California Public Utilities Commission

Pipeline Safety and Reliability Project –

New Natural Gas Line 3602 and De-rating Line 1600 (PSRP)

Appendix B

Description of Potential Alternatives

for

CEQA Master Environmental Assessment

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LIST OF ACRONYMS AND ABBREVIATIONS

applicants	San Diego Gas and Electric Company and Southern California Gas Company
CEA	Cost Effectiveness Analysis
CEQA	California Environmental Quality Act
CPCN	Certificate of Public Convenience and Necessity
CPUC	California Public Utilities Commission
DER	Distributed Energy Resources
EIR	Environmental Impact Report
I-15	Interstate 15
LNG	liquefied natural gas
MAOP	maximum allowable operating pressure
MCAS	Marine Corps Air Station
MEA	Master Environmental Assessment
MMcfd	million cubic feet per day
MW	megawatts
MWh	megawatt hours
NOP	Notice of Preparation
PG&E	Pacific Gas and Electric Company
PEA	Proponent’s Environmental Assessment
PHMSA	Pipeline and Hazardous Materials Safety Administration
proposed project	Pipeline Safety and Reliability Project – New Natural Gas Line 3602 and De-Rating Line 1600
psig	pounds per square inch gauge
PSRP	Pipeline Safety and Reliability Project – New Natural Gas Line 3602 and De-Rating Line 1600
ROW	right-of-way
SB 100	Senate Bill 100
SDG&E	San Diego Gas and Electric Company
SMYS	specified minimum yield strength
SoCalGas	Southern California Gas Company
TGN	Transportadora de Gas Natural

1 Introduction

The California Public Utilities Commission (CPUC) was the lead agency for review of San Diego Gas and Electric Company (SDG&E) and Southern California Gas Company's (SoCalGas; collectively, the applicants) proposed Pipeline Safety and Reliability Project – New Natural Gas Line 3602 and De-Rating Line 1600 (PSRP, or proposed project) pursuant to the California Environmental Quality Act (CEQA). Per the requirements of CEQA, the CPUC began preparing an Environmental Impact Report (EIR) to analyze the environmental impacts of the proposed project, which would have analyzed the alternatives to the proposed project, and compare the impacts of those alternatives with those of the proposed project. On June 22, 2018, the CPUC denied the applicants the Certificate of Public Convenience and Necessity (CPCN) for the proposed project. The purpose of this appendix to the Master Environmental Assessment (MEA) is to identify and describe potential alternatives to gas pipeline projects, specifically, or similar linear energy projects that may be proposed in San Diego County.

Among the potential alternatives considered to the proposed Line 3602 pipeline are those that would include the construction of battery storage facilities. Supporting calculations are provided in Attachment A to this Appendix. A compilation of geospatial data for the proposed project and alternatives is available for download from the project website at:
http://www.cpuc.ca.gov/environment/info/ene/sandiego/sandiego.html.

1.1 Existing System

SDG&E and SoCalGas, subsidiaries of Sempra Energy, own and operate an integrated natural gas transmission system consisting of pipeline and storage facilities throughout southern California. The existing system is described in detail in Chapter 2 of this MEA. Currently, gas flows to the SDG&E system from the north via three SoCalGas transmission pipelines: Line 1027, Line 1028, and Line 6900. SDG&E's service territory covers approximately 4,100 square miles and includes approximately 250 miles of natural gas transmission pipelines and approximately 14,600 miles of distribution pipelines. SDG&E's natural gas system in San Diego County begins at the southern border of Riverside County and transports natural gas originating in the southwestern United States, south toward San Diego, terminating in Otay Mesa, California, at the Mexican border. Alternatively, SDG&E can receive up to 400 million cubic feet per day (MMcfd) via the southern end of the natural gas system at Otay Mesa, to flow north if the supply is available. The applicants have indicated that the current system can supply 595 MMcfd during the winter operating season and 560 MMcfd during the summer operating season (SDG&E 2017a). Prior to the reduction of the maximum operating pressure of Line 1600 by CPUC Resolution SED-1, the system provided 630 MMcfd during the winter operating season and 590 MMcfd during the summer operating season (SDG&E 2016).

The major components of the SDG&E/SoCalGas natural gas system in San Diego County are two transmission pipelines and the Moreno Compressor Station. All natural gas flowing south into San Diego County passes through this compressor station. The compressor station has over 16,000 installed horsepower that increases pressure, when necessary, to move higher volumes of natural gas to meet San Diego County's natural gas demand. The two transmission lines include 30-inch-diameter Line 3010 (Line 3010) and 16-inch-diameter Line 1600 (Line 1600). Line 3010 and Line 1600 both originate at the existing Rainbow Metering Station at the Riverside-San Diego county line, traverse through San Diego County, and terminate at the southern boundary of the San Diego metropolitan area.

1.2 Proposed Project

The proposed project would have been located in San Diego County, California, and would have traversed the cities of Escondido, San Diego, and Poway, California; unincorporated communities in San Diego County; and federal land (Marine Corps Air Station [MCAS] Miramar). The proposed project included two components: (1) constructing a new Natural Gas Line 3602 and supporting facilities, and (2) de-rating the existing Line 1600 and making the modifications required to convert it from a transmission pipeline to a distribution pipeline (De-Rating Line 1600).

1.3 Potential Alternatives to the Proposed Project

This appendix describes 28 potential alternatives to the proposed project (see Figure 1).

A. No Project Alternative

B. Proposed Route, Alternate Diameter Pipeline (42-inch) Alternative

C. United States – Liquefied Natural Gas Alternative

D. Liquefied Natural Gas Storage (Peak Shaver) Alternative

E. Existing Alignment Alternatives

    E1. Line 1600 In-Kind Replacement Alternative

    E2. Installation of a New 16-Inch Pipeline Parallel to Line 1600 Alternative

    E3. Installation of a New 36-Inch Pipeline Parallel to Line 1600 Alternative

    E4. Second Pipeline along Line 3010 Alternative

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I. South Orange County Coastal Alternative

J. Blythe to Santee Alternative 1

K. Blythe to Santee Alternative 2

L. Cactus City to San Diego Alternative

M. Looped Pipeline/Compressor Upgrade in Mexico

N. Rainbow – El Norte Parkway – Santee Alternative

O. Non-pipeline Alternatives, Battery Storage

    O1. Grid-Scale Battery/Energy Storage

    O2. Smaller-Scale Battery Storage

P. Non-pipeline Alternative, Safety Variation

Q. Non-pipeline Alternatives, Gas Purchase and Delivery

    Q1. Northern Baja Alternative

    Q2. Energía Costa Azul to Otay Mesa LNG Purchase and Storage

    Q3. Tariff Change Alternative

R. Non-pipeline Alternative, Energy Conservation and Distributed Resources

S. Proposed Route, Alternate Diameter Pipeline (10- to 30-inch) Alternative

T. Rainbow to Santee Non-Miramar Alternative

U. Rainbow – El Norte Parkway – Santee Non-Miramar Alternative

V. Line 2010 Looping Alternative

For the proposed project and all other alternatives, with the exception of the No Project Alternative and the Existing Alignment Alternatives, Line 1600 would be de-rated and operated as a distribution pipeline.

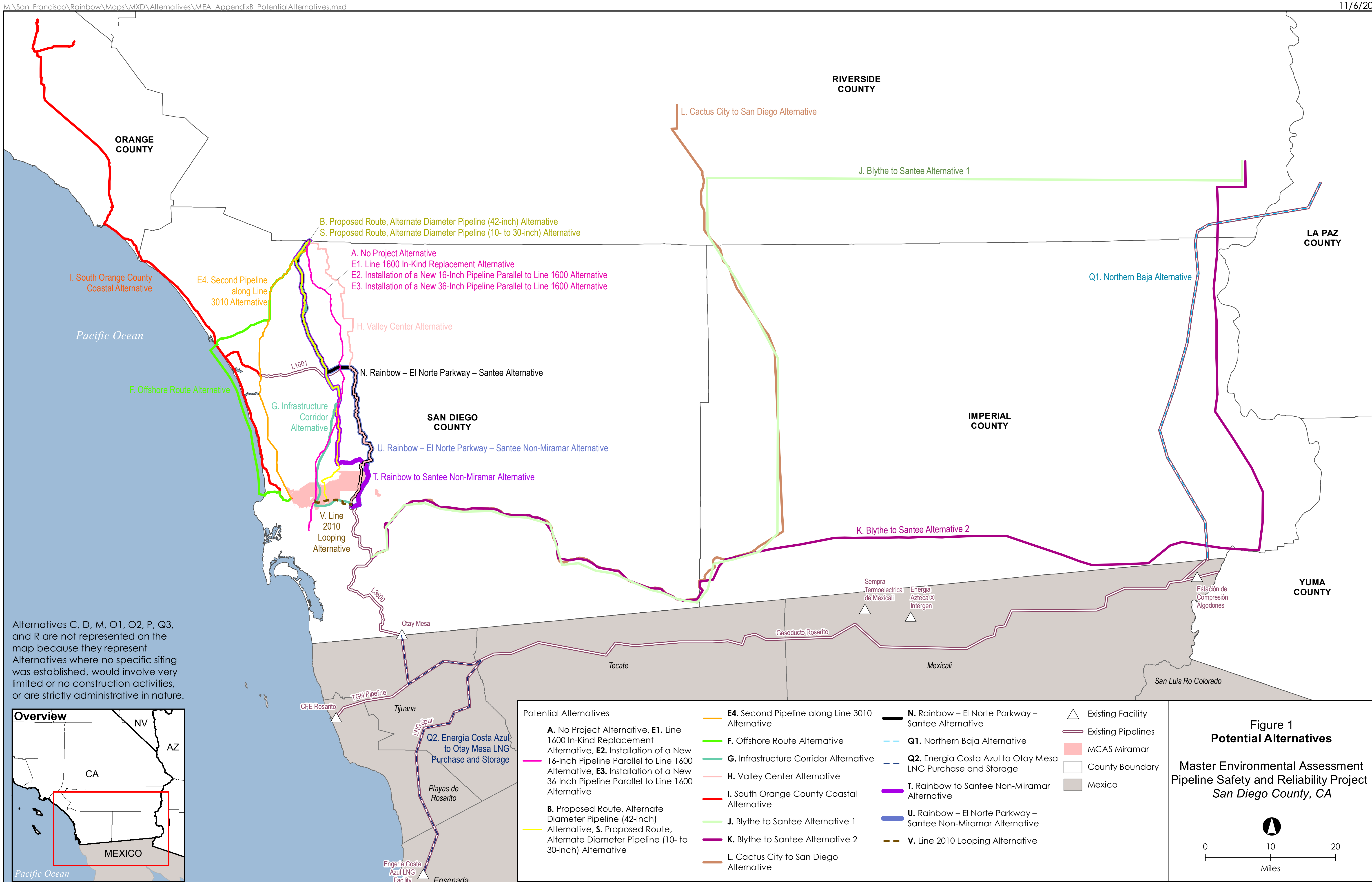

Figure 1
Potential Alternatives

Master Environmental Assessment
Pipeline Safety and Reliability Project
San Diego County, CA

Sources: ESRI 2012; SDG&E 2017b; USMC 2017

2 Development of the Range of Potential Alternatives

Many of the alternatives described in this appendix were identified by the applicants in their application for a CPCN, including the Proponent's Environmental Assessment (PEA) and the Cost Effectiveness Analysis (CEA) required by the CPUC, or were provided in response to the CPUC deficiency or data requests for further information on the proposed project. Other alternatives were developed after review of the proposed project, and with input from stakeholders. The range of alternatives was identified through a multi-step process involving several sources of information, including the following:

- **Proponent's Environmental Assessment.** The applicants submitted a PEA for the proposed project to the CPUC in September 2015, which included an evaluation of potential project alternatives (SDG&E and SoCalGas 2015a).
- **Cost Effectiveness Analysis.** On January 22, 2016, the CPUC's Assigned Commissioner and Administrative Law Judge issued a joint ruling directing the applicants to file and serve an amended application for a CPCN for the Pipeline Safety and Reliability Project Application (A.15-09-013) by March 21, 2016. The ruling also directed the applicants to include with the amended application a needs analysis and a cost analysis report, or CEA, that applies quantifiable data to define the relative costs and benefits of the proposed project and compares them to a range of alternatives (SDG&E and SoCalGas 2017a). In response, the applicants filed the CEA that identified additional alternatives beyond those presented in the PEA.
- **Public Scoping and Stakeholder Input.** On May 9, 2017, the CPUC distributed a Notice of Preparation (NOP) of an EIR to potential responsible and trustee agencies under CEQA, interested parties, and members of the public. The purpose of the NOP was to inform stakeholders that the CPUC was beginning to prepare an EIR for the proposed project and to solicit information and guidance on the scope and content of the environmental information to be included in the EIR and identify potential alternatives. The NOP was circulated for a 35-day public review and comment period beginning on May 9, 2017, and ending on June 12, 2017. Following the release of the NOP, six public scoping meetings occurred (two meetings each day on May 23, 24, and 25, 2017). Comments concerning alternatives received during the public scoping meetings were considered when developing alternatives. Additional alternatives were identified during the public scoping and stakeholder input processes, focusing on reducing and avoiding the potential significant impacts of the proposed project.

The range of alternatives included the proposed project, the No Project Alternative, non-pipeline alternatives, different sizes of pipe, and alternative routes for a new pipeline.

3 Description of Potential Alternatives

This section describes the 28 potential alternatives to the applicants' PSRP, identified based on the PEA, the CEA, public scoping, and stakeholder input.

A. No Project Alternative

The applicants stated that under the No Project Alternative, Line 3602 would not be built (SDG&E and SoCalGas 2015a). The No Project Alternative would involve hydrostatic testing of Line 1600 and repairing or replacing pipeline sections as needed. Line 1600 would maintain service to customers during the testing and repair period through the construction of 42 bypasses. Line 1600 would remain in service as a transmission line after repair. Line 1600, one of two transmission pipelines serving the San Diego area from the north, is an approximately 49.7-mile, 16-inch-diameter, high-pressure natural gas transmission pipeline that begins at the Rainbow Metering Station, in the community of Rainbow, south of the city of Temecula, California, and terminates at Mission Station in the city of San Diego.

No new facilities would be constructed as part of the No Project Alternative, only bypasses. Only sections of Line 1600 identified for repair or replacement based on pressure-testing results would be impacted. It is unknown which sections (if any) might be identified for repair or replacement, but it is assumed that any disturbance in these areas would be localized and specific to only the repair segments needed.

B. Proposed Route, Alternate Diameter Pipeline (42-inch) Alternative

The applicants identified the Proposed Route, Alternate Diameter Pipeline (42-inch) Alternative in both their PEA and CEA, and they provided the following description. This alternative would follow the same route and use the same construction techniques as the proposed 36-inch-diameter pipeline (Line 3602), but a larger diameter pipe would be installed. This alternative would involve construction, operation, and maintenance of an approximately 47-mile-long, 42-inch-diameter natural gas transmission pipeline that would carry natural gas from SDG&E’s existing Rainbow Metering Station to the pipeline’s terminus on MCAS Miramar. Installation of a larger pipe would require a larger construction corridor than the proposed project (SDG&E and SoCalGas 2015a, 2017a).

C. United States – Liquefied Natural Gas Alternative

The applicants identified The United States – Liquefied Natural Gas (LNG) Alternative in their PEA; they provided the following description. Under the United States – LNG Alternative, the applicants would construct a natural gas liquefaction and storage facility that would connect with the existing transmission pipeline system in southeast San Diego County. The LNG facility would include equipment for the liquefaction, storage, and regasification of natural gas and have the capability of storing in more than one billion standard cubic feet (SDG&E and SoCalGas 2015a). The LNG facility would result in a permanent footprint that would likely exceed 150 acres.

The applicants provided, in early data requests, a theoretical, suitable area in southeast San Diego County that may allow for the development of a LNG facility of this size (SDG&E and SoCalGas 2015b). This alternative would require the construction of two new 30-inch-diameter pipelines totaling approximately 85 miles to connect a 150-acre LNG facility at this location to the existing transmission system. A 70-mile segment would be required in order to deliver regasified LNG to existing Line 3010, and a second 15-mile pipeline would be required to connect existing Line 3600 to the LNG facility to supply the natural gas to be liquefied (SDG&E and SoCalGas 2015b).

D. Liquefied Natural Gas Storage (Peak Shaver) Alternative

The applicants identified the LNG Storage (Peak Shaver)[1] Alternative in their CEA. The alternative would provide natural gas from on-site storage for a finite amount of time in order to meet peak demand by California consumers. The applicants provided the following description. The LNG Storage (Peak Shaver) Alternative would involve construction of four independent LNG storage and regasification facilities adjacent to existing electric generation plants, each with the capacity to store 250 million cubic feet of LNG for a total storage capacity of more than one billion standard cubic feet (SDG&E and SoCalGas 2015a). This alternative would be similar to the United States – LNG Alternative in that it would provide storage for LNG, which could be used to maintain service during a potential service reduction or changes in peak demand (SDG&E and SoCalGas 2017a).

This alternative requires LNG storage facilities to serve four existing natural-gas-fired generation sites in the SDG&E system: the Encina Power Plant located in Carlsbad, California, which consists of combustion and steam turbines; the Palomar Energy Center in Escondido, which consists of combined

[1] A LNG storage peak shaver facility is part of a larger natural gas transmission and storage system and typically used for storing surplus natural gas to meet the sudden consumption requirements of extreme cold weather or heat waves.

cycle plants; the Otay Mesa Energy Center in Otay Mesa, San Diego, California, which also consists of combined cycle plants; and the Pio Pico Energy Center in San Diego, which consists of three combustion turbines. Each of the four LNG storage facilities would require rail or truck deliveries of LNG to support peak shaving requirements, which would allow each electric generating plant to operate for at least five days from LNG storage (SDG&E and SoCalGas 2017a).

E. Existing Alignment Alternatives

The following alternatives are all new pipelines that would follow the current alignment of the existing Line 1600 or existing Line 3010. These alternatives include in-kind replacement of Line 1600, construction of a new 16-inch-diameter pipeline parallel to Line 1600, construction of a new 36-inch-diameter pipeline parallel to Line 1600, or a second pipeline parallel to Line 3010.

E1. Line 1600 In-Kind Replacement Alternative

The applicants identified the Line 1600 In-Kind Replacement Alternative in their PEA and CEA; they provided the following description. This alternative would remove and replace the existing Line 1600 with a new 16-inch-diameter pipeline. The replacement pipeline would be 49.6 miles long and would be installed within the existing permanent right-of-way (ROW), which ranges in width from 5 to 20 feet. To accommodate construction equipment for the pipeline replacement in a safe manner, additional temporary workspace 40 to 50 feet wide would be required—up to 100 feet in some areas, depending on topographic, geologic, and soil conditions that may include steep side slopes, bedrock, sandy soils, and/or topsoil salvage requirements. Assuming that an average, conservative width of 40 feet would be required along the 50 miles of existing Line 1600, this alternative would require approximately 250 acres of land to construct.

Two construction options are evaluated for this alternative:

- Removing and replacing the existing line one segment at a time, or
- Removing the entire existing line first and then constructing the replacement line.

E2. Installation of a New 16-Inch Pipeline Parallel to Line 1600 Alternative

The applicants identified the Installation of a New 16-Inch Pipeline Parallel to Line 1600 Alternative in their PEA and CEA; they provided the following description. This alternative would involve installing a new 49.6-mile-long, 16-inch-diameter pipeline parallel to the existing Line 1600.

Two construction options are evaluated for this alternative:

- Constructing the replacement line adjacent to the existing line and then removing the existing line, or
- Constructing the replacement line adjacent to the existing line and then abandoning Line 1600 in place.

Line 1600 would remain in operation during construction of the Installation of a New 16-Inch Pipeline Parallel to Line 1600 Alternative. As a result, construction of a pipeline parallel to the existing Line 1600 would require acquisition of new temporary workspace and permanent ROW adjacent to the existing Line 1600 permanent ROW. Assuming that an average, conservative width of 40 feet would be required along the 50 miles of existing Line 1600, this alternative would require approximately 250 acres of land to construct. Where possible, the replacement pipeline would be installed parallel and immediately adjacent to the existing permanent ROW, which ranges in width from 5 to 20 feet. Constructing the new 16-inch-diameter pipeline would require an additional 40 to 50 feet of temporary workspace, with some areas requiring up to 100 feet or more, depending on steep side slopes, bedrock, sandy soils, and/or topsoil salvage requirements.

E3. Installation of a New 36-Inch Pipeline Parallel to Line 1600 Alternative

The applicants identified the Installation of a New 36-Inch Pipeline Parallel to Line 1600 Alternative in their PEA and CEA; they provided the following description. Under this alternative, the applicants would install a new 49.6-mile-long, 36-inch-diameter pipeline parallel to the existing Line 1600, where possible, and abandon the existing Line 1600 in place. Line 1600 would remain in operation during construction of the Installation of a New 36-Inch Pipeline Parallel to Line 1600 Alternative. As a result, construction of a pipeline parallel to the existing Line 1600 would require acquisition of new temporary workspace and permanent ROW adjacent to the existing Line 1600 permanent ROW. The replacement pipeline would be installed parallel and immediately adjacent to the existing approximately 20-foot-wide permanent ROW. The new 36-inch line would require an additional 40 to 50 feet of temporary workspace during construction, and up to or more than 100 feet in areas with side slopes, bedrock, sandy soils, and/or topsoil salvage requirements (SDG&E and SoCalGas 2015a, 2017a). Assuming that an average, conservative width of 40 feet would be required along the 50 miles of existing Line 1600, this alternative would require approximately 250 acres of land to construct.

E4. Second Pipeline along Line 3010 Alternative

The Second Pipeline along Line 3010 Alternative was identified by the applicants in their PEA and CEA; the following description was provided by the applicants. This alternative would include constructing approximately 45 miles of new 36-inch-diameter pipeline adjacent to the existing Line 3010; this alternative would utilize existing Line 3010 permanent ROW for construction, which would help minimize but not eliminate the amount of temporary workspace outside of existing ROWs needed to construct this pipeline (SDG&E and SoCalGas 2015a, 2017a). This alternative would begin at the existing Rainbow Metering Station and end at Line 3010's interconnection with Line 2010, and would cross the cities of Oceanside, Vista, Carlsbad, Encinitas, Solana Beach, and San Diego.

F. Offshore Route Alternative

The applicants identified the Offshore Route Alternative in their PEA and CEA; they provided the following description. This alternative would consist of construction and operation of a 36-inch-diameter underwater pipeline off the shore of Southern California. The pipeline would begin at the existing Rainbow Metering Station and be routed west to the coastline. The pipeline would transition from onshore to offshore on the north end of Oceanside, California. Off the coast, it would continue west to a distance approximately 1 mile from shore, where it would turn south. The pipeline would run parallel to the California coastline between 0.7 and 1.5 miles offshore until a point offshore of La Jolla, California, where it would turn east and transition again to an onshore pipeline. After transitioning onshore, the pipeline would continue east to a point on the west side of MCAS Miramar, where it would interconnect with Line 3010/3011, which is a receiving point for supplying gas to other pipelines in the San Diego region (SDG&E and SoCalGas 2015a, 2017a). The applicants would need to utilize horizontal directional drilling[2] to avoid sensitive coastal environments, including special status species habitats, migration corridors, and natural communities. The pipeline would be anchored to the ocean floor.

[2] "Horizontal directional drilling" is a steerable trenchless method of installing underground pipe, conduit, or cable in a shallow arc along a prescribed bore path by using a surface-launched drilling rig, with minimal impact on the surrounding area.

G. Infrastructure Corridor Alternative

The applicants identified the Infrastructure Corridor Alternative in their PEA; they provided the following description. This alternative would involve installing a new 36-inch-diameter pipeline in segments of the Interstate 15 (I-15) corridor south of the city of Escondido and along State Route 52 to consolidate transportation and pipeline infrastructure ROWs along one route. This alternative presents a notable advantage in that the route would be located entirely along the California Department of Transportation I-15 ROW corridor; therefore, easements, encroachment permits, and/or fees would be coordinated with just one agency (SDG&E and SoCalGas 2015a).

H. Valley Center Alternative

The applicants identified the Valley Center Alternative in their PEA; they provided the following description. This alternative involves construction of a 36-inch-diameter pipeline beginning at the Rainbow Metering Station and generally traveling south, ending in the city of Santee, California (SDG&E and SoCalGas 2015a). The alternative pipeline route would be approximately 55 miles long. It would run roughly parallel to and east of the proposed project route and cross the communities of Escondido, Poway, and San Diego, as well as MCAS Miramar and the reservation lands of the Pala Band of Mission Indians, one of California’s federally recognized tribes.

I. South Orange County Coastal Alternative

The applicants identified the South Orange County Coastal Alternative in their PEA; they provided the following description. This alternative would provide an alternate supply of natural gas for San Diego County and would involve constructing a new, approximately 108-mile-long, 36-inch-diameter pipeline from Brea, California, southeast of Los Angeles, California, and a new compressor station that would be constructed near the San Onofre Nuclear Generating Plant in San Diego County (SDG&E and SoCalGas 2015a). From the compressor station, the pipeline would continue south and terminate in La Jolla, north of the city of San Diego. The pipeline would interconnect with Line 2009 near the city of Carlsbad. Starting near the city of Dana Point, California, the existing Line 1026, which is a 12-inch-diameter distribution line, would be paralleled or replaced with the proposed 36-inch-diameter line between Oceanside and the University of California San Diego, north of La Jolla. The alternative would cross both Orange and San Diego counties, as well as several cities.

J. Blythe to Santee Alternative 1

The applicants identified the Blythe to Santee Alternative 1 in their PEA and CEA; they provided the following description. This alternative would involve construction of a 36-inch-diameter pipeline approximately 222 miles in length (approximately 175 miles longer than the proposed project route). This alternative route would begin in the city of Blythe, California, and travel directly west, turning south near the northwestern corner of the Salton Sea in Riverside County. The route would then continue south through Imperial County until just north of the community of Ocotillo, California, and would generally continue west until its terminus within the community of Spring Valley, California (SDG&E and SoCalGas 2015a, 2017a). Approximately 202 miles of the route would be constructed cross-country.

K. Blythe to Santee Alternative 2

The applicants identified the Blythe to Santee Alternative 2 in their PEA and CEA; they provided the following description. The Blythe to Santee Alternative 2 would involve construction of a 36-inch-diameter pipeline along a route from the city of Blythe to the community of Spring Valley. From Blythe, the route would travel south to the city of Yuma, Arizona. West of the city of Yuma, the route would veer west, following Interstate 8 until its terminus in the community of Spring Valley. This alternative route would cross Riverside, Imperial, and San Diego counties. The route would measure a total of approximately 223 miles, which is approximately 176 miles longer than the proposed project (SDG&E and SoCalGas 2015a, 2017a).

L. Cactus City to San Diego Alternative

The applicants identified the Cactus City to San Diego Alternative in their PEA and CEA; they provided the following description. This alternative would involve construction of a 36-inch-diameter pipeline along a route beginning in Cactus City, California, and traveling generally south until just north of the community of Ocotillo, where the route would turn west and travel generally in a westerly direction until its terminus within the community of Spring Valley. The Cactus City to San Diego Alternative route would be approximately 160 miles long, which is 113 miles longer than the proposed project route (SDG&E and SoCalGas 2015a, 2017a).

The Cactus City to San Diego Alternative crosses the U.S. Navy's West Mesa Range Complex, Loom Lobby Ordnance Range. Managed by Naval Air Facility El Centro, the Loom Lobby Ordnance Range is used for live ordnance training, including air-to-ground bombing, rocket, and strafing exercises (Hulse 2017). This alternative would also cross the southern portion of Anza-Borrego Desert State Park.

M. Looped Pipeline/Compressor Upgrade in Mexico

The applicants partially defined the Looped Pipeline/Compressor Upgrade in Mexico Alternative in their CEA. The Looped Pipeline/Compressor Upgrade Alternative would transport gas from Blythe/Ehrenberg (SoCalGas/El Paso pipeline system) to Otay Mesa. In order to deliver an incremental 400 dekatherms per day to Otay Mesa, the following would likely be required: expanding the existing compressor station on the North Baja pipeline system and the existing Algadones compressor station; constructing a new compressor station on the Gasoducto Rosarito pipeline system; and pipeline looping. To expand the existing North Baja pipeline system, the applicants would need to secure a multi-year capacity contract for the transportation of gas supplies. New construction workspace would be needed to expand and build a new compressor station; it is assumed that all pipeline looping workspace would occur within existing ROW.

N. Rainbow – El Norte Parkway – Santee Alternative

The applicants identified the Rainbow – El Norte Parkway – Santee Alternative in their PEA; they provided the following description. This alternative will include the construction of a 36-inch-diameter pipeline that would be approximately 54 miles in total length and would follow the same route as the proposed project from the Rainbow Metering Station until the intersection of Centre City Parkway and West El Norte Parkway. At that point, the Rainbow – El Norte Parkway – Santee Alternative would leave the proposed project's route corridor and travel east through the city of Escondido until the city's easternmost limits, and would then turn south and end in the city of Santee (SDG&E and SoCalGas 2015a).

Similar to the Valley Center Alternative discussed above, this alternative would cross the eastern portion of MCAS Miramar, formerly Camp Elliot, which has historically been used for live fire ordnance training and has since been classified by the United States Army Corps of Engineers as a Formerly Used Defense Site (USACE 2014).

O. Non-pipeline Alternative, Battery Storage

The applicants identified the Non-pipeline Alternative, Battery Storage in their CEA. Under the Non-pipeline Alternative, Battery Storage, the proposed project would not be built. The Non-pipeline Alternative, Battery Storage would involve pressure testing Line 1600 and repairing or replacing pipeline sections found to be in need of repair. In combination with testing and repair of Line 1600, various smaller scale and stand-alone alternative energy projects would be implemented. These projects could include, but would not be limited to, grid scale and smaller scale battery storage options, renewable electric microgeneration projects (solar, wind, etc.), or development of other energy generation or storage projects that do not rely on gas and could serve as backup energy supplies in varying scales.

Implementation of a series of smaller-scale battery storage and renewable energy projects would offset potential gas demand associated with electric generation plants. Successful implementation of this alternative would require a sufficient number of these smaller projects across SDG&E's territory to reduce peak gas demand by the quantity of gas transported by Line 1600 (e.g., about 10 percent of peak capacity).

O1. Grid-Scale Battery/Energy Storage

The applicants identified the Grid-Scale Battery/Energy Storage Alternative in their CEA; they provided the following description. This alternative would include installing a system of grid-scale lithium-ion batteries and associated infrastructure sufficient to supply customers approximately 11,200 megawatt hours (MWh) of energy storage capacity for 4 hours. As proposed by the applicants, a facility capable of storing 11,200 MWh of energy that could be used over the course of four hours would be able to deliver 2,800 megawatts (MW) of power per hour. A new or upgraded substation facility and transmission lines may be needed to support this alternative. The applicants estimated that a 2,800-MW battery storage facility could occupy 100 acres of land or more. With the installation of a system of grid-scale batteries, Line 1600 would be de-rated and power would be drawn from the battery system to supplement the power generation potentially lost from de-rating Line 1600. This alternative would be used to supply electricity during periods of peak demand as well as in the event of electrical generation outages (SDG&E and SoCalGas 2017a).

To calculate the battery storage requirements for this alternative, the applicants assumed 4 hours of service and:

- Complete disruption of gas supply during a peak electric load day;
- Peak SDG&E Electric Load Forecast: 5,372 MW;
- Import capability: 2,500 MW;
- Net Qualifying Capacity of non-gas generation: 70 MW; and
- Hence: Peak Load *minus* Import Capability *minus* Non-Gas Generation = **2,802 MW** (or 2,800 MW).

Additional energy generation may be required in order to supply electrical power stored by the battery system. The applicants have not identified associated projects that would be capable of supplying power to the battery system; however, if operated similarly to other battery systems, excess power generated during non-peak times would be used to charge the batteries. The batteries would then be discharged as needed to keep up with peak demand. To comply with the CPUC Storage Mandate Decision 13-10-040, energy storage products would use the excess renewable energy to charge the battery or system during the time of low energy demand and would provide energy back into the grid during periods of high-energy demand (CPUC 2013).

The Grid-Scale Battery/Energy Storage Alternative would require additional electrical transmission facilities in order to connect to the electrical grid. The siting of the facility would determine the exact need for and size of additional transmission facilities needed.

O2. Smaller-Scale Battery Storage

The applicants identified the Smaller-Scale Battery Storage Alternative in their CEA; they provided the following description. This alternative would include installation of a number of small-scale battery storage facilities throughout the regional electrical system to provide power in the event of a service disruption or during changes in peak demand; these facilities would need the ability to deliver 2,800 MW of power per hour for 4 hours to meet the applicants' requirements. It is likely that substation facilities would be needed to host this alternative. The Smaller-Scale Battery Storage Alternative would in aggregate supply the same amount of energy as the Grid-Scale Battery/Energy Storage Alternative (approximately 11,200 MWh) (SDG&E and SoCalGas 2017a). With the installation of smaller-scale batteries throughout the system, Line 1600 would be de-rated and power would be drawn from the battery systems as needed to supplement the power generation potential lost from the de-rating of Line 1600. As required by the CPUC Storage Mandate Decision 13-10-040, energy storage products would use the excess renewable energy to charge the battery or system during the time of low energy demand and would provide energy back into the grid during periods of high-energy demand (CPUC 2013).

P. Non-pipeline Alternative, Safety Variation

The State of California Office of Ratepayer Advocates identified the Non-pipeline Alternative, Safety Variation as part of the CPUC Formal Proceedings to prioritize the safe operation and integrity of Line 1600. This alternative would involve pneumatically pressure testing and repairing Line 1600 and continuing to use it as a transmission pipeline operated under transmission safety requirements. Under this alternative, Line 1600 would not be de-rated to a distribution line. At each point where a line with an maximum allowable operating pressure (MAOP) greater than 325 pounds per square inch gauge (psig) connects to Line 1600, overpressure protection equipment would be installed consisting of: 1) a pressure regulator; 2) two monitoring valves; and 3) a pressure relief valve. These safety measures would minimize the risk of Line 1600 becoming over-pressurized by gas coming through these connection points and potentially failing.

Following these initial improvements to Line 1600, the pipeline would be pneumatically pressure tested (e.g., testing air or an inert gas, such as nitrogen). The applicants would need to submit an application to the Pipeline and Hazardous Materials Safety Administration (PHMSA) to obtain permission in order to pneumatically test Line 1600 at a pressure slightly higher than the 30 percent specified minimum yield strength (SMYS) limit of 487.5 psig. Testing at a slightly higher pressure would ensure that each point on the line would be subjected to a test pressure of at least 30 percent SMYS, the necessary test pressure to validate the MAOP of 325 psig. Three hundred twenty-five psig is equivalent to 20 percent SMYS. A pressure test to at least 487.5 psig (30 percent SMYS) is commensurate with 49 Code of Federal Regulations Part 192 for pressure testing to 1.5 times the MAOP of the pipeline. During the pressure test, leak tests would be performed as required by federal safety requirements to provide a further margin of safety on Line 1600, and, to extend that margin of safety on Line 1600, repairs to the line would be completed, as needed, based on these tests. Line 1600 would continue to operate as a transmission line following completion of necessary repairs.

Alternatively, pending approval by the PHMSA, the applicants would provide records of valid leak surveys performed at historic operating pressures, which are well in excess of 487.5 psig and would serve as evidence of a valid pressure test. With prior approval from the PHMSA, this approach could also satisfy the requirement to pressure test Line 1600. Segments of Line 1600 would be repaired or replaced, as needed, based on these leak survey records, and Line 1600 would continue to operate as a transmission line. This alternative would not require construction of a new pipeline.

Q. Non-pipeline Alternatives, Gas Purchase and Delivery

The applicants identified the following alternatives. The Northern Baja Alternative, Energía Costa Azul to Otay Mesa LNG Purchase and Storage Alternative, and Tariff Change Alternative have been grouped together in the following section. Each alternative involves customers procuring natural gas supply from Mexico and transporting the natural gas to the applicants' system via receipt points along the U.S. Mexico border. Each alternative would require the applicants to secure a multi-year capacity contract for the transportation of gas supplies.

Under each of these alternatives, the proposed project would not be built. Line 1600 would be de-rated to a distribution line. Contracts to obtain sufficient capacity would be sought, and gas would be delivered to the applicants' system from Otay Mesa or other receipt points. Each alternative is described below.

Q1. Northern Baja Alternative

Identified by the applicants in their PEA, the Northern Baja Alternative entails importing natural gas from Mexico utilizing the existing Transportadora de Gas Natural (TGN) Otay Mesa receipt point to access gas supply transported on the TGN system. The existing North Baja pipeline that exports natural gas to Mexico near El Centro, California, currently has existing capacity for natural gas transmission to the Gasoducto Rosarito/TGN pipelines, which can in turn transport and deliver natural gas to the Otay Mesa receipt point (SDG&E and SoCalGas 2015a).

Q2. Energía Costa Azul to Otay Mesa LNG Purchase and Storage

Identified by the applicants in their PEA, the Non-pipeline Alternative, Otay Mesa: Energía Costa Azul to Otay Mesa LNG Purchase and Storage would involve import of natural gas from Mexico utilizing the existing TGN Otay Mesa receipt point to access gas supply transported on the TGN system, which was purchased from Sempra Energy’s existing Energía Costa Azul LNG facility. The existing Energía Costa Azul LNG facility is a LNG receipt, storage, and regasification terminal located 15 miles north of Ensenada in Baja California, Mexico. Alternatively, customers/applicants would purchase natural gas at the United States/Mexico border from suppliers who control access to LNG stored or delivered to the Energía Costa Azul LNG facility. This alternative is a limited construction or no construction alternative to the proposed project (SDG&E and SoCalGas 2015a).

Q3. Tariff Change Alternative

The Tariff Change Alternative was identified as a way to implement tighter gas operating rules. Gas suppliers/marketers/customers on the applicants’ system are free to deliver gas at any pipeline interconnection for re-distribution by the applicants to the customer. Accordingly, most of the gas received by the applicants is from a receipt point where the gas is less expensive than at other receipt points. This market outcome does not necessarily support the applicants’ desired operating conditions. As a result, more expensive gas may have to be purchased at other receipt points to ensure operational reliability. When gas is needed at other receipt locations to maintain operational requirements, the applicants can have their core gas group buy gas delivered to specific receipt locations to provide the necessary quantity of gas. Under this alternative, the applicants’ tariff would be changed to require specific quantities or percentages of gas to be delivered to all existing receipt points (including Otay Mesa) for noncore customers (e.g., electric generators in the San Diego area). This could result in customers on different parts of the applicants’ system paying different prices for gas. In October 2017, the Otay Mesa receipt point was used by the applicants to bring in more than 200 MMcfd of natural gas due to operational issues and constraints on their system (SoCalGas 2017).

A tariff change of this nature may be required for reasons not directly associated with the proposed project. Among mitigation measures proposed to address issues associated with the ongoing operation of the Aliso Canyon natural gas storage facility[3] were tariff changes that would require users of the applicants’ system to more closely match their gas deliveries to their customers’ gas usage than the current monthly 10 percent tolerance. Another mitigation measure proposed was increased operational coordination. Over the past five years, the California Independent System Operator and SoCalGas have made significant strides to improve the quantity, content, and timing of communication to coordinate between electricity and gas operations (CPUC et al. 2017). In addition, the CPUC expedited the approval of 104.5 MW of energy storage projects in Southern California Edison and SDG&E territories in May 2016 in response to the Aliso Canyon leak. Installation of 70 MW of the 100 MW occurred in about six months, and 37.5 MW of the total was installed in SDG&E’s service territory (Pyper 2017; Wagman

[3] In October 2015, a major natural gas leak was detected from a well within the Aliso Canyon’s natural gas underground storage facility in the Santa Susana Mountains near Porter Ranch, Los Angeles.

2017). Energy storage is discussed below, under the Non-pipeline Alternative, Energy Conservation and Distributed Resources.

R. Non-pipeline Alternative, Energy Conservation and Distributed Resources

The Non-pipeline Alternative, Energy Conservation and Distributed Resources addresses the potential for the SDG&E system to operate without a replacement gas transmission pipeline. It assumes that at some point in the future, the applicants could implement energy conservation initiatives in combination with one or more representative distributive energy generation or energy storage projects that would offset the equivalent amount of power lost from de-rating Line 1600. This alternative would involve carrying out pipeline safety enhancement requirements for Line 1600, which may entail pressure testing and repairing or replacing Line 1600, abandoning it in place, or de-rating its use from a transmission to distribution line by permanently lowering its pressure while maintaining system reliability.

The range of initiatives and distributed generation projects described in this alternative represent the type and scale of similar projects that have recently been developed in Southern California. The level of detail in the comparative analysis of this alternative to the project is limited because no specific details for this alternative have been developed. More specifically, concepts like the size of the potential facility or the functionality of the facility (like the recharge ability of a 333 MW battery system) would need further investigation and development. Examples presented in this alternative should be considered illustrative of the type of infrastructure that could be implemented in the San Diego region.

Demand Response and Energy Conservation Programs

Demand management and energy conservation programs are demand-side response actions designed to reduce overall energy use or to shift energy use to off-peak times. Examples of demand-side conservation programs include those that promote the use of high-efficiency appliances (e.g., efficient heating, ventilation and cooling systems, energy efficient lighting and energy efficient consumer products like computers and televisions, etc.); weatherization assistance programs that subsidize advanced technologies to increase the energy performance of residential buildings; and other coproduction methods challenging individuals to take an active stake in achieving desirable environmental targets through conservation-minded behavior modification directed at how and when energy resources are consumed.

Advanced meters, also referred to as “smart” meters, are useful tools for monitoring, quantifying, and analyzing energy consumption. As part of California’s Energy Action Plan II, in 2005, the state began directing utility providers to replace aging analogue electrical and natural gas meters with new advanced digital meters (State of California 2005). This directive, described in the Integrated Energy Policy Report, complies with state goals set for investor-owned utilities that requires utility providers to install advanced meters in all newly constructed facilities as a matter of course and to deploy meters to existing customers upon request (CEC 2016a).

Smart meters enable utility providers to generate information about a customer’s energy usage, expressed in kilowatt hours, a standard measurement of 1,000 watts of electricity used for one hour. Smart meters also allow customers to better and more proactively manage their energy use at varying times during the day because they can be read by both customers and utility providers.

Further, smart meters enable utility providers to administer system-scaled initiatives like SDG&E’s Summer Saver Program that encourages end users to manage electricity demands more efficiently during warmer months. Participants agree to install a cycling device on their air conditioning units that, when activated, switches the unit on and off for conservation periods lasting up to 4 hours. The Summer Saver Program, Technical Assistance, and Technology Incentives Program for commercial customers are designed to leverage technology and conservation-minded shifts in behavior to reduce peak electrical demand (SDG&E 2013). As of 2017, all SDG&E customers—residential and commercial—currently have or will receive smart meters, unless they opt out of the program. Demand-side management and energy efficiency programs have been adopted by customers, as evidenced by peak demand data recorded for the service area (Nexant, Inc. 2017). Less than 10 MW of annual reduction in annual demand is minor with respect to the average annual demand for San Diego County, which was 19,781 gigawatt hours in 2015 (CEC 2016b). In September of 2014, due to the extreme weather conditions, SDG&E reached a new all-time peak demand record of 4,890 MW in a single day (SDG&E 2014). Furthermore, electricity consumption for the SDG&E planning area is projected to reach between 22,926 and 24,962 gigawatt hours by 2026 (CEC 2016b).

Clean Energy Initiatives

California's Renewables Portfolio Standard was established in 2002 under Senate Bill 1078 and requires production of energy in the state from renewable energy sources, such as wind, solar, biomass, and geothermal. The Renewables Portfolio Standard goals have been accelerated since 2006, establishing new targets for electricity retail sales served by renewable energy resources. In 2006, Governor Arnold Schwarzenegger signed the state's landmark climate change legislation, the California Global Warming Solutions Act (Assembly Bill 32), to reduce the state's greenhouse gas emissions to 1990 levels by 2020. The state's Air Resources Board has developed a Scoping Plan based on input from agencies and stakeholders across the state to chart a course toward this target.

California is on track to meet or exceed the current target of reducing greenhouse gas emissions to 1990 levels by 2020, as established in Assembly Bill 32. California's new emission reduction target of 40 percent below 1990 levels by 2030 will make it possible to reach the ultimate goal of achieving an 80 percent reduction in 1990 levels by 2050.

In October 2015, Governor Edmund G. Brown, Jr., signed the Clean Energy and Pollution Reduction Act (Senate Bill 350), which, among other things, requires the state to generate at least half of its electricity from qualified clean, renewable resources and to double energy efficiency in all existing, vital end uses by 2030. Closely related are California's Mobile Source Strategy and Sustainable Freight Action Plan, which represent efforts to reduce emissions from cars, trucks, and other forms of transport; promote cleaner fuel use; and support vehicle electrification efforts. These integrated strategies have a twofold purpose: to innovate efficient mobility for people and goods in the state while substantially reducing the greenhouse gas emissions from the state's transportation sector.

Most recently, in September 2018, Governor Brown approved Senate Bill 100 (SB 100) known as "The 100 Percent Clean Energy Act of 2018." SB 100 speeds up the state's timeline for moving to renewable energy sources like solar and wind and requires that all retail electricity be carbon-free by 2045. SB 100 increases how much of California's electricity portfolio must come from renewables by 2030 from 50 percent to 60 percent. It establishes a further goal to have an electric grid that is entirely powered by clean energy by 2045. The bill also extends and expands policies established pursuant to the California Renewables Portfolio Standard Program and codifies the policies established pursuant to Section 454.53 of the Public Utilities Code, and that both be incorporated in long-term planning.

Distributed Energy Resources

Distributed Energy Resources (DER) comprise distribution-connected, distributed generation resources; energy efficiency programs and initiatives; energy storage projects; electric vehicles; and demand response technologies, which are supported by a wide-ranging suite of CPUC policies. Since 2007, the CPUC has sought to integrate demand-side energy solutions and technologies through utility program offerings.

CPUC Decision 07-10-032 directs utilities to "integrate customer demand-side programs, such as energy efficiency, self-generation, advanced metering, and demand response, in a coherent and efficient manner." The integration of demand-side programs and technologies is intended to achieve maximum savings while avoiding duplicative efforts and reducing transaction costs and customer confusion. Integrated DER is a strategy that seeks to provide comprehensive building energy management solutions via the integration of technologies, programs, and strategies to facilitate customer behavior changes that reduce load and grid inefficiencies.

Conventional systems[4] are scaled to deliver energy across large transmission networks. In these systems, a power plant transmits electricity, or bulk power, in a single direction over the grid where it is distributed to load centers and then to consumers. Distributed energy differs from conventional systems mainly through the use of smaller power generation and storage systems. Most distributed energy generation systems provide power from renewable energy sources such as solar, wind, and hydroelectric. Energy storage systems, like batteries, play an important part in the system by storing energy generated by intermittent renewable power sources to ensure reliability and ease demands on the power grid. Conventional facilities tend to be centralized and often require electricity to be transmitted over long distances, unlike DER systems, which are typically decentralized, modular, located near the load they serve, and tend to have modest generation capacities compared to conventional grid based power generation.

San Diego's Climate Action Plan (2015) commits San Diego to 100 percent renewable energy by 2035. Within the same 20-year period, demand for natural gas for electric generation is anticipated to decline at a rate of 0.2 percent per year, due to more efficient production processes at existing power plants, statewide efforts to minimize greenhouse gas emissions, and the use of low carbon emission resources (California Gas and Electric Utilities 2014, 2016).

The 2016 Annual Report on San Diego's Climate Action Plan indicates that 35 percent of San Diego's energy came from renewable sources in 2015; the city produced upward of 157 MW of solar energy from 22,098 installed rooftop photovoltaic systems, and had a fleet of approximately 5,000 electric vehicles. As of October 2016, San Diego County reported 54 on-line renewable energy projects, including biomass, geothermal, small hydroelectric, solar photovoltaic, solar thermal, and wind energy. San Diego County authorized Power Purchase Agreements to install 13.4 MW of solar arrays at eight sites across the county (City of San Diego 2016).

California is ahead of schedule for meeting its renewable energy targets. The Energy Commission estimates that about 29 percent of its electricity retail sales in 2016 was served by renewable energy generated from sources such as wind, solar, geothermal, biomass, and small hydroelectric (CEC 2017). As of June 30, 2017, almost 10,400 MW of distributed generation capacity were operating or installed in the state, with an additional 500 MW pending. The data include about 5,800 MW of solar self-generation capacity, which exceeds the state's goal established through the California Solar Initiative of installing 3,000 MW of solar energy residential and commercial sites by the end of 2016 (CEC 2017).

Rooftop Solar

Small-scale distributed generation, such as rooftop solar panels and fuel cell systems, have the potential to reduce demand on the applicants' system. As of October 2016, San Diego County reported 36 on-line solar photovoltaic facilities capable of generating 195 MW (CEC 2016c).

In 2014, the CPUC was directed to develop a successor tariff that continues the Net Energy Metering Tariff. In 2016, the CPUC approved Decision 16-01-044 adopting the successor tariff. These tariffs or

[4] For comparative purposes in this report, the term "conventional systems" or "conventional energy systems" include facilities that generate electricity from non-renewable resources (oil, coal, natural gas, etc.) at a central plant, which functions as an integral part of an electric grid, where the large generating facility is typically located close to resource inputs and/or far from populated load centers.

incentives were designed to increase the enrollment and participation in the applicants' Net Energy Metering Program, which allows a customer generator (e.g., a family home with rooftop solar installed) to receive financial credit for power generated by their on-site system and feed back into the utility's electrical system, and will increase the number of customer generators feeding into the system (CPUC 2014, 2016).

Energy Storage

Energy storage options include battery, pumped-hydro, and natural gas storage that are available to support grid flexibility and reliability, which may reduce the cost of renewable resource intermittency and help manage the physical grid constraints that limit high penetration of renewable resources. Energy storage projects must also address integration of renewable energy sources, grid optimization (including peak load reduction, reliability needs, or deferment of transmission or distribution upgrades), and greenhouse gas emissions reductions.

A variety of legislation, policies, and programs in California affect energy storage, two of which are the CPUC's Long-term Procurement Planning proceeding and Assembly Bills 2514 and 2868. Long-Term Procurement Planning is the CPUC's "umbrella" proceeding that ensures system reliability by looking ahead 10 years from the perspective of system needs, local needs, grid integration, and flexible resources.

Assembly Bill 2514, Assembly Bill 2868, and CPUC Proceeding R.15-03-011

Assembly Bill 2514 requires the CPUC to determine appropriate targets for the state's investor-owned utilities to procure viable and cost effective energy storage systems. It also requires the state's publicly owned utilities to consider adopting energy storage targets. The CPUC established a target of 1,325 MW of energy storage procurement by 2020, which is anticipated to drive required energy storage installations in the state to be completed no later than 2024 (CPUC 2013). Further, in April 2015, the CPUC opened an Order Instituting Rulemaking in response to the enactment and ongoing implementation of legislation Assembly Bill 2514 and to continue to refine policies and program details, which established the Energy Storage Procurement Framework and Program and approved the utilities' applications in implementing the program. This rulemaking considers recommendations included in the California Energy Storage Roadmap, an interagency guidance document which was jointly developed by the California Independent System Operator, the California Energy Commission, and the CPUC.

Assembly Bill 2868 furthers the development of distributed energy storage and requires the CPUC to direct Pacific Gas and Electric Company (PG&E), Southern California Edison, and SDG&E to develop programs to accelerate deployment of up to 500 MW of distributed energy storage systems, and would require the CPUC to prioritize programs and investments that provide distributed energy storage systems to public sector and low-income customers. CPUC Decision D.17-04-039 for Proceeding R.15-13-011ordered the utility companies to each add 166.66 MW (roughly 500 MW combined) of distributed energy storage systems to their 2018 energy storage procurement and investment plans. This establishes a target of 1,825 MW of energy storage procurement by 2020 (CPUC 2017a).

Stand-alone Pipelines

According to supplemental testimony for the applicants supplied by Paul Borkovich and CPUC Decision 18-06-028, approximately 115 MMcfd can be provided by Line 1600 when operating as a stand-alone transmission line (i.e., Line 1600 at roughly 512 psig and isolated from Line 3010 and the existing pipeline cross ties) (SDG&E and SoCalGas 2017b). Similarly, SDG&E would be able to provide 570 MMcfd, through Line 3010 as a stand-along pipeline (SDG&E and SoCalGas 2017c). Table 3-1 shows the stand-alone operational capacity potential of Line 1600 at the current pressure of 512 psig and proposed de-rated pressure of 320 psig and the resulting reduction in flow from operation of Line 1600 as a stand-alone line.

Table 3-1 Operating Capacities of Lines 3010 and 1600 as Stand-alone Lines

Original[a]			Current[b]		
Pipeline ID	Pressure of Each Line (psig)	Capacity (MMcfd)	Pipeline ID	Pressure of Each Line (psig)	Capacity (MMcfd)
3010	640	570	3010	640	570
1600	640	150	1600	512	115
	System Capacity (Total MMcfd)	720		System Capacity (Total MMcfd)	685

Source: SDG&E 2017c; SDG&E and SoCalGas 2017c

Notes:
(a) The initial nominal stand-alone operating pressures and capacities of Lines 1600 and 3010 before pressure reductions
(b) The current nominal stand-alone operating pressures and capacities of Lines 1600 and 3010 after Line 1600's pressure was reduced to 512 psig

Key:
MMcfd = million cubic feet per day
psig = pounds per square inch gauge

Under this scenario, with additional compression and system reconfiguration, Line 3010 could potentially provide more than 570 MMcfd when run as a stand-alone line, if pressure higher than 640 psig is determined to be safe by the CPUC Safety Enforcement Division.

Lithium Ion Battery Storage

Energy storage addresses intermittency challenges associated with renewable energy because batteries storage can smooth the ebbs and flows associated with wind and solar power production by supplementing the grid when those resources are not available. Batteries function by storing energy when it is abundant; for example, when the sun is shining, the wind is blowing, and/or energy use is low. Energy storage plays a key role in the utilities' ability to deliver clean, safe, and reliable energy. As of February 2017, SDG&E anticipated developing or interconnecting more than 330 MW of energy storage to the system by 2030 (SDG&E 2017d). CPUC Decision D.17-04-039, however, accelerated the timeframe for procuring 330 MW (331 MW, specifically) by 10 years.

In 2016, the CPUC directed Southern California investor-owned electric utilities to fast track additional energy storage options to enhance regional energy reliability. In response, SDG&E expedited ongoing negotiations and contracted with AES Energy Storage to build two projects: a 30 MW lithium ion battery energy storage facility in Escondido and a smaller 7.5 MW installation in the city of El Cajon. Together, the facilities comprise some 400,000 batteries in nearly 20,000 modules stored in 24 containers (SDG&E 2017d). SDG&E was required to procure 165 MW of energy storage by the end of 2021, and as of September 2018, SDG&E had been authorized or has a pending authorization to procure 159.91 MW of energy storage (Application A.18-02-016). SDG&E proposed to procure 100 MW of additional energy storage pursuant to Assembly Bill 2868 (Application A.18-02-016).

Table 3-2 shows the historic, current, and de-rated SDG&E system capacity in MMcfd. Line 1600 could still be de-rated to 320 psig and be able to supply the 40 MMcfd capacity to the SDG&E system. De-rated Line 1600 (at 320 psig) and Line 3010 would be able to supply a capacity of 570 MMcfd. If Line 1600 removed from service all together, the applicants have stated that Line 3010 would have a nominal stand-alone capacity of 570 MMcfd, if operated without Line 1600 (SDG&E and SoCalGas 2017b).

Table 3-2 Historic, Current, and Projected Operating Capacities of the SDG&E System, Lines 3010 and 1600

Historic			Current			De-rated		
Pipeline ID	Pressure of each Line (psig)	Capacity (MMcfd)	Pipeline ID	Pressure of each Line (psig)	Capacity (MMcfd)	Pipeline ID	Pressure of each Line (psig)	Capacity (MMcfd)
3010	640	530	3010	640	530	3010	640	530
1600	640	100	1600	512	65	1600	320	40
System Capacity (Total MMcfd)		630	System Capacity (Total MMcfd)		595	System Capacity (Total MMcfd)		570
			Difference From Historic System Capacity (MMcfd)		-35	Difference From Current System Capacity (MMcfd)		-25

Source: SDG&E 2017c; SDG&E and SoCalGas 2017c

Key:
MMcfd = million cubic feet per day
psig = pounds per square inch gauge

Table 3-3 presents a preliminary comparison of electric energy generated by battery storage as opposed to the combustion of natural gas. Sizes of battery facilities needed to compensate for the system capacity lost from de-rating or decommissioning Line 1600 were calculated (see Attachment A). The table shows the de-rated base capacity of the system (570 MMcfd), which can be supplied stand-alone by Line 3010 or by Lines 3010 and 1600 jointly (SDG&E and SoCalGas 2017b). Capacity increments of 2 MMcfd were used when preparing the Table 3-3 to show the incremental increase in battery facility size needed to compensate for various reductions in gas capacity.

Table 3-3 Preliminary Natural Gas Capacity Comparisons to Energy from Battery Storage

Battery Storage Requirement					4-HOUR SERVICE NEEDS[(a)]		
Base Capacity[(b)] (MMcfd) (L3010 Capacity)	Additional Capacity[(c)] (MMcfd)	System Total (MMcfd)	MWh for 24 Hours[(d,e)]	MWh for 24 Hours[(f)]	MWh Needed for 4 Hours[(f,g)]	Required Energy Rate for Battery Facility (MW)	Approximate Disturbance Area (Acres)[(h)]
570	0	570	0	0	NA	0	0
570	2	572	598	359	60	15	0.6
570	4	574	1,196	717	120	30	1.2
570	6	576	1,794	1,076	179	45	1.8
570	8	578	2,391	1,435	239	60	2.3
570	10	580	2,989	1,794	299	75	2.9
570	12	582	3,587	2,152	359	90	3.5
570	14	584	4,185	2,511	419	105	4.1
570	16	586	4,783	2,870	478	120	4.7
570	18	588	5,381	3,228	538	135	5.3

Table 3-3 Preliminary Natural Gas Capacity Comparisons to Energy from Battery Storage

Battery Storage Requirement					4-HOUR SERVICE NEEDS[a]		
Base Capacity[b] (MMcfd) (L3010 Capacity)	Additional Capacity[c] (MMcfd)	System Total (MMcfd)	MWh for 24 Hours[d,e]	MWh for 24 Hours[f]	MWh Needed for 4 Hours[f,g]	Required Energy Rate for Battery Facility (MW)	Approximate Disturbance Area (Acres)[h]
570	20	590	5,979	3,587	598	149.5	5.8
570	22	592	6,577	3,946	658	164	6.4
570	24	594	7,174	4,305	717	179	7.0
570	25	595	7,473	4,484	747	187	7.3

Sources: SDG&E 2017c; Attachment A

Notes:
(a) What is needed to provide 4 hours of power. Four hours is an industry standard for approximating a battery's charge capacity. To double the capacity of a facility, the number of batteries needs to be doubled.
(b) Base capacity (570 MMcfd) was determined using the total capacity for the de-rated system ([capacity of L3010 at 640 psig] + [capacity of L1600 at 320 psig]) or the stand-alone capacity Line 3010
(c) (Additional Capacity * [conversion factor MMBtuD] * [conversion factor MWh]) * [turbine efficiency factor 0.6]) / 3 = MWh needed for 8 hours.
(d) Does not take into account the generation efficiency factor.
(e) Conversion factors used: Btu/cf = 1020; 1 MMBtu = 0.2930711 MWh (f) Calculated assuming turbine generator efficiency 0.6.
(g) (Additional Capacity * [conversion factor MMBtuD] * [conversion factor MWh]) * [turbine efficiency factor 0.6]) / 6 = MWh needed for 4 hours. (h) Acreage calculations based on Tesla** 50KW/210KWH power pack foot print for the number of power packs required and 25% extra for spaces between power pods, and for roads, office building, grid connection/substation, etc. (Tesla 2017).

**The energy storage market continues to change rapidly. For this analysis, publicly available Tesla battery specifications were applied, but many other lithium-ion battery products could also have been used.

Key:
Btu/cf = British thermal units per cubic foot
KW = kilowatts
KWH = kilowatt hours
MMBtuD = million British thermal units per day
MMcfd = million cubic feet per day
MW = megawatt
MWh = megawatt hours
psig = pounds per square inch gauge

Some possible scenarios for using battery storage facilities to meet the SDG&E peak demand forecast, shown in Table 3-4, have been reviewed, including the following: 1) replacement of lost capacity needed to meet 2020/2021 peak demand (590 MMcfd), 2) replacement of lost capacity needed to meet 2023/2024 peak demand (572 MMcfd), 3) replacement of total system capacity lost to de-rating or abandonment of Line 1600 (reducing the capacity from 595 MMcfd to 570 MMcfd), and 4) the replacement of 44.5 MMcfd of gas, which is approximately the reduction in capacity from reducing pressure on Line 1600 from 512 to 320 psig and operating Line 1600 as a stand-alone pipeline.

Table 3-4 SDG&E Long-Term Demand Forecast

Operating Year[a],[b]	1-in-35-Year Cold Day Demand (MMcfd)				1-in-10-Year Cold Day Demand (MMcfd)			
	Core	Noncore C&I	EG	Total	Core	Noncore C&I	EG	Total
2017/18	395	0	0	395	374	61	153	588
2018/19	396	0	0	396	374	61	154	589
2019/20	395	0	0	395	374	62	154	589
2020/21	396	0	0	396	374	62	154	*590*[c]

Table 3-4 SDG&E Long-Term Demand Forecast

Operating Year(a),(b)	1-in-35-Year Cold Day Demand (MMcfd)				1-in-10-Year Cold Day Demand (MMcfd)			
	Core	Noncore C&I	EG	Total	Core	Noncore C&I	EG	Total
2021/22	394	0	0	394	373	62	146	581
2022/23	393	0	0	393	372	62	138	572
2023/24	392	0	0	392	371	62	130	563
2024/25	392	0	0	392	370	62	123	556
2025/26	391	0	0	391	370	62	116	548
2030/31	396	0	0	396	374	62	103	539
2035/36	403	0	0	403	381	61	103	546

Source: SDG&E 2017a.
Notes:
(a) SDG&E Long-Term Demand Forecast derived from data developed for the 2016 California Gas Report
(b) April through December, along with the following January through March.
(c) The system's winter capacity is currently 595 MMcfd (SDG&E 2017a).
Key:
C&I = Commercial and Industrial
EG = electric generation
MMcfd = million cubic feet per day
SDG&E = San Diego Gas and Electric Company

Scenario 1: 2020/2021 Peak Demand, 590 MMcfd (Table 3-3)

If Line 1600 was de-rated or decommissioned immediately, the applicants would have the base capacity to supply only 570 MMcfd (Line 3010 stand-alone or Lines 3010 and 1600 jointly). This would create an electrical generation deficit equivalent to 20 MMcfd of gas needed to meet the 2020/2021 forecasted 1-in-10 year peak, cold day demand, which has been projected by the applicants at 590 MMcfd. The applicants would potentially be able to meet this need with the construction of an approximately 150-MW battery facility capable of supplying 600 MWh for 4 hours. In other words, this size of battery facility could free up 20 MMcfd of natural gas capacity at peak that would have otherwise been used for electrical generation purposes. The facility would potentially be able to be constructed and operational in a relatively short timeframe on approximately 6 acres of land.

Scenario 2: 2023/2024 Peak Demand, 572 MMcfd (Table 3-3)

Based on testimony by Douglas M. Schneider on behalf of the applicants during public hearings held on July 10, 2017, the proposed project would not be operational and Line 1600 would not be de-rated, decommissioned, or pressure-tested and repaired until 2023 (CPUC 2017b). If the Line 3602 is not built, Line 1600 can be de-rated to 320 psig or decommissioned in 2023, which will still allow the applicants to supply 570 MMcfd of gas through Line 3010 stand-alone, or through Lines 3010 and 1600 jointly. Based on the demand forecast for 2023/2024, this de-rating/decommissioning would leave a 2-MMcfd deficit in electricity production available to meet peak demand. It may be possible for the applicants to make up for this 2-MMcfd deficit by constructing a 15-MW/670 MWh battery storage facility. It would be possible to construct a battery storage facility of this size in a matter of months, as demonstrated by SDG&E's 30-MW battery storage facility built in Escondido, California, in 2016. Additionally, a 15-MW/60 MWh battery facility would have an approximate footprint of 0.6 acres.

Scenario 3: Reproduce Current Capacity of the System, 595 MMcfd (Table 3-3)

If the Line 3602 is not built and Line 1600 can be de-rated to 320 psig or decommissioned, the applicants would be able to supply the power equivalent to the current system, or 595 MMcfd, by constructing a 187-MW battery facility capable of supplying 747 MWh of power for 4 hours, which is equivalent to the electrical generation potential from 25 MMcfd of gas capacity during a 4-hour period. A battery facility of this size would have an approximate footprint between 7.3 and 14.6 acres, as demonstrated in Table 3-3.

A recent example of an operator's ability to reproduce natural gas generation capacity using battery storage is shown in the response to CPUC Resolution E-4909. This resolution ordered the utility to hold a competitive solicitation for energy storage and preferred resources. In response, the utility proposed to procure 567.5 MW/2,270MWh of storage from four new lithium-ion battery facility projects in Advice Letter 5322-E to the CPUC (June 29, 2018). Each of the four lithium-ion battery storage facilities would be owned and operated by separate parties. The utility company proposed to own the 182.5 MW facility. The other three facilities in the proposal ranged in size from 10 MW to 300 MW. Each facility would provide up to 4 hours of energy.

Scenario 4: Replacement of 44.5 MMcfd (Table 3-4)

A separate analysis, considering Line 1600 as a stand-alone pipeline and derating the line from current 512 psig to 320 psig, was performed. De-rating Line 1600 (stand-alone) to 320 psig would result in a capacity reduction of approximately 44.5 MMcfd,[5] which is equivalent to roughly 45.4 billion British Thermal Units per day or roughly 13,305 MWh per day (24 hours), as shown in Table 3-5. This would require an approximately 333-MW facility to provide electricity for 4 hours due to reduced gas flow from de-rating a stand-alone Line 1600 to 320 psig.

Conventional power generation efficiency varies from 30 to 60 percent, depending on the type of gas-fired power plant (e.g., simple cycle, combined cycle, etc.); therefore, power generation is not equivalent to total heating value of the gas being burnt as fuel. As such, a battery facility only needs to provide what would have been generated by a conventional gas-burning power plant, if it had a 44.5 MMcfd flowrate available. Using a conservative approach to calculating the amount of power generated by conventional gas plants, 60 percent (0.6) efficiency was assumed in order to derive MWh per day. In this scenario, the total energy needed to replace what would be lost if Line 1600 were de-rated would be about 7,983 MW per day, or roughly a 333-MW facility. For example, lithium-ion battery storage facilities are rated to provide 4 hours of power; therefore, a 333-MW plant utilizing lithium-ion batteries can provide 1,332 MWh, providing 4 hours of service.

Table 3-5 Capacity Reduction Analysis performed for Line 1600

Pressure	Capacity (MMcfd)[(a)]	MWh	MWh for 4 hrs	Conventional Generation[(b)]	Energy Rate (MW) Required for 4 hrs	Number of Powerpacks Required[(c)]	Approximate Disturbance (Acres)[(d)]
512	107.8[(e)]	32,234	5,372	3,223.4	806	15,344	31.5
320	63.3	18,928	3,155	1,892.8	473	9,010	18.5
Reduction	44.5	13,305	2,218	1,331	333	6,336	13

5 The reduction of Line 1600's capacity (44.5 MMcfd) was the calculated reduction based on 320 psig inlet and 100 psig delivery pressure, 15.5-inch inside diameter, 14.7 atmospheric pressure, 14.73 base pressure, 70 degree Fahrenheit flowing temp, and 47 miles of pipeline.

Table 3-5 Capacity Reduction Analysis performed for Line 1600

Pressure	Capacity (MMcfd)[(a)]	MWh	MWh for 4 hrs	Conventional Generation[(b)]	Energy Rate (MW) Required for 4 hrs	Number of Powerpacks Required[(c)]	Approximate Disturbance (Acres)[(d)]

Source: Attachment A

Notes:

(a) Calculation Assumptions: Base Pressure = 14.73 psi; Atmospheric Pressure = 14.7 psi; Base Temperature = 60 deg F; Flowing Temperature = 70 deg F; Pipe Roughness = 1750 µ in; Elevation change = 0 ft; OD = 16 in; Wall Thickness = 0.25 in; Pipe Length = 47 miles; Heat energy = 1020 Btu/cf
(b) Calculated assuming turbine generator efficiency 0.6
(c) Tesla** 2017
(d) Acreage calculations based on Tesla** 50KW/210KWH power pack foot print for the number of power packs required and 25% extra for spaces between power pods, and for roads, office building, grid connection/substation, etc. (Tesla 2017)
(e) Note that SDG&E shows stand-alone capacity at 115 MMcfd at 512 psig. The difference may be because of difference in assumptions used to calculate the stand-alone capacity.

**The energy storage market continues to change rapidly. For this analysis, publicly available Tesla battery specifications were applied, but many other lithium-ion battery products could also have been used.

Key:

Btu/cf	=	British thermal units per cubic feet
deg. F	=	degrees Fahrenheit
KW	=	kilowatts
KWH	=	kilowatt hours
hrs	=	hours
in	=	inches
MMcfd	=	million cubic feet per day
MW	=	megawatt
MWh	=	megawatt hours
OD	=	outer diameter
psi	=	pounds per square inch
SDG&E	=	San Diego Gas & Electric Company
µ in	=	micro inches

The CPUC mandated that SDG&E procure 165 MW of energy storage by the end of 2021 (CPUC 2017a, Application A.18-02-016). Scenarios 1, 2, and 3 could each be fulfilled within the framework of SDG&E's mandate and additional procurement pursuant to Assembly Bill 2868.

Pumped Hydroelectric Storage

Pumped hydroelectric energy is the dominant utility-scale electricity storage technology in California. A typical pumped hydroelectric facility uses pumps and generators to move water between an upper and lower reservoir. When electricity is cheap during times of low demand, water is pumped from the lower reservoir to the upper reservoir. During periods of high demand, water is released from the upper reservoir through a generator to produce electricity that can be sold at higher prices.

The recently completed Lake Hodges Pumped Storage Facility is part of San Diego County Water Authority's Emergency & Carryover Storage Project serving two important objectives: 1) create new storage capacity of 20,000 acre-feet of water at Hodges Reservoir, approximately 31 miles north of San Diego near Escondido, California, through a connection to the nearby Olivenhain Reservoir, which allows water to flow throughout the region if an earthquake or drought were to cut or interrupt water deliveries; and 2) create a new source of hydroelectric energy from the movement of water between Lake Hodges in the city of San Diego and Olivenhain Reservoir.

Construction of the Lake Hodges facilities began in 2005 and included a 1.25-mile-long underground pipeline between Lake Hodges and Olivenhain Reservoir, a pump station, an electrical switchyard, and an inlet-outlet structure. During periods of high energy demand, water stored in Olivenhain Reservoir is released downhill to Hodges Reservoir, and as it passes through the Lake Hodges Pump Station, it activates the pump turbines, generating up to 40 MW of peak hydroelectric energy—enough power to annually sustain nearly 26,000 homes. At times of low energy demand, the same turbines pump water 770 feet uphill from Hodges to Olivenhain.

S. Proposed Route, Alternate Diameter Pipeline (10- to 30-inch) Alternative

The applicants identified the Proposed Route, Alternate Diameter Pipeline (10- to 30-inch) Alternative in their CEA; they provided the following description. This alternative will replace and augment the capacity of Line 1600 and facilitate implementation of the applicants' Pipeline Safety Enhancement Plan. This alternative is identical to the proposed project in route siting and construction techniques, and is intended to evaluate the installation of smaller pipelines, ranging in diameter from 10 to 30 inches. Differing pipe diameters within this range would have different effects on the economics analysis and potential costs to SDG&E ratepayers (SDG&E 2017a). Though the pipes utilized may differ in diameter, the construction equipment, techniques, and disturbance area will be similar for each diameter of pipe. As such, pipelines ranging in diameter from 10 to 30 inches are being identified as a single alternative.

T. Rainbow to Santee Non-Miramar Alternative

The applicants identified the Rainbow to Santee Non-Miramar Alternative in their PEA; they provided the following description. This alternative would include the construction of 50 miles of 36-inch-diameter pipeline that follows the northern portion of the proposed project from the Rainbow Metering Station until north of MCAS Miramar, where the route would turn east, avoiding MCAS Miramar, then continue south until its termination in the city of Santee (SDG&E and SoCalGas 2015a). Approximately 1 mile of the route would cross a known conservation easement, the Goodan Ranch Sycamore Canyon Preserve.

U. Rainbow – El Norte Parkway – Santee Non-Miramar Alternative

The Rainbow – El Norte Parkway – Santee Non-Miramar Alternative is a version of an alternative initially identified by the applicants in their PEA, but was altered in order to avoid impacts to MCAS Miramar. This alternative will include the construction of a 36-inch-diameter pipeline that would be approximately 54 miles in total length and would follow the same route as the proposed project from the Rainbow Metering Station until the intersection of Centre City Parkway and West El Norte Parkway. At that point, the Rainbow – El Norte Parkway – Santee Non-Miramar Alternative would leave the proposed project's route corridor and travel east, along El Norte Parkway, through the city of Escondido until the city's easternmost limits, and would then turn south and via a combination of cross-country and within rural roadways travel south until it meets Sycamore Canyon Road, which it would continue to follow south, skirting the eastern edge of MCAS Miramar and end in the city of Santee (SDG&E and SoCalGas 2015a).

V. Line 2010 Looping Alternative

On September 27, 2017, the applicants testified that by looping a 20-inch pipeline parallel to Line 2010 from Santee to Kearny Villa Station, the transmission system capacity north of Otay Mesa could be increased to 570 MMcfd. The Line 2010 Looping Alternative was identified in response to the formal proceeding at the CPUC for the proposed project (A.15-09-013) and involves the looping of Line 2010 to create sufficient capacity to transport 570 MMcfd from Otay Mesa. Therefore, the Line 2010 Looping Alternative was developed to necessitate importing natural gas from Mexico utilizing the existing Otay Mesa receipt point to access gas supply transported on the existing TGN, Gasoducto Rosarito, or North Baja Pipelines. The existing North Baja pipeline that exports natural gas to Mexico near El Centro, California, currently has existing capacity for natural gas transmission to the Gasoducto Rosarito/TGN pipelines, which can in turn transport and deliver natural gas to the Otay Mesa receipt point (SDG&E and SoCalGas 2015a).

Otay Mesa is currently rated to receive up to 600 MMcfd, with the facilities already in place in the SDG&E/SoCalGas transmission system; therefore, to coincide with the increased capacity from the looping of Line 2010, the receipt point at Otay Mesa would not need to be upgraded to handle additional demand for capacity created by the looping. The receipt point also has an amended 2005 Presidential Permit that authorizes flows of up to 800 MMcfd to the north or the south (i.e., bidirectional flow).

Looping Line 2010 would include the construction of approximately 6.3 miles of 20-inch pipeline parallel to existing SDG&E Line 2010. The pipeline loop would begin at the interconnection with the applicants' Line 3600 near West Hills Parkway in Santee. The loop would proceed west along Mast Boulevard and would cross under California State Route 52 and continue north and west along Line 2010 through Mission Trails Regional Park, for approximately 2.4 miles, then turn north and again cross the San Clemente Canyon Freeway onto land managed by MCAS Miramar. It would then veer west again and continue cross-country for another 3.6 miles until reaching the tie-in point at the Kearny Villa Pressure-Limiting Station. Currently, the majority of the Line 2010 ROW is approximately 30 feet in width. In order to construct a looping alternative, additional new temporary and permanent ROW easements would need to be acquired in order to accommodate construction activities. However, the current easement could be utilized during construction of this alternative.

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Attachment A

Non-Pipeline Alternatives - Lithium Ion Battery Storage Scenarios

(Supporting Calculations)

Supporting calculations are available for download in an Excel file on the project website.

Website Link: http://www.cpuc.ca.gov/Environment/info/ene/sandiego/sandiego.html