BrightSource

July 20, 2012

John Courtis
Manager
Alternative Fuels Section
California Air Resources Board
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Dear Mr. Courtis,

BrightSource Energy, Inc. ("BrightSource") is pleased to provide these comments in response to the July 12th workshop held by the California Air Resources Board ("ARB") on the Oil Production Greenhouse Gas Emissions Estimator ("OPGEE") model, which will be used to calculate carbon intensity values of crude oil production within the Low Carbon Fuel Standard ("LCFS"). We hope that the ARB will take these comments into consideration, and will update the OPGEE to account for enhanced oil recovery ("EOR") that utilizes steam produced with solar thermal technology.

BrightSource is a designer and developer of concentrated solar thermal power tower technology for both electric generation and industrial steam production. BrightSource has partnered with Chevron to provide the solar technology for the world's largest solar thermal EOR facility, which is located in Coalinga, California. Solar thermal EOR offers a unique marriage of cutting edge renewable energy technology and traditional fuel sources, providing zero-carbon steam for crude oil extraction. This proven technology is an important means of reducing the carbon intensity of traditional fuels and net greenhouse gas emissions. Solar thermal EOR has tremendous growth potential and, with widespread use, could confer significant reductions in air pollution.

The Coalinga solar-to-steam demonstration facility commenced operations in September 2011. Coalinga's solar thermal energy system uses fields of tracking mirrors to concentrate sunlight onto a solar boiler atop a tower. The solar boiler produces high-temperature, high-pressure steam, which is injected deep into a sub-surface oil reservoir. The resulting sub-surface steam heating increases the pressure of the reservoir and reduces the viscosity of the oil, making it easier to extract. The use of solar steam, in place of steam generated through fossil fuel combustion, avoids the usual greenhouse gas emissions that result from thermal EOR.

Solar thermal steam production technology has the potential to dramatically reduce the emissions associated with extracting the crudes from mature oil fields, like Coalinga, that are used to make California's transportation fuels. However, the OPGEE is not currently configured to take this potential into account. A version of the OPGEE that is capable of determining the carbon

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intensity of crudes extracted with solar steam would assist the ARB and all stakeholders in recognizing the potential value of solar-to-steam technology as an "innovative method" of reducing the carbon intensity of crude oil under the LCFS.

Currently, the OPGEE model only contains provisions for calculating the greenhouse gas emissions of two technologies of steam generation for thermal oil recovery: (i) once-through steam generators ("OTSG"), and (ii) combinations of gas turbine ("GT") and heat recovery steam generators ("HRSG"). The energy consumption of both steam generation technologies, as well as the emissions factors for the combustion of the fuels required to power those technologies, contribute to the final carbon intensity score of the crude that is extracted using those technologies. The inclusion of solar steam would provide a very useful basis for comparison, in addition to serving as a means of identifying potential emissions reductions in the production of fuels. As the "Energy Consumption" gathering sheet in the OPGEE only lists natural gas, natural gas liquids, diesel fuel, electricity, and crude oil as the possible energy sources that power the steam injection component of the process, the OPGEE is missing an important opportunity. In contrast to conventional means of producing steam, solar steam requires no fuel besides the natural energy from the sun. The OPGEE should accommodate this distinction.

As the solar steam technology expands across more mature oil fields, the exact proportion of solar steam to conventionally produced steam would vary. Accordingly, BrightSource recommends that the OPGEE model include provisions for assessing the percentage of the steam used in the thermal EOR process was produced via concentrated solar thermal technology, and for crediting this zero-emission extraction method in calculating carbon intensity scores. Ostensibly, adding such provisions in the OPGEE would require an additional fuel type for the "Energy Consumption" gathering sheet, such as "Onsite Renewable Source."

Updating the OPGEE to include provisions for calculating the carbon intensity of crudes extracted with solar steam would be an important and useful addition to the model. By providing recognition of the role of solar steam can play for EOR, and by streamlining the process for fuel providers that wish to generate credits by implementing solar steam systems as "innovative methods" under Method 2A of the LCFS regulation, this relatively simple step could significantly enhance the success of the LCFS.

Thank you very much for this opportunity to provide input on the ARB's OPGEE model and for considering our request. Please contact us with any questions you may have about our technology, or the potential solar EOR offers for reducing carbon intensity.

Sincerely,

Arthur L. Haubenstock
VP Regulatory Affairs
AH/nk