

**DOCKETED**

<b>Docket Number:</b>	22-ERDD-02
<b>Project Title:</b>	Climate Innovation Program
<b>TN #:</b>	253023
<b>Document Title:</b>	Elliott Hoffman and Marvin Keshner Comments - Climate Innovation Program Update Workshop
<b>Description:</b>	N/A
<b>Filer:</b>	System
<b>Organization:</b>	Elliott Hoffman and Marvin Keshner
<b>Submitter Role:</b>	Public
<b>Submission Date:</b>	11/7/2023 1:39:11 PM
<b>Docketed Date:</b>	11/7/2023

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Submitted On: 11/7/2023  
Docket Number: 22-ERDD-02*

## **Climate Innovation Program Update Workshop**

*Additional submitted attachment is included below.*

**CEC Nov 2<sup>nd</sup> Session – 9AM-Noon – Climate Innovation Program**  
**From: Elliot Hoffman and Marvin Keshner – Solar Synergies**

Jonah, David

We understand that you will be asking on Nov 2 for inputs on investments that California can make to reach its carbon emission and energy infrastructure goals in 2030 and beyond. Here are some initial thoughts. We will attend the November 2<sup>nd</sup> session and will offer additional ideas based on the discussion on Nov 2<sup>nd</sup>. We are deeply committed to supporting California's climate and energy goals and our technologies are highly aligned with those same goals.

As you already know, Solar Synergies has developed two technologies that need to be demonstrated and then piloted at significant scale:

- **A system to capture CO2 directly from the air (DAC)**
  - Cost is \$65 per mton CO2 with electricity at the wholesale price of \$0.072 per kWh
  - Capacity is 200,000 mtons CO2 per year on 10 acres of land; the goal is massive scale (gigatons / year by mid-late 2030s), low cost
  - Inputs are electricity (18 MW average), 2.7 GJ per mton CO2, and water (55 gallons per mton CO2), which can be collected from rainfall with additional land.
  - The CO2 can be sequestered in depleted wells in the Central Valley or by drilling a horizontal well ½ mile down, letting the CO2 percolate through the rock and soil, where it will combine with Fe, Mg, Ca and other minerals to form stable, insoluble carbonates
  
- **Ultra-compact transmission lines**
  - 3x capacity at 70% of the cost of conventional lines
  - Can shorten permitting time by use existing rights-of-way next to existing transmission lines, highways, or rail lines
  - Completely enclosed in concrete – almost impossible to start a forest fire
  - Our 230 kV version has a capacity of 1.2 GW, is 10 feet high x 10 feet wide, and costs \$2M/mile.

You may not know that we also developed a smokestack capture system for CO2 that bubbles compressed air through water to separate the CO2 from the nitrogen. This smokestack capture system can be easily retrofitted onto an existing power plant by diverting the exhaust gas from the chimney, through pipes, and to our system, which is mounted on multiple skids. As with DAC systems, the output is compressed CO2 that can be sequestered in depleted wells or in a horizontal well.

Our smokestack capture system has the significant advantage that it uses only 40% of the energy per mton CO2 that is required for DAC. As a result, its cost is much lower, circa \$30 versus \$65 per mton CO2. However, because the utilities were so resistant to any extra costs, we shelved our smokestack system and began developing our DAC system. Without the utilities, DAC systems still enjoy a niche market, in which companies are buying CO2 credits in return for positive public relations. Unfortunately,

this market will top out between \$2.5 B and \$10 B per year, which is only 25 – 100 million mtons of CO2 per year at a price of \$100 per mton.

As you know, California has the 2030 goal of reducing emissions by 160 – 200 million mtons CO2. With the extra CO2 put into the air by forest fires (approximately 15 million mtons per 100,000 acres burnt), we believe that California will need 50 – 100 million mtons of either DAC or smokestack capture to meet its goals. Although the public relations CO2 credit market might just meet this requirement, it is very unlikely that all direct air capture systems, throughout the U.S. can be used just to meet the requirements in California.

Once the PR market is exhausted, we will need to fund DAC and/or smokestack systems with some combination of mandates on utilities and other CO2 emitters, taxes on fossil fuels, or funding from California's general funds. Once we have legislated mandates or fossil fuel taxes, the utilities will welcome smokestack capture, since it is so much less expensive for them than DAC.

In summary, our input to your future planning is the same as the policy of President Obama—all of the above. Please include funding for upgrades to the electrical grid, smokestack capture of CO2, and DAC systems. Hopefully, we will not be the only system that can capture CO2 at well below \$100 per mton.

#### **Our Initial Thoughts, prior to Nov 2<sup>nd</sup>:**

We propose the following as a potential funding plan for the CIP to accelerate the most promising climate technologies as soon as possible:

#### **Three Technologies – the power of all three at scale**

1. Carbon Capture / Sequestration – massive scale, low cost,
2. Transformation to the Green All-Electric Future – major transmission grid development to carry expected increase in renewable energy demand
3. Smokestack Capture Systems from existing power plants (ensuring major net emissions reductions from these plants)

#### **Funding at 3 Levels for Each: (assuming \$500 million total)**

1. **Promising Prototypes - \$75M – 10-20% match**
2. **Pilots - \$125M – 25-33% match with outside capital sources**
3. **Early Scale - \$300M – 50% match with outside capital sources**