

Considerations for central biogas upgrading to renewable natural gas from anaerobic digestion on multiple dairy farms

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Anaerobic digestion (AD) of dairy manure to produce renewable natural gas (RNG) requires large-scale to be economically viable. Centralized AD-to-RNG systems can enable multiple farms to collectively participate. One possible arrangement is to use a central biogas upgrading skid to upgrade biogas from multiple farms. This allows multiple farms with their own AD systems to convert biogas to RNG by sharing the cost of the RNG upgrading equipment and pipeline insertion point. There are several factors to consider when planning a centralized system; many are discussed below.

New versus existing anaerobic digesters and biogas upgrading equipment

Centralized biogas upgrading to RNG is feasible for both existing and newly built on-farm AD systems. Existing AD systems that are configured to convert biogas to electricity will need to replace combined heat and power (CHP) systems with boiler heating for the digester and likely improve or change the existing biogas cleaning system. Since the goal will be to maximize the biogas flow to the RNG system, existing biogas electrical generation will likely be eliminated. A boiler with a continual fuel supply will then be needed to replace the engine generator heat recovery system. Access to a natural gas pipeline would be the most economic fuel source. The increased use of grid electricity also needs to be considered in the case of a farm with an existing AD-to-electricity system that is participating.

Specific biogas cleaning prior to the removal of carbon dioxide (CO₂) from the biogas is required to facilitate upgrading to RNG. For biogas to be transported to a central upgrading site, the farm should expect to need hydrogen sulfide (H₂S) removal, moisture removal, and some level of gas compression onsite, that meet the RNG developer's requirements. Existing AD systems may need to improve (or add) H₂S removal to prevent corrosion in the compressor and gas handling prior to the RNG upgrade. A new AD system will allow the system to be built specifically for converting biogas to RNG, and often the RNG developer will cover the costs associated with installing a new system and assume ownership of the system and the carbon market benefits.

Siting biogas upgrading to RNG

Piping or trucking the biogas from each farm's AD system to the biogas upgrading skid means the upgrading equipment can be located on one of the farm sites or in a separate location. Considerations include the location of each participating farm and the location of a natural gas pipeline where RNG can be inserted. Pipelines for biogas are typically PVC plastic and low pressure. Engage with local utilities to determine the locations and capacities of natural gas pipelines and discuss any permitting requirements. Siting the biogas upgrading equipment in a location that will require a substantial distance of pipeline to reach may require obtaining land

rights and a lengthy permitting process that could delay the system installation or end the project altogether. Transporting the biogas to the central upgrading skid by truck may be an option, though is less common due to additional cleaning and compression required and the potential for opposition from communities concerned about additional traffic and road deterioration.

Farm and manure management

As each farm in this central system will be utilizing their own anaerobic digester, it is unlikely that farms will need to make any manure management changes. Farms where an AD system will be added may need to manage their bedding (e.g., remove sand before the AD) and consider wastewater diversion. Farms interested in co-digesting food waste should discuss the possibility of co-digestion with the RNG developer. Some RNG markets, such as the California Low Carbon Fuel Standard, pay significantly less for RNG produced from food waste co-digestion versus RNG produced from AD of manure only. However, if the RNG is being purchased by a private buyer, there may be allowances for RNG produced from AD of manure and food waste. Payments to each farm will likely be made on a biogas delivery basis. Metering systems will need to be developed on each farm to determine the volume of methane being delivered from each digester.

Centralized RNG insertion option

A related centralized option is for each farm to utilize their own AD and RNG upgrading system and have one central RNG insertion point for multiple farms. Development of a RNG insertion point in an existing natural gas utility pipeline can cost in excess of one million dollars, though it is highly variable. Centralizing the RNG insertion point so that multiple farms can access could allow more farms to participate. Payments will likely be made to the RNG developer on a volume basis, assuming RNG quality (i.e., methane content) delivered is consistent among farms participating. Commonly, RNG is delivered by trucks to the central RNG insertion point and should be equipped with meters to show the volume on each truckload.

Siting RNG insertion point

There is more flexibility when determining a location for the RNG insertion point. Discussions with local utilities will identify the locations of existing natural gas pipelines, potential insertion point locations, and any permitting requirements. It is important to consider the distance that the RNG will need to be transported (often by truck), and volume of traffic that may be encountered. Communities may be opposed to additional routine traffic on heavily trafficked roads, especially if it includes heavy vehicles that may accelerate wear and tear on roads.

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This material is based upon work that is supported by the New York Energy Research & Development Authority (NYSERDA) under agreement #141020. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of NYSERDA.