not impossible, for companies to contract to build renewable plants, because adding more renewable generation could hurt, rather than support, grid reliability.

To ensure reliability in an environment with large amounts of renewable generation, CAISO recently released its first straw proposal for these initiatives: the creation of a "flexiramp product" (CAISO 2010). As its name suggests, this flexiramp product will be a new ancillary service for flexible ramping. The costs for flexiramp services will be divided into three buckets: costs caused by load, costs caused by generators that deviate from their hourly schedules, and costs caused by generators that deviate from ISO dispatch instructions.

In a recent paper, "Meeting Renewable Energy Targets in the West at Least Cost," the Western Governors' Association drew attention to CAISO simulations that found that, under a 20% RPS, the total procurement of regulation and load-following reserves would increase anywhere from 11% to 37%, depending on the season (Porter et al., 2012).[6] Fortunately, CAISO also noted the occurrence of some over-generation of hydro power in the spring that would reduce the need for inflexible imports (California ISO, 2010). This would allow for additional commitments of dispatchable natural gas plants to provide downward ramping (California ISO, 2010).

Subsequently, CAISO evaluated alternative CPUC renewable-resource scenarios for a 33% RPS in 2020, modeled on a Western Electricity Coordinating Council (WECC-wide basis) transmission and generation planned infrastructure. These studies include some 17,000 MW to 18,000 MW of wind and solar resources serving California, with both in-state and out-of state resources. The simulation shows that integrating wind and solar is quite possible with additional flexible generation (Rothleder, 2011).

V. Natural Gas Can Provide the Least-Cost Climate Strategy

For better or worse, shale gas has revolutionized the energy industry. This new technology has made natural gas much more accessible and increased supplies to levels that people would never have considered possible in 2007. It has dropped natural gas prices from record highs to historic lows. As California transitions its energy infrastructure to one that is more environmentally friendly, natural gas holds promise as a fuel that can complement the state's cap-and-trade program, energy-efficiency measures, and transition to renewables. Natural gas can displace dirtier fuels, and it is a highly efficient and cleaner form of energy. As public policies are further developed to address (a) the potential impacts of and proper disclosure of chemicals used in fracking and (b) natural gas transportation, natural gas can be a reliable fuel source, supporting the adoption of more variable output generation.

Some may be concerned that supporting natural gas generation is not an effective long-term means of confronting climate change. It is possible that, in the long term, natural gas may no longer be needed. It is possible that a different fuel or new technology will render natural gas unnecessary. That technology has not yet been discovered, however; in the meantime, natural gas complements other efforts on the part of California to reduce emissions. Importantly, because (a) a natural gas infrastructure already exists in California, (b) the fuel is plentiful, and

[6] The study assumed approximately 6,700 MW of wind and 2,250 MW of solar resources using a model of the California grid with fixed import-export balances based on a historical year.

(c) it is cheap, it provides the state with valuable energy-production flexibility and buys it time. Robert N. Stavins of Harvard's John F. Kennedy School of Government and the National Bureau of Economic Research believes that the window of time provided by natural gas will allow gradual—not jarring—change to occur (Stavins, 2008, p. 303). In other words, even if natural gas is not the optimal energy source for reducing emissions, it is an energy source that emits fewer greenhouse gases than many other currently used fuels, supports the adoption of even cleaner fuels, and is a step in the right direction (CARB, 2012a). According to Sabina Shaikh of the University of Chicago's Program on the Global Environment, this flexibility is critical to encouraging innovation and permitting the time required for developing the best technologies and practices with which to confront climate change (Shaikh, 2012). This flexibility allows people to innovate and bring the best technologies for addressing climate change to maturity, rather than forcing unprepared products onto the market.

CARB, in its Climate Change Scoping Plan, also endorses such flexibility. In its Resolution 11-27, passed in 2011, CARB explains that it reviewed six possible courses of action for complying with AB 32. Of the five that were rejected, two (Alternatives 2 and 3) were considered too reliant on cap and trade and insufficiently flexible (CARB, 2011). Indeed, the Scoping Plan includes language explicitly meant to include flexibility in reducing emissions. Flexibility may permit some mistakes, but the Climate Change Scoping Plan explains that there is a "margin of safety" in the cap to ensure that 2020 emission-reduction targets are met even if uncapped sectors do not reduce emissions as significantly as planned (CARB, 2008, p. 2). This means that there is minimal risk that increasing the use of natural gas will set back California's climate-change goals.

It is important to remember that the goal of California's energy policies is not to reduce emission levels to zero, as desirable as that might be. The goal of California's energy policies is to reduce emissions to a level that minimizes adverse environmental impacts. This means that California could achieve its climate goal not by supporting the fuels that will result in the largest absolute drop in CO_2e emissions, but by supporting the fuels that will reduce CO_2e emissions to safe levels. An optimistic perspective will hold that natural gas is "good." A pessimistic perspective will hold that natural gas is "good enough." Either way, optimists and pessimists should agree that cheap, plentiful natural gas is something appropriate for California now.

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