To: Draft EMP Committee, c/o NJ Board of Public Utilities

From: Susan Dorward, Sustainability & Energy Coordinator
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Date: September 15, 2019

Subject: Comments on Strategy 7 (Expand the Clean Energy Innovation Economy)

Dear Sir/Madam,

I am a Carbon Management graduate student at Columbia University and the Sustainability & Energy Coordinator of Raritan Valley Community College (RVCC). RVCC serves 8,000 students from Somerset and Hunterdon Counties and in 2017 became the first community college in the nation to be carbon neutral for scopes 1 and 2. I am strongly supportive of the BPU, DEP, and Governor Murphy's efforts to reduce CO2 emissions. I respectfully submit these comments on R&D, workforce training, and the proposed technology incubator and clean buildings hub. My primary R&D message is that you include carbon management as part of your plan. I have provided supporting details and links. I hope that you find these comments to be a useful reference as you move forward with the plan.

Goal 7.1.1 Grow world-class research and development and supply chain clusters for high-growth clean energy sub-sectors.

The IPCC has shown that models that meet the goals of the Paris climate accord rely on negative emissions. As depicted in the draft EMP in figure 2, NJ's natural areas negate 8.1% of NJ's total emissions. BPU should encourage additional negative emissions, as this would help meet emissions goals and offset some emissions from fossil fuels.

One area of innovation for BPU to consider is CCUS (carbon capture, utilization, and sequestration). CO2 capture, either from flue gas or from the air, enables the utilization or sequestration of CO2. Similarly, improved farming practices, improved forest management (including proforestation), reforestation, and tidal marsh and wetland restoration can capture and store CO2. RGGI has a protocol for creating carbon offsets for forests (only). See a 2011 federal report for more information about terrestrial sequestration potential in NJ.

RESEARCH AGENDA

In 2019, Princeton Prof. Stephen Pacala led a committee for the National Academy of Sciences, Engineering, and Medicine that published an extensive consensus study report entitled "Negative Emissions Technologies and Reliable Sequestration: A Research Agenda." In addition to background information and estimated CO2 reductions, the report proposes research topics, timeframes, and annual cost estimates for a range of approaches. I suggest that you review the report and follow up with Prof. Pacala.

Another good but less thorough reference is the New Carbon Economy (NCE) Consortium's report "Building a New Carbon Economy: An Innovation Plan" (2018), which presents short-, medium-, and long-term research needs for engineered, biological, and hybrid solutions. The NCE is a group of universities, national labs, and NGOs.

The Innovation for Cool Earth Forum (ICEF) has R&D roadmaps specifically for direct air capture (2018) and CO2 utilization (versions 1.0 and 2.0, from 2016 and 2017 respectively).

CO2 UTILIZATION PRODUCTS
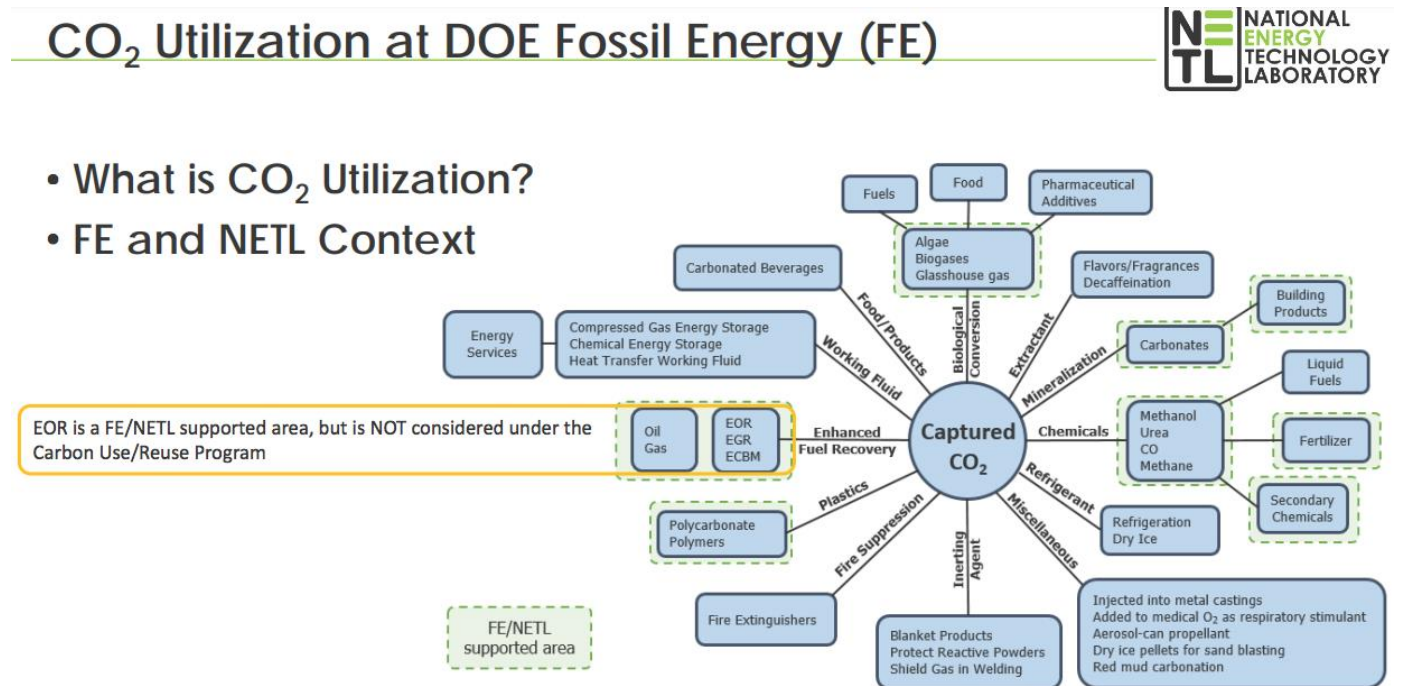

Figure 1: Chart from Dec. 2017 DOE presentation

As shown in the above chart, there are dozens of ways to utilize CO2, some of which are supported by federal programs. Surprisingly, according to the chart, liquid fuels are not supported. One interesting CO2 utilization product not mentioned in Figure 1 is carbon nanotubes, which can be a stronger, lighter replacement for steel and aluminum (see C2CNT, a startup associated with George Washington University).

CCUS STARTUPS

The only NJ CCUS startups that I am aware of are Piscataway's Solidia and Belle Mead's RRTC. Both were founded by Rutgers' Prof. Richard Riman and are spin-offs from his lab. Solidia's technology enables low-emissions production of cement and concrete (one of the highest-emitting industrial sectors). Their patented technology was invented by Riman and his graduate student, Vahit Atakan (now Solidia's chief scientist).

RRTC is a younger company focused on low-cost (potentially <$10/ton), low-energy CO_2 capture from flue gas. The capture process creates solid carbonates, which can be transported if needed and then subjected to a low-energy process that releases the CO_2. Bell Meade is located in Somerset County, which RVCC serves. You may want to contact Riman, Solidia, and RRTC to find out about the challenges that they (and others) have faced/are facing and how the State may be able to help.

A CO_2 capture startup in our region is Global Thermostat (GT), founded by two Columbia University professors and one of only three companies globally with pilot-scale direct air capture technology. They have just (2019) entered into a partnership with ExxonMobil. Dr. Vijay Swarup, VP of R&D at ExxonMobil's Clinton NJ facility, initiated the partnership with GT.[1] ExxonMobil recently (2017) expanded their Clinton facility, one focus of which is "accelerating development of scalable energy solutions with reduced environmental impact." Clinton is located in Hunterdon County, which RVCC serves. You may want to contact Dr. Swarup and GT.

For a catalog of CCUS startups around the world, see http://www.airminers.org/. NJ needs more representatives on this list!

OFFSHORE CARBON SEQUESTRATION

Large-scale carbon capture should be paired with permanent underground CO_2 sequestration, which for NJ is primarily limited to offshore locations. The identified reservoirs could store 8.4-33.5 Gt CO_2. For details, see the 2016 "Mid-Atlantic U.S. Offshore Carbon Storage Resource Assessment" report and a related 2017 article. Rutgers Prof. Kenneth Miller is a co-author on both. I suggest that you follow up with him for more information.

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[1] Swarup was a post-doc of GT's founder Prof. Peter Eisenberger twenty years ago. Also, Eisenberger directed a lab at ExxonMobil in the '80s.
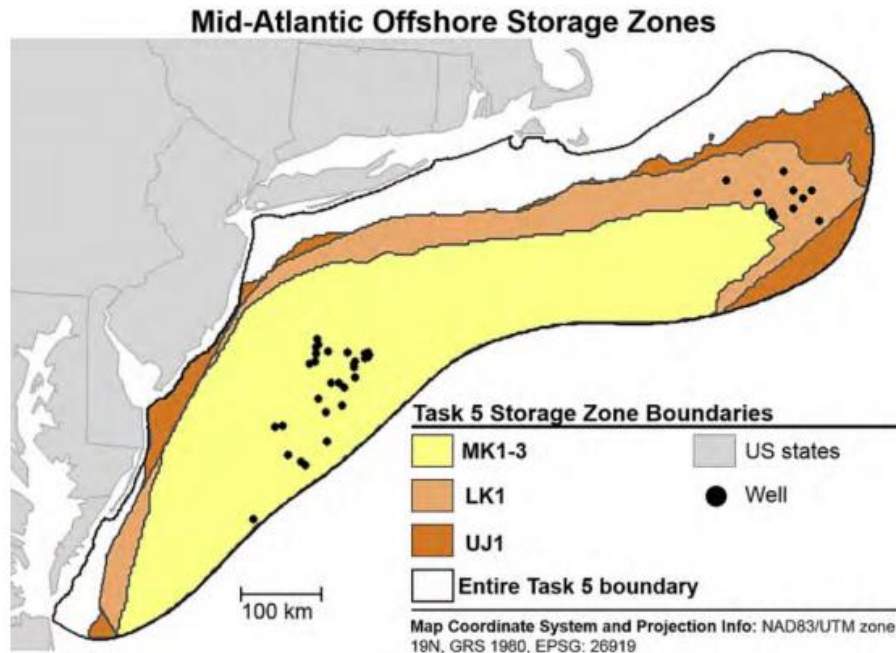
Figure 2: Area studied for offshore CO2 sequestration in the 2016 "Mid-Atlantic U.S. Offshore Carbon Storage Resource Assessment" report

Transport to CO2 sequestration sites would require the construction of CO2 pipelines for transport to offshore injection wells and possibly as an alternative to ground transportation onshore. (As of 2015, there were 50 onshore CO2 pipelines in the US spanning 4,500 miles, primarily for enhanced oil recovery. See the NETL report for more information.)

Webb and Gerrard (Columbia Law School's Center for Law, Energy, & the Environment) have published a detailed legal analysis of sequestering CO2 in the Atlantic.

CO2 SEPARATION AT POWER PLANTS

CO2 sequestration and utilization capabilities make feasible the construction of fossil fuel-based power plants that output pure CO2 streams. While flue gas capture retrofits for existing fossil fuel power plants have been expensive to date (though perhaps RRTC will change that), new technologies such as fuel cells and Allam cycle-based generators isolate their CO2 output by design. Examples are ExxonMobil's partnership with FuelCell Energy and NET Power's 50MWth demonstration facility, which came online in Texas in 2018. Assuming CO2 sequestration and/or large-scale utilization is planned, these technologies make sense for NJ.

Goal 7.2 Establish workforce training programs

RVCC already has highly successful workforce training programs, with exceptional graduate employment rates in our new NSF-funded Commercial Energy Management program (100%),

Advanced Manufacturing (100%) with state- and federally-funded apprenticeships, and Environmental Control Technology (HVAC) (95%). These programs could be expanded to meet EMP goals. For information, contact Prof. Paul Flor (Commercial Energy Management and HVAC) or Director of Workforce Development Joanie Coffaro, or visit RVCC's Career Training web site.

I suggest that the BPU work with the NJ Council of County Colleges to develop and implement the Clean Energy Job Training program and vocational programs. A great resource for workforce development in Somerset and Hunterdon Counties is the Greater Raritan Workforce Development Board.

Goal 7.5 Establish a Carbon-Neutral New Technology Incubator
Goal 7.6 Establish a Clean Buildings Hub

With its R&D and manufacturing businesses, available R&D and industrial space, and highly skilled and educated population, Somerset County would be an ideal location for the incubator and hub. It is centrally located for RVCC (Branchburg), Rutgers (New Brunswick), Princeton University (Princeton), US Green Building Council (Morristown), Solidia (Piscataway), RRTC (Belle Mead), and ExxonMobil's low-carbon R&D facility (Clinton).

Locating the incubator and hub in Somerset County is strongly supported by the County's Comprehensive Economic Development Strategy (CEDS), which identifies business resources and the re-use of significant properties as two of just three high priority focus areas. See p. 46 of the CEDS (p. 56 of the PDF). For more information about the CEDS or business in Somerset County, contact Mike Kerwin, President & CEO of the Somerset County Business Partnership (mkerwin@scbp.org).