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Docket No. 08-AFC-08A: HYDROGEN ENERGY CALIFORNIA, LLC

Hydrogen Energy California (HECA) Project

Monthly Progress Report for July 2015

In compliance to the Committee Order Denying Motion to Terminate Application for Certification and Granting Request for Suspension

Submitted July 31, 2015

Introduction

Pursuant to the terms of the CEC order titled "Committee Order Denying Motion to Terminate Application for Certification and Granting Request for Suspension" handed down on July 3, 2015 HECA is herein responding to and providing its status update regarding the milestones to be completed on or before January 6, 2016 as set forth in the ruling.

Milestone 1:

Documentation of an executed CO2 off-take and carbon sequestration agreement, for a site that is both feasible and available for such use;

It is HECA's intent to forgo any discussions with oil producers at this time and permit the project as a CCS project without EOR associated with its carbon sequestration. The feasibility of this CCS program results from three factors: (1) EPA issued rules and certification of Class VI wells pursuant to those rules for FutureGen and subsequently ADM. Further, these EPA rules associated with Class VI well certification are conducive to financing these projects in the capital markets. (2) The technical work done under the auspices of WESTCARB in the San Joaquin Valley indicates that formations in proximity to the HECA site have sufficient capacity to store the proposed volume of CO2. (3) The economic strength of the HECA project makes it financially feasible to do CCS without a revenue stream from the sale of CO2 and to cover the cost associated with a CCS program. The proximity of the most likely injection point makes the cost even more manageable.

During the last month we asked LBNL what existing WESTCARB studies tell us about the potential to store the CO2 in formations within a 30km radius of the site and, additionally, the potential for having the injection wells on the HECA site itself. Shifting to a saline formation injection on-site as an alternate appears to have high potential for success. What follows is a draft summary of the LBNL response.

Preliminary Assessment of the Geologic Storage Potential at the HECA Site

The HECA site near the communities of Tupman and Buttonwillow lies within the geologic basin known as the Southern San Joaquin Valley. The West Coast Regional Carbon Sequestration Partnership (WESTCARB) has studied the geologic CO2 storage potential of the rock formations in the Southern San Joaquin Basin at various levels of detail. These findings are relevant to the HECA site and indicate that there is significant storage potential in the rock formations below the HECA plant site. Further work is recommended to provide greater certainty of the potential relative to the volume of emissions HECA will produce. Within the next 6 months, an existing WESTCARB model may be adapted to provide semi-quantitative estimates of the storage potential at HECA; within 18 months, with schedule dependent on permitting, a characterization well and pilot injection could be completed at the site to provide the higher degree of confidence necessary to proceed with commercial-scale injection planning.

Previous Studies

Several reports on this work were published by the California Energy Commission. These reports demonstrate that the formations of the Southern San Joaquin Basin are a very large potential storage resource based upon criteria developed by NETL and applied to California by the California Geological Survey. These criteria include that: the depth to target storage reservoirs exceeds 800 meters; target formations have suitable thickness and permeability to provide storage; and there is suitable thickness of overlying shales or other impermeable cap rock formations to prevent upward migration of stored CO2 over time.

The San Joaquin Basin extends about 350 km (220 mi.) from the Stockton Arch to its southern terminus at the northern Transverse Ranges, and averages 80–110 km (50–70 mi.) wide. It is bounded on the east by the Sierra Nevada and on the west by the Central Coast Ranges and the San Andreas Fault. The basin is filled with predominantly marine sedimentary rocks that attain an aggregate thickness of over 9,150 m (30,000 feet). These rocks are interbedded sequences of sands and shales that make ideal CO2 storage sites. The California Geological Survey notes that the San Joaquin Basin contains many more rock sequences with geologic carbon sequestration potential than any other California basin (Figure 1). The great thickness of these rock sequences means that there are potentially several stacked target sand formations that may be usable for storage at the HECA site.

In addition to these basin-scale studies, WESTCARB also undertook more detailed studies of the storage potential of the rock formations in the Southern San Joaquin Valley around a specific site, the Kimberlina power plant, which is located at the intersection of Highway 99 and Kimberlina Road, north of Bakersfield. Most of the reports of the Kimberlina work are currently pending publication. The radial distance from the Kimberlina site to the HECA power plant site is approximately 30 km. This is well within the 50 km radius of the three-dimensional geo-model developed by WESTCARB centered on the Kimberlina site.

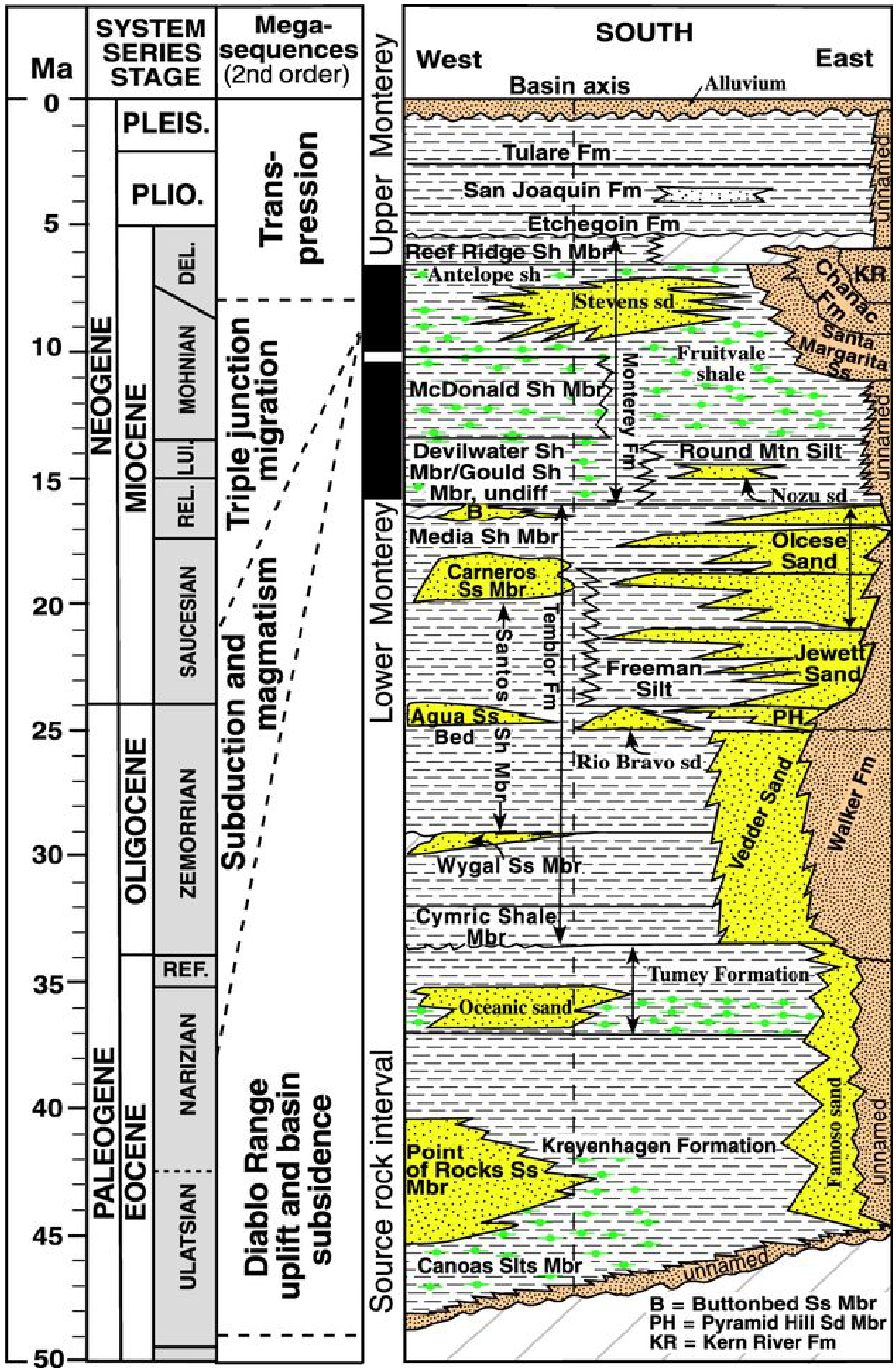

Figure 1: Stratigraphy of the Southern San Joaquin Valley (From USGS publication: Hosford Scheirer, A. and L.B. Magoon, 2008, Age, Distribution, and Stratigraphic Relationship of Rock Units in the San Joaquin Basin Province, California). Sandstones (storage formations) are shown in yellow. Shales (sealing units) are shown in dashed gray.

The Kimberlina site model was developed for saline storage within rock formations that were delineated in 3 dimensions and assigned porosity and permeability characteristics by using well data from DOGGR for exploration and production wells located in oilfields and wildcat wells within the 50 km radius of the model. Over 1500 well datasets were used (Figure 2). The WESTCARB geomodel for Kimberlina can be used to provide greater detail on the storage potential of the four formations at the HECA site which lies within its boundaries.

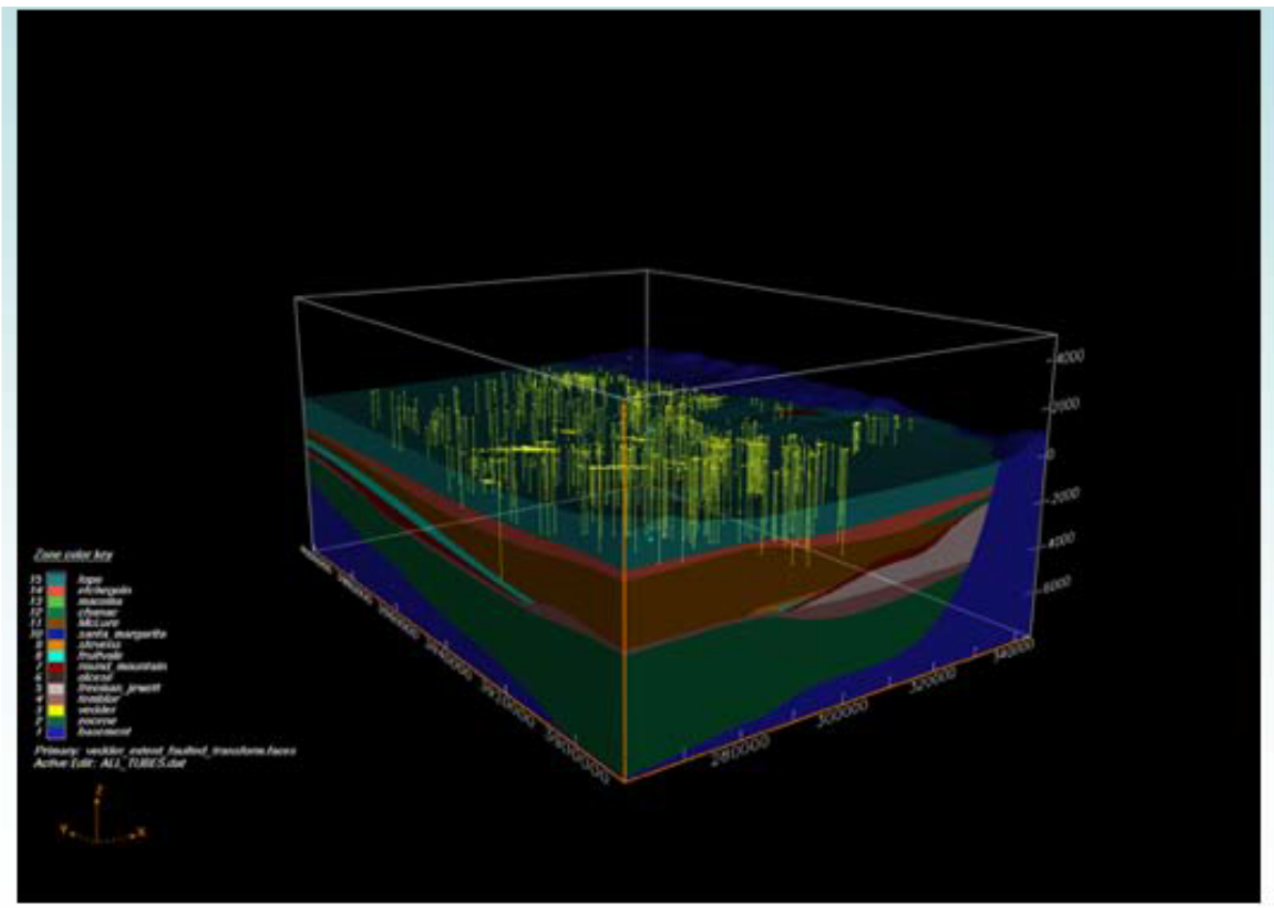

Figure 1: View of the 3-dimensional Kimberlina geomodel showing the locations of the 1500 well sites used to develop the volumes of the sandstone and shale formations.

The Kimberlina geomodel indicates that the rock formations which are potentially good targets for CO2 storage in the southern San Joaquin at Kimberlina include the Vedder, Olcese, Stevens (Monterey and Fruitvale), and Etchegoin (See Figure 1). All of these formations are also present at the HECA site within the model volume.

The Vedder is Oligocene–lower Miocene in age and was deposited predominantly in a marine shelf environment as sea level was rising. At moderate depths of 1,525– 2,745 m (5,000–9,000 feet), porosities range from 20–40 percent and permeabilities from 31–2,400 md.

Vedder sandstones are overlain by the lower Miocene Jewett and Pyramid Hills sandstones and the Freeman silt. The Freeman silt gradationally overlies and intertongues with the Jewett sandstone and the overlying lower Miocene Olcese Sandstone. Porosities between 15–22 percent are typical in sandstones below 3,050 m (10,000 feet), while higher porosities of up to 38 percent occur in shallow sands. Permeabilities range from 6–5,000 md (DOGGR, 1998). Olcese sands range in depth from 700 m (2,300 feet) in the Ant Hill Field to 2,715 m (8,900 feet) in the Mountain View Field. Porosities range from 20–34 percent and permeabilities from 150–2,000 md (DOGGR, 1998).

During the Late Miocene, the southern San Joaquin Basin underwent rapid tectonic changes. Localized uplifts shed sands into a deep water basin so that the Stevens sandstones also include the interbedded shales of the Monterey Formation and laterally equivalent Fruitvale Formation on the east side of the basin. Stevens sandstones are generally medium–fine grained sands between 2–76 m (5–250 feet) thick. However, thick sections of interbedded sandstone and shale can exceed 1,525 m (5,000 feet) in aggregate thickness. Depths range from less than 60 m (200 feet) on the west side of the basin to over 4,270 m (14,000 feet) in the south central basin. Porosities in sandstones shallower than 3,050 m (10,000 feet) range from 20–35 percent with permeabilities of up to 6,500 md in the shallowest sandstones. Below 3,050 m (10,000 feet), porosity and permeability decline to 10–20 percent and 0.2 to 1,000 md, respectively (DOGGR, 1998). The Stevens sandstones provide significant oil production in the area and were the main formations targeted for CO2-EOR operations at Elk Hills using HECA's CO2.

The Etchegoin Formation consists largely of sands and mudstones deposited in transitional marine to coastal bay and riverine environments throughout much of the west and central basin where it reaches a thickness of about 1,680 m (5,500 feet). Individual sandstone units are generally thin, ranging from 2 to over 60 m (5 to over 100 feet) but total sandstone thickness is considerably more. Sandstones are enclosed in or overlain by Etchegoin shales ranging from >1 m (a few feet) to over 300 m (1,000 feet) thick. Porosities range from 12–40 percent and permeabilities from 1 to 22,320 md in sandstones up to 2,290 m (7,500 feet) deep, and decline to 17 percent and 200 md, respectively, at 3,170 m (10,400 feet) in the Yowlumne Field (DOGGR, 1998).

The primary target formation for storage chosen at Kimberlina was the Vedder Formation. The Kimberlina geomodel was used to develop a simulation of a large-scale CO2 injection of approximately 1 million tonnes over four years into the Vedder. The simulation indicated that this volume could be successfully injected into the Vedder, provided information for leakage risk assessment over the predicted interval for migration of the CO2 and stabilization after twenty years, and provided a basis for planning injection and monitoring well placement and operations.

Recommended Studies to Improve Storage Potential Assessments

It is clear from the above data that at least four sandstone formations underlying the HECA site meet the criteria for high storage potential. As noted above, however, the porosity, permeability and thicknesses of these units vary significantly across the southern San Joaquin Basin. The Kimberlina geomodel interpolates these values from surrounding well data and is inclusive of the HECA site, but needs to be manipulated to provide preliminary semi-quantitative estimates of storage capacity at HECA's location. Further reductions in the uncertainty of storage assessments would involve obtaining site-specific data by drilling a characterization well and performing a pilot CO2 injection at the HECA site. A two-phase approach is recommended:

Next Steps for finalizing site location for storage and sequestration of HECA's captured CO2.

1. August-December 2015: Manipulate the Kimberlina geomodel to obtain volumetric estimates of the storage potential of the four target sand formations at the HECA site and produce preliminary simulations of CO2 injections at the volume and rate of projected CO2 emissions from the HECA plant. These simulations predict the movement of the injected CO2 underground, determining the distance over time the CO2 may travel away from the injection point for the purposes of risk assessment and MMV design.

2. January 2016-December 2016: Drill a characterization well and perform a pilot injection at the HECA site to obtain direct site-specific data on rock formations, including depths, thicknesses, porosities, and permeabilities of target storage and overlying sealing formations.

Based on the foregoing, HECA will be in a position to confirm relatively quickly whether the injection point for HECA's CO2 will be the HECA site itself. Obviously, we will be examining alternative injection sites also as the geologists focus on the specifics of HECA's location and CO2 volumes. In any event, the injection site permitting data previously requested of CRC should now be under HECA's control. Jurisdiction over the wells themselves will shift to the EPA as Class VI well certification is required.

Milestone 2:

A letter dated June 18, 2015 (CEC Docket TN 205090) from Lorelei Oviatt, Director, Kern County Planning and Community Development Department, sets forth the County's position that the project is not authorized under current land use designations to operate a chemical production facility at the proposed site. Applicant shall provide an up-to-date listing of any and all *commercial products proposed to be produced by the project. In addition, Applicant shall provide a written discussion of whether or not, and why, the production of each such commercial product is or is not in compliance with Kern County's General Plan and zoning ordinance.*

This question seems to have arisen from statements by James Croyle about the product mix changing at HECA. For clarification, HECA's products remain precisely the same as they have been throughout the CEC process. There is no change. We have no intention of doing anything counter to our zoning restrictions.

For background, DEF is made by simply adding de-ionized water to Agricultural Urea to use for NOx reduction in diesel engines. DEF is worth considering because it uses high grade, uncontaminated Agricultural Urea, which we produce, and has a higher market value in that use. Previous mention of DEF was premature but it is one we plan to discuss with county officials to determine their view of the zoning restriction and whether DEF could be permitted.

Next Steps:

Meet with the county and seek guidance.

Milestone 3:

Completed docketed responses to all presently outstanding data requests from the parties. To the extent that any such outstanding data requests are no longer applicable due to changes in the HECA project since issuance of the data requests, Applicant shall provide a discussion of what changes to the project render the data requests inapplicable. To the extent possible, Applicant shall modify the inapplicable data requests so that they apply to the changes in the project and respond to those modified data requests.

A majority of the outstanding data requests were the responsibility of Oxy/CRC and pertain to their site for EOR storage. As HECA moves toward qualifying an alternative site for permanent storage and sequestration of its captured CO2, HECA will provide a discussion of the changes and address the applicability of all data requests.

Next Steps:

1. Review all outstanding data requests with counsel, provide appropriate discussions of any proposed changes, and, respond to the data requests appropriately.