5.11 Energy

This section defines energy and explains why it is important to the project. It analyzes the energy consumption by the project alternatives within the study area during construction and operation and proposes mitigation measures to offset any potential adverse effects.

5.11.1 What is energy and why is it important to this project?

During construction of any of the project alternatives, energy will be expended to operate machinery, transport materials, mix and pour concrete, and perform many other work tasks. On a highway such as I-70, large amounts of energy are consumed by the hundreds of thousands of vehicles on the road every day.

Energy impacts are important to this project because energy is closely related to air quality, greenhouse gases, and national security, and should be considered throughout the planning, design, development, construction, and use of a transportation project such as I-70 East.

5.11.2 Have there been any changes to the energy resources or to the analysis process since the release of the 2008 Draft EIS?

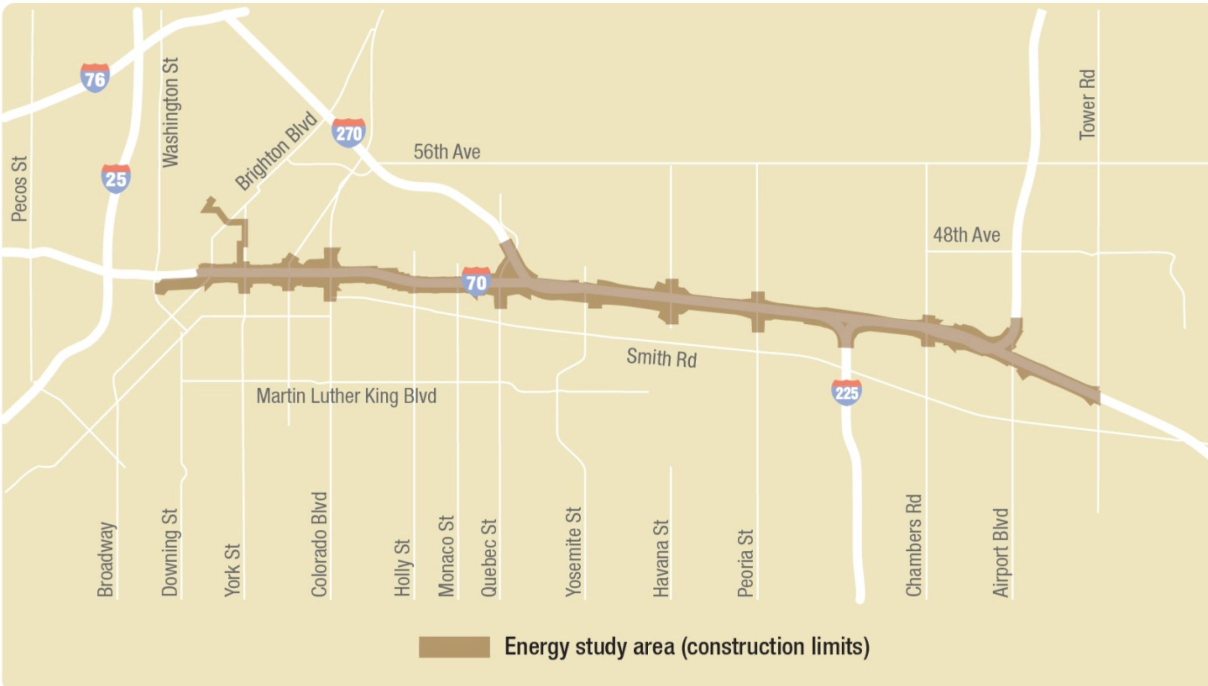
Because of the elimination of the Realignment Alternatives proposed in the 2008 Draft EIS, a new study area was defined, as presented in Exhibit 5.11-1.

The analysis process to identify energy impacts has not changed since the publication of the 2008 Draft EIS. However, the operational energy analysis now uses energy consumption factors from the EPA's Motor Vehicle Emissions Simulator (MOVES) model.

5.11.3 What study area and methodology were used to analyze energy impacts?

The study area used for evaluating energy consumption is the construction limits of the project, as shown in Exhibit 5.11-1.

Exhibit 5.11-1. Study area for energy resources



Energy consumption is calculated for the construction period and during the highway operation design year of 2035. Energy consumption during construction includes manufacturing and movement of construction materials, operation and servicing of equipment, and many other construction-related work tasks.

Energy consumption rates developed by the California Department of Transportation in their Energy and Transportation Systems report (1983) were applied in this analysis. This report, although dated, is widely used in estimating energy consumed during the construction of highway facilities. It correlates energy consumption during construction with the project cost in 1977 dollars.

Using the construction energy consumption rate for an urban freeway and adjusting from 1977 to 2013 dollars using the Consumer Price Index tables from the U.S. Department of Labor, Bureau of Labor Statistics, yields a figure of approximately 6,980 British thermal units (BTUs) consumed for every $1 of construction cost (in 2013 dollars). This energy consumption rate is multiplied by the construction cost estimate for each of the project alternatives to arrive at the estimates of energy consumed during construction.

Operational energy consumption is calculated by multiplying VMT from the DRCOG Compass model by an energy consumption factor from EPA's MOVES model. This is done for every roadway segment in the study area based on the link's traffic volume, congested speed, vehicle type (mix), and fuel type (i.e., gas, diesel). The energy consumption values then are summed across all roads in the study area to obtain an alternative's total operational energy value.

Because average vehicle speeds change by time period and fuel consumption rates vary by speed, the addition of the congested speed variable in the analysis for this Supplemental Draft EIS allows for a more meaningful comparison of energy consumption among alternatives.

The MOVES model inputs include, but are not limited to, fuel specifications, vehicle inspection/maintenance program parameters, fleet characteristics, and meteorological data. The MOVES model input assumptions are consistent with those used to calculate greenhouse gas emission factors, including the use of correction factors from FHWA to account for the most recent changes to the federal corporate average fuel economy standards.

5.11.4 What are the existing conditions for energy consumption?

The year 2010 is defined as the base year for existing conditions because the VMT and speed data are available from the DRCOG model for that year. In 2010, no construction activities occurred, so there was no energy consumed during construction. I-70, however, currently operates as a six-lane freeway, so there is a considerable amount of operational energy consumed. The existing operational conditions can be characterized as heavy traffic congestion in the peak periods compounded by an outdated geometric design and aging structure and pavement.

5.11.5 How do the project alternatives potentially affect energy consumption?

The energy consumed during construction and operation will differ among each of the alternatives in the 2035 project analysis year. This subsection presents the energy estimates for construction and operations for each of the alternatives.

Energy consumed during construction (2035)

Construction energy consumption is affected by the varying efforts to build any of the alternatives, including ease of construction, length of construction, and materials used during construction. In this manner, construction energy is closely connected with the estimated construction cost (excluding engineering, design, and right-of-way costs) of each alternative discussed in the methodology section.

Exhibit 5.11-2 details construction costs and energy consumption during construction for each project alternative.

Exhibit 5.11-2. Construction costs and energy consumption during construction

Alternative/ Option	General-Purpose Lanes Option		Managed Lanes Option	
	Construction Cost* (millions of 2013 dollars)	Energy Consumption (BTUs in billions)	Construction Cost* (millions of 2013 dollars)	Energy Consumption (BTUs in billions)
No-Action Alternative, North Option	$385.2	2,690	—	—
No-Action Alternative, South Option	$370.6	2,590	—	—
Revised Viaduct Alternative, North Option	$1,020.9	7,130	$1,130.9	7,890
Revised Viaduct Alternative, South Option	$1,023.7	7,150	$1,134.1	7,920
Partial Cover Lowered Alternative, Basic Option	$1,244.4	8,690	$1,246.9	8,700
Partial Cover Lowered Alternative, Modified Option	$1,235.7	8,630	$1,238.2	8,640

**Note: Construction costs do not include right-of-way, engineering, or design.*

Energy consumed during operations (2035)

Each alternative influences operational energy consumption by its ability to relieve traffic congestion. Generally, higher operational speeds, or less traffic congestion, equates to less energy consumed on a per vehicle-mile basis.

Exhibit 5.11-3 presents the energy consumption estimates for on-road vehicles in the study area. The 2010 existing conditions estimate is included for reference.

Exhibit 5.11-3. Operational energy consumption per day (2035)

Alternative/Option	Energy Consumption (billion BTUs per day)
Existing Conditions (2010)	49.9
No-Action Alternative	65.9
Build Alternatives	67.4
Managed Lanes Option (option to Build Alternatives)	65.2

Based on Exhibit 5.11-3, approximately the same amount of energy will be expended during normal freeway operations in 2035 regardless of the alternative. This includes the No-Action Alternative, which has slightly lower operational energy consumption as compared to the build alternatives. The options with managed lanes show slightly less energy expenditure than those with general-purpose lanes. In short, operational energy consumption is not substantially different among the alternatives.

5.11.6 How are the negative effects from the project alternatives mitigated for energy?

Construction contracts are a primary tool for implementing CDOT's commitment to environmental stewardship. CDOT's *Environmental Stewardship Guide* (2003b) explains and documents CDOT's environmental ethic and the policies and procedures CDOT uses in carrying out that ethic. CDOT commits to work with designers, contractors, and suppliers to implement environmental sustainability policies as infrastructure is designed and constructed. Where appropriate, energy conservation measures—including energy-efficient electrical systems, lighting, and mechanical equipment—will be implemented.

In addition, to minimize the use of energy during the construction period, the following mitigation measures will be used during construction:

- Limit idling of construction equipment
- Encourage employee carpooling and vanpooling for construction workers
- Encourage use of closest material sources
- Locate construction staging areas close to work sites

- Encourage use of cleaner and more fuel-efficient construction vehicles (for example, low sulfur fuel, biodiesel, or hybrid technologies)
- Implement traffic management schemes that minimize delays and idling

Exhibit 5.11-4 lists the impacts and mitigations associated with energy.

Exhibit 5.11-4. Summary of energy impacts and mitigations

Alternative/ Option	Impacts and/or Benefits	Mitigation Measures Applicable to All Alternatives
No-Action Alternative	• 65.9 billion BTUs consumed per day • 2,590 billion BTUs to 2,690 billion BTUs consumed during construction	• Follow procedures set forth in CDOT's *Environmental Stewardship Guide* (2003b) • Limit idling of construction equipment • Encourage employee carpooling and vanpooling for construction workers • Encourage use of closest material sources • Locate construction staging areas close to work sites • Encourage use of cleaner and more fuel-efficient construction vehicles (for example, low sulfur fuel, biodiesel, or hybrid technologies) • Implement traffic management schemes that minimize delays and idling • Where appropriate, implement energy conservation measures, such as energy-efficient electrical system specifications, lighting, mechanical equipment, and building insulation
Revised Viaduct Alternative	• 67.4 billion BTUs consumed per day • 7,130 billion BTUs to 7,150 billion BTUs consumed during construction	
Partial Cover Lowered Alternative	• 67.4 billion BTUs consumed per day • 8,630 billion BTUs to 8,690 billion BTUs consumed during construction	
Managed Lanes Option (option to Build Alternatives)	• 65.2 billion BTUs consumed per day • 7,890 billion BTUs to 8,700 billion BTUs consumed during construction	