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August 20, 2012 EIN 20-501557

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RE: Department of Energy under Award Number RW-0000257 Final Report

This is the final report submitted by Integrated Energy Solutions, Inc. (IES) to the Addison County Regional Planning Commission under DOE Award Number RW-0000257. The report conducted for this grant is intended "to determine the technical and economic feasibility of building or expanding a local biogas refining facility for converting biogas from a local, on farm biodigester into renewable bio-methane for use in vehicles."

Introduction

IES is developing a "biogas refining facility" as referenced above. The planned biogas facility will include an anaerobic digester that generates bio gas from dairy farm wastes and other organic sources, as described. The planned facility will also have a gas upgrade plant to clean and convert the bio gas to finished bio methane.

The digester will be an above ground, stainless steel, complete flow system, manufactured by WELTEC Biogas of Germany. Here is a picture of a WELTEC digester similar to the planned project digester.

The gas upgrade equipment removes CO_2 and cleanses impurities from the bio gas. This converts the bio gas to bio methane – renewable natural gas (“RNG”). The gas upgrade plant will be supplied by Flotech/Greenlane Gas Co, a Swedish company. Here is a picture of equipment similar to the planned gas upgrade plant.

The plant’s RNG gas product will be chemically equivalent to pipeline grade natural gas. In this finished form, the RNG will be marketed primarily as a renewable alternative for heating fuel. As contemplated for this report, the RNG may also be marketed as an alternative vehicle fuel in compressed form, like pipeline natural gas (CNG).

While still not as prevalent as electricity produced by digester technology, RNG produced from such a combined digester and upgrade plant is beginning to emerge as an alternative boiler fuel and vehicle fuel in the European market and elsewhere. Application of this emerging technology abroad serves as the model for the planned Middlebury RNG production plant.

The planned RNG plant is being developed primarily to supply a large volume of RNG to Middlebury College, under a long-term purchase/supply contract between IES and the College. In furtherance of its carbon neutrality objective, the College will use this supply of RNG to replace the equivalent volume of #6 heating oil fuel currently used by the College for steam production.

IES is developing and will operate the planned RNG plant under long-term lease with a dairy farm near the College. The plant's digester will process manure from this "host farm" and other nearby dairy farms, other organic farm materials produced on nearby farms, and food wastes.

The RNG will be transported from the farm plant site to the College's boiler plant by an underground pipeline. This "feeder" pipeline between the plant and College will likely be constructed and managed by Vermont Gas Systems. Vermont Gas operates a long-established natural gas transmission pipeline in Vermont.

Vermont Gas Systems is currently working through the regulatory process to expand its transmission pipeline from South Burlington to Rutland, through Middlebury. The route for this new proposed natural gas transmission line includes part of the planned IES feeder pipe.

The output capacity of the planned Middlebury RNG plant reflects the "model" sizing of the Flotech gas upgrade plant equipment necessary to meet the supply requirements of the College contract. Flotech offers a series of models with increasing, fixed output capacities. The Flotech model chosen for the planned project is the minimum size needed to meet the supply requirement for the College contract.

As so sized, the planned plant has the capacity to produce some amount of RNG in addition to the amount to be provided to the College. The amount is approximately 225,000 gallons of diesel or gasoline vehicle fuel, equivalent. This report assesses the conceptual, technical and economic, feasibility of marketing this additional, secondary production of RNG for local vehicle fuel use in the Middlebury area.[1] To account for the possibility of greater demand for RNG vehicle fuel in the market, the report also considers the feasibility of expanding the size of the plant to provide a larger supply of RNG fuel for vehicle use.

As a separate consideration, the report also considers the feasibility of incorporating phosphorus removal equipment into the RNG production system.

[1] Except as otherwise discussed, the engineering and business plan for this project are not part of this report.

1. Executive Summary

The threshold issue for this feasibility study is to identify the base volume of available and serviceable local demand for RNG vehicle fuel. The study must then assesses whether this identified volume of fuel may be marketed at a workable price, which accounts for the various costs involved with offering RNG as vehicle fuel from the planned plant – plant production, fuel delivery, and vehicle conversion. The analysis also provides for the determination of whether the local demand for RNG vehicle fuel is sufficient to support expansion of the existing planned RNG plant.

This assessment of local supply and demand must also account for the impact of the potential and likely establishment of the Vermont Gas Systems natural gas transmission line in the Middlebury area.

It is initially concluded that, in the absence of the Vermont Gas Systems transmission pipeline, local sale of the RNG fuel for vehicle use in the Middlebury area would be feasible. As first required, there is a sufficient volume of demand for the RNG as vehicle fuel, by local fleet vehicle operations, which may be serviced as a technical matter. Further, while a close call because of the current absence of incentives for the use of CNG vehicle fuel, it appears the RNG may be marketed, over time, at a cost effective price for both plant and the prospective customers.

RNG is best suited for fleet vehicle use in the scaled amount available from the planned plant. There are a number of fleet vehicle operations in the Middlebury area capable of and interested in switching from gasoline or diesel. As a technical matter, the RNG may be supplied to these fleets by one or two filling stations located on the "feeder" pipeline; the fleets are adaptable for this purpose; and their collective, potential demand roughly matches the planned plant's additional RNG output.

In the absence of the pipeline, the price for the fuel should be sufficiently competitive against the price of gasoline or diesel to entice them to make the fuel switch. And this price

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offering should be able to provide sufficient margin to account for the cost factors involved with offering the RNG as vehicle fuel.

In the absence of any governmental incentives for CNG, much less RNG, as is currently the case, the margin's capability to so provide for these cost factors is problematic. The aggregate volume of local fleet vehicle fuel use, and the per vehicle use among these fleets, are both relatively small. This relatively small scale of use places substantial pressure on the available margin.

The impending competition from the proposed natural gas pipeline transforms this initial assessment, however. First, at least in the short-term, some substantial volume of potential sales to the identified local customers will simply be lost to price competition from natural gas. Natural gas will likely be available for substantially less than the best possible RNG price that might be offered. In this case, rather than being offered the chance to meet or even reduce their fuel costs by switching from fossil fuel to RNG, potential fleet customers will be asked instead to pay a premium above the price of natural gas.

The market analysis does indicate some limited willingness to pay a premium for a renewable fuel, as long as the net price still remains below the equivalent fossil fuel price. There is also interest in receiving a fixed price that would provide protection from the market risk of increased natural gas prices. There is strong indication, however, that many customers will simply choose the lower price offering of natural gas, and so some substantial portion of the potential local sales will be lost to CNG use.

At the same time, the coming availability of the transmission pipeline will create a substantial, new, additional marketing opportunity for the RNG fuel. As described, part of the plant's feeder pipe will connect to the Vermont Gas Systems' transmission line. This connection means the RNG may be marketed from the greater transmission pipeline in a "blended" RNG/NG form, in addition to being offered as pure RNG directly from the production plant's feeder pipeline.

This additional market for the blended product will extend beyond the local area and include the entire geographic service area of the transmission pipeline. This greater market will also include fuel service for individual cars and trucks as well as fleet vehicles. The additional offering would thus make the RNG far more available as vehicle fuel than only the local offer of “pure” RNG direct from the plant feeder pipe.

Though providing this substantial new market, the additional offering of the RNG blended product will still face the same, strong competitive pricing pressure as the offer of the pure RNG product. The effect of this competition is significant. A substantial premium as compared with the price of natural gas will be necessary to cover the costs involved with both offerings of the RNG alternative fuel. Again, in the absence of any governmental incentives, this needed premium margin will again be severely constrained by the competitive pressure from natural gas.

On balance, it is determined that it will be also feasible to offer the additional RNG output from the planned Middlebury plant as vehicle fuel, if the new Vermont Gas Systems transmission pipeline is established as anticipated. In fact, this scenario is more feasible than the first. Demand should build over time for the more widely available blended RNG, at a premium price capable of accounting for the costs involved, at least to make up for the loss of local sales of pure RNG.

The key economic consideration for this second marketing scenario is the amount of premium that may be charged above the price of natural gas, and again its capability to cover the costs involved with providing RNG as vehicle fuel. In addition to the incremental cost of vehicle replacement and fuel dispensing, there is the additional tariff cost that Vermont Gas will charge for transport of the fuel through its transmission system.

The availability of grant or other governmental incentives to assist with vehicle conversion and fuel transport and delivery costs is obviously an important consideration for both scenarios. As described below, at inception of the contract for this study last fall, substantial subsidies were available for CNG use. These included grant financing for vehicle replacement and filling station construction. Substantial tax credits for the purchase of natural gas were also then available. Congress, however, allowed this public assistance for natural gas conversion to expire at year’s end.

CNG is exempt from state sales tax, and the two feasibility assessments for the two scenarios made for this report assumes that additional governmental assistance for CNG conversion and use, if not also for RNG, will be restored and even enhanced, soon. At least, the public benefit of CNG use by municipal fleets will be accounted for in the continuing public discussion of energy policy. It is also believed that this public discussion will soon begin to account better for the substantial reduction in carbon emissions that result from RNG use.

In summary, the planned RNG plant may be used to provide RNG for vehicle fuel. In the more likely scenario, once the natural gas system pipeline is established, some of the vehicle fleet operations in the Middlebury area will choose to convert some or all of their fleets to RNG usage, along with local individuals desiring a “green” alternative vehicle fuel. The balance of the plant’s RNG output will be marketed across the transmission pipeline system, to provide other fleet operators and individuals this alternative fuel choice.

Feasibility of System Expansion. As described, the identified local demand for RNG roughly equates only to the additional production of the planned plant. Service of this limited market is itself problematic, and so there is no basis for expansion to serve only the local market.

As also described there would be greater market opportunity with establishment of the Vermont Gas Systems natural gas pipeline. While it is expected that the pipeline will be established as planned, such reliance on the pipeline is at best conjectural at this point. Given all the contingencies and cost variables involved, it would not be prudent to expand the production capacity of the plant at this time.

Feasibility of Incorporating Phosphorus Removal Equipment. While continuing to show promise, phosphorus removal systems are still not commercially available. This is problematic for an investor owned RNG plant. The plant may be retrofitted should the equipment realize its promise and become commercially available.

2. Market Analysis

A. Potential customers, Fuel usage and Number of Fleet Vehicles

As identified in the Executive Summary, there are two groups of potential customers for the RNG vehicle fuel: 1) local fleet vehicle users in the Middlebury area to be supplied from the planned plant’s feeder pipeline, and 2) all vehicle users with access to the greater Vermont Gas

Systems transmission pipeline, if and when it is expanded and has been adapted for the provision of vehicle fuel.

i. Local Customers Supplied from the Planned System's Feeder Pipe

This group of customers is defined in the first instance by the technology and cost of fuel delivery. Local customers for locally produced RNG must be fleet vehicles operations. Fleet vehicles can supplied by a slow or "time fill" filling station, which is the only method of fuel delivery that is cost effective for a small scale project. Fast fill, which corresponds to gasoline service station fueling in time and convenience, is cost prohibitive at the small supply scale contemplated by the planned Middlebury system. It would not be possible to offer the fuel at a price that that can cover the costs of both the fast filling station and the incremental vehicle conversion costs.

Slow or "time" fill requires a vehicle to be hooked up to the filling station for some number of hours of continuous filling. This duration depends on the capacity of the fuel tank and the filling speed of the station. This slower fill process, while substantially longer than for a conventional gas station fueling, involves far less cost and expense than fast fill equipment and service.

Fleet vehicles operating on a defined schedule are the best adaptable customers for time fill equipment and service. With set routes and times, fleet operation can take into account the additional scheduling concern of fuel fill-up duration. Fleet vehicle operation usually occurs mostly during the day, so the time fill-up can be scheduled for the evening hours and cause minimal disruption in this regard, as well.

In addition to limiting the type of customer, the scheduling requirement limits also the geographic service area. As a matter of both cost and convenience, fleet vehicles cannot be transported very far from their home base for fueling. The geographic area further constrained in this case by the limited capability of the planned system itself to deliver vehicle fuel. It will be feasible to provide only one or two fueling stations along the route of the feeder pipeline, between the farm RNG production site and the College boiler plant.

The base of operations for potential fleet vehicle customers for the planned plant must therefore be in relatively close proximity to these two fueling sites.

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Six potential fleet vehicle customers meeting this profile have been identified in and around Middlebury proper and close to the possible sites for RNG filling stations. These six potential fleet vehicle customers are a mix of private enterprise and municipal service. They employ a variety of vehicles for a number of different short haul purposes, and consume approximately 300,000 gallons of gasoline and diesel, in total.

This group of potential customers provides a good representative sample for the further conduct of this study. Interviews with the six different customers disclosed common interest and concerns with regard to converting to either or both CNG and RNG. Their comments provide a good basis for assessing the technical and economic issues involved.

Further review indicates that a substantial amount of the identified fuel volume utilized by these six fleets may not be replaced with RNG fuel. Some of the fuel volume reflects travel and refueling beyond the service area; other fuel volume represents very minimal, local operation of a few vehicles in each of the fleets; and other fuel is consumed by a large number of very small fleet vehicles that cannot be converted cost effectively.

In net total, it is estimated that approximately 150,000-200,000 gallons may be replaced with RNG. This approximates the amount that would be available from the planned RNG plant, and so represents, if marginally, a sufficient potential base volume of customer demand.

The survey of the six potential customers represents a working identification of only a base demand for purposes of the study, and is not necessarily an exhaustive list of all fleet operators available locally for the fuel conversion. An exhaustive list beyond the base demand has not been compiled in part because there do not appear to be enough of them sufficient to support the system's expansion, and because the surveyed group provides adequate basis for the further analysis required by the study. The likelihood that there are other potential customers does provide additional assurance for the determination that there is a local base volume of serviceable fuel demand.

In total, the base fuel volume is consumed by 40 vehicles collectively among the six fleet operations. These vehicles are mostly International, six cylinder diesel and gasoline transit buses. There are also some heavier duty vehicles in the group.

On average, the 40 vehicles thus use 4000-5000 gallons each, per year. As highlighted in the Executive Summary and discussed in detail, below, this is relatively low fuel usage when accounting for the incremental cost of vehicle replacement or conversion for RNG use.

ii. Customers with Access to the Vermont Gas Systems Transmission Pipeline

Once expansion of the transmission pipeline is complete, there will be an approximately 100-mile corridor along the pipeline route from St. Albans to Rutland, including the Middlebury area, where filling stations could be established. This author has not been specifically provided with any information about VT Gas' specific plans for use of this corridor to supply CNG for vehicle use. VT Gas has indicated informally, however, that it is intending, if economically feasible, to make CNG available in both fast and time fill fueling stations so as to make the fuel available for all forms of vehicles, both fleet and individual.

VT Gas has also expressed its interest in providing the blended RNG product from the planned Middlebury NRG plant as an alternative vehicle fuel. This would mean, as previously described, that the RNG produced at the Middlebury plant could be made available anywhere along the pipeline route, for all types of vehicles

All fleet operations in the pipeline corridor would then become available as customers, along with individual operators of cars or trucks desiring to buy a green alternative vehicle fuel. There will then be available some greater number of potential fleet operation customers better suited to lower cost time fill, having fewer vehicles per fleet and higher per vehicle consumption. There will also then be access to a growing individual demand for RNG vehicle fuel use.

B. Vehicle conversion and Replacement Requirements

i. Fleet Vehicle Conversion and Replacement; Incremental Costs.

As highlighted in the Executive Summary, fleet vehicle conversion for RNG use is similar to and shares many of the benefits of CNG use. Vehicles may be operated with good fuel economy and reduced vehicle maintenance and cost. As discussed further below, carbon offset value is also created because of the reduced carbon emissions from CNG or RNG as compared with fossil-based vehicle fuel.

The Clean Cities Initiative provides an excellent description of these many advantages. http://www.afdc.energy.gov/fuels/natural_gas.html

Almost all of the fleet vehicles reviewed for this report can operate efficiently and cost effectively on CNG and RNG, as described. In particular, the international transit buses are readily adaptable to CNG and RNG usage. The larger vehicles under review have some limitations, but their use for local operation is still advantageous.

The existing fleet vehicles operating on fossil fuels may be converted to natural gas with relative ease. Conversion kits are available and may be installed without difficulty. IES has obtained a quote for vehicle conversion in the range of $20,000. This cost is prohibitive at the scale of this project, and so vehicle conversion is not considered further for this report.

As new fleet vehicles capable of operating on natural gas are becoming more readily available, the need to absorb such prohibitive conversion costs is beginning to diminish. IES has obtained a quote of $12,000 as the incremental cost for final delivery of a completely modified International transit bus capable of operating on CNG. IES has also obtained a quote of $18,000 for the incremental cost of delivering the other fleet vehicles so modified for RNG use.[2]

ii. Light Duty Vehicles

Individually operated light duty vehicles capable of using CNG are still quite rare in the marketplace. Incremental conversion and replacement costs, however, are substantially less, making them a very viable alternative if and when CNG service is established.

Honda currently offers a factory furnished Civic model capable of using natural gas. Here is the link to the Honda site for the CNG Civic. http://automobiles.honda.com/civic-natural-gas/?ef_id=UElP8jvId3oAAFx2:20120703002440:s

The Automaster in Burlington is a local Honda dealership. Its site shows different Civic models and corresponding prices. The comparable gasoline-powered Civic appears to be approximately $4,000 less than the CNG model.

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[2] The best available literature provides detailed cost analysis for larger fleet conversion. http://www.afdc.energy.gov/afdc/pdfs/47919.pdf

IES has obtained quotes for conversion of light duty vehicles approximating this $4,000 replacement cost for light duty vehicles.

C. *Filling Station Design and Location Options*

i. General Design Requirements

A time fill station resembles a fossil fuel filling station with one important difference. As with a conventional station, vehicles are stationed alongside and serviced by a fuel dispenser. Also like a conventional station, the fuel dispensers employ a hose connection for putting the fuel into the vehicles. The difference is that the station is in effect connected to the gas transmission pipeline rather than an underground liquid storage tank.

Here is a further general description of a time fill station, from the Clean Cities' site: http://www.afdc.energy.gov/afdc/fuels/natural_gas_cng_stations.html#timefill

> **Time-fill**: Time-fill stations are used primarily by fleets. This type of setup works great for vehicles with large tanks that refuel at a central location every night. ... At a time-fill station, a fuel line from a utility delivers fuel at a low pressure to a compressor on site. Unlike fast-fill stations, time-fill stations may have larger compressors and the vehicles are generally filled directly from the compressor, not from fuel stored in tanks. Although there is a small buffer storage tank, its purpose is not to fill vehicles, but to keep the compressor from turning off and on unnecessarily and wasting electricity.
>
> The time it takes to fuel a vehicle depends on the number of vehicles, compressor size, and the amount of buffer storage. Vehicles may take a several minutes to many hours to fill. The advantage of time-fill is that the heat of recompression is less so you usually get a fuller fill then with fast-fill. And you can control when you fill the vehicles, and thus, get better electricity rates needed to run the compressor, such as off-peak hours at night.

ii. Location.

RNG Supply. For supply of pure RNG, this need for pipeline connection limits station locations to the feeder pipe's planned route between the farm plant and the College. Matching site potential and customer base, two possible filling stations locations have been identified on the feeder route. One of these would be at or near the new ACTR garage. The second potential location is on College property, either near the boiler plant or near Eastview.

Blended RNG Supply. As described above, if devised by Vermont Gas Systems, a network of filling stations would be established all along the pipeline corridor route. These stations would likely include time fill stations as well as fast fill stations. If this network is established, it is anticipated that some form of station would be located on Exchange Street in Middlebury.

2. Environmental Analysis

A. Carbon Reduction and Carbon Emission Valuation

In contrast to CNG and most other alternative fuels, the production of RNG and its use as an alternative for fossil fuel results in two forms of reduced or avoided carbon emissions. The first, common to all alternative fuels, is the net offset reduction in emissions produced by the particular fuel switch, here the replacement of gasoline and diesel fuel with RNG. The second, unique to RNG produced by the anaerobic digestion of dairy cattle manure, are the avoided "lagoon" emissions, or the emissions from the manure pit that are captured by the anaerobic digestion process.

Here are the calculations of these two sets of avoided emissions, annually, for alternative use of the 200,000 gallons equivalent of RNG produced from cow manure.

Avoided Lagoon Emissions		**Avoided Fossil Fuel Emissions**	
2.5	met. ton/cow	20	lbs carbon/gal
2050	cows		
		225,000	gasoline/diesel replaced
11,275,000	pounds carbon	4,387,500	pounds carbon
5,125	metric tons	1,994	metric tons

TOTAL ANNUAL AVOIDED EMISSIONS	
15,662,500	pounds carbon
7,119	metric tons

This double savings represents a potentially significant contribution to the overall effort to reduce carbon emissions. It may be seen that the secondary reduction of the lagoon emissions, created by the production of the RNG fuel, is two to three times the offset reduction in emissions achieved from the fuel switch. This additional reduction in emissions is

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substantially more than the emissions produced from subsequent combustion of the RNG fuel. This means that the employment of RNG as an alternative fuel results in an actual net reduction in carbon emissions, and not just a reduced offset amount.

These combined avoided carbon emissions have value in the marketplace, in the form of tradeable carbon offsets. This value is discussed in the financial analysis, below.

B. Air quality

Research and communication with the Vermont Agency of Natural Resources indicates that production of this amount of RNG will require provision to the Agency of an annual monitoring letter, but will not require a permit.

3. Financial Analysis

As highlighted throughout, there are two quite different marketing and pricing scenarios under review. In the first scenario the RNG price must be less by some measure than the retail price for gasoline or diesel. In the second scenario, assuming establishment of the natural gas pipeline, it will be necessary for fleet operators, or others to pay some premium amount for the RNG blend above the compressed natural gas price. For those willing to pay such a premium, there again seems little willingness to pay more than the fossil fuel price. The fossil fuel price may thus be understood as setting the limit of both the pricing point scenario for the first scenario as well as the potential premium charge in the second.

The financial analysis must consider the capability of the pricing point limit for the pure RGN and the premium limit for the blend RNG to absorb the incremental per gallon costs associated with providing the fuels for vehicle fuel use. As identified throughout, these costs are: 1) the incremental cost of vehicle conversion or replacement; and 2) the incremental cost of fuel delivery.

For the supply of RNG from the feeder pipeline, this latter is the cost of installing and operating one or two time fill stations. For the offering of the blend RNG, the cost of fuel delivery would involve the tariff charge that would be imposed by Vermont Gas for the transport of the RNG through its transmission system. The tariff charge would also include a proportionate share of the filling station delivery cost.

The financial analysis must also account for the availability of incentives on the one hand, including governmental programs and carbon offset trading, and per gallon state and local fuel taxes on the other.

A. *Incremental Costs of Fleet Vehicle Replacement*

As described, IES has obtained quotes of $12,000 to replace the fleet transit buses and $18,000 to replace the other fleet vehicles. Assuming a seven-year useful life for the vehicles and no subsidization of this cost, here is a simple representation of the payback cost, per gallon, for these two vehicle replacements. The first two lines show the cost based on the average use for the local fleet vehicles. The second two lines show the impact of a higher per vehicle fuel usage amount that might be expected for other fleet vehicles to be served the blend RNG from the pipeline.

Incremental Vehicle Cost	Annual Vehicle Cost (7 Years)	Annual Fuel Usage	Per Gallon Cost
12000	1714	4500	0.38
18000	2571	4500	0.57
12000	1714	8000	0.21
18000	2571	8000	0.32

As described below, the recently expired federal program for the conversion or replacement of vehicle for CNG use would have provided a subsidy of up to $32,000 per vehicle replaced. This amount would be sufficient to eliminate completely this cost for all vehicles under consideration for this study.

B. Time Fill Station

The feeder pipe for the planned system is still in the design stage with Vermont Gas. There are also many variables involved with the installation of the station, itself. It is therefore difficult to identify precise amounts for the capital expense or the operating costs for the two possible time RNG filling stations that might be established on the feeder pipeline route. Based on research and discussion, the study estimates $0.40-$0.60 per gallon for this incremental cost.

This is the estimated cost per gallon for the establishment of two stations to supply the whole available amount, or a single station supplying one-half of that amount.

C. Pipeline Tariff

Again, because of the many variables involved, it is difficult to identify a specific amount for the pipeline tariff that would be imposed by Vermont Gas. The tariff will include regulated Daily Access and Distribution Charges. The Distribution Charge would like provide the regulatory means also to incorporate the proportionate amount of the expense and cost involved with utilizing the transmission system's filling station apparatus to dispense the RNG blend.

CNG is available from a fast fill station at the Burlington City Public Works garage. The natural gas is supplied by Vermont Gas Systems, and the prices include the base regulated part of the tariff - the Daily Access and Distribution Charges. These charges amount to approximately $0.30 per gallon, equivalent. This amount does not include the cost of the filling station, however. That cost is incorporated into the overall price set by Burlington City Public Works.

The additional incremental amount for the filling station should be significantly less than the $0.40-$0.60 estimated above.

D. Incentives/Grant Opportunities

Until the end of last year, a series of comprehensive incentives were available for the use of CNG vehicle fuel. These incentives covered the cost of installing filling stations, the incremental cost of vehicle replacement and the purchase of the fuel, itself. The incentives were available to municipalities as well as to businesses and individuals. Congress, however, allowed all of these incentives to expire at the end of last year, and it is unknown whether Congress will reinstitute them.

Here are descriptions of these incentives, from a Department of Energy web site. http://www.afdc.energy.gov/afdc/pdfs/47919.pdf

Refueling Station

The Alternative Fuel Infrastructure Tax Credit is available to reimburse 50% of the cost of installing a CNG station, up to $50,000. Tax-exempt entities are allowed to pass this credit onto the company that is building the station. The VICE baseline assumes that the builder reduces the purchase price by an amount equal to this tax credit.

Vehicles

The Alternative Motor Vehicle Credit provides a tax credit equal to 80% of the incremental cost of a CNG vehicle, to a maximum of $32,000 per vehicle. The VICE model assumes that this tax credit is fully capitalized on by passing to the vehicle manufacturer in exchange for a lower purchase price.

Fuel

The VICE model assumes CNG and diesel are taxed at the same level, which treats tax-exempt and non-exempt fleets the same. To do this, we had to subtract the $0.183 federal or $0.20 average state motor fuels excise tax on diesel or CNG fuel (IFTA 2008) from the projected retail price of diesel, which included these motor fuel taxes.

The SAFETEA-LU Act of 2005, the Tax Extenders Act of 2009, and the two NAT GAS Acts currently under consideration provide a $0.50 motor fuels excise tax credit for each gasoline- gallon equivalent (GGE) (or $0.55 per DGE) of CNG purchased. This credit is applicable to both taxable and tax-exempt fleets through a rebate provision in the Act (NGVAmerica 2008) and is applied to both in the VICE model.

E. Taxes

The federal tax on vehicle fuel, including CNG, gasoline and diesel, is $0.18 per gallon equivalent. There is no federal exemption for either CNG or RNG. The state tax is $0.25 per gallon. Currently CNG is exempt from state tax. Municipalities are exempt from all vehicle taxes.

F. Value of Carbon Offsets

According to Native Energy, a Vermont broker of carbon offsets and credits, the carbon offset value is currently $5 per metric ton of carbon. At this rate, here is the current offset value of the two forms of avoided emissions produced by use of RNG for vehicle fuel.

	Metric Ton	Value/ Ton	Total Value	Value/ Gal
Avoided Lagoon Emissions	5,125	$5	$25,625	$0.13
Avoided Fossil Fuel Emissions	1,994	$5	$9,972	$0.05
			$35,597	$0.18

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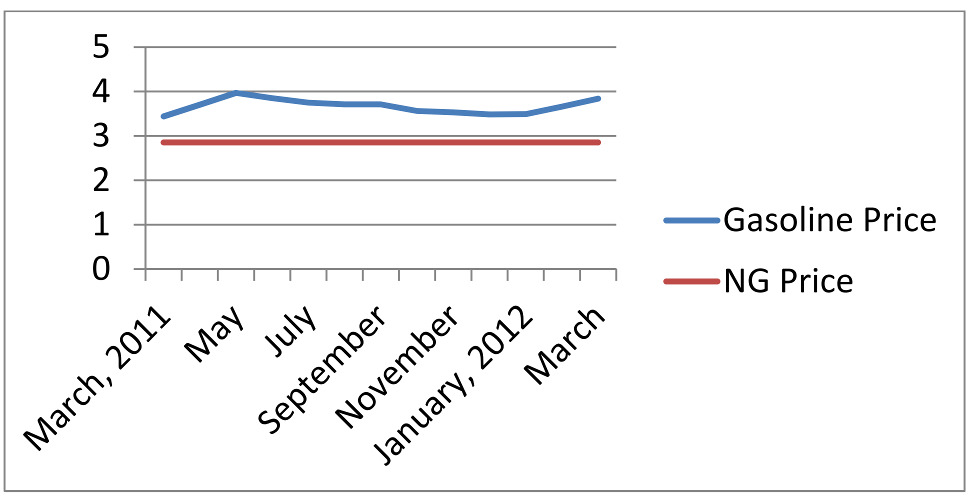
At the inception of the creation of carbon exchanges, it was expected that carbon might come to be valued in an amount at least 3-4 times the present value of $5 per metric ton. In that case, the offset value for RNG would approach or even exceed the $0.50 per gallon amount of the recently expired tax credit for CNG use, and would then have a significant impact on the economics of renewable energy.

This increased valuation has not come to pass however, and the value of carbon offsets, if anything, has been dampened in recent years. Even so, in a circumstance, as here, where margins are tight, this contribution is still significant.

Moreover, as noted in the discussion of carbon emissions, above, RNG use results in an actual net reduction in carbon emissions. This characteristic of RNG fuel should enhance its value as the public discussion of energy policy proceeds and intensifies.

G. Projected Fuel Price

With CNG currently being sold in Vermont, and with reported prices also available for Vermont gasoline sales, an actual benchmark range for the two, critical, CNG and fossil fuel prices, may be established. Here is a chart of this range, showing the Vermont state average gasoline price for a recent one-year period[3], and the current price of compressed natural gas in Burlington[4] ($2.85) as a fixed amount for the same period.



[3] http://publicservice.vermont.gov/pub/vt-fuel-price-report.html
[4] http://www.cngprices.com/stations/CNG/Vermont/Burlington/

The average gasoline price for this recent period was about $3.70. This establishes a serviceable figure for the upper pricing point for the offer of the pure RNG and the limit of the available premium charge for the blend RNG.

For the latter scenario, the available premium amount may also be calculated in the amount of $0.85 per gallon equivalent, reflecting the difference between the reported CNG price and the average gasoline price for the period.

Adjustment must be made to reflect fuel taxes and exemptions. The state exemption for CNG provides some additional room in the margin and premium for private party purchases. (The CNG price would otherwise be $3.10.)

On the other hand, the exemption for municipalities from all taxes means they may purchase CNG for $2.65 rather than $2.85. This also means that the gasoline price for municipalities was $3.25, on average, rather than $3.70. Combined, this reduces the pricing point limit for RNG, and the premium ceiling for the blend, to $3.25 per gallon equivalent, and the range of the premium for the blend to $0.60. Here is a table summarizing these calculations:

	CNG Price	Price Point/ Premium Limit	Premium Per Gallon Limit
Private	2.85	3.70	0.85
Muni	2.65	3.25	0.60

The following table illustrates the impact if the full amount of the incremental vehicle conversion is to be absorbed by available margin and premium. The first two lines show the impact on purchases by local fleet operators, assuming their average fuel usage. The second two lines show the impact of higher fuel usage and resulting lower per gallon price that would likely apply for the service of the blend RNG to other fleet operators.

	CNG Price	Vehicle payback	Net Price	Price Point/ Premium Limit	Net Available Premium Per Gallon
Private	2.85	0.38	3.23	3.70	0.47
Muni	2.65	0.57	3.22	3.25	0.03
Private	2.85	0.21	3.06	3.70	0.64
Muni	2.65	0.32	2.97	3.25	0.28

It may be seen that, if fleet operators are unwilling to absorb at least some of the vehicle replacement costs, there will be little room left to absorb the additional cost of $0.40-0.60 for the filling station for local purchases, particularly by municipalities. The impact of higher fuel usage is significant; there should then be sufficient premium value to absorb the tariff cost, if operators are willing to accept little fuel switching cost savings and pay the full premium.

It may also be seen that the expired incentives were well constructed for their purpose. The expired amounts would go far to create margin and premium sufficient to prompt the fuel switch offered by this project.

5. Regulations/Permitting Considerations

Marketing the RNG for vehicle fuel usage would require local and state permitting for the construction of the filling stations. There are no special permits involved with establishing filling stations, or for vehicular filling or vehicular use of RNG.

6. Impact on Economic, Market and Environmental analysis of Adding Phosphorous Removal Technology to RNG Plant

The capability of the anaerobic digestion of farm manure to remove phosphorus from the waste stream is widely known to have great potential for addressing this significant environmental concern. A number of mechanical and chemical systems continue to be in the promising development stage. These systems continue to improvement, but a review of current work in the field indicates that they are not yet available for commercial use.

The lack of general commercial application creates concern about technology risk for investors in projects such the planned Middlebury RNG plant. Without actual data, it is also difficult to assess and present to investors the accompanying risk reward calculation. For this reason, it is determined that the planned plant cannot be adapted at this time to include a phosphorus removal system.

Without actual data, it is also difficult to assess the potential financial impact of inclusion of this equipment for this study.

7. Recommendations

A. Develop and Construct the facility at the planned size;
B. Pursue local fleet sales;
C. Negotiate with Vermont Gas to determine costs and prices for the combined offer of pure RNG and RNG blended products;
D. Pursue tax credits and exemptions for CNG and RNG use that account for carbon valuation;
E. Pursue the restoration/establishment of state and federal financial incentives for
    a. CNG and RNG vehicle conversion;
    b. Establishment of CNG and RNG filling stations; and
F. Pursue public support to assist with the development of phosphorus removal equipment to the next stage of commercial development.

Sincerely,

Daniel Smith

Daniel Smith, President

This material is based upon work supported by the Department of Energy under Award Number RW-0000257.