Energy Technical Report

High Desert Corridor
Palmdale to Apple Valley (State Route 14 to State Route 18)

December 2015

PARSONS
Parsons Transportation Group Inc.
100 West Walnut Street
Pasadena, CA 91124

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Energy Technical Study
High Desert Corridor (HDC) Project

LOS ANGELES and SAN BERNARDINO COUNTIES, CALIFORNIA
District 07 – LOS ANGELES – NEW 138 – PM 42.4 to PM 74.9
District 08 – SAN BERNARDINO – New 138 – PM 0.0 to PM 35.0
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December 2015

STATE OF CALIFORNIA
Department of Transportation

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ABBREVIATIONS/ACRONYMS

AA............................Alternatives Analysis
AB………………..Assembly Bill
ARB..........................Air Resources Board
ART..........................Alternative Rail Technology
BTU..........................British Thermal Unit
CAFE.......................Corporate Average Fuel Economy
Caltrans...................California Department of Transportation
CEQA.......................California Environmental Quality Act
CNG………………compressed natural gas
CTP..........................California Transportation Plan
DEIR........................Draft Environmental Impact Report
DEIS.........................Draft Environmental Impact Statement
EIR...........................Environmental Impact Report
EIS............................Environmental Impact Statement
EV………………..electric vehicle
FTA..........................Federal Transit Administration
GHG……………..greenhouse gases
HDC.........................High Desert Corridor
HSR………………High Speed Rail
kWh…………...…kilowatt-hour
LADWP…………Los Angeles Department of Water and Power
LAX..........................Los Angeles International Airport
LNG………………liquefied natural gas
LRT..........................Light Rail Transit
LRTP.......................Long Range Transportation Plan
MAP-21………….Moving Ahead for Progress in the 21st Century
Metro........................Los Angeles County Metropolitan Transportation Authority
NEPA.......................National Environmental Policy Act
PV………………..photovoltaic
RCP..........................Regional Comprehensive Plan
RFS...........................Renewable Fuels Standard
ROW……………..right-of-way
RTP..........................Regional Transportation Plan
SCAG.......................Southern California Association of Governments
SCS……………….Sustainable Communities Strategy
SR-14........................State Route 14
SR-18........................State Route 18
U.S. (US)…………United States
VMT.........................Vehicle Miles Traveled

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SUMMARY

The California Department of Transportation (Caltrans), the Federal Highway Administration, and the Los Angeles County Metropolitan Transportation Authority (Metro) have initiated a Draft Environmental Impact Statement (DEIS)/Draft Environmental Impact Report (DEIR) for the High Desert Corridor (HDC) Project. The purpose of this Energy Technical Report is to provide quantitative and comparative analyses of the energy-related impacts of the HDC Project. The analyses consisted of calculating the energy required to construct each alternative and the energy consumed by vehicles operating on the completed project in 2020 (Existing) and 2040 (Baseline). A discussion of the Green Energy Component is also provided.

INTRODUCTION

The HDC Project is considering construction of a new multi-modal link between State Route 14 (SR-14) in Los Angeles County and State Route 18 (SR-18) in San Bernardino County. This project would connect some of the fastest growing residential, commercial, and industrial areas in Southern California, including the cities of Palmdale, Lancaster, Adelanto, and Victorville and the Town of Apple Valley.

ALTERNATIVES

The alternatives being studied for the project include the following:

- No Build
- Freeway/Tollway Alternative (Avenue P-8, Interstate-15 [I-15] and SR-18) (4 Variations)
- Freeway/Tollway Alternative (Avenue P-8, I-15 and SR-18)
- Freeway/Tollway Alternative with High Speed Rail Feeder/Connector Service
- Freeway/Tollway Alternative with High Speed Rail Feeder/Connector Service

CONCLUSION

The energy required to construct the HDC Project ranges from approximately 11 to 32 trillion British Thermal Units (BTU) - equivalent to the energy usage of 45,000 to 130,000 households during the four-year construction period, depending on the alternative.[1] This increase represents a nominal change in regional energy use and would not substantially deplete energy supplies. Regarding operations, implementation of any one of the build alternatives would increase vehicle speeds and reduce travel times, resulting in a more efficient use of energy compared to existing or baseline conditions. Approximately 81 percent of the projected high-speed rail ridership would be diverted from automobiles. This would result in a BTU reduction of approximately 15.9 trillion BTU over a 26-year period from 2015 to 2040. Based on available information about fossil fuel availability, vehicle technology advancements, and the trends from data related to traffic, all of the build alternatives would have less-than-significant impacts on operational energy consumption.

1Based on an average California household energy usage of 61.5 million BTUs per year from 2009 EIA Survey.

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1. PROJECT DESCRIPTION

Caltrans, in cooperation with Metro, proposes construction of the HDC as a new transportation facility in the High Desert region of Los Angeles and San Bernardino counties. The proposed 63-mile-long west-east facility would provide route continuity and relieve traffic congestion between SR-18 and United States Highway 395 (US 395) in San Bernardino County and SR-14 in Los Angeles County. The project would comprise of one or more of the following major components, including highway, tollway, rail transit, bikeway, and recommendation for green energy facilities. Figures 1-1 and 1-2 are project vicinity and location maps, respectively.

1.1. Purpose and Need

The purpose of the proposed action is to improve west-east mobility through the High Desert region of southern California by addressing present and future travel demand and mobility needs within the Antelope and Victor valleys. The proposed action is intended to achieve the following objectives:

- Increase capacity of east-west transportation facilities to accommodate existing and future transportation demand
- Improve travel safety and reliability within the High Desert region
- Improve the regional goods movement network
- Provide improved access and connectivity to regional transportation facilities, including airports and the existing and future passenger rail systems, which include the proposed California high-speed rail (HSR) system and the proposed XpressWest HSR system
- Contribute to state greenhouse gas (GHG) reduction goals through the use of green energy features.

The specific needs to be addressed by the proposed action include:

- Recent and future planned population growth within the High Desert region
- Limited and unreliable west-east connectivity within the High Desert region
- Regional demands for goods movement to support the growth of the regional economy
- Future demands for the use of green energy, including sustainability and green energy provisions in state law and policy

1.2. Project Alternatives

Several project alternatives and design variations have been considered and evaluated. A No Build Alternative and four build alternatives were selected for detailed evaluation in the Draft Environmental Impact Report/Environmental Impact Statement.

Figure 1-1 Project Vicinity Map

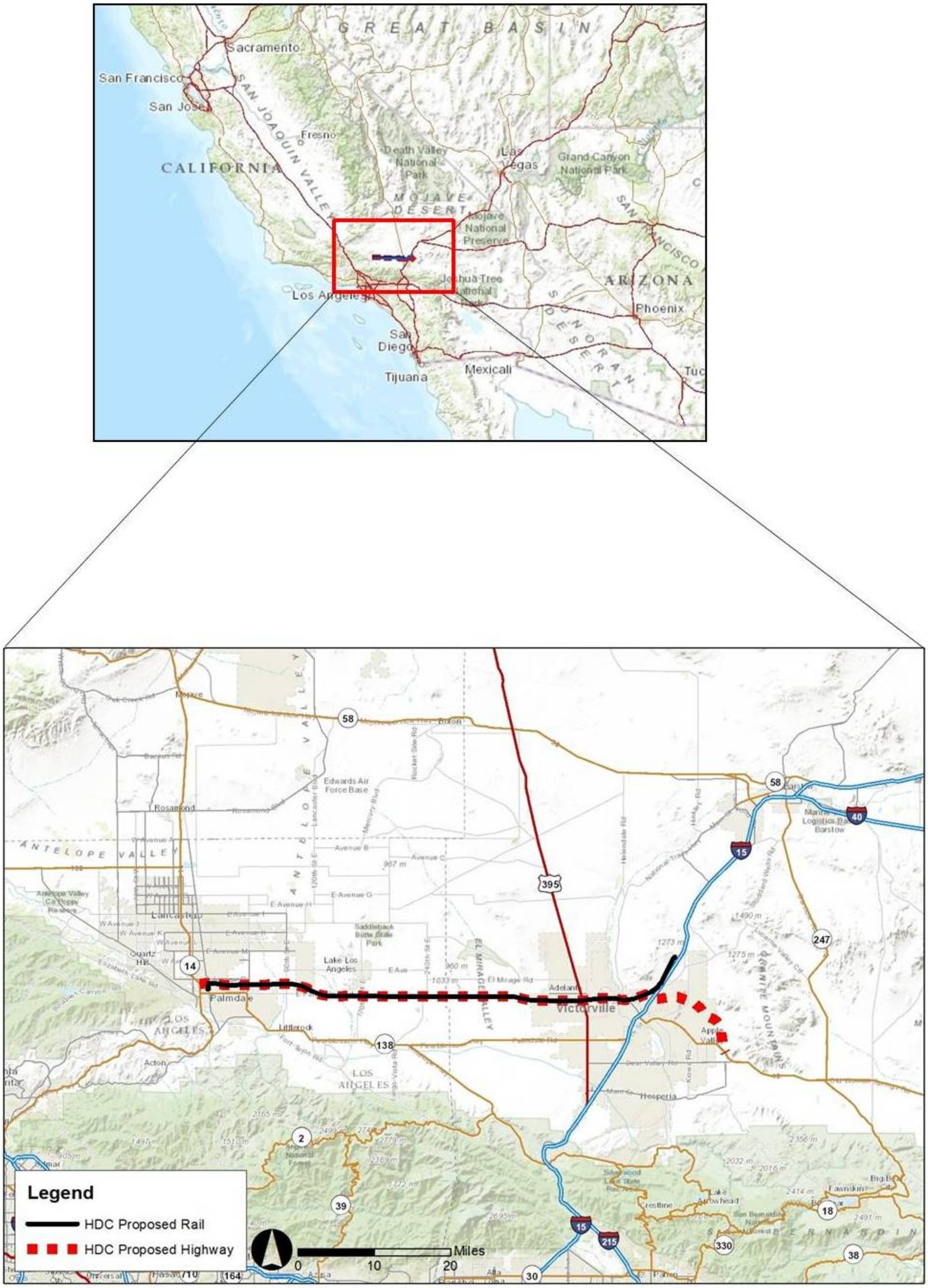
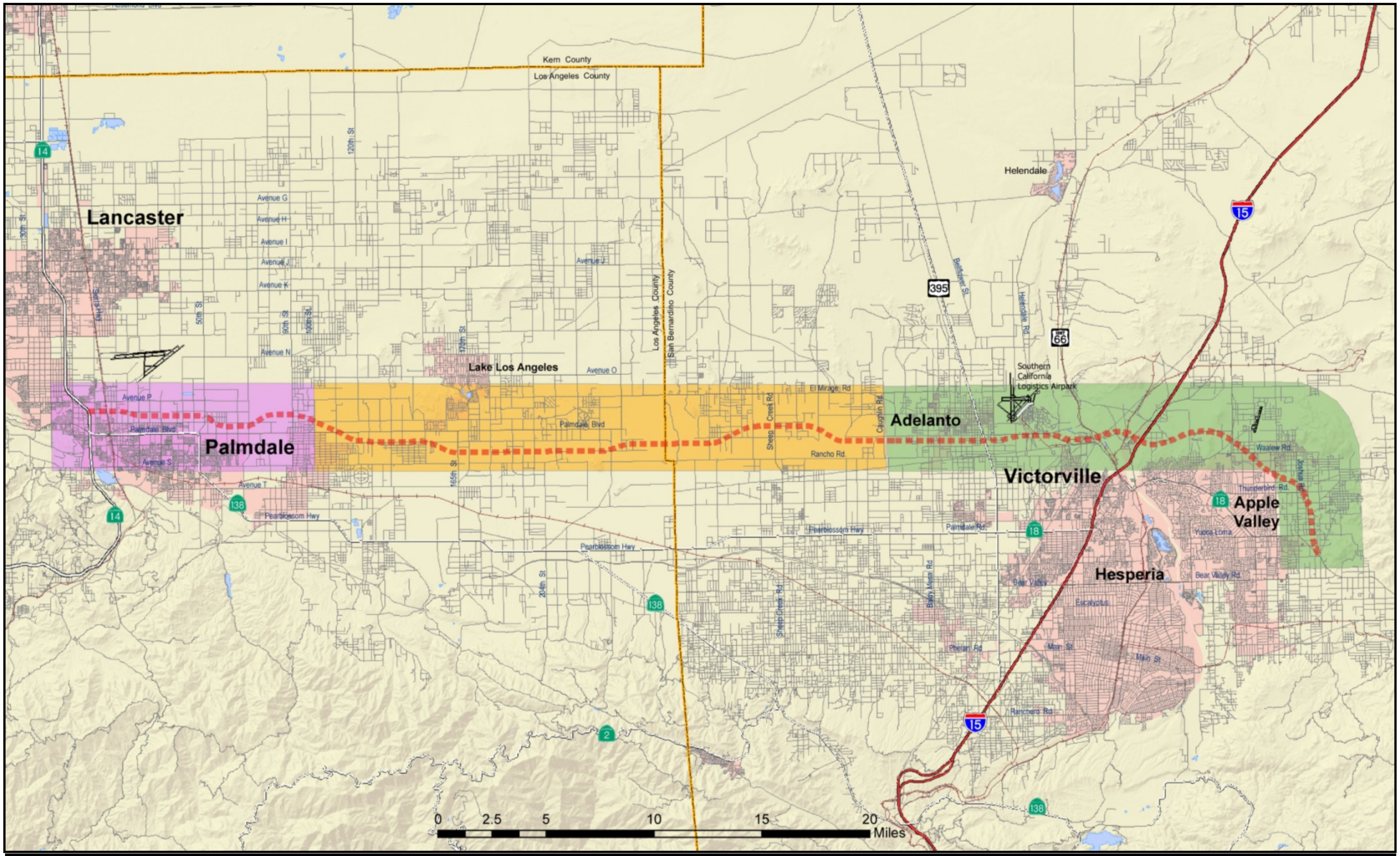


Figure 1-2 Project Location Map



ANTELOPE VALLEY	HIGH DESERT	VICTOR VALLEY
Los Angeles County	**Los Angeles County–San Bernardino County**	**San Bernardino County**
Lancaster, Palmdale	Lake Los Angeles, El Mirage	Adelanto, Victorville, Apple Valley, Hesperia

No Build Alternative

Under the No Build alternative, no new transportation infrastructure would be built within the project area to connect Los Angeles and San Bernardino Counties aside from existing SR-138 safety corridor improvements in Los Angeles County and SR-18 corridor improvements in San Bernardino County. Traffic circulation and congestion currently experienced on Palmdale Boulevard, Air Expressway, and Happy Trails Highway (existing SR-18) would remain. The no action alternative functions as a baseline to compare against all of the proposed build alternatives.

Freeway/Tollway Alternative (Avenue P-8, I-15 and SR-18) –
This Alternative would consist of a combination of a controlled-access freeway and an expressway. It generally would follow Avenue P-8 in Los Angeles County and just south of El Mirage Road in San Bernardino County. This alternative then extends east to Air Expressway Road near I-15 and curves south, terminating at Bear Valley Road. The incorporation of green energy technologies and a bike path along segments of the alternative would also be considered.

Four physical alignment variations are being considered, including:

- Variation A: Near Palmdale, the freeway/tollway would dip slightly south of the main alignment, approximately between 15th Street East and Little Rock Wash.
- Variation B: East of the county line, the freeway/tollway would flare out slightly south of the main alignment between Oasis Road and Coughlin Road. Variation B1 would be at the same location, but it would flare out a little less and pass through the Krey airfield.
- Variation D: Near the community of Lake Los Angeles, the freeway/tollway would dip slightly south of the main alignment, just south of Avenue R approximately between 180th Street East and 230th Street East.
- Variation E: Near Adelanto and Victorville, the freeway/tollway would dip south of the federal prison.

Freeway/Tollway Alternative (Avenue P-8, I-15 and SR-18) –
This Alternative would follow the same physical alignment as the Freeway/Tollway Alternative (including Variations A, B, D, and E), but it would have a section between 100th Street East and US 395 operate as a tollway. Details of this operating feature are being evaluated as part of an ongoing P3 analysis. The incorporation of green energy technologies and a bike path would also be considered.

Freeway/Tollway Alternative with High Speed Rail (HSR) Feeder/Connector Service –
This Alternative is the same as the Freeway/Tollway Alternative except that it would include an HSR Feeder/Connector Service between the cities of Palmdale and Victorville. The HSR Feeder/Connector Service would utilize proven steel wheel-on-steel track technology and have a design speed of 180 miles per hour (mph) with an operating speed of 160 mph. Additional details of this operating feature, including the type of train technology (i.e., electric versus diesel-electric), its location in relation to the HDC (median-running alignment), and its connections to existing and proposed rail stations, are being evaluated as part of an ongoing Rail Alternatives Analysis. The incorporation of green energy technologies and a bike path would also be considered.

Freeway/Tollway Alternative with HSR Feeder/Connector Service –
This Alternative is the same as the Freeway/Tollway Alternative except that it would include an HSR Feeder/Connector Service between the cities of Palmdale and Victorville. The incorporation of green energy technologies and a bike path would also be considered.

1.3. REPORT PURPOSE AND STRUCTURE

This report provides an overview of the applicable regulatory framework that relates to energy resources and consumption, and discusses existing conditions related to energy resources and consumption in the study area and the Southern California Association of Governments (SCAG) region. In addition, this section evaluates the potential energy impacts for both the construction and operation stages of the HDC Project, and identifies necessary measures to avoid, minimize, or mitigate impacts.

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2. REGULATORY FRAMEWORK/METHODOLOGY

2.1. Federal

2.1.1. The Energy Policy and Conservation Act of 1975

The Energy Policy and Conservation Act of 1975 was enacted for the purpose of serving the nation's energy demands and promoting conservation methods when feasibly obtainable. This Act mandated vehicle economy standards, extended oil price controls to 1979, and directed the creation of a strategic petroleum reserve.

2.1.2. Alternative Motor Fuels Act of 1988

The Alternative Motor Fuels Act of 1988 amended a portion of the Energy Policy and Conservation Act to encourage the use of alternative fuels, including electricity. This Act directed the Secretary of Energy to ensure that the maximum practicable number of federal passenger automobiles and light duty trucks be alcohol-powered vehicles, dual energy vehicles, natural gas-powered vehicles or natural gas dual energy vehicles. This Act directed the Secretary to conduct a study regarding such vehicles' performance, fuel economy, safety, and maintenance costs and report to Congress the results of a feasibility study concerning the disposal of such alternative-fueled federal vehicles.

2.1.3. Surface Transportation Acts

2.1.3.1. Intermodal Surface Transportation Efficiency Act of 1991 and Congestion Mitigation and Air Quality Improvement Program

The Intermodal Surface Transportation Efficiency Act of 1991 was the first federal legislation regarding transportation planning and policy. This Act presented an intermodal approach to highway and transit funding with collaborative planning requirements, giving additional powers to State and local transportation decision-makers and metropolitan planning organizations. This Act provided funds for non-motorized commuter trails, defined a number of High Priority Corridors to be part of the National Highway System, and called for the designation of up to five high-speed rail corridors.

The Congestion Mitigation and Air Quality Improvement Program was created under the Intermodal Surface Transportation Efficiency Act, and reauthorized in 1998. It was reauthorized again in 2005 as part of the 2005 Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users. The purpose of the Congestion Mitigation and Air Quality Improvement Program is to fund transportation projects or programs and related efforts that contribute air quality improvements and provide congestion relief.

2.1.3.2. Transportation Equity Act for the 21st Century

The Transportation Equity Act for the 21st Century was enacted in 1998 as the successor legislation to the Intermodal Surface Transportation Efficiency Act and builds on its established initiatives. The Transportation Equity Act reauthorized the Congestion Mitigation and Air Quality Improvement Program and authorized federal highway, highway safety, transit and other surface transportation programs over the next six years. It combines the continuation and improvement of current programs with new initiatives to meet the challenges of improving traffic safety, protecting and enhancing communities and the natural environment as transportation is provided, and advancing economic growth and competitiveness domestically and internationally through efficient and flexible transportation.

2.1.3.3. Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users

The $286 billion Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users reauthorized the Congestion Mitigation and Air Quality Improvement programs and authorized federal highway, highway safety, transit, bicycle and pedestrian, freight rail, and other surface transportation programs from 2005 to 2009. The funding formulas for this measure were renewed several times after its 2009 expiration date. Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users was replaced in 2012 by Moving Ahead for Progress in the 21st Century.

2.1.3.4. Moving Ahead for Progress in the 21st Century

On July 6, 2012, a new two-year transportation authorization, entitled Moving Ahead for Progress in the 21st Century (MAP-21) was signed into law. MAP-21 creates a streamlined and performance-based surface transportation program and builds on many of the highway, transit, bike, and pedestrian programs and policies established in 1991. MAP-21 furthers several important goals, including safety, state of good repair, performance, and program efficiency.

Under MAP-21, the metropolitan planning process will consider projects and strategies that:

- Support economic vitality, increase safety and security of the transportation system for motorized and non-motorized users, and increase the accessibility and mobility of people and for freight;
- Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and economic growth and development;
- Enhance integration and connectivity across and between modes; and

Promote efficient system management and operations; and emphasize the preservation of the existing systems.

2.1.4. Energy Policy Acts

2.1.4.1. Energy Policy Act of 1992

The Energy Policy Act of 1992 reduces dependence on imported petroleum and improves air quality by addressing all aspects of energy supply and demand, including alternative fuels, renewable energy and energy efficiency. This Act encourages the use of alternative fuels through both regulatory and voluntary activities and through the approaches carried out by the U.S. Department of Energy. It requires federal, State, and alternative fuel provider fleets to acquire alternative fuel vehicles. The Department of Energy's Clean Cities initiative was established in response to the Energy Policy Act of 1992 to implement voluntary alternative fuel vehicle deployment activities.

2.1.4.2. Energy Policy Act of 2005

The Energy Policy Act of 2005 requires the development of grant programs, demonstration and testing initiatives, and tax incentives that promote alternative fuels and advanced vehicles production and use. This Act also amends existing regulations, including fuel economy testing procedures and Energy Policy Act of 1992 requirements for federal, State, and alternative fuel provider fleets.

2.1.5. Energy Independence and Security Act of 2007

The Energy Independence and Security Act was signed into law in 2007 and consists of provisions designed to increase energy efficiency and the availability of renewable energy. Key provisions of this Act include:

- The Corporate Average Fuel Economy (CAFE), which sets a target of 54.5 miles per gallon for the combined fleet of cars and light trucks by model year 2025.
- The Renewable Fuels Standard (RFS), which sets a modified standard that starts at 9.0 billion gallons in 2008 and rises to 36 billion gallons by 2022.
- The Energy Efficiency Equipment Standards, which includes a variety of new standards for lighting and for residential and commercial appliance equipment.
- The Repeal of Oil and Gas Tax Incentives, which includes repeal of two tax subsidies in order to offset the estimated cost to implement the CAFE provision.

2.2. State

2.2.1. California Energy Commission

The California Energy Commission is the State's primary energy policy and planning agency. Created by the legislature in 1974, the commission has five major responsibilities: (1) forecasting future energy needs and keeping historical energy data, (2) licensing thermal power plants 50 megawatts or larger, (3) promoting energy efficiency through appliance and building standards, (4) developing energy technologies and supporting renewable energy and (5) planning for and directing the State's response to energy emergencies. Senate Bill 1389 (Chapter 568, Statutes of 2002) requires the commission to prepare a biennial integrated energy policy report assessing major energy trends and issues facing the State's electricity, natural gas, and transportation fuel sectors. The report also provides policy recommendations to conserve resources, protect the environment, and ensure reliable, secure and diverse energy supplies. The Final 2013 Integrated Energy Policy Report was issued in February 2014.

2.2.2. California Public Utilities Commission

The California Public Utilities Commission regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit and passenger transportation companies. It regulates investor-owned electric and natural gas utilities operating in California, including Pacific Gas and Electric Company, Southern California Edison, San Diego Gas and Electric Company, Southern California Gas Company. The California Public Utilities Commission also promotes programs to help consumers improve their energy efficiency and lower their energy bills.

2.2.3. Alternative and Renewable Fuel and Vehicle Technology Program

In 2007, Assembly Bill 118 (AB 118) created the Alternative and Renewable Fuel and Vehicle Technology Program, to be administered by the California Energy Commission. The Program authorizes the California Energy Commission to award grants, revolving loans, loan guarantees and other appropriate measures to qualified entities to develop and deploy innovative fuel and vehicle technologies that will help achieve California's petroleum reduction, air quality and climate change goals, without adopting or advocating any one preferred fuel or technology. In addition to funding alternative fuel and vehicle projects, the Program also funds workforce training to prepare the workforce required to design, construct, install, operate, produce, service and maintain new fuel vehicles.

2.2.4. California Transportation Plan

The California Transportation Plan (CTP) is a Statewide, long-range transportation plan to meet future mobility needs and reduce GHG emissions. The Plan defines performance-based goals, policies, and strategies to comply with MAP-21 and to achieve an integrated, multimodal transportation system. The Plan is prepared in response to federal and State requirements and is updated every five years. The first Plan, CTP 2025 was approved in 2006, updated to CTP 2030 as an Addendum in 2007. Caltrans is in the beginning stages of preparation of CTP 2040 which is scheduled for completion in December of 2015. Caltrans is required to prepare a California Transportation Plan before 2016 and every five years thereafter. The Plan will address how the State will achieve maximum feasible emissions reductions, taking into consideration the use of alternative fuels, new vehicle technology and tailpipe emissions reductions. Caltrans must consult and coordinate with related State agencies, air quality management districts, public transit operators and regional transportation planning agencies. Caltrans must also provide an opportunity for general public input, and submit a final draft of the Plan to the legislature and governor.

2.3. Regional

2.3.1. Southern California Association of Governments

SCAG serves as the metropolitan planning organization for the region. The Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), adopted April 2012, and Regional Comprehensive Plan (RCP) are tools used for identifying the transportation priorities of the Southern California region. The policies and goals of both plans focus on the need to coordinate land use and transportation decisions to manage travel demand within the region. The RCP was never formally adopted, but serves as an advisory document that defines solutions to interrelated housing, traffic, water, air quality, energy and other regional challenges, and is intended to provide a framework for local government decision-makers regarding growth and development. The RCP lays out a strategy to reverse the current energy trends and diversify energy supplies to create clean, stable and sustainable sources of energy. This strategy includes the reduction of fossil fuel consumption and an increase in the use of clean, renewable technologies. RCP policies that are applicable to the HDC Project include:

- *Policy EN-14*: Developers and local governments should explore programs to reduce single occupancy vehicle trips such as telecommuting, ridesharing, alternative work schedules and parking cash-outs (A State law to reduce vehicle commute trips and emissions by offering employees the option of "cashing out" their subsidized parking space and taking transit, biking, walking or carpooling to work).

- *Policy EN-16*: Local governments and project implementation agencies should consider various best practices and technological improvements that can reduce the consumption of fossil fuels such as:
  - Encouraging investment in transit, including light rail; and
  - Developing infrastructure for alternative fuel vehicles.

The RTP/SCS provides a framework for the future development of the regional transportation system through the year 2035 and addresses all modes of transportation within the region. 2012-2035 RTP/SCS goals that are applicable to the proposed project include:

- Preserve and ensure a sustainable transportation system; and
- Protect the environment, improve air quality, and promote energy efficiency.

These goals are implemented through the five policies established by SCAG in the RTP/SCS. Policies include balancing safety, maintenance and efficiency of the existing transportation system with the need for system expansion.

2.3.2. County of Los Angeles General Plan

The Mineral and Energy Resources Section of the Conservation and Natural Resources Element in the County's General Plan addresses the use and management of valuable energy and mineral resources in Los Angeles County (Los Angeles County 2015). The County recognizes that there is a high demand for energy resources and projected growth in the region will continue to strain these supplies. The General Plan seeks to promote efficient and sustainable use of energy resources and combat the stress placed on finite energy resources by patterns of low-density, automobile-dependent communities. Conservation and Natural Resources Goal 12 (Sustainable management of renewable and non-renewable energy resources) includes the following policies:

- *Policy C/NR 12.1*: Encourage the production and use of renewable energy resources.
- *Policy C/NR 12.2*: Encourage the effective management of energy resources, such as ensuring adequate reserves to meet peak demands
- *Policy C/NR 12.3*: Encourage distributed systems that use existing infrastructure and reduce environmental impacts.

The Mobility Element of the General Plan includes policy guidelines and strategies to reach the County's long-term transportation goals. Specific policies include the following:

- *Policy M 4.1*: Expand transportation options that reduce automobile dependence.
- *Policy M* 4.10: Support the linkage of regional and community-level transportation systems, including multi-modal networks.
- *Policy M* 4.12: Work with adjacent jurisdictions to ensure connectivity and the creation of an integrated regional network.

- Policy M 4.15: Reduce vehicle trips through the use of mobility management practices, such as the reduction of parking requirements, employer/institution based transit passes, regional carpooling programs, and telecommuting.
- Policy M 4.16: Promote mobility management practices, including incentives to change transit behavior and using technologies, to reduce VMTs [vehicle-miles traveled].
- Policy M 5.3: Maintain transportation right-of-way corridors for future transportation uses, including bikeways, or new passenger rail or bus services

2.3.3. County of San Bernardino General Plan

The Conservation Element of the County of San Bernardino General Plan addresses the use and management of valuable energy. Applicable policies include:

- *Policy CO8.1*: Maximize the beneficial effects and minimize the adverse effects associated with the siting of major energy facilities.
- *Policy CO8.3*: Assist in efforts to develop alternative energy technologies that have minimum adverse effect on the environment, and explore and promote newer opportunities for the use of alternative energy sources.
- *Policy CO8.4*: Minimize energy consumption attributable to transportation within the County.

2.4. LOCAL

2.4.1. City of Palmdale General Plan

The Environmental Resources Element of the City of Palmdale General Plan establishes the following applicable policy:

- *Policy ER9.1*: Support the growth of solar power as a renewable energy source in the City of Palmdale.

In addition, the City of Palmdale has adopted an Energy Action Plan for the conservation and reduction of energy use that contains the following applicable policies:

- *Policy 3.4:* Facilitate the establishment of large-scale solar facilities to supply regional energy needs.
- *Policy 4.3:* Reduce emissions from mobile sources through efficient vehicle flow.
- *Policy 4.7:* Support the expansion of transit options within Antelope Valley to reduce vehicle miles traveled.

2.4.2. City of Lancaster General Plan

The Energy Resources section of the Natural Environment Chapter of the City of Lancaster General Plan contains the following applicable policies:

- *Policy 3.6.1a:* Require the inclusion, where feasible, of provisions for energy efficient modes of transportation and fixed facilities which establish transit, bicycle, equestrian, and pedestrian modes as desirable alternatives.

- *Policy 3.6.3a:* Investigate the feasibility of adopting an Energy Ordinance that will encourage the installation of energy conservation measures on rehabilitation or expansion projects; and retrofitting energy conservation measures on existing structures that require major renovation. Specific measures include, but are not limited to, solar heating systems for pools and other appropriate facilities and provisions for industrial projects that will facilitate the installation of photovoltaic electric generating units.
- *Policy 3.6.4a:* Work with federal, State, and utility agencies to identify and support legislation for funding of research and/or the development of alternate energy sources.
- *Policy 3.6.4b:* Maintain open communication with other local, regional, State or federal agencies regarding the evaluation of current energy problems and state-of-the-art technologies and practices.
- *Policy 3.6.5a:* Emphasize fuel efficiency in the acquisition and use of City-owned vehicles, and consider all programs which would serve to enhance or encourage the use of alternative fuel vehicles, non-motorized and public transit systems.
- *Policy 3.6.6:* Consider and promote the use of alternative energy such as wind energy and solar energy.

2.4.3. City of Adelanto General Plan

The Natural Resources and Air Quality sections of the Conservation/Open Space Element of the City of Adelanto General Plan contains the following applicable policies:

- *Policy NR1.1*: The City shall promote the development and use of alternative energy sources, such as passive solar in industrial, commercial, and residential developments.
- Policy AQ1.8: The City will consider all feasible means of reducing vehicle miles traveled by City employees and residents.

2.4.4. City of Victorville General Plan

The Circulation and Resource Elements of City of Victorville General Plan contain the following applicable policies:

- *Policy 3.1.1*: Planning and design of new roadways and expansion/completion of existing roadways shall include consideration of water, sewer, storm drainage, communications, and energy facilities that can be co-located within the road right-of-way.
- *Policy: 6.1.1*: Encourage planning and development activities that reduce the number and length of single occupant automobile trips.
- *Policy 7.1.1*: Support development of solar, hybrid, wind and other alternative energy generation.

2.4.5. Town of Apple Valley General Plan

The Air Quality and Energy and Mineral Resources Elements in the Environmental Resources Chapter of the Town of Apple Valley General Plan contain the following applicable policies:

- *Policy 1.A*: The community and all economic sectors shall be urged to conserve energy, with particular focus on the inclusion of energy saving measures in transport systems, and in the planning and construction of urban uses.
- *Policy 1.B*: Promote building design and construction that integrates alternative energy systems, including but not limited to solar, thermal, photovoltaics and other clean energy systems.
- *Policy 1.D*: The Town will encourage and facilitate the exploitation of local renewable resources by supporting public and private initiatives to develop and operate alternative systems of electricity generation, using wind, solar and other renewable energies.
- *Policy 1.F*: The Town shall support, encourage, and facilitate the development of projects that enhance the use of alternative modes of transportation, including pedestrian-oriented retail and activity centers, dedicated bicycle paths and lanes, and community-wide multi-use trails.
- *Policy 1.K:* The Town shall participate in regional greenhouse gas reduction planning efforts.

3. AFFECTED ENVIRONMENT/EXISTING CONDITIONS

3.1. Energy Resources

Energy is currently consumed in the study area for the construction of public and private projects; operation of automobiles and trucks; and for the operation of existing land uses. Proposed construction improvements would occur along the length of the HDC.

California contains abundant sources of renewable and non renewable energy. Non-renewable resources include large crude oil and natural gas deposits that are located within six geological basins in the Central Valley and along the coast. A majority of these reserves are concentrated in the southern San Joaquin Basin. Approximately 17 percent of the country's 100 largest oil fields are located in California, including the third largest oil field in the contiguous United States, the Belridge South Oil Field, located approximately 40 miles west of Bakersfield in the San Joaquin Valley. Studies have also indicated that large undiscovered deposits of recoverable oil and gas lie offshore in the Outer Continental Shelf, although federal law currently prohibits new leases on oil and gas extraction in that area.

California's renewable energy sources include: hydroelectric, with a power potential that ranks second in the country; geothermal and wind power resources found along the coastal mountain ranges and the eastern border with Nevada; and solar energy potential concentrated in the southeast deserts. As the most populous state, California is second only to Texas in terms of total energy demand. Despite its high energy demand, California has one of the lowest per capita energy consumption rates in the country, partially attributable to energy-efficiency programs that have resulted in less energy consumption. As part of the overall economy, the transportation sector is responsible for the most energy consumption of any sector within the State. More motor vehicles are registered in California than any other state, and commute times rank as some of the longest in the country. The most abundant energy resources within the State are described below.

Petroleum. California is one of the top producers of crude oil in the country, accounting for approximately 8 percent of the country's total production in 2012. Drilling is concentrated primarily in Kern County and the Los Angeles Basin, although production can take place offshore in both State and federal waters. Concerns regarding the cumulative environmental impacts of offshore oil and gas development have led to a permanent moratorium on new offshore oil and gas leasing in California waters. The federal moratorium on leasing expired in 2008, however, no California off-shore areas have been included in the federal five year lease plan through 2017. Development on existing State and federal leases issued prior to the date of the moratorium can still occur. A network of pipelines connects the drilling areas to refining centers in the Los Angeles area, the San Francisco Bay area, and the Central Valley. California refineries also process Alaskan and foreign crude oil received at ports in Los Angeles, Long Beach, and the Bay Area. Crude oil production in California is in decline and refineries have become increasingly dependent on foreign imports. Foreign suppliers currently provide more than 50 percent of the crude oil refined in California (U.S. Energy Information Administration 2014).

California refineries are capable of processing a wide variety of crude oil types and are designed to yield a high percentage of light products such as motor gasoline. The refineries are configured to produce cleaner fuels, including reformulated motor gasoline and low-sulfur diesel. Since 1996, refineries in California have been producing a special motor gasoline blend called California Clean Burning Gasoline. In the ozone nonattainment areas of Imperial County and the Los Angeles metropolitan area, motorists are required to use Oxygenated California Clean Burning Gasoline. Because California requires specific and unique fuel blends and the State petroleum market is relatively isolated, motorists are vulnerable to short-term spikes in the price of gasoline. As a result, California refineries often operate at close to maximum capacity.

California completed a transition from methyl tertiary butyl-ether to ethanol as a gasoline oxygenate additive in 2004, making California the largest ethanol fuel market in the United States. Four ethanol production plants are located in central and southern California, but most of the ethanol supply is imported by rail from the Midwest.

Natural Gas. California natural gas production accounts for approximately one percent of total production in the country and satisfies less than 20 percent of State demand. Production takes place in basins located in northern and southern California, as well as offshore. California receives most of its natural gas by pipeline from production regions in the Rocky Mountains, the southwest, and western Canada. While California natural gas production is in decline, the supply has remained relatively stable due to increasing amounts of natural gas shipped from the Rocky Mountains. California markets are served by two key natural gas trading centers—the Golden Gate Center in northern California and the California Energy Hub in southern California—and the State has nearly a dozen natural gas storage facilities that help stabilize supply. Several companies have proposed building liquefied natural gas import terminals in southern California to help meet California's demand for natural gas.

Electricity. The major sources of electricity in California are from natural gas powered plants, hydroelectric, and nuclear. Natural gas-fired power plants generate more than 50 percent of the State's electricity. California is one of the largest hydroelectric power producers in the country, producing approximately 13 percent of the State's electricity. California has one remaining nuclear power plant (Diablo canyon in Central California) accounting for approximately 9 percent of the State's electricity. Due to strict emission laws, only a few small coal-fired power plants operate in California.

Renewable Energy. California is second in the country in electricity generation from non-hydroelectric renewable energy sources. A facility known as "The Geysers," located in the Mayacamas Mountains north of San Francisco, is the largest complex of geothermal power plants in the world, with more than 750 megawatts of installed capacity. California is the top producer of electricity from geothermal energy in the country, generating 7 percent of its electricity in 2012. Five percent of the electricity generated in the State is produced by wind energy, which is ranked third in the country. The world's largest solar power facility operates in California's Mojave Desert. Two southern California utilities are planning to build new solar farms, a 500-megawatt facility in the Mojave Desert and a 300-megawatt plant in the Imperial Valley. The California Energy Action Plan includes incentives that encourage the installation of individual solar power systems on rooftops to further increase renewable energy usage.

Due to high electricity demand, California imports more electricity than any other state. States in the Pacific Northwest deliver power to California markets primarily from hydroelectric sources, while states in the Desert Southwest deliver power primarily from coal- and natural gas-fired sources. Hydroelectric power comes to California primarily through the Western USA interconnection, which runs from northern Oregon to southern California. The system, also known as the Pacific Intertie, is the largest single electricity transmission program in the United States. Although the Pacific Intertie was originally designed to transmit electricity south during California's peak summer demand season, flow is sometimes reversed overnight and has occasionally been reversed during periods of reduced hydroelectric generation in the Northwest. California restricts the use of coal-fired generation within its boundaries; however, the Los Angeles Department of Water and Power (LADWP) operates a coal-fired power plant in Utah, which delivers three-fourths of its output to LADWP and other California municipal utilities. Recent California legislation prohibits utilities from entering into new long-term contracts with conventional coal-fired power producers.

California suffered an energy crisis in the early 2000s that was characterized by electricity price instability and four major blackouts caused by a supply and demand imbalance. Following the energy crisis, the California State government created an Energy Action Plan designed to eliminate outages and excessive price spikes. To achieve these goals, the plan calls for optimizing energy conservation, building sufficient new generation facilities, upgrading and expanding the electricity transmission and distribution infrastructure, and ensuring that generation facilities can quickly come online when needed. In 2006, California amended its renewable portfolio standard to require investor-owned utilities, electric service providers, small and multi-jurisdictional utilities, and community choice aggregators to provide at least 20 percent of retail sales from renewable sources by the end of 2010 and 33 percent by the end of 2020. California has also adopted other policies to promote energy efficiency and renewable energy, including energy standards for public buildings, power source disclosure requirements for utilities, and net metering.

3.2. Current Energy Consumption

Energy consumption is expressed in BTU as a common unit of measure.[2] Other units of energy can be converted into equivalent BTU and, thus, the BTU is used as a basis for comparing the consumption of different energy resources. Table 3-1 is a comparison of equivalent BTU for four types of energy.

Table 3-1. Energy Comparisons

Energy Type	Energy Unit	Equivalent BTU
Electricity	Kilowatt Hour (kWh)	3,412
Natural Gas	Cubic Foot	1,034
Crude Oil	Barrel (42 gallons)	5,800,000
Gasoline	Gallon	125,000

Source: California Energy Commission 2011

Energy consumption in California continues to be dominated by growth in passenger vehicles; hence, approximately 38 percent of all energy consumed in the State is used for transportation.[3] California's population is estimated to reach 41 million by 2020, which would result in substantial increases in the State's transportation fuel demand[4].

[2] A BTU is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at sea level.
[3] United States Energy Information Administration, *2011, State Energy Data 2011: Consumption.*
[4] Demographic Research Unit, California Department of Finance, December 2014.

Table 3-2 shows the anticipated transportation fuel demand from 2010 to 2030. While gasoline usage is reaching a plateau, demand for diesel, ethanol, and jet fuel are all projected to increase by over 50 percent for the 20 year period. Regarding gasoline, California vehicle standards have resulted in fleet improvements in passenger vehicle efficiency. As a result, the State is predicted to experience a 2-billion-gallon decline in gasoline consumption from 14.6 billion gallons per year in 2012 to 12.7 billion gallons per year by 2022.[5] The increase in diesel fuel is generally related to growth in freight transport and the increase in ethanol is related to State policies related to encouraging the use of alternative fuels.

Table 3-2. California Transportation Fuel Demand

Year	Gasoline	Diesel	Ethanol	Jet Fuel
	Barrels (million/year)/a/			
2010	361	80	0.08	76
2015	380	90	0.09	88
2020	353	102	0.10	100
2025	335	114	0.18	114
2030	332	125	0.21	129
/a/ The numbers shown for barrels per year are the average between the High Petroleum Demand Forecast and Low Petroleum Demand Forecast numbers.				

Source: California Energy Commission, 2011

Table 3-3 displays the energy requirements for various modes of transportation including automobile, bus and rail.

Table 3-3. Fuel Demand By Transportation Mode

Transport Mode	BTU/Passenger Mile	BTU/VMT
Automobile	3,538	5,489
Transit Bus	4,242	39,160
Commuter Rail	2,812	91,936
Urban Rail	2,462	64,585

Source: Oak Ridge National Laboratory, 2011

Urban growth patterns have caused California's VMT to increase at a rate of over three percent per year between 1975 and 2011. Table 3-4 shows the trend in daily VMT within Los Angeles and San Bernardino Counties from 2010 through 2035. It is anticipated that the VMT will increase by approximately 13.4 percent from 2013 to 2035 in Los Angeles County. In San Bernardino County, it is anticipated that the VMT will increase by approximately 44.2 percent from 2013 to 2035 in San Bernardino County.

[5]University of California San Diego, Black Carbon and the Regional Climate of California, January 22, 2013.

Table 3-4. Daily VMT

Year	VMT (millions)	BTU/a/ (trillions)	Barrels of Oil/b/
County of Los Angeles			
2010	227.7	1.25	215,491
2013	231.6	1.27	219,181
2020	242.7	1.33	229,686
2035	262.6	1.44	248,519
County of San Bernardino			
2010	64.6	0.355	61,136
2013	68.1	0.374	64,448
2020	77.5	0.426	73,534
2035	98.2	0.539	92,934
/a/ The energy consumption factor for passenger vehicles (which includes cars, motorcycles and light trucks was used to calculate BTU. One passenger vehicle mile is equal to 5,489 BTU. /b/ One barrel of oil is equal to 42 U.S. gallons which is equal to 5,800,000 BTU (based on U.S. production, 2009).			

Source: EMFAC2011; U.S. Energy Information Administration, September 2011

Table 3-5 shows the annual energy usage associated with motor vehicles within Los Angeles and San Bernardino Counties. Currently, the total energy usage within Los Angeles and San Bernardino Counties is approximately 107 trillion BTU per year, based on an estimated 109 billion VMT for 2013. Energy usage associated with motor vehicles within the counties of Los Angeles and San Bernardino could approach 132 trillion BTU by 2035.

Table 3-5. Annual Motor Vehicle Energy Usage

Scenario	BTU (trillions)
Los Angeles County	
2013	84.5
2035	95.8
San Bernardino County	
2013	24.8
2035	35.8

Source: EMFAC2011

Energy consumption for transportation and its associated environmental effects can be reduced through the application of advanced technologies, such as materials that are lighter, stronger and more durable; improved fuel efficiency or use of alternative/renewable fuels; and new energy storage and delivery sources (advanced batteries, fuel cells).

Fuel savings and pollution reduction have resulted from transportation control measures mandated by the Clean Air Act Amendments of 1990; namely expanded urban mass transit and advanced rail options; switching to cleaner fuels in congested non-attainment areas (e.g., from diesel to compressed natural gas, or alternative fuels); and reducing VMT with incentives and disincentives (e.g., restricting parking, promoting high occupancy vehicles or car-pooling, offering transit subsidies); and instituting pollution controls at the source (e.g., stricter inspection and maintenance requirements, improved catalytic converters).

California has experienced modest but notable increases in the use of alternative fuels. Alternative fuels include liquid and gaseous fuels and electricity used in cars, trucks, and buses.

Liquid biofuels are blended with gasoline or diesel, or in some instances, replace gasoline (E85) or diesel (B100 or 100 percent biodiesel and renewable diesel). During the period from 2003 to 2012, alternative fuel market penetration grew to 7.3 percent of on road transportation fuel consumption.[6] This growth is mainly due to an increase in ethanol blends in gasoline and modest growth in natural gas and biodiesel fuel use in trucks and buses. Several industry experts conclude that multiple factors increase the plausibility of alternative fuel growth within the next ten years in North America and particularly in California. The trend toward increased use of alternative fuels could potentially contribute to the future transition away from petroleum dependency, could facilitate an expansion of the alternative fuels infrastructure, and provide consumers with an alternative given the finite supply of petroleum, which could minimize the effects of future petroleum-related energy scenarios.

[6]U.S. Energy Information Administration, Annual Energy Outlook 2012 with Projections to 2035, June 2012.

4. ENVIRONMENTAL CONSEQUENCES

4.1. METHODOLOGY

The energy analysis is based on the methodology described in the Caltrans Standard Environmental Reference, Volume 1, Chapter 13 – Energy. The energy analysis addresses both direct and indirect energy consumption. Direct energy refers to the fuel consumed by vehicles traveling within the study area. There are a number of other indirect energy-using phases in the lifecycle of transport systems as well, including the energy required for construction and maintenance of roads, manufacturing and service of vehicles and facilities, and production and distribution of gasoline and diesel. For purposes of this analysis, indirect energy refers to the energy associated with construction and maintenance of the proposed project.

Direct energy consumption for the project was estimated using traffic model forecasts for VMT and the EMFAC2011 air quality model, which provides estimated gasoline and diesel fuel consumption rates for years 2020 and 2040 that incorporate adopted energy and conservation measures. Estimated energy consumption in 2040 is considered to be the most conservative (i.e., highest) because population and employment are projected to be higher in that year than in any earlier year. In addition, the analysis reflects approved efficiency and conservation measures in future years although it does not reflect policies that are being considered but not yet adopted. The impact of energy efficiency and conservation measures that are likely to be adopted in the future would result in lower energy consumption than projected in these estimates (i.e., new California Environmental Protection Agency fuel economy standards, transit improvements, and high-occupancy vehicle lanes). Energy consumption factors for the various transportation modes were developed by the Oak Ridge National Laboratory (2011) and the Federal Transit Administration (2011), National Transit Database. These factors were used to calculate energy consumed by the various modes of transportation. The energy consumption of the proposed project is compared to the projected 2040 baseline conditions, which assume that limited transportation improvements have occurred, but that the proposed project was not implemented. Given average values of energy consumption for various vehicles based on available data, and knowing the number of vehicle miles of travel, it is possible to determine energy consumption per vehicle miles of travel and ultimately per day or per year.

The indirect energy impacts associated with the construction and maintenance of the build alternatives are directly related to the total project capital cost and maintenance cost. The amount of energy consumed during construction was calculated on an assumed construction cost per-lane-mile and whether the construction is anticipated to be at grade or grade-separated. Construction energy for the highway build alternatives (Freeway/Tollway and Freeway/Tollway) is not separated because the lane configurations and type of construction would be similar.

In addition, indirect energy consumption was calculated for the movement of fill material needed to construct the infrastructure. The estimated soil needed was based on the facility width and height characteristics of each alternative. The number of haul truck trips needed to move the soil was calculated based on a load capacity of 20 cubic yards per truck. Based on the distribution of mines that could potentially supply fill material for the project, it was estimated that the average haul truck trip length would be approximately 45 miles for imported fill material and 10 miles for on-site fill material. The amount of energy was then calculated based on the number of haul truck trips and distance, using a haul truck energy intensity factor of 20,539 BTU per mile.

4.2. Impact Thresholds

4.2.1. NEPA Guidance

According to the Council on Environmental Quality regulations (40 CFR §§ 1500-1508), the determination of a significant impact is a function of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Both short- and long-term effects are relevant. Intensity refers to the severity of impact. To determine significance, the severity of the impact must be examined in terms of the type, quality and sensitivity of the resource involved; the location of the proposed project; the duration of the effect (short- or long-term) and other consideration of context. Adverse impacts will vary with the setting of the proposed action and the surrounding area.

4.2.2. California Environmental Quality Act (CEQA) Guidance

In accordance with Appendix F of CEQA, the HDC Project would result in a significant impact related to energy if it would:

- Conflict with adopted energy conservation plans;
- Use non-renewable resources in a wasteful or inefficient manner; or
- Result in a need for energy supplies and distribution infrastructure or capacity enhancing alterations to existing power or natural gas facilities.

For purposes of the HDC Project, the following impact significance threshold has been applied in the energy analysis, to address both the National Environmental Policy Act (NEPA) and CEQA significance criteria:

Energy Threshold

Will the proposed project alternatives result in an inefficient use of energy that is inconsistent with current plans and policies, or would require significant upgrades to the existing energy transmission infrastructure?

4.3. Impacts

Implementation of the proposed project would affect the use of energy resources in Los Angeles and San Bernardino Counties. The analysis of these impacts is at the regional level and is therefore, by its nature, an analysis of cumulative impacts. Three main areas of impact have been identified: (1) energy demands for construction; (2) energy demands for operation of the project; and (3) the cumulative impacts of the growing energy demand associated with implementation of the project.

4.4. No Build Alternative

Under the No Build Alternative, the permanent effects on energy consumption for the build alternatives would not occur for the project itself, but these permanent energy consumption effects would occur for the other transportation improvement projects included in the No Build

Alternative. Energy use would occur under the No Build Alternative for all of the cumulative transportation projects in the study area. Without the capacity improvements proposed in the build alternatives, congested traffic conditions and limitations on mobility would be more prevalent throughout the study area. These conditions would contribute to inefficient energy consumption, as vehicles would use extra fuel while idling in stop-and-go traffic or moving at slow speeds through congested roadways. Under the No Build Alternative, transportation improvement projects would adhere to adopted regulations and policies regarding energy efficiency. The energy inefficiency would not be the result of actions that are inconsistent with current plans and policies. Therefore, the No Build Alternative would result in less-than-significant impacts.

4.5. Build Alternatives

4.5.1. Direct Energy Use

Energy use during operations of any alternative are directly related to the gasoline and diesel consumption of automobiles, trucks, and buses, as well as to the propulsion energy generated for powering transit vehicles. Operational energy consumption was estimated for the vehicles (autos and heavy-duty trucks) traveling within the proposed area and for the proposed HSR service. The energy usage associated with a round trip for the operation of the HSR Feeder/Connector Service from the city of Palmdale to Victorville is shown in Table 4-1. Based on frequency of scheduled service, the annual energy would be 104,716 million BTU, which is a fraction of the 871.8 and 998.7 trillion BTU consumed annually with the No Build Alternative in 2020 and 2040, respectively. The HSR Feeder/Connector Service would consume approximately 2.7 trillion BTU combined over the lifetime period of 26 years, which is a nominal increase of approximately 0.3 percent for one year of energy consumption under the No Build Alternative. No further analysis is necessary.

Table 4-1. HSR Feeder/Connector Service Energy Usage

Segment	Distance (miles)	Time (minutes)	Energy Consumption	
			Kw-hr /a/	BTU (millions)
Westbound Victorville-Palmdale	52	21.44	3,277	11.18
Eastbound Palmdale-Victorville	52	21.59	3,285	11.21
Roundtrip	104	43.03	6,562	22.39
Annual			30,690,738	104,716
/a/ One Kw-hr is equal to 3,412 BTU				

Source: HSR Feeder/Connector Service Load Simulation and Modeling (Appendix A), 2013.

The proposed project improvements would occur along the length of the HDC Project. Local energy demand for transportation projects typically is dominated by vehicle fuel consumption. For study area VMT, energy calculations are based on annual VMT (Table 4-2) for the 2020 base year and the build-out year 2040, for each alternative.

Table 4-2. Annual Projected Operational Energy Consumption By Alternative

Alternative	VMT (millions)	Energy Consumption		% Change from No Build
		BTU /b/ (trillions)	Barrels /c/ (millions)	
2020				
No Build	158,824	871.8	150.3	--
Freeway/Tollway	159,369	874.8	150.8	0.34
Freeway/Tollway	159,429	875.1	150.9	0.38
Freeway/Tollway with HSR /a /	158,967	872.6	150.4	0.09
Freeway/Tollway with HSR /a /	159,010	872.8	150.5	0.12
2040				
No Build	181,941	998.7	172.19	--
Freeway/Tollway	182,734	1,003.0	172.94	0.44
Freeway/Tollway	182,782	1,003.3	172.98	0.46
Freeway/Tollway with HSR/a /	182,156	999.9	172.4	0.12
Freeway/Tollway with HSR /a /	182,247	1000.3	172.5	0.17

/a/ The ridership for HSR results in less auto VMT than the Freeway/Tollway and Freeway/Tollway Alternatives. The VMT for HSR was back-calculated using an energy consumption factor for rail transit from an estimated energy usage that was calculated through a Load Flow Simulation and Modeling run (Table 4-1).
/b/ The energy consumption factor for passenger vehicles (which includes cars, motorcycles and light trucks was used to calculate BTU. One passenger vehicle mile is equal to 5,489 BTU.
/c/ One barrel of oil is equal to 42 U.S. gallons which is equal to 5,800,000 BTU (based on U.S. production, 2009).

Sources: Parsons, 2014; EMFAC2011; U.S. Energy Information Administration, 2011

Table 4-2 shows that the VMT would increase for each of the build alternatives compared to the No Build Alternative. This increase could be interpreted to indicate that the project would create trips, when in fact, it would primarily redistribute trips. This increase in VMT represents a worst-case scenario as the project would decrease travel delay by creating a shorter, direct route with faster travel speeds. However, the model reflects an increase in VMT due to the following reasons:

- The increased capacity for vehicles with implementation of the proposed project. Vehicles from outside the area would be attracted to the shorter route provided by the proposed project, resulting in less regional VMT.
- The mode shift from automobiles to transit with the provision of the HSR service.
- The trip lengths for individual vehicles within the study area is held constant when in actuality, the more direct route provided by the proposed alternatives would result in shorter trip lengths and an associated reduction in VMT.

However, for project consistency, the VMT was analyzed as output by the model.

Freeway/Tollway Alternative. As shown in Table 4-2, the Freeway/Tollway Alternative would result in a 0.34 percent increase in energy consumption in 2020 and a 0.44 percent increase in energy consumption in 2040 compared to the No Build Alternative. This increase represents a nominal change and would not substantially deplete energy supplies. Vehicle speeds would be increased and travel times would be reduced and the increased energy would be used efficiently. Therefore, a less-than-significant energy impact related to the operation of the Freeway/Tollway Alternative would occur.

Freeway/Tollway Alternative. As shown in Table 4-2, the Freeway/Tollway Alternative would result in a 0.38 percent increase in energy consumption in 2020 and a 0.46 percent increase in energy consumption in 2040 compared to the No Build Alternative. This increase represents a nominal change and would not substantially deplete energy supplies. Vehicle speeds would be increased and travel times would be reduced and the increased energy would be used efficiently. Therefore, a less-than-significant energy impact related to the operation of the Freeway/Tollway Alternative would occur.

Freeway/Tollway with HSR Feeder/Connector Service. As shown in Table 4-2, the Freeway/Tollway with HSR Feeder/Connector Service Alternative would result in a 0.09 percent increase in energy consumption in 2020 and a 0.12 percent increase in energy consumption in 2040 compared to the No Build Alternative. This increase represents a nominal change and would not substantially deplete energy supplies. Vehicle speeds would be increased and travel times would be reduced and the increased energy would be used efficiently.

The traffic analysis prepared for the proposed project found that approximately 81 percent of the projected HSR ridership would be diverted from automobiles. When subtracting HSR annual energy requirements, this would result in a reduction in energy consumption of approximately 641 billion BTU in 2020 and 833 billion BTU in 2040. Over the 26-year span of the project, an approximately 15.9-trillion BTUs reduction would occur as a result of automobile diversion to HSR Feeder/Connector Service. Therefore, a less-than-significant energy impact related to the operation of the Freeway/Tollway with HSR Feeder/Connector Service Alternative would occur.

Freeway/Tollway with HSR Feeder/Connector Service Alternative. As shown in Table 4-2, the Freeway/Tollway with HSR Feeder/Connector Service Alternative would result in a 0.12 percent increase in energy consumption in 2020 and a 0.17 percent increase in energy consumption in 2040 compared to the No Build Alternative. This increase represents a nominal change and would not substantially deplete energy supplies. Vehicle speeds would be increased and travel times would be reduced, and the increased energy would be used efficiently. As described above, a substantial reduction in energy consumption of approximately 641 billion BTU in 2020 and 833 billion BTU in 2040 would result from HSR ridership diversion from automobiles. Therefore, a less-than-significant energy impact related to the operation of the Freeway/Tollway with HSR Feeder/Connector Service Alternative would occur.

All of the energy policies described in the regulatory setting involve achieving varying degrees of energy efficiency, reduced consumption of non-renewable resources, and increased use of alternative modes of transportation. The build alternatives would be consistent with these policies as vehicle speeds and trip lengths would be reduced.

By 2040, the decreased supply of fossil fuels could potentially affect travel. As time goes on, public policy will likely continue to press for further changes in fuel type, resulting in more hybrids and electrically powered vehicles. Also decreased consumption of gasoline as a result of these developments may produce other changes in public policy, such as introducing carbon or vehicle-miles of travel taxes, which could also result in decreased travel overall. These reductions could also result in increased fuel costs, which could result in decreased travel overall. The differences among the alternatives are small enough to have little to no effect on total energy usage or fuel availability along the corridor or in the region. Operational energy consumption calculations are based on study area VMT; because the changes among the

Alternatives are incremental, no significant differences in energy usage would result. The alignment variations for the alternatives would also have no significant impact on energy usage. No substantial alterations to the existing energy infrastructure would be required for the HDC Project. Therefore, based on available information about fossil fuel availability, vehicle technology advancements, and the trends from data related to traffic, all of the build alternatives would have less-than-significant operational energy consumption impacts.

Green Energy Component

This HDC Project will comply with the goals set forth in Assembly Bill 32 and Senate Bill 375 to establish a sustainable corridor with a green energy capability. All viable green and sustainable technologies currently available and those anticipated to be available in the future have been studied. The viable options will be incorporated into the project design. Technologies that have been identified to have potential for incorporation into the HDC are as follows:

Photovoltaic Solar Highways

Photovoltaic (PV) technology is one of the most promising technologies researched and is already in use at some state departments of transportation and several international transportation highway facilities. The PV panels are generally fixed in place or on tracking systems designed to optimize the location's solar-generation capability. In California, solar energy is commonly used by the property owner to power energy-using devices or returned to the electric grid to offset energy usage by the facility in a net-metering program approved by the California Public Utilities Commission.

Design Requirements and Locations

Solar generation usually requires significant amounts of land or building roof space and is best suited for areas where energy does not have to travel far to access an existing utility transmission line. Other ideal locations would be those parcels or areas on flat land that do not have any shading concerns to impede sunlight. Specific areas that may be suitable for this type of technology may be highway interchanges and or utility substations. Solar lighting at interchange locations, at the on- and off- ramps, would conserve the amount of right-of-way (ROW) needed and could be grid-free, not requiring any tie of hard wiring to an existing electric grid. Additional locations that may be considered are median barriers in the center of the HDC or solar panels mounted at soundwalls along the HDC. Mounting solar panels at these locations would not incur the use of additional ROW for the highway footprint.

Non-Fossil Fuel Refueling Stations

Non-fossil refueling stations are more commonly known as Alternative Fueling Stations. The United States Department of Energy defines alternative fuels as either alcohol blends, such as ethanol; hydrogen; biofuels (e.g., biodiesel); or natural gas (e.g., propane, compressed natural gas [CNG], and liquefied natural gas [LNG]).

With stricter air quality regulations and fuel efficiency requirements, the demand for "greener" fueling and new vehicle technologies is projected to be higher. Businesses and communities could develop various alternative refueling dispensing facilities such as Electric Vehicle (EV) Charging Station, CNG, and LNG.

Federal and State subsidies have encouraged the development of alternative fuels and technologies that use these alternative fuels. Currently, there are many Alternative Fueling Stations located near the HDC.

Design Requirements and Locations

A typical footprint necessary to construct an Alternative Fueling Station would be relatively small in comparison to a regular gas station. With the creative use of ROW, EV charging stations could be conveniently sited at or near interpretive pullout locations and rest areas located at or near bicycle and pedestrian paths and trails. At these pullout areas, vehicles could stop and use electricity generated onsite through solar shade structures. This type of mutual relationship, solar shade structures at parking areas, especially in the hot High Desert areas, would be beneficial to freeway motorists who need to access these areas for either recreational or fueling purposes.

Opportunity for Utility Utilization of Highway Right-of-Way

Major electrical utility providers near the HDC include Southern California Edison and LADWP. For gas transmission, Sempra Energy (Southern California Gas Company) and Pacific Gas and Electric are the providers within the HDC area. Several water purveyors may serve the communities around the HDC. The opportunity exists for these utility companies to utilize the existing highway ROW to transmit electricity natural gas, and water; however, specific requirements will have to be considered to ensure that the use of highway ROW by the utility companies would not affect highway safety.

Design Requirements and Locations

Transmission lines, depending on their voltage capacity, carry varying amounts of electricity. Most high-voltage lines are 230 kilovolts. The amount of area necessary for transmission lines would depend on how much electricity is transmitted. For high-voltage transmission, the area needed would be limited to the locations of the transmission towers, which typically have four legs on footings and air space for the power lines. For lower-voltage lines, such as those found in residential areas, power poles and airspace for the power lines are needed. Some jurisdictions may require the power lines to be buried. Gas lines would require excavation and be buried. Similar to gas lines, water and sewer main pipes would require excavation and be buried. If reclaimed/recycled water is available, installation of those lines would require special piping design requirements.

Summary of Green Energy Component Impact

The inclusion of the green energy component into the proposed project would further improve energy efficiency. Beneficial effects would result from reduced requirements from energy produced from fossil fuels and no significant impact would occur.

4.5.2. Indirect Energy Use

Indirect Impacts

Energy consumed for construction and maintenance is referred to as indirect energy usage. Energy use for maintenance comprises day-to-day upkeep of equipment and systems, as well as the energy embedded in any replacement equipment, materials, and supplies. The indirect energy impacts associated with the construction and maintenance of the Build Alternatives are directly related to the total project capital cost and maintenance cost. Table 4-3 shows the estimated construction costs for the Highway, HSR, and Highway with HSR Alternatives.

Table 4-3. Projected Construction and Maintenance Energy Consumption for the Build Alternatives

Annual Indirect Energy	Highway Alternatives	Highway with HSR/d/
Construction		
Lane Miles/a/	630	756
Conversion Factor (BTU per lane-mile) /b/	13,885	13,885/130,739/c/
Energy Use (trillion BTUs)	8.8	25.2
Maintenance		
Energy Use (trillion BTUs)/e/	2.2	6.3
Total Indirect Energy Usage	10.9	31.5

Note: BTU- British thermal units.
/a/ Assumed maximum build-out of 4 lanes + High Occupancy Vehicle lanes in each direction of the 63-mile alignment
/b/ Construction energy factors from Oakridge Laboratory, 1993
/c/ Includes combination of at grade and grade separated construction
/d/ HSR was analyzed as a fully grade-separated two-lane facility
/e/ Maintenance costs assumed to be 20% of total indirect costs

Source: EMFAC2011; U.S. Energy Information Administration, April 2011

The projected construction and maintenance energy consumption is greatest for the Freeway/Tollway with HSR Feeder/Connector Service Alternative, followed by the Freeway/Tollway with HSR Feeder/Connector Service Alternative, Freeway/Tollway Alternative, Freeway/Tollway Alternative, and No Build Alternative. The Freeway/Tollway Alternative would have the lowest indirect energy cost of the build alternatives because of the least amount of infrastructure to construct and maintain. The Freeway/Tollway Alternative with HSR Feeder/Connector Service would have the highest associated energy costs due to increased infrastructure and maintenance requirements.

Construction of the proposed project would require a substantial amount of grading and excavation. The freeway/tollway component of the project would require approximately nine feet of fill above grade upon which to build the highway. The HSR component of the project would require approximately 15 feet of fill above grade. Given the amount of soil needed to construct the new infrastructure, the import of fill material from offsite locations would be required in addition to fill material produced during earth moving activities within the right-of-way. The following analysis quantifies the energy consumption anticipated for the import of fill by trucks. A list of mines and their locations used as off-site fill supply is attached as Appendix B.

Table 4-4 shows the total estimated fill required, the amount of fill that can be supplied with on-site excavation, and the amount of imported off-site soil required for the project alternatives. Two types of truck trips will be required as a result of earthwork activities: (1) Earthwork Balance – truck trips within the project site to utilize excess material as fill wherever possible; and (2) Imported Fill – truck trips to import borrow material from nearby mines. Table 4-5 shows both types of truck trips and equivalent truck hours and the equivalent BTU consumed to acquire the fill material for the project alternatives. The estimated construction energy for truck trips to import soil ranges from 1,140 to 1,556 billion BTU for the alternatives.

Table 4-4. Projected Fill Required for Construction of the Build Alternatives

Alternative	Quantity and Type of Earthwork (million cubic yards)			
	On-Site Fill Excavated	Imported Soil Off-Site	Total Fill/a/	Soil Disposal Off-Site
Highway Alternatives	12	22	34	0
Highway with HSR Feeder/Connector Service	12	31	43	0
/a/ Assumes 9-foot fill for the Highway Alternatives, 15 feet fill for the HSR.				

Source: Caltrans 2014.

Table 4-5. Projected Construction Energy Consumption Required for Truck Activity for the Build Alternatives

Alternative	Truck Miles			BTU (billion)/a/
	Earthwork Balance (On-site)	Import	Total	
Highway Alternatives	6,000,000	49,500,000	55,500,000	1,140
Highway with HSR Feeder/Connector Service	6,000,000	69,750,000	75,750,000	1,556
/a/ Assumes 20,539 BTU per truck-mile for heavy duty trucks				

Source: Caltrans, 2014, US Department of Energy, 2007.

The energy consumption numbers are estimated values and do not depend on when the construction takes place or its duration. Indirect energy consumption ranges from approximately 11 to 32 trillion BTU for the alternatives. The variations in the alternatives would not a have a significant impact on the indirect energy requirements for the build alternatives.

Freeway/Tollway Alternative. As shown in Table 4-3, the energy consumption associated with the construction of the Freeway/Tollway Alternative would be an increase of 10.9 trillion BTU. This energy consumption represents approximately 1.09 percent of the operational energy consumption for the No Build Alternative in 2040. As shown in Table 4-5, energy consumed for soil transportation is estimated to be about 1,140 billion BTU, which is substantially higher than for the No Build Alternative. This is due to the comparatively wide right-of-way required for a 10-lane grade-separated highway. Although construction would require the use of nonrenewable resources, including fossil fuels and natural gas, the use of these resources would not substantially deplete existing supplies. The energy consumed during construction of the proposed project would be a small proportion of regional energy consumption. Therefore, construction of the build alternatives is not anticipated to create a significant impact on short-term energy demand during project construction. Therefore, a less-than-significant energy impact would occur during construction of the Freeway/Tollway Alternative.

Freeway/Tollway Alternative. The Freeway/Tollway Alternative would contain the same length of alignment and number of lanes as the Freeway/Tollway Alternative. This energy consumption represents approximately 1.09 percent of the operational energy consumption for the No Build Alternative in 2040. As this Alternative would likely include some private investment, the energy costs would be distributed to (an) additional source(s); however, the total energy consumption would be the same as the Freeway/Tollway Alternative. The energy consumed for soil transportation would be the same as the Freeway/Tollway Alternative at 1,140 billion BTU. Similar to the Freeway/Tollway Alternative, a less-than-significant energy impact would occur during construction of the Freeway/Tollway Alternative.

Freeway/Tollway with HSR Feeder/Connector Service Alternative. As shown in Table 4-3, the Freeway/Tollway with High Speed Rail Feeder/Connector Service Alternative would consume an additional 20.6 trillion BTU during construction, when compared to the Freeway/Tollway Alternative, for a total of 31.5 trillion BTU. This energy consumption represents approximately 3.16 percent of the operational energy consumption for the No Build Alternative in 2040. As shown in Table 4-5, energy consumed for soil transportation would be 1,556 billion BTU, which is substantially higher that the No Build construction energy consumption. The energy consumed during construction of the proposed project would be a small proportion of regional energy consumption. Similar to the alternatives described above, a less-than-significant energy impact would occur during construction of the Freeway/Tollway with HSR Feeder/Connector Service Alternative.

Freeway/Tollway with HSR Feeder/Connector Service Alternative. The Freeway/Tollway Alternative with HSR Feeder/Connector Service would contain the same length of alignment and number of lanes as the Freeway/Tollway Alternative with HSR Feeder/Connector Service. This energy consumption represents approximately 3.16 percent of the operational energy consumption for the No Build Alternative in 2040. The energy consumed for soil transportation would be the same as the Freeway/Tollway with HSR Feeder/Connector Service Alternative at 1,556 billion BTU. The energy consumed during construction of the proposed project would be a small proportion of regional energy consumption. Similar to the alternatives described above, a less-than-significant energy impact would occur during construction of the Freeway/Tollway with HSR Feeder/Connector Service Alternative.

In summary, the indirect energy consumption required for the HDC Project would be consistent with the applicable energy policies described in Chapter 2.0. As shown in the annual VMT data for the build alternatives in Table 4-2, the nominal increases in VMT and increases in population in the region, as well as the project improvements, would result in very small increases in indirect energy consumption in the study area compared to the No Build Alternative. No substantial alterations to the existing energy infrastructure would be required for construction of the HDC Project. In addition, the green energy infrastructure, if selected as part of the proposed project, would further offset some or all of the direct and indirect energy consumption associated with the proposed project. Therefore, no significant impacts related to indirect energy consumption would occur for the No Build, or any of the build alternatives.

5. AVOIDANCE, MINIMIZATION, AND/OR MITIGATION MEASURES

While the energy consumption of various build alternatives would not be substantially increased over the No Build Alternative as discussed above, Metro and Caltrans have planned to incorporate the green and sustainable technologies as part of the project components. Based on the Draft Green Energy Feasibility Study prepared for this project (June 2014), the following technologies are being recommended for further detailed study: photovoltaic solar highways; non-fossil fuel refueling stations; and opportunity for utility utilization of highway right-of-way. Inclusion of the green energy component into the proposed project would further improve energy efficiency. Should additional right-of way be required green energy infrastructure, such as a solar array, additional environmental review would likely be required to analyze the site-specific effects.

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Appendix A
Energy Calculations and Data

Appendix A

Energy Calculations and Data

Auto VMT Reduction based on Rail Ridership

Year	Miles	passengers/ vehicle	ridership	Auto diversion rate	VMT	VMT/vehicle	BTUs	
								2015-2020 annual rate of
2015	126	2.454	4183672	0.81	426,985,564	173,995,747	615,596,954,590	ridership increase
	126	2.454	4212577.2	0.81	429,935,626	175,197,891	619,850,139,967	0.00691
	126	2.454	4241682	0.81	432,906,069	176,408,341	624,132,710,781	
	126	2.454	4270988	0.81	435,897,035	177,627,154	628,444,870,058	
	126	2.454	4300496.4	0.81	438,908,666	178,854,387	632,786,822,226	
								2020-2025 annual rate of
2020	126	2.454	4357103	0.81	444,685,932	181,208,611	641,116,066,851	ridership increase
	126	2.454	4411472.3	0.81	450,234,866	183,469,791	649,116,119,442	0.0125
	126	2.454	4466520.1	0.81	455,853,042	185,759,186	657,215,999,264	
	126	2.454	4522254.8	0.81	461,541,323	188,077,149	665,416,951,992	
	126	2.454	4578684.9	0.81	467,300,584	190,424,036	673,720,238,848	
								2025-2030 annual rate of
2025	126	2.454	4683319	0.81	477,979,537	194,775,688	689,116,382,397	ridership increase
	126	2.454	4745999.2	0.81	484,376,675	197,382,508	698,339,313,762	0.013
	126	2.454	4809518.2	0.81	490,859,430	200,024,218	707,685,682,134	
	126	2.454	4873887.4	0.81	497,428,949	202,701,283	717,157,139,557	
	126	2.454	4939118.1	0.81	504,086,392	205,414,178	726,755,360,185	
								2030-2035 annual rate of
2030	126	2.454	5059400	0.81	516,362,364	210,416,611	744,453,970,592	ridership increase
	126	2.454	5108535.8	0.81	521,377,167	212,460,133	751,683,951,661	0.00971
	126	2.454	5158148.9	0.81	526,440,673	214,523,502	758,984,148,793	
	126	2.454	5208243.7	0.81	531,553,355	216,606,909	766,355,243,911	
	126	2.454	5258825.1	0.81	536,715,689	218,710,550	773,797,925,560	
								2035-2040 annual rate of
2035	126	2.454	5354215	0.81	546,451,183	222,677,744	787,833,857,009	ridership increase
	126	2.454	5406214.2	0.81	551,758,218	224,840,350	795,485,156,786	0.00971
	126	2.454	5458718.3	0.81	557,116,794	227,023,958	803,210,764,601	
	126	2.454	5511732.4	0.81	562,527,411	229,228,774	811,011,402,121	
	126	2.454	5565261.4	0.81	567,990,576	231,455,002	818,887,798,020	
2040	126	2.454	5666210	0.81	578,293,393	235,653,379	833,741,655,672	
Total (26 years)							**18,591,896,626,781**	
HSR Energy Requirements (26 year)							**2,722,636,749,456**	
Net Energy Reduction							**15,869,259,877,325**	

Model VMT	Adjusted VMT for HSR diversion
Freeway Expressway (2020)	
159,412,000,000	158,967,314,068
Freeway/Tollway (2020)	
159,455,000,000	159,010,314,068
Freeway Expressway (2040)	
182,734,000,000	182,155,706,607
Freeway/Tollway (2040)	
182,825,000,000	182,246,706,607

High Speed Rail Annual Energy Usage

annual energy	unit	btus	x26 years
30690738	kwhr	104,716,798,056	2,722,636,749,456
		Percent of no build usage	0.3%

Percentage of indirect vs No Build	(trillion btus)	
TSM/TDM	6.79	0.68%
Highways	10.93	1.09%
HSR	20.59	2.06%
Highway with HSR	31.53	3.16%
No Build Alternative (2040)	998.7	100%

	LA County VMT (millions)	auto energy intensity factor per vehicle (BTU/miles)	BTUs (millions)	BTUs	Barrels of oil
2010	227.7	5489	1249845.3	1,249,845,300,000.00	215,490.57
2013	231.6	5489	1271252.4	1,271,252,400,000.00	219,181.45
2020	242.7	5489	1332180.3	1,332,180,300,000.00	229,686.26
2035	262.6	5489	1441411.4	1,441,411,400,000.00	248,519.21
2040	269.2	5489	1477821.8	1477821766666.7	254796.9
	San Bernadino County VMT			-	-
2010	64.6	5489	354589.4	354,589,400,000.00	61,136.10
2013	68.1	5489	373800.9	373,800,900,000.00	64,448.43
2020	77.7	5489	426495.3	426,495,300,000.00	73,533.67
2035	98.2	5489	539019.8	539,019,800,000.00	92,934.45
2040	105.0	5490	576633	576,633,000,000.00	99,419.48

	LA County VMT Growth	San Bernardino County VMT growth
2010-2013	3.9	3.5
	1.7%	5.4%
2013-2020	11.1	9.6
	4.8%	14.1%
	31.0	30.1
2013-2035	13.4%	44.2%

	High Speed Rail Energy Usage per trip kwh	miles	minutes	BTU	
westbound	3276.68	52	21.44	11,180,032.16	rail energy intensity factor
eastbound	3284.77	52	21.59	11,207,635.24	2462
	6561.45	104		22,387,667.40	
			btu	104,716,798,056.00	Total Rail VMT
	kwh/mile	63.09086538	215,266.03		42,533,224.23

annual vmt	LA (millions)		SB (millions)	
2013	84534	84,534,000,000.00	24856.5	24,856,500,000.00
2035	95849	95,849,000,000.00	35843	35,843,000,000.00

annual 2013 combined vmt	annual 2035 combined vmt
109390.5	131,692.00
109,390,500,000.00	131,692,000,000.00

High Spped Rail Energy Usage		project vmt		btus		barrels		change	%	%	
		2020	2040	2020	2040	2020	2040	2020	2040	2020	2040
	no build	1.58824E+11	1.81941E+11	871,784,936,000,000	998,674,149,000,000	150,307,747.59	172,185,198.10	-			
	tsm		1.82046E+11	-	999,250,494,000,000	-	172,284,567.93		99,369.83		0.06%
	free/express	1.59369E+11	1.82734E+11	874,776,441,000,000	1,003,026,926,000,000	150,823,524.31	172,935,676.90	515,776.72	750,478.79	0.34%	0.44%
	free/toll	1.59429E+11	1.82782E+11	875,105,781,000,000	1,003,290,398,000,000	150,880,307.07	172,981,103.10	572,559.48	795,905.00	0.38%	0.46%
	free/express w hsr	1.58967E+11	1.82156E+11	872,569,863,000,000	999,854,284,000,000	150,443,079.83	172,388,669.66	135,332.24	203,471.55	0.09%	0.12%
	free/toll w hsr	1.5901E+11	1.82247E+11	872,805,890,000,000	1,000,353,783,000,000	150,483,774.14	172,474,790.17	176,026.55	289,592.07	0.12%	0.17%

Build Alternatives construction			Construction	Construction+Maintenance
lane miles	btu/mile energy usage facto	Energy (millions BTUs)	Energy BTUs	Energy BTUs
630	13,885	8,747,550.00	8,747,550,000,000	10,934,437,500,000
126	130,739	16,473,114.00	16,473,114,000,000	20,591,392,500,000
Total		25,220,664.00	25,220,664,000,000	31,525,830,000,000
TSM construction				
lane miles	btu/mile energy usage facto	Energy (BTUs)	Energy BTUs	
26	130739	3,399,214.00	3,399,214,000,000.00	4,249,017,500,000
146.2	13885	2,029,987.00	2,029,987,000,000.00	2,537,483,750,000
Total		5,429,201.00	5,429,201,000,000.00	6,786,501,250,000

	daily change
tsm	272.25
free/express	2,056.11
free/toll	2,180.56
free/express w hsr	557.46
free/toll w hsr	793.40

2030 state energy demand
457,000,000.00
project %
0.1741586%

Soil Requirements, Truck Hours, and Associated BTUs

	cross section square feet	length (52 miles) feet	cubic feet	Total Cubic Yards	Imported	On-site	Truckloads	Imported Truckloa	Import Distance (r	Imported Truck Hours	On-Site Truckloads	On-Site Distance	On-Site Hours	Total Hours	BTUs
TSM/TDM															
grade-separated	1,440	17160	24,710,400	915,200	549,120	366,080	76,267	45,760	45	51,832	30,507	10	12,203	64,035	6,210,852,267
at-grade	127	181632	23,021,856	852,661	511,597	341,065	71,055	42,633	45	48,290	28,422	10	11,369	59,659	5,786,444,028
Total TSM/TDM	1,567	198,792	47,732,256	1,767,861	1,060,717	707,145	147,322	88,393	91	100,123	58,929	20	23,571	123,694	11,997,296,295
Freeway	1,674	274,560	459,613,440	17,022,720	10,213,632	6,809,088	1,418,560	851,136	45	964,082	567,424	10	226,970	1,191,051	115,521,852,160
HSR	750	274,560	205,920,000	7,626,667	4,576,000	3,050,667	635,556	381,333	45	431,936	254,222	10	101,689	533,625	51,757,102,222
Total Freeway + HS	2,424	549,120	665,533,440	24,649,387	14,789,632	9,859,755	2,054,116	1,232,469	45	1,396,018	821,646	10	328,658	1,724,677	167,278,954,382

TSS-02WB.hdc
Train Operations Model
Train Performance Simulation - Station Summary

HDC HSR 5-Car EMU Train-All cars & axles powered/driven
All WB P-Sta in Service-30secDwell-HDC-HSR
WB(IB)(-dir); 2.0mph/s Max Acceleration

	Distance miles	Time minutes	Speed mph	Energy kwh	Energy kwhpcm
Victorville TO Palmdale	52.00	21.44	145.53	3276.68	12.60
RUN SUMMARY	52.00	21.44	145.53	3276.68	12.60

FILENAME: C:\tom\tomdat\hdc\TPS-2WB.hdc DATE: 10/18/2013 TIME: 14:18:46
CAPTION: WB(IB)EMU w/stops-all P-Sta-Full Accel; HDC-HSR

TSS-01EB.hdc
Train Operations Model
Train Performance Simulation - Station Summary

HDC HSR 5-Car EMU Train-All cars & axles powered/driven
All EB P-Sta in Service-30secDwell-HDC-HSR
EB(OB)(+dir); 2.0mph/s Max Acceleration

		Distance miles	Time minutes	Speed mph	Energy kwh	Energy kwhpcm
Palmdale	TO Victorville	52.00	21.59	144.48	3284.77	12.63
	RUN SUMMARY	52.00	21.59	144.48	3284.77	12.63

FILENAME: C:\tom\tomdat\hdc\TPS-1EB.hdc DATE: 10/18/2013 TIME: 14:17:45
CAPTION: EB(OB)EMU w/stops-all P-Sta-Full Accel; HDC-HSR

Estimated Power Usage for the High Desert Corridor (HDC) High Speed Rail (HSR) System based on a 2 x 25 kV Autotransformer Traction Electrification System (TES) with two Traction Power Substations and three Paralleling Stations per Nodal Diagram Rev.1.

				Monday through Friday (5 Days)		Saturday and Sunday (2 Days)		Week (Mon-Sun) (7 Days)	Year (52 weeks)	Year (52 weeks)
Peak Period Train Service AC Power Consumption for 15-minutes (KWHr) See Notes 1 through 6	**Trai Service Time Periods for 1-Day**	**Hours (Hrs)**	**Description of Train Service**	**Percentage of Peak-Period Train Service Power Loading**	**KWHr**	**Percentage of Peak-Period Train Service Power Loading**	**KWHr**	**KWHr**	**KWHr**	**MWHr**
6903										
	6:00AM - 9:00AM	3	Morning Peak-Period	100%	20709	50%	10355			
	9:00AM to 3:00PM	6	Mid-Day	50%	20709	50%	20709			
	3:00PM to 7:00PM	4	Afternoon Peak-Period	100%	27612	50%	13806			
	7:00PM to 10:00PM	3	Evening	50%	10355	50%	10355			
	10:00PM to 12:00AM	2	Twilight	50%	6903	50%	6903			
	12:00AM to 4:00AM	4	No-Service	0%	0	0%	0			
	4:00AM to 6:00AM	2	Early Morning	50%	6903	0%	0			
		24			**93,191**		**62,127**	**590,207**	**30,690,738**	**30,691**

Note 1: All Traction Power Substations (TPSS) and Paralleling Stations (PS) energized and in service Per Nodal Diagram Rev.1; No equipment outages.
Note 2: The sum of the four (4) utility electric meters for 15 minutes during Peak-period Train Service (Rush-hour) (KWHr).
Note 3: Final Traction Electrification System (TES) power loads pending final train vehicle data, final TES configuration, civil data, and operations data.
Note 4: Train Vehicle Energy Regeneration into the Overhead Contact System (OCS) during dynamic braking was Turned Off for these simulations and calculations.
Note 5: HDC Track Vertical and Horizontal Alignment Data used.
Note 6: Peak Period Train Service consist of 15 minute headways (4 trains per hour).

Appendix B
Location of Mines

MINE_ID	MINENAME	ADDRESS	LATITUDE	LONGITUD	ACRES_DIS	MINESTATI	PRIPRODU	OTHER_PR	OPT_TYPE	PERMIT_NUM	PERMITACI	MECH_TOT	FACEAMOUNT
91-36-0023	ORO GRANDE QUARRIES	P.O. BOX 158	34.62306	-117.297	540	ACTIVE	LIMESTON	ROCK		BLANK,BLANK,BLANK,BLA		379790	379790
91-36-0007	APPLE VALLEY CLAY MINE	1985 SAMPSON AVENUE	34.47	-117.108	5	ACTIVE	CLAY		OPEN PIT	DN250-127N,SAMR92-00		35695.44	35581.86
91-36-0046	AGCON, INC.	23382 NATIONAL TRAILS HIGHWAY	34.66667	-117.333	150	ACTIVE	SAND AND GRAVEL		OPEN PIT	2003M-02	244	186729	1518062.7
91-19-0021	BIG ROCK CREEK	35451 155TH STREET EAST	34.52611	-117.855	177.01	ACTIVE	SAND AND GRAVEL		OPEN PIT,PLANT OR I	SMP88-126	585	112191.2	76966
91-19-0001	HOLLIDAY - PALMDALE	7747 EAST AVENUE T	34.54694	-117.987	113	ACTIVE	SAND AND GRAVEL		QUARRY	84-001(5)	313	206487	245019
91-19-0002	ANTELOPE VALLEY AGGREGATE, INC	7311 EAST AVENUE T	34.54694	-117.994	215	ACTIVE	SAND AND GRAVEL		STREAMBED OR GRA	RP 89-1	234	204964	180938
91-19-0008	LITTLEROCK	PO BOX 6744	34.54	-118.003	240	ACTIVE	SAND AND GRAVEL		OPEN PIT	87-115	236	390051.4	393489.77
91-19-0020	PALMDALE	6851 EAST AVENUE T	34.54694	-118.016	360.2	ACTIVE	SAND AND GRAVEL		OPEN PIT,PLANT OR I	CUP 08-01	665	1493286	1555568
91-19-0026	LITTLE ROCK QUARRY	6500 E. AVENUE T	34.53806	-118.001	170	ACTIVE	SAND AND GRAVEL		OPEN PIT	1017-5,CUP 02/06,RP 84-		207785	226013
91-19-0033	PALMDALE	37790 75TH STREET - EAST	34.555	-117.989	203	ACTIVE	SAND AND GRAVEL		OPEN PIT	CUP 00-02	293	245907.2	257020
91-19-0040	LANE QUARRY	PARCEL 3205-0001-056	34.62889	-118.252	4.4	ACTIVE	DECOMPOSED GRANI		OPEN PIT	GRANDFATHEI	17	14409	15255.79
91-36-0007	APPLE VALLEY CLAY MINE	1985 SAMPSON AVENUE	34.47	-117.108	5	ACTIVE	CLAY		OPEN PIT	DN250-127N,SAMR92-00		35695.44	35581.86
91-36-0082	OPAH DITCH BORROW PIT		35.11869	-116.198	18	IDLE	SAND AND GRAVEL						
91-36-0077	NEWBERRY BORROW PIT		34.80389	-116.631	27	IDLE	SAND AND GRAVEL						

Appendix C

SCE Substation Description and Equipment Requirements

SUBSTATION DESCRIPTION AND EQUIPMENT REQUIREMENTS

SUBSTATION ENGINEERING

Substation Engineering provided a high level scope of work and an order of magnitude cost estimate for the proposed customer-dedicated substation. For the purpose of this MOS Study, this substation would be called VDP Substation. The detailed information is listed below:

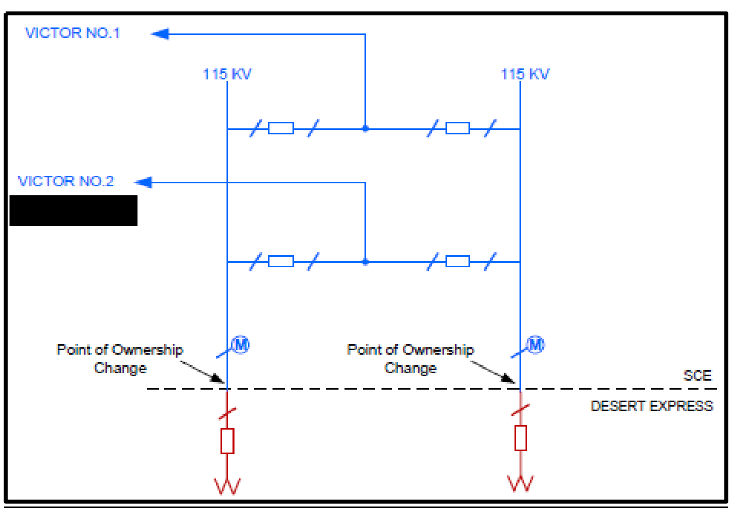
115 kV Options No. 1 or No. 2

SCE would engineer and construct a new VDP 115kV Substation, with two overhead incoming 115 kV subtransmission lines. The bus arrangement would be a ring-bus configuration. The property dimension for this facility would be 306 feet by 145 feet, which includes the 10 foot buffer outside the perimeter fence.

Scope Detail:

Install the following equipment and structures:

- Ring bus switchrack as shown on the plot plan
- Two 115 kV overhead incoming subtransmission lines
- Two 115 kV transformer high side connections



VDP 115 kV Options: Substation Bus Arrangement
(See Appendix-14)

115 kV Switchyard: Buses
Install the following equipment and structures:

- Install two 115 kV buses as shown on the plot plan
- Install four bus dead-end structures
- Install twelve bus dead-end insulator assemblies
- Twelve station service [redacted] voltage transformers for station light and power
- Six 115 kV revenue metering units
- Install six [redacted] bus conductors (Approximately 500 feet of conductor)
- Equip 115 kV switchrack with:
  - ✓ Two 115 kV line dead-end structures
  - ✓ Four [redacted] gas CBs
  - ✓ Eight [redacted] horizontal mounted grouped-operated disconnecting switches
  - ✓ Six [redacted] ightning arresters
- Three [redacted] potential transformers (PTs) shall be installed for each 115 kV line position to provide protection relay potential source
- The switchrack would be constructed with one [redacted] conductor per phase, except for the connections to the voltage transformers, which would be conductored with [redacted] ACSR.
- To support connection to customer transformers, install two 115 kV horizontal mounted, motor operated disconnect switches

Mechanical Electrical Equipment Room (MEER)
Provide an approximately 52 feet by 20 feet area for the MEER within VDP Substation. The MEER would include a 14 feet by 20 feet communication room. The following equipment would need to be installed:

- Batteries, battery parallel box, and battery charger
- Station Light and Power selector switch
- Station Light and Power automatic transfer switch
- Three phase AC panel
- Single phase AC panel
- DC distribution panel

[redacted]

- One [redacted] cabinet
- One [redacted] Ronan annunciator
- One RTU interface racks
- One RTU rack
- Synchronizing panel
- Eight relay racks

Protection Relays
Install the following equipment:

Option No. 1:

- Four [redacted] Breaker Management Relays
- Four [redacted] Line Current Differential Relays
- Two [redacted] Line Directional Distance Overcurrent Relays
- Two [redacted] Line Current Differential Relays

Option No. 2:

- Four [redacted] Breaker Management Relays
- Three [redacted] Line Current Differential Relays
- One [redacted] Line Directional Distance Overcurrent Relays
- One [redacted] Line Directional Distance Overcurrent Relays
- Three [redacted] Line Current Differential Relays

Other Station Elements To Be Installed
Install the following equipment:

- Approximately 822 linear feet of perimeter fence 8 feet in height with double barbed wire to cover an 286 feet by 125 feet area.
- One 20 feet wide double door driveway gates
- Grounding grid to cover an 292 feet by 131 feet area (3 feet outside the perimeter fence on each side)
- Site Preparation (Grading) for an area of 306 feet by 145 feet (10 feet outside the perimeter fence) ***(Customer's responsibility and not included in the cost summary)***
- Approximately 590 linear feet of 20 feet wide paved driveway

- Approximately 250 linear feet of control cable trench
- [redacted] cable riser structure with two [redacted] station light and power transformers
- Two revenue metering cabinets

[redacted]

115 kV Option: Substation One-Line (See Appendix-9)

[redacted]

115 kV Option: Substation Plot Plan (See Appendix-8)

Related Work At Other Substation(s)

The existing SCE substation listed below would require new installation/modification/reconfiguration in order to accommodate the future VDP 115 kV Substation as follows:

[redacted] Substation related to Option No. 1
Relocate the existing [redacted] 220 kV transmission pole approximately 40 feet east to accommodate the proposed 115 kV switchrack extension.

115 kV Switchrack:
Install and modify the following equipment:

- Extend the 115 kV switchrack approximately 60 feet toward the east of the substation
- Provide a ground grid for the new 115 kV switchrack positions. Utilize [redacted] bare copper conductor
- Install the 115 kV North and South Operating Buses, east dead-end structures, and two bay positions toward the east to form two additional 115 kV positions; [redacted]
- Extend the 115 kV operating buses. Utilize two [redacted] conductors per phase.
- Equip [redacted] double-breaker 115 kV line position [redacted] Install the following:
  - ✓ Two line dead-end structure
  - ✓ Four [redacted] CBs
  - ✓ Eight [redacted] group-operated disconnecting switches
  - ✓ Six [redacted] PTs
  - ✓ Twenty-two bus support pedestals
  - ✓ Two [redacted]
- Utilize one [redacted] conductor per phase for new positions wiring
- Extend the existing [redacted] control cable trenches 60 feet each
- Provide lighting for the new 115 kV positions

Existing MEER:
Install the following equipment:

- Three additional relay racks would be installed:
  - ✓ Two [redacted] subtransmission line relay rack
  - ✓ Four [redacted] and control racks
- Add new points at the existing annunciator, PLC, HMI and DFR as required

[redacted] Substation related to Option No. 2
Add new 115 kV line [redacted] and convert existing 115 kV [redacted] from a two-point line position to a three point line

115 kV Switchrack
Install and modify the following equipment:

- Equip existing spare [redacted] as line position
  - ✓ One [redacted] CB
  - ✓ Two [redacted] group operated disconnecting switches,
  - ✓ Three (3) [redacted] PTs,
  - ✓ Six conduit risers for line termination.
- Utilize two [redacted] per phase for new position OH connections
- Provide six [redacted] conduit duct with intermediate pull box from [redacted] line risers to north fence new [redacted]

Existing MEER:

- Provide an additional communication channel to the existing 115 kV subtransmission line relay [redacted]
- Revise RTU and Annunciator point list as required
- Provide 20 feet of telecommunication cable tray and [redacted]

[redacted] Substation related to Option No. 2

The following modifications are required:

Existing MEER:

- Provide an additional communication channel to the existing 115 kV subtransmission line relay [redacted]
- Revise RTU and Annunciator point list as required
- Provide [redacted]

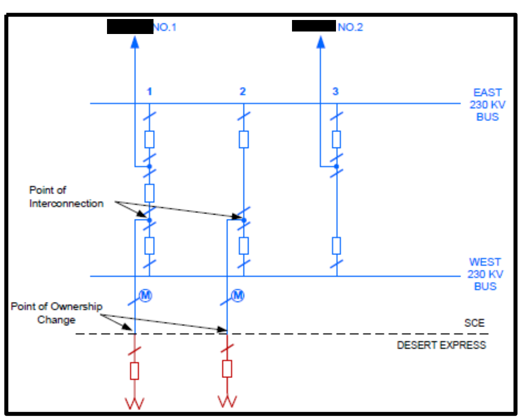
220 kV Option

SCE would engineer and construct a new VDP 220 kV Substation, with two new overhead incoming 220 kV transmission line sections. The bus arrangement would be a breaker-and-half configuration, equipped with three bay positions. The property dimensions for this facility would be approximately 459 feet by 306 feet, which includes the 10 foot buffer outside the perimeter fence.

Scope Detail

Construct the following equipment and structures:

- Two 220 kV Operating Buses covering three positions
- One breaker-and-half 220 kV position to terminate the [redacted]-VDP No. 1 220 kV Transmission Line and the DX Bank No. 1 high side leads
- One double-breaker position for the DX Bank No. 2 high side leads
- One double-breaker 220 kV position to terminate the [redacted]-VDP No. 2 220 kV Transmission Line



115 kV Options: Substation Bus Arrangement
(See Appendix-14)

220 kV Switchyard: Operating Buses
Construct new 220 kV east and west buses as follows:

- Install four bus dead-end structures (45 feet high by 50 feet wide)
- Install twelve bus dead-end insulator assemblies
- Install six [redacted] Coupling Capacitor Voltage Transformers (CCVTs)
- Install 12 Station Service [redacted] voltage transformers for Station Light and Power
- Install six 180 feet sections of [redacted]

[redacted]
Provide a breaker-and-half position for the new [redacted]-VDP No.1 220 kV Transmission Line and the DX Bank No. 1 high side connection. Install the following equipment:

- Two dead-end structures (64 feet high by 45 feet wide)
- Three [redacted]
- Six 220 kV horizontal mounted, group operated disconnect switches (two of them equipped with grounding attachments)
- Six tie-downs with [redacted] conductors
- Three [redacted] CCVTs
- Six [redacted] station class surge arresters
- Three 285 feet sections of [redacted] (Approximately 900 feet of conductor)

[redacted]
Construct a double-breaker position in a breaker-and-half configuration to terminate the DX Bank [redacted] high side leads. Install the following equipment:

- One dead-end structure (64 feet high by 45 feet wide)
- Two [redacted] CBs, with Operator Interface Cabinet
- Four [redacted] horizontal mounted, group operated disconnect switches (one of them equipped with grounding attachments).
- Three tie-downs with [redacted] conductors
- Three [redacted] station class surge arresters

- Three 285 feet sections of [redacted] Conductors (Approximately 900 feet of conductor)

[redacted]

Install a double-breaker 220 kV transmission line position in a breaker-and-half configuration to terminate the new [redacted] VDP No. 2 220 kV Transmission Line as follows:

- One dead-end structure (64 feet high by 45 feet wide)
- Two [redacted] with Operator Interface Cabinet
- Four [redacted] horizontal mounted, group operated disconnect switches (one of them equipped with grounding attachments).
- Three line tie-downs with [redacted] conductors
- Three [redacted] CCVTs
- Three [redacted] station class surge arresters
- Three [redacted] conductors (Approximately 900 feet of conductor)

Motor operated disconnects and Revenue Meters
To support the connection to the customer transformers, the following would need to be installed:

- Two 220 kV dead-end structures equipped with two 220 kV horizontal mounted, vertical break, motor operated disconnect switches
- Six 220 kV revenue metering units.

Mechanical Electrical Equipment Room (MEER)
Provide an approximately 52 feet by 22 feet area for the MEER within the VDP Substation. The MEER would include approximately 14 feet by 20 feet by communication room. The following equipment would need to be installed:

- Batteries; battery parallel box and battery charger
- Station Light and Power selector switch
- Station Light and Power automatic transfer switch
- Three phase Alternating Current (AC) panel
- Single phase AC panel
- Direct Current (DC) distribution panel
- One [redacted] Power Management Unit

[redacted]

(PMU) cabinet
- One [redacted] Ronan annunciator
- One Remote Terminal Unit (RTU) interface racks
- One RTU cabinet
- Synchronizing panel
- Twenty relay racks

Protection Relays
Install the following equipment:

- Four [redacted] Bus Differential Relays
- Seven [redacted] Breaker Management Relays
- Four [redacted] Line Current Differential Relays
- Two [redacted] Line Current Differential Relays
- Two [redacted] Line Directional Distance Overcurrent Relays

Other Station Elements To Be Installed
Install the following equipment:

- Approximately 1,450 linear feet of perimeter fence approximately 8 feet in height with double barbed wire to cover an approximate 439 feet by 286 feet area.
- Two 20 feet wide double door driveway gates
- Grounding grid to cover a 445 feet by 292 feet area (3 feet outside the perimeter fence)
- Site Preparation (grading) for an area of 459 feet by 306 feet (10 feet outside the perimeter fence on each side) ***(DX responsibility and not included in the cost summary)***
- Approximately 1,300 linear feet of 20 feet wide paved driveway
- Approximately 500 linear feet of control cable trench
- [redacted] cable riser structure with two [redacted] Station Light and Power transformers
- Two revenue metering cabinets

[redacted]

220 kV Option: Substation One-Line
(See Appendix-9)

[redacted]

220 kV Option: Substation Plot Plan
(See Appendix-8)

Related Work At Other Substation(s)

[redacted] Substation
The existing SCE substation listed above would require new installation/modification/reconfiguration in order to accommodate the future VDP 220 kV Substation as follows:

- Extend the 220 kV switchrack approximately 90 feet toward the east
- Relocate the 3 feet chain barrier.
- Provide a ground grid for the new 220 kV switchrack positions. Utilize [redacted] bare copper conductor.
- Relocate the 220 kV North and East operating buses east dead-end structures two bay positions toward the east to form two additional [redacted]
- Extend the 220 kV operating buses.
- Utilize two [redacted] conductors per phase
- Equip [redacted] double-breaker 220 kV line [redacted] For each position install the following:
  - ✓ One line dead-end structure
  - ✓ Two [redacted] with operating interface cabinet
  - ✓ Four [redacted] horizontal mounted, group operated disconnecting switches
  - ✓ Three [redacted] CCVTs
  - ✓ Eleven bus support pedestals
  - ✓ One [redacted] splice cabinet
- Utilize two [redacted] conductors per phase for new position wiring.
- Extend the existing 220 kV North and South control cable trenches 60 feet each
- Provide lighting for the new 220 kV positions.

Existing MEER:
Total six additional relay racks would be installed:

- Two 220 kV lines relay racks
- Four [redacted] and control racks.
- Add new points at the existing annunciator, [redacted] as required.

METERING SERVICE
The revenue metering requirements for the proposed VDP Substation are provided below.

For Both 115 kV and 220 kV Options

The following metering requirement is available:

- Install new revenue metering at the high side, located at VDP Substation

The metering estimate is based on the technical information provided with the request. Metering Service Organization (MSO) costs may very if changes are made with installation schedules or designs.

Equipment such as, metering units, meter cabinets, meter rings, test switches are to be provided by SCE Substation Engineering and are not included in this metering estimate in the Cost Summary sheets

PROTECTION
Protection requirements are designed and intended to protect SCE's system only. The applicant is responsible for the protection of its own system and equipment. The preliminary protection requirements provided below were based upon the MOS plan and the current SCE approved manufacturers for relays; [redacted]

115 kV Options

Option No. 1:

VDP SUBSTATION

[redacted] No.1 115 kV Line:

- 1 [redacted] relay
- 1 [redacted] relay
- 1 [redacted] per Circuit Breaker

[redacted] No. 2 115 kV Line:

- 1 [redacted] relay
- 1 [redacted] relay
- 1 [redacted] relay per Circuit Breaker

No. 1 Transformer Bank:
- 1[redacted]relay
- 1[redacted]relay
- 1[redacted]relay per Circuit Breaker

No. 2 Transformer Bank:
- 1[redacted]relay
- 1[redacted]relay
- 1[redacted]relay per Circuit Breaker

[redacted]SUBSTATION

Pos.[redacted]VDP No. 1 115 kV Line:
- 1[redacted]relay
- 1[redacted]relay
- 1[redacted]relay per Circuit Breaker

Pos.[redacted]VDP No. 2 115 kV Line:
- 1[redacted]relay
- 1[redacted]relay
- 1[redacted]relay per Circuit Breaker

See Note Below:
****Provide a diverse[redacted]digital channel from Victor to VDP*
***Provide a diverse[redacted]digital channel from VDP to Customer*
**Provide a diverse[redacted]digital channel from VDP to Victor*

Option No. 2:

VDP SUBSTATION

[redacted]115 kV Line:
- 1[redacted]relay
- 1[redacted]relay
- 1[redacted]relay per Circuit Breaker

[redacted]115 kV Line:
- 1[redacted]relay
- 1[redacted]relay
- 1[redacted]relay per Circuit Breaker

No. 1 Transformer Bank:

- 1[redacted]relay
- 1[redacted] relay
- 1[redacted]relay per Circuit Breaker

No. 2 Transformer Bank:

- 1[redacted]relay
- 1[redacted]relay
- 1[redacted]relay per Circuit Breaker

[redacted]SUBSTATION

[redacted]VDP 115 kV Line:

- 1[redacted]relay
- 1[redacted]relay
- 1[redacted]relay per Circuit Breaker

[redacted]-VDP 115 kV Line:
Retain existing relay protection*****

[redacted]SUBSTATION

[redacted]-VDP 115 kV Line:
Retain existing relay protection******

See note below:

[redacted]

220 kV Option

VDP SUBSTATION

220 kV East Bus Protection:
- [redacted] relay

220 kV West Bus Protection:
- [redacted] relay

Pos. [redacted] 220 kV Line:
- 1 [redacted] relay
- 1 [redacted] relay
- 1 [redacted] relay per Circuit Breaker

In the event that SCE Power System Technology Group determines during engineering that high speed clearing is required at all times, then the line protection shown in red will be the protection requirements.
- [redacted] relay
- [redacted] relay

[redacted] Transformer Bank:
- 1 [redacted] relay
- 1 [redacted] relay
- 1 [redacted] relay per Circuit Breaker

[redacted] Transformer Bank:
- 1 [redacted] relay
- 1 [redacted] relay
- 1 [redacted] relay per Circuit Breaker

[redacted] 220kV Line:
- 1 [redacted] relay
- 1 [redacted] relay
- 1 [redacted] relay per Circuit Breaker

In the event that SCE Power System Technology Group determines during engineering that high speed clearing is required at all times, then the line protection shown in red will be the protection requirements.

- *1*[redacted] relay
- *1*[redacted] relay

[redacted] SUBSTATION

[redacted] VDP No. 1 220 kV Line:

- 1[redacted] relay
- 1[redacted] relay
- 1[redacted] relay per Circuit Breaker

In the event that SCE Power System Technology Group determines during engineering that high speed clearing is required at all times, then the line protection shown in red will be the protection requirements.

- *1*[redacted]*** relay
- *1*[redacted]* relay

[redacted] VDP No. 2 220 kV Line:

- 1[redacted] relay
- 1[redacted] relay
- 1[redacted] relay per Circuit Breaker

In the event that SCE Power System Technology Group determines during engineering that high speed clearing is required at all times, then the line protection shown in red will be the protection requirements.

- *1*[redacted]*** relay
- *1*[redacted]*** relay

See note below:

[redacted]

POWER SYSTEM CONTROLS

SCE Power System Controls Engineering has determined that the following telemetry equipment is required to accommodate the new VDP Substation.

The estimate provided in this MOS Study assumes that one dedicated 125 VDC circuit, one 115 VAC convenience circuit, one communication circuit, and all station interface wiring are provided and brought to the RTU by other SCE departments.

For 115 kV or 220 kV Options

Install the following:

- One RTU at VDP Substation to monitor data from the 220 kV or 115 kV lines, transformer bank data, relay protection status alarm, and also provide 220 kV or 115 kV CB status alarms and control.
- One communication circuit between each new RTU and the SCE Energy Management System (EMS) front-end port servers at the most convenient Regional Control Center (RCC).

LINE DESCRIPTION AND EQUIPMENT REQUIREMENTS

115 kV SUBTRANSMISSION LINE SERVICE

SCE has performed evaluations and cost analyses on the 115 kV subtransmission line options provided by SCE Transmission Interconnection and Planning line arrangement**.** There are two possible options.

Option No. 1:
Construct two new 115 kV subtransmission lines; VDP-[redacted]No. 1 115 kV Subtransmission Line and the VDP-[redacted]No. 2 115 kV Subtransmission Line from the existing[redacted]Substation to the proposed VDP Substation. The conceptual line route would be approximately 16 miles in length and would consist of a double circuit with a conductor type of[redacted]

Scope Detail
The overhead subtransmission work includes, but is not limited to installing:

- Approximately 200 Tubular Steel Poles (TSPs), double circuit construction
- Install approximately 148,000 circuit feet of [redacted]
- Install of approximately 74,000 feet of ½-inch shield wire

DX has requested redundancy for the line service to power the VDP Substation. In order to accommodate this request, SCE has selected TSPs to configure the double circuit construction over double circuit construction on light weight steel or wood poles. The advantages of TSP construction are as follows:

- Less susceptible to damage due to vehicle/equipment damage
- Less susceptible to lightning damage
- Pole and arms require very little maintenance, which minimize outages
- Structures resistant to fire

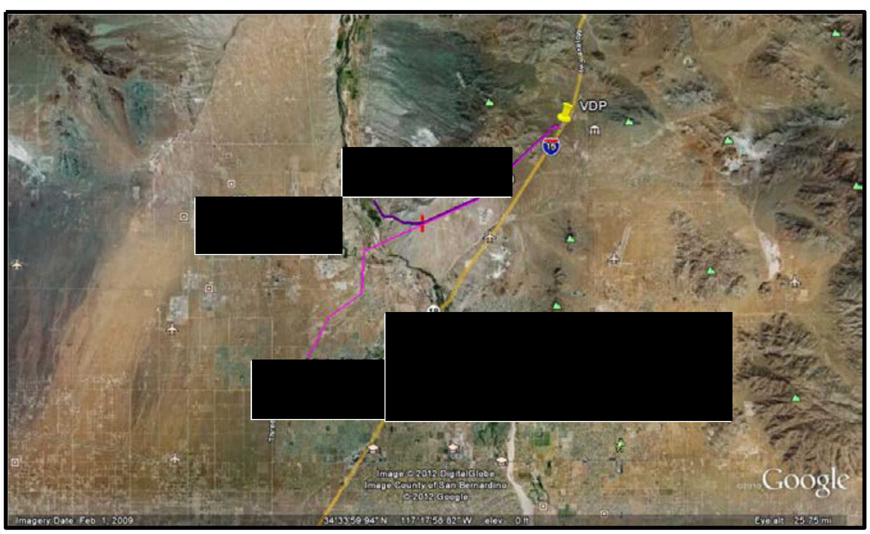
Option #1: Conceptual Drawing and Design for the Overhead
(See Appendix-10)

See note below:
[redacted]

<u>Option No. 2</u>:
Construct a two substransmission lines service to VDP Substation: **1)** Construct a new 115 kV circuit from the existing [redacted] Substation to the proposed VDP Substation, approximately 16 miles in length, consisting of single circuit of [redacted] This will create the new VDP-[redacted] 115 kV Subtransmission Line. **2)** Tap the existing [redacted] 115 kV Subtransmission Line to serve the proposed VDP Substation, approximately 8 miles in length, consisting of single circuit of [redacted] This will create the new VDP[redacted] 115 kV Subtransmission Line.

Scope Detail:
The overhead subtransmission work includes, but is not limited to installing:

- ✓ Approximately 80 TSPs, double circuit construction where the two circuits merge
- ✓ Approximately 250 Light Weight Steel Poles (LWSPs), single circuit construction and associated guying were the circuits run independent of each other
- ✓ Three 115 kV remote switches at the tap location
- ✓ Approximately 117,000 circuit feet of [redacted]
- ✓ Approximately 85,000 feet of ½-inch shield wire



Option #2: Conceptual Drawing and Design For The Overhead
(See Appendix-10)

See note below:

From [redacted] to tap is approximately 7.7 miles (single circuit)
From [redacted] to tap is approximately 2.1 miles (single circuit)
From tap to VDP Substation is approximately 6.2 miles (double circuit)

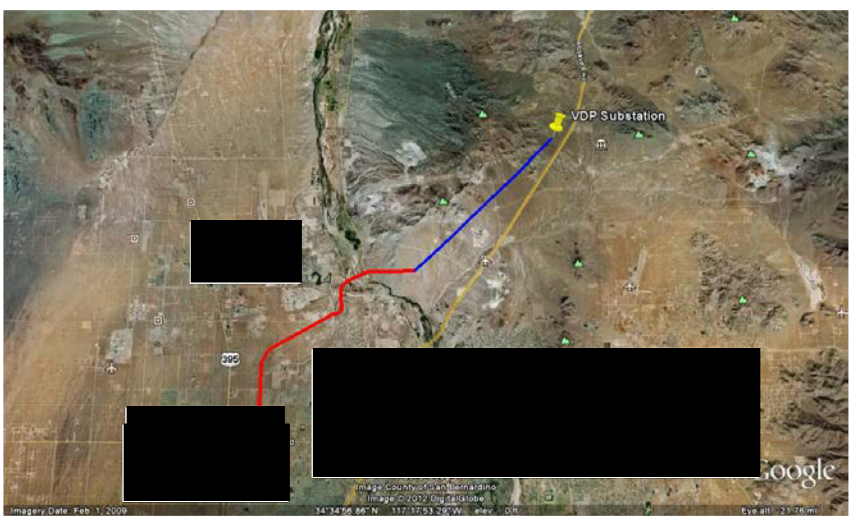
220 kV TRANSMISSION LINE SERVICE

Transmission Engineering has performed evaluation and cost analysis on the 220 kV transmission line option provided by SCE Transmission Interconnection and Planning. The VDP Substation would be served by constructing two 220 kV circuits from the existing Victor Substation to VDP Substation, approximately 9 miles of double circuit and 6 miles of single circuit construction using bundled 1590 ACSR conductors. This will form the two new 220 kV transmission lines.

Scope Detail

The overhead transmission work includes, but is not limited to installing:

- Approximately 119 Lattice Steel Towers (LSTs)
- Two circuits roughly 15 miles in length of two [redacted] per phase
- Approximately 15 miles of [redacted]



[redacted]

220 kV Conceptual Drawing and Design of the Overhead Line

(See Appendix-11)

See note below:

Blue is two separate single circuit T/L (Approximately 6 miles)
Red is double circuit T/L (Approximately 9 miles)

DISTRIBUTION ENGINEERING

Distribution Engineering has evaluated the technical requirements needed to provide Station Light & Power service from the distribution system at the proposed VDP Substation. The following information below provides detail of the distribution scope of work.

For 115 kV or 220 kV Options

The following equipment is required to be installed:

- Add 3rd phase to approximately 26 spans
- Install Overhead Omni-rupter switch
- Install approximately 3,000 feet of new underground facilities (two 5-inch conduits and a 6 feet by 12 feet structures) to the substation fence

TELECOMMUNICATION DESCRIPTION AND EQUIPMENT REQUIREMENTS

INFORMATION TECHNOLOGY

Information Technology (IT) has evaluated the telecommunication requirements for the proposed VDP Substation. To support diverse Protection, Supervisory Control and Data Acquisition (SCADA), RTU circuit, and data and voice requirements, the following scope of work are detailed for each of the options below.

Scope Detail
For 115 kV Option No. 1 at* [redacted] *and VDP:
***For 115kv Option No. 2 at* [redacted]**
***For 220kV Option at* [redacted]**

- Install lightwave equipment
- Install channel equipment
- Install associated data and common equipment supporting lightwave and channel equipment for VDP Substation
- Install and test circuits supporting the diverse Protection, SCADA, RTU circuit, and data and voice communications for VDP Substation

FIBER COMMUNICATION

To support the Protection and Supervisory Control and Data Acquisition (SCADA) RTU for VDP Substation to SCE Energy Management System (EMS), ECS will need to construct ring communication system of Fiber Optic (FO) cables. Protection requires a dual communication path to minimize communication failure during system operation. In that essence, there would be a primary and diverse route (redundancy) which are detailed below.

115 kV Options

Option No. 1

Primary Route: [redacted] **- VDP**

The communication route of approximately 80,000 feet of cable will follow the new 115 kV subtransmission structure path from [redacted] Substation to VDP Substation.

Scope Detail

FO route on the proposed transmission/subtransmission pole lines

- Install approximately 80,000 feet [redacted]
- Install approximately 1,100 feet [redacted]
- Install approximately 800 feet 1-5 inch. conduit
- Splice and test

At VDP Substation tie cable to DX

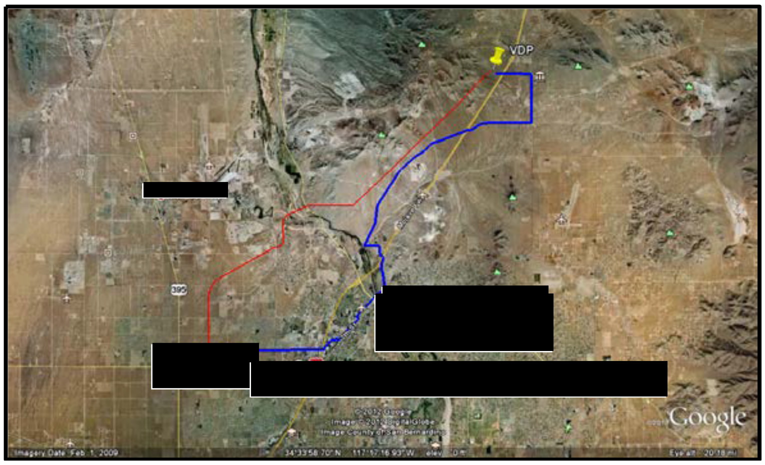
- Install approximately 2,400 feet [redacted]
- Install approximately 2,200 feet [redacted]
- Splice and test

Diverse Route: [redacted] **– VDP**

The communication route of approximately 117,200 feet of cable will follow the new 115 kV subtransmission structure path from VDP Substation to [redacted] Substation, and then reconnect to the existing communication path between [redacted] Substation to [redacted] Substation.

Scope Detail
<u>New FO route construction from [redacted] to VDP Substation</u>

- Install approximately 102,000 feet [redacted]
- Install approximately 1,000 feet [redacted]
- Install approximately 14,200 feet [redacted]
- Splice and test



Conceptual Fiber Cable Route for 115 kV Option No. 1
(See Appendix-12)

See note below:
<u>Red</u> route is primary (all is new FO cable)
<u>Blue</u> route is diverse [redacted] is existing [redacted] VDP is new FO cable)

Option No. 2

Primary Route: [redacted] - VDP
The communication route of approximately 44,900 feet of cable will follow the new 115 kV subtransmission structure path from VDP Substation to [redacted] Substation, and then reconnect to the existing communication path between [redacted] Substation to [redacted] Substation.

Scope Detail
<u>New FO route construction from [redacted] Substation to VDP Substation</u>

- Install approximately 44,000 feet [redacted]
- Install approximately 900 feet [redacted]

- Splice and test

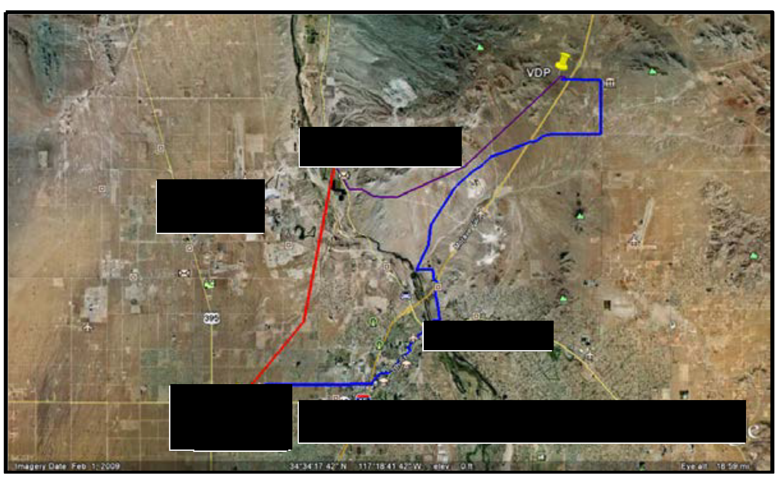
At VDP Substation tie cable to DX

- Install two diverse tie cables approximately 2,400 feet [redacted]
- Install two diverse tie cables approximately 2,200 feet [redacted]
- Splice and test

Diverse Route: [redacted] – VDP
The communication route of approximately 117,200 feet of cable will follow the new 115 kV subtransmission structure path from VDP Substation to [redacted] Substation, and then reconnect to the existing communication path between [redacted] Substation to [redacted] Substation.

Scope Detail
New FO route construction from Victorville Substation to VDP Substation

- Install approximately 102,000 feet 48/[redacted]
- Install approximately 1,000 feet 48/[redacted]
- Install approximately 14,200 feet 48/[redacted]
- Splice and test



[redacted]

Conceptual Fiber Cable Route for 115 kV Option No. 2

(See Appendix-12)

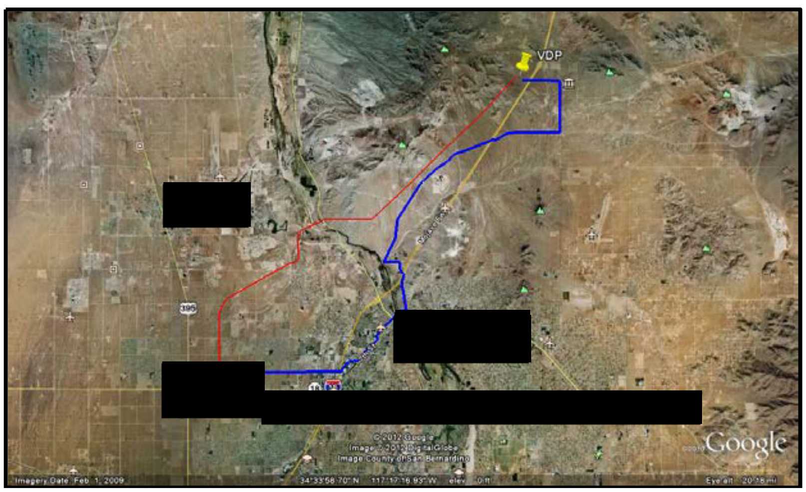
See note below:
Red route is primary [redacted] is existing and Purple is new FO cable)
Blue route is diverse [redacted] is existing, [redacted] VDP is new FO cable)

220 kV Option

Primary Route: [redacted] - VDP
The communication route of approximately 44,900 feet of cable will follow the new 220 kV transmission structure path from VDP Substation to [redacted] Substation, and then reconnect to the existing communication path between [redacted] Substation to [redacted] Substation.

Scope Detail

- Splice and test
- Transmission Engineering will be installing the FO



Conceptual Fiber Cable Route for 220 kV Option
(See Appendix-12)

See note below:
Red route is primary (all is new FO cable)
Blue route is diverse [redacted] is existing, [redacted] VDP is new FO cable)

Diverse Route: [redacted] **– VDP**
The communication route of approximately 117,200 feet of cable will follow the new 220 kV transmission structure path from VDP Substation to [redacted] Substation, and then reconnect to the existing communication path between [redacted] Substation to [redacted] Substation.

Scope Detail
New FO route construction from [redacted] to VDP Substation

- Install approximately 102,000 feet [redacted]
- Install approximately 1,000 feet [redacted]
- Install approximately 14,200 feet [redacted]
- Splice and test

REGULATORY, ENVIRONMENTAL AND REAL PROPERTIES REQUIREMENTS

LICENSING

The construction of electric subtransmission line facilities operating between 50 kV and 200 kV, and construction of substations operating greater than 50 kV are subject to the CPUC's Permit to Construct (PTC) requirements, and electric transmission line facilities operating at or above 200 kV are subject to the CPUC's Certificate of Public Convenience and Necessity Requirements (CPCN) as specified in GO 131-D, Section III.B and Section III.A, respectively. Based on preliminary evaluation, the proposed project would be subject to review under GO 131-D. Therefore, SCE would be required to submit a Proponent's Environmental Assessment (PEA) along with a PTC/CPCN application for approval to the CPUC before proceeding with construction and operation of VDP Substation[1]. The above determination is based on the following conditions:

- SCE would be constructing a substation and power line facilities greater than 50 kV.
- This project has not undergone an environmental review pursuant to the California Environmental Quality Act (CEQA)

In the event that various scope changes occur or that any of the above listed assumptions change, the need for the PTC/CPCN should be revisited.

[1] If the 115 kV option is selected SCE would be required to obtain a PTC, while a CPCN would be required for the 220 kV option.