HUDSON RIVER FOODWAY TRANSPORTATION ANALYSIS

Draft Final Report

Prepared for

LOWER HUDSON LONG ISLAND

RESEARCH CONSERVATION AND DEVELOPMENT COUNCIL

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December 2012

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1. INTRODUCTION

The goal of this feasibility project is to evaluate the merits of a waterborne transportation system for agricultural products in the Hudson Valley. This project includes a detailed transportation analysis to evaluate potential benefits of shifting agricultural produce transportation from primarily truck transport to combination truck & tug/barge operation, utilizing barge transport for the majority of the distance. The objective of the Transportation Benefit Analysis is a mode comparison study to estimate the product specific energy cost for transporting a fresh produce commodity using the Foodway Corridor concept versus the product transported by the conventional means to a given market destination. Evaluation metrics include fuel consumption, fuel consumption costs, and associated emissions for each mode. Transport unit options will include diesel refrigeration units (TRUs), hybrid electric refrigeration units (eTRUs), and transport only figures (representing non-refrigerated containers/trailers).

Product specific metrics were provided by the Agricultural Product Research, including the potential type of produce, amount of produce, required logistics, and its origin/destination locations. This data was used as an input to the transportation model developed by New West Technologies (NWT) to evaluate the specific merits of each transportation mode procedure. It was determined that the transportation analysis would include produce transported from Pomona Packing, in Wolcott, NY, to destinations in either Hunts Point Food Market or the Red Hook Container Terminal (both in New York City). These locations are shown in Figure 1. The combination truck and tug & barge mode route was to connect at the Port of Albany, NY. The volume of produce to be transported was estimated to be approximately four-hundred (400) truckloads carrying a maximum of 40,000lbs

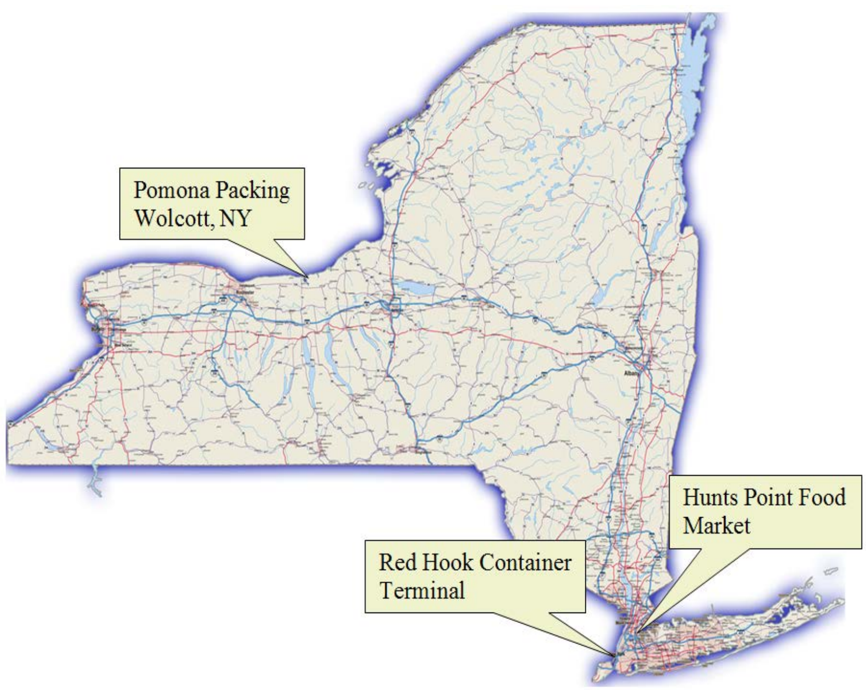

Figure 1: Foodway Transportation Analysis Origin/Destination

/2,000cft each between September and June. The analysis assumes that either 48ft trailers or two (2) twenty-foot-equivalent-unit (TEU) containers would be used to transport the produce between locations. It was determined that weekly trips would be taken by the barge resulting in ten (10) 48' trailers or twenty (20) 20' containers (400,000lbs/20,000cft max) per barge per trip. For the purpose of ensuring equal comparison between modes, the evaluation was limited to 1-way trips to NYC without consideration of backhaul quantities or frequencies. While the backhaul potential is an extremely important variable for the success of this concept, it was agreed that a comprehensive backhaul analysis is beyond the scope of this project.

2. TRANSPORTATION ANALYSIS

The purpose of this this analysis is to compare the transportation factors of current transportation methods and the potential for marine transportation modes. To achieve this, energy calculations were completed for a truck hauling a trailer directly to the destination and for a truck & tug/barge operation that carries the same produce between the same locations.

Truck-Only Transport Analysis

For the baseline truck transportation energy analysis, the evaluation included routes from the Pomona Packing facility to Hunts Point Food Market and from the Pomona Packing facility to Red Hook Container Terminal. These route analyses were completed for diesel TRU, eTRU, and non-refrigerated trailers to cover the possible scenarios. The use of shipping of two (2) 20' containers on trailer chassis was also evaluated; however, the on-road evaluation of this is essentially the same as transportation of (1) basic 48' trailer. The energy usage calculations for the TRUs and eTRUs were established based on historic data obtained from several fleets throughout NYS. This data was used to establish the operational percentage with respect to the ambient temperature. The typical ambient conditions for the time of year and location were then applied to this metric to obtain the operational percentage for this application. This allowed the overall energy calculations to be conducted by simply multiplying the full power fuel rate for diesel operation (1.7 gal/hr) or energy rate for electric operation (10.1 kW) by the percent operation and total time. Using Google Earth©, the direct routes between Wolcott and Albany/NYC final destination points are broken down by roads, their associated speed limits, and the traffic potential on each street. These are compiled into the total distance, time required, and fuel used for each truck haul. For transit time calculations, it is assumed that the trucks will travel at posted speed limits and average loading/unloading, waiting and mandated resting periods are included. To compensate for decreased fuel economy while traveling in congested areas (such as NYC), and adjusted fuel economy was calculated based on expected traffic flow rate and data recorded by ACEE.[1] The respective vehicle speeds and fuel economy figures are demonstrated for transport from Pomona to both Hunts Point and to Red Hood in Figure 2 below. Energy costs were established at $3.84/gal for on-road diesel (for fueling the truck), $3.38/gal for off-road diesel (for fueling the TRU and eTRU when in transit), and $0.08/kW for electricity (used for eTRUs while plugged in).[2]

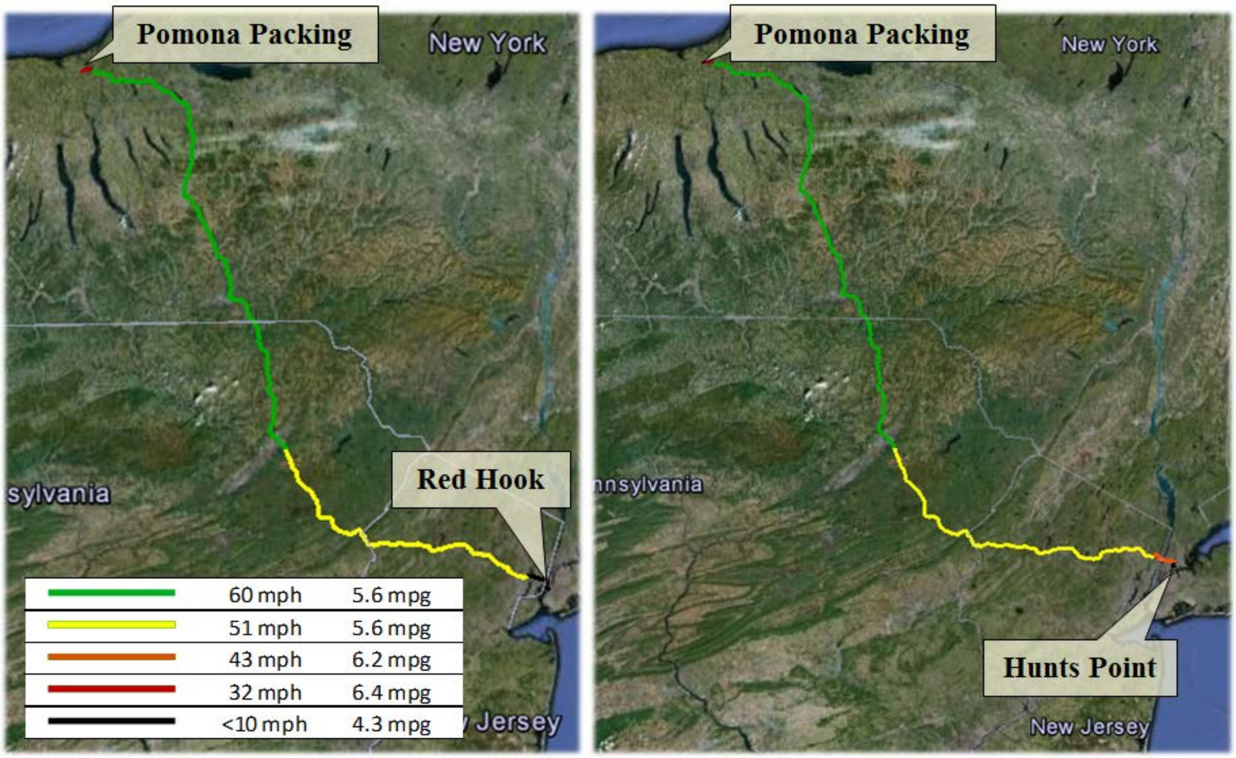

Figure 2: Truck Routes from Pomona Packing to Hunts Point and Red Hook

Tug and Barge Transport

To utilize marine transportation, the Port of Albany was chosen as the port of origin for produced to be shipped from. This necessitated the transport of produce from the Pomona Packing facility to the Port of Albany via truck to be loaded on the barge. To effectively model this, the techniques described above for truck transport were used for the first leg of the trip from Wolcott, NY to the Port of Albany. The method of evaluation for the TRUs and eTRUs was also used for the duration of the trip to calculate the energy usage while over the road and also when on the barge. The truck-only results for this initial portion of the route are included in overall Tug/Barge results. Once at the port, the trailers would be loaded from a staging area using a dock ramp. However, it must be noted that no infrastructure is

[1] (2010) ACEE. Segmentation and Flexibility in Fuel Economy Standards for Tractor-Trailers. Retrieved August 16, 2012 from http://www.aceee.org/files/pdf/white-paper/Segmentation%20and%20Flexibility%204-15_1_3.pdf
[2] Averaged over the last 12 months, Sourced from http://www.eia.gov/petroleum/data.cfm

currently installed at the Port of Albany to allow loading/unloading of roll-on/roll-off cargo, and significant modifications to the site would be required to accommodate this. The containers would be loaded from the staging area via overhead crane. Based on inquiries at both Ports of Albany and Coyemans, the estimated average unit loading and unloading time is 15 minutes each (30 min. total); however, this could be reduced if volumes significantly increase. The marine transport of ten (10) 48' trailers would require a minimum deck barge size of 200 feet long by 43 feet wide. A smaller 90' x 30' deck barge could handle twenty (20) TEU containers due to their tighter and multi-layer stacking capabilities. Larger size barges with their maximum carrying capacities were also evaluated to take into consideration potential future growth and optimize the benefits of marine transportation.

Based on conversations with operators at the Port of Albany, a 1,400 hp tug would be utilized to push these barges down the Hudson River to either Hunts Point or Red Hook. It was reported that this tug could transport the required barges at approximately 8 knots (other than barges over 300 ft in length which would be slightly slower at 7 knots). The specific tug referenced in this model has a transporting fuel consumption rate of 45 gal/hr and consumes approximately 2 gal/hr when idling. Fuel costs for marine portion of the trip were estimated at approximately $3.15/gal for marine fuel (a slightly lower grade diesel fuel).[2] According to NYS Marine Highway, each trip will require an average of 7 hours of waiting time due to "right of way" traffic, dock staging lines, and poor fog visibility. Figure 3 shows the route that the barge would be required to take to deliver the product to Hunts Point Food Market or Red Hook Container Terminal. The energy consumption from just the transportation (not including TRU/eTRU energy usage) is also indicative of fuel consumption and cost for non-refrigerated units.

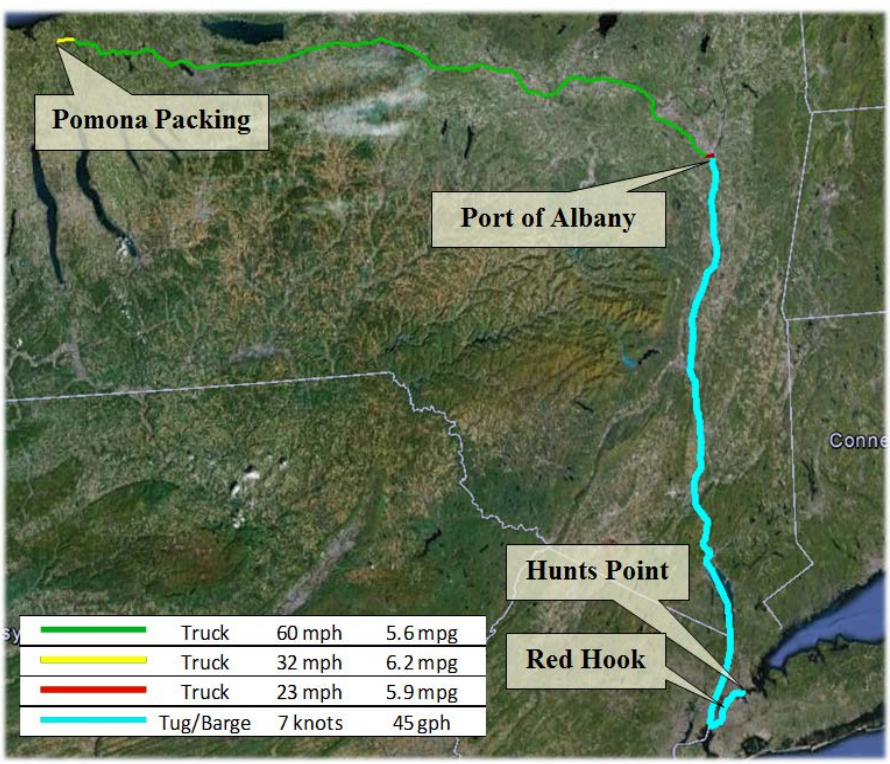

Figure 3: Truck and Tug/Barge Route to Hunts Point and Red Hook

3. ANALYSIS RESULTS

The overall goal of this transportation analysis was to provide comparison results for the time, fuel consumption, energy cost, and emission production factors for the various modes and routes considered. These results were calculated based on the best information available from the transportation industry and conversations with transportation operators. No favor was shown to one mode over the other, resulting in a completely neutral analysis and data results.

Time Considerations

The transportation time requirements are important to the feasibility of a transportation concept because they are the primary driving factor behind the TRU and eTRU operation and also a limiting factor to the "freshness" of the product that can be transported by a certain mode. The time required by each mode can be easily shown when analyzing the movement of a single trailer or container over the distance. However, to compare the total time required to transport a barge full of trailers or containers, significantly more information is required. This is because each trailer/container must first be transported to the port to be loaded on the barge. To accurately compare these situations, additional information is required including the dynamics of distribution (e.g. 1 truck ready per day vs. all trucks ready at once), the number of trucks in the fleet (1 truck must travel back and forth), backhaul percent (takes time to load/unload truck on trip back), and how these factors affect the driver's hours-of-service and the required resting periods. However, the time required to make the trip when just focused on one trailer/two TEU containers, using both truck and tug/barge modes, can be calculated based on the information available. The comparison between these modes, focusing on one trailer/two containers is shown in Figure 4.

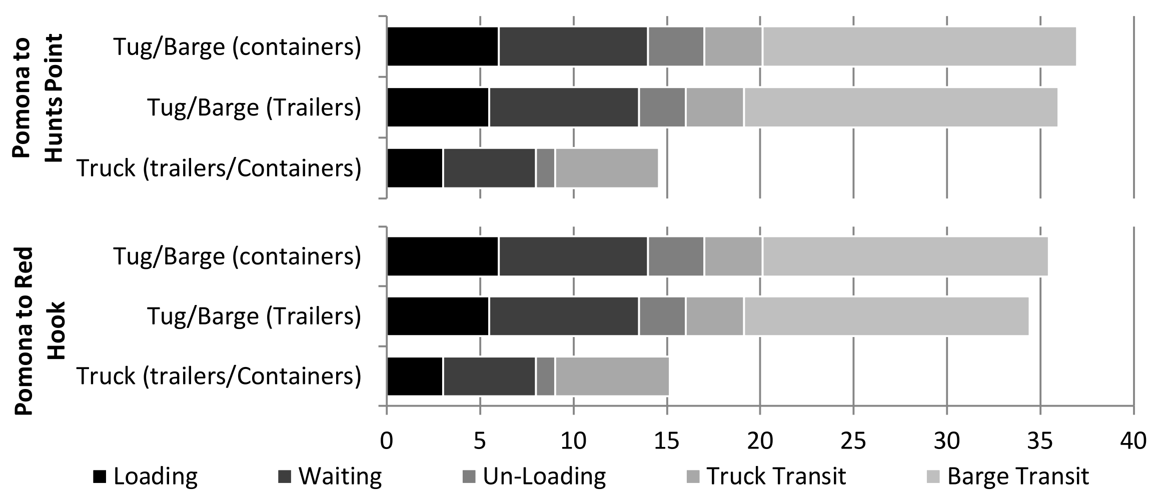

Figure 4: Transport Time Comparison

Energy Considerations

For this transportation mode evaluation, there are two primary sources of energy consumption, the prime mover (tractor or tug) and the TRU/eTRU's operation. The prime mover consumes energy, in the form of diesel fuel, to transport the product and when idling. The TRU consumes energy, also in the form of diesel fuel, to cool the produce storage. If an eTRU is utilized, a portion of the diesel fuel consumption can be offset with electricity when the trailer is stationary and grid power is available. The breakdown of the calculated energy consumptions figures for the locations presented earlier is shown in Figure 5.

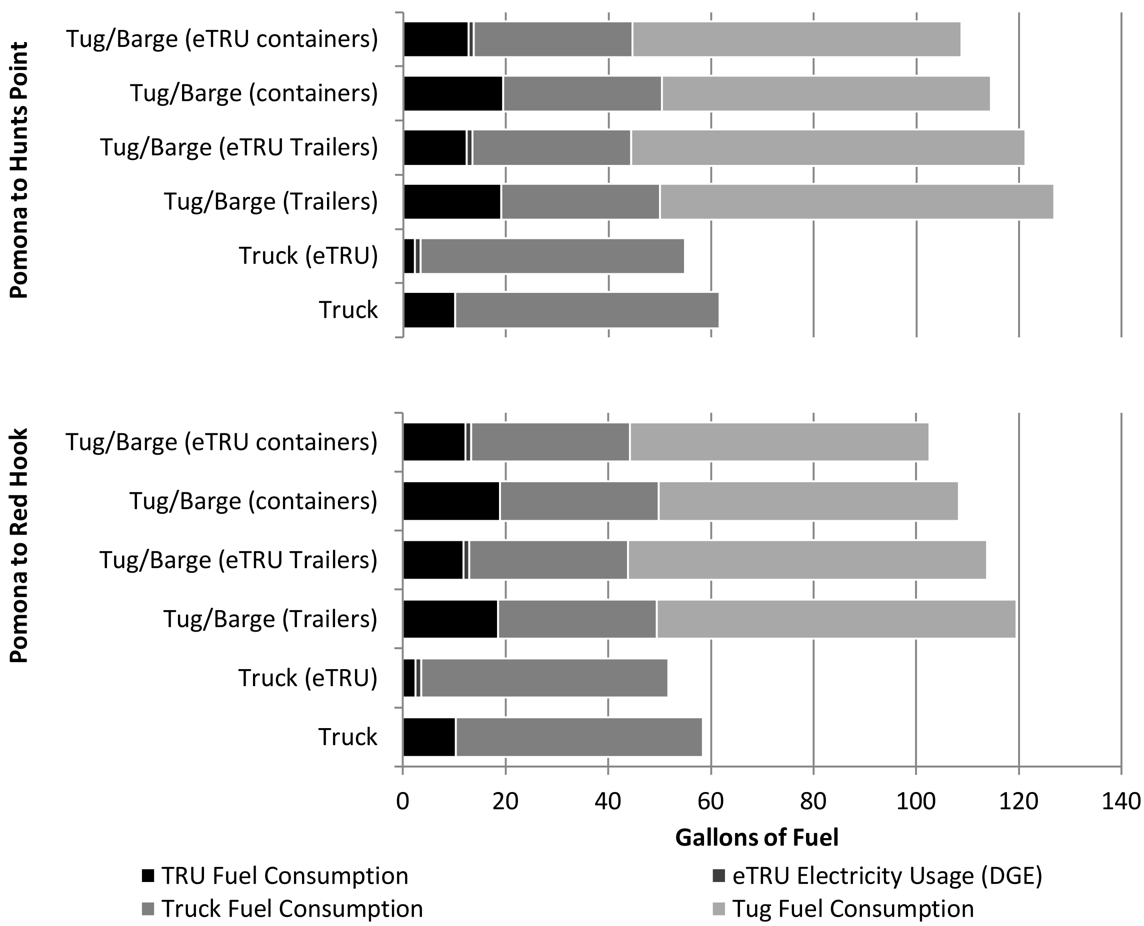

Figure 5: Transportation Energy Consumption Comparison

Cost Considerations

The economics of transporting produce includes many variables such as vehicle maintenance, labor, licensing, and energy use. However, because of the scope of this evaluation, only the costs associated with energy are analyzed. Energy costs result directly from the amount of energy consumed; however, electricity and diesel energy cost differ which results in a variation of total cost depending on the quantity of each consumed. Total transportation costs for one trailer/two containers to be transported one way are shown in Figure 6.

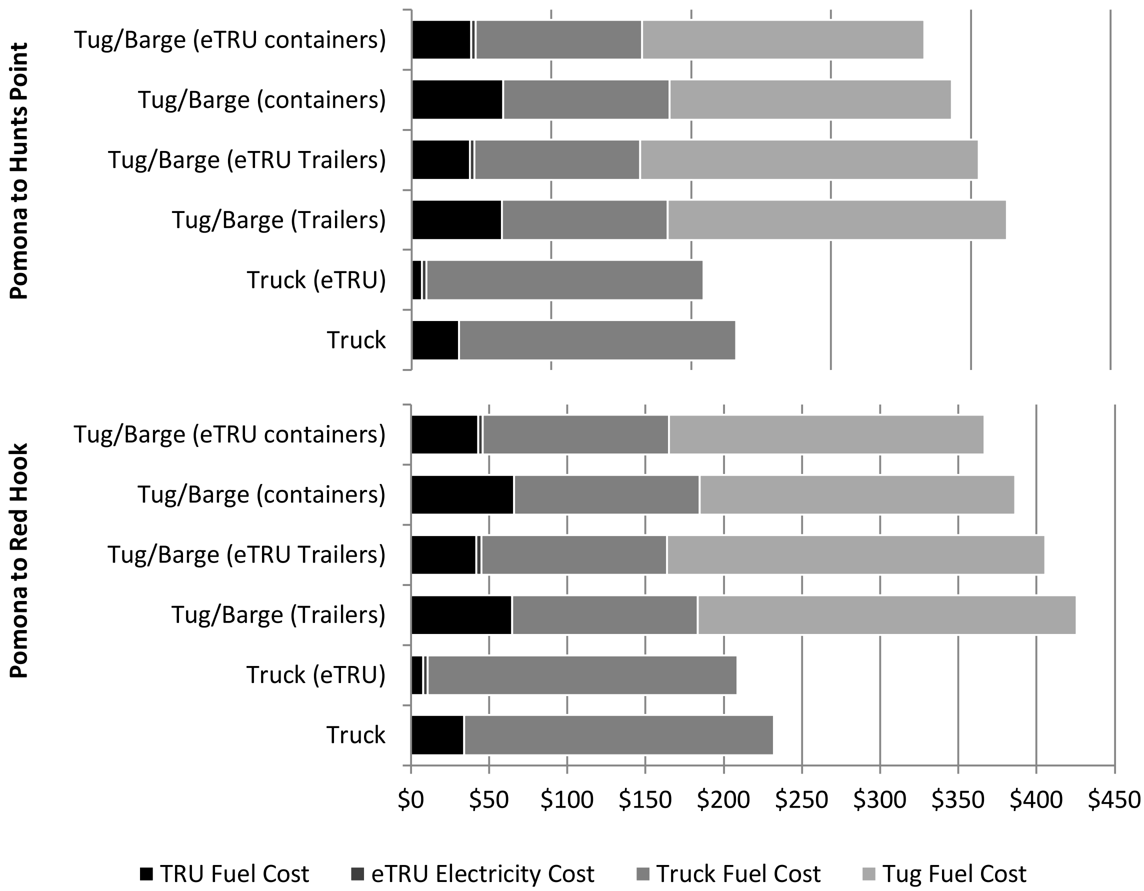

Figure 6: Transport Cost Comparison

Emissions Considerations

Emissions created from the transport of produce within NYS are also dependent on the amount of energy required to transport produce and maintain the produce's temperature during transit. Because of the efficiency of electricity generation and the significant renewable resources (mostly hydro sourced) found within NYS, the emission factors for electricity are significantly lower when utilizing electricity as opposed to diesel fuel. Emission savings due to electric eTRU operation, in all of the criteria emissions including CO, NOX, PM, and CO2, can be seen in Table 1. This table was created with emission factors for each mode of transportation and average electricity emission factors for NYS.

Table 1: Total Transport Emissions Produced (kg)

		CO	NOX	PM	CO2
Pomona to Hunts Point	Truck	1.16	6.30	0.160	575
	Truck (eTRU)	1.12	6.06	0.152	544
	Tug/Barge (Trailers)	2.99	25.92	0.662	1,298
	Tug/Barge (eTRU Trailers)	2.88	25.31	0.641	1,223
	Tug/Barge (containers)	2.65	22.53	0.578	1,174
	Tug/Barge (eTRU containers)	2.39	20.33	0.517	1,035
Pomona to Red Hook	Truck	1.10	5.94	0.151	543
	Truck (eTRU)	1.05	5.69	0.143	512
	Tug/Barge (Trailers)	2.80	24.03	0.615	1,223
	Tug/Barge (eTRU Trailers)	2.69	23.42	0.593	1,148
	Tug/Barge (containers)	2.49	20.94	0.538	1,110
	Tug/Barge (eTRU containers)	2.39	20.33	0.517	1,035

4. CONCLUSIONS

As clearly demonstrated with the analysis results shown above, the concept of using a tug and barge operation to offset truck traffic coming from Pomona Packing in Wolcott, NY to NYC would not be feasible under current operations in terms of time, energy consumption & cost, and associated emissions. The two primary reasons behind this lack of feasibility for this application include the selected origin point and volume of produce. Because the most direct route used to transport produce by truck from Pomona Packing to Hunts Point or Red Hook does not coincide with Albany, the route to the barge is not much shorter than the direct route to NYC. Without significant enough fuel savings during the trucking portion of the trip, the efficiency of the tug and barge operation cannot offset sufficient fuel to become competitive. The volume of trailers transported during each trip down the Hudson by the tug and barge is also not fully optimizing the potential of marine transportation. As a general rule, the efficiency of marine transportation increases with the volume/weight of product transported. The inherent efficiency of this mode arises from the fact that the propulsor (the tugboat in this case) consumes fuel at a predominately fixed rate, largely independent of small cargo variations. As an example, a barge loaded with fifty (50) trailers uses only slightly more fuel per mile than a barge loaded with ten (10) trailers to transport. While increasing load size may decrease the fuel mileage of the tug itself (on a miles per gallon basis), the efficiency of the entire transport unit significantly increases (on a ton-miles per gallon basis).

Assuming a location was chosen that requires trucks to travel directly past Albany (such as Northern and Eastern-Central NY), the viability of the tug and barge operation would be significantly increased dependent on the volume of trailers that could be transported per trip. As shown in Figure 7, a minimum of thirty-five (35) trailers per trip would be required to provide fuel savings over direct trucking (cost and emissions percent savings would be similar as well). This graphic takes into account the time required to load each trailer, which results in the flattening of the curve due to refrigeration system fuel usage during increased loading times. The data shown is figured for refrigerated trailers, utilizing diesel refrigeration units (TRUs), being transported from Albany to Hunts Point only. However, this data would also hold true for the same portion of the trip which would include a variety of origin points in Northern NYS and Eastern-Central NY.

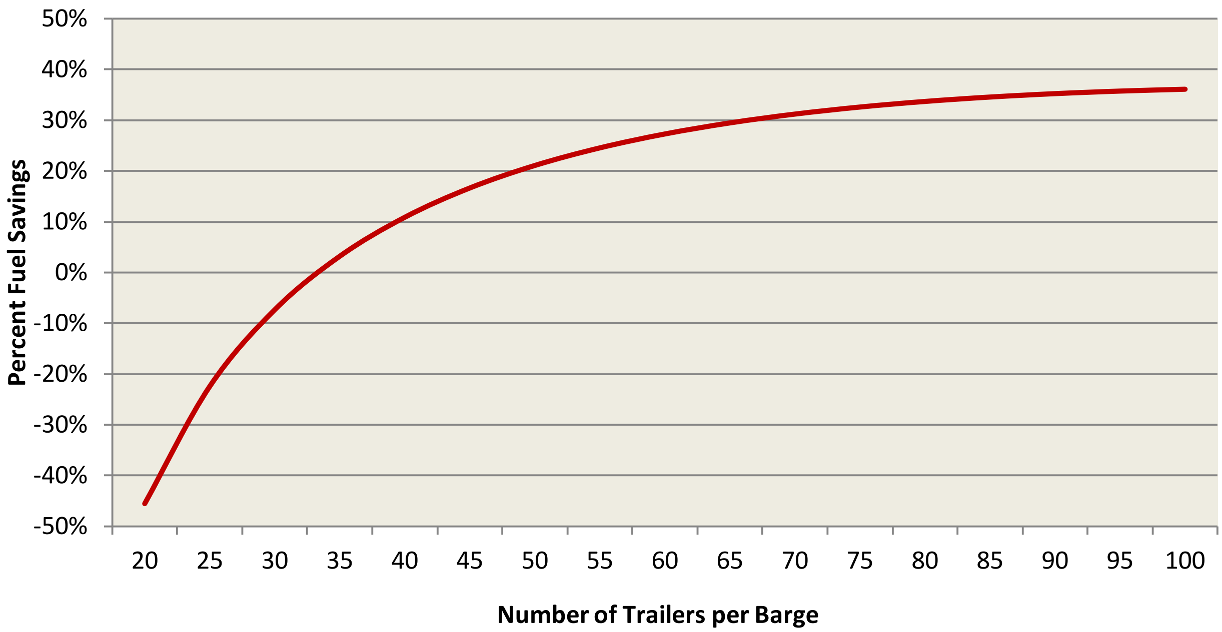

Figure 7: Tug/Barge Fuel Savings from Albany to Hunts Point

A further study that would include in-depth analysis of markets (multiple products & regions), logistics (transportation companies), infrastructures (loading/unloading & eTRU Plug-In) and back-hauling (via barge & trucking) could provide real and improved results to support the intended goals of this project, the demonstration and implementation of waterborne transportation of Upstate NY agricultural products on the Hudson River to NYC.