20. Energy

20.1. Chapter Overview

20.1.1. Introduction

The following assessment compares the direct and indirect energy expenditures associated with Light Rail to Tenafly (Preferred Alternative) and Light Rail to Englewood Route 4 in compliance with FTA Impact Analysis Regulations (23 CFR 771). Direct energy expenditure is the operational consumption of fuel by roadway and rail vehicles under each alternative, as well as energy consumed by facilities and ancillary elements. Indirect energy expenditure is the consumption of fuel required during construction activities. Alternatives must be compared for both the potential to recoup energy expended during construction (payback potential) and the potential for operational energy savings.

20.1.2. Summary of Findings

Currently, the existing Northern Branch rail right-of-way is not electrified and serves only diesel-powered freight trains. The operation of light rail vehicles under each Build Alternative would require the right-of-way to be electrified via the installation of overhead electric catenary along the alignment. As a result, the Build Alternatives would require electrical power supplied from the existing power grid. The existing power grid has a sufficient energy supply to support either Build Alternative.

The direct annual energy reduction associated with Light Rail to Tenafly (Preferred Alternative) would be 154.8 billion British Thermal Unit (BTU). The one-time indirect energy expenditure is estimated to be 349.6 billion BTU. This would yield a payback potential, which is a measure of the number of years it will take for the energy savings of a transit project to zero-out the energy costs associated with construction, of 2.3 years. The direct annual energy reduction associated with Light Rail to Englewood Route 4 is 112.7 billion BTU. The one-time indirect energy expenditure is estimated to be 288.1 billion BTU, with a payback potential of 2.7 years.

Accordingly, energy expenditures associated with the proposed project under either Build Alternative are not anticipated to result in energy consumption impacts or the disruption of energy services within the Northern Branch study area.

20.2. Methodology

The methodology for this analysis involved a comparison between the direct and indirect energy expenditures relative to each alternative. An overview of direct and indirect energy expenditure as well as payback potential follows.

The standard comparative measure for energy expenditure is the BTU. One BTU is the quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit. According to the U.S. Energy Information Administration, the annual statewide consumption of power from all energy sources in New Jersey is approximately 2,394 trillion BTU for the year 2009. The FTA National Transit Database 2009 data release indicates that NJ TRANSIT's annual energy consumption rate is 7.4 trillion BTU, or 0.31% of statewide consumption.

The calculation of direct energy expenditure takes into account the projected number of diversions of drivers to transit, the energy costs of transit service, and the energy costs of operating ancillary facilities. In this calculation, diverted drivers are a negative number and the other energy items are positive. According to *Transportation Energy Data Book, Edition 16, Oak Ridge National Laboratory, June, 2003,* one light rail vehicle uses 28,442 BTUs of energy to operate each vehicle mile traveled (VMT); one station site uses 175 million BTUs each year, and one Vehicle Base Facility (VBF) uses 8.7 billion BTUs each year. Ideally, an alternative would result in a negative change in energy expenditure indicating that the total energy needs of the area have decreased because people are using a more efficient means of transportation. This only works when enough drivers divert to transit, so an ideal energy expenditure depends in great part on ridership.

Indirect energy expenditure for rail transportation projects is calculated from data regarding the length and type of the proposed right-of-way. This is generally accomplished with reference to numeric BTU conversion factors for planned at-grade or elevated rights-of-way promulgated jointly by the Federal Highway Administration (FHWA) and the California Department of Transportation (Caltrans). BTU conversion factors have not been developed for gauging construction energy expenditures for rail facilities, including stations and operations and maintenance facilities, due to the diverse nature of such facilities. For this reason, indirect energy expenditure is not calculated for stations or yards.

Lastly, payback potential is typically measured in the number of years it will take for the energy savings associated with a transit project to zero-out the energy costs incurred during construction. Payback is only possible if an alternative has a negative direct energy expenditure, indicating that it is saving energy in each year of operation. Alternatives with positive direct energy expenditure would never pay back the energy costs of construction.

20.3. Environmental Review

The following sections discuss energy expenditure associated with each alternative in terms of the overall change in total energy expenditure in the region. For the purposes of the Build Alternative energy estimates, it was assumed that because freight rail service will continue to operate within the Northern Branch study area rights-of way, freight VMT is assumed to remain constant. Similarly, bus VMT has been assumed to remain constant under all of the Build Alternatives. For the purposes of this analysis, the energy analysis area was assessed at the project corridor level as potential energy expenditure was uniform across municipalities, and the analysis was performed as it relates to a change in energy usage, over existing conditions.

20.3.1. Existing Conditions

The surrounding communities are served by overhead electric distribution lines providing power to the existing residential, commercial, and industrial uses in the study area. As this is a comparative analysis of the Build Alternatives compared to the No Build Alternative, existing conditions have not been analyzed.

20.3.2. Potential Impacts and Mitigation

20.3.2.1. No Build Alternative

The No Build Alternative assumes that there would be no reduction in auto VMT or an increase in rail VMT. Additionally, no energy would be consumed to operate stations or the VBF. Therefore, there would be no change in BTU usage for the No Build Alternative.

20.3.2.2. Light Rail to Tenafly (Preferred Alternative)

Impacts – Due to the addition of 8,800 new daily transit trips to NJ TRANSIT’s commuter system, the Light Rail to Tenafly (Preferred Alternative) would cause a reduction of almost 34 million auto VMT annually, resulting in a reduction of 211.2 billion BTU. This light rail system would operate 1.6 million rail VMT annually (using 46.1 billion BTU); with nine stations (using 1.6 billion BTU); and one VBF (using 8.7 billion BTU); totaling approximately 56.4 billion BTU per year. When combined with the energy savings of the reduction in auto VMT, the Light Rail to Tenafly (Preferred Alternative) would save approximately 154.8 billion BTU per year.

Construction of the Light Rail to Tenafly (Preferred Alternative) would require approximately 21.2 miles of at-grade track (using 260.8 BTU) and 1.6 miles of structured track (using 88.8 BTU), resulting in the consumption of 349.6 billion BTU. Should the VBF be placed at Englewood Route 4 instead of North Bergen, 0.2 track miles less would be needed, reducing the consumption by 2.5 billion BTU to 347.1 billion BTU. The projected indirect energy expenditures are marginal when compared with overall statewide figures. The one-time indirect construction expenditure represents approximately 0.001 percent of annual statewide industrial energy consumption. Additionally, the indirect energy costs would be paid back due to the reduction in direct energy costs in approximately 2.3 years.

The Preferred Alternative would require traction power substations along the Northern Branch right-of-way to maintain the current necessary to power the light rail vehicles. As described in Chapter 3: Alternatives Considered, voltage drop occurs when electricity is passed over a long distance and occurs in all electrical applications. The requirement for substations is not an indicator that there is insufficient electrical power supply in the area.

Mitigation – Due to the small relative sizes of the projected one-time energy expenditure in comparison with overall statewide figures, the projected indirect expenditures are not considered significant. In addition, the energy savings anticipated to result from an annual reduction in the direct energy expenditure would payback the indirect energy expenditure in approximately 2.3 years. The existing power grid also contains enough supply to power Light Rail to Tenafly (Preferred Alternative). Therefore, no significant energy impacts are foreseen, and no mitigation is warranted.

20.3.2.3. Light Rail to Englewood Route 4

Impacts – Due to the addition of 6,600 new daily transit trips to NJ TRANSIT's commuter system, the Light Rail to Englewood Route 4 would cause a reduction of almost 25 million auto VMT annually, resulting in a reduction of 155.8 billion BTU. This light rail system would operate 1.2 million rail VMT annually (using 33.5 billion BTU); with five stations (using 0.9 billion BTU); and one VBF (using 8.7 billion BTU); totaling approximately 43.1 billion BTU per year. When combined with the energy savings of the reduction in auto VMT, the Light Rail to Route 4 would save approximately 112.7 billion BTU per year.

Construction of the Light Rail to Englewood Route 4 would require approximately 16.2 miles of at-grade track (using 199.3 BTU) and 1.6 miles of structured track (using 88.8 BTU), resulting in the consumption of 288.1 billion BTU. Should the VBF be placed at Englewood Route 4 instead of North Bergen, 0.2 track miles less would be needed, reducing the consumption by 2.5 billion BTU to 285.6 billion BTU. The projected indirect energy expenditures are marginal when compared with overall statewide figures. The one-time indirect construction expenditure represents approximately 0.001 percent of annual statewide industrial energy consumption. Additionally, the indirect energy costs would be paid back due to the reduction in direct energy costs in approximately 2.7 years.

The Preferred Alternative would require traction power substations along the Northern Branch right-of-way to maintain the current necessary to power the light rail vehicles. As described in Chapter 3: Alternatives Considered, voltage drop occurs when electricity is passed over a long distance and occurs in all electrical applications. The requirement for substations is not an indicator that there is insufficient electrical power supply in the area.

Mitigation – Due to the small relative sizes of the projected one-time energy expenditure in comparison with overall statewide figures, the projected indirect expenditures are not considered significant. In addition, the energy savings anticipated to result from an annual reduction in the direct energy expenditure would payback the indirect energy expenditure in approximately 2.6 years. The existing power grid also contains enough supply to power Light Rail to Englewood Route 4. Therefore, no significant energy impacts are foreseen, and no mitigation is warranted.

20.4. Summary of Potential Environmental Effects

A comparison of energy expenditures for Light Rail to Tenafly (Preferred Alternative) and Light Rail to Englewood Route 4 is provided below in Table 20-1. In terms of energy savings, Light Rail to Tenafly (Preferred Alternative) is more efficient than Light Rail to Englewood Route 4 with a payback potential of approximately 2.3 years. Energy consumption associated with the proposed project is not anticipated to result in a significant impact to the provision of energy services within the Northern Branch corridor as the existing power grid contains sufficient supply to accommodate the Build Alternatives under consideration. As such, no energy impacts are anticipated under either Build Alternative.

Table 20-1: Comparison of Alternatives (BTU in billions)

Mode	No Build	Light Rail to Tenafly (Preferred Alternative)	Light Rail to Englewood Route 4
Direct Energy Expenditure			
Auto	0	-211.2	-155.8
Rail	0	46.1	33.5
Stations	0	1.6	0.9
Yard	0	8.7	8.7
Total Direct Energy Expenditure	***0***	***-154.8***	***-112.7***
Indirect Energy Expenditure			
Track Miles – At-Grade	0	260.8	199.3
Track Miles – Structure	0	88.8	88.8
Total Indirect Energy Expenditure	***0***	***349.6***	***288.1***
Payback Potential	***n/a***	***2.3 years***	***2.7 years***

Notes: Direct energy expenditure (BTU): Auto 6,233, Light Rail 28,442/VMT, Station 175 million, and Yard 8.7 billion.
Energy Expenditure for Construction 12.3 BTU/Mile for At-Grade track; 55.5 BTU/Mile for track on structure (At-grade miles includes yard trackage.)
The option of constructing a VBF at Englewood Route 4 instead of North Bergen would subtract 0.2 track miles, resulting in the reduction of 11.1 billion BTU.

Source: Transportation Energy Data Book, Edition 16, Oak Ridge National Laboratory, June, 2003; Urban Transportation and Energy: The Potential Savings of Different Modes, Congressional Budget Office, September, 1977; NJ TRANSIT, 2010; Jacobs, 2010.