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Transmission Capability and Requirements Report

Transmission Technical Input Group

Renewable Energy Transmission Initiative 2.0

October 24, 2016

FINAL REPORT

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California Natural Resource Agency
California ISO
Imperial Irrigation District
Los Angeles Department of Water and Power
Modesto Irrigation District
Pacific Gas & Electric
Sempra Energy
Southern California Edison
Transmission Agency of Northern California
Turlock Irrigation District
Western Area Power Administration

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1. EXECUTIVE SUMMARY

The RETI 2.0 Transmission Technical Input Group (TTIG) is pleased to provide this Transmission Capability and Requirements report to the Plenary Group. This report details the California transmission system's current capabilities to interconnect and deliver 50% renewable energy to California consumers by 2030, and identifies the new transmission necessary to interconnect the potential generation in each Transmission Assessment Focus Areas (TAFA).

The estimates of available and new transmission requirements and cost are based on existing information and data provided by TTIG members and other RETI stakeholders. Much of this information comes from transmission reliability and interconnection studies performed by Balancing Authorities (BAs), as well as utility and BA planning studies. TTIG did not independently develop any information or perform system modeling to develop projections of existing or new transmission capacity. TTIG believes the information provided and presented here is reliable and appropriate for the planning nature of the RETI 2.0 effort, but cautions that this information is highly conceptual in nature and should not be relied on for assessing specific resource interconnections.

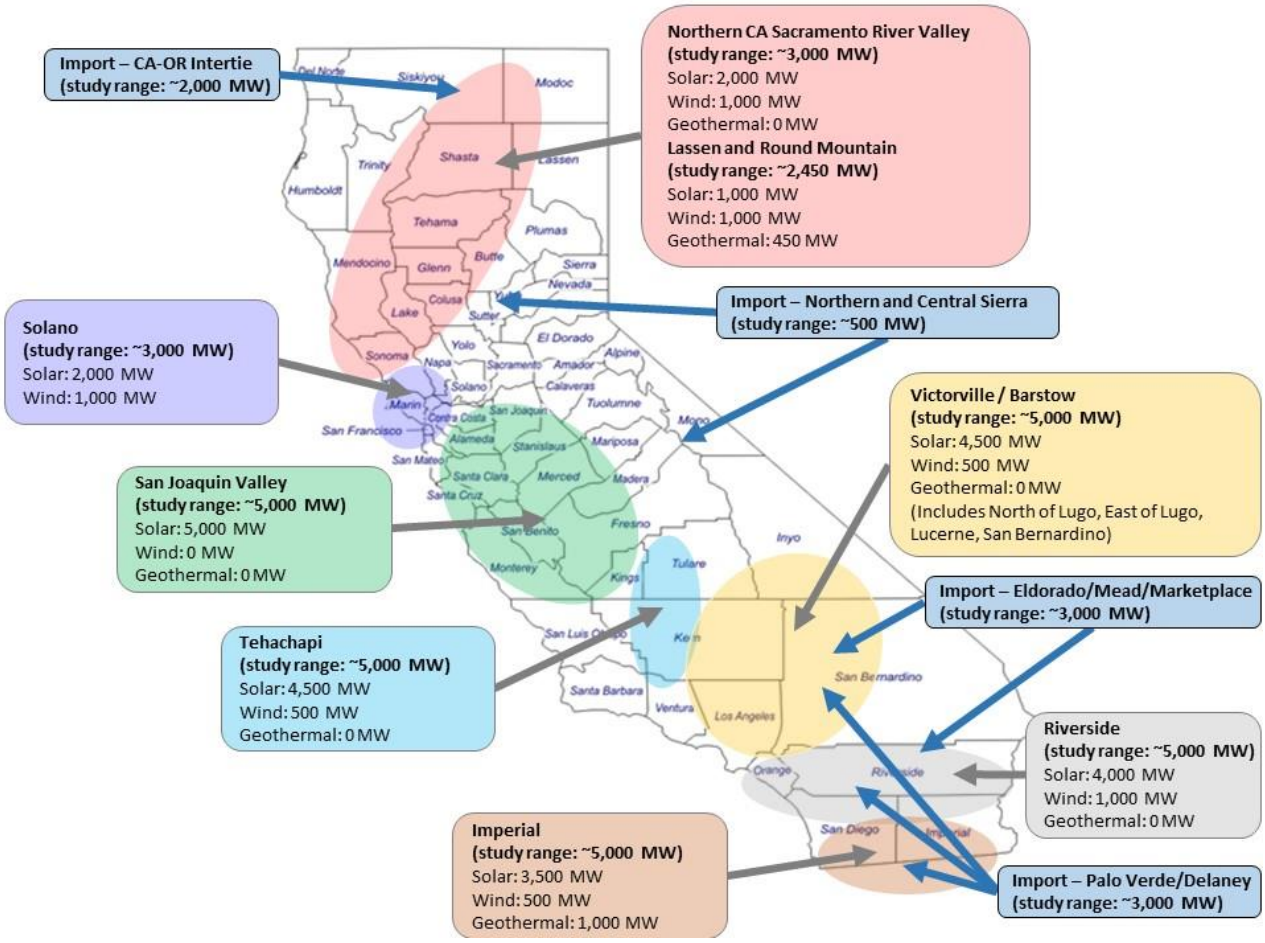
1.1. TRANSMISSION ASSESSMENT FOCUS AREAS

The RETI 2.0 Plenary Committee identified several TAFAs within California where significant quantities of additional renewables could potentially be developed to meet the S.B. 350 renewable energy goals. Each TAFA was assigned a "resource range," a hypothetical renewable development potential through 2030, based on a qualitative assessment of renewable resource technical potential, commercial interest in the area, and the technical feasibility of transmission development. Additionally, the estimates for several TAFAs were guided by existing resource area studies, including the Desert Renewable Energy Conservation Plan (DRECP) and the San Joaquin Valley Solar Study. The purpose of these resource ranges was merely to provide a target for assessment purposes, and doesn't represent any formal calculation or endorsement of generation goals.

Collectively, the TAFAs include over 40,000 MW of potential generation, incorporating hypothetical development potential for wind, solar and geothermal resources. Biomass resource potential was not specifically identified for the TAFAs, as the generation capacity of individual biomass facilities in each region tends to be small and have minimal impact on high-voltage transmission development. However, there is substantial resource potential for biomass energy and any facilities in each TAFA would benefit from available transmission capacity. The Plenary Group did not distinguish whether hypothetical additional resources would have full-capacity or energy-only interconnections.

In addition to California resources, the Plenary Group identified potentially available import capabilities for California interties to accommodate non-California renewable projects, which may seek to deliver energy to the California grid. Figure 1-1 depicts the renewable resource quantities by TAFA.

Figure 1-1 - TAFA and Intertie Potential Resource Additions



1.2. TAFA EXISTING AND NEW TRANSMISSION REQUIREMENTS

The existing transmission system, including transmission under development, has limited capability for new full capacity resource interconnections. Only the Tehachapi TAFA is capable of accommodating most of the potential capacity with full capacity interconnections, while other TAFAs having varying capability to interconnect full capacity resources. The area with the least potential to deliver new renewable energy is Northern California. The bulk transmission system in the region is heavily utilized and would require substantial investment to allow for the delivery of new full capacity resources.

While there is limited transmission for full-capacity interconnections, there is a substantial amount of capability for generators to interconnect to the grid as energy-only resources. The California ISO estimates that its system could accommodate over 22,000 MW of energy-only resources. TTIG notes that only the California ISO has studied its system to estimate energy-only interconnection capability; additional non-firm capability may be available on the systems of other California BAs.

The TTIG used information from previous studies to estimate the quantity and cost of new transmission required to deliver all of the capacity from each individual TAFA. It assumed that all resources would require full capacity interconnections. The costs included here should be considered as "order of magnitude" costs. Specific developments will have unique interconnection requirements and associated

costs, which will differ than the costs presented here. Table 1-1 summarizes the existing transmission that may be used to accommodate new renewables, and identifies the cost to deliver the Plenary Group target capacity quantities for each TAFA.

Table 1-1 - Existing Transmission Capability and Estimated Cost to Deliver TAFA Target Capacity

Delivery Area or Path	New Capacity (MW)	Capacity to Accommodate New Renewable		New Transmission Required for Deliverability	Estimated Cost to Deliver All Energy
TAFA		**Full Capacity (MW)**	**Energy Only (MW)**		
Tehachapi	Up to 5,000	4,500	5,600	No	NA
Victorville/Barstow	Up to 5,000	1,900*	3,300	Yes	$34 million (Lugo-Victorville upgrade) would result in ~2,000 MW incremental capability across Victorville, Riverside and Imperial TAFA
Riverside	Up to 5,000	2,450**	4,754	Yes	
Imperial Valley (CAISO)	Up to 5,000	523[1]	1,849	Yes	> $1 billion to mitigate the East of Miguel constraint *AND* $34 million to mitigate the Lugo – Victorville 500 kV constraint
Imperial Valley (IID)		2,300***	NA	Yes	$113 million to upgrade IID transmission structure to support additional generation
San Joaquin Valley	Up to 5,000	1,823	3,131	Yes	$440 million
Solano	1,500-3,000	Unknown	880	Yes	$20-50 million
Sacramento River Valley	1,500-3,000	0	2,100	Yes	Making new resources fully deliverable would cost $2-4 billion
Lassen / Round Mountain	1,450-2,450	0	1,250	Yes	

* Victorville Full Capacity is sub-area specific.

** Transmission capability provided for the Riverside East TAFA is based on the additional capacity provided by the West of Devers Upgrade Project as proposed by SCE and approved by the CPUC on August 18, 2016.

[1] This number is subject to change. IID has recently provided the ISO with new study assumptions regarding its system that will require further study. The ISO 2016-2017 Transmission Plan currently under development will take into account the latest system conditions and provide information regarding additional deliverability expected to be available for IID and ISO connected Imperial area generation.

*** For IID, Imperial Valley North Full Capacity is 1,100 MW and Imperial South Full Capacity is 1,2,10 MW.

It is important to note there are interdependencies in the transmission system that will impact transmission availability. The transmission system is a dynamic network, and the development of resources in one area may impact the ability to interconnect and deliver energy to customers from another area. The information provided here is based on the delivery of energy from each TAFA discretely. There are many potential permutations of resource additions, each of which will have an impact on the delivery of energy from the TAFAs.

1.3. SHARED TRANSMISSION CONSTRAINTS

Most of the TAFAs will require additional transmission in order to interconnect the target quantity of resources and deliver the energy to California consumers. In addition to these TAFA-specific constraints, there are overarching transmission constraints in Northern and Southern California limiting the delivery of energy from multiple TAFAs, as well as energy imports over the interties into these regions.

In Southern California, a transmission constraint on the Lugo – Victorville 500 kV line impacts the Victorville, Riverside East, and Imperial TAFAs, as well as energy imports from the desert Southwest. This constraint is also knows as the Desert Area Constraint in prior studies conducted by California ISO. Generation resources across a very large footprint adversely impact this constraint. Resources in some areas have less adverse impact than resources in some other areas. Section 4 of this report provides more details about California ISO and LADWP are currently coordinating efforts to explore a potential upgrade that would mitigate this constraint.

In Northern California, the EHV system includes three 500-kV lines (the California-Oregon Interties or COI) which extend from the Oregon border to the Tesla and Tracy Substations south of Sacramento. These lines, with a combined path rating of 4,800 MW, are operated in parallel with a number of 230-kV lines with which a number of hydroelectric facilities are interconnected. Operating and planning studies (including those done by the Operating Studies Subcommittee (OSS) and the California ISO during 2015 and 2016) indicate that it is not possible to simultaneously deliver 4,800 MW over the COI facilities and the 4,200 MW of hydroelectric capacity to load centers in northern California. Based on this information, the interconnection of new firm deliverability resources in northern California would require upgrades to the transmission grid. It is possible that energy only resources could be interconnected, though such new resources would likely have to be curtailed to mitigate post-contingency overloads.

1.4. INTERTIE CAPABILITY

There is limited ability to deliver energy to California consumers from non-California power. Power coming into the California grid over the interties delivered into one of several defined TAFAs. This energy will then compete with all other TAFA resources for transmission to deliver the energy to consumers, and is subject to the same constraints and transmission availability as other new resources in the TAFA. Table 1-2 identifies the Intertie and the TAFAs for the imported energy.

Table 1-2 - Intertie Points and TAFAs

Intertie Point	Hypothetical Study Range	TAFA
Eldorado / Mead / Marketplace	3000	Victorville (East of Lugo) and Riverside
Palo Verde / Delaney	3000	Riverside and Imperial
California-Oregon Intertie	2000	Northern CA (Round Mtn, Lassen and Sacramento River)
Central Sierra	500	Northern CA

2. INTRODUCTION

The Transmission Technical Input Group (TTIG) is pleased to provide this Transmission Capability and Requirements report to the RETI 2.0 Plenary Group. This report details the existing and planned transmission that is available to support the development of additional renewable resources in California, as well as identifies the additional conceptual transmission that would be required to deliver the hypothetical renewable resource ranges identified by the Plenary Group. The characterization of the new transmission is based on existing studies completed by the TTIG participants and other input provided by TTIG members.

The report addresses only the transmission systems in California required to deliver energy from resources located in the identified Transmission Assessment Focus Areas (TAFAs). In addition to these in-state resources, the Plenary Group identified potential renewable energy imports from other areas in the Western U.S. This report only addresses the delivery of out-of-state energy once it reaches the California grid (defined as any transmission that is within the BA of a California BA operator). Any transmission development required to deliver the energy to the California grid interconnection points is addressed in the RETI 2.0 Western Outreach Project report.

This report incorporates all of the technical information included in the TTIG Interim report of June 9, 2016. That report detailed the transmission available on the existing transmission system and was designed to provide the RETI 2.0 Plenary Group with information that could be used to assist in the development and refinement of TAFAs.

2.1. RENEWABLE ENERGY TRANSMISSION INITIATIVE OVERVIEW

The Renewable Energy Transmission Initiative 2.0 is a statewide, non-regulatory planning effort convened by the California Natural Resources Agency, with participation from the California Energy Commission, California Public Utilities Commission (CPUC), California Independent System Operator, and the U.S. Bureau of Land Management California Office. The RETI 2.0 initiative was created to explore the renewable generation potential available to California utilities to help meet state-wide greenhouse gas (GHG) reduction and renewable energy goals, and to identify the potential transmission implications of accessing and integrating these resources.

The state's goals, codified in the Clean Energy and Pollution Reduction Act of 2015 (SB 350, De Leon) and in Governor Brown's Executive Order B-30-15, include serving at least 50% of statewide retail electricity load from renewable energy by 2030, and more broadly reducing total statewide greenhouse gas emissions by 40% below 1990 levels. While no definitive estimate of the total renewable energy necessary to meet these goals has been produced, the RETI 2.0 Plenary Group reviewed previous studies to generate a potential range of incremental renewable energy that could be required by 20302, above and beyond the amount required to meet the 33% RPS in 2020. This review found that by 2030, between 25 and 108 terawatt-hours of additional renewable energy (beyond the 33% levels) could be necessary to meet both RPS and GHG goals. If all of this power were produced at an average capacity factor of 30%, then between 9.4 and 41 gigawatts of new renewable energy capacity would be required by 2030 (or 7 to 31 GW at a 40% average capacity factor). While some of the grid-connected capacity may be located outside of California, the presumption of this study is that all of it will be delivered through the California grid.

[2] RETI 2.0 Plenary Group Report, Brian Turner, 2 May 2016.

As part of this effort, RETI 2.0 established several working groups, including the Plenary Group, Environmental and Land Use Technical Group, and the Transmission Technical Input Group. The role of the TTIG is to document the capacity of the existing transmission system to support additional renewable development and to identify the potential need for new transmission investments to access and integrate additional renewables.

2.2. TTIG GOALS AND ORGANIZATION

The TTIG assisted the RETI 2.0 effort by assembling relevant in-state and west-wide transmission capability and upgrade cost information to inform resource development combinations as to reasonably-needed transmission additions and to assist in developing potential corridor scenarios.

The TTIG membership includes all North American Electric Reliability Corporation (NERC)-registered Transmission Planners and Planning Coordinators that operate in California. **Error! Reference source not ound.** identifies the organizations participating in TTIG activities.

Table 2-1 - Table 2 1: TTIG Participants

Transmission Technical Input Group Member Organizations	
Sacramento Municipal Utility District	California Independent System Operator
Imperial Irrigation District	Los Angeles Department of Water and Power
Silicon Valley Power	Turlock Irrigation District
Modesto Irrigation District	Western Area Power Administration - SNR
San Francisco Public Utilities Commission	Transmission Agency of Northern California
City of Santa Clara	Pacific Gas & Electric
Southern California Edison	San Diego Gas & Electric

2.3. TRANSMISSION ASSESSMENT FOCUS AREAS

The Plenary Group identified several Transmission Assessment Focus Areas (TAFA) within California where significant quantities of renewables could be developed to meet the 2030 renewable development goals. The TAFAs identify the "feasible" development potential for wind, solar and, where applicable, geothermal resources. Biomass resource potential was not specifically identified for the TAFAs, as the capacity of these resources tend to be small and has minimal impact on high-voltage transmission development. The feasible development potential estimates are a qualitative assessment of potential development and consider the renewable resource technical potential, commercial interest in the area, and the technical feasibility of transmission development. Additionally, the estimates for several TAFAs are guided by existing resource area studies, including the Desert Renewable Energy Conservation Plan (DRECP) and the San Joaquin Valley Solar Study.

In addition to California resources, the Plenary Group also identified the potential availability of energy import/exports for California interties. There are numerous developers proposing resources outside of California for delivery to the California grid, as well as potential exports of renewable energy from

California to surrounding BAs, particularly during periods when renewable generation and other "must-run" resources exceed load in California. Figure 2-1 depicts the renewable resource quantities by TAFA, while Table 2-2 summarizes the total resource capability by TAFA and import/export location.

Figure 2-1 - Renewable Resource Quantities by TAFA and Intertie

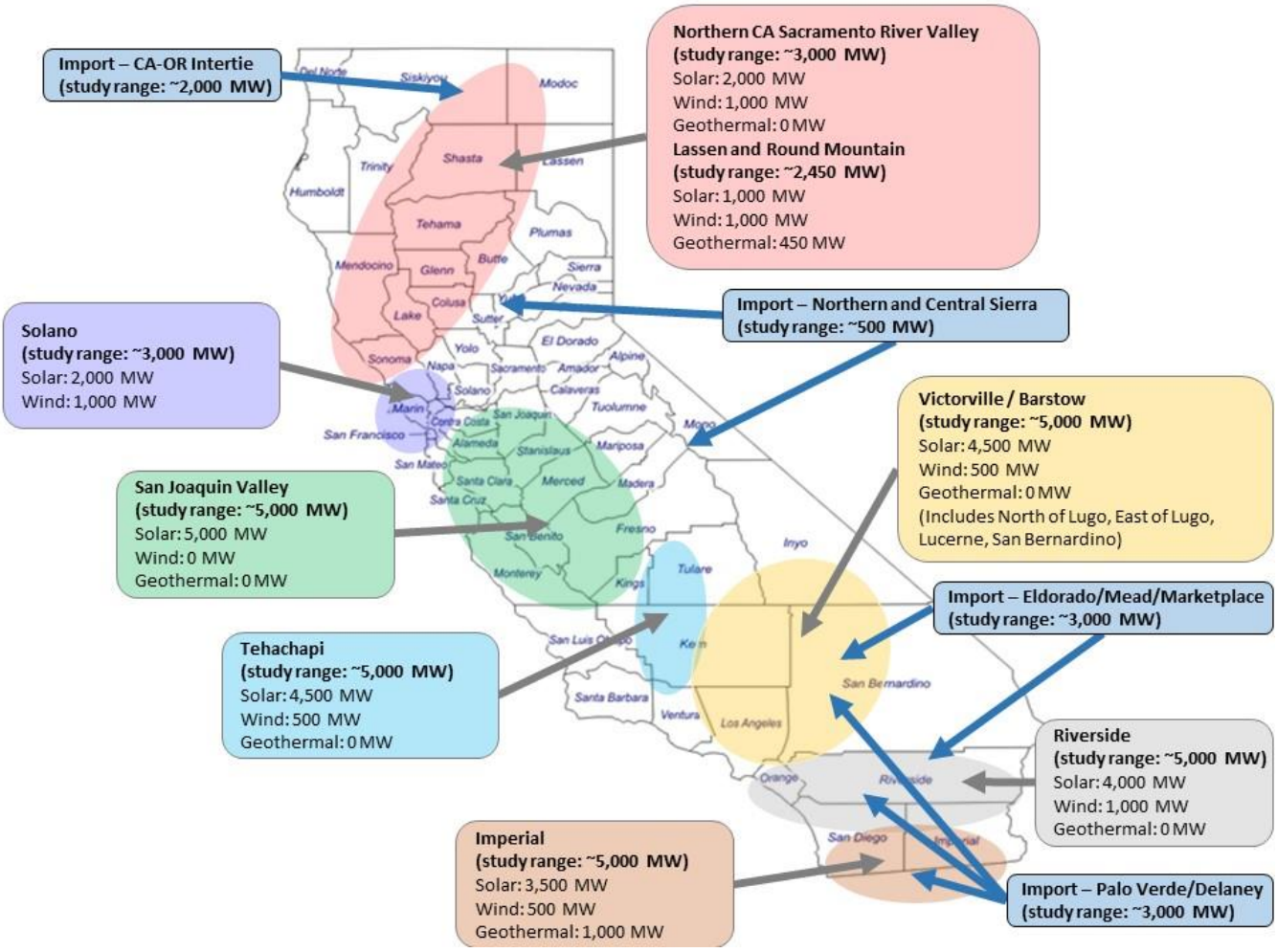


Table 2-2 - Hypothetical New Renewable Resources in TAFAs

Delivery Area or Path	New Capacity (MW)
TAFA	
Tehachapi	Up to 5,000
Victorville/Barstow	Up to 5,000
Riverside East	Up to 5,000
Imperial Valley	Up to 5,000
San Joaquin Valley	Up to 5,000
Solano	1,500-3,000
Sacramento River Valley	1,500-3,000
Lassen / Round Mountain	1,450-2,450
Import / Export Path	
Path 46 / Palo Verde / Delaney	Up to 3,000
Path 46 / Eldorado / Marketplace	Up to 3,000
Path 66 / California-Oregon Intertie	Up to 2,000
Central/Northern Sierra (Path 76; Path 24; Path 52)	Up to 500

2.4. METHODOLOGY ON DATA AND COST INFORMATION

Data on transmission capability, utilization and availability was requested of all TTIG participants and, more broadly, of all participants in RETI 2.0. In response, the TTIG members provided a variety of information, mostly from the results of their individual planning processes. These processes vary widely and the provided information was therefore not entirely uniform. The transmission information included in this report was provided by grid planners and operators, transmission developers, and other RETI stakeholders. This report attempts to summarize this information in a consistent manner.

TTIG did not independently develop any information or perform any system modeling to develop projections of potential existing or new transmission capacity. The potential transmission capacity values included in this report are estimates of the transmission that will likely be available once all projects under construction as of January 1, 2016 are completed. Measurements of transmission capability are affected by a variety of physical and operational factors and may change as demand and resources are changed on the system. While the TTIG has made a good-faith effort to provide accurate and current information on transmission capability for purposes of resource planning, it makes no warranty that the transmission is or will be available, at any particular cost or degree of firmness, to specific projects seeking to interconnect to the California grid.

The transmission capital cost information included in this report should be considered as conceptual or "high-level" estimates. The cost estimates included here were generally derived from previous studies, which may vary in vintage and may have been designed to address specific resource interconnections. The TTIG believes this information is appropriate for the RETI 2.0 purposes, but should not be considered as reliable for specific resource addition purposes.

2.5. ISSUES IMPACTING TRANSMISSION ASSESSMENT

There are numerous issues that impact the availability of transmission capacity on the grid; grid planners typically address these issues in their respective planning processes. In addition, there are several issues unique to this effort that we highlight below. These include:

- Full Capacity Deliverability and Energy-only resources
- Out-of-state resources and in-state transmission capacity
- Interaction between TAFAs
- Physical transmission constraints
- Advanced grid technologies
- California ISO expansion

2.5.1. DELIVERABLE AND ENERGY-ONLY RESOURCES

This report characterizes existing transmission system capacity and planned and potential improvements/changes and the implications for accessing additional renewable resources. To "characterize" this information in a meaningful way, an understanding of the terms Full Capacity Deliverability Status (FCDS) and Energy-only (EO) transmission capacity are necessary. For its current transmission grid, the California ISO developed estimates of the available FCDS and EO transmission capacity. These provide an estimate of the capability for new resource interconnections on the existing infrastructure that would not trigger network upgrades required for FCDS or that would mitigate material congestion-related costs. For purposes of RETI 2.0, we define FCDS and EO as:

- Full Capacity Deliverability Status (FCDS) – A California ISO FCDS transmission interconnection provides a reasonable assurance that a generator's dependable capacity can be delivered to load under contingency conditions simultaneously with all other dependable generation in the same general area at peak load conditions. Transmission upgrades may be required to allow a generator to be available at system peak load during contingency conditions, so that it can be counted in the CPUC's Resource Adequacy (RA) program. While deliverability reduces the likelihood of curtailment, there is no assurance -- other resources or imports may be more economic and get dispatched in the market instead.
- Energy-only - A California ISO EO interconnection allows a generator to deliver energy when transmission is available, with no assurance that delivery of that resource will be dispatched. EO interconnection does not provide deliverability, and the generator cannot be counted in the CPUC's RA program. The EO resources may be curtailed if there is insufficient transmission capacity to allow these facilities to deliver their energy to the grid, and in times of over-generation.

Considering California's resource adequacy program, which requires "deliverability", virtually all resources interconnecting to the California ISO transmission grid have sought FCDS interconnection,

which is an option that an interconnecting generator may seek under California ISO's FERC-approved tariff. As a result, the California ISO transmission grid has been expanded and reinforced, often at substantial expense, to allow for FCDS service. As FCDS transmission capacity on the existing grid becomes less available, the ability to develop and site new transmission becomes more expensive and time consuming.

An alternative to the FCDS interconnection is "energy-only" resource interconnection. EO interconnection is much faster and less expensive, as there is no need to ensure resource deliverability. This allows substantially more generation capacity to interconnect to the grid, increasing transmission utilization while decreasing the cost of interconnection since few additional network facilities would be required.

The 50% RPS goal is defined in terms of meeting the energy needs; the need for resource adequacy capacity from future renewable development is not defined at this time. There are a number of advantages, and a number of potential drawbacks of EO resource development. Table 2-3 provides a summary of the most notable potential advantages and drawbacks for resources using EO interconnections.

Table 2-3 - Potential Advantages and Drawbacks for Resources Using EO Interconnections

Energy Only Interconnections	
Potential Advantages	Potential Drawbacks
• Interconnect substantially more capacity without new network upgrades • Lower cost interconnection • Faster interconnection • Allow for the interconnection of more renewables	• No RA value for EO resources; no RA revenue stream • Operating and revenue uncertainty • Increased exposure to congestion related costs • Increased exposure to congestion-related costs may create uncertainty about ability to finance projects

The California ISO has developed estimates of the capacity that could be added to its system to accommodate both FCDS and EO resources. Currently, only the California ISO estimates transmission capacity that is available for EO resources. While there may be additional EO-equivalent capacity on systems represented by other TTIG members, this has not been quantified at the time this report was written.

2.5.2. OUT OF STATE TRANSMISSION CAPACITY AND ENERGY DELIVERY

While this report is primarily focused on the transmission capability on the existing California grid and from transmission projects currently under development within the BAs operated by California entities, there are several transmission projects under development throughout the Western United States that offer the possibility of delivering large quantities of renewable energy to California. Most of these transmission projects are proposed to connect to the California ISO at existing grid intertie points (e.g., California-Oregon border, Eldorado, Hassayampa, northern Baja, Mexico) or, alternatively, on existing import paths of other California balancing authorities (e.g., the Nevada-Oregon border, Mead,

Intermountain Power Project).

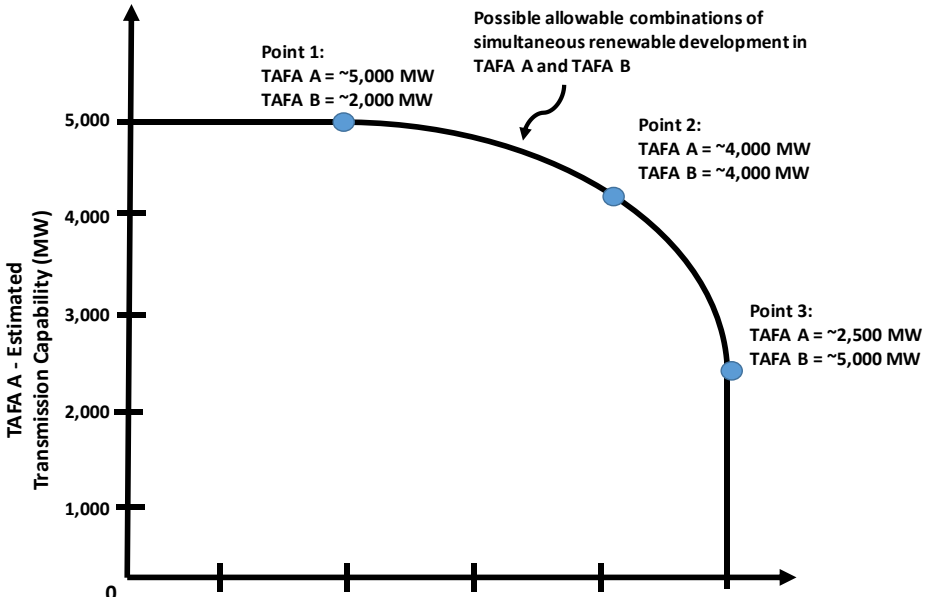
The interaction of these out-of-state projects, the existing grid interties and import paths, and the in-state transmission grid is complex, especially when considering energy deliverability and RPS accounting rules. Consideration of proposed transmission project development along with the capability of existing infrastructure is needed to develop a clear and comprehensive representation of the opportunity to import additional renewable energy into California.

2.5.3. INTERACTION BETWEEN TAFAS

THE RETI 2.0 TAFAs identify the potential resource capacity for each area, which total to over 40,000 MW. This is a considerably greater amount of resources than will likely be required to achieve the 50% RPS development goals. Further, the TAFA capacity assumes all incremental MW in each area to be FCDS (for the purpose of identifying conceptual transmission upgrades). At this time, it is not possible to determine where incremental renewable capacity will be developed, and whether it will be FCDS or EO.

The TTIG assessment of the TAFAs considered each TAFA to be a discrete transmission area, and the addition of the target MW for the TAFA is independent of the capacity developed in other TAFAs. While this is an appropriate evaluation approach for this effort, in reality, not all capacity from all transmission areas is always simultaneously available.

Figure 2-2 - Conceptual transmission capability limit and resource area interaction



Resource additions in one TAFA may utilize the transmission system capability in another TAFA. This is true especially when a common transmission constraint limits the transmission capability in multiple TAFAs. Because of this interaction, the total simultaneous transmission capability for the two TAFAs may be less than the sum of the transmission capability for each TAFA evaluated independently. Figure 2-2 depicts the interaction of conceptual transmission capability limits for resource areas. For example, suppose independent evaluation of TAFAs resulted in 5,000 MW of transmission capability for TAFA A and 5,000 MW of capability in TAFA B. Since the estimate of 5,000 MW of capability in each one of these TAFAs is based on an assumption of no interaction between TAFAs, we cannot claim that both TAFA A and TAFA B together can accommodate 10,000 MW of

renewable resources. Due to a common transmission constraint that limits the transmission capability in both these TAFAs, it is very likely that the simultaneous transmission capability for both these TAFAs would total to somewhere less than 10,000 MW (as shown by point 1, point 2 and point 3 as possible combinations of allowable simultaneous renewable development in TAFA A and TAFA B). To assess whether and how the development in one TAFA may impact development in another TAFA, reliability studies detailing the specific development in each area are required.

2.5.4. PHYSICAL TRANSMISSION CONSTRAINTS

In the California ISO system, there are physical transmission constraints and economic transmission constraints. Physical constraints are a result of insufficient transmission capability to deliver all of the energy to the desired location, while economic constraints are based on the cost of delivering energy from a specific resource or location relative to the cost of delivering energy from another resource. In determining the FCDS and Energy-only system capabilities, the TTIG only considered the known physical transmission constraints.

2.5.5. ADVANCED GRID TECHNOLOGIES

Technology is changing the way the grid is managed, and the use of new technologies may impact the need for new transmission to add capacity to the grid. Widespread deployment of storage devices, Distributed Flexible Alternating Current Transmission Systems (D-FACTS), and other new technologies may allow for the addition of more generators on the existing grid. These “non-wire” alternatives for expanding the grid interconnection capabilities should be considered by all grid managers in their respective transmission expansion planning processes.

2.5.6. CALIFORNIA ISO GRID EXPANSION

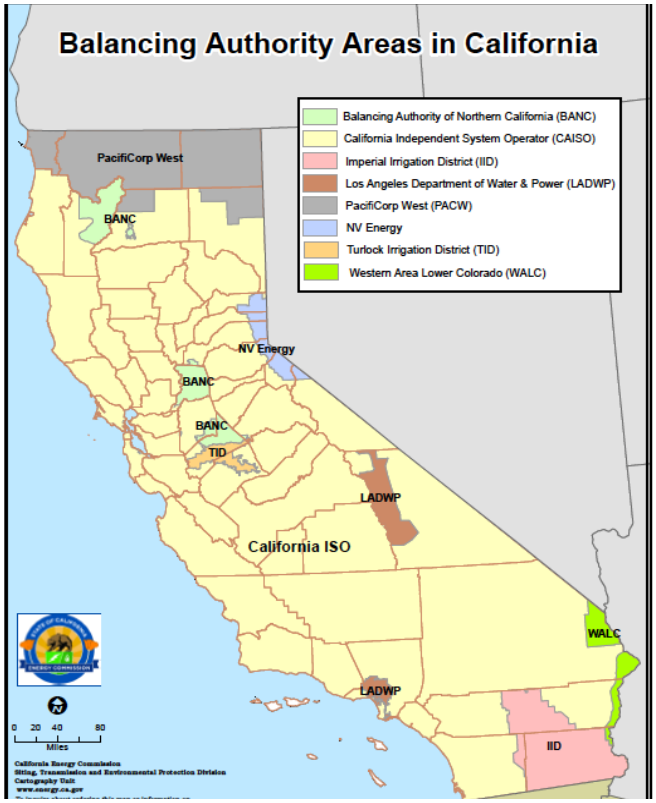
The transmission capacity reported for the California ISO portion of the California grid is based on the current physical and electrical grid boundaries between the California ISO controlled grid and adjacent balancing authorities. While a broader regional footprint for the California ISO is being explored at this time, it is uncertain whether and/or when this expansion may occur and further, how resources within the expanded portion of the footprint will be treated from the standpoint of RPS accounting and from the standpoint of the California Air Resources Board’s (CARB’s) GHG compliance rules. This report assumes the existing grid continues to be operated by the current BA operators. It also only considers California’s current renewable requirements.

3. CALIFORNIA TRANSMISSION SYSTEM – EXISTING AND PLANNED CAPACITY

The California electric grid includes a multitude of discrete electric utilities, energy service providers, transmission owners and generation owners. To ensure loads are served reliably, each Balancing Authority (BA) coordinates the near-term (typically, day-ahead through real-time) activities of all entities electrically located within the BA. BAs within California are shown in **Error! Reference source not found.**.

While the North American Electric Reliability Corporation (NERC) Reliability Standards for the Bulk Electric Systems of North America are uniformly applied throughout the balancing authority areas (BAAs), the processes used by these entities to operate and plan their facilities varies, reflecting each system's unique situation and needs. This is to say that while there are certain attributes of planning that are common within all of the BAAs, there are a variety of approaches used in developing estimates of available transmission capacity and expected transmission service requirements.

Figure 3-1 - Balancing Authority Areas in California



This section of the report conveys information that has been provided by the TTIG participants for inclusion in each TTIG participant's section of the report. As such, each of the TTIG participants are solely responsible for the content in their section and the views represented therein may not reflect the views of other individual TTIG participants, nor do they necessarily reflect the consensus view of the TTIG.

3.1. CALIFORNIA INDEPENDENT SYSTEM OPERATOR

The California ISO operates the state's wholesale transmission grid, providing open and non-discriminatory access supported by a competitive energy market and comprehensive planning efforts. Partnering with about 150 entities, the California ISO is dedicated to developing and operating a modern grid that includes over 65,000 MW of installed power plant capacity and 26,000 circuit-miles of transmission lines serving over 30 million customers.

3.1.1. TRANSMISSION ESTIMATING METHODOLOGY

To develop estimates of transmission capacity to support FCDS and EO resources, the California ISO used information from studies in several of its annual transmission planning processes (TPP) and the annual Generator Interconnection and Deliverability Allocation Procedures (GIDAP) process. Additionally, the California ISO conducted a special transmission study in its 2015-2016 TPP to assess the potential transmission capacity necessary for achieving 50% renewables.

The 33% RPS policy-driven studies performed as part of the California ISO TPP historically have focused on ensuring FCDS for renewable resources based on the California ISO generator deliverability assessment methodology3. These policy-driven studies along with GIDAP allocation studies performed over the course of three planning cycles have provided information helpful in understanding the transmission upgrades that would be needed to make all resources fully deliverable.

As part of the CAISO's special transmission study for 50% renewables, a preliminary study of the capability of the California ISO grid was performed to evaluate the impact of additional renewable generation resources interconnection on an EO basis. The results of that study are included in the California ISO estimates of transmission capacity discussed below.

3.1.2. TRANSMISSION CAPACITY ESTIMATES

TTIG member BAs provided estimates of transmission capacity for Transmission Assessment Focus Areas (TAFAs). Noted above, these estimates are based on historical analyses, and if an area has not been recently analyzed to assess its transmission availability, no estimates are available. Additionally, there are areas within California that have renewable energy potential that are not located in the TAFAs. The TTIG has not conducted an assessment to determine the transmission potential from these areas. This should not be interpreted to mean that transmission capacity is not available; rather it should be considered as unknown.

The vast majority of the transmission with available capacity serves the Tehachapi and Riverside / Palm Springs areas, assuming that Southern California Edison's "West of Devers" upgrades are completed. While it does not appear the California ISO's existing transmission system is capable of providing full deliverability for all of the renewable generating capacity that would be needed to reach a 50% RPS, the California ISO estimates that up to 22,000 MW of new generation could nevertheless be physically interconnected to the current system. The amount of new generation that could be interconnected with FCDS or EO status, based on the existing California ISO transmission system, is identified in

[3] http://www.caiso.com/Documents/On-PeakDeliverabilityAssessmentMethodology.pdf

by transmission area.

Table 3-1 = Transmission Capability Estimates within the California ISO

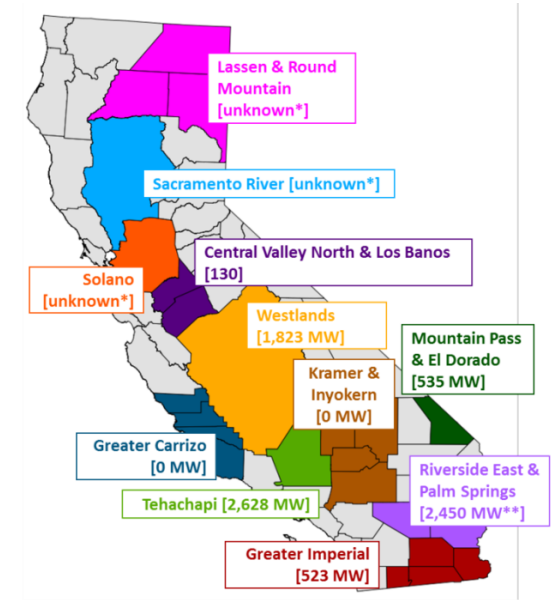
Renewable Zones	FCDS Transmission Accommodating FCDS Resources (MW)	EO Transmission Accommodating EO Resources (MW)
Greater Carrizo	0	590
Central Valley North & Los Banos	130	1,889
Greater Imperial (CAISO)	523[4]	1,849
Imperial North and South (IID)	2300	NA
Kramer & Inyokern	0	412
Lassen & Round Mountain	unknown	1,250
Mountain Pass & El Dorado	535	2,735
Tehachapi	4,500	5,600
Solano	Unknown	879
Sacramento River	Unknown	2,099
Riverside East & Palm Springs	2,450[5]	4,754

This generation capacity is graphically depicted in Figure 3-2 and Figure 3-3.

[4] This number is subject to change. IID has recently provided the ISO with new study assumptions regarding its system that will require further study. The ISO 2016-2017 Transmission Plan currently under development will take into account the latest system conditions and provide information regarding additional deliverability expected to be available for IID and ISO connected Imperial area generation.

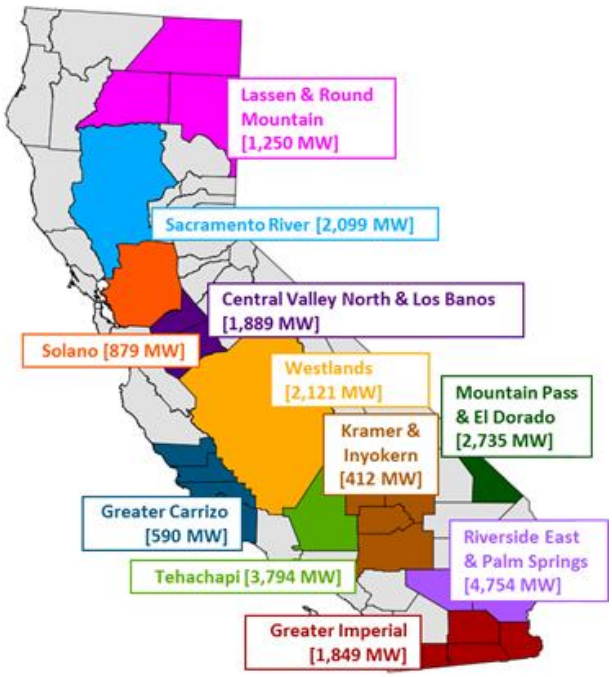
[5] Transmission capability provided for the Riverside East and Palm Springs zones is based on the capacity provided by the West of Devers Project as proposed by SCE and approved by the CPUC on August 18, 2016.

Figure 3-2: California ISO Fully Deliverable Capability by Transmission Area



* Insufficient information available through prior transmission planning studies due to very little generation in the interconnection queue
** WOD upgrade factored in

Figure 3-3: California ISO energy only Capability by Transmission Area



3.1.3. DELIVERABILITY FROM THE IMPERIAL AREA

When the California ISO's system is capable of delivering additional energy from the Imperial area, the California ISO either assigns this deliverability to generation that will be connecting directly to the California ISO controlled facilities in the area, or increases the Maximum Import Capability (MIC) from the Imperial Irrigation District. How the California ISO assigns the additional deliverability depends on the location of new generating projects that have entered resource adequacy power purchase agreements with entities that serve load on the California ISO system.

In its 2011 Renewable Portfolio Standard proceeding, the CPUC established a forecast assumption of 1,400 MW of total Maximum Import Capability from IID in order to facilitate procurement. This 1,400 MW reflects the existing MIC of 462 MW plus a forecast of additional future MIC of 938 MW. However, only 240 MW of additional generation on the IID system was ultimately procured by entities with load serving responsibilities within the CAISO BA. Based on the amount of generation that entered into resource adequacy power purchase agreements, the California ISO announced its intention to increase the MIC from the IID BA from 462 MW to 702 MW, once the transmission upgrades necessary to facilitate that increase were completed.

Since then, the forecast requirements for deliverability from the Imperial area overall, and for increased MIC from IID, have been established through the renewable generation planning portfolios provided by the CPUC each year as input into the California ISO's annual transmission planning process. This input sets the total amount of incremental generation planned for from the Imperial area overall, as well as the specific locations of the forecast generation within IID and connecting directly to the California ISO controlled grid.

3.1.4. NEW CALIFORNIA ISO TRANSMISSION

The transmission capability estimates included in this report include transmission projects that have been recently completed or are currently under development. These projects are listed in

Table 3-2. Please note that "Online" dates are subject to change.

Table 3-2: Transmission Upgrades Underway

Transmission Upgrade	California ISO Status	Online Date
Carrizo-Midway	LGIA[6]	energized
Sunrise Powerlink	Approved	energized
Suncrest dynamic reactive support	Approved	2017
Eldorado-Ivanpah	LGIA	energized
Valley-Colorado River	Approved	energized
West of Devers	LGIA	2021
Tehachapi (segments 1, 2, 3a, 4, 5, 9, 10 and 11 completed)	Approved	2016
South Contra Costa	LGIA	2016
Borden-Gregg	LGIA	2018
Path 42 reconductoring (SCE portion)	Approved	2016
Sycamore Canyon-Penasquitos	Approved	2017
Lugo-Eldorado line reroute	Approved	2017
Lugo-Eldorado and Lugo-Mohave series caps	Approved	2019
Warnerville-Bellota reconductoring	Approved	2017
Wilson-Le Grand reconductoring	Approved	2020

More detailed description and status updates of these and a few other transmission projects in Pacific Gas and Electric (PG&E), Southern California Edison (SCE) and San Diego Gas and Electric (SDG&E) areas are presented in Table 3-3, Table 3-4, and Table 3-5.

[6] "LGIA" stands for "Large Generator Interconnection Agreement."

Table 3-3: Summary of On-going and Completed Projects in the PG&E Power Flow Study Area

Project	Planning Entity	Brief Description	Renewable Area Affected	Status
Table Mountain – Rio Oso 230 kV Reconductor	PG&E	The scope of this project was to reconductor the Table Mountain -Rio Oso 230 kV DCTL with larger capacity conductors.	PG&E North, North Valley	Project is operational
Palermo - Rio Oso 115 kV Reconductoring		The scope of this project was to reconductor the 115 kV lines between Palermo and Rio Oso substations with larger capacity conductors.	PG&E North, Sierra	Project is operational
South of Palermo 115 kV Reinforcement	PG&E	The scope of this project is to reconductor the southern portions of the Palermo – Rio Oso Nos. 1 and 2 115 kV Lines as well as the entire Palermo – Pease and Pease – Rio Oso 115 kV Lines.	PG&E North, Sierra	Project is in engineering and design
New Rio Oso – Atlantic 230 kV Line	PG&E	The scope of this project is to install a new 18 mi. Rio Oso – Atlantic No.2 230 kV Line and convert the Atlantic 230 kV Substation to standard 4 element bus.	PG&E North, Sierra	Project is in engineering and design
Rio Oso 230/115 kV Transformer Replacements	PG&E	The scope of this project is to replace the Rio Oso 230/115 kV transformers (Nos. 1 and 2) with higher capacity rated units.	PG&E North, Sierra	Project is in engineering and design
Midway-Solar SS 230 kV Reconductoring	PG&E	The scope of this project was to reconductor the Midway-Caliente SS-Solar SS 230 kV lines with higher capacity conductors.	Carrizo, Los Padres	Project is operational
Gates #2 500/230 kV Transformer Addition	PG&E	The scope of this project is to install a second 500/230 kV transformer at Gates substation.	San Joaquin Valley	Project is in engineering and design
Central Valley Power Connect (Gates-Gregg 230 kV Line)	PG&E	The scope of this project is to build of a new 230 kV line between Gates and Gregg substations.	San Joaquin Valley	Project is in engineering and design
Wilson-Legrand 115 kV Reconductoring	PG&E	The scope of this project is to reconductor the Wilson-Le grand 115 kV line with a large capacity conductor	San Joaquin Valley	Project is in early planning phase
Bellota – Warnerville 230 kV Reconductoring	PG&E	The scope of this project is to reconductor the Bellota – Warnerville 230 kV Line with a larger capacity conductor	San Joaquin Valley	Project is in early planning phase

Table 3-4: Summary of On-going and Completed Transmission Projects in the SCE Power Flow Study Area

Projects	Planning Entity	Brief Description	Renewable Areas Affected	Status
Tehachapi Renewable Transmission Project (TRTP)	SCE	New and upgraded transmission infrastructure from the Tehachapi Wind Resource Area in southern Kern County to the existing Mira Loma Substation in Ontario.	Tehachapi, Los Angeles County (partial), & San Bernardino Lucerne	In construction with a 11/03/2016 operating date
West of Devers (WoD)	SCE	The project consists of the removal and replacement of approximately 48 miles of existing 220 kV transmission lines with new double-bundle 1590 ACSR 220 kV transmission lines, between the existing Devers Substation (near Palm Springs), Vista Substation (in Grand Terrace), and San Bernardino Substation.	Riverside East, Palm Springs, Riverside County (partial), and San Bernardino-Lucerne	Approved by CPUC on 8/18/16, Project in Engineering/Design with an operating date is 08/01/2021
Mesa	SCE	Expand Mesa Substation to a 500 kV substation. Construct new 500 kV switchbacks and rebuild the 230/66/16 kV switch racks. Loop-in Mira Loma-Vincent 500 kV to Mesa. Loop in Goodrich-Laguna Bell and Rio Hondo-Laguna Bell 230 kV lines into Mesa Substation.	Los Angeles County (partial)	In licensing with an operating date of 12/31/2020
Calcite Substation	SCE	New 220 kV Substation to support generation interconnections in the Lucerne Valley.	San Bernardino-Lucerne	In licensing with an operating date of 08/01/2020
Path 42 Upgrade	SCE	Install relays, meters and logic controllers as necessary associated with IID's new proposed SPS. Upgrade the following transmission lines post Devers-Coachella Valley Loop-in Project: Devers-Mirage #1 230kV T/L, Devers-Mirage #2 230kV T/L, SCE-owned portion of Mirage-Ramon #1 230kV T/L and SCE-owned portion of Mirage - Coachella Valley 230 kV T/L.	Palm Springs	In construction with an operating date of 12/31/16 for the SCE portion of the ugprade
Victor Loop-In	SCE	Loop the existing Kramer-Lugo #1 & #2 230 kV lines into Victor Substation.	Kramer, Victorville, & San Bernardino-Lucerne	Project in Engineering/Design with an operating date of 12/31/2016

Projects	Planning Entity	Brief Description	Renewable Areas Affected	Status
Eldorado-Lugo Series Capacitor Upgrade	SCE	This project involves the upgrade of the existing 500 kV Series Capacitors at Eldorado and Lugo on the Eldorado-Lugo 500 kV T/L to 3,300A continuous rating, as well as a new Series Capacitor rated 3,300A in the vicinity of Pisgah Substation.	Mountain Pass, San Bernardino-Baker, Pisgah, San Bernardino-Lucerne	Project in Engineering/Design with an operating date of 12/31/2019
Lugo-Mohave Series Capacitor Upgrade	SCE	This project involves the upgrade of the existing 500 kV Line Series Capacitors at Mohave on the Lugo-Mohave 500 kV T/L's to 3,300A Continuous Rating, as well as a new Series Capacitor rated 3,300A in the vicinity of Pisgah Substation.	Mountain Pass, Pisgah, & San Bernardino-Lucerne	Project in Engineering/Design with an operating date of 12/31/2019
Lugo -Victorville 500 kV SPS	SCE	This SPS is required to reliably interconnect and integrate the Transition Cluster (TC) generation projects. This SPS will trip the TC projects for the N-1 loss of the Eldorado-Lugo and N-2 loss of the Eldorado-Lugo & Lugo-Mohave 500 kV Transmission Lines.	Mountain Pass, San Bernardino-Baker, Pisgah, San Bernardino-Lucerne,	Project in Engineering/Design with an operating date of 09/30/2016
Whirlwind 3rd AA Bank and SPS	SCE	Install the third AA 500/230 kV transformer bank at Whirlwind Substation. This will also require the need to modify the existing Special Protection System to trip generation under an N-1 of one transformer bank.	Tehachapi	Project in Engineering/Design with an operating date of 12/31/2016
Eldorado-Mohave & Eldorado-Moenkopi 500 kV Line Position Swap	SCE	This project involves swapping the line positions of the Eldorado-Mohave and Eldorado-Moenkopi 500 kV lines to reduce the risk of thermal overloads caused by the loss of the Eldorado-Lugo and Eldorado-Mohave 500 kV transmission lines.	Non-TAFA (Nevada)	Project in Engineering/Design with an operating date of 5/1/2017
Kramer High Voltage Mitigation - Tertiary and Bus Shunt Reactors	SCE	This project includes a Phase 1 and Phase 2 to mitigate high voltage concerns at Kramer Substation. Phase 1: Installs two (2) 34 Mvar reactors to the 12 kV tertiary winding of the existing 230/115 kV No.1 and No.2 transformer banks. Phase 2: Installs one (1) 230kV 45 Mvar bus shunt reactor at the 230 kV bus at Kramer Substation	Kramer	Project in Engineering/Design with operating dates of: Phase 1: 6/01/16 Phase 2: 12/31/17

Table 3-5: Summary of On-going and Completed Transmission Projects in the San Diego Power Flow Study Area

Project	Planning Entity	Brief Description	Renewable Areas Affected	Status
South Orange County Reliability Enhancement Project	SDG&E	Expand Capistrano 138/12 sub to 230/138/12 kV sub with two 230/138 transformers. Build 230 kV line between Talega, Capistrano and San Onofre.	San Diego Local Area	CPCN application under review at CPUC. Estimated ISD: 12/2020.
Sycamore Canyon - Penasquitos 230 kV line	SDG&E	Build underground 230 kV line between Sycamore Canyon and Penasquitos substations.	Greater Imperial	CPCN application under review at CPUC. Estimated ISD: 11/2017.
IV phase shifting transformer	SDG&E	Add two 400 MVA 230 kV phase shifting transformers in parallel at Imperial Valley substation on the 230 kV Imperial Valley – La Rosita transmission line.	n/a	Under construction. Estimated ISD: 6/2017.
New reactive support at San Luis Rey and SONGS	SDG&E	Two 225/-120 synchronous condensers units connected to San Luis Rey 230 kV bus and one 225/-120 Mvar unit connected to San Onofre 230 kV bus.	n/a	Under construction. Estimated ISDs: before the end of 6/2017.
Series capacitor bypass on Southwest Powerlink and the Sunrise Powerlink 525 kV lines	SDG&E	Bypass the existing series capacitors on 500 kV Suncrest – Ocotillo, 500 kV Miguel – ECO, and 500 kV Imperial Valley – North Gila lines.	Greater Imperial	SDG&E supports a long-term, permanent solution to address the issues that this short-term solution mitigates, and therefore the series capacitors should not be assumed as bypassed as a part of the baseline assumptions for RETI 2.0 studies.
Interconnect fourth 500/230 kV transformer at Imperial Valley sub.	IID	4th 500/230 transformer in the Imperial Valley Substation.	n/a	SDG&E has completed the interconnection study.

Project	Planning Entity	Brief Description	Renewable Areas Affected	Status
New static var compensator (SVC) interconnected at Suncrest Substation	NEET West	+300/-100 Mvar SVC interconnected to Suncrest 230 kV bus through a one mile underground circuit.	n/a	SDG&E and NEET West negotiating interconnection agreement.
Bay Boulevard substation	SDG&E	Construct a new 230/69 kV substation to replace the existing South Bay 138/69 kV substation. Loop existing 230 kV Otay Mesa-Silvergate-Miguel line into the new Bay Boulevard 230 kV bus.	n/a	This project is already in-service.
230 kV Miguel – Bay Boulevard #2 transmission line	SDG&E	Add a new 10 mile 230 kV line between Miguel 230 kV bus and Bay Blvd 230 kV bus on existing overhead structure.	San Diego Local Area and Greater Imperial	Cost recovery approved by California ISO. Need date: 6/2019.
230 kV transmission line between Mission and Penasquitos subs	SDG&E	Build a 230 kV Mission-Penasquitos transmission line	Greater Imperial	Cost recovery approved by California ISO.

3.2. IMPERIAL IRRIGATION DISTRICT

Imperial Irrigation District (IID) was formed pursuant to the California Water Code that provides irrigation and electric service in Southern California. IID provides electric service to more than 145,000 customers in Imperial County and parts of Riverside County with a peak load of approximately 1,100 MW. IID is a registered Balancing Authority ("BA") and owns and operates generation, transmission and distribution facilities.

The Imperial Valley has long been at the forefront of renewable energy production. For nearly 20 years, more than 500 MW of geothermal capacity and associated energy has been produced and delivered to California Load Serving Entities ("LSE"). There is a significant amount of additional geothermal resource potential in the Imperial Valley. These renewable resources produce zero emissions, utilize proven technologies and are produced in-state.

As a public agency providing power and irrigation services to the Imperial Valley, IID has a strong interest in promoting the development of renewable energy in the region. Imperial County is one of the most impoverished regions in the nation. It has an unemployment rate of over 23.5% and nearly one in four residents live at or below federal poverty level. The development of the renewable energy industry in Imperial County will provide economic development and jobs to a region of California that is in desperate need.

Figure 3-4: Imperial Irrigation District

Transmission lines:

1,421.1 miles

Service Territory:

Imperial County: 4,225 mi^2

Riverside County: 1,954 mi^2

San Diego County: 293 mi^2

Total: 6,471 mi^2

Interties with California ISO, SDGE, SCE, APS, and WAPA

3.2.1. IID RENEWABLE RESOURCE AREA INFORMATION

California's Imperial Valley represents an abundant supply of untapped renewable energy resources. The Desert Renewable Energy Conservation Plan (DRECP) estimates the Valley's renewable energy generating potential at a minimum of 10,000 megawatts. The Salton Sea itself possesses more geothermal capacity than anywhere else in the nation. An estimated 2,000 megawatts of geothermal energy await development, in addition to the 544 megawatts already providing reliable power from facilities at the Salton Sea to California energy consumers.

The U.S. Bureau of Land Management (BLM) and the DRECP have also recognized the area surrounding the Sea as ideal for new solar development. BLM's recently designated West Chocolate Mountains Renewable Energy Evaluation Area includes lands along the Salton Sea designated for solar and geothermal development. Research is also underway to determine how best to develop biofuels from algae found at the nutrient-rich Sea.

In addition to spurring new jobs and economic development in Imperial Valley, unlocking the Salton Sea's renewable energy potential can help meet real and immediate energy needs and satisfy California's ambitious 50% percent renewable energy standard.

3.2.1.1. A SOLUTION FOR SALTON SEA RESTORATION

In addition to providing a reliable and renewable energy source for California, producing new clean energy at the Salton Sea will also generate much-needed funds for restoration activities such as wildlife habitat and air quality management. These activities will help address the Sea's decline, which will reach a tipping at the end of 2017 when mandated mitigation water inflows cease and hasten water quality and air pollution problems. As an added benefit, renewable energy projects sited on exposed Sea lakebed can help control harmful dust emissions, improving the health of surrounding communities and the environment.

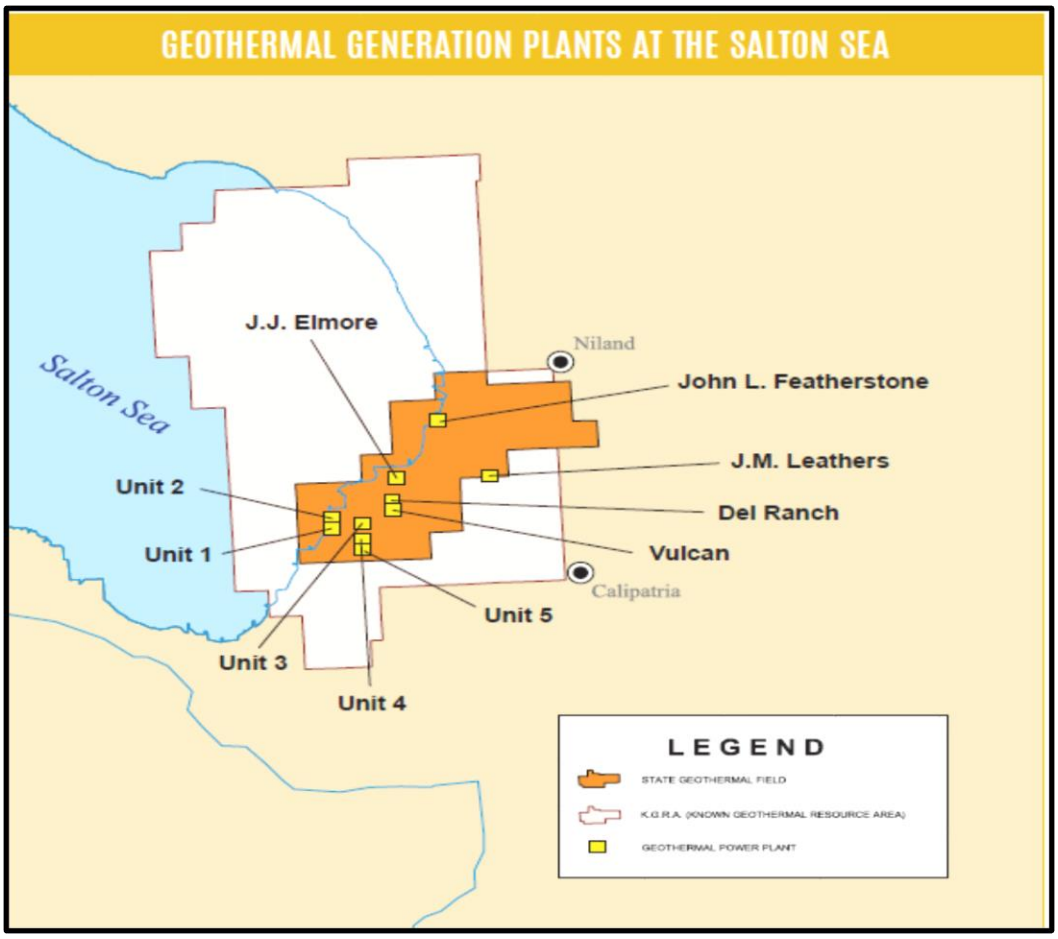
3.2.1.2. WORKING IN PARTNERSHIP FOR RESPONSIBLE ENERGY PLANNING & DEVELOPMENT

In order to ensure responsible renewable energy planning and development at the Salton Sea, the Imperial Irrigation District is working closely with local, regional, state, and federal partners to implement the following components of this initiative:

- Designating the Salton Sea area as a renewable energy zone, in concert with Imperial County
- Conducting environmental assessments on the best places to site renewable energy development, in coordination with Imperial County and the DRECP as well as environmental stakeholders
- Pledging the use of IID land and mineral assets for new renewable energy projects and habitat, and securing a commitment from the federal government to use government-owned lands at and around the Sea for renewable energy development
- Pursuing public-private partnerships with energy developers for new geothermal energy facilities – to potentially be followed by wind, algae and solar energy projects in later stages
- Establishing an "open season" during which renewable energy developers can bid for projects

- Planning and securing funding for a new transmission line with export capacity of up to 1,200 megawatts (STEP project) to deliver renewable energy from Imperial Valley to energy consumers throughout the state of California.

Figure 3-5: Imperial County Geothermal Resources



3.2.2. IID TRANSMISSION CAPACITY

IID has over 3000 MW of total transmission capacity that can be used to export renewable energy to the other California LSEs. The capacity is presently underutilized as described in

Table 3-6 which shows that there is 2,310 MW of available transmission capacity. For example, Imperial County is located near the Chocolate Mountain area, which has a large potential for developing new renewables and is in close proximity to IID's 1100 MW of available transmission capacity on Path 42.

Table 3-6: List of Total and Available Transmission Capacity for Export to CAISO

Existing Transmission Paths for Export to CAISO	Total Transmission Capacity MW	Brief Description	Available Transmission Capacity MW	Renewable Zones
Path 42	1,500	IID approved a project to re-conductor the double circuit 230 kV lines connecting the IID and SCE transmission systems. IID estimates that this reconductoring project will increase import and exports between the CAISO and IID BAs from 600 MW to 1500 MW.	1,100	Imperial and Riverside
Imperial Valley Substation	370	The IID and SDGE transmission systems interconnect via a single 230 kV line ("S line")	180	Imperial
FERN	1,170	This one mile interconnection from the existing Fern to Imperial Substation has a rating of 1171 MW. The gen-tie delivers the output of an existing 140 MW interconnected solar facility. Fern substation represents a unique opportunity for generators to interconnect at a very low cost since Fern connects directly into the CAISO BA at Imperial Valley substation and has an IID transmission rate of approximately 0.016 to .022 cents per kW-month.	1,030	Imperial
Total	3,040		2,310	

In support of further renewable development, IID is proposing several other transmission projects to increase exports from the Imperial Valley to CAISO and other BA's (Refer to Table below). IID's proposed Strategic Transmission Expansion Plan ("STEP") will provide additional transmission for Southern California load centers to access renewable energy from the West Chocolate Mountains area. IID's STEP initiative is designed not only to facilitate the export of Imperial Valley renewables to the Southern California, but also to deliver this energy to other regions of the Southwest. IID submitted its STEP proposal into the California ISO 2013-14 Transmission Planning Process request window. Although its proposed configuration could be refined, the STEP proposal's key element is a new 1500 MW 500 kV AC transmission line from IID's existing Midway substation to SCE's existing Devers substation. The 500 kV circuit will span about 85 miles from the Imperial Valley to SCE's substation near Palm Springs.

The STEP also allows for a potential Phase 2 and further expansion of AC line capability by an additional 1100 MWs as well as further expansion of the capacity on the collector system in the Imperial Valley.

Further, this project could be completed with relatively limited environmental impacts. Approximately 50 percent of the proposed AC line will be within existing IID rights-of-way or on land owned by IID. Approximately 70 percent of the proposed Imperial Valley collector system has already been permitted by IID. This will greatly ease the burden of siting and permitting.

IID has also submitted another 500 kV Transmission project in CAISO 2016 "Request Window" referred as N.Gila-Midway-Devers 500 kV AC Intertie described below that will provide another path to carry generation east of Imperial Valley substation directly into SCE load center around Devers area, thus relieving congestion on the constrained ECO-Miguel transmission line.

Table 3-7: Proposed Transmission Capability to Export to CAISO and WAPA

Proposed New IID Transmission for Increasing Export to CAISO and/or Other BA's	Total Transmission Capacity MW	Brief Description	Renewable Zones
Strategic Transmission Expansion Plan ("STEP") Phase 1 (a.k.a. Midway-Devers 500 kV AC Intertie)	1,500	This 500 kV transmission line is 85 miles long and would be constructed adjacent to the existing Path 42. This will strengthen the link between IID and SCE. IID has acquired about 55% of the Right-of-Way. The line is proposed to interconnect IID's Midway substation to SCE's Devers substation.	Imperial and Riverside
N.Gila-Midway-Devers 500 kV AC Intertie	2200 MW	A 500 kV AC transmission line originating from APS' North Gila substation then looping through a new 500 kV switchyard adjacent to IID's existing 230 kV Midway substation to SCE's Devers 500 kV substation in Riverside County.	Portion of southern Arizona, Imperial and Riverside
Desert Southwest (DSW) Project (From IID to CAISO/WAPA)	1,200	Proposed 118 miles, 1200 MW transfer capability on a single circuit 500 kV transmission line. The proposed DSW project connects the Keim substation near Blythe to SCE's Devers substation. IID holds BLM Right-Of-Way Grants.	Imperial and Riverside
CFE (From IID to CFE)	600	Several alternatives are under evaluation. The objective is to directly connect IID and CFE through a 300 to 600 MW interconnection.	Imperial
Total	5,500		

3.2.3. IID PROPOSED GENERATION INTERCONNECTION LOCATIONS

To accommodate the high resource potential for geothermal, solar, wind and biomass in the IID BA, Table 3-8 lists desirable generation interconnection locations.

Table 3-8: List of Potential Generation Interconnection

Location	MW	Imperial CREZ Location
Bannister 230 kV Substation	600	North
Midway 92 kV Substation	150	North
Midway 230 kV substation	600	North
Midway 500 kV	800	North
Coachella Valley 92 kV	150	North
Avenue 58 Sub	150	North
Anza 92 kV Substation	150	North
Calipatria Substation	150	North
Pilot Knob 230 kV Substation	250	East
Niland 92 kV Substation	400	East
Fern 230 kV Substation	800	South
Total	4,200	

3.2.4. POTENTIAL IID TRANSMISSION UPGRADES TO ACCOMMODATE NEW GENERATION

IID has a few transmission and substation upgrades on standby and ready for moving forward to accommodate new generation. These potential upgrades are listed in Table 3-9 below.

Table 3-9: List of Transmission and Substation Upgrades

Location	Brief Description	Capacity Addition (MW)
Midway - Bannister 230 kV #2 line	This project consists of placing another 230 kV bundle conductor the existing and newly constructed Midway - Bannister #1, 230kV line.	800
Midway 500kV Substation	Expand the existing Midway 92 kV and 230 kV to accommodate STEP and DSW 500 kV lines.	1500
N. Gila - Pilot Knob and expansion of Pilot Knob substation	Expand the existing Pilot Knob substation and build a new 230 kV line from N. Gila to Pilot Knob. This will provide access to the southwestern market.	800

Fern to CFE 230 kV line	New transmission line from IID to CFE.	600

3.2.5. IID PROPOSAL ON MAXIMIZING THE EFFICIENT USE OF EXISTING TRANSMISSION IN IMPERIAL TAFA

IID recommends an examination of the current CAISO policy for utilization of existing transmission to allow exports from IID into CAISO. For instance, even with IID and SCE upgrades of Path 42 (from 600 MW to 1500 MW), the CAISO determined that Maximum Import Capability (MIC) into the CAISO BA from the IID BA would not increase.

Maximizing use of existing transmission in valuing exports from the IID system is crucial to ensure maximum usage of existing transmission capacity and must be a #1 priority. IID believes that the ISO's current MIC is inconsistent with the physics of the grid, underutilizes existing transmission capacity, provides incentive to locate projects that have the highest adverse impact on the grid, and increases costs to both IID and CAISO/IOU ratepayers. The current ISO MIC calculation from IID into CAISO can be improved to better utilize existing and unused transmission capacity. The current MIC calculation results in unintended consequences of underutilizing certain available transmission capacity in the northern IID area and over-utilizing unavailable transmission capacity in the Southern IID area.

To better understand this point, IID offers the following example and explanation:

As California's power system evolves in response to 33% -- now 50% -- renewable energy requirements and beyond, it is important to create incentives for new generation projects to make the best possible use of existing transmission facilities. The vehicle by which to satisfy this objective is to incorporate an explicit consideration of how to utilize existing transmission capacity in a flexible and efficient manner in renewable project valuation. This can be accomplished by taking into account: (1) the optimal utilization of existing transmission infrastructure; (2) an assignment of a proportional share of transmission costs to projects utilizing new transmission infrastructure regardless of the rationale for the new build; and (3) the allocation of transmission deliverability in a manner that creates an incentive for proposed new generation projects to interconnect to facilities that will minimize the generation projects' overall contribution to existing transmission constraints.

3.2.5.1. BACKGROUND AND FACTS

1. The IID's BAA accounts for 98 percent of the entire area in the Imperial CREZ.
2. Only 2 percent of the Imperial CREZ lies within the CAISO BAA.
3. Over 1,200 MW of wind and solar are under PPAs with the IOUs that directly connect to the CAISO facilities in the Imperial CREZ.
4. However, only one solar project of 150 MW (one PPA) with SDGE has been constructed in the IID BAA and is currently delivering solar energy to SDGE customers.
5. IID has ample available transmission capacity to allow significant additional amounts of renewable generation to reach the CAISO BAA. The cost of this available capacity is the lowest in California at $3/MWh.
6. As a result of the MIC currently available for importing dependable capacity from the IID BA into the CAISO BA, there is an incentive for renewable energy projects in the Imperial CREZ to obtain

transmission service from CAISO, bypassing the IID system, despite the inefficiency of doing so.

7. There are two existing interties between CAISO's system and IID's system that provide the needed bridges between these two energy producing and energy consuming areas. These bridges also provide an efficient and effective pathway that can enable California to achieve a significant percentage of its renewable energy goals at a cost that is significantly lower than the cost associated with projects that would interconnect directly into the CAISO.
8. IID submitted to CAISO in March, 2015 an analysis demonstrating the generation locational impact in the three CEC designated Imperial CREZ regions (North, South and East). In addition, CAISO has acknowledged these locational impacts.

3.2.5.2. INADEQUATE DELIVERABILITY FROM IID INTO THE CAISO

In 2011, several stakeholders, including IID, CAISO and California Public Utilities Commission (CPUC) identified potential issues with the way in which the MIC between the IID Balancing Authority Area (BAA) and the CAISO BAA was calculated. Recognizing the disadvantage that renewable energy projects interconnecting to IID's BAA faced, the CPUC issued an Assigned Commissioner Ruling (ACR) by Commissioner Ferron on July 7, 2011 that proposed to modify the CAISO's MIC process by developing a forward looking MIC calculation methodology, as opposed to relying solely on historical scheduled imports into the CAISO from IID. In that ACR, the MIC from the IID BAA to the CAISO was determined to be 1,400 MW, which is consistent with resource development projections in IID. The ACR specifically stated that it would be unreasonable for CPUC-jurisdictional load serving entities ("LSEs") to assume less than the 1,400 MW of MIC for procurement calculation purposes.

Since the issuance of its 2012 Transmission Planning Report (2011-2012 TPP), the CAISO has included a MIC value table showing the MIC from IID to CAISO for a ten-year planning horizon. Since then, this MIC value table has been used by LSE procurement staff in RFO bid evaluations for projects situated in the IID BAA. This MIC value table is used to assign resource adequacy values to generation projects connected within the IID BA. Project lenders also use the MIC value table in their project evaluations. As such, the contents of this MIC value table are of paramount importance to projects situated in the IID BA, to LSE procurement staff, and to project lenders for successful completion of renewable projects connecting within the IID BA.

In its 2013-2014 transmission plan, however, the CAISO indicated zero incremental deliverability for generators connecting to the IID BAA, while projects that are within the Imperial CREZ or a few yards away, which can interconnect directly to the CAISO system, were deemed deliverable, and some of these were awarded PPAs[7].

Other renewable energy projects that otherwise would have been located in and interconnected to the IID BAA were forced to construct gen-ties and connect to the CAISO BAA in order to obtain deliverability and be considered in the Investor Owned Utilities' (IOUs') solicitations. The renewable energy projects built gen-ties in order to connect directly to the CAISO BAA, in some instances only a few hundred yards away from comparable project sites in the IID BAA. These renewable energy projects were awarded with Power Purchase Agreements (PPAs) totaling 1200 MW, whereas otherwise competitive projects that would interconnect to the IID BAA were awarded no PPAs at all.

To demonstrate the seriousness of this problem, consider two projects X and Y, both 100 MW and both

[7] http://www.8minutenergy.com/news/press/srpcorp

projects bidding $60/MWh and $50/MWh respectively for renewable energy as a fully deliverable product. Both projects are located in the Imperial CREZ. Project X plans to connect to CAISO Imperial Valley substation as shown in Figure 3-6.

Project Y plans to connect to IID's Coachella Valley Substation as shown in Figure 3-6: Project Y. Because of where the projects interconnect and the resultant energy flows toward the load center in San Diego, the congestion on the transmission corridor downstream leading to San Diego where the energy is consumed is worsened considerably by Project X (CAISO BAA interconnection), but only minimally by Project Y (IID BAA interconnection). By interconnecting to the CAISO's Imperial Valley Substation, Project X contributes 35% of its energy output toward worsening congestion on the transmission corridor to San Diego. However, because Project Y is interconnected further north to IID's Coachella Valley Substation, it contributes only 2% of its energy output to worsening congestion on the transmission corridor to San Diego.

Figure 3-6: Project X

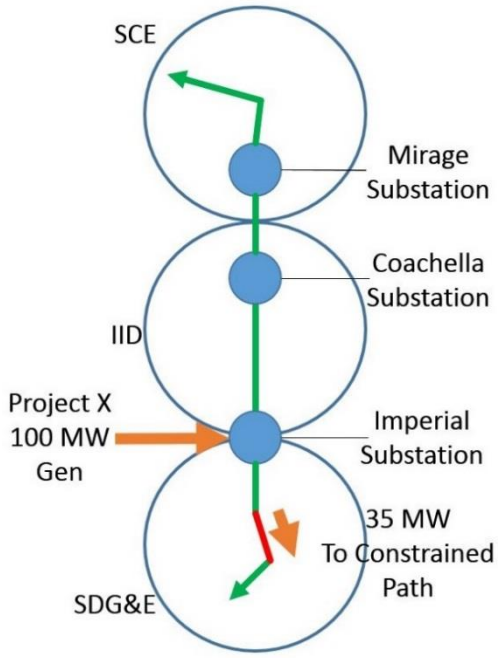
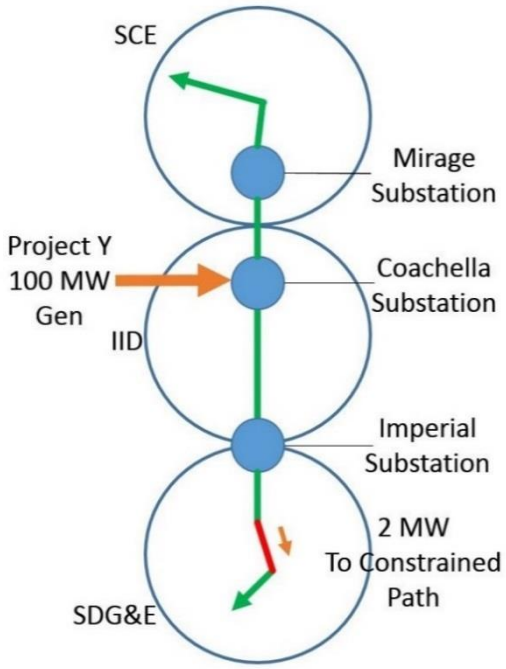


Figure 3-7: Project Y



Everything else being equal, and assuming the IOU intends to purchase 100 MW, the current CAISO MIC "kills" Project Y from even competing with project X based on the wrong assumptions of no available MIC from the IID BA into the CAISO BA. Even if Project Y is cheaper than Project X, the IOU's procurement will disqualify Project Y based on no MIC availability. In this instance, projects connecting within the IID BAA always lose to projects a few miles away but connected to the CAISO BAA. The irony is that in order for Project X to be fully deliverable, Project X uses 20 MW of IID transmission capacity that the CAISO indicated is not available. Furthermore, Project X has the most adverse impact on the transmission grid and exacerbates loading on already heavily loaded lines.

This outcome will result in increasing congestion and subsequent higher energy and transmission costs to ratepayers and generators. There is a better solution. In order to maximize the use of the existing

transmission system capacity and minimize the need for new transmission lines, the appropriate choice should have been to select Project Y for a full 100 MW (based on price, physically available transmission and effectiveness). This alternative outcome would ensure that projects that have the least overall impact on the existing transmission system (and the lowest overall transmission-related cost, along with other important attributes) should have an edge over projects that worsen congestion.

This example is not a hypothetical example, it's real and it's one of many examples that IID has directly experienced since 2012. This illustrates that the current method used by the CAISO to calculate and allocate the MIC from the IID BA into the CAISO BA and the total amount of deliverability from the Imperial CREZ, is impacting the viability of projects connecting to IID BAA. This method is inconsistent with the physics of the grid and actually increases congestion. For instance, most of the new generation awarded PPAs in the Imperial CREZ is clustered in one area near the CAISO BAA's Imperial Valley Substation. This location appears to be the worst possible location from a deliverability perspective, because it adversely affects congestion on the transmission corridor to San Diego. By comparison, projects that are located in the Coachella Valley area of the Imperial CREZ have much less impact on the congested transmission corridor than those interconnected to the CAISO's BAA near Imperial Valley Substation.

Recently, Southern California Edison ("SCE") procured over 406 MW[8] of solar connecting to the CAISO Imperial Valley Substation ("IVS"), in a location with one of the worst impacts on the constrained path. A power system analysis conducted by IID Planners found that the location of generation within the Imperial CREZ[9] would have a very significant impact on the grid, and, therefore, on the MIC from the IID BA into the CAISO BA, as illustrated in

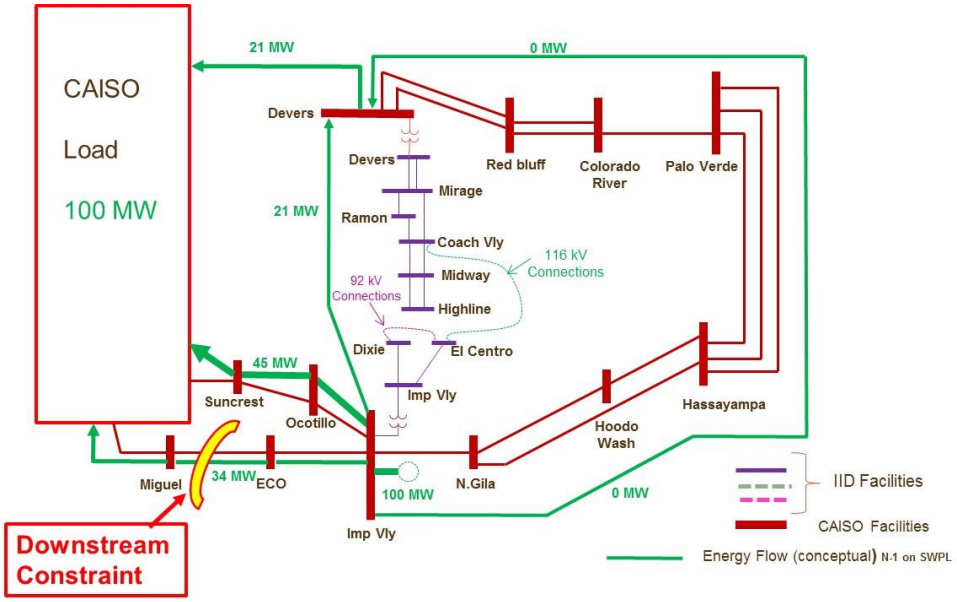
[8] http://www.8minutenergy.com/news/press/srpcorp

Two 20-year power purchase agreements to sell 406 megawatts-ac of clean, renewable solar energy from Mount Signal Solar Farm II (154 MW-ac; 200 MW-dc) and Mount Signal Solar Farm V (252 MW-ac, 328 MW-dc) utility-scale solar projects in Imperial County, California, to Southern California Edison (SCE).

[9] Imperial CREZ consist of all of Imperial County and all of IID BAA.

Figure 3-8 below.

Figure 3-8: Impact of 100 MW Generator Interconnected at Imperial Valley Substation on Downstream Constraint



Interconnecting a 100 MW generator on the CAISO grid at the Imperial Valley Substation results in roughly 34 MW flowing through the downstream constraint into the San Diego load center. Much like trying to build a new on-ramp onto a congested freeway exacerbates traffic congestion, interconnecting a new generator upstream of a well-known transmission constraint exacerbates congestion on the transmission corridor. Locating a generator further north and away from the constraint, nearer to Devers substation in the northern part of IID's BAA, considerably reduces the impact of new generation on the grid and, consequently, the need for additional transmission.

Table 3-10 below summarizes the disproportional impact of new generators on the constrained path.

Table 3-10: Disproportional Impact of New Generators on the Constrained Path

Projects Approved and Online	IOU	Min MW	Technology	Vintage	Location	BAA	Impact on the Eco-Miguel 500kV Constrained Path (%)	Impact on the Eco-Miguel 500kV Constrained Path (MW)
Kumeyaay Wind	SDG&E	51	Wind	New	San Diego County	CAISO	25%	12.75
Ocotillo Express Wind Project	SDG&E	265	Wind	New	Ocotillo, CA	CAISO/IVS	35%	92.75
Campo Verde/Mt.	SDG&E	49	Solar PV	New	Fillaree Ranch, Imperial	CAISO/IVS	35%	17.15

Signal Solar					Valley			
Imperial Solar Energy Center - South	SDG&E	130	Solar PV	New	El Centro, CA	CAISO/IVS	35%	45.5
Centinela Solar (expansion)	SDG&E	30	Solar PV	New	Calexico, CA	CAISO/IVS	35%	10.5
Imperial Solar Energy Center - West	SDG&E	130	Solar PV	New	El Centro, CA	CAISO/IVS	35%	45.5
Arlington Valley Solar Energy II	SDG&E	127	Solar PV	New	Arlington, AZ	CAISO	40%	50.8
Mt. Signal Solar II	SCE	154	Solar	New	Calexico, Imperial County, CA	CAISO/IVS	35%	53.732
Mt. Signal Solar IV	SCE	252	Solar	New	Calexico, Imperial County, CA	CAISO/IVS	35%	88.312
Subtotal (1)		1188					35.1%	416.994
ORNI 18	SCE	50	Geothermal	New	North Brawley, CA	IID	2%	1
SG2 Imperial Valley	SDG&E	150	Solar PV	New	Calipatria, CA	IID	15%	22.5
Seville Tallbear LLC	SDG&E	20	Solar PV	New	Calipatria, CA	IID	18%	3.6
Calipatria	SDG&E	20	Solar PV	New	Calipatria, CA	IID	15%	3
Midway Solar Farm I	PG&E	50	Solar PV	New	Calipatria, CA	IID	15%	7.5
Subtotal (2)		290					13.0%	37.6
Total		1478						454.6

On average, the CAISO-interconnected projects impact the constraint by 35% as opposed to 13% for IID-

interconnected projects. That means for every 100 MW interconnected to the CAISO-grid, the active transmission constraint is worsened by 35 MW.

A second consequence of interconnecting generators to the CAISO grid is the impact on IID's BAA. Because electricity flows through the path of least resistance, interconnecting generation on one entity's electrical grid necessarily changes the amount of power flowing on other entities' grids. To the extent that flow adversely impacts a neighbor's grid, neighbors notify the generators of the need to mitigate the impact.

In the case of generators interconnecting to the CAISO grid, IID is impacted in the form of reduced MIC from the IID BA into the CAISO BA.

Figure 3-8 above illustrates the impact of a 100 MW generator interconnected to Imperial Valley Substation on IID's grid. Roughly 21 MW flows through IID's BAA. Table 3-11 below summarizes the impact of CAISO-interconnected generators on MIC from IID's BAA into the CASIO BAA.

Table 3-11: Impact of CAISO-interconnected Generators on MIC from IID's BAA into the CAISO's BAA

Projects Approved and Online	IOU	Min MW	Technology	Vintage	Location	BAA	Impact on IID MIC (%)	Impact on IID MIC (MW)
Kumeyaay Wind	SDG&E	51	Wind	New	San Diego County	CAISO	15%	7.7
Ocotillo Express Wind Project	SDG&E	265	Wind	New	Ocotillo, CA	CAISO/IVS	18%	47.7
Campo Verde/Mt. Signal Solar	SDG&E	49	Solar PV	New	Fillaree Ranch, Imperial Valley	CAISO/IVS	20%	9.8
Imperial Solar Energy Center -South	SDG&E	130	Solar PV	New	8 mi SW of El Centro, CA	CAISO/IVS	20%	26.0
Centinela Solar (expansion)	SDG&E	30	Solar PV	New	Calexico, CA	CAISO/IVS	20%	6.0
Imperial Solar Energy Center -West	SDG&E	130	Solar PV	New	8 mi SW of El Centro, CA	CAISO/IVS	20%	26.0
Arlington Valley Solar Energy II	SDG&E	127	Solar PV	New	Arlington, AZ	CAISO	40%	50.8
Mt. Signal Solar II	SCE	154	Solar	New	Calexico, Imperial County, CA	CAISO/IVS	20%	30.7
Mt. Signal Solar IV	SCE	252	Solar	New	Calexico, Imperial County, CA	CAISO/IVS	20%	50.5
Subtotal (1)		1188					21.5%	255.1
ORNI 18	SCE	50	Geothermal	New	North Brawley, CA	IID	0%	0.0
SG2 Imperial Valley	SDG&E	150	Solar PV	New	Calipatria,CA	IID	0%	0.0
Seville Tallbear LLC	SDG&E	20	Solar PV	New	Calipatria,CA	IID	0%	0.0

Calipatria	SDG&E	20	Solar PV	New	Calipatria,CA	IID	0%	0.0
Midway Solar Farm I	PG&E	50	Solar PV	New	Calipatria,CA	IID	0%	0.0
Subtotal (2)		290						0.0
Total		1478						255.1

As a result of the 1,188 MW interconnected to the CAISO's BAA near Imperial Valley Substation, MIC from IID's BAA into the CAISO BAA is reduced by roughly 255 MW. By incorporating the effect that new generation projects would have on existing transmission from adjacent BAAs, such as IID, the incentives to locate generation in a manner that is conducive to maximizing use of existing transmission infrastructure would be aligned. Therefore, transportation of renewable energy to load centers at the lowest possible cost would be maximized. This step is critical to provide the appropriate indicator to facilitate the development of generation in locations that do not stress the grid and, thereby, assist the IOUs and other buyers in their procurement process.

Power system analysis results indicate that generation interconnected to IID's Coachella Valley substation has only a 2% impact on the constrained path of the ECO-Miguel 500 kV line[10]. By contrast, a generator connected to the Imperial Valley 230 kV substation has a 35% impact on the same constrained path. The lower the impact that any generator has on a constrained path, the lower will be the cost to ratepayers.

The specific location of projects situated within the Imperial CREZ will have a significant impact on the amount of total CREZ generation that can be reliably delivered to load centers. Thus, the specific location of generation located within the Imperial CREZ will have a wide range of impacts on the total amount of generation that can be built in a world-class renewable energy resource area. Given California's aggressive renewable energy mandate, and the remarkably high quality of the resources in the Imperial CREZ, it is of the greatest importance to maximize the amount of high-quality renewable generation that the State can rely on from this area.

Specifically, the deliverability calculation for generation connected, respectively, to CAISO facilities and within the IID BAA should be modified based on the geographic location of a given generator and the actual behavior of the transmission system based on that geographic location (a geographical map of Imperial CREZ is shown below). This can be accomplished by adopting the Locational Effectiveness Factor ("LEF") methodology. The CAISO recently adopted similar methods for the Los Angeles and San Diego basins[11].

The need to change: Under the example discussed above, the LEF for a generator connected to the Coachella Valley (CV) substation is 98%. These results indicate that injecting 100 MW of generation at the CV substation will result in 2 MW of flow increase on the CAISO's constrained path and 98 MW on its unconstrained paths. By contrast, for a generator interconnecting at the CAISO's Imperial Valley 230 kV substation, the LEF is 65%. This indicates that a generator connecting to that substation will result in 35

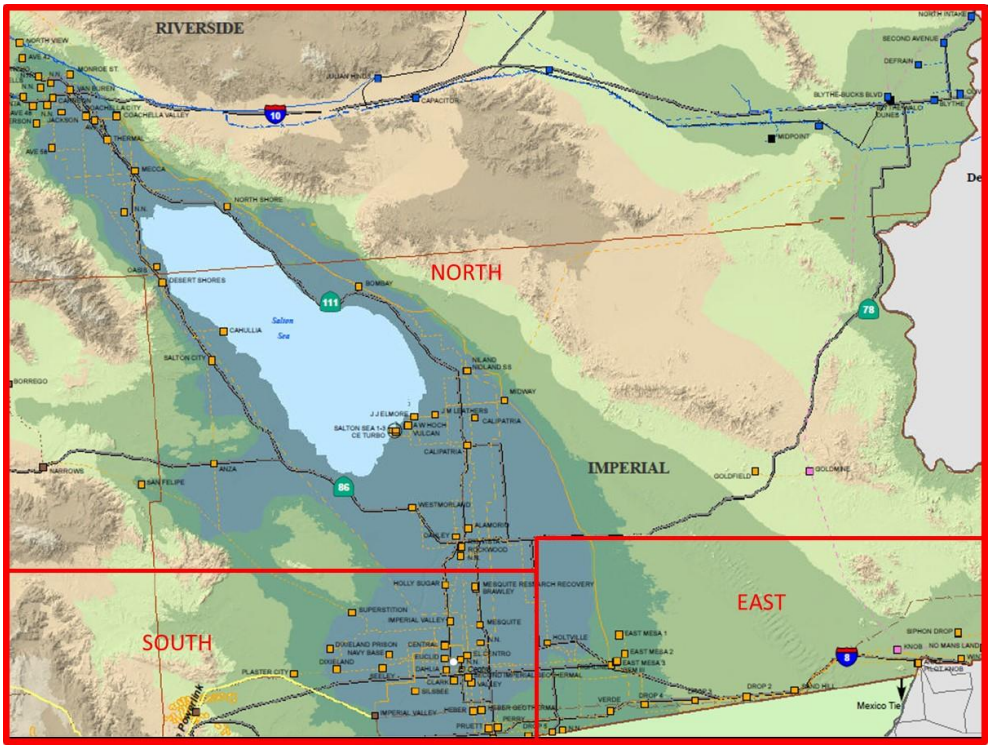
[10] A 100 MW injection at the Coachella Valley substation will result in 2 MW or 2% flow on the constrained path. The rest (98 MW or 98%) will flow on other non-constrained paths.

[11] http://www.CAISO.com/Documents/LocationalEffectivenessFactors-LA-Basin_2013-2014.pdf; http://www.CAISO.com/Documents/LocationalEffectivenessFactors-SanDiego_2013-2014.pdf

MW of flow on the constrained path and 65 MW flow on unconstrained paths. The key point is that when more generation connects to buses with higher LEFs, there will be a higher degree of deliverability. In the specific case of interconnections of new generation within the IID BAA, this means that such interconnections will result in less congestion than new interconnections directly to the CAISO BAA within the Imperial CREZ. Hence, the CAISO's presumed MIC of 0 MW that is assigned to the IID BAA ignores both the actual impacts, as well as the basic physics, of interconnections within the Imperial CREZ and must be revised upward by a very significant amount. As a first step in this necessary correction, the CAISO should utilize the LEF to inform its stakeholders regarding the impacts of the procurement and the interconnection of new generation in both IID and CAISO BAAs.

The current ISO policy of ignoring generation locations' impact is costing California ratepayers millions of dollars. Since an overwhelming amount of renewable generation from the Imperial CREZ has been procured on behalf of the IOUs and since CAISO has implemented a similar method for IOU procurement in the San Diego and Los Angeles areas under the CPUC in D.13-02-015, why not implement the same method for the three regions within the Imperial CREZ?

Figure 3-9: Geographic Map of Imperial CREZ



3.3. LOS ANGELES DEPARTMENT OF WATER AND POWER

The Los Angeles Department of Water and Power (LADWP) transmission system consists of high-voltage (above 230 kV) alternating current (AC) and direct current (DC) transmission corridors as well as a 115 kV-to-230 kV in-basin network totaling more than 3,600 miles. Of those, high-voltage AC and DC transmission lines alone account for 2,900 miles and provide over 5,000 MW of import capability. LADWP utilizes these resources to transport power from the Pacific Northwest, Utah, Arizona, Nevada, and from within California to serve its customers and to wheel power for the Cities of Burbank and Glendale. In addition, LADWP's transmission system is interconnected with other utilities in the Western Electricity Coordinating Council (WECC) to coordinate and promote electric reliability throughout the Western United States. Thus, the importance of the security and adequacy of LADWP's transmission system extends beyond its physical boundaries.

3.3.1. TRANSMISSION EXPANSION

In order to meet 50% Renewable Portfolio Standard (RPS) requirement in 2030, LADWP has initiated and planned three major transmission projects which consist of Barren Ridge Renewable Transmission Project, South of Haskell Canyon Transmission Project, and Victorville-LA Basin Transmission Project.

- Barren Ridge: Implement Barren Ridge Renewable Transmission Project to transmit renewables from Mohave Desert and Owens Valley areas for meeting RPS from 2016 through 2020
- South of Haskell: Upgrade South of Haskell Canyon Transmission System to further improve transfer capability of Barren Ridge Renewable Transmission Project for meeting RPS from 2024 through 2030
- Victorville-LA Basin: Upgrade Transfer Capability of Victorville to LA Basin transmission system to enable the transmission of renewable energy from Eldorado Valley, Arizona, and Southern Nevada areas for meeting RPS from 2024 through 2030

Figure 3-10: LADWP Transmission Projects

Table 3-12 details the specific activities to be undertaken for each of these projects.

Table 3-12: Summary of LADWP's On-going and Completed Projects

Projects	In-Service
Barren Ridge Renewable Transmission Project	
Construct new Haskell Canyon 230 kV Substation	September-2016
Construct new Barren Ridge - Haskell Canyon 230 kV Line 2 & 3	September-2016
Reconductor Haskell Canyon - Rinaldi 230 kV Line 1	May-2016
Loop Castaic lines into Haskell Canyon Substation	May-2016
Reconductor Barren Ridge - Haskell Canyon 230 kV Line 1	June 2017
Construct new Castaic-Haskell Canyon Line 3	June-2017
South of Haskell Canyon Transmission Project	
Rerate Olive-Northridge 230 kV Line 1	December-2017
Rerate Haskell Canyon - Olive 230 kV Line 1	December-2017
Rerate Haskell Canyon - Sylmar 230 kV Line 1	December-2017
Construct new Haskell Canyon - Sylmar 230 kV Line 2	December-2022
Victorville to LA Basin Transmission Project	
Upgrade equipment at Victorville, Mead, and Century Substations	June-2020
Install new 500/287 kV auto-transformer at Victorville Substation	June-2020
Upgrade 500/230 kV auto-transformer Bank H at Toluca Receiving Station	June-2020
Reconductor Valley-Rinaldi 230 kV Line 1 & 2	June-2018
Reconductor Valley-Tuloca 230 kV Line 1 & 2	June-2020
Replace 230kV Circuit Breakers at Rinaldi	December-2022
Install shunt capacitors at Century, Gramercy, and Hollywood Substations	December-2022

LADWP has increased the use of renewable energy to serve end-use loads through successful project development and completed agreements with multiple generation developers and generation project entities. Renewable projects that supply power to LADWP are geographically diverse; solar energy comes from Mohave Desert and Owens Valley, wind energy comes from the ridges of the California Tehachapi Mountains, the north-central hills of Oregon, the southern Washington Columbia River Gorge area, the Milford Valley of Utah, and Southwestern Wyoming, and geothermal energy comes from Southwest Nevada. Planning for future renewable energy will continue to emphasize geographic diversity, as well as technology diversity.

The solar energy from Owens Valley and Mohave Desert will reach 650 MW in 2016 with an additional 600 MW by 2030.

3.3.2. INTERMOUNTAIN POWER PROJECT (IPP) REPLACEMENT

To support LADWP's strategy to completely divest from coal-fired resources by 2025, a combination of energy efficiency, demand response, renewable resources (consisting of wind, solar and geothermal), and energy storage as well as energy from a combined-cycle natural gas generating facility are identified as key resources to replace two 950 MW coal-fired units. In 2015, all 36 participants approved an amendment to replace IPP by 2025 by repowering IPP with at least one combined-cycle natural gas generating unit. The repowered IPP unit will provide flexible capacity that will be used to firm and back-up renewable resources, and provide a mechanism to integrate them reliably into LADWP's grid. The 2,400 MW capacity of the Intermountain Power Project DC Line (IPPDC) would then import the energy from the combined-cycle natural gas generating facility and renewable resources in the Rocky Mountain Region.

3.3.3. LADWP TAFA TRANSMISSION CAPACITY

The transmission capacity to deliver 1,755 MW from the Barren Ridge area includes existing and new interconnection queues (See Table 3-13). Based on the capacity of interconnection queues, the transfer capability of the Barren Ridge area is oversubscribed. In order to accommodate the interconnection queues, the Barren Ridge Renewable Project and the South of Haskell Canyon Upgrade are required.

Table 3-13: Existing and Queue Interconnection Request in the Barren Ridge Area

Interconnection	MW	Location	Comments
Pinetree	135	Barren Ridge	Existing
Pinetree	10	Barren Ridge	Existing
Beacon	250	Barren Ridge	Existing
Springbok	350	Barren Ridge	Existing
Recurrent	60	Barren Ridge	Existing
Q25	150	Barren Ridge	Interconnection Queue
Q30	300	Barren Ridge	Interconnection Queue
Q42	150	Barren Ridge	Interconnection Queue
Q40	150	Barren Ridge	Interconnection Queue
Q47	200	Barren Ridge	Interconnection Queue
Total	1755		

The transmission capacity to deliver 2724 MW at the Victorville area includes Marketplace queue interconnections and Intermountain queue interconnections. Presently both queue interconnections are oversubscribed and in order to accommodate the total capacity of 2724 MW (See Table 3-14) the upgrade of the Victorville to LA Basin transmission system will be required.

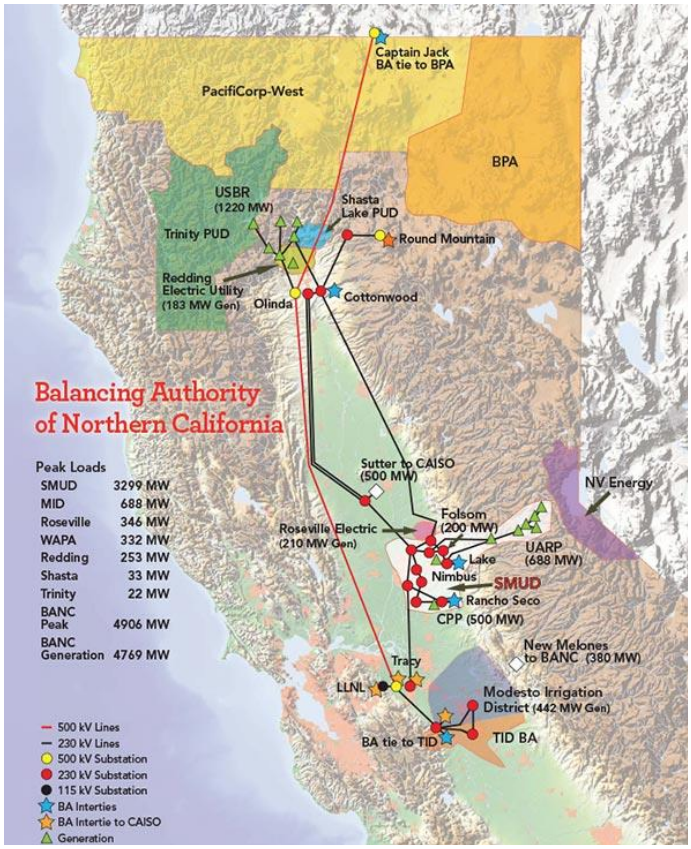
Table 3-14: Total Interconnection Requests in the Victorville and Intermountain Areas

Interconnection	MW	Location	Comments
Q06	350	Marketplace	Interconnection Queue
Q24	250	Marketplace	Interconnection Queue
Q37	100	Marketplace	Interconnection Queue
Q45	300	Marketplace	Interconnection Queue
Q44	300	Intermountain	Interconnection Queue
Q49	300	Intermountain	Interconnection Queue
Q50	400	Intermountain	Interconnection Queue
Q51	400	Intermountain	Interconnection Queue
Q52	324	Intermountain	Interconnection Queue
Total	2724		

3.4. BALANCING AUTHORITY OF NORTHERN CALIFORNIA

The Balancing Authority of Northern California (BANC) is a Joint Powers Authority (JPA) consisting of the Sacramento Municipal Utility District (SMUD), Modesto Irrigation District (MID), Roseville Electric, Redding Electric Utility, Trinity Public Utility District (TPUD) and the City of Shasta Lake as its founding Members. BANC assumed the Balancing Authority responsibilities on May 1, 2011 from SMUD that include the matching of generation to load and coordinating system operations with neighboring Balancing Authorities.

Figure 3-11: BANC Transmission System



BANC is the third largest Balancing Authority in California and the 16th largest Balancing Authority within the WECC area. The Central Valley Project (CVP) generation, owned by the Bureau of Reclamation and Western Area Power Administration's transmission facilities along with the 500 kV California Oregon Transmission Project (COTP), are included among other transmission facilities, generation resources and end-use loads within the BANC footprint. BANC Members contract for about 40% of the CVP hydroelectric resource. The COTP is jointly owned by several parties including WAPA and BANC Members via the Transmission Agency of Northern California (TANC).

BANC is the Balancing Authority but not the Planning Authority for its members. BANC members perform their own planning functions. Below is a discussion of the BANC members' transmission plans and transmission capabilities.

3.4.1. SACRAMENTO MUNICIPAL UTILITY DISTRICT

Colusa Sutter 500 kV Transmission Line Proposal

Sacramento Municipal Utility District (SMUD) and the Western Area Power Administration – Sierra Nevada Region (Western) propose to construct a 500 kV transmission project interconnecting the California Oregon Intertie Project (COTP) near the existing Maxwell 500 kV series capacitor station to a new 500/230 kV substation near the existing O'Banion 230 kV station. The project name is Colusa Sutter Transmission Line or CoSu.

SMUD and Western are not seeking a formal Western Electricity Coordinating Council (WECC) Path Rating using the WECC Path Rating Process. However, due to the proximity of the project proposal to the existing WECC Path 66, all technical studies were performed with the California Oregon Intertie (COI) at its rating of 4800 MW to ensure there are no adverse impacts to the existing COI rating.

A primary objective for this new transmission project is to provide SMUD full transmission access to its current rights on the COTP, which it currently cannot fully utilize. To address this need, SMUD requested additional capacity on Western's transmission system between the COTP and the SMUD system. Western did not have sufficient available transmission capacity to meet the request and the SMUD and Western agreed to initiate discussions to evaluate a jointly developed project that could accomplish the objective.

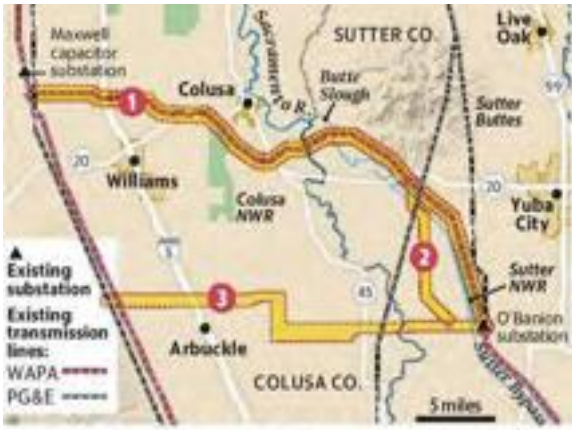
SMUD and Western have formed a project coordination review group within WECC that is currently studying the CoSu project's impacts, if any, to neighboring transmission systems and existing WECC rated paths.

It is important to note that the SMUD Board of Directors has only approved an agreement that allows initiation of an environmental review and to begin regional transmission review activities. Hence, no final decision has been made regarding the project.

Benefits

- Increased Access to Pacific Northwest Clean Power
- Direct COTP Interconnection
- Supports GHG Reduction from SMUD Thermal Generators
- Preserves Reliability at high load Levels
- Increases import limits

Figure 3-12: Colusa - Sutter



New transmission lines study areas

Proposals for possible routes for transmission lines for SMUD and the Western Area Power Administration in Colusa and Sutter counties:

1. Would closely follow route of existing WAPA line
2. Travels much the same route as the first proposal but would bypass the Sutter National Wildlife Refuge
3. Avoids both wildlife refuges

3.4.2. TRANSMISSION AGENCY OF NORTHERN CALIFORNIA

The Transmission Agency of Northern California (TANC) is the largest owner of and project manager for the California-Oregon Transmission Project (COTP) which includes approximately 350 miles of 500 kV line extending from the California-Oregon Border to the Tracy area and two 500/230 kV substations (one in the Cottonwood area and the other in the Tracy area). The COTP is operated in parallel with the two Pacific AC Intertie 500 kV lines and these three lines comprise the California-Oregon Interties (COI). The rated transfer capability of the COI facilities is 4,800 MW in the north-to-south direction and 1/3 of this capacity is allocated to the COTP. The COTP is used to transmit power between the Pacific Northwest and California.

In the recent past TANC worked with other parties to identify potential transmission facilities that would allow for significant amounts of renewable generation located in Northern California, Northern Nevada, and the Pacific Northwest to be delivered to load centers in California while maintaining the existing capability of the COI facilities. This effort included optimizing the use of existing transmission lines and corridors and TANC strongly believes that such should be done as part of the RETI 2.0 process. TANC is also of the opinion that the RETI 2.0 process should include maintaining the existing transfer levels of the COI facilities (including the COTP) such that they can continue to be used to import resources (largely hydro and renewables) from the Pacific Northwest.

While TANC does have a generation interconnection process in place, there are no generation projects in the TANC interconnection queue at the present time. However, TANC is of the opinion that "energy only" renewable generation located in the Sacramento Valley area could be interconnected with the COTP.

3.4.3. WESTERN AREA POWER ADMINISTRATION – SIERRA NEVADA DISTRICT

The following table provides a summary of on-going and completed projects in the Western Area Power Administration – Sierra Nevada District (Western SNR) power flow study area.

Table 3-13: Summary of Western SNR's On-going and Completed Projects

Project	Planning Entity	Brief Description	Status
SLTP	Western	San Luis Transmission Project links Tracy 230 kV to San Luis 230 kV. The project will enable federal hydro-power facilities at San Luis, O'Neil and Dos Amigos to be integrated with the rest of the CVP facilities. SLTP will also enable future renewable generation at these sites to be interconnected with Western systems. The expected in service date is 1/2022. Another possible alternative is for a partnership project to build the SLTP at 500 kV from Tracy Substation to a new 500 kV yard to be connected south of Los Banos to the Los Banos/Gates 500 kV line.	System Impact Study completed. Environmental and facility studies are underway. Environmental Impact Statement will be issued in Spring of 2016.
San Luis Solar Project South	Western	A 16.5 MW solar generation project is to be connected to O'Neil 70 kV substation through a gen-tie. The expected in service date is 12/2016.	System Impact Study completed.
San Luis Solar Project North	Western	A 10 MW solar generation is to be connected to O'Neil 70 kV substation through a gen-tie. The expected in service date is 12/2016.	System Impact Study completed.
Lassen Wind Project	Western	100 MW wind generation, located in Lassen County, approximately 10 miles northwest of Eagle Lake, proposed to connect to Western's Round Mountain-Cottonwood 230 kV line, through a gen-tie. The expected in service date is 6/2022.	Project in LGI queue. Feasibility Study to be started soon.
Elverta Line Swap	Western	Swapping the Roseville–Elverta 230 kV line with the O'Banion–Elverta #2 230 kV line at Elverta substation. With all lines in-service, the project will mitigate overload on Elverta–Hurley 230 kV, due to Elverta 230 kV Breaker 1182 internal fault or failure. Mitigates most overloads under clearance conditions, on both the Western and SMUD systems.	Scheduled to be completed by Fall of 2016.
Cottonwood-Olinda Line Reconductor		The scope of this project is to reconductor the Cottonwood-Olinda 230 kV line with larger capacity conductors.	Scheduled to be completed by Fall of 2016.

3.5. TURLOCK IRRIGATION DISTRICT

The Turlock Irrigation District (TID) transmission system is interconnected with:

- the Pacific Gas & Electric Company and the California Independent System Operator (California ISO) at the Westley Tap near the Westley Switchyard
- the City and County of San Francisco (CCSF) and the California ISO at the Oakdale Tap of CCSF's Moccasin-Newark #3 and #4 115 kV lines
- the Western Area Power Administration, the Sacramento Municipal Utility District, and the California-Oregon Transmission Project at Tracy Substation.

Transmission service using TID's share of the California-Oregon Transmission Project is also available through the Transmission Agency of Northern California.

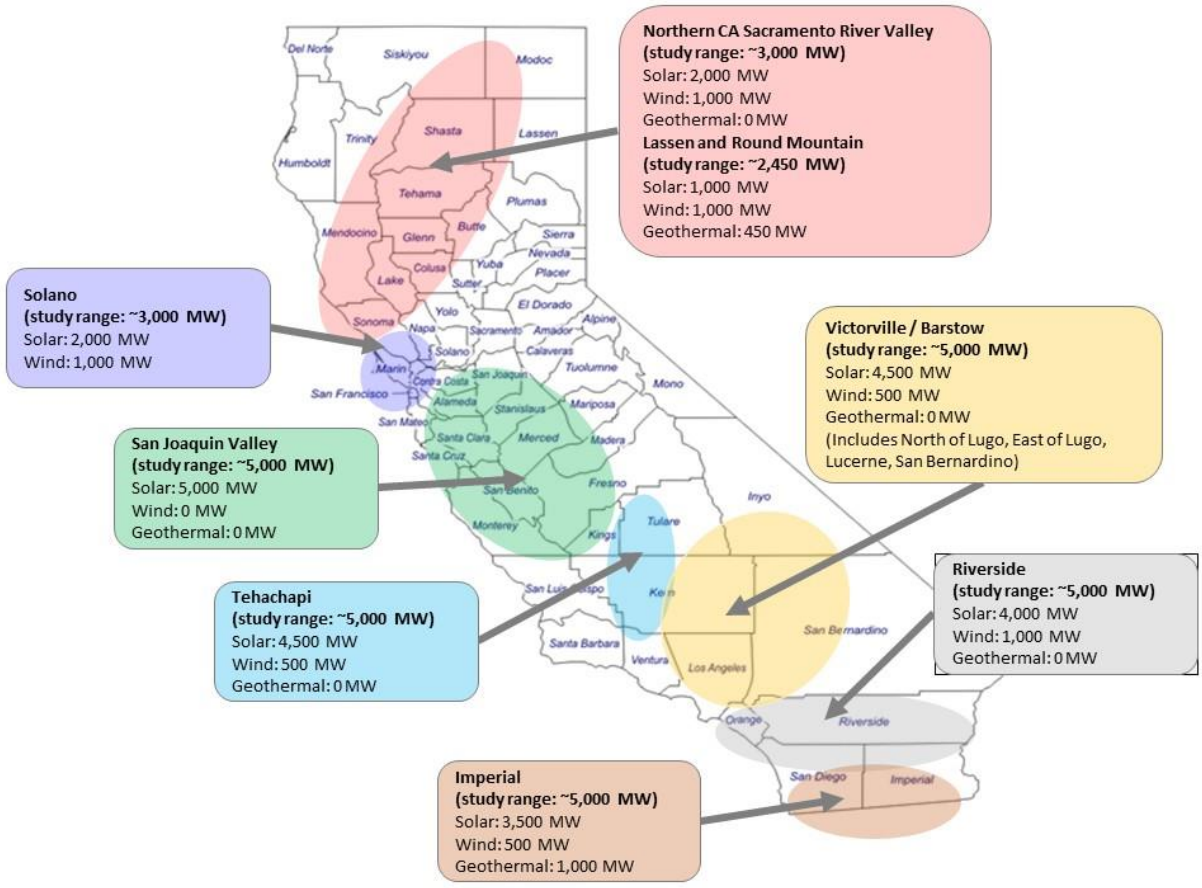
TID does not currently have any Available Transfer Capability (ATC) Paths and therefore does not calculate ATC.

4. TRANSMISSION IMPLICATIONS FOR CALIFORNIA OF ADDITIONAL RENEWABLE RESOURCES

4.1. DESCRIPTION OF TAFAS

As discussed in Section 2, the Plenary Group identified TAFAs where significant quantities of renewables could be developed to meet the 2030 renewable development goals. The TAFAs identify a "hypothetical" development potential for wind, solar and, where applicable, geothermal resources. In addition to California resources, the Plenary Group also identified hypothetical import/export capacities for California interties. Figure 4-1 depicts the renewable resource quantities by TAFA.

Figure 4-1 - TAFA Potential Resource Quantities



4.2. TRANSMISSION CAPACITY ESTIMATES

Each TAFA was assessed to determine the transmission requirements to deliver the proposed capacity to the grid. The process considered the target capacity and the existing transmission. Estimates for new transmission requirements and cost are based primarily on previous studies completed by transmission operators to increase capacity in the TAFA area. Additional information was provided by TTIG members

where information was available. Below is a discussion of the transmission and new conceptual transmission requirements for each TAFA.

Noted above, to develop estimates of transmission capacity to support FCDS and EO resources within the California ISO footprint, the California ISO used information from studies in several of its annual transmission planning processes (TPP) and the annual Generator Interconnection and Deliverability Allocation Procedures (GIDAP) process. Additionally, the California ISO conducted a special transmission study in its 2015-2016 TPP to assess the potential transmission capacity necessary for achieving 50% renewables.

In preparing for the anticipated wave of new renewable development to achieve the 50% RPS, the California ISO conducted special studies within the 2015-2016 TPP to assess potential transmission additions to meet the RPS. As part of this effort, a preliminary study of the capability of the California ISO grid was performed to evaluate the impact of additional renewable generation resources interconnection on an EO basis. The results of that study are included in the California ISO estimates of transmission capacity discussed below.

TTIG has developed estimates of transmission capacity for TAFAs. These estimates are based on earlier analyses, and if an area has not been recently analyzed to assess its transmission availability, no estimates are available. Additionally, there are areas within California that have renewable energy potential that are not located in the TAFAs. TTIG has not conducted an assessment to determine the transmission potential from these areas. This should not be interpreted to mean that transmission capacity is not available; rather it should be considered as unknown.

We note the capacity estimates for FCDS ('firm") and energy-only interconnections are not additive. The estimates for FCDS and EO were independently developed, and the addition of any new resource(s) on the system will limit the capability to add additional resources. It is anticipated in the future that many of the new resources will interconnect as energy-only resources, so the total transfer capability for any given TAFA will likely be somewhere between the FCDS and energy-only estimates provided here.

4.3. SHARED REGIONAL TRANSMISSION CONTRAINTS

Most of the TAFAs will require additional transmission in order to interconnect the target quantity of resources and deliver the energy to California consumers. In addition to these TAFA-specific constraints, there are overarching transmission constraints in Northern and Southern California limiting the delivery of energy from multiple TAFAs, as well as energy imports over the interties into these regions.

4.3.1. NORTHERN CALIFORNIA

The EHV system in northern California includes three 500-kV lines (the California-Oregon Interties or COI) which extend from the California-Oregon Border to the Tesla and Tracy Substations south of Sacramento. These lines (which have a WECC approved path rating of 4,800 MW) are operated in parallel with a number of 230-kV lines with which a number of hydroelectric facilities (with an installed capacity of approximately 4,200 MW) are interconnected. Operating and planning studies (including those done by the Operating Studies Subcommittee (OSS) and the California ISO during 2015 and 2016) have indicated that it is not possible to simultaneously deliver 4,800 MW over the COI facilities and the 4,200 MW of hydroelectric capacity to load centers in northern California. For example, the 2016 summer operating studies indicate:

- If COI imports are at 4,800 MW, the amounts of hydro capacity that could be delivered would be limited to about 2,900 MW (70% of the installed capacity), and

- If the hydro generation is above 3,800 MW (90% of the installed capacity) the COI imports would have to be limited to about 4,000 MW.

Based on the above information it is clear that the interconnection of new firm deliverability resources in northern California would require upgrades to the transmission to avoid having to curtail hydroelectric resources in Northern California and/or renewable or hydro resources in the Pacific Northwest. It is possible that energy only resources could be interconnected to the grid in Northern California. However, such new resources would likely have to be curtailed to mitigate post-contingency overloads and, therefore, the aggregate capacity of such would have to be limited to be compatible with the CAISO's planning standards.

4.3.2. SOUTHERN CALIFORNIA

There is an overarching transmission constraint in Southern California limiting the delivery of energy from multiple TAFAs in southeast California, as well as energy imports from the southwestern U.S. This transmission constraint on Lugo – Victorville 500 kV line , impacts the Victorville, Riverside East, and Imperial TAFA's, as well as energy imports from the desert southwest. Prior studies have indicated that additional resource development in the aforementioned areas could result in an overload on Lugo-Victorville 500 kV line under the single element outage of the Eldorado-Lugo 500 kV line and the double element outage of the Eldorado-Lugo and Lugo-Mohave 500 kV lines. This constraint is also referred to as the Desert Area Constraint in California ISO's transmission studies. These studies have indicated that an upgrade of the Lugo-Victorville 500 kV line would mitigate this constraint and provide approximately 2,000 MW of additional capacity. LADWP, SCE, and CAISO are currently coordinating on this upgrade and the cost is approximately $34 million.

4.4. INDIVIDUAL TAFA TRANSMISSION EVALUATION

The following is an evaluation of the transmission requirements and costs for each TAFA to support the target level of development identified by the Plenary Group.

4.4.1. NORTHERN CA (LASSEN, ROUND MOUNTAIN AND SACRAMENTO RIVER VALLEY)

The high voltage transmission system in northern California includes three 500-kV lines (the California-Oregon Interties or COI) which extend from the California-Oregon Border to the Tesla and Tracy Substations south of Sacramento. These lines (which have a WECC approved path rating of 4,800 MW) are operated in parallel with a number of 230-kV lines with which a number of hydroelectric facilities (with an installed capacity of approximately 4,200 MW) are interconnected. Operating and planning studies (including those done by the Operating Studies Subcommittee (OSS) and the California ISO during 2015 and 2016) have indicated that it is not currently possible to simultaneously deliver 4,800 MW over the COI facilities and the 4,200 MW of hydroelectric capacity to load centers in northern California. For example, the 2016 summer operating studies indicate:

- If COI imports are at 4,800 MW, the amounts of hydro capacity that could be delivered would be limited to about 2,900 MW (70% of the installed capacity), and
- If the hydro generation is above 3,800 MW (90% of the installed capacity) the COI imports would have to be limited to about 4,000 MW.

Figure 4-2 - Northern California Area

Based on the above information it is clear that the interconnection of new firm deliverability resources in northern California would require upgrades to the transmission to avoid having to curtail hydroelectric resources in Northern California and/or renewable or hydro resources in the Pacific Northwest. It is possible that energy only resources could be interconnected to the grid in Northern California. However, such new resources would likely have to be curtailed to mitigate post-contingency overloads and, therefore, the aggregate capacity of such would have to be limited to be compatible with the CAISO's planning standards.

Table 4-1 - Northern California TAFA Information

Transmission System Operator	CAISO, SMUD, TANC	
Hypothetical Study Rang (MW)	**2,000 – 4,500**	
Solar	1,000 -2,000	
Wind	500 - 1,000	
Geothermal	450	
Available Transmission	**FCDS**: Unknown	
	EO – Sacramento River: 2,100	
	EO – Lassen Rnd. Mt.: 1,250	
Interconnection Queue Information (MW)	No active interconnection requests	
Primary Data Sources	• California ISO generation interconnection studies • California ISO Transmission Plan (including 50% RPS special studies) • TANC transmission planning studies	
Transmission Limiting Constraints	Existing grid cannot currently deliver all COIO import potential and existing Northern California generation simultaneously. Additional capacity is required to transmit any incremental firm renewable capacity.	
Relevant Transmission Upgrades Assumed to be in Place While Evaluating TAFA		
NA	No transmission facilities are anticipated in the area at this time	
Conceptual Mitigation Examples and Costs (in order to make the TAFA deliverable)		
New 500 kV line	Expected to require upgrades such as a new 500 kV line between CA/OR border and Tracy/Tesla area.	Estimated cost is $ 2-4 billion

4.4.2. SOLANO

The Solano TAFA is located between the San Francisco Bay area and Sacramento.

The electric transmission infrastructure in this area is composed of interconnected 500 kV, 230 kV, 115 kV, and 60 kV facilities and is an integral part of the bulk electric system that facilitates power transfers throughout the ISO-controlled grid. The transmission infrastructure also helps meet electric demand in major load centers in Northern California including the Greater Bay Area and Sacramento.

This area currently does not have any active interconnection requests on the CAISO Queue. The transmission grid will require upgrades to accommodate the RETI 2.0 hypothetical generation.

Figure 4-3 - Solano Area

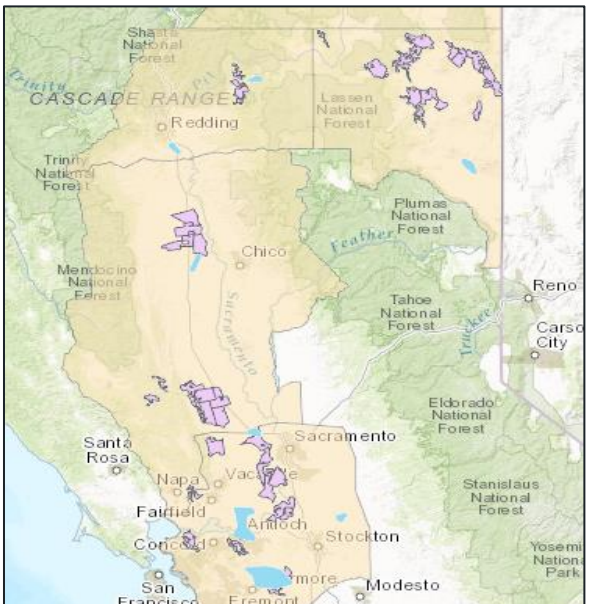
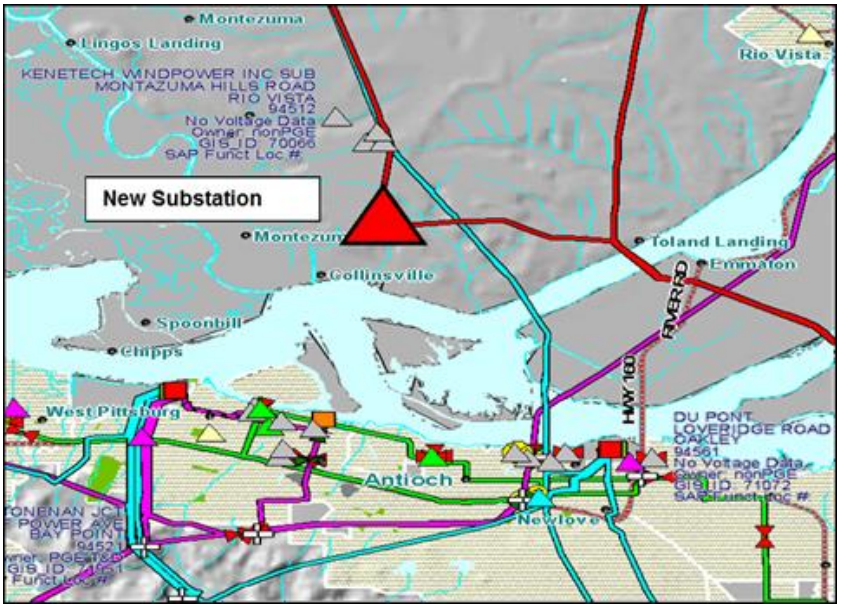


Table 4-2 - Solano TAFA Information

Transmission System Operator	CAISO
Hypothetical Study Range (MW)	**3,000**
Solar	2,000
Wind	1,000
Available Transmission	**FCDS:** Unknown
	EO: 880
Interconnection Queue (MW)	No active requests in CAIS Interconnection Queue
Primary Data Sources	• California ISO generation interconnection studies • California ISO Transmission Plan (including 50% RPS special studies)CAISO TPP • PG&E Transmission Planning Studies
Transmission Limiting Constraints	Inability for new facilities to interconnect to existing grid. In addition, depending on location and concentration, the projected amount of generation could create issues on the existing sub-transmission system

	(60 and 115 kV) which has limited capacity.	
Relevant Transmission Upgrades Assumed to be in Place While Evaluating TAFA		
NA	No transmission facilities are anticipated in the area at this time	
Constraints, Conceptual Mitigation Examples and Costs (in order to make the TAFA deliverable)		
Existing Capacity	Smaller facilities may be able to interconnect to existing transmission network with minor upgrades	$ nil
500 kV bulk power substation	A new substation would be connected both to the 500 kV bulk system as well as the 230 kV Greater Bay Area transmission system. The project would involve building a 500 kV bulk power substation in southern Solano County (location TBD). The proposed substation would be looped off the existing Vaca Dixon-Tesla 500 kV line via a 500 kV double circuit tower line. The substation would have 500 kV and 230 kV line terminations and one 500/230 kV transformer bank. This conceptual plan would install two new 230 KV transmission line connections between the substation and the existing Pittsburg Substation, these are likely to be submarine cables (length TBD).	Cost to be determined

Figure 4-4 - Potential new Solano area substation design



4.4.3. SAN JOAQUIN VALLEY

There is currently a Substantial amount of solar development in the San Joaquin Valley, including projects currently under development and proposed resources. The transmission grid in the area system is being upgraded to accommodate current proposed generation, and will require additional upgrades to accommodate the RETI 2.0 hypothetical generation.

Figure 4-5 - San Joaquin Valley Area

Table 4-3 - San Joaquin Valley TAFA Information

Transmission System Operator	CAISO
Hypothetical Study Range (MW)	**5,000**
Solar	5,000
Wind	0
Available Transmission	**FCDS:** 1,823
	EO: 3,131
Interconnection Queue (MW)	4,000
Primary Data Sources	• California ISO generation interconnection studies (QC5 and QC8) • California ISO Transmission Plan (including 50% RPS special studies) • PG&E Transmission Planning Studies • San Joaquin Valley Solar Initiative

Transmission Limiting Constraints	While there are smaller pockets of potential development areas, the largest concentrated area is located in the west central area of the San Joaquin Valley bordering adjacent to the 500 kV lines between the Gates and Los Banos substations. Generally, adding 5000 MW into the San Joaquin Valley could create issues on the existing sub-transmission system (70 and 115 kV) which has limited capacity and may require extensive upgrades to accommodate generation at those voltage levels. As the generation then flows onto the bulk electric system (230 and 500 kV) this amount of generation could also result on capacity constraints on the transmission path from Los Banos – Panoche – Gates – Arco – Midway.	
Relevant Transmission Upgrades Assumed to be in Place While Evaluating TAFA		
	PG&E is currently working on several upgrades in the area. This includes: • Warnerville-Wilson series reactor • Gates 500/230 kV transformer #2 • Kearney-Herndon 230 kV reconductor Please see Table 30-3 for complete description of these upgrades	
Constraints, Conceptual Mitigation Examples and Costs (in order to make the TAFA deliverable)		
Fresno area constraints	Several upgrades between Gates and Los Banos and Gates and Midway will be required to mitigate 230 kV, 115 kV and 70 kV constraints. Major upgrades could potentially include a third 500/230 kV transformer at Gates along with multiple 230 kV transmission line section reconductoring between Los Banos and Panoche, Borden and Gregg, Gates and Arco, and, Gates and Midway. In addition, depending on concentration and location, reconductoring local 70 and 115 kV lines and various substation upgrades will be required. Alternatively, a new 500 kV transmission station can be considered to transfer the generation on to the 500 kV system.	~$400 to $500 million TBD

4.4.4. TEHACHAPI

The TTIG does not expect an area-wide constraint to trigger a major transmission upgrade in Tehachapi by adding ~5,000 MW to the existing planned system. But this level of additional generation may result in increased renewable curtailment especially during maintenance outage conditions. A significant increase in generation in this area could cause stability issues and trigger expensive 500 kV upgrades in the South of Vincent area.

Figure 4-6 - Tehachapi Area

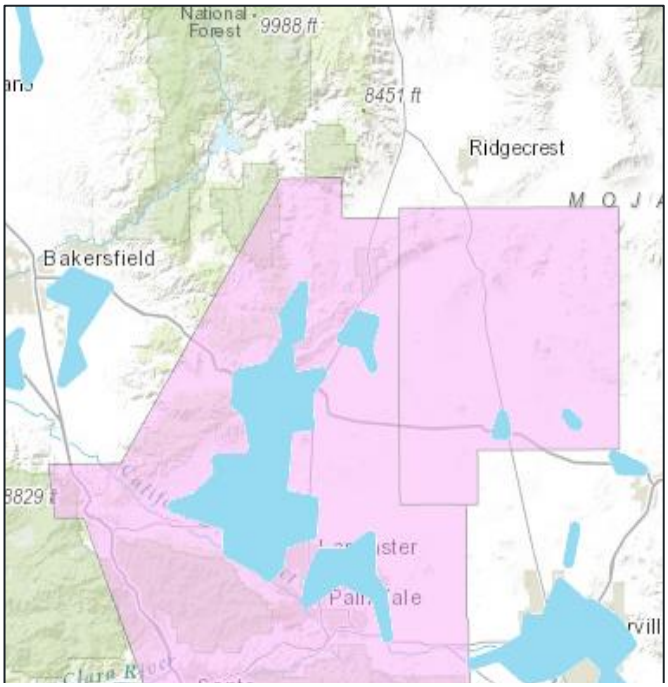


Table 4-4 - Tehachapi TAFA Information

Transmission System Operator	CAISO
Hypothetical Study Range (MW)	**5,000**
Solar	4,500
Wind	5,00
Available Transmission	**FCDS:** 4,500
	EO: 5,600
Interconnection Queue (MW)	4,732
Primary Data Sources	• California ISO generation interconnection studies • California ISO Transmission Plan (including 50% RPS special studies)
Transmission Limiting Constraints	None identified

Transmission Upgrades Assumed to be in Place While Evaluating TAFA	
Tehachapi Renewable Transmission Project (TRTP)	The remaining TRTP construction involves the underground work in Chino Hills and is necessary to enable in-servicing of the Mira Loma-Vincent 500 kV transmission line. This work is currently estimated to be completed in the fourth quarter of 2016, with an approximate cost of $2.5 billion.
Whirlwind 3rd AA Bank and SPS	Generation projects seeking interconnection to the Whirlwind Substation triggered the need for a third AA 500/230 kV transformer bank at Whirlwind Substation. This will also require the need to modify the existing Special Protection System to trip generation under an N-1 of one transformer bank.
Conceptual Mitigation Examples and Costs (in order to make the TAFA deliverable)	
	None required

4.4.5. VICTORVILLE / BARSTOW

The TTIG does expect the area-wide and local constraints to trigger major transmission upgrades in the Victorville/Barstow area by adding ~5,000 MW to the existing planned system from a FCDS perspective. The 2015-2016 transmission plan included a 50% RPS special study to look at the impact of adding Energy-Only resources to get from 33% RPS to 50% RPS. This study did not identify any area-wide constraint that would prohibit a large amount of generation (~5,000) MW from being interconnected in the Victorville/Barstow area from an Energy-Only perspective. The study highlighted the possibility of more than 1,000 MW of renewable curtailment under maintenance outage condition.

Figure 4-7 - Victorville/Barstow Area

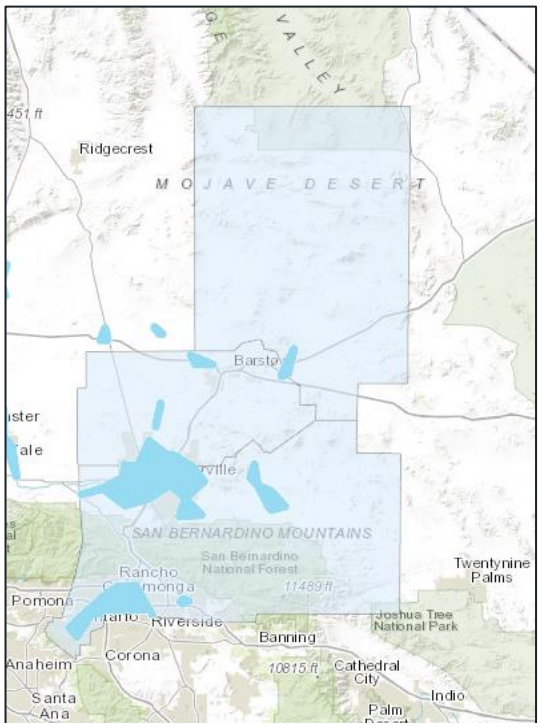


Table 4-5 - Victorville/Barstow TAFA Information

Transmission System Operator	CAISO, LADWP
Hypothetical Study Range (MW)	**5,000**
Solar	4,500
Wind	500
Available Transmission	**FCDS :** 1,000 MW (North of Lugo) 470 MW (North of Kramer) 400 MW (Calcite-Lugo area) 1755 MW (LADWP Barren Ridge area – already oversubscribed)
	EO: 2,735 MW (East of Pisgah) 470 MW (North of Kramer)

Interconnection Queue (MW)	5,917 (through CAISO Cluster 8)	
Primary Data Sources	• California ISO generation interconnection studies • California ISO Transmission Plan (including 50% RPS special studies) • LADWP's transmission planning studies • LADWP's generation interconnection studies	
Transmission Limiting Constraints	If 1,500 MW of the proposed generation level of 5,000 MW develops in the SCE service territory, the TTIG expects three different constraints in SCE's North of Lugo transmission area. 1. The first constraint is the south of Kramer 220 kV lines constraint, 2. The second constraint is the Calcite-Lugo 220 kV line constraint, and 3. The third constraint would be on the existing two Lugo No.1AA and No.2AA 500/220 kV transformer banks. Previous studies have indicated a new Lugo No. 3AA 500/220 kV transformer bank and a new Coolwater-Lugo 220 kV line or Kramer-Llano 500 kV line would be necessary to mitigate these constraints. If additional MW develop in the East of Lugo transmission area, the TTIG anticipates the Lugo-Victorville overload for the single outage of the Eldorado-Lugo 500 kV line and the double outage of the Eldorado-Lugo and Lugo-Mohave 500 kV lines to be a constraint.	
Relevant Transmission Upgrades Assumed to be in Place While Evaluating TAFA		
Calcite Substation	As part of previous Cluster generation studies, generators interconnecting in the Lucerne Valley area have required a new Calcite 220 kV Substation in order to loop the existing Lugo-Pisgah No.1 220 kV line. The current estimated in-service date of this project is 2020.	~ $50 million
Victor Loop-In	Loop the existing Kramer-Lugo No.1 and No.2 220 kV lines into Victor Substation. The current estimated in-service date is 2016.	~ $16 million
Eldorado-Lugo Series Capacitor Project	This project involves the upgrade of the existing 500 kV Series Capacitors at Eldorado and Lugo on the Eldorado-Lugo 500 kV T/L to 3,300A continuous rating, as well as a new Series Capacitor rated 3,300A in the vicinity of Pisgah Substation. The current estimated in-service date of this project is 2019.	~ $135 million
Lugo-Mohave Series Capacitor Project	This project involves the upgrade of the existing 500 kV Line Series Capacitors at Mohave on the Lugo-Mohave 500 kV T/L's to 3,300A Continuous Rating, as well as a new Series Capacitor rated 3,300A in the vicinity of Pisgah Substation. The current estimated in-service date of this project is 2019.	~ $164 million

Eldorado Line Swap	This project involves swapping the line positions of the Eldorado-Mohave and Eldorado-Moenkopi 500 kV lines to reduce the risk of thermal overloads caused by the loss of the Eldorado-Lugo and Eldorado-Mohave 500 kV transmission lines. The current estimated in-service date of this project is 2017.	~ $18 million
Barren Ridge Renewable Transmission Project	This project includes the addition of two 230 kV lines, reconductoring of the existing line from Barren Ridge to Haskell Canyon, the addition of a new 230 kV substation at Haskell Canyon, construction of a new line to the Castaic Pumped Storage Power Plant, and a reconductored 230 kV line to Rinaldi Substation.	~$325 million
Constraints, Conceptual Mitigation Examples and Costs (in order to make the TAFA deliverable)		
Kramer-Victor No.1 and No.2 220 kV lines	Generation development in the North of Kramer area could create base case overloads on the Kramer-Victor No.1 & No.2 220 kV lines. Previous studies have triggered a new Coolwater-Lugo 220 kV line or a Kramer-Llano 500 kV line to address this constraint. A Coolwater-Lugo 220 kV line would consist of a new 34 mile 220 kV line from the existing Coolwater 220 kV Substation, south to the Lugo-Pisgah corridor, and 28 miles of tear down and rebuild from Calcite Substation west to Lugo Substation. Alternatively, a Kramer-Llano 500 kV line would require new 500 kV facilities at Kramer Substation, a new 40 mile 500 kV line heading south from Kramer Substation, which would loop into the existing Lugo-Vincent No.2 500 kV line near the community of Llano.	~ $480 million
Calcite-Lugo 220 kV line	Generation development at Calcite Substation could create base case overloads on the Calcite-Lugo 220 kV line. Previous studies have indicated the required mitigation is a tear down and rebuild of the Calcite-Lugo 220 kV line.	$260 million
Lugo-Victorville 500 kV line	The Lugo-Victorville 500 kV line overload constraint is triggered by the single outage of the Eldorado-Lugo 500 kV line or the simultaneous outage of the Eldorado-Lugo and Lugo-Mohave 500 kV lines. Generators in East of Lugo area contribute to this constraint. Previous studies have indicated an upgrade of the Lugo-Victorville 500 kV line would mitigate this constraint and provide approximately 2,000 MW of additional capacity. LADWP and CAISO are currently coordinating on this upgrade.	~ $34 million
Lugo No.1AA and No.2AA 500/220 kV transformers	Generation development in the north of Kramer area, at Calcite Substation, or in the East of Lugo area could create base case overloads on the existing Lugo No.1AA & No.2AA 500/220 kV transformer banks. Previous studies have indicated the required mitigation is a new Lugo No.3AA 500/220 kV	~ $150 million

	transformer bank.	

4.4.6. RIVERSIDE EAST

The TTIG expects area-wide and local constraints to trigger major transmission upgrades in Riverside East by adding ~5,000 MW to the existing planned system. This level of additional generation may also result in increased renewable curtailment especially during maintenance outage conditions.

Figure 4-8 - Riverside East Area

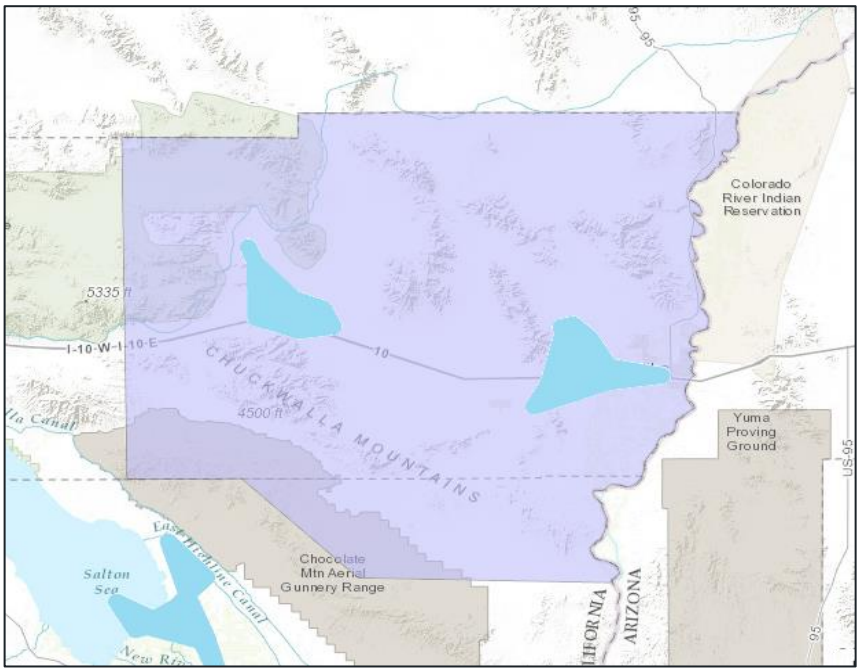


Table 4-6 - Riverside East TAFA Information

Transmission System Operator	CAISO, LADWP
Hypothetical Study Range (MW)	**2,500 – 5,000**
Solar	2,000-4,000
Wind	500-1,000
Available Transmission	**FCDS:** 5,500 - 8,500 MW (East of Pisgah, Riverside, Imperial)
	EO: 4,754 MW (Riverside only)
Interconnection Queue (MW)	6,052 (through CAISO Cluster 8)
Primary Data Sources	• California ISO generation interconnection studies • California ISO Transmission Plan (including 50% RPS special studies)

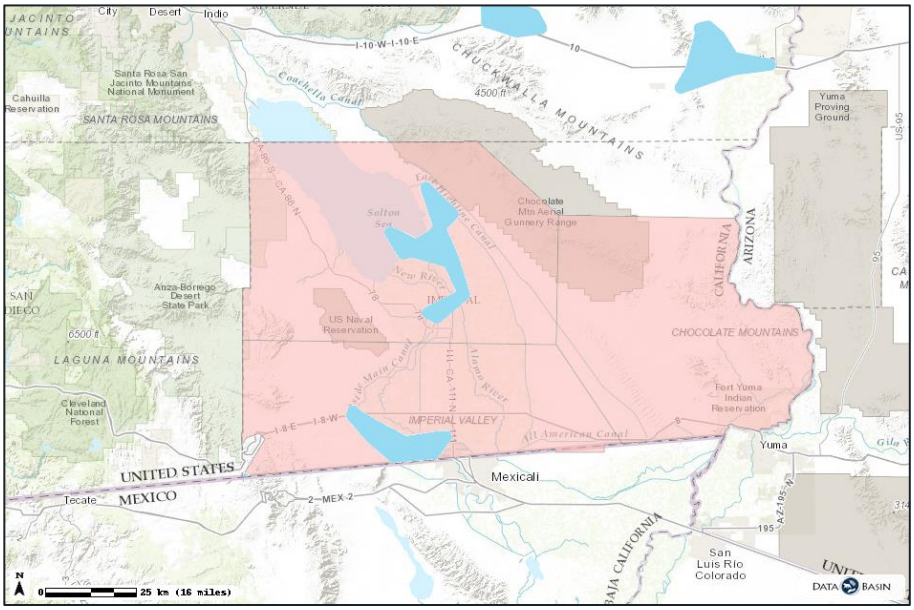
Transmission Limiting Constraints	At the proposed incremental generation level of 500 – 1,000, the TTIG expects that the Lugo-Victorville 500 kV line, also known as the desert area constraint, would be the deliverability limitation. Coordination between the CAISO and LADWP is currently underway to upgrade this line, which would provide additional capacity of ~2,000 MW. An incremental generation level of 2,000 – 4,000 would then trigger additional constraints, which would likely be base case thermal overloads on the Alberhill-Valley and Alberhill-Serrano 500 kV lines and single contingency overloads on the Devers - Valley No.1 or No.2 and the Devers-Red Bluff No.1 or No. 2 500 kV lines. Projects developing in the Riverside East area would also be included in a special protection system (SPS) to curtail them under certain outage conditions to avoid overloading the remaining facilities.	
Relevant Transmission Upgrades Assumed to be in Place While Evaluating TAFA		
West of Devers (WOD)	To accommodate generation development in the Riverside East area, the following 220 kV upgrades were identified, which involve remove and replace all existing infrastructure with new double circuit structures in order to support double bundled 1590 KCMIL ACSR conductors on the following lines: • Devers – El Casco 220 kV T/L • El Casco – San Bernardino 220 kV T/L • Devers – San Bernardino 220 kV T/L • Devers – Vista No.1 220 kV T/L • Devers – Vista No.2 220 kV T/L In addition, substation terminal equipment will need to be upgraded to 4,000A to maximize utilization of the double bundled 1590 KCMIL ACSR conductors. . The current estimated in-service date of this project is August 1, 2021.	~ $1 billion
Special Protection Schemes	As part of the Transition Cluster, generation projects located in the Eastern Area triggered the need for a new Colorado River Corridor SPS. This SPS involves tripping up to 1,400 MW of the new generation projects under double outage or 1,150 MW under single outage conditions. Specifically, the new SPS is envisioned to monitor line status for various outage conditions among the following lines: • Red Bluff – Devers 500 kV T/L No.1 • Red Bluff – Devers 500 kV T/L No.2 • Colorado River – Red Bluff 500 kV T/L No.1 • Colorado River – Red Bluff 500 kV T/L No.2 • Colorado River transformer banks (T-1) • Red Bluff transformer banks (T-1) If outage of the monitored element occurs, generation projects interconnected at Colorado River and/or Red Bluff Substation will be tripped to prevent overloads as well as system instability. This SPS is currently in service and projects requesting interconnection in the	NA

	Riverside East area become participants in this SPS. Cost for addition into this SPS varies by project location, size, and configuration.	
Colorado River and Red Bluff substations Expansions	Cluster generation studies have identified the need to expand the transformation capacity at both Colorado River and Red Bluff substations to accommodate additional generations.	NA
Eldorado-Lugo Series Capacitor Project	This project consists of upgrading the series capacitor banks located at Eldorado and Lugo Substations on the Eldorado-Lugo 500 kV line to a rating of 3,300 A (normal) and 3,960 A (emergency). The project also includes equipping the terminating positions at Eldorado and Lugo Substations with 4,000 A rated equipment. The current estimated in-service date of this project is 2019.	~ $135 million
Lugo-Mohave Series Capacitor Project	This project consists of upgrading the series capacitor banks located at Lugo and Mohave Lugo-Mohave Series Capacitor Project Substations on the Lugo-Mohave 500 kV line to a rating of 3,300 A (normal) and 3,960 A (emergency). The project also includes equipping the terminating positions at Lugo and Mohave Substations with 4,000 A rated equipment. The current estimated in-service date of this project is 2019.	~ $164 million
Eldorado Line Swap	The project consists of reconfiguring the Eldorado-Moenkopi and Eldorado-Mohave 500 kV lines to eliminate the adjacent circuit transmission corridor contingency of the Eldorado-Lugo and Eldorado-Mohave 500 kV lines per WECC regional criteria which creates an overload problem. The current estimated in-service date of this project is 2017.	~$18 million
Mesa Loop-in Project	Mesa loop-in reduces flows west of Serrano and is needed to support deliverability in Riverside East	~ $550 million to $700 million
Conceptual Mitigation Examples, Constraints and Costs (in order to make the TAFA deliverable)		
Lugo – Victorville 500 kV line upgrade	The Lugo-Victorville 500 kV line overload constraint is triggered by the single outage of the Eldorado-Lugo 500 kV line or the simultaneous outage of the Eldorado-Lugo and Lugo-Mohave 500 kV lines. Generators in Riverside East area contribute to this constraint. Mitigation to upgrade the line is currently underway between LADWP and CAISO, which will provide additional capacity of 3204 MW continuous rating and 3877 MW emergency rating.	~ $34 million
A new Red Bluff – Mira Loma 500 kV line or a new Eldorado – Lugo 500 kV line	Generation development in the Riverside East area could create base case thermal overloads on the 500 kV lines between Valley, Alberhill, and Serrano Substation (Alberhill-Valley 500 kV line and Alberhill-Serrano 500 kV lines overload under base case conditions). Cluster studies have determined that the likely mitigation is either (i) a new series compensated Mira Loma-Red Bluff 500 kV line and reactive support at the Colorado River, Red Bluff, and Serrano Substations or (ii) a new Eldorado – Lugo 500 kV line.	> $1 billion

4.4.7. IMPERIAL VALLEY

The Imperial Valley TAFA includes potential generation located in Imperial, southern Riverside and northern San Diego counties. The TAFA includes transmission operated by both the CAISO and the Imperial Valley Irrigation District. Within the IID-controlled area, it is further divided into "Imperial North" and "Imperial South" to reflect the transmission constraints between the two areas. Following are discussions of the CAISO transmission in the TAFA, and the IID transmission system located in the Imperial North and Imperial South sub-TAFAs.

Figure 4-9 - Imperial Valley Area



The target capacity for the entire TAFA is 5,000 MW. While any geothermal resource will be located in IID transmission control area, future wind and solar resource may be located in either the CAISO or IID control areas.

Table 4-7 - Imperial Valley TAFA Information

Transmission System Operator	CAISO, IID
Hypothetical Study Range (MW)	**5,000**
Solar	3,500
Geothermal	500
Wind	1,000

The CAISO and IID have independently analyzed the current transmission capacity available to deliver resources to the grid, as well as identifying potential mitigation options necessary to accommodate this level of resources. It should be noted that the CAISO and IID estimates of current or potential transmission capacity are not additive, rather reflect estimates that each transmission operator has

made for their respective systems. Due to methodological and assumption differences, these estimates do not match.

4.4.7.1. IMPERIAL VALLEY – CAISO

The TTIG expects area-wide and local constraints to trigger transmission upgrades in Imperial TAFA by adding ~5,000 MW to the existing planned system. This level of additional generation may also result in increased renewable curtailment under certain operating conditions. The estimated transmission capability in Imperial TAFA is subject to change. IID has recently provided the California ISO with new study assumptions and system models for the IID system; this new information triggers the need to conduct further studies. The ISO 2016-2017 Transmission Plan currently under development will take into account the updated system models and assumptions to provide information regarding additional deliverability expected to be available for the Imperial area generation.

Table 4-8 - Imperial Valley - CAISO TAFA Information

Available Transmission	**FCDS:** 523[12] (Only Greater Imperial area) 5,500 - 8,500 MW (East of Pisgah, Riverside, Imperial)
	EO: 1,849 MW
Interconnection Queue (MW)	4,375 (through CAISO Cluster 8)
Primary Data Sources	• California ISO generation interconnection studies • California ISO Transmission Plan (including the 50% RPS special studies)
Transmission Limiting Constraints	At the proposed incremental generation level of 5,000 MW, the TTIG expects the East of Miguel Constraint to be the deliverability limitation. This constraint is caused by an overload on Miguel 500/230 kV bank, ECO-Miguel 500 kV and Ocotillo-Suncrest 500 kV lines for N-1 contingencies in this area. Generation in Imperial TAFA would also adversely impact the previously described desert area constraint. If additional MW beyond a certain level develop in Imperial, Victorville and Riverside TAFAs, then TTIG anticipates the Lugo-Victorville overload for the single outage of the Eldorado-Lugo 500 kV line and the double outage of the Eldorado-Lugo and Lugo-Mohave 500 kV lines to be a constraint. West of the River path rating limitation may be reached at this level of generation in Imperial TAFA, requiring exploration of path rating

[12] This number is subject to change. IID has recently provided the ISO with new study assumptions regarding its system that will require further study. The ISO 2016-2017 Transmission Plan currently under development will take into account the latest system conditions and provide information regarding additional deliverability expected to be available for IID and ISO connected Imperial area generation.

	increase.	
Relevant Transmission Upgrades Assumed to be in Place While Evaluating TAFA		
Imperial Valley Flow Controller: Phase Shifter (2x400 MVA)	The Imperial Valley Flow Controller is 800 MVA phase shifting transformer at or near the Imperial Valley Substation on the 230 kV circuit to CENACE's La Rosita substation. The expected in-service date is 2017	~$55 - $300 million
Sunrise/SWPL series capacitor bypass	Bypass the series capacitors on Sunrise Power Link and Southwest Power Link to relieve the constraint in Imperial area.	N/A
Suncrest static var compensator (SVC)	300 Mvar dynamic reactive support at Suncrest 230 kV substation. The approved in-service date for this project is 2017 but may be experience some delays.	~$65 million
Sycamore-Penasquitos 230 kV line	A new 230 kV line between Sycamore 230 kV substation and Penasquitos 230 kV sybstation. The approved in-service date for this project is 2017, but a delay is expected.	~$111 - ~$222 million
Conceptual Mitigation Examples, Constraints and Costs (in order to make the TAFA deliverable)		
A new Imperial Valley-Valley 500 kV line	East of Miguel constraint comprises of an overload on Miguel 500/230 kV banks, ECO-Miguel 500 kV and Ocotillo-Suncrest 500 kV lines for N-1 contingencies in this area. Mitigations such as the ones listed in the adjacent column will be required to mitigate this constraint and deliver higher MW amounts out of Imperial TAFA.	~ $2 billion
Midway – Devers 500 kV AC Intertie (a.k.a. STEP proposal)		~ $388 million
Hoober – SONGS HVDC		~ $2 billion
DC conversion of N. Gila-Miguel 500 kV line		~ $900 million
Lugo – Victorville 500 kV line upgrade	The Lugo-Victorville 500 kV line overload constraint is triggered by the single outage of the Eldorado-Lugo 500 kV line or the simultaneous outage of the Eldorado-Lugo and Lugo-Mohave 500 kV lines. Generators in Riverside East area contribute to this constraint. Mitigation to upgrade the line is currently underway between LADWP and CAISO, which will provide additional capacity of 3204 MW continuous rating and 3877 MW emergency rating.	~ $34 million
West of the River path rating limitation	West of the River path rating limitation may be reached at this level of generation requiring exploration of path rating increase. Upgrade such as DC conversion of N. Gila-Miguel 500 kV line and Lugo-Victorville 500 kV upgrade may increase Path	TBD

	46 rating.	

4.4.7.2. IMPERIAL VALLEY NORTH - IID

This TAFA area consists of all the Salton Sea area, northern Imperial County and a portion of Riverside county served by IID (previously known as Imperial north CREZ). All distribution services in this area are provided by IID. There is some capacity available to interconnect facilities today, but to achieve the RETI 2.0 hypothetical capacity renewable exports from IID Imperial North to CAISO, Path 42 will be constrained and an upgrade on path 42 will be needed. IID has performed a study that shows that up to 1,500 MW can be exported to CAISO using path 42 without any transmission upgrades on IID system. Currently, 544 MW is being exported to CAISO, LADWP and the Southwest region.

Table 4-9 - Imperial Valley North - IID TAFA Information

Available Transmission	**FCDS:** 1,100	
	EO: N/A	
Interconnection Queue (MW)	516 MW "Active", 205 MW under construction, 620 MW with GIA suspended due to lack of Maximum Import Capability (MIC) determined by CAISO	
Primary Data Sources	• California ISO generation interconnection studies (QC5 and QC8) • California ISO Transmission Plan (50% RPS special studies) • IID RPS studies • IID Generation Interconnection studies • IID Transmission Capability studies	
Transmission Limiting Constraints	The TTIG does expect an area-wide constraint to trigger a major transmission upgrade in this TAFA by adding ~2200 MW to the existing planned system. Additional transmission will be needed for level of renewables above 1100 MW within IID system and some upgrades may be needed within SCE system around Mirage, Julian Hinds areas.	
Transmission Upgrades Assumed to be in Place While Evaluating TAFA		
Path 42 upgrade	This upgrade is completed and the transmission was increased from 600 MW to 1500 MW from IID to CAISO.	
West of Devers	This project is approved and is under way.	
Constraints, Conceptual Mitigation Examples and Costs (in order to make the TAFA deliverable)		
STEP (a.k.a. Midway-Devers 500	A new 500 kV line will be needed for generation above 1000 MW.	$ 388 million

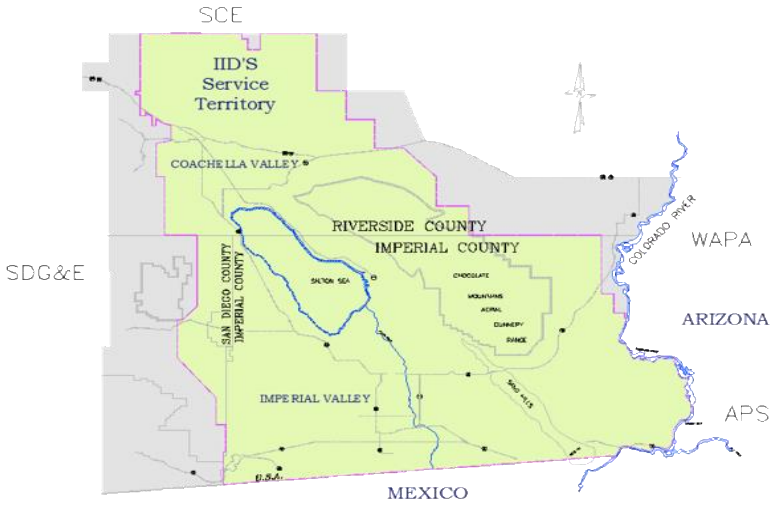
kV AC Intertie)		
Imperial Valley – Eco 500 kV	Very few generators in Northern Imperial area contribute to this constraint and the impact is small. So this constraint is not a major concern at the proposed generation levels (~2200 MW).	N/A

Figure 4-10 - Strategic Transmission Expansion Plan Routes

4.4.7.3. IMPERIAL SOUTH - IID

This TAFA consist of all the area south of the Salton Sea, southern Imperial County to the US/Mexico Border south, San Diego County west and Arizona east. This TAFA include CAISO facilities in Imperial County (previously known as Imperial south and east CREZ). All Distribution services in this area are provided by IID.

Figure 4-11 - Imperial South - IID Area



IID has performed a study that shows that up to 370 MW can be exported to CAISO using the IID/SDG&E intertie at Imperial Valley substation without any transmission upgrades on IID system. Currently, 190 MW is contracted for export to CAISO. Another 1170 MW from IID Fern Substation can be connected with no IID upgrades, with 140 MW already contracted. Therefore, IID estimates that a total of 1,210 MW of transmission capacity is available to export to CAISO in the Imperial South area.

Table 4-10 - Imperial South - IID TAFA Information

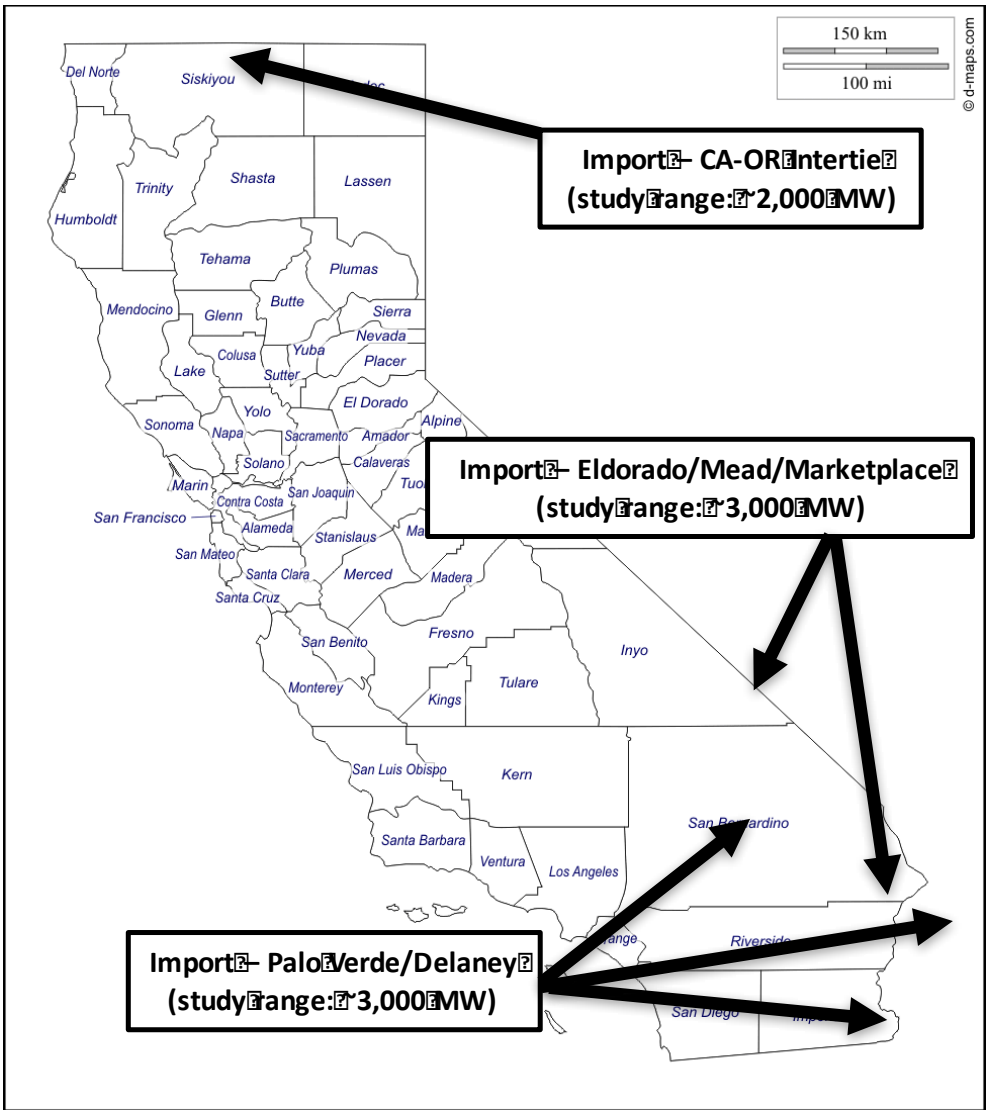
Available Transmission	**FCDS:** 1,210
	EO: N/A
Interconnection Queue (MW)	444 MW "Active", 14 MW under construction
Primary Data Sources	• California ISO generation interconnection studies • IID RPS studies • IID Generation Interconnection studies • IID Transmission Capability studies
Transmission Limiting Constraints	The TTIG does expect an area-wide constraint to trigger a major transmission upgrade in this TAFA by adding ~2800 MW to the existing planned system. Additional transmission will be needed for level of renewables above 500 MW west of Imperial Valley Substation. Additional

	transmission will be needed for any level of renewables east of Imperial Valley Substation.	
Transmission Upgrades Assumed to be in Place While Evaluating TAFA		
	• Midway - Bannister 230 kV line #2 • Midway 500 kV substation • N. Gila – Pilot Knob 230 kV line	$ 113 million
Constraints, Conceptual Mitigation Examples and Costs (in order to make the TAFA deliverable)		
Due to the increased amount of generation requesting interconnection in the Imperial South region to both CAISO and IID facilities, IID has proposed a new 500 kV line from N. Gila to Devers via Midway. The newly proposed transmission line will provide a cost effective path to generation in the area and will relieve constraints on the SWPL and Imperial Valley-Eco-Miguel lines.		

4.5. IMPORT/EXPORT PATH EVALUATION

In addition to the defined TAFAs, the RETI 2.0 Plenary Group requested an assessment of the transmission availability and requirements to import generation from outside of California over existing interties. Specifically, the Plenary Group sought to identify requirements for imports coming into primary transmission gateways on the grid including the California-Oregon Intertie (COI), and delivery points in Nevada, and Arizona. Figure 4-2 depicts the interties and target additional capacity for each point.

Figure 4-12 - Import Capacity Targets by Intertie



For energy imported into California, transmission must be arranged from the point of generation to the edge of a California Balancing Authority area. For California BAs other than the CAISO BA, it may also be necessary to arrange transmission service within the BA. Further, there needs to be sufficient transfer capacity between the edge of the California BA and the location of loads within the California BA to

allow the energy to flow to end use consumers.

Once the energy has reached the edge of a California BA, it is considered "delivered" into that area of the grid. In this instance, most of the imported energy will be delivered into RETI 2.0 defined TAFAs. It will then compete with all other TAFA resources for transmission to deliver the energy to consumers, and is subject to identical constraints and transmission availability as is energy from all other generators within the California BA.

Table 4-11 - Import Path Energy Delivery to California TAFAs

Delivery Point or Path	Hypothetical Study Range	Affected TAFA
Eldorado / Mead / Marketplace	3,000	Victorville (East of Lugo) and Riverside
Palo Verde / Delaney	3,000	Riverside East and Imperial
California-Oregon Intertie	2,000	Northern California (Round Mountain, Lassen and Sacramento River)

4.5.1. CALIFORNIA-OREGON INTERTIE (COI)

The Plenary Group identified a hypothetical 2,000 MW of additional generation to be delivered through the COI transmission lines, with the energy received into California in the Round Mountain/Lassen and Sacramento River TAFAs. These areas currently have approximately 3,350 MW of transmission for EO resource interconnections, but there is effectively no firm transmission available to delivery energy from this area. Any upgrade to deliver the import capacity could be comparable to deliver new capacity from the TAFAs, approximately $2-4 billion.

4.5.2. SOUTHERN CALIFORNIA INTERTIES

The Plenary Group identified potential imports that would be delivered to California at existing intertie points in Nevada (Eldorado/Mead/Marketplace) and Arizona (Palo Verde/Delaney). As noted above, these imports would be subject to the same constraints as the TAFAs that would receive this energy, as well as the Southern California constraints discussed in Section 4.2.1. Specific mitigation activities for these TAFAs are discussed in Section 4.3.

4.5.3. CENTRAL SIERRA

The Plenary Group identified 500 MW of potential energy imports into California from the Central/Northern Sierra area. This energy could potentially be delivered using two NV Energy transmission lines – Path 24, which connects the NV Energy system to the CAISO along the I-80 corridor near Truckee, and the Alturas transmission line (WECC Path 76).

Path 24 is a 115-kV transmission line extending from the NV Energy system in Reno, NV westward to the PG&E system at Truckee. The energy transfer capability is limited due to transmission constraints in the

Reno area. This constraint is explained in NV Energy's 2014 IRP Filing[13]

Transmission system exports to the west of Reno are limited due to east to west transfer limitations on Reno area transmission lines. This limitation is due to single line outage (N-1) contingencies, such as the outage of the 345 kV line from East Tracy Substation to North Valley Road 345 kV. If this outage occurs during peak load periods it may cause violations on parallel 120 kV transmission lines. The initial transmission solution is construction of the Bordertown – _Cal Sub 120 kV line. If loads continue to increase, the West Tracy to Ft. Sage 345 kV line may also be required eventually.

The transfer capability of the lien changes based on the load in the Reno area. Below is the monthly export ratings and export capability for Path 24.

Table 4-12 - WECC Path Rating and Transfer Capability for Path 24

Max of Reno Area Load	Timeframe		Reno Area Limits on Path 24 Export (east-to-west) Rating		
Month	Off Peak	On Peak	Off Peak Capability	On Peak Capability	Monthly Export Rating for OASIS Posting
1	550	623	58	55	**70**
2	549	605	62	57	**70**
3	521	551	64	62	**75**
4	486	524	67	62	**80**
5	649	685	51	47	**55**
6	696	738	31	21	**50**
7	715	813	28	10	**45**
8	767	850	38	30	**40**
9	639	683	52	48	**55**
10	506	590	65	57	**80**
11	529	565	63	60	**80**
12	593	638	57	52	**70**

Source: http://www.oatioasis.com/SPPC/SPPCdocs/NVN-TOP-019_Path_24_Sierra-Summit_PGE_Intertie_11-20-09.pdf

The Alturas line (Path 76) is a 345-kV line owned by NV Energy and extends approximately from Reno, NV northwest to the Hilltop substation located in southern Oregon, where it interconnects to the BPA system. Theoretically, power generated in Nevada or northeastern California could interconnect to this line, and the power would then flow north on the Alturas line to the Hillto substation. From Hilltop the power would transfer to the BPA system, where it would flow to the Malin substation, where it could be imported into California. This energy would be subject to the same constraints as other energy imports from the northwest U.S. that would use the COI.

An additional line could potentially deliver energy to California. Lassen PUD submitted comments to RETI 2.0 in May, 2016 indicating interest in developing a trans-Sierra line that would interconnect the Alturas line to the California grid. The Lassen information indicated the line could be a double circuit 230 kV line. A line of this size would likely allow the delivery of 500 MW to the California grid.

[13] NV Energy 2014 IRP Filing, p.104

4.6. SUMMARY OF TAFA EVALUATION

The Plenary Group identified over 40,000 MW of potential development in TAFAs. Only the Tehachapi TAFA could accommodate most of the potential capacity with existing transmission, while other TAFAs could deliver some or most of this energy using full capacity and energy-only interconnections.

The area with the least potential to deliver new renewable energy is Northern California. The bulk transmission system is heavily utilized and would require substantial investments to allow for the delivery of new resources. Table 4-3 summarizes the existing transmission that may be used to accommodate new renewables, and identifies the cost to allow each TAFA to deliver the Plenary Group target capacity quantities.

Table 4-13 - Existing Transmission Capability and Estimated Cost to Deliver TAFA Target Capacity

TAFA		Capacity to Accommodate New Renewables		New Transmission Required for Deliverability	Estimated Cost to Deliver All Energy
Delivery Area or Path	New Capacity (MW)	Full Capacity (MW)	Energy Only (MW)	No	NA
Tehachapi	Up to 5,000	4,500	5,600	No	NA
Victorville/Barstow	Up to 5,000	1,900*	3,300	Yes	$34 million (Lugo-Victorville upgrade) would result in ~2,000 MW incremental capability across Victorville, Riverside and Imperial TAFA
Riverside	Up to 5,000	2,450**	4,754	Yes	
Imperial Valley (CAISO)	Up to 5,000	523 - 1400	1,849	Yes	> $1 billion to mitigate the East of Miguel constraint *AND* $34 million to mitigate the desert area constraint
Imperial Valley (IID)	Up to 5000	2,300***	NA	Yes	$113 million to upgrade IID transmission structure to support additional generation
San Joaquin Valley	Up to 5,000	1,823	3,131	Yes	$440 million
Solano	1,500-3,000	Unknown	880	Yes	$20-50 million
Sacramento River Valley	1,500-3,000	0	2,100	Yes	Making new resources fully deliverable would cost $2-4 billion
Lassen / Round Mountain	1,450-2,450	0	1,250	Yes	

* Victorville Full Capacity is sub-area specific.

** Transmission capability provided for the Riverside East TAFA is based on the additional capacity provided by the West of Devers Upgrade Project as proposed by SCE and approved by the CPUC on August 18, 2016.

*** For IID, Imperial Valley North Full Capacity is 1,100 MW and Imperial South Full Capacity is 1,2,10 MW.