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University of California, Riverside - Renewable Gas comments

Additional submitted attachment is included below.

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California Energy Commission
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July 14, 2017

Re: Docket: 17-IEPR-10 – Renewable gas

The Center for Renewable Natural Gas and the College of Engineering – Center for Environmental Research and technology (CE-CERT) at the University of California, Riverside submit the below comments on the Renewable Gas Docket: 17-IEPR-10 of the California Energy Commission's Integrated Energy Policy Report (IEPR).

Benefits

The benefits of replacing fossil fuels with Renewable Natural Gas (RNG) are broad and multifaceted. A key advantage of RNG compared to other renewable fuels is its potential to make significant contributions in the transportation sector. RNG has the unique advantage of a mature, and extensive storage and distribution infrastructure and the availability of heavy duty natural gas vehicle technologies.

RNG pathways, in general, have very low carbon intensities and have the potential to play a key role in helping the State achieve GHG emission targets, including Short Lived Climate Pollutant reductions. RNG production is an excellent way to convert a significant portion of the State's organic waste streams, especially if thermochemical processes are applied in large scales. RNG also offers criteria pollutant mitigation benefits. While GHG emissions have received increased attention over the past two decades due to climate change, criteria pollutant emissions are still the cause of most immediate and serious health hazards and environmental damage related to combustion. The South Coast Air Quality Management District (SCAQMD) will significantly rely on a NO_x heavy reduction strategy in order to achieve the 2023 and 2031 federal ozone standard deadlines in the South Coast Air basin[1]. Reducing NO_x emissions also lead to reductions in PM2.5 levels.

Converting carbonaceous wastes into high value fuels results in diverse economic, environmental and land use benefits. Forest residues cause serious wildfire hazards and the ongoing drought in California has led to a tree mortality rates epidemic, prompting an executive order by the Governor to expedite the removal of dead and dying hazardous trees[2]. RNG production will address these dangers while creating a fuel with very low carbon intensities.

[1] http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/final2016aqmp.pdf?sfvrsn=15
[2] https://www.gov.ca.gov/news.php?id=19180

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Renewable gas, either as hydrogen or in the form of methane, is likely to be an important future energy storage option. As more renewable power plants are integrated into the grid, there is an increasing 'mismatch' between generation and demand that affects grid reliability. The Power To Gas pathway can help address many of these challenges while increasing the renewable energy utilization levels. Converting excess renewable electricity into hydrogen or methane essentially allows this energy to be stored safely and efficiently with little loss over long periods.

Technological Challenges

Current RNG production relies heavily on biological pathways such as anaerobic digestion that are well understood and are commercially mature but have limitations including limited feedstock acceptability and low conversion efficiency. Two technology options can enable RNG production in significantly higher quantities: thermochemical conversion and water electrolysis. Both technologies are available, with electrolysis being a commercially mature technology while thermochemical biomass conversion is still undergoing commercialization. However, important technology, logistic, and process economy issues must be addressed to expedite widespread commercial implementation.

Carbonaceous renewable feedstocks such as biomass, biosolids, and waste matter can be directly converted into Renewable Natural Gas (RNG) or hydrogen through thermochemical processes such as gasification and pyrolysis. Direct thermochemical conversion can enable the use of significant quantities of sustainable carbonaceous resources including waste streams such as Municipal Solid Waste (MSW), agricultural residue, etc. and energy crops. Gasification is the best-known pathway for direct RNG production, and a number of gasification technologies are currently available, although commercial success has not been achieved. Besides issues related to gasification technology itself, there are significant additional barriers such as feedstock availability, collection and transportation costs, feedstock pretreatment, tar formation, gas cleanup, and high capital costs.

Technology development/project location: This is a critical component of the process and there are several challenges including technology maturity and scaleup: Besides issues related to gasification technology itself, there are significant additional barriers such as feedstock availability, collection and transportation costs, feedstock pretreatment, tar formation, gas cleanup, and relatively high capital costs.

Technology versatility: The key challenge when it comes to renewable carbon conversion is that the feedstock is distributed *and* has a diverse composition. Gasification technologies are often best suited for a specific set of feedstocks and have difficulty converting some material. The technology development process needs to focus not just on scale-up but also on identifying the right combination of feedstock/scale/product and

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business model. In essence, the technology and the feed/product/business configuration need to be developed in parallel to identify the most viable approach.

One of the key technology challenges is the high cost of oxygen in smaller scales. There has to be a focused effort on finding low cost alternatives and also processes that avoid oxygen use. The other challenge is gas cleanup and upgrading – improving efficiencies and reducing costs in these areas is extremely important.

Pipeline injection: There need to be targeted incentives for pipeline injection. California has very high costs when it comes to pipeline injection so this is an area where significant work is needed to evaluate the costs and the approaches to reduce the costs and encourage injection.

Business model/financing: Commercial viability is the key factor that determines market entry and so far has been responsible for many promising technologies to be abandoned. Commercial viability challenges cannot be resolved in the early years without significant government support. Governmental support needs to be reliable and consistent until RNG production pathways can get to where solar and wind power are today, i.e., economically self-sustaining.

Demand and vehicle availability: Focusing on fungible fuels helps significantly with ensuring there is adequate demand in most sectors. Transportation sector is the exception to this where significant government intervention is needed to ensure there is sufficient demand. A particularly attractive approach is to focus on specific fuel focused fleets.

Policy Barriers

Policy related issues pose some of the biggest challenges to RNG project developers, even in California, a pioneer state in climate benefitting regulations. Several policy measures have been adapted by the State that encourage renewable energy generation. However, the direct impact of these measures on RNG production have been limited. This demonstrates a clear need for programs that directly address the technological and commercial issues discussed above while encouraging commercial ventures.

Examples of such policy efforts include creating a renewable gas standard, recognizing power to gas as a storage option, and encouraging innovative production and end use technologies towards commercialization.

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Recommended governmental action required to support development and use of emerging fuels and technologies:

Thermochemical conversion:

1. Invest in applied research and demonstration. Specifically, pilot/pre-commercial demonstrations are critical and must be pursued aggressively. Specific technology options of importance include:
    a. Advanced gasification and pyrolysis technologies
    b. Innovative approaches to existing technologies including to create new revenue streams (ex. the biorefinery approach)
2. Specific actions on enabling RNG production projects include:
    a. Create a reliable, consistent framework for feedstock collection, procurement, and supply throughput the state. Long term feed supply contracts at reasonable cost is a critical component for these projects to be sustainable.
    b. Create consistent, sustainable demand for the products through regulatory mandates and incentives. The products include fuels, chemicals, and power. Often such efforts focus on too narrow a selection of feedstocks and fuels. It's important to cover a broad range of feedstocks and fuels so that technology and project developers have as much flexibility as is possible.
    c. Perform independent technology and pathway validation to identify the technologies and pathways with the highest potential. There is no comprehensive program that does this right now.

Power to gas:

1. This is an area that needs significant planning and action by the federal and /or state government. The government must plan ahead for the high renewables in the grid to anticipate and avoid cost and infrastructure problems. The key actions include:
    a. Incorporate power to gas as a key component of grid decarbonization. Without seasonal storage and the ability to shift renewable energy across sectors and regions, adding renewables is going to be increasingly challenging.
    b. Power to gas should be recognized as a storage option – mandates and incentives must be created to encourage power to gas storage.
    c. Methanation is necessary in the short term and as such should be included in the process.
    d. Creating a specific market for seasonally shifted power must be explored and developed. This will help to create the capital necessary to establish a

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power to gas infrastructure and also to create a system to distribute and use renewable energy effectively.

Thank you for the opportunity to participate in the renewable gas workshop. We are available to provide additional information and/or detailed responses to specific questions.

Sincerely,

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