FTA ALTERNATIVES ANALYSIS
DRAFT/FINAL ENVIRONMENTAL IMPACT STATEMENT

DANBURY BRANCH IMPROVEMENT PROGRAM TASK 5

ENVIRONMENTAL TECHNICAL MEMORANDUM IMPACTS ANALYSIS

STATE PROJECT 302-008



SECTION 4: ENERGY

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This section details the impacts of the Danbury Branch rail system alternatives on energy consumption. Existing energy usage associated with operations on the Danbury Branch primarily includes diesel fuel to power trains and electricity utilized to operate stations (lighting, heating, cooling, etc.). Based upon the Alternatives being considered, future energy usage may include diesel fuel and/or electricity to power trains as well as electrical usage for passenger stations. Electrical energy will also be consumed by the signal system and at maintenance yards; however, there will not be a significant difference from current energy usage based upon the improvements included in each alternative. Additional local bus service will be provided with Alternative B, anticipating using vehicles that utilize diesel fuel. With improvements, some auto trips are expected to be eliminated as commuters and others increase their use of transit as a substitute for their personal vehicles.

METHODOLOGY

To assess changes in energy consumption associated with the project, energy use for each of the alternatives is compared to current use. For comparison purposes, energy use is discussed in terms of Vehicle Miles Traveled (VMT) and British Thermal Units (BTUs). VMT is defined as: number of trips per week x route length x number of weeks. BTUs are a standardized unit of energy consumption. Data relative to fuel and energy consumption by trains for current and future locomotives (diesel and electric) that was developed for this study is presented in the "Train Simulation Report for Alternatives." To estimate the annual energy use for all stations along the corridor, the monthly electricity use at one representative station, Bethel Station, was examined. The Connecticut Light and Power (CL&P) billing statement provided by the Connecticut Department of Transportation (CTDOT) Office of Rails for the Bethel Station was reviewed.

The measure of energy consumption was calculated using several assumptions including:

- Trains run 365 days per year (52 weeks per year).
- Locomotive types include GE Genesis (diesel), Brookville BL20GH (diesel) and electric multiple unit (EMU) cars with no model specified (electric).
- The average diesel fuel consumption rate for the total MNR locomotive fleet is two gallons per mile.
- Bus types utilized in Alternative B would be diesel-fueled El Dorado Aerotech and Startrans "Senator" body-on-chassis.
- The average diesel fuel consumption rate for the buses is 10 miles per gallon (0.1 gallons per mile).
- Buses operate 255 days per year.

Additional energy consumption would be associated with construction of improvements and long-term maintenance of planned updated and/or new facilities. The construction-related fuel expenditure is a one-time irretrievable commitment of energy resources. Maintenance-related fuel expenditures include activities such as snow and trash removal at stations, sediment removal

from drainage structures, and activities associated with the general upkeep of rails, ballast, and ties. These are irretrievable commitments of energy inherent to the operation of the Danbury Branch for all study alternatives.

IMPACTS

Energy consumption associated with the Danbury Branch train service and station facilities under the study alternatives is assessed below and summarized in Table 1.

There are no anticipated impacts on regional power supply infrastructure from any of the alternatives. In view of the construction of facilities to supply railroad traction power at the Peaceable Street substation in Ridgefield in the 1970s and their continued retention and 115 Kv and 345 Kv transmission lines in the study corridor, Northeast Utilities/CL&P, which supplies electrical power in southwest Connecticut, is anticipated to have capacity in their electric service infrastructure to accommodate alternatives that include Traction Power System (TPS).

Alternative A - No Build

Under Alternative A, the existing weekday train schedule would be maintained to include 11 trains that travel in each direction for a total of 22 trips per day or 110 trips per five-day work week. The existing weekend train schedule would continue to include six trains that travel in each direction for a total of 12 trips per day or 24 trips per weekend. The total trips traveled on this line during a seven-day week are 134 trips. One trip from South Norwalk to Danbury is 23.5 miles and trains operate 52 weeks per year. The estimated VMT is 134 trips/week x 23.5 miles/trip x 52 weeks/year for a total of 163,748 VMT per year.

Diesel locomotives would continue to be used to operate trains on the line. Fuel consumption is calculated by multiplying the VMT per year by the diesel fuel consumption rate of two gallons per mile. The 163,748 VMT would result in and estimated 327,496 gallons of diesel fuel consumed per year. Using a conversion of 141,000 BTUs per gallon of diesel fuel, the estimated energy consumed by the Danbury Branch trains under Alternative A would be 46.2 billion BTUs per year.

The No Build Alternative has eight stations: the seven existing stations plus the proposed Georgetown Station. The existing stations along the Danbury Branch are; Merritt 7, Wilton, Cannondale, Branchville, Redding, Bethel, and Danbury. To estimate the annual energy use for all stations along the corridor, the monthly electricity use at Bethel Station was reviewed. The monthly electricity use averages approximately 250 kilowatt hours (KWH) for the Bethel station. This monthly electricity use was applied to all eight existing stations, with annual station energy use thus calculated by the following equation: 12 (months) x 8 (stations) x 250 KWH = 24,000 KWH (annual electricity use for all stations). Using a conversion factor of 3,412BTUs per KWH of electricity, the energy consumed by the existing Danbury Branch railroad stations would be approximately 81.9 million BTUs per year.

Alternative B - Transportation System Management (TSM)

Under Alternative B, the weekday train schedule would include 13 trains that travel in each direction for a total of 26 trips per day or 130 trips per five-day work week. The weekend train schedule would include 10 trains that travel in each direction for a total of 20 trips per day or 40 trips per weekend. The total trips traveled on this line during a seven-day week would be 170 trips. One trip from South Norwalk to Danbury is 23.5 miles, and trains operate 52 weeks per year. The estimated VMT is 170 trips/week x 23.5 miles/trip x 52 weeks/year for a total of 207,740 VMT per year.

Diesel locomotives would continue to be used to operate trains on the line. Fuel consumption is calculated by multiplying the VMT per year by the diesel fuel consumption rate of two gallons per mile. The 207,740 VMT would result in 415,480 gallons of diesel fuel consumed per year. Using a conversion of 141,000 BTUs per gallon of diesel fuel, the energy consumed by the Danbury Branch trains under Alternative B is estimated at 58.6 billion BTUs per year.

Additional bus service is also included in this Alternative, which would add diesel fuel usage to the energy consumption. Buses would make 10 trips per day from Danbury to New Milford, which is 36 miles roundtrip. Buses operate 255 days per year for a total of 91,800 miles per year. The buses have an average fuel consumption rate of 10 miles per gallon for a total diesel fuel consumption of 9,180 gallons per year. Using a conversion of 141,000 BTUs per gallon of diesel fuel, the energy consumed by the Danbury Branch additional buses under Alternative B is estimated at 1.3 billion BTUs per year.

The total energy consumption under Alternative B, including train and bus service increases, is approximately 59.9 billion BTUs per year. Under Alternative B, there is a 30% increase in fuel consumed to power trains and buses compared to Alternative A. This increase is due to the additional bus and train service.

The electricity utilized at the eight existing stations would be the same as for Alternative A, since no new stations or station improvements are included in Alternative B. Thus, station energy use is estimated at 81.9 million BTUs per year.

Alternative C - South Norwalk to Danbury Improvements

Under Alternative C, the weekday train schedule would include 21 trains that travel in each direction for a total of 42 trips per day or 210 trips per five-day work week. The weekend train schedule would include 10 trains that travel in each direction for a total of 20 trips per day or 40 trips per weekend. The total trips traveled on this line during a seven-day week would be 250 trips. One trip from South Norwalk to Danbury is 23.5 miles and trains operate 52 weeks per year. The estimated VMT for Alternative C would therefore be 250 trips/week x 23.5 miles/trip x 52 weeks/year for a total of 305,500 VMT per year.

Alternative C would involve electrification of the line between South Norwalk and Danbury. Energy consumption associated with electric trains is calculated by multiplying the VMT per year by an average electrical energy consumption rate of 25.7 kilowatt hours (KWH) per mile. This consumption rate was calculated from electrical energy usage data in the Train Simulations. The 305,500 VMT per year results in 7,851,350 KWH of electricity consumed per year. Using a

conversion of 3,412 BTUs per KWH of electricity, the energy consumed by the Danbury Branch trains under Alternative C would be approximately 26.8 billion BTUs per year. There is a savings in energy consumption by the use of electric trains as shown in Table 1. The 26.8 billion BTUs per year consumed under Alternative C is 42% lower than Alternative A even though the number of trips increase from 134 under Alternative A to 250 under Alternative C. This energy savings is attributed to the use of electric equipment, which consumes less energy than diesel locomotives.

Under this alternative, five (Merritt 7, Cannondale, Branchville, Redding, and Bethel) of the eight existing stations from Norwalk to Danbury would be improved Upgrades at each station site will vary and may include new high level platforms with canopies, new passenger waiting areas, new or expanded surface parking lots, and new pedestrian overpasses, among others. All planned infrastructure improvements would require some amount of electrical energy for illumination and/or other requirements. It was assumed that the energy demand would be approximately 20% higher for these improved stations than the energy demand at existing stations. Thus, to determine annual electricity usage for all corridor stations under this alternative, the following equation was used: [(300 KWH x 5 upgraded stations) + (250 KWH x 3 existing stations)] x 12 months = 27,000 KWH per year. Using a conversion factor of 3,412 BTUs per KWH of electricity, the energy consumed by the existing Danbury Branch Line railroad stations would be approximately 92.1 million BTUs per year.

Alternative D - Extension from Danbury to New Milford

Under Alternative D, the weekday train schedule would include 21 trains that travel in each direction for a total of 42 trips per day or 210 trips per five-day work week. The weekend train schedule would include 10 trains that travel in each direction for a total of 20 trips per day or 40 trips per weekend. The total trips traveled on this line during a seven-day week would be 250 trips. One trip from Danbury to New Milford is approximately 15 miles, and trains operate 52 weeks per year. The estimated VMT for this alternative is 250 trips/week x 15 miles/trip x 52 weeks/year for a total of 195,000 VMT per year.

One option under Alternative D is to run all electric service (EMUs). The other option is to use all diesel locomotives. Calculations were performed separately for the two options. For electric locomotives, fuel consumption is calculated by multiplying the annual VMT by an average electrical energy consumption rate of 21.4 KWH per mile, which was calculated from data in the Train Simulations. The 195,000 VMT result in 4,173,000 KWH of electricity consumed per year. Using a conversion of 3,412 BTUs per KWH of electricity, the energy consumed by the Danbury Branch Line trains from Danbury to New Milford under Alternative D (electrical) would be approximately 14.2 billion BTUs per year. The 14.2 billion BTUs per year consumed under the electric version of Alternative D is 69% lower than Alternative A.

For diesel fuel locomotives, diesel fuel consumption is calculated by multiplying the annual VMT by the diesel fuel consumption rate of two gallons per mile. The 195,000 VMT result in 390,000 gallons of diesel fuel consumed per year. Using a conversion of 141,000 BTUs per gallon of diesel fuel, the energy consumed by the Danbury Branch Line trains from Danbury to New Milford under Alternative D (diesel) would be approximately 55 billion BTUs per year.

The 55 billion BTUs per year consumed under the diesel version of Alternative D is 19% greater than the consumption under Alternative A.

There would be a reduction in energy consumption with the use of electric trains instead of diesel trains. For the same VMT, the diesel equipment would consume 3.9 times more energy than the electric equipment. This would result in the consumption of an additional 440.8 billion BTUs per year with diesel train operation.

Under this alternative, two new railroad stations are included between Danbury and New Milford. Electrical energy use at the two new stations is calculated by the following formula: 250 KWH x 2 (new stations) x 12 (months) = 6,000 KWH per year. Using a conversion factor of 3,412 BTUs per KWH of electricity, the energy consumed by the two new stations north of Danbury would be approximately 20.5 million BTUs per year.

Alternative E - Improvements from South Norwalk to Wilton

Under Alternative E, south of Wilton the weekday train schedule would include 21 trains in each direction for a total of 42 trips per day or 210 trips per five-day work week. The weekend train schedule would include 10 trains in each direction for a total of 20 trips per day or 40 trips per weekend. The total trips traveled on this section during a seven-day week would be 250 trips. Between Wilton and Danbury, the weekday train schedule would include 13 trains in each direction for a total of 26 trips per day or 130 trips per five-day work week. The weekend train schedule would include 10 trains in each direction for a total of 20 trips per day or 40 trips per weekend. The total trips traveled on this section during a seven-day week would be 170 trips.

Alternative E includes electric service with EMUs that would operate from South Norwalk to Wilton and diesel locomotives that would operate from Wilton to Danbury. One trip from South Norwalk to Wilton is 7.5 miles, and trains operate 52 weeks per year. The estimated VMT is therefore calculated as 250 trips/week x 7.5 miles/trip x 52 weeks/year for a total of 97,500 VMT per year.

The trip from Wilton to Danbury is 16 miles, and trains operate 52 weeks per year. The estimated annual VMT is calculated as 170 trips/week x 16 miles/trip x 52 weeks/year for a total of 141,440 VMT per year.

Energy consumption associated with electric trains is calculated by multiplying the VMT per year by an average electrical energy consumption rate of 22.9 KWH per mile, which was calculated from data in the Train Simulations. The 97,500 VMT from South Norwalk to Wilton result in 2,232,750 KWH of electricity consumed per year. Using a conversion of 3,412 BTUs per KWH of electricity, the energy consumed by the Danbury Branch trains under Alternative E (electrical) would be approximately 7.6 billion BTUs per year.

Energy consumption from diesel trains is calculated by multiplying the VMT per year by the MNR diesel fuel consumption rate of two gallons per mile. The 141,440 VMT from Wilton to Danbury result in 282,880 gallons of diesel fuel consumed per year. Using a conversion of 141,000 BTUs per gallon of diesel fuel, the energy consumed by the Danbury Branch trains

under Alternative E (diesel) would be approximately 39.9 billion BTUs per year. The total energy usage for the combined electrical and diesel locomotives for Alternative E is therefore approximately 47.5 billion BTUs per year. The annual BTU consumption under Alternative E is 3% greater than the consumption under Alternative A.

Under this alternative, only one (Merritt 7) of the existing stations from Norwalk to Danbury would be improved. Upgrades at this station would include a new high level platform with canopy, new passenger waiting shelter, access stairs and ramps, a new surface parking lot and a new pedestrian overpass. It was assumed that the energy demand would be approximately 20% higher after improvements, for illumination and other station requirements. Thus, to determine annual electricity usage for all corridor stations under this alternative, the following equation was used: [(300 KWH x 1 upgraded station) + (250 KWH x 7 existing stations)] x 12 months = 24,600 KWH per year. Using a conversion factor of 3,412 BTUs per KWH of electricity, the energy consumed by the existing Danbury Branch railroad stations would be approximately 83.9 million BTUs per year.

Summary

Table 1 summarizes the results of the energy impact analysis. As evidenced in the energy calculations, electrification is a less-energy consumptive choice compared to diesel locomotives. Electrification of the existing line (Alternative C) could result in a 42% reduction in energy consumption compared to the No Build (Alternative A). This reduction would occur even with an increase of train service from the 134 trips per week (Alternative A) to 250 trips per week (Alternative C).

Alternative D provides a direct comparison of diesel versus electrification under the same train service schedule. Based on the estimated diesel locomotive consumption of 55 billion BTUs per year compared to electric locomotive consumption of 14.2 billion BTUs per year, electrical locomotives are shown to be approximately 74% more efficient.

Table 1: Energy Consumption per Danbury Branch Alternative

Alternative	Fuel Consumed to Operate Trains/Buses (Billion BTUs/Yr)	Change from No Build (%)	Change from No Build (Billion BTUs)	Energy Consumed at Stations (million BTUs/Yr)	Brief Description
A					
	46.2	N/A	N/A	81.9	All diesel locomotives
B					
	59.9	30 %	13.7	81.9	All diesel locomotives, increased number of trains, added bus service
C					
	26.8	-42 %	-19.4	92.1	All electric (EMUs). Station improvements assumed to require 20% more energy than unimproved stations.
D (Danbury to New Milford segment only)					
Diesel	55	119 %*	55		All diesel locomotives (no electric)
Electric	14.2	31 %*	14.2	20.5	All electric (no diesel)
E					
South Norwalk to Wilton	7.6	N/A	N/A		Electric (EMUs)
Wilton to Danbury	39.9	N/A	N/A		Diesel locomotives
Total	47.5	3 %	1.3	83.9	Total (electric and diesel)

* Increase resulting from only Alternative D as compared to Alternative A (No-Build); does not assume any changes in service from Norwalk to Danbury.