

3.7 AIR QUALITY AND ENERGY

3.7.1 Air Quality

3.7.1.1 Introduction to Analysis

The purpose of the air quality analysis is to determine the potential impacts of the No Action Alternative and Build Alternative on air quality in the Denver metropolitan area. The following sections document the study methodology, analyses performed, results, and impacts to conformity and State Implementation Plan (SIP) status.

Summary of Results

The Build Alternative is in compliance with the regional transportation conformity requirements and would not cause any long-term adverse regional air quality impacts. Short-term impacts would result from temporary construction activities, and localized or indirect impacts associated with the project would have an affect on air quality; however, neither the short-term nor long-term impacts would exceed applicable standards.

Based on VMT projections for 2015 and 2030, the annual regional criteria pollutant emissions of concern for DMU and EMU would decrease for either DMU or EMU in 2015 and 2030 for the Build Alternative as compared to the No Action Alternative. The implementation of either the DMU or EMU Build Alternative would not result in exceedances of the National Ambient Air Quality Standards (NAAQS) for carbon monoxide (CO) at the station park-n-Rides or critical intersections.

The Mobile Source Air Toxic (MSAT) levels for the DMU Build Alternative would be higher than the EMU Build Alternative due to the emissions from the diesel vehicles. However, for the study area, overall future MSATs are expected to be substantially lower than today due to implementation of the USEPA's vehicle and fuel regulations. Finally, for greenhouse gas (GHG) emissions in 2030, the EMU Build Alternative results in a decrease in GHG emissions and the DMU Build Alternative results in a negligible increase compared to the No Action Alternative.

Short-term impacts to air quality would result from equipment emissions during site preparation and construction activities such as clearing, grading, excavation, and demolition. These activities involve the use of heavy-duty off-road diesel and gasoline-powered equipment that would generate emissions from air pollutants such as oxides of nitrogen (NO_x), particulate matter less than 10 microns in diameter (PM₁₀), particulate matter less than 2.5 microns in diameter (PM_{2.5}), sulfur dioxide (SO₂), and volatile organic compounds (VOCs). Fugitive dust would be generated from earth-moving activities, such as grading and excavating, and from traveling on temporary, unpaved roads.

The rail operations associated with the CRMF Fox North Site, a connected action, are included in the FastTracks Program and are accounted for within each individual commuter rail corridor. Emissions of criteria pollutants from the CRMF are not anticipated to cause significant impacts to air quality. The CRMF would not cause new violations of the 1-hour or 8-hour CO NAAQS in future years. MSAT emission levels would be similar for the CRMF and No Action Alternative. At the Fox North Site, removing the emissions associated with the existing facilities would partially offset the emissions from the proposed project operation. Construction emissions would be temporary and are not anticipated to cause any air quality violations.

Relevant Law

Federal and State Air Quality Standards

The United States Environmental Protection Agency (USEPA) has established NAAQS for six criteria pollutants to protect the public from the adverse health effects associated with air pollution. These six criteria pollutants are CO, ground-level ozone (O₃), NO_x, SO₂, particulate matter (PM₁₀, PM_{2.5}), and lead.

Air Quality Conformity

Section 176(c) of the Clean Air Act of 1990 (CAA) and related requirements of the SAFETEA-LU and the FTA require that transportation plans, programs, and projects that are developed, funded, or approved by the USDOT and by metropolitan planning organizations or other recipients of funds under SAFETEA-LU or the FTA, must demonstrate and assure conformity of such activities to the applicable SIP. These conformity regulations were developed to ensure that transportation plans, programs, and projects would not jeopardize attainment of NAAQS.

The North Metro Corridor Project is included in the *Metro Vision 2030 Plan* (DRCOG 2006a), the *Metro Vision 2035 Plan*, as amended (DRCOG 2009), and the *2007-2012 TIP* (DRCOG 2006b). Therefore, the North Metro Corridor Project is part of a fiscally-constrained long-range plan, for which both regional and local conformity has been demonstrated, including that this project will not cause or contribute to any new violation of the air quality standard, increase the frequency or severity of any existing violation of any standard, or delay timely attainment of any standard.

3.7.1.2 Affected Environment

Criteria Pollutants

The criteria pollutants of concern for transportation projects are PM₁₀, CO, and O₃ because these are pollutants for which Denver has been classified as either a nonattainment or maintenance area. O₃ is not emitted directly into the air, but is formed through chemical reactions between the precursor emissions of VOCs and NO_x in the presence of sunlight. O₃ is the major component of smog. PM₁₀ is particulate matter less than 10 microns in diameter. The concentration of a pollutant in the atmosphere depends on the amount of pollutant released, the nature of the source, and the ability of the atmosphere to transport and disperse the pollutant. The North Metro corridor is located in a broad valley along the South Platte River, within the six-county Denver metropolitan area. The terrain to the east of the region is dominated by gently rolling plains, while the Front Range foothills of the Rocky Mountains are to the west, trapping pollutants and elevating ambient air concentrations.

Based on air quality monitoring data, regions are designated as having either “attainment” or “nonattainment” status for the criteria pollutants based on the NAAQS. Nonattainment status means that a region is not compliant with NAAQS. Once a nonattainment area achieves compliance with the NAAQS, the area is considered an air quality “attainment/maintenance” area until the standard has been maintained for 10 years and a long-term maintenance plan has been approved by the USEPA. The Denver metropolitan area is designated as attainment/maintenance for CO and PM₁₀, and nonattainment for the 8-hour O₃ standard. The USEPA designated the Denver metropolitan and North Front Range area as nonattainment on 20 November 2007, due to high readings in July 2007, resulting in a 3-year (2005 to 2007) monitored value of 0.085 parts per million at one monitor (Rocky Flats North), which violated the

8-hour O₃ NAAQS. Currently, the 2008 O₃ standard has been lowered to 0.075 parts per million.

In September 2008, the Colorado Department of Public Health and Environment (CDPHE) released a revision to the *Denver Metro Area and North Front Range Ozone Action Plan* (2008a) with a goal to reduce O₃ levels in the Denver/Northern Front Range area by 2010. A detailed SIP to reduce O₃ has been developed by the CDPHE Air Pollution Control Division (APCD), along with the Regional Air Quality Council, DRCOG, and the North Front Range Metropolitan Planning Organization. This attainment plan was submitted to USEPA for review by 1 July 2009.

The CDPHE APCD operates air quality monitoring stations in Denver and Adams County. There have been no exceedances of NAAQS at the nearest air quality stations. A summary of the monitoring values for 2007 and the NAAQS standards for a representative monitoring station in the study area is shown in Table 3.7-1.

TABLE 3.7-1. AMBIENT AIR QUALITY VALUES

Pollutant	Averaging Time	National and State Standards	Welby Monitoring Station (2007)
CO	1-hour	35 ppm	3.0 ppm
	8-hour	9 ppm	2.1 ppm
PM ₁₀	24-hour	150 µg/m ³	78 µg/m ³
	Annual	50 µg/m ³	29.9 µg/m ³
PM _{2.5}	24-hour	35 µg/m ³	29.1 ¹ µg/m ³
	Annual	15 µg/m ³	9.84 ¹ µg/m ³
NO _x	Annual	0.053 ppm	0.0206 ppm
SO ₂	3-hour	0.5 ppm	0.018 ppm
	24-hour	0.14 ppm	0.005 ppm
	Annual	0.03 ppm	0.0019 ppm
O ₃	1-hour	None	0.09 ppm
	8-hour	0.075 ² ppm	0.07 ppm

Source: CDPHE, 2007.

Notes:

¹The 2007 PM_{2.5} values are representative of the CAMP Monitoring Station located at 2105 Broadway in Denver, Colorado.

²The 2008 standard.

The Welby Monitoring Station is located at 3174 East 78th Avenue in Commerce City, Colorado. This station was selected because it monitors the most pollutants of the stations in the North Metro corridor study area and because of its central location.

µg/m³ = micrograms per cubic meter

CO = carbon monoxide

NO_x = oxides of nitrogen

O₃ = ozone

PM_{2.5} = particulate matter less than 2.5 microns in diameter

PM₁₀ = particulate matter less than 10 microns in diameter

ppm = parts per million

SO₂ = sulfur dioxide

According to the CDPHE emission inventories for Denver County and Adams County, the major sources of particulate matter in the Denver metropolitan area are construction, road dust, and stationary sources (see Table 3.7-2).

TABLE 3.7-2. DENVER COUNTY AND ADAMS COUNTY PM₁₀ EMISSIONS FOR 2006

County	Three Highest Emission Categories (tpy) (Percent of Total)			Total Tons of PM ₁₀ per Year
	Construction	Road Dust	Stationary Sources	
Adams	2,674 (18%)	3,944 (27%)	2,870 (19%)	14,807
Denver	3,613 (47%)	2,308 (30%)	580 (8%)	7,711

Source: CDPHE, 2008b.

Notes:

% = percent

PM₁₀ = particulate matter less than 10 microns in diameter

tpy = tons per year

Nationally, PM₁₀ levels have been decreasing over the past 30 years (CDPHE 2007). The overall levels of this pollutant in the Northern Front Range have been fairly constant since 1997 (CDPHE 2007).

Mobile Source Air Toxics

In addition to the criteria air pollutants for which there are NAAQS, USEPA also regulates air toxics. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (such as trains), area sources (such as dry cleaners), and stationary sources (such as factories or refineries).

MSATs are a subset of the 188 air toxics defined by the CAA. MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline.

The USEPA has not yet issued guidance or regulations establishing unsafe levels for MSATs; however, the USEPA does develop and refine cancer and non-cancer health benchmarks for MSATs, which serve as guidelines for evaluating their effects.

USEPA's national emission control programs are projected to reduce MSAT emissions by 60 to 80% by 2030. These programs include the use of reformulated gasoline, the national low emission vehicle program, and stricter standards for passenger vehicles. Additional programs include the drastic reduction of allowable sulfur content in diesel fuel from 500 parts per million to 15 parts per million by 31 December 2009; more stringent emission standards and emission control requirements for new on-road diesel vehicles which started in 2007; and more stringent Tier 2 emission standards for new locomotives.

Although local conditions may differ from the national reduction projections due to area-specific conditions such as VMT growth projections, vehicle fleet mix (trucks versus passenger

vehicles), vehicle turnover, and local emission control requirements, the anticipated effectiveness of the USEPA's emission control requirements is likely to outweigh these local conditions. Therefore, the MSAT emissions in the study area are likely to be lower in the future.

Greenhouse Gases and Climate Change

Carbon dioxide (CO₂) emissions constitute around 80% of all GHGs. In 2005, the last year covered, CO₂ emissions represented 83.9% of the total GHG emissions (CDPHE 2008b). The main source of man-made CO₂ emissions is fossil-fuel combustion, which accounts for approximately 70% to 90% of all man-made CO₂ emissions. Fossil-fuel combustion is used mostly in energy production, transportation, heating, and industry.

3.7.1.3 Impact Evaluation

Methodology

Direct Impacts

Regional Criteria Pollutants

Direct impacts are evaluated by multiplying the annual VMT for each alternative scenario by the emission factors generated by the CDPHE APCD using the USEPA MOBILE 6.2 model to determine the emissions (in tons per year) for the No Action Alternative and Build Alternative, for DMU and EMU, and for 2015 and 2030. Coordination activities to date are documented in Chapter 6, Public Comment and Agency Coordination. The project team will continue to coordinate with CDPHE through the USEPA process.

The status of current air quality levels and their relationship to the Colorado SIP was documented for each pollutant of concern. Also, the current (2008) air quality conditions were assessed on a corridor level in the North Metro corridor study area to determine the relative change in emissions between the No Action Alternative and the Build Alternative.

The regional air quality impacts of the North Metro Corridor Project are based on the comparison of the No Action Alternative to the Build Alternative for the commencement of operation (2015) and the horizon year (2030), in conformance with the DRCOG *Metro Vision 2030 Plan* (2006a).

Direct Operational Emissions

There are no direct emissions for EMU technology. The pollutants of consideration for DMU technology direct emissions are CO, NO_x, VOCs, PM₁₀, and PM_{2.5}. These pollutants are evaluated for the 2015 and 2030 No Action Alternative and Build Alternative.

Mobile Source Air Toxics

FHWA's "Interim Guidance Update on Mobile Source Air Toxic Analysis in USEPA Documents" (30 September 2009) presents a tiered approach for analyzing MSATs based on the project type. No analysis is needed for projects with no potential for meaningful MSAT effects. The next level of analysis is a qualitative analysis for projects with low potential MSAT effects. This qualitative approach has been applied for this project. Although a qualitative analysis cannot identify and measure health impacts from MSATs, it can give a basis for identifying and comparing potential differences of MSAT emissions among alternatives. The qualitative approach is based on VMT and vehicle type analysis.

Indirect Impacts

The methodology for assessing indirect impacts relates to the introduction of traffic at the station park-n-Rides and changes at traffic intersections, as well as GHG emissions.

Intersection Carbon Monoxide Hot Spot

Carbon monoxide “hot spot” modeling was completed for intersections selected by CDOT for the No Action Alternative and Build Alternative during the a.m. and p.m. peak-hours for years 2015 and 2030. CDOT selected three intersections with a Level of Service (LOS) of D or worse. LOS is a rating of intersection congestion designated using a letter from A to F, with LOS A being the best operating condition and LOS F being the worst operating condition.

The USEPA's CAL3QHC computer model was used for hot spot analysis. CAL3QHC is a computer-based modeling program that predicts CO concentrations from motor vehicles at roadway intersections. The CAL3QHC model accounts for emissions from both moving and idling vehicles. Inputs for the model included projected traffic volumes, motor vehicle emission rates calculated using USEPA MOBILE 6.2, roadway geometry, traffic signal timing, and worst-case meteorological conditions.

Parking Facility Carbon Monoxide Analysis

Localized CO impacts were evaluated by assessing new station parking areas. The worst-case stations were selected based on the parking lot size and the vehicle volume during peak hours. Worst-case CO impacts occur when large numbers of vehicles are entering or leaving the parking facility at the same time and when the emissions are concentrated within a relatively small area. This includes vehicles parking at the lot as well as buses transporting passengers to and from the park-n-Ride. Carbon monoxide emissions from the parking facilities were analyzed for the 104th Avenue Station and 162nd Avenue Station, the worst-case stations in 2015 and 2030, using USEPA's SCREEN 3 air-dispersion model. The maximum CO concentrations due to vehicle traffic were combined with CO background concentrations within the North Metro corridor study area and compared to the NAAQS.

Greenhouse Gases

Carbon dioxide production is used as a surrogate for GHG emissions in the North Metro analysis.

Greenhouse gas emissions were calculated by multiplying the energy use by the CO₂ conversion factors taken from the New Starts criteria. New Starts is the term used by the FTA for the process of funding major new fixed-guideway transit facilities such as LRT lines, BRT, commuter rail, or heavy rail transit. The conversion factors were:

- Bus (compressed natural gas [CNG]) = 0.0585
- LRT and commuter rail (electric) = 0.0665
- Passenger vehicle = 0.0765
- Heavy-duty vehicle (truck) and bus (diesel) = 0.0788
- Commuter rail (diesel) = 0.2364 (based on three heavy-duty vehicles)

Temporary Construction Impacts

Emissions of fugitive dust (PM₁₀) during the construction phase of the Build Alternative were estimated using the emissions factor from the URBEMIS 2007 model developed by the Air Resources Board of the State of California (URBEMIS 2007). The URBEMIS 2007 model average fugitive dust emission factor of 10 pounds per acre of disturbed area per day was used to estimate the emissions. The total area disturbed for the North Metro Corridor Project was assumed to be approximately 310 acres, which included all new rail stations and parking lots. It was assumed that the maximum acreage disturbed per day would be approximately 31 acres, likely over a 2-mile area.

Results

Both the No Action Alternative and the Build Alternative would result in short-term (construction) and localized or indirect long-term related impacts; however, neither alternative would result in exceedances of applicable regulatory standards.

No Action Alternative

The No Action Alternative presumes that other funded transportation projects would proceed, including construction of the proposed Gold Line and East corridor transit improvements, the CRMF, and improvement projects identified in the DRCOG *Metro Vision 2030 Plan* (2006a), the DRCOG *2007-2012 TIP* (2006b), and local jurisdiction CIPs.

Direct Impacts

Regional Criteria Pollutants

Based on VMT projections for 2015 and 2030 and emission factors provided by CDPHE, the annual regional criteria pollutant emissions for the No Action Alternative are shown in Table 3.7-3.

TABLE 3.7-3. ANNUAL REGIONAL EMISSIONS FOR THE NO ACTION ALTERNATIVE

Emissions	Year 2015 (tpy)	Year 2030 (tpy)
CO	268,634.5	295,952.7
NO _x	16,793.5	10,345.7
PM ₁₀	18,571.0	25,233.5
VOCs	17,403.7	14,094.7

Source: North Metro Corridor Project Team, 2008.

Notes:

- CO = carbon monoxide
- NO_x = oxides of nitrogen
- PM₁₀ = particulate matter less than 10 microns in diameter
- tpy = tons per year
- VOC = volatile organic compound

Mobile Source Air Toxics

As noted in the Methodology subsection, a qualitative approach is being used for MSAT analysis. Therefore, the No Action Alternative is compared to the Build Alternative in the Build Alternative subsection below.

Indirect Impacts

Intersection Carbon Monoxide Hot Spot Analysis

The three worst-case intersections identified in consultation with CDOT were analyzed for the CO hot spot analysis. Table 3.7-4 and Table 3.7-5 show modeled background concentrations in 2015 and 2030 for the No Action Alternative for the CO hot spot analysis. The model is not sensitive enough to differentiate CO concentration differences for relatively minor changes in traffic volumes, so those estimates are very similar or the same for 2015 and 2030.

TABLE 3.7-4. CARBON MONOXIDE HOT SPOT ANALYSIS RESULTS FOR THE NO ACTION ALTERNATIVE, 2015

CO Scenario	Concentration (ppm)					
	Colorado Boulevard and 104 th Avenue		US 6/US 85 and 69 th Avenue		69 th Avenue and Dahlia Street	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
1-hour ¹	8.97	9.19	6.03	6.71	5.69	5.24
8-hour ²	5.83	5.96	4.16	4.55	3.97	3.71

Source: North Metro Corridor Project Team, 2008.

Notes:

¹ The 1-hour maximum for CO is 35 ppm. The 1-hour background concentration is 4 ppm (APCD).

² The 8-hour maximum for CO is 9 ppm. The 8-hour background concentration is 3 ppm (APCD).

A.M. = morning

APCD = Air Pollution Control Division

CO = carbon monoxide

P.M. = evening

ppm = parts per million

US # = United States Highway #

TABLE 3.7-5. CARBON MONOXIDE HOT SPOT ANALYSIS RESULTS FOR THE NO ACTION ALTERNATIVE, 2030

CO Scenario	Concentration (ppm)					
	Colorado Boulevard and 104 th Avenue		US 6/US 85 and 69 th Avenue		69 th Avenue and Dahlia Street	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
1-hour ¹	8.86	9.08	6.03	6.83	5.69	5.24
8-hour ²	5.77	5.89	4.16	4.61	3.97	3.71

Source: North Metro Corridor Project Team, 2008.

Notes:

¹ The 1-hour maximum for CO is 35 ppm. The 1-hour background concentration is 4 ppm (APCD).

² The 8-hour maximum for CO is 9 ppm. The 8-hour background concentration is 3 ppm (APCD).

A.M. = morning

APCD = Air Pollution Control Division

CO = carbon monoxide

P.M. = evening

ppm = parts per million

US # = United States Highway #

Parking Facility Carbon Monoxide Analysis

Since no park-n-Rides would be built in the project area as part of the No Action Alternative, a parking facility CO analysis was not undertaken.

Greenhouse Gas Emissions

Carbon dioxide production is used as a surrogate for GHG emissions in the North Metro analysis. Table 3.7-6 shows the tons of CO₂ produced per year within the Denver region for the No Action Alternative.

TABLE 3.7-6. CARBON DIOXIDE PRODUCED FOR THE NO ACTION ALTERNATIVE, 2015 AND 2030

	Year 2015	Year 2030
CO ₂ Produced per Year (in million tons)	12,369,070,010.0	16,665,652.5

Source: North Metro Corridor Project Team, 2008.

Note:

CO₂ = carbon dioxide

Temporary Construction Impacts

The construction of the projects that are part of the No Action Alternative would result in fugitive dust emissions, estimated as PM₁₀. The construction emissions would be temporary and are not anticipated to cause any air quality violations. The PM₁₀ analysis for stations associated with other FasTracks projects would be completed as part of the project-specific environmental analysis for each of those projects.

Cumulative Impacts

Air quality trends from the 1960s, when ambient air monitoring began in the Denver metropolitan area to today, show that most pollution emission controls and programs instituted as a result of the CAA and its amendments have been successful in reducing criteria pollutant levels (RTD 2007). Future mobile source pollutant emissions of CO, NO_x, PM₁₀, PM_{2.5}, SO₂, lead, and MSATs are expected to continue to decline as a result of new low-sulfur fuel requirements, stricter retrofit and engine exhaust emission controls, and engine efficiency improvements.

As discussed previously, Colorado is in non-attainment for O₃, and CDPHE is working to reduce O₃ levels by 2010 to prevent further air quality deterioration.

Build Alternative

Direct Impacts

Regional Criteria Pollutants

Based on VMT projections for 2015 and 2030 and emission factors provided by CDPHE, the annual regional criteria pollutant emissions for DMU and EMU are estimated in Table 3.7-7. Annual regional emissions would decrease for either DMU or EMU in 2015 and 2030 for the Build Alternative as compared to the No Action Alternative.

TABLE 3.7-7. ANNUAL REGIONAL EMISSIONS FOR THE BUILD ALTERNATIVE — DMU AND EMU

Emissions	DMU		EMU	
	Year 2015 (tpy)	Year 2030 (tpy)	Year 2015 (tpy)	Year 2030 (tpy)
CO	267,491.0	295,701.7	267,451.1	295,687.9
NO _x	16,784.5	10,337.0	16,782.0	10,336.5
PM ₁₀	18,561.0	25,212.1	18,558.3	25,210.9
VOCs	17,394.3	14,082.7	17,391.7	14,082.1

Source: North Metro Corridor Project Team, 2008.

Notes:

- CO = carbon monoxide
 DMU = diesel multiple unit
 EMU = electric multiple unit
 NO_x = oxides of nitrogen
 PM₁₀ = particulate matter less than 10 microns in diameter
 tpy = tons per year
 VOC = volatile organic compound

Direct Operational Emissions

There are no direct emissions for EMU because it has an electric power supply provided by power plants located remotely from the North Metro corridor study area. The emissions resulting from the No Action Alternative and Build Alternative with DMU technology are summarized in Table 3.7-8. The results show that in both 2015 and 2030, emissions would be higher with the Build Alternative with DMU technology than with the No Action Alternative.

TABLE 3.7-8. DMU EMISSIONS FOR THE NO ACTION ALTERNATIVE AND BUILD ALTERNATIVE, 2015 AND 2030

Emissions	Year 2015		Year 2030	
	No Action Alternative (tpy)	Build Alternative (tpy)	No Action Alternative (tpy)	Build Alternative (tpy)
CO	1.6	2.7	1.6	2.7
NO _x	2.0	3.4	2.0	3.4
PM ₁₀	0.2	0.3	0.2	0.3
VOCs	1.3	2.2	1.3	2.2

Source: North Metro Corridor Project Team, 2008.

Notes:

- CO = carbon monoxide
 DMU = diesel multiple unit
 NO_x = oxides of nitrogen
 PM₁₀ = particulate matter less than 10 microns in diameter
 tpy = tons per year
 VOC = volatile organic compound

Mobile Source Air Toxics

Based on the regional VMT analysis, the EMU Build Alternative would result in a small reduction in VMT in 2030 compared to the No Action Alternative, and therefore should result in an equivalent reduction in MSAT emissions, assuming the vehicle mix is similar. Although the VMT for the DMU Build Alternative would be similar to the EMU Build Alternative, the DMU vehicle

would have emissions, including diesel particulate matter, whereas the EMU vehicle would have no emissions. Therefore, the MSAT levels for the DMU Build Alternative would be higher than the EMU Build Alternative.

For the DMU Build Alternative, there may be localized areas within the vicinity of the commuter rail corridor where ambient concentrations of MSATs would be higher than the No Action Alternative or EMU Build Alternative (e.g., in non-industrial areas). However, the magnitude and the duration of the potential increases cannot be reliably quantified for project-specific MSAT health impacts. For the study area, overall future MSATs are expected to be substantially lower than today due to implementation of the USEPA’s vehicle and fuel regulations.

For the Build Alternative with DMU and EMU technology and the No Action Alternative in 2030, emissions are likely to be lower than present levels as a result of the USEPA’s national control programs that are projected to reduce annual MSAT emissions by 72% from 1999 to 2050. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the USEPA-projected reduction is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in the future than they are today.

Indirect Impacts

Intersection Carbon Monoxide Hot Spot Analysis

The three worst-case intersections identified in consultation with CDOT were analyzed for the CO hot spot analysis. The 1-hour and 8-hour CO Build Alternative results are presented in Table 3.7-9 and Table 3.7-10 for DMU or EMU in 2015 and 2030, respectively. In 2015, the Colorado Boulevard and 104th Avenue intersection would have slightly higher CO concentrations from the Build Alternative. However, in 2030, similar to the other intersections, the modeled CO concentrations for the Build Alternative are the same as the No Action Alternative. This is likely due to the small percentage of the station traffic relative to the overall volume of traffic at these intersections. Based on the results of the CO analysis, the Build Alternative would not result in a violation of the CO standards in either year.

TABLE 3.7-9. CARBON MONOXIDE HOT SPOT ANALYSIS RESULTS FOR THE BUILD ALTERNATIVE, 2015

Alignment	Station	Concentration (ppm)					
		Colorado Boulevard and 104 th Avenue		US 6/US 85 and 69 th Avenue		69 th Avenue and Dahlia Street	
		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
1-hour CO Scenario¹							
Southern Section — DUS Access to 84th Avenue							
A-3 and B-4	68 th Avenue	NA	NA	6.03	6.83	5.69	5.24
A-3, B-2, B-3, and B-4	72 nd Avenue South	NA	NA	6.03	6.83	5.69	5.24
Northern Section — 84th Avenue to 162nd Avenue Area							
Alignment	104 th Avenue	9.08	9.54	NA	NA	NA	NA

TABLE 3.7-9. CARBON MONOXIDE HOT SPOT ANALYSIS RESULTS FOR THE BUILD ALTERNATIVE, 2015

Alignment	Station	Concentration (ppm)					
		Colorado Boulevard and 104 th Avenue		US 6/US 85 and 69 th Avenue		69 th Avenue and Dahlia Street	
		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
8-hour CO Scenario²							
Southern Section — DUS Access to 84th Avenue							
A-3 and B-4	68 th Avenue	NA	NA	4.16	4.61	3.97	3.71
A-3, B-2, B-3, and B-4	72 nd Avenue South	NA	NA	4.16	4.61	3.97	3.71
Northern Section — 84th Avenue to 162nd Avenue Area							
Alignment	104 th Avenue	5.89	6.16	NA	NA	NA	NA

Source: North Metro Corridor Project Team, 2008.

Notes:

¹ The 1-hour maximum for CO is 35 ppm. The 1-hour background concentration is 4 ppm (APCD).² The 8-hour maximum for CO is 9 ppm. The 8-hour background concentration is 3 ppm (APCD).

A.M. = morning

APCD = Air Pollution Control Division

CO = carbon monoxide

DUS = Denver Union Station

NA = not applicable

P.M. = evening

ppm = parts per million

US # = United States Highway #

TABLE 3.7-10. CARBON MONOXIDE HOT SPOT ANALYSIS RESULTS FOR THE BUILD ALTERNATIVE, 2030

Alignment	Station	Concentration (ppm)					
		Colorado Boulevard and 104 th Avenue		US 6/US 85 and 69 th Avenue		69 th Avenue and Dahlia Street	
		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
1-hour CO Scenario¹							
Southern Section — DUS Access to 84th Avenue							
A-3 and B-4	68 th Avenue	NA	NA	6.03	6.83	5.69	5.24
A-3, B-2, B-3, and B-4	72 nd Avenue South	NA	NA	6.03	6.83	5.69	5.24
Northern Section — 84th Avenue to 162nd Avenue Area							
Alignment	104 th Avenue	8.86	9.08	NA	NA	NA	NA
8-hour CO Scenario²							
Southern Section — DUS Access to 84th Avenue							
A-3 and B-4	68 th Avenue	NA	NA	4.16	4.61	3.97	3.71
A-3, B-2, B-3, and B-4	72 nd Avenue South	NA	NA	4.16	4.61	3.97	3.71

TABLE 3.7-10. CARBON MONOXIDE HOT SPOT ANALYSIS RESULTS FOR THE BUILD ALTERNATIVE, 2030

Alignment	Station	Concentration (ppm)					
		Colorado Boulevard and 104 th Avenue		US 6/US 85 and 69 th Avenue		69 th Avenue and Dahlia Street	
		A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
Northern Section — 84th Avenue to 162nd Avenue Area							
Alignment	104 th Avenue	5.77	5.89	NA	NA	NA	NA

Source: North Metro Corridor Project Team, 2008.

Notes:

¹ The 1-hour maximum for CO is 35 ppm. The 1-hour background concentration is 4 ppm (APCD).

² The 8-hour maximum for CO is 9 ppm. The 8-hour background concentration is 3 ppm (APCD).

- A.M. = morning
- APCD = Air Pollution Control Division
- CO = carbon monoxide
- DUS = Denver Union Station
- NA = not applicable
- P.M. = evening
- ppm = parts per million
- US # = United States Highway #

Parking Facility Carbon Monoxide Analysis

As shown in Table 3.7-11, the maximum 1-hour and 8-hour CO concentrations in the vicinity of the 104th Avenue Station or 162nd Avenue Station would be below the NAAQS. These are the two largest stations for the North Metro corridor, and the CO analysis results presented here represent the worst-case CO impacts. These impacts would be the same for DMU or EMU.

TABLE 3.7-11. MAXIMUM PREDICTED CARBON MONOXIDE CONCENTRATIONS FOR THE BUILD ALTERNATIVE

Station	Averaging Time	Maximum Concentration Increase (ppm)	Maximum Background Concentration ¹ (ppm)	Total CO Concentration ² (ppm)	NAAQS (ppm)
104 th Avenue (2015)	1-hour	0.619	8.7	9.319	35
	8-hour	0.433	4.4	4.833	9
162 nd Avenue (2030)	1-hour	0.862	8.7	9.562	35
	8-hour	0.603	4.4	5.003	9

Source: North Metro Corridor Project Team, 2008; Wells, 2008.

Notes:

¹Background concentrations are the maximum concentrations observed between 2004 to 2007 at the CAMP Station located at 2015 Broadway Street in Denver, Colorado.

²Total CO concentration was calculated by adding the maximum concentration increase (ppm) with the maximum background concentration (ppm).

- CO = carbon monoxide
- NAAQS = National Ambient Air Quality Standards
- ppm = parts per million

Greenhouse Gas Emissions

Table 3.7-12 shows that in both 2015 and 2030, the Build Alternative with DMU technology would produce slightly more CO₂ than the No Action Alternative within the Denver region. Although there is a reduction in VMT for passenger vehicles for the DMU Build Alternative compared to the No Action Alternative, there is an increase in VMT for heavy-duty vehicles, diesel buses, and DMU vehicles that emit CO₂. Therefore, the CO₂ emission reductions gained from the reduction in VMT for passenger vehicles is offset and the total CO₂ emissions are higher for the DMU Build Alternative than the No Action Alternative in 2015. In 2030, the VMT for heavy-duty vehicles is similar for the No Action Alternative and Build Alternative, so the 2030 increase in CO₂ associated with the DMU Build Alternative is negligible.

TABLE 3.7-12. CARBON DIOXIDE PRODUCED FOR THE NO ACTION ALTERNATIVE AND BUILD ALTERNATIVE WITH DMU TECHNOLOGY, 2015 AND 2030

	Year 2015		Year 2030	
	No Action Alternative	Build Alternative	No Action Alternative	Build Alternative
CO ₂ Produced per Year (in million tons)	12,369,070.0	12,380,854.3	16,665,652.5	16,665,968.9
Difference from the No Action Alternative (in million tons)	NA	11,784.3	NA	3,164
Percent Difference	NA	0.0953	NA	0.0019

Source: North Metro Corridor Project Team, 2008.

Notes:

- CO₂ = carbon dioxide
- DMU = diesel multiple unit
- NA = not applicable

Table 3.7-13 shows that in 2015, the Build Alternative with EMU technology would produce slightly more CO₂ than the No Action Alternative. Although there is a reduction in VMT for passenger vehicles for the EMU Build Alternative compared to the No Action Alternative, there is an increase in VMT for heavy-duty vehicles, diesel buses, and DMU vehicles (outside the North Metro corridor) that emit CO₂. Therefore, the CO₂ emission reductions gained from the reduction in VMT for passenger vehicles is offset and the total CO₂ emissions are higher for the EMU Build Alternative than the No Action Alternative in 2015. However, the increase in CO₂ emissions for the EMU Build Alternative is less than the DMU Build Alternative in 2015 because without the DMU vehicles in the North Metro corridor, there are fewer DMU vehicles on the FasTracks system. Although no direct GHG emissions are produced by the EMUs, the indirect emissions associated with the EMU vehicle occur at the power plant. These emissions are small enough to be accounted for in the results presented below.

In 2030, although there is an increase in VMT for diesel buses, the VMT for heavy-duty vehicles is similar for the No Action Alternative and Build Alternative. There are no DMU vehicles in the North Metro corridor for the EMU Build Alternative. Therefore the reduction in VMT for passenger vehicles compared to the No Action Alternative results in an overall net reduction in CO₂ in 2030 for the EMU Build Alternative.

TABLE 3.7-13. CARBON DIOXIDE PRODUCED FOR THE NO ACTION ALTERNATIVE AND BUILD ALTERNATIVE WITH EMU TECHNOLOGY, 2015 AND 2030

	Year 2015		Year 2030	
	No Action Alternative	Build Alternative	No Action Alternative	Build Alternative
CO ₂ Produced per Year (in million tons)	12,369,070.0	12,373,695.9	16,665,652.5	16,659,795.7
Difference from the No Action Alternative (in million tons)	NA	4,625.9	NA	-5,856.8
Percent Difference	NA	0.0373	NA	0.0351

Source: North Metro Corridor Project Team, 2008.

Notes:

- CO₂ = carbon dioxide
- EMU = electric multiple unit
- NA = not applicable

Temporary Construction Impacts

The fugitive dust emissions, estimated PM₁₀, associated with construction of the proposed project would be 310 pounds per day, based on the assumption that the maximum disturbed area would be 31 acres per day. The construction emissions would be temporary and are not anticipated to cause any air quality violations.

Connection Action – CRMF Fox North Site

As described below, the CRMF would result in no violations of existing or proposed NAAQS during operation or construction.

Direct Impacts

Transportation Conformity

The CRMF is a support facility for the FasTracks commuter rail projects listed in the most recently approved *Metro Vision 2030 Plan* (DRCOG 2006a), and is thus consistent with the plan. Therefore, it satisfies the regional transportation conformity requirements and is not expected to cause any violations of the air quality standards.

Criteria Pollutants Analysis

The estimated emissions of the CRMF would be much lower for PM₁₀ and PM_{2.5} compared to the No Action Alternative and existing conditions. Emissions of VOCs from the CRMF would be slightly higher than the No Action Alternative but are lower when compared to the existing condition.

The CRMF NO_x and CO emissions, would be higher than the existing condition and the No Action Alternative, due to the in-yard DMU operations and the increase in worker commutes to the facility in future years. However, ambient CO concentrations near the facility are far below the NAAQS, and the slight increase of emissions from the CRMF is not expected to exceed CO standards.

CO Hot Spot Analysis

There are no existing or projected air quality problems associated with CO hot spots at the proposed CRMF site. The LOS at the only signalized intersection near the proposed site (53rd Avenue and Bannock Street) would not change when comparing the No Action Alternative

and existing conditions. Because the intersection is projected to operate at LOS C or better, a hot-spot analysis is not required.

PM₁₀ Hot Spot Analysis

Due to more stringent future emission standards and the removal of existing facilities from the Fox North Site, the PM₁₀ emissions in 2015 and 2030 for the CRMF would be much lower than those in 2005 (existing condition) and the No Action Alternative. The CRMF PM₁₀ emissions would be less than 6% of the existing PM₁₀ emissions from the current site condition. Since PM₁₀ standards have not been exceeded at the site over the past 3 years, a 94% reduction of these emissions would result in no violations of future standards with implementation of the CRMF.

Mobile Source Air Toxics

The MSAT analysis was completed in two geographic areas. The Tier 1 Study Area represented the specific MSAT impacts at the CRMF site, while the Tier 2 Study Area represented the local impacts in the adjacent neighborhoods (Chaffee Park, Sunnyside, Globeville, and part of unincorporated Adams County).

Tier 1 Study Area Analysis. According to the *Commuter Rail Maintenance Facility Supplemental Environmental Assessment to FasTracks Commuter Rail Corridors* (FTA and RTD 2009), the CRMF MSAT emissions would be higher compared to the existing conditions and the No Action Alternative due to an increase in worker commutes and the in-yard DMU operations. It may also be due to an underestimate of emissions under existing conditions and the No Action Alternative. The only MSAT emissions included for the existing facility operation were from worker commutes. Other MSAT emissions, such as those from the delivery trucks associated with the existing facilities operation, were not included due to lack of information. Considering the information available, it can be reasonably assumed that MSAT emission levels would be similar for the CRMF and the No Action Alternative.

Tier 2 Study Area Analysis. According to the *Commuter Rail Maintenance Facility Supplemental Environmental Assessment to FasTracks Commuter Rail Corridors* (FTA and RTD 2009), MSAT emissions are similar to the No Action Alternative for 2015 and 2030, in the Tier 2 Study Area. Due to stricter USEPA emission standards, MSAT emissions are predicted to be significantly lower in the future years than under existing conditions.

Greenhouse Gas Emissions

As a supporting component to the FasTracks Program, the impacts of the CRMF are analogous to the conclusions presented above under the Build Alternative.

Indirect Impacts

The placement of the CRMF at the Fox North Site is not anticipated to attract new development or result in land uses changes. Therefore, there would be no indirect impacts to air quality.

Temporary Construction Impacts

According to the *Commuter Rail Maintenance Facility Supplemental Environmental Assessment to FasTracks Commuter Rail Corridors* (FTA and RTD 2009), the emissions of fugitive dust (PM₁₀) during the construction phase of the facility were estimated by using the emissions factor from the URBEMIS2007 model. The fugitive dust emissions (estimated as PM₁₀) associated with construction of the CRMF would be 100 pounds per day, based on the assumption that the maximum disturbed area would be 10 acres per day. There would also be emissions of other criteria pollutants associated with the engine exhaust from construction equipment and vehicles.

The construction emissions would be temporary and are not anticipated to cause any air quality violations.

Cumulative Impacts

The cumulative air quality impacts for the Build Alternative have already been accounted for in the regional modeling, because the model assumes the construction of the entire *FasTracks Plan* and major roadway projects for the next 20 years. In general, the *FasTracks Plan* would not result in any additional air quality impacts and would reduce the dependence on passenger vehicles for travel, lowering overall pollutant level emissions. This reduction would be partially offset by emissions from new transit vehicle emissions (RTD 2007).

3.7.1.4 Mitigation

Mitigation measures for the Build Alternative are summarized in Table 3.7-14.

TABLE 3.7-14. PROPOSED MITIGATION MEASURES — AIR QUALITY

Impact	Impact Type	Mitigation Measures
Air Emissions	Construction	<ul style="list-style-type: none"> • RTD will include language in the construction specifications that will require all construction equipment be equipped to be in accordance with USEPA requirements. • Water or wetting agents to manage dust will be used. • Wind barriers and wind screens will be used to minimize the spreading of dust in areas where large amounts of materials are stored. • A wheel wash station and/or large-diameter cobble apron will be used at egress/ingress areas to minimize dirt being tracked onto public streets. • Vacuum-powered street sweepers will be used to control dirt tracked onto streets. • All dump trucks leaving the site will be covered. • Temporary excavated materials will be covered or wetted. • A binding agent for long-term excavated materials will be used. • For winter construction, engine pre-heater devices will be installed to eliminate unnecessary idling. • Tampering with equipment to increase horsepower or to defeat the effectiveness of emission control devices will be prohibited. • Construction vehicle engines will be required to be properly tuned and maintained. • Construction vehicles and equipment with the minimum practical engine size for the intended jobs will be utilized.

Source: North Metro Corridor Project Team, 2008.

Notes:

RTD = Regional Transportation District

USEPA = United States Environmental Protection Agency

3.7.2 Energy

3.7.2.1 Introduction to Analysis

This section describes the estimated energy that would be consumed, primarily in the form of petroleum fuels and electricity, to construct and operate the Build Alternative or implement the No Action Alternative.

Summary of Results

The Build Alternative options (DMU and EMU) result in slightly less direct energy consumption in 2030 than the No Action Alternative. Compared to the regional total, the difference would be small (less than 1.0%), and most of the energy savings would occur within the North Metro corridor study area.

The most likely indirect impact of the North Metro rail line would be TOD in the vicinity of the stations. TOD areas have higher-density development, which generally results in lower energy-consumption rates. The Build Alternative with either technology has high potential for TOD and, thus, has better (i.e., fewer) indirect impacts compared to the No Action Alternative.

Energy consumed during the construction of the Build Alternative with either technology, which includes all projects under the No Action Alternative, is expected to be 1,905,004 (DMU) to 2,129,930 (EMU) million British thermal units (BTUs). The total North Metro rail line portion of that is 525,090 (DMU) to 750,016 (EMU) million BTUs, approximately 28% (DMU) to 35% (EMU) of the total construction energy consumption.

At the CRMF Fox North Site, a connected action, the two largest demands on energy would be from the movement of the commuter rail vehicles and the operation of the buildings. The CRMF would have no indirect energy impacts. Energy would be required to construct the buildings associated with the new facility. The impacts would occur under either the CRMF or the No Action Alternative scenarios. If the CRMF were not constructed at the Fox North Site, it would be constructed at an alternate location.

Relevant Law

The North Metro Corridor Project energy consumption does not fall under specific regulations (e.g., TIFIA does not provide specific guidance on energy consumption for transportation projects); however, RTD recognizes the importance of decreasing energy consumption in the transportation sector and seeks to encourage ridership on public transportation through the FasTracks Program. In addition, 40 CFR 1502.16(e) includes energy as a topic for which to analyze environmental consequences under USEPA.

3.7.2.2 Affected Environment

Energy sources for transportation are most commonly petroleum fuels for automobiles, trucks, buses, and trains, and electricity for electrified transit. Currently, approximately 90% of RTD buses operate on diesel fuel and 10% on CNG. The existing RTD transit system does not include any commuter rail facilities. The current LRT fleet operates on electric power purchased from Xcel Energy (Xcel).

Xcel currently operates ten power plants in Colorado that are supplemented by two wind farms and numerous hydroelectric facilities (Xcel 2007). Throughout their eight-state operating region, Xcel produces approximately 75% of the power it provides to its customers, and purchases the other 25% through long- and short-term contracts with other energy companies.

In 2006, the power supplied by Xcel, on a system-wide basis, was from four primary sources (Xcel 2006):

- Low-sulfur western coal (45%)
- Nuclear (10%)
- Oil and gas (38%)
- Renewable sources (solar, wind, hydroelectric, refuse-derived fuel, and biomass) (7%)

Petroleum products (e.g., motor vehicle fuel, distillate fuel, etc.) supply approximately 40% of the energy demand in the US. Coal and natural gas each supply approximately 23% of national demand, and renewable and nuclear resources supply the rest.

Currently, 98% of the energy in Colorado is produced from fossil fuels — coal, petroleum, and natural gas. They are plentiful and inexpensive today, but their supply is finite and their combustion has environmental consequences. In contrast, clean energy resources such as solar and wind are constantly replenished and could provide economic advantages to the state (CGEO 2008).

Petroleum use accounts for approximately 36% of all energy consumption in Colorado. Approximately 53% of petroleum use is for motor vehicle fuel. In 2005, total statewide energy consumption was 1,425.7 tera BTUs (USDOE 2005). Motor vehicle fuel use accounted for 19% of total use, or 265 tera BTUs (8.03 billion liters, or 2.12 billion gallons of fuel).

3.7.2.3 Impact Evaluation

This evaluation includes analysis of potential DMU or EMU vehicle technology impacts. When the technology impacts this resource, it is described below in Results.

Methodology

This section evaluates energy consumption (measured in BTUs) based on the four types of impacts: direct, indirect, temporary construction, and cumulative.

Direct impacts are related to future operations and are determined by calculating the differences in energy consumption based on traffic and transit service projections for 2015 and 2030 for the No Action Alternative and the Build Alternative with either technology. For this study, direct energy consumption is calculated by VMT of the various transportation modes under the alternatives. The evaluation uses the following assumptions:

- VMT data are estimated from the DRCOG regional travel demand model. The model represents a typical weekday, so VMT numbers were annualized by appropriate mode-specific factors (e.g., roadway VMT was multiplied by 300).
- Energy consumption in BTUs is derived from VMT and varies by mode (passenger, heavy trucks, buses, commuter rail-diesel, light rail, or commuter rail-electric).
- The energy consumption in BTUs per mile (BTU/mile) for each category of VMT is taken from the FTA New Starts Program standardized evaluation criteria (FTA 2001), except for commuter rail (diesel) as footnoted:
 - Passenger Vehicle = 6,233 BTUs/mile
 - Heavy-duty Vehicle = 22,046 BTUs/mile
 - Diesel or CNG Vehicle = 41,655 BTUs/mile

- Commuter Rail (Diesel) = 66,138 BTUs/mile¹
- LRT = 77,739 BTUs/mile
- Commuter Rail (Electric) = 95,000 BTUs/mile

Indirect impacts are defined as those caused by the proposed action later in time or those farther removed in distance but reasonably foreseeable. For example, TOD may develop over time near stations to serve the needs of transit commuters; such areas typically have higher-density development, which generally results in lower energy consumption rates.

Temporary construction impacts consist of the energy required to construct roadway and transit projects. Energy consumption during construction varies by technology and by construction type, as follows (DNA 2006; North Metro Corridor Project Team 2008):

- Roadway
 - At-grade = 13,885 BTUs/mile
 - Elevated Structure = 130,739 BTUs/mile
- Commuter Rail (DMU)
 - At-grade = 8,605 BTUs/mile
 - On Retained Fill² = 23,715 BTUs/mile
 - Elevated Structure = 38,820 BTUs/mile
- Commuter Rail (EMU)
 - At-grade = 12,290 BTUs/mile
 - On Retained Fill = 33,875 BTUs/mile
 - Elevated Structure = 55,460 BTUs/mile

Energy consumed during construction of the North Metro corridor with DMU technology would be expected to be approximately 70% of the energy consumed during construction of the North Metro corridor with EMU technology. This is due to the additional energy required to construct infrastructure related to electrification of the EMU line.

Cumulative impacts result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency or organization undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. For this analysis, activities include development in the Denver metropolitan area between 1950 and 2030.

Results

Direct and indirect impacts for the alternatives are summarized in Table 3.7-15.

¹ The commuter rail (diesel) cars proposed for the North Metro corridor and other FasTracks projects use diesel multiple unit (DMU) technology, which has lower energy consumption than traditional locomotive-hauled coaches. For the purposes of energy calculations, each train is assumed to be equivalent to three heavy-duty vehicle engines.

² Assumes that construction on retained fill uses more energy than at-grade construction but less than construction on elevated structures.

- Direct impacts are represented by BTUs resulting from operations (VMT). The Build Alternative with either technology would have less energy consumption than the No Action Alternative.
- Indirect impacts are represented by TOD potential; more TOD means more energy-efficient types of development. Less TOD means development impacts are greater because they are dispersed and lower density. The Build Alternative with either technology has higher potential for TOD than the No Action Alternative and, thus, has better (i.e., fewer) indirect impacts than the No Action Alternative.

TABLE 3.7-15. DIRECT AND INDIRECT IMPACTS SUMMARY — ENERGY

Alternative	Year 2030 Direct Impacts (BTUs, Millions)	Indirect Impacts (TOD Potential)
No Action Alternative	217,311,182	More
Build Alternative (DMU)	217,234,886	Fewer
Build Alternative (EMU)	217,242,230	Fewer

Source: North Metro Corridor Project Team, 2008.

Notes:

- BTU = British thermal unit
 DMU = diesel multiple unit
 EMU = electric multiple unit
 TOD = transit oriented development

Temporary construction impacts are summarized in Table 3.7-16. The temporary construction impacts represent the energy consumption associated with constructing the projects in the DRCOG *Metro Vision 2030 Plan (2006a)* that are within the North Metro corridor. Construction was estimated based on mainline rail impacts only and did not include station impacts. Construction of the Build Alternative with either technology (including the North Metro rail line) would consume 1,905,004 to 2,129,930 million BTUs, while construction of the No Action Alternative would consume approximately 1,379,914 million BTUs. The North Metro rail line represents approximately 28 to 35% of the construction energy consumption of the Build Alternative with either technology.

TABLE 3.7-16. TEMPORARY CONSTRUCTION IMPACTS SUMMARY — ENERGY

Alternative ¹	Temporary Construction Impacts (BTUs, Millions)
No Action Alternative	1,379,914
Build Alternative (DMU)	1,905,004
Build Alternative (EMU)	2,129,930

Source: North Metro Corridor Project Team, 2008.

Notes:

¹ Data presented for the Alternative include mainline rail impacts only and do not include station impacts. The selected mix of station options must be added to this figure to determine the total impact.

- BTU = British thermal unit
 DMU = diesel multiple unit
 EMU = electric multiple unit

Energy consumption has steadily increased over the last 50 years due to increased population. This has resulted in the construction of new power plants to meet the energy needs of the

TABLE 3.7-18. ENERGY CONSUMED FOR THE NO ACTION ALTERNATIVE, 2030

Vehicle	VMT ¹	BTUs per VMT (Millions)	Total BTUs (Millions)
Commuter Rail (Diesel)	0.9	66,138	59,524
Commuter Rail (Electric)	1.9	95,000	180,500
Total	32,741.3	350,466	217,311,182

Source: North Metro Corridor Project Team, 2007.

Notes:

¹Rounded to the nearest tenth.

BTU = British thermal unit

CNG = compressed natural gas

HDV = heavy-duty truck

LDT = light-duty truck

LDV = light-duty vehicle

VMT = vehicle miles traveled

Indirect Impacts

Even if the North Metro Corridor Project was not built, continued development and population increases would occur within the North Metro corridor study area. This would result in additional demand for energy in several forms, including but not limited to construction of new homes, electricity for utilities, and gasoline for automobiles.

Temporary Construction Impacts

The DRCOG *Metro Vision 2030 Plan* (2006a) includes transportation projects throughout the region that are likely to be built by 2030. Several of the projects are within the North Metro corridor study area. Calculating the total energy required to construct these projects gives a baseline for comparison of the energy consumed during construction of the Build Alternative with either technology. As shown in Table 3.7-19, the construction of roadway and other FasTracks rail projects in the North Metro corridor study area associated with the No Action Alternative would consume approximately 1,379,914 million BTUs.

TABLE 3.7-19. ENERGY CONSUMED DURING CONSTRUCTION OF THE NO ACTION ALTERNATIVE

No Action Alternative Component	Miles of New Roadway or Rail ¹	BTUs per Mile At-Grade (Millions)	BTUs per Mile of Elevated Structure (Millions)	Total BTUs (Millions)
Roadway				
Washington Street: Elk Place to 52 nd Avenue – At-Grade	1	13,885	NA	13,885
Quebec Street: I-270 to SH 2 – At-Grade	13.6	13,885	NA	188,836
I-270: Vasquez Boulevard to Quebec Street – At-Grade	4.4	13,885	NA	61,094
I-25: US 36 to Thornton Parkway – Add Through Lane(s)	6	13,885	NA	83,310
Thornton Parkway: Downing Street to Steele Street – At-Grade	2.2	13,885	NA	30,547
Thornton Parkway: Steele Street to Colorado Boulevard – At-Grade	2.8	13,885	NA	38,878
104 th Avenue: Northglenn City Limits to Croke Drive – At-Grade	1.6	13,885	NA	22,216
104 th Avenue: Colorado Boulevard to US 85 – At-Grade	6	13,885	NA	83,310
Quebec Street: 128 th Avenue to 132 nd Avenue – At-Grade	2	13,885	NA	27,770
Colorado Boulevard: 136 th Avenue to 140 th Avenue – At-Grade	1	13,885	NA	13,885

TABLE 3.7-19. ENERGY CONSUMED DURING CONSTRUCTION OF THE NO ACTION ALTERNATIVE

No Action Alternative Component	Miles of New Roadway or Rail ¹	BTUs per Mile At-Grade (Millions)	BTUs per Mile of Elevated Structure (Millions)	Total BTUs (Millions)
Washington Street: 136 th Avenue to 144 th Avenue – At-Grade	2	13,885	NA	27,770
Washington Street: 144 th Avenue to 152 nd Avenue – At-Grade	4	13,885	NA	55,540
I-25: 144 th Avenue New Interchange – At-Grade ²	2	13,885	NA	27,770
I-25: 144 th Avenue New Interchange – Elevated Structure ²	2	NA	130,739	261,478
144 th Avenue: Huron Street to Washington Street – At-Grade	2	13,885	NA	27,770
152 nd Avenue: Washington Street to York Street, North to E-470 – At-Grade	3.2	13,885	NA	44,432
Colorado Boulevard: 152 nd Avenue to 156 th Avenue – At-Grade	1.2	13,885	NA	16,662
Colorado Boulevard: 156 th Avenue to 160 th Avenue (SH 7) – At-Grade	1	13,885	NA	13,885
SH 7: I-25 to 164 th Avenue – At-Grade	2	13,885	NA	27,770
SH 7: 164 th Avenue to US 85 – At-Grade	16	13,885	NA	222,160
Rail				
East Corridor Rail – At-Grade ³	7.4	12,290	NA	90,946
Bus Improvements				
RTD Bus Improvements	0	NA	NA	0
Total				1,379,914

Source: North Metro Corridor Project Team, 2007; CRMF Project Team, 2008; DRCOG, 2007.

Notes:

¹Assumed miles are based on approximate project limits, not on design documents.

²Assumes that half would be elevated and half would be surface.

³Represents East corridor track between Denver Union Station and Colorado Boulevard.

BTU = British thermal unit

NA = not applicable

CRMF = Commuter Rail Maintenance Facility

RTD = Regional Transportation District

DRCOG = Denver Regional Council of Governments

SH # = State Highway #

I-# = Interstate # (e.g., I-25, I-270)

US # = United States Highway #

Connected Action – CRMF Fox North Site

The two largest demands on energy from the CRMF would be from the movement of the commuter rail vehicles and the operation of the buildings at the CRMF. This includes the non-revenue (out-of-service) movements to and from the Fox North Site, which would result in a per day energy usage of approximately 10,174,698 BTUs in 2015 and 12,217,039 BTUs in 2030.

The operation of the buildings at the CRMF would result in the use of approximately 36,925,942 BTUs per day³ (RTD 2008).

³ This calculation was based on the 2007 Elati Facility energy usage proportioned to the Commuter Rail Maintenance Facility (CRMF) based on building square footage.

The CRMF would have no indirect energy impacts.

The construction of the tracks associated with the CRMF would result in the use of approximately 157,185 million BTUs. Energy would also be required to construct the buildings associated with the new facility.

The impacts presented would occur under either the CRMF or the No Action Alternative scenarios. As noted in the No Action Alternative description, if the CRMF were not constructed at the Fox North Site, it would be constructed at an alternate location.

Cumulative Impacts

Energy consumption has steadily increased over the last 50 years due to increased population. This has resulted in the construction of new power plants to meet the energy needs of the Denver metropolitan area. The No Action Alternative would require proportionate increases in energy to meet the 2030 population growth.

Build Alternative

Direct Impacts

VMT by mode for the year 2015 is summarized and compared in Table 3.7-20. Implementing the Build Alternative would decrease passenger VMT by 18 million miles per year for DMU and by 21.6 million miles per year for EMU. Total VMT for all modes would decrease by 12.3 million miles per year for DMU and by 15.9 million miles per year for EMU.

TABLE 3.7-20. REGIONAL VEHICLE MILES TRAVELED PER YEAR FOR THE NO ACTION ALTERNATIVE AND BUILD ALTERNATIVE, 2015

Vehicle	No Action Alternative ¹ (Miles, Millions)	Build Alternative (DMU) ¹ (Miles, Millions)	Build Alternative DMU Difference from No Action Alternative ¹ (Miles, Millions)	Build Alternative (EMU) ¹ (Miles, Millions)	Build Alternative EMU Difference from No Action Alternative ¹ (Miles, Millions)
Passenger Vehicles (LDV/LDT)	23,496.6	23,478.6	-18.0	23,475.0	-21.6
Commercial Trucks (HDV)	545.2	548.8	+3.6	548.8	+3.6
Bus (Diesel)	47.1	48.6	+1.5	48.6	+1.5
Bus (CNG)	0.3	0.3	0.0	0.3	0.0
Light Rail	7.1	7.1	0.0	7.1	0.0
Commuter Rail (Diesel)	0.9	1.5	+0.6	0.9	0.0
Commuter Rail (Electric)	1.9	1.9	0.0	2.5	+0.6
Total	24,099.1	24,086.8	-12.3	24,083.2	-15.9

Source: North Metro Corridor Project Team, 2008.

Notes:

¹All numbers rounded to the nearest tenth.

+ = plus

- = minus

CNG = compressed natural gas

DMU = diesel multiple unit

EMU = electric multiple unit

HDV = heavy-duty truck

LDT = light-duty truck

LDV = light-duty vehicle

As shown in Table 3.7-21, overall energy consumption increases slightly (+69,337 million BTUs, or +0.043% with DMU, and +64,215 million BTUs, or +0.040% with EMU). This is because of the increase in bus and commuter rail energy consumption.

TABLE 3.7-21. ENERGY CONSUMED FOR THE NO ACTION ALTERNATIVE AND BUILD ALTERNATIVE, 2015

Vehicle	No Action Alternative (BTUs, Millions)	Build Alternative (DMU) (BTUs, Millions)	Build Alternative (EMU) (BTUs, Millions)
Passenger Vehicles (LDV/LDT)	146,454,308	146,342,114	146,319,675
Commercial Trucks (HDV)	12,019,479	12,098,845	12,098,845
Bus (Diesel)	1,961,951	2,024,433	2,024,433
Bus (CNG)	12,497	12,497	12,497
Light Rail	551,947	551,947	551,947
Commuter Rail (Diesel)	59,524	99,207	59,524
Commuter Rail (Electric)	180,500	180,500	237,500
Total	161,240,206	161,309,543	161,304,421
Difference in BTUs Between the Build Alternative and the No Action Alternative	NA	+69,337	+64,215
Percent Change in Energy Use from the No Action Alternative	NA	+0.043%	+0.040%

Source: North Metro Corridor Project Team, 2008.

Notes:

- % = percent
- BTU = British thermal unit
- CNG = compressed natural gas
- DMU = diesel multiple unit
- EMU = electric multiple unit
- HDV = heavy-duty vehicle
- LDT = light-duty truck
- LDV = light-duty vehicle
- NA = not applicable

Similar to 2015, the numbers for 2030 in Table 3.7-22 show a decrease in passenger VMT.

TABLE 3.7-22. REGIONAL VEHICLE MILES TRAVELED PER YEAR FOR THE NO ACTION ALTERNATIVE AND BUILD ALTERNATIVE, 2030

Vehicle	No Action Alternative ¹ (Miles, Million)	Build Alternative (DMU) ¹ (Miles, Million)	Build Alternative DMU Difference from No Action Alternative ¹ (Miles, Million)	Build Alternative (EMU) ¹ (Miles, Million)	Build Alternative EMU Difference from No Action Alternative ¹ (Miles, Million)
Passenger Vehicles (LDV/LDT)	32,000.9	31,971.6	-29.3	31,970.0	-30.9
Commercial Trucks (HDV)	681.9	681.9	0.0	681.9	0.0
Bus (Diesel)	48.3	49.9	+1.6	49.9	+1.6
Bus (CNG)	0.3	0.3	0.0	0.3	0.0
Light Rail	7.1	7.1	0.0	7.1	0.0
Commuter Rail (Diesel)	0.9	1.5	+0.6	0.9	0.0
Commuter Rail (Electric)	1.9	1.9	0.0	2.5	+0.6
Total	32,741.3	32,714.2	-27.1	32,712.6	-28.7

Source: North Metro Corridor Project Team, 2008.

Notes:

¹All numbers rounded to the nearest tenth.

CNG = compressed natural gas

DMU = diesel multiple unit

EMU = electric multiple unit

HDV = heavy-duty vehicle

LDT = light-duty truck

LDV = light-duty vehicle

Overall, Table 3.7-23 shows that region-wide energy consumption under the Build Alternative with either technology is expected to be from approximately 68,952 to 76,296 million BTUs less than the No Action Alternative (-0.032% to -0.035%).

TABLE 3.7-23. ENERGY CONSUMED FOR THE NO ACTION ALTERNATIVE AND BUILD ALTERNATIVE, 2030

Vehicle	No Action Alternative (BTUs, Million)	Build Alternative (DMU) (BTUs, Million)	Build Alternative (EMU) (BTUs, Million)
Passenger Vehicles (LDV/LDT)	199,461,610	199,278,983	199,269,010
Commercial Trucks (HDV)	15,033,167	15,033,167	15,033,167
Bus (Diesel)	2,011,937	2,078,585	2,078,585
Bus (CNG)	12,497	12,497	12,497
Light Rail	551,947	551,947	551,947
Commuter Rail (Diesel)	59,524	99,207	59,524
Commuter Rail (Electric)	180,500	180,500	237,500
Total	217,311,182	217,234,886	217,242,230
Difference in BTUs Between the Build Alternative with Either Technology and the No Action Alternative	NA	-76,296	-68,952
Percent Change in Energy Use from the No Action Alternative	NA	-0.035%	-0.032%

Source: North Metro Corridor Project Team, 2008.

Notes:

- % = percent
- BTU = British thermal unit
- CNG = compressed natural gas
- DMU = diesel multiple unit
- EMU = electric multiple unit
- HDV = heavy-duty vehicle
- LDT = light-duty truck
- LDV = light-duty vehicle
- NA = not applicable

Indirect Impacts

Indirect impacts associated with the Build Alternative with either technology are related to development. With the Build Alternative, there is an opportunity for TOD development around the stations, which would replace the dispersed development identified in the No Action Alternative. The energy requirements to serve this population under the Build Alternative with either technology may be slightly less than the No Action Alternative because of smaller residences in redeveloped neighborhoods, decreased dependence on automobiles, and increased transit use associated with TOD land-use patterns.

Temporary Construction Impacts

Table 3.7-24 quantifies the energy consumed during the construction of the Build Alternative with either technology. The energy consumed during construction varies by technology, with DMU construction expending approximately 70% of the energy used by EMU on a per-mile basis. The North Metro Corridor Project still has several Build Alternative alignments being analyzed. Although each alignment would have slightly different energy consumption because of differences in the construction components, in the context of the entire corridor, the overall differences among the Build Alternative alignments for a given technology would be minimal. As shown in Table 3.7-24, compared to the sum of construction of all other major *Metro Vision*

2030 Plan (DRCOG 2006a) projects in the North Metro corridor study area, construction of the North Metro rail line is fairly large (27.6 to 35.2% of the total).

TABLE 3.7-24. ENERGY CONSUMED DURING CONSTRUCTION OF THE BUILD ALTERNATIVE

Construction Component	Miles of Single Track ¹	BTUs per Mile of Single Track for DMU (Millions)	DMU Build Alternative Total BTUs (Millions)	BTUs per Mile of Single Track for EMU (Millions)	EMU Build Alternative Total BTUs (Millions)
At-grade Track	25.7 ²	8,605 ³	221,149	12,290 ³	315,853
On Retained Fill	2.9	23,715 ⁴	68,774	33,875 ⁴	98,238
On Elevated Structure	2.0	38,820	77,640	55,460	110,920
System ⁵	NA	NA	157,527	NA	225,005
North Metro Corridor Total Energy ⁵	NA	NA	525,090	NA	750,016
No Action Alternative Construction Energy (from Table 3.7-19)	NA	NA	1,379,914	NA	1,379,914
North Metro Corridor Plus No Action Alternative Total Energy	NA	NA	1,905,004	NA	2,129,930
North Metro Corridor as Percent of Total Construction Energy	NA	NA	27.6%	NA	35.2%

Source: North Metro Corridor Project Team, 2007.

Notes:

¹ The entire North Metro corridor alignment includes approximately 13.6 miles of double-track and 4.9 miles of single-track.

² Subtracted the segment from Denver Union Station to the CRMF (1.6 single-track miles) which will be built as a part of the CRMF.

³ DNA, 2006.

⁴ Assumes that construction on retained fill uses more energy than at-grade construction, but less energy than construction on elevated structures.

⁵ The energy estimate assumes that 70% of the project energy would be for guideway construction, with the remaining 30% for systems.

% = percent

DNA = Downtown/Natomas/Airport

BTU = British thermal unit

EMU = electric multiple unit

CRMF = Commuter Rail Maintenance Facility

NA = not applicable

DMU = diesel multiple unit

Cumulative Impacts

The TOD concept encouraged by the Build Alternative with either technology could result in smaller average home sizes and more efficient use of public infrastructure, which would both reverse the past trends of energy consumption increasing faster than population. The Build Alternative with either technology would result in a slight decrease in energy consumption within the North Metro corridor study area, consistent with the region-wide reduction in energy consumption that is expected with implementation of the entire *FasTracks Plan* (RTD 2007).

3.7.2.4 Mitigation

Mitigation measures to reduce energy usage are described in Table 3.7-25.

TABLE 3.7-25. PROPOSED MITIGATION MEASURES — ENERGY

Impact	Impact Type	Mitigation Measures
Use of Energy Resources During Construction and Operations	Construction and Operations	<ul style="list-style-type: none"> • Design efforts to reduce energy consumption and overall VMT will be implemented. • Multiple access points will be created for parking lots, where possible. • “Kiss-n-Ride” drop-offs will be designed to maximize efficiency and to minimize the number of vehicles idling. • Stations will be positioned to be more easily accessible by pedestrians and bicyclists. • Park-n-Ride improvements will be designed to decrease energy consumption, consistent with RTD’s sustainability policy.

Source: North Metro Corridor Project Team, 2009.

Notes:

- RTD = Regional Transportation District
- VMT = vehicle miles traveled

