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A Critical Component to Achieving Renewable Power

By Michael J. Carroll and Marc T. Campopiano

With all of the recent attention on renewable energy projects, one might ask whether there is any future in California for the development of fossil fuel-fired power plants. The answer is "yes." Although seemingly paradoxical, fossil fuel power plants are critical to California achieving its ambitious goals for a high-renewable, low-carbon energy future. On Sept. 23, 2010, the California Air Resources Board unanimously adopted the "Renewable Electricity Standard" to require by 2020 a 33 percent renewable energy mandate for most retail sellers of electricity in California. The Renewable Electricity Standard is an independent requirement from California's existing Renewables Portfolio Standard, which statutorily requires a renewable energy mandate of 20 percent by 2010. To meet this renewable mandate, the California Public Utilities Commission has estimated that the "magnitude of the infrastructure that California will have to plan, permit, procure, develop and integrate in the next 10 years is immense and unprecedented," potentially requiring $115 billion in new infrastructure investment and at least seven major new transmission lines.

In conjunction with these ambitious goals for renewable power, the California energy agencies have recognized a critical need for new and retrofitted fossil fuel power plants to be developed in tandem with renewable generation. In 2009, the California Energy Commission issued a report identifying myriad roles that new low-polluting, state-of-the-art natural gas power plants must perform in a high-renewable future, including to: support intermittent renewable power; achieve critical grid reliability functions; modernize the electricity system to reduce environmental impacts; and cut greenhouse gas emissions by displacing dirtier power sources. The Energy Commission concluded that new gas plants are needed to "cut GHG [greenhouse gas] emissions, expand renewable energy, and to continue protecting the state's environment." Rapid advancements in technology may also be shepherding a new area of clean-coal and cleantech fossil fuel advancements.

Natural gas-fired power plants provide critical support functions for renewable energy sources that are inherently intermittent. Wind generation is highest during non-peak periods of electricity demand and solar generation is limited to daytime hours. In contrast, electricity demand is instantaneous and spikes during peak periods (daily and seasonally), mandating a reliable and flexible stream of electricity to avoid grid disruptions such as blackouts and price jumps. Severe transmission line constraints also restrict the transport of renewable generation from locations of high supply (such as the inland deserts) to high demand centers (such as the coastal metropolitan areas).

In the 2009 report, the California Energy Commission identified the "real and serious implications of adding substantial amounts of intermittent renewable resources [to] the integrated grid." "[I]ntermittent renewable resources will increase minute-to-minute and hourly variability of the electric system, which will require more ancillary services and ramping capabilities that permit the grid to operate reliably." Fast-starting (or "peaker") gas-fired power plants are excellent at meeting this demand and providing critical ancillary support functions. Gas power plants can smooth the intermittent nature of renewable generation by providing power to the grid when the wind is not blowing or the sun not shinning.

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California's largest electricity markets in the Bay Area and Southern California have pockets of extreme energy supply constraints. The regions continue to be vulnerable to supply shortages such as occurred during the 2000-2001 energy crisis, which left 50 million people without power. The consequences of local grid failures can be extreme, causing billions of dollars in economic damage. Given the long delays associated with permitting and constructing new transmission lines, supply bottlenecks must be addressed locally. Gas-fired power plants are the only economically viable, large-scale power source that can address most local energy crises.

California's stringent air quality and water quality regulations will force older power plants to be retrofitted or replaced - particularly coastal plants using once-through-cooling water intake structures. The California State Water Resources Control Board recently passed an aggressive rule requiring coastal power plants using once-through-cooling to install very costly retrofit technology within the next 10 to 15 years. Given the high cost of retrofitting (over a billion dollars in certain cases), power plants could shut down instead of complying, threatening the local energy supply. Where retrofitting is not feasible, new natural gas-fired power plants will be best suited to meet the supply need.

To achieve California's rigorous greenhouse gas reduction goals, the California Air Resources Board is counting on a disproportionate reduction of greenhouse gases from the energy sector. Renewable generation accounts for a large portion of these reductions but another necessary component is replacing older power plants with cleaner, state-of-the-art gas-fired power plants. The California Energy Commission has determined that new gas-fired plants would result in a net decrease in system-wide greenhouse gas emissions by displacing dirtier power sources. Even the most optimistic projections do not foresee enough new renewable generation to displace the older, dirtier generation, making new gas-fired power plants the only viable option to advancing this greenhouse gas reduction goal.

Rapid technological advances may also create a prominent role for fossil fuel power in a low-carbon energy future. For example, Hydrogen Energy California has submitted an application to the California Energy Commission to develop an integrated gasification combined cycle power generating facility, which would gasify petroleum coke and coal to produce hydrogen to fuel combustion turbines operating in combined cycle mode providing low-carbon baseload power to the grid. The gasification component would capture approximately 90 percent of the carbon dioxide from the raw syngas, which will be compressed and transported for use in carbon dioxide enhanced oil recovery resulting in permanent sequestration of the gas.

Emerging green energy technologies - often referred to as "greentech" or "cleantech" - have also shown a symbiotic relationship between nascent renewable technologies and traditional fossil fuel energy sources. A Silicon Valley start-up company, Calera, recently advanced a method to turn carbon from existing coal- and gas-fired power plants into a synthetic limestone used to make cement, thereby reducing greenhouse gas emissions. The process also traps criteria pollutants: sulfur dioxide, nitrogen oxides, particulates, and heavy metals. This is just one example of many cleantech advancements that are transforming fossil fuel power sources.

As energy demands increase even in a new era of high-renewable generation, fossil fuel power plants will play a critical role by supporting renewable development, maintaining grid reliability, and addressing areas of local supply crises. Future advancement in clean technologies and carbon capture will also ensure that fossil fuels are part of California's clean energy, low carbon paradigm.

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